University Hospitals Coventry and Warwickshire NHS Trust
Department of Anaesthesia

Obstetric Anaesthetists Handbook

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The consultant members of the Obstetric Anaesthesia Group, and the clinical director for anaesthesia, have agreed this handbook as a clinical guideline. Printed copies are available from the Anaesthesia Office at the University Hospital, Coventry, or direct from epubli.
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The guidelines within are presented in good faith and are believed to be accurate. The responsibility for actions and drug administration, including necessary modification for co-morbidity or other significant patient considerations, remains with the clinician concerned.

Edition history
First edition August 1999
Second edition June 2000
... ...
Sixth edition January 2009
Seventh edition February 2013
Eighth edition February 2015
Ninth edition July 2016

My thanks are due to Dr John Elton, who inspired this book, and to Dr Seema Quasim, who helped with the revisions from the eighth edition onward.

These guidelines have been produced with close reference to the obstetric and maternity clinical guidelines available on the e-library.
Document control for approved clinical guidelines

All clinical guidelines change with time. We have carefully considered the relative merits of having collected guidelines published on paper against having a set of guidelines available on an intranet. On balance we feel that the usability of a handbook outweighs the potential for live changes if we required you to consult the intranet all the time.

All users of clinical guidelines should be confident that they are working from the approved version – the latest authorised version. As users you should ensure that the version that you are working to matches the latest version on the e-library and that all updates since the hard copy was issued are incorporated.

Important updates will be displayed in a prominent position in the maternity theatres office and in the maternity operating theatres. You should check these locations as part of your work.

Furthermore, some of our work is done through shared management of patients, particularly those receiving obstetric high dependency care. Guidelines for their management may change from time to time and you should be alert to changing requirements. If you are in doubt at any time you should seek senior help.

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Author name: Dr Mark Porter, consultant anaesthetist

Reviewer name: Dr Seema Quasim, consultant anaesthetist

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Introduction and scope of guidelines

This handbook is intended to assist you in your duties as the labour ward anaesthetist at the University Hospital, Coventry. We expect you to perform to a high standard in a demanding environment. We have provided you with information to allow you to orient yourself, and specific advice on a number of matters that will arise. This handbook contains clinical guidelines that have been developed from national recommendations and evidence review, reinforced by local audit. They represent a consensus of opinion on obstetric anaesthetic practice. They are not exhaustive and do not include the minor variations seen in consultants' daily work.

The guidelines do not necessarily represent the only good practice, but they do represent good practice, agreed practice and the practice you are expected to follow.

You should read this handbook through, as or before you start work as the labour ward anaesthetist. This handbook is not a textbook and nor is it completely comprehensive. There are other sources of information that you must use:

- Your professional skills and training.
- Your knowledge derived from personal study (see ‘Further reading’, page 311).
- The UHCW obstetric guidelines available on the e-library.

In any case where you are unsure as to the safe and effective way to proceed, you must seek advice from a more senior and experienced member of staff. This may be another anaesthetist, or indeed a midwife or obstetrician.

Changing guidelines

All clinical guidelines change with time. We have carefully considered the relative merits of having collected guidelines published on paper against
having a set of guidelines available on an intranet. On balance we feel that the usability of a handbook outweighs the potential for live changes if we required you to consult the intranet all the time.

Nevertheless, you should look out for any significant changes to guidelines. They will usually be displayed in a prominent place in the labour ward theatres and office.

**A word on guidelines**

“...medical decision-making can never be automated. All patients are different and it is sometimes necessary to depart from conventional practice. The recent emphasis on narrative-based medicine, taking account of individual characteristics of patients, is a healthy corrective to the notion that medical practice can be reduced to a series of algorithms. While evidence-based medicine is a necessary condition of good medical practice, it is not a sufficient condition. The evidence and the guidelines and protocols that are based upon it do not take the doctor all the way to the decision in the individual case. There is room for judgment, for application of common sense, and for modifying practice in the light of the patient’s priorities. Those who depart from the guidance, however, should do so in full knowledge of the guidelines and document the reasons for deviating from recommended practice.” [1]

**Points to remember**

There are some cardinal points that should be remembered when confronted by any situation in obstetric anaesthesia [2].

- The pregnant woman comprises two people: the mother and the fetus. Changes seen in the mother such as hypotension will have adverse effects on the fetus if not treated promptly.
- The maintenance of adequate oxygenation and placental perfusion are the goals of the treatment of the pregnant woman.
- All pregnant women after the first trimester are at risk of aspiration of gastric contents during general anaesthesia and for this reason regional anaesthesia should be used wherever possible.
Introduction and scope of guidelines

- Aortocaval compression must be anticipated and treated in all pregnant women (after 20 weeks’ gestation) by lateral displacement of the uterus either manually or by positioning the mother in the wedged or lateral position.

- Always summon senior anaesthetic assistance when significant problems are anticipated, or if not anticipated then very soon after difficulties arise.


Principal changes in this edition

This edition of the Obstetric Anaesthetists handbook has been updated with the latest information and guidelines in use. All sections have been updated in line with new knowledge, experience and practice.

Principal changes are:

- Adoption of the 2015 OAA DAS guidelines for failed or difficult intubation – page 37.
- Updated information on sepsis diagnosis in pregnancy – page 94.
- Clarification on glucose drinks in women with diabetes – page 121.
- Postoperative heparin for ten days where indicated – page 123.
- Postoperative Bromage score monitoring – page 154.
- New flow chart for postpartum headache – page 183.
- Postnatal visiting now two days for spinals, not three – page 216.
- Rocuronium and sugammadex now mentioned – page 254.
- New books added to ‘further reading’ and some retired – page 311.
Orientation to the University Hospital

Delivery unit description

The labour ward is on the first floor of the West Wing of the University Hospital. Entrance is controlled by a card swipe keyed to your ID badge and you should make sure that it works – if not then contact the anaesthesia office immediately. The labour ward contains from one end to the other a staff room, doctors’ on call rooms, an assessment and admissions area, a delivery area including a room equipped for multiple births, two high dependency rooms, an anaesthetics and theatres office, and two operating theatres. The blood fridge and a blood gas machine are in the theatre lobby. There is a backup blood gas machine in the neonatal ICU. Anaesthesia preparation areas with consumables, drugs and equipment are recessed into each operating theatre. There is a communicating door linking to the main operating theatres; the nearest two theatres are used for gynaecology.

Wards 24 and 25 are the main antenatal and postnatal wards respectively, on the floor above.

The antenatal clinics are adjacent to the assessment and admissions area on labour ward.

Midwife-led birth unit

The Lucina Birth Centre opened in 2013. It has five delivery rooms, each equipped with a bath for water birth.

The birth centre is designed for a birthing experience that does not involve medical intervention. Mothers in need of medical intervention (e.g. epidural, retained placenta, pre-eclampsia, operative delivery) will be transferred to labour ward and should normally be assessed on labour ward.

Anaesthetists should not normally enter the birth centre except in response to an emergency alarm system call or obstetric emergency call. You may get a specific invitation from a midwife in order to talk to a
mother. This will be rare. Please be aware that epidural pain relief can only be administered on the labour ward, and that any discussion with the mother should take place in the presence of the midwife.

Remember that badges have to be programmed for access to maternity. If your badge is currently able to get you into labour ward, then you will be able to get into Lucina. If not, and you need maternity access, then see the anaesthesia general manager.

**The services that we offer**

We run three services together as part of the commitment to obstetric anaesthesia.

1. The round-the-clock urgent and emergency service.
   a. Labour epidurals.
   b. Emergency caesarean sections.
   c. Other operative cases e.g. manual removal of placenta, repair of perineal tear and trial of operative delivery.
   d. Obstetric high dependency care – principally obstetric haemorrhage, sepsis and pre-eclampsia.
   e. Postnatal review of all patients.

2. The planned caesarean section service.
   a. As part of a dedicated operating list.
   b. Integrated with the emergency service. Mothers awaiting caesarean usually cannot be deferred to another day.

3. Antenatal assessment and planning service.
   a. Assessment of patients referred by midwives or obstetricians during pregnancy. This clinic usually runs every alternate Thursday afternoon.
   b. Planning of elective caesarean delivery and support of same-day admission. This clinic usually runs every Friday afternoon.
Staff

Consultant obstetric anaesthetists

See page 308 for names and contact numbers.

During absences the remaining members of the group endeavour to give informal cover in order to enhance supervised training. The department weekly rota at CLWRota details fixed commitments and registrar cover. In the absence of direct consultant cover, discuss problems with or request help from the 2813 bleep holder and if necessary the on call consultant.

Junior staff

The following text is taken from the Anaesthetists Handbook.

All non-consultant anaesthetists must spend at least one supervised session in the labour ward with a consultant anaesthetist or a post-fellowship trainee before working without direct supervision as the on call obstetric anaesthetist. Service lists may be cancelled to allow this introduction to working facilities, practices and duties.

Locum anaesthetists should not commence work as the obstetric anaesthetist until approved by the general consultant on call for the day, and they have been issued with a copy of the Obstetric Anaesthetists Handbook. (There are copies available on the labour ward). This consultant should satisfy himself or herself that the locum understands their responsibilities and duties, and the path of referral for help and advice.

Operating department practitioners

There is an assigned ODP for the labour ward around the clock, with bleep number 1465.

You are not permitted to anaesthetise a woman without assistance. In dire and life-threatening emergencies, a member of the midwifery staff may be asked to assist you – to the exclusion of all other duties not
related to anaesthesia – pending the arrival of an ODP or other anaesthetist.

**Theatre staff**

Rebecca Cadman is the theatre manager for obstetric theatres. Theatre staff (including scrub staff and support workers) for planned and emergency cases on a 24/7 basis are provided out of main operating theatres, and while allocated to maternity are generally based in the unit.

**Equipment list**

You must make sure that you are familiar with the use of the equipment in theatres – ask for specific training if you are unsure. It includes:

- Datex Avance anaesthesia machines, and their imminent replacement.
- Alaris Asena GH, CC and PK syringe drivers.
- CADD-Solis PCEA pump.
- Mallinckrodt automatic pressure infuser.
- Belmont rapid infuser (for massive obstetric haemorrhage; kept outside theatre 7).
- Polio blade laryngoscope.
- ProSeal LMA and LMA Supreme.
- Dideco Electa cell saver (operated by the ODP).
- The maternity unit has re-equipped with Phillips HeartStart MRx ALS monitor/defibrillators. These units still work in manual mode with the usual three buttons or AED mode. They are also equipped with a Q-CPR puck for monitoring the effectiveness of external cardiac compression.

**Unit workload**

The University Hospital is experiencing a significant increase in the number of deliveries and the obstetric workload. We are currently
undertaking about 6,000 deliveries per year (with more in the Lucina centre) and this is expected to rise.

The figures below are a guide to the approximate annual procedure frequency, taken from the birth database for 2013.

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Caesarean sections by category</th>
<th>Other del.</th>
<th>Total del.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>All</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Spinal</td>
<td></td>
<td>962</td>
<td>118</td>
</tr>
<tr>
<td>Spinal + epi.</td>
<td></td>
<td>46</td>
<td>15</td>
</tr>
<tr>
<td>Spinal + GA</td>
<td></td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>Epidural + GA</td>
<td></td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>GA alone</td>
<td></td>
<td>86</td>
<td>59</td>
</tr>
<tr>
<td>Epidural alone</td>
<td></td>
<td>265</td>
<td>94</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not recorded</td>
<td></td>
<td>53</td>
<td>20</td>
</tr>
<tr>
<td>Total CS</td>
<td></td>
<td>1455</td>
<td>325</td>
</tr>
<tr>
<td>GA rate</td>
<td></td>
<td>9%</td>
<td>26%</td>
</tr>
<tr>
<td>CS rate</td>
<td></td>
<td>25%</td>
<td>6%</td>
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The epidural rate is at about 18%, and the conversion rate to GA from any regional block is 1.9%.
Working in the labour ward

Criteria for being the duty obstetric anaesthetist

You should fulfil the following criteria before and while working as the duty obstetric anaesthetist.

- At least one year working in clinical anaesthesia.
- A satisfactory record of assessment in obstetric anaesthesia. You should bring your workplace based assessment records and competency sheets from your previous posting.
- Approval from the lead clinician, (or the consultant anaesthetist on call in the case of locum anaesthetists – this is exceptionally rare).
- At least one accompanied session for orientation in the labour ward at the University Hospital, Coventry.

For locum anaesthetists, see ‘Junior staff’ on page 18.

Principal duties of the resident

The resident’s room is on the labour ward next to the staff room. There is a repeater siren for the emergency call system in the room. The bleep (2178) is handed from the outgoing to the incoming anaesthetist at 08:00 hours and 20:00 hours. Handover time is built into the rota. You are the principal anaesthetist to the labour ward, and are expected to base yourself there. Your principal duties are to work in the following areas. It is important for the team to work in an integrated fashion to cover all the work.

- Completion and maintenance of clinical and audit records, in black ink and including your name, grade and GMC number on every record.
- Recording the supervising consultant on the theatre anaesthetic chart.
Working in the labour ward

Labour ward work

This includes:

- Provision and supervision of safe, effective and timely epidural analgesia for pain relief in labour.
- Provision of safe, effective and timely anaesthesia for operative delivery and obstetric surgery.
- Management of high dependency obstetric patients in the labour ward, in conjunction with obstetricians and midwives.
- Attendance at obstetric handovers at 08:30, 17:30 and 20:30 and the joint obstetric ward rounds that follow.
- Attending ‘obstetric emergency’ calls and giving prompt emergency treatment.
- Intravascular access and sampling when requested.
- Review and treatment, where necessary, of patients who have recently received an epidural, spinal or general anaesthetic.
- Review of other postnatal patients as requested.
- Stocking the epidural trolleys fully, at the start of each morning shift.

Surgical safety checklist (modified for maternity)

Use of the surgical safety checklist is mandatory for all cases in the operating theatres. You play a key role in leading this process and making sure that it is followed in every case with no exceptions.

Team brief

As appropriate before planned lists. We are currently introducing team brief prior to urgent cases. This will usually take place in the central office on labour ward.

Sign in

On entry to the operating theatre. This must be done in the presence of the anaesthetist and ODP as a minimum.
Stop before you block

Before doing a regional block in theatre. Not part of the checklist as such, this is a professional recommendation from the Association of Anaesthetists of Great Britain and Ireland and adopted in our hospital. Check the names and doses of the drugs to be injected into the central neuraxis against the planned surgery.

Time out

This must be completed before surgery commences, for all operative cases. There are no exceptions whatsoever to this fundamental safety rule and as a health care professional we expect anaesthetists to lead this process personally or make sure that it happens.

Sign out

Before the principal surgeon leaves the operating theatre, and in the presence of the midwife and the recovery practitioner. This is also the time to agree on EBL (estimated blood loss) and make sure that it has been recorded including on the cell salvage audit.

In some cases, particularly emergencies out of hours, surgical safety checklists have not been completed. This is not acceptable practice.

Planned caesarean sections

These lists are usually led by consultant anaesthetists.

- Assessment and preparation of patients.
- Provision of anaesthesia for planned caesarean sections.

Antenatal referrals

- Antenatal assessment of patients with medical problems that may influence anaesthetic management at time of delivery.
- Preoperative and other assessment of mothers who are antenatal inpatients.

On occasion you may be asked for help by the senior resident anaesthetist to assist in the main theatres or undertake a transfer. You should respond appropriately but remember that your first duty is to
Working in the labour ward

obstetric anaesthesia. Always inform the labour ward midwife coordinator and the general on call consultant anaesthetist if you take on a commitment elsewhere.

Assessing preoperative patients

Most women are seen in a weekly planned caesarean clinic, to which you may be attached. Some will attend the labour ward, for example after failed ECV, and some will be inpatients on the antenatal ward, for example those with placenta praevia or unstable lie.

Where you are asked to undertake preoperative assessment on the ward, you should conduct interviews in clinical rooms if there is a particular need for attention to confidentiality. This applies especially to patients scheduled to receive preoperative antiretroviral therapy but may also be appropriate for other patients. Curtained bed spaces may not be sufficiently private. Midwives will direct you to the most suitable room and act as chaperones when required.

You should recommend subarachnoid block for elective caesarean section, in the absence of contraindications.

Handover

The outgoing and incoming duty obstetric anaesthetists should formally hand over responsibility at the change of shift in the morning and in the evening. All clinical activities should be discussed and in particular, patients in high dependency care should be specifically handed over. The bleep should also be handed over. You may not leave the bleep on the labour ward and go off duty without handing over.

Presence on the labour ward

There should be a resident anaesthetist on or near the labour ward at all times. The on call room is provided on labour ward, and there is a shop in the main entrance to the West Wing. You must be immediately available using the allocated bleep at all times.

You must not leave the building while holding the labour ward anaesthetist’s bleep unless agreed by a consultant anaesthetist.
You should be immediately available during the second stage in vaginal breech delivery and in multiple deliveries, and during external cephalic versions. See page 192.

**Excessive workload**

It will inevitably happen that at some times the demands on your time will exceed the capacity of one person to respond, for example for epidural analgesia while you are doing a caesarean section.

Unless you are very near the end of your other commitment and will be able to respond shortly and in an appropriate time, make sure that the midwives refer such a request through to the general on call team – usually the senior resident anaesthetist – or that you call them yourself. It is part of the senior resident’s duties to assist in labour ward at busy times, or to escalate the request to a consultant as appropriate.

**Seeking advice and senior help**

There will be times when you need to ask advice or request help. (See the Anaesthetists Handbook for general advice.)

**Clinical alarm system**

The labour rooms and theatres have a red triangular knob on the wall. If you pull this red knob out, a siren will sound in that clinical area and all nearby staff should attend to help.

‘Obstetric emergency’ group call

You should call the obstetric emergency group page if you need urgent help from a team of labour ward clinicians. On hearing such a call over your bleep you should attend immediately or have someone ascertain the nature of the emergency.

Call – 2222 “obstetric emergency in...”

Many of the calls will be to do with immediate delivery or neonatal problems that do not require the presence of an anaesthetist, in which case and having checked, leave the team to proceed with necessary care.
Working in the labour ward

Calling the senior resident anaesthetist

Many sections in this handbook refer to the necessity to seek senior advice. This means the senior resident anaesthetist or the consultant anaesthetist on call. You should call the senior resident anaesthetist first, particularly if a second pair of hands is required urgently. (With the present on call system this will be a consultant from 08:00-20:00 each day.)

If you are a specialty registrar in year 5 or above, then you should use a greater degree of flexibility and discretion. You should call the senior resident anaesthetist for practical assistance. You may make those decisions that are here reserved for senior resident anaesthetists and if you need advice, call the consultant anaesthetist on call.

The consultant anaesthetist on call

There is always a consultant anaesthetist responsible for the labour ward. Mobile phones do not work reliably in the University Hospital and you should use the bleep system if you think the consultant is there (see page 18 for numbers).

Monday to Friday during the day

There is a member of the Obstetric Anaesthesia Group assigned to the labour ward for regular sessions (when not on leave; if away informal consultant cover may be supplied).

Out of hours and during leave

The general consultant on call provides cover. You may contact this consultant at any time via the hospital switchboard, usually after calling the senior resident anaesthetist.

Calling members of the Obstetric Anaesthesia Group

Members of the Obstetric Anaesthesia Group are available for consultation during working hours. Check with the anaesthesia coordinator (extension 25871) or check CLWRota to see who is most conveniently placed.
On occasion the general consultant on call will not be a member of the Obstetric Anaesthesia Group. After first calling the general consultant on call, group members may be called through the switchboard particularly for problems relating specifically to obstetric anaesthesia. This is an informal arrangement and there is no commitment to be available.

**Asking other professionals for help**
Always remember that you work with colleague professionals in obstetric anaesthesia. The views of midwives and obstetricians should be sought, respected and taken into account.

**Referral to the consultant anaesthetist**
Inform the labour ward consultant in the daytime of all theatre cases: they will be the ‘supervising consultant’.

There are certain cases, which you **must** notify to the consultant anaesthetist present on the labour ward or on call:

- Potential difficult intubation (page 37).
- Massive obstetric haemorrhage (page 50).
- Women declining blood transfusion who are to be delivered in theatre or who bleed (page 71).
- Amniotic fluid embolism (page 79).
- Eclampsia (page 77).
- Unexplained collapse and cardiopulmonary arrest (page 80).
- Cases for which admission to the general adult critical care unit (level 2 or 3) is considered (page 83).
- Maternal morbid obesity (page 108).
- Severe complications of central neuraxial block.
- Prescription of sedative premeds (page 128).
- Elective cases out of hours (page 128).
- Major problems with consent (page 136).
- Unintentional dural puncture (page 175).
- Total spinal anaesthesia (page 178).
- Placenta praevia (page 261).
- Severe pre-eclampsia requiring caesarean section (page 289).
Working in the labour ward

- Any other cases about which you feel unsure after seeking the advice of the senior resident anaesthetist, such as cases of severe co-existing medical disease.

Seeking advice on unusual techniques

General

No handbook can be totally comprehensive. There may be instances when it is appropriate to use techniques that are not described here. You must seek senior advice before doing so, from the senior resident anaesthetist and in many cases from the consultant anaesthetist.

In particular, you must not administer any substance that is not recommended in this handbook to the epidural or subarachnoid spaces.

If you are asked by the obstetrician to administer a drug for an obstetric indication, you may do so only if you are aware of the benefits, principal contraindications and side effects of that drug.

Parenteral opioids – diamorphine, remifentanil and fentanyl

The National Institute for Clinical Excellence has recommended that all women having caesarean section be offered intrathecal or epidural diamorphine [3] and this is our recommended neuraxial opioid in most instances. The side effects of neuraxial diamorphine include nausea and vomiting, typically 50-60% [4]; a systematic review [5] found rates of nausea and vomiting at 75% and pruritus at 95% of patients. In use we have found the rates to be much lower and the symptoms less troublesome, perhaps because of the emphasis we place on early oral food and drink after surgery, and the concurrent standardised administration of NSAIDs, ondansetron and paracetamol.

Intramuscular opioids are a mainstay of treatment of mild to moderate labour pains and are used in the labour ward. The effectiveness, and therefore the ethical basis, of using intramuscular or intravenous opioids to treat labour pain is repeatedly challenged; they may have no significant efficacy but many side effects [6,7,8]. You should therefore consider very carefully, and with senior advice, how it would be appropriate to respond
to a request, which may be made from the midwives or obstetricians, for an intravenous infusion of opioid to treat labour pains.

We rarely use PCA opioids. In our unit their use is mainly reserved for treatment of pain and distress in women who have suffered intrauterine death, those who have needle phobia, and morphine allergy as below. Our midwives are not familiar with PCA and if you use it, you must explain carefully the requirements for clinical supervision.

We do use PCA fentanyl for patients who have an allergy to morphine and are having caesarean section. PCA fentanyl for intravenous administration is available in main theatres recovery: 5 mg in 100 mL, 25 mcg bolus with 5-minute lockout. There are a very small number of women in this category. It is not safe to administer diamorphine to women who are allergic to morphine.

We do not use PCA remifentanil routinely due to concerns over its use in a situation where continuous 1:1 clinical supervision of the mother cannot be guaranteed. We may explore the possibility of use for mothers who decline epidural analgesia or in whom epidurals are otherwise contraindicated. Its place in obstetric analgesia has yet to be fully determined but it may be better than pethidine, while requiring specific maternal training, and not as effective as a working epidural [9,10]. We have recently supported the RESPITE trial comparing remifentanil intravenous PCA and intramuscular pethidine for pain relief in labour, and you may be asked to commence an infusion with the help and advice of the research midwives.

Intravenous morphine (1mg mL⁻¹ titrated as needed) may be used in high-dependency care for postoperative pain, usually because NSAIDs are relatively contraindicated in patients admitted to HDU for massive haemorrhage or severe pre-eclampsia. (NSAIDs are normally withheld until the patient is stable in haemorrhage cases, or for 24 hours in severe pre-eclampsia. As the patient starts to recover though, the balance of risks shifts and it is important to allow the patient sufficient analgesia for mobility.)
**Working in the labour ward**

**TAP blocks**

We do not support the use of transversus abdominis plane blocks (TAP blocks) as routine postoperative analgesia for caesarean section. If indicated in individual cases, decision and placement should be supervised by a consultant anaesthetist.

Initial enthusiasm about the opioid-sparing effect of TAP blocks [11] has given way to a realisation that their place in post-caesarean analgesia is not certain. This is largely due to the short duration of the block, the inconsistent evidence about benefit and the incidence of potentially serious complications [12]. There is no benefit when concurrently used with neuraxial opioid [13] and they do not seem to be very effective for surgery on the peritoneum as opposed to abdominal wall surgery.

Further, in local experience, an audit showed no measurable benefit against combined paracetamol, NSAID and non-neuraxial morphine and the use of the technique was associated with long postoperative delays while a variety of bespoke block techniques and pieces of equipment were employed.

**Disposal of medicinal products**

All medicinal products should be discarded into gel jars, yellow bags or sharps bins. No medicinal products should be discarded into any orange or white bags that may be provided in the labour ward delivery rooms. All syringes and ampoules can be discarded into the sharps bin if there is no yellow bag. Put controlled drugs into the absorbent gel containers provided in each theatre.

**Autonomy and responsibility**

These guidelines are not intended to constrain the practice of consultant anaesthetists. When a consultant is called in for advice and help, this will often be because a problem has been encountered which forces thinking and practice outside these guidelines. This will especially apply to the on call period and to patients with critical illnesses. Consultants retain clinical autonomy and the concomitant responsibility.
Working as a junior doctor on the labour ward can seem like protocol-driven care. Insofar as this is true, it is because of the need for the entire multidisciplinary team to be clear on respective roles and expectations in a demanding and time-pressured environment. This is also an area associated with high litigation caseload. There is tremendous satisfaction to be gained from communicating with patients at a special time of their lives, satisfying their expectations, working closely with colleagues in obstetrics, midwifery and other disciplines, and diagnosing and managing emergency medical and surgical conditions. We hope and believe that these clinical guidelines leave room for this satisfaction.


Preparations for emergency anaesthesia

You must be aware at all times of the options for conducting emergency anaesthesia, and be assured that cases can be conducted with the minimum of delay. The response time for a particular condition will vary (see page 196) and we do not presume that general anaesthesia is always the appropriate choice for emergencies – unless contraindicated or impossible, spinal anaesthesia or epidural extension should be used for caesarean section. You will find detailed advice in this handbook.

Theatre equipment

You should check that both the main and second obstetric theatres are available for operation in conjunction with the senior midwifery sister. If either theatre is non-operational, then you should identify a backup theatre with the main theatres floor control on 25959.

Prepared drugs

There have been several serious drug-related incidents. One common factor is the advance preparation of too many drugs. When associated with poor labelling this has the potential for lethality. It also raises issues of sterility, and adequate handover between different anaesthetists.

Any operative case should have one lead anaesthetist, whether registrar or consultant, who is primarily responsible for the conduct of the anaesthetic and the administration of drugs.

Do not draw up or prepare drugs for more than one case except as below.

Storage of other prepared drugs may seem convenient but exposes patients to a higher risk of drug error. In particular, syringes that you have prepared and not used must not be stored. Do not put your syringes in the fridge for future use.

General anaesthesia

You should make sure that the following drugs are immediately available for use in the anaesthetics area attached to the main obstetric theatre.
**Preparations for emergency anaesthesia**

- Thiopental 500 mg in 20 mL (drug, syringe, needle and water for injections in a specific box).
- Suxamethonium 100 mg in 2 mL (ampoule or boxed glass syringe, in the fridge).
- Ephedrine 30 mg in 10 mL (ampoule or boxed glass syringe).
- Atropine 600 µg in 1 mL (ampoule or boxed glass syringe).

Storage of informally prepared drugs may seem convenient but exposes patients to a higher risk of drug error. **It is good practice to prepare all drugs fresh at the time of use.** There are occasional supply problems with some of the boxed syringes but do not make up open syringes if this happens.

The boxed glass syringes are provided for emergency use only (and are about ten times the price of ampoules). On most occasions when these drugs are used, especially suxamethonium, you will have ample time to prepare fresh drugs from ampoules. You should prepare suxamethonium and anticholinergic fresh for use at the time of need.

**Regional anaesthesia**

You should prepare a tray containing unopened drugs for use in ‘Quickmix’ epidural anaesthesia for caesarean section (see ‘Extending the epidural for a caesarean section’ on page 241). This tray should be kept on the work surface in theatre.

- Lidocaine 2% 20 mL.
- Adrenaline 1 mg in 1 mL, with unopened 1 mL syringe (0.1 mL to be used).
- Sodium bicarbonate when available. The dose is 84 mg per 20 mL mixture. The Martindale sodium bicarbonate with EDTA preservative is available and suitable for use.

You will need to obtain the opioid ampoule from the controlled drugs cupboard.
Emergency treatment

All obstetric emergencies must be managed immediately in conjunction with midwifery and obstetric staff.

Call for help immediately if you are not able, for any reason, to give immediate, safe and effective treatment.

Consider sending for senior help early and in any case where this is specifically indicated.

If you are the only anaesthetist nearby and you are engaged in the care of another patient, you should bear in mind the advice of the Association of Anaesthetists of Great Britain and Ireland:

“If it is essential for the anaesthetist to leave the patient to deal with a life-threatening emergency nearby (which is a matter of individual judgement), he or she should instruct another person to observe the patient’s vital signs and should delegate overall responsibility to another registered medical practitioner” [14].

Managing labour ward emergencies

- Pull the emergency knob (the red triangle on the wall).
- Make 2222 call ‘obstetric emergency’ and state precise location.
- Call for senior help as appropriate.
- Nominate a lead professional to direct and allocate tasks.
- Give clear instructions and ensure they are acted upon.
- Designate one person to document events in the patient’s notes.
- Communicate with all team members and patient.

Specific advice on some emergencies is given in the next few chapters.
Emergency treatment

Recommendations for Standards of Monitoring during Anaesthesia and Recovery. (London: AAGBI)
Failed or difficult intubation

Failed or difficult intubation is a leading cause of anaesthesia-related maternal mortality and death is more often a result of hypoxia than inhaled gastric contents. Failed intubation occurs in at least 1:300 obstetric anaesthetics and in as many as 1:150; the principal reason may be failure of adequate preparation by the anaesthetist.

You should perform an airway assessment, including modified Mallampati score and an assessment of other relevant anatomical and obstetric features, for all patients presenting for anaesthetic procedures.

You should determine whether difficult intubation could be anticipated. It is not possible to give exact criteria for this and the predictive power of criteria may not be good. However, if you are faced with a patient whose Mallampati class is 3 or 4 and who has associated features such as a short neck or a receding mandible etc., it is reasonable to anticipate a difficult intubation.

You must notify the consultant anaesthetist on call before undertaking general anaesthesia in a patient in whom you anticipate a difficult intubation.

In all cases of unanticipated difficult intubation or failed intubation, call for help.

Airway assessment

A detailed preoperative airway assessment can assist you in predicting difficult intubation, difficult mask or SAD ventilation and difficult front-of-neck access. Effective airway management requires careful planning. You should have a backup plan for when your primary plan fails.

History

During the preoperative visit, you should elicit previous ‘difficult airway alerts’, surgeries or injuries in head and neck, radiotherapy, snoring, obstructive sleep apnoea, neurological disorders.
Failed or difficult intubation

Clinical examination:
Any gross craniofacial anomaly and gross abnormality of neck should be apparent on clinical examination

- Mouth opening: when fully opened should allow patient’s middle three fingers held in vertical plane.
- Jaw movement: Good forward movement (lower teeth can protrude further than the upper teeth) is associated with easy laryngoscopy.
- Buck teeth are associated with high score on Mallampati classification and also limit the protrusion of lower teeth further than upper teeth.
- Movement of cervical spine and extension at atlanto-occipital joint.
- Thyromental distance should be > 6.5 cm (measured while neck is extended).
- Sternomental distance should be >12.5 cm (measured while neck is extended).

Modified Mallampati’s classification
Conducted with the patient sitting upright, opening the mouth as far as is possible and maximally protruding the tongue. Allocate a class based on what you see at the back of the mouth.

Class 1: Faucial pillars, soft palate and uvula seen.
Class 2: Faucial pillars and soft palate seen. Base of tongue masks uvula.
Class 3: Only soft palate visible
Class 4: Even soft palate not visible.

Preparing yourself
Remember all the usual measures for ensuring that intubation succeeds: position the patient appropriately at the right height and with one pillow under the occiput, with the neck flexed on the body and the head extended on the neck. Consider using a head-up position, or in morbidly
obese mothers, using a ramped position. In this position the head and trunk are supported to align the external auditory meatus with the sternal notch in the horizontal plane.

Use a suitable laryngoscope remembering that insertion into the patient’s mouth can bring significant difficulty in rapid sequence induction and pregnancy. (We recommend learning to use the polio blade laryngoscope.)

Be ready to accept that failed intubation might happen in your practice, even after trying alternative tools. The difficult intubation equipment on the ‘airway trolley’ includes introducers, smaller tubes and polio blade, McCoy blade (levering) and short-handled laryngoscopes. Use a video-laryngoscope if you anticipate challenging intubation and you are skilled in its use. The most important factor in recovery is to follow a pre-planned drill, as below, and not to start experimenting with unfamiliar equipment.

You must use capnography to confirm the position of the endotracheal tube, when intubating the trachea during induction of anaesthesia or managing an intubated patient during anaesthesia.

Two of the four recommendations from NAP4 are relevant here [15].

**Recommendation**: despite the relative infrequency of general anaesthesia for caesarean section, obstetric anaesthetists need to maintain their airway skills including strategies to manage difficult intubation, failed intubation and CICV [now defined as CICO].

**Recommendation**: obstetric anaesthetists should be familiar and skilled with supraglottic airway devices for rescuing the airway: particularly those designed to protect from aspiration and to facilitate ventilation and/or intubation.

**Guidelines for failed or difficult intubation**

As with any clinical guideline, but perhaps most acutely here, bear in mind that no clinical guideline can be a complete substitute for good clinical judgement. You may need to vary the practice described here in individual circumstances. Your success in doing so will be built on your
working knowledge of the guidelines themselves. Alternative actions, such as decisions about whether to wake or proceed after difficult intubation, will necessarily involve integrating more information than can be presented in an algorithm that gives guidance.

**Avoid fixation error.** The overall aim of your actions is to provide safe anaesthesia for the mother and deliver her of a baby, and not to succeed in using any particular technique to achieve this aim. It is failure to oxygenate that causes death, not failure to intubate.

We have adopted the joint guidelines published in 2015 by the Obstetric Anaesthetists Association and the Difficult Airway Society. (Our previous guideline from 2006 focused on the swift insertion of a ProSeal or LMA Supreme to oxygenate the patient before the offset of neuromuscular blockade). The joint guidelines are necessarily based on a limited clinical evidence base but nevertheless provide a consistent framework for providing safe obstetric general anaesthesia [16].

The guidelines below are reproduced with permission from the Obstetric Anaesthetists’ Association and the Difficult Airway Society [17]. There are four algorithms and two tables, and you should study them carefully. Think about how you will deal with this situation, and practise the algorithms with colleagues.

A **master algorithm** provides an overview.

**Algorithm 1** gives a framework on how to optimise a safe general anaesthetic technique in the obstetric patient, and emphasises: planning and multidisciplinary communication; how to prevent the rapid oxygen desaturation seen in pregnant women by advocating nasal oxygenation and mask ventilation immediately after induction; limiting intubation attempts to two; and consideration of early release of cricoid pressure if difficulties are encountered.

**Algorithm 2** summarises the management after declaring failed tracheal intubation with clear decision points, and encourages early insertion of a (preferably second generation) supraglottic airway device if appropriate.

**Algorithm 3** covers the management of the ‘can’t intubate, can’t oxygenate’ situation and emergency front-of-neck airway access,
including the necessity for timely perimortem caesarean section if maternal oxygenation cannot be achieved.

Table 1 gives a structure for assessing the individual factors relevant in the decision to awaken or proceed should intubation fail, which include: urgency related to maternal or fetal factors; seniority of the anaesthetist; obesity of the patient; surgical complexity; aspiration risk; potential difficulty with provision of alternative anaesthesia; and post-induction airway device and airway patency. This decision should be considered by the team in advance of performing a general anaesthetic to make a provisional plan should failed intubation occur.

Table 2 gives practical considerations of how to awaken or proceed with surgery.

Some new points are discussed below.

**Preoxygenation**

If the patient is apnoeic and the airway is not being instrumented, continued administration of 100% oxygen with a tightly fitting facemask and maintenance of a patent airway allows continued oxygenation by bulk flow to the alveoli (apnoeic oxygenation). Consider attaching nasal cannulas with 5 L min\(^{-1}\) oxygen flow before starting preoxygenation, to maintain bulk flow of oxygen during intubation attempts.

**Cricoid pressure**

This is universally used in the UK though not so in many other countries. Many mothers presenting for general anaesthesia will have had ranitidine either orally or intravenously and all should have sodium citrate administered orally. Have a low threshold to reduce or remove cricoid pressure in order to facilitate endotracheal intubation and particularly insertion of a SAD.

**Facemask ventilation**

Bag-facemask ventilation can reduce oxygen desaturation safely when used in conjunction with correctly applied cricoid pressure and a restricted peak ventilation pressure (\(P_{\text{max}} < 20 \text{ cm H}_2\text{O}\)), and it may allow
Failed or difficult intubation

an estimation of the likelihood of successful bag-mask ventilation should it be required during prolonged or failed intubation attempts. Consider its use during rapid sequence induction after administration of induction drugs.

Front-of-neck procedure

This will only rarely be required after failed intubation but may be life-saving where life is threatened by failure of oxygenation. Small-bore cannula techniques have a high failure rate, especially in obese patients. Surgical airways may be more successful and provide a definitive airway. If the front-of-neck procedure fails then institute the cardiac arrest procedure including caesarean delivery if the fetus is greater than 20 weeks’ gestation.

Continuing with anaesthesia or waking

See table 1. It is no longer appropriate to wake a mother routinely after rescuing difficult or failed intubation, and in most cases general anaesthesia will proceed when a satisfactory airway is established. The overriding indications to proceed with general anaesthesia are maternal compromise not susceptible to resuscitation and irreversible acute fetal compromise due to such causes as major placental abruption, ruptured umbilical scar, fetal haemorrhage, umbilical cord prolapse and failed instrumental delivery. You should take into account the risks of repeated anaesthesia to the mother, the original indication for general anaesthesia, and whether regional anaesthesia is contraindicated (e.g. haemorrhage or patient refusal). If postponement is acceptable, then wake the patient. Subsequent anaesthesia must be conducted with a consultant present. Use either a regional technique or an awake intubation.
Master algorithm – obstetric general anaesthesia and failed tracheal intubation

Algorithm 1
Safe obstetric general anaesthesia

- Pre-induction planning and preparation
  - Team discussion

- Rapid sequence induction
  - Consider facemask ventilation ($P_{\text{max}}$ 20 cmH$_2$O)

- Laryngoscopy
  - (maximum 2 intubation attempts; 3rd intubation attempt only by experienced colleague)

  - Success
    - Verify successful tracheal intubation and proceed
    - Plan extubation

  - Fail
    - Algorithm 2
      - Obstetric failed tracheal intubation

      - Declare failed intubation
      - Call for help
      - Maintain oxygenation
      - Supraglottic airway device (maximum 2 attempts) or facemask

      - Fail
        - Algorithm 3
          - Can’t intubate, can’t oxygenate

          - Declare CICO
          - Give 100% oxygen
          - Exclude laryngospasm – ensure neuromuscular blockade
          - Front-of-neck access

          - Fail
            - Is it essential / safe to proceed with surgery immediately?*
              - No
                - Proceed with surgery*
              - Yes
                - Wake*

*See Table 1, *See Table 2
Algorithm 1 – safe obstetric general anaesthesia

Pre-theatre preparation
- Airway assessment
- Fasting status
- Antacid prophylaxis
- Intrauterine fetal resuscitation if appropriate

Plan with team
- WHO safety checklist / general anaesthetic checklist
- Identify senior help, alert if appropriate
- Plan equipment for difficult / failed intubation
- Plan for / discuss: wake up or proceed with surgery (Table 1)

Rapid sequence induction
- Check airway equipment, suction, intravenous access
- Optimise position – head up / ramping + left uterine displacement
- Pre-oxygenate to $F_{O_2} \geq 0.9$ / consider nasal oxygenation
- Cricoid pressure (10 N increasing to 30 N maximum)
- Deliver appropriate induction / neuromuscular blocker doses
- Consider facemask ventilation ($P_{max} \geq 20 \text{ cmH}_2\text{O}$)

1st intubation attempt
- If poor view of larynx optimise attempt by:
  - reducing / removing cricoid pressure
  - external laryngeal manipulation
  - repositioning head / neck
  - using bougie / stylet

Success
- Verify successful tracheal intubation
- Proceed with anaesthesia and surgery
- Plan extubation

Fail
- Ventilate with facemask
- Communicate with assistant

2nd intubation attempt
- Consider:
  - alternative laryngoscope
  - removing cricoid pressure

3rd intubation attempt only by experienced colleague

Fail
- Follow Algorithm 2 – obstetric failed tracheal intubation

Algorithm 2 – obstetric failed tracheal intubation

 Declare failed intubation
 Theatre team to call for help
 Priority is to maintain oxygenation

Supraglottic airway device
(2nd generation preferable)
Remove cricoid pressure during insertion
(maximum 2 attempts)

Facemask +/- oropharyngeal airway
Consider:
• 2-person facemask technique
• Reducing / removing cricoid pressure

Is adequate oxygenation possible?

No
Follow Algorithm 3
Can’t intubate, can’t oxygenate

Yes

Is it essential / safe to proceed with surgery immediately?*

No
Wake*

Yes
Proceed with surgery*

*See Table 1, *See Table 2
Algorithm 3 – can’t intubate, can’t oxygenate

Declare emergency to theatre team
Call additional specialist help (ENT surgeon, intensivist)
Give 100% oxygen
Exclude laryngospasm – ensure neuromuscular blockade

Perform front-of-neck procedure

Is oxygenation restored?

Yes
Is it essential / safe to proceed with surgery immediately?*

Yes
Proceed with surgery$*

No
No
Maternal advanced life support
Perimortem caesarean section

No
Wake$*
<table>
<thead>
<tr>
<th>Factors to consider</th>
<th>WAKE</th>
<th>PROCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal condition</td>
<td>• No compromise</td>
<td>• Mild acute compromise</td>
</tr>
<tr>
<td>Fetal condition</td>
<td>• No compromise</td>
<td>• Compromise corrected with intrauterine resuscitation, pH &lt; 7.2 but &gt; 7.15</td>
</tr>
<tr>
<td>Anaesthetist</td>
<td>• Novice</td>
<td>• Junior trainee</td>
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<tr>
<td>Obesity</td>
<td>• Supermorbid</td>
<td>• Morbid</td>
</tr>
<tr>
<td>Surgical factors</td>
<td>• Complex surgery or major haemorrhage anticipated</td>
<td>• Multiple uterine scars</td>
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<td>Aspiration risk</td>
<td>• Recent food</td>
<td>• No recent food</td>
</tr>
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<td>Airway device / ventilation</td>
<td>• Difficult facemask ventilation</td>
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</tr>
<tr>
<td>Airway hazards</td>
<td>• Laryngeal oedema</td>
<td>• Stridor</td>
</tr>
</tbody>
</table>

Criteria to be used in the decision to wake or proceed following failed tracheal intubation. In any individual patient, some factors may suggest waking and others proceeding. The final decision will depend on the anaesthetist’s clinical judgement.

### Table 2 – management after failed tracheal intubation

#### Wake
- Maintain oxygenation
- Maintain cricoid pressure if not impeding ventilation
- Either maintain head-up position or turn left lateral recumbent
- If rocuronium used, reverse with sugammadex
- Assess neuromuscular blockade and manage awareness if paralysis is prolonged
- Anticipate laryngospasm / can’t intubate, can’t oxygenate

#### Proceed with surgery
- Maintain anaesthesia
- Maintain ventilation - consider merits of:
  - controlled or spontaneous ventilation
  - paralysis with rocuronium if sugammadex available
- Anticipate laryngospasm / can’t intubate, can’t oxygenate
- Minimise aspiration risk:
  - maintain cricoid pressure until delivery (if not impeding ventilation)
  - after delivery maintain vigilance and reapply cricoid pressure if signs of regurgitation
  - empty stomach with gastric drain tube if using second-generation supraglottic airway device
  - minimise fundal pressure
  - administer H₂ receptor blocker i.v. if not already given
- Senior obstetrician to operate
- Inform neonatal team about failed intubation
- Consider total intravenous anaesthesia

#### After waking
- Review urgency of surgery with obstetric team
- Intrathoracic fetal resuscitation as appropriate
- For repeat anaesthesia, manage with two anaesthetists
- Anaesthetic options:
  - Regional anaesthesia preferably inserted in lateral position
  - Secure airway awake before repeat general anaesthesia
Debriefing and follow up

Make sure that a consultant visits the patient. Minor injuries are common. Serious but rare morbidity includes trauma or perforation to the larynx, pharynx or oesophagus. Perforation, presenting with pyrexia, retrosternal pain and surgical emphysema, is associated with a high mortality; if suspected, refer for urgent review by the ENT surgeons. Awareness during anaesthesia is more frequent if intubation has been difficult: enquire directly about this.

Make full documentation about the ease of mask ventilation, grade of laryngoscopy, airway equipment or adjuncts used, complications and other relevant information, and offer the patient a follow-up outpatient appointment with an anaesthetist. Complete a clinical adverse event form for each case.

You can download an airway alert form from www.das.uk.com. When completed, send one copy to the patient’s records, one to the patient and one to the GP.


Obstetric haemorrhage

Major haemorrhage is defined as a haemorrhage in excess of 15% of circulating volume (typically 1000 mL using an estimated blood volume at term of 90 mL kg\(^{-1}\)). **Massive haemorrhage** is usually defined as blood loss in excess of 1500 mL in pregnancy, labour, or following delivery, or continuing loss in excess of 150 mL min\(^{-1}\).

- The median blood loss at caesarean section is about 500 mL. Sometimes it can rapidly transform into massive haemorrhage.
- Tachycardia, hypotension, and vasoconstriction in an obstetric patient represent severe hypovolaemia.
- Coagulopathy may cause haemorrhage. Haemorrhage causes coagulopathy.

There are appropriate immediate actions as below; and further considerations for antepartum and postpartum haemorrhage follow. The successful management of haemorrhage includes obstetric management specific to the cause of the haemorrhage – usually delivery for antepartum haemorrhage and uterine contraction or surgical repair for postpartum haemorrhage. Improved survival from massive transfusion over the past ten years is attributed to more effective efficient warming devices, aggressive resuscitation and component therapy and improved blood banking. Early recognition and effective action prevent shock and its consequences.

**When continuing massive haemorrhage occurs, it threatens life: you must send for help. Do not attempt to manage it on your own.**

**Consultant attendance**

CEMD has made an unambiguous recommendation regarding obstetric haemorrhage [18]:

"If haemorrhage occurs, experienced consultant obstetric and anaesthetic staff must attend."
Massive obstetric haemorrhage – put the call out

**Aims**
To resuscitate the patient and treat the cause.

**Call for help**
Pull the red emergency knob on diagnosis of **MASSIVE OBSTETRIC HAEMORRHAGE** – blood loss in excess of 1500 mL or 150 mL min\(^{-1}\). MOH call.

Labour ward coordinator to call outside help – **obstetric and anaesthetic consultants** and residents.

Dedicated midwife to record all events and times.

One person to direct team tasks clearly.

**Resuscitate**
Airway, breathing and high flow oxygenation.

Circulation – two 14-gauge cannulas, blood warmers, pressure infusers such as Belmont. **Consider intraosseous access.**

Prevent aortocaval compression if still pregnant.

**Send bloods**
FBC, coagulation screen + fibrinogen, phone blood bank (25398 / 25322 or bleep 2169) to check cross-match and electronic issue; consider cell salvage.

**Monitor**
Pulse, blood pressure, pulse oximetry.

Urine output.

**Fluids**
Warmed crystalloid till blood ready.

Infuse against pulse rate and other signs.

‘O’ negative blood in blood fridge if desperate.

Group specific blood if emergency.

Give crystalloids with plasma-reduced blood.

Use a warming device with all intravenous fluids.

Use the rapid infusion device.
Obstetric haemorrhage

More monitors
Invasive arterial blood pressure and ABG.
Core temperature – check the patient warming device.
Consider early use of cardiac output monitoring such as LiDCO or oesophageal Doppler.
Consider CVP (do not impede volume resuscitation).

Operation
May indicate general anaesthesia; use reduced doses, consider ketamine.

Drugs
Uterotonics and systemic haemostatics. Start with tranexamic acid 1 g slow intravenous bolus.

More bloods
Monitor ABG and laboratory values regularly.
Anticipate and manage acidosis and coagulopathy.

Afterwards
Obstetric high dependency care; consider critical care.

Massive haemorrhage call
In case of massive haemorrhage or when you expect cross-matched blood to be exhausted: call for senior help, then contact blood bank to discuss the patient’s needs. In a massive haemorrhage situation, with blood loss more than 1500 mL and continuing, you should also activate the massive haemorrhage protocol. With bleeding in the 1500-2000 mL range, and well controlled, MOH activation is not needed.

Call 2222 and state ‘MASSIVE OBSTETRIC HAEMORRHAGE at location’.
Activating the protocol will ensure blood bank and portering staff are aware of the need for assistance.
Remember to call 2222 and stand down the MOH call once the clinical situation is stable, and to complete the massive haemorrhage proforma.

Resuscitation
The priorities in resuscitation include in decreasing order of importance:
1. Restoring blood volume to maintain tissue perfusion and oxygenation.
2. Restoration of oxygen-carrying capacity with adequate haemoglobin concentration.

3. Securing haemostasis through surgical treatment of the cause of bleeding or by correcting coagulopathy.

Delay in restoration of circulating volume (with warmed crystalloid fluids, then blood) may result in tissue hypoperfusion, organ failure and disseminated intravascular coagulopathy [19].

**Maintaining records**

This is essential and can be forgotten as the clinical work proceeds. Keep in close touch with the midwife who will have allocated to act as the scribe.

**Complications of resuscitation**

Iatrogenic complications of resuscitation are important and you should be alert for them.

- Pulmonary oedema, occurring as a result of over-vigorous crystalloid or colloid therapy, or when associated with transfusion related acute lung injury (TRALI).
- Dilutional coagulopathy, occurring as a result of giving imbalanced or over-vigorous fluid therapy with insufficient blood components. Send samples at maximum intervals of two hours. TEG (thromboelastography) is available in cardiothoracic critical care.

Blood component transfusion is associated with risk and adverse outcomes in its own right. It is positively correlated with increased risk of:

- Multi-organ failure (MOF).
- Infection.
- Mortality (it is a better predictor of mortality than the Injury Severity Score).
- ICU admission.
- Prolonged ICU and hospital stay.
Obstetric haemorrhage

It is important to minimise transfusion by:

- Controlling haemorrhage effectively.
- Using red cell salvage as much as possible.
- Transfusing red cells for an indication, not just to improve a number (see page 62).
- Where red cell transfusion is indicated, giving the minimum number needed and rechecking. For example, many patients who do need a postoperative blood transfusion will only need one unit, and the next unit should only be prescribed after a further check.

Anticipation and prediction

Massive obstetric haemorrhage as defined above occurred in 7.2% of all caesarean sections carried out in Coventry between 2006-08, and 3.8% of all caesareans in 2011-12. This reduction is to be welcomed, but we can expect to see one case every eight days. It can also happen in any delivery, whether vaginal or caesarean, with no warning.

Certain conditions carry a greater risk. Caesarean section in labour, especially where labour is prolonged and a Syntocinon infusion has been used, is regularly followed by PPH, as is multiple delivery by caesarean section. Iron deficiency anaemia will reduce the ability to tolerate haemorrhage and may contribute to uterine atony through depleted uterine myoglobin levels.

Where a delivery is known to be one with a high risk of massive haemorrhage, for example placenta praevia, especially with previous caesarean section, myomectomy scars, uterine fibroids, placental abruption or previous third-stage complications, anticipative steps are essential.

- Antenatal anaemia should be checked and corrected in the antenatal period if possible.
- A consultant should perform all elective or emergency surgery.
- A consultant should give any anaesthetic.
Adequate intravenous access (two large bore cannulas) should be in place before surgery starts.

Check blood availability, whether electronic issue compatible or cross-match.

Consider inserting a preoperative arterial line.

Ensure the availability of intraoperative cell salvage.

**Estimation of blood loss and its effects**

Estimation is a continual process to keep the woman’s state under review. With the circulating blood volume at term of typically between 90-100 mL kg\(^{-1}\) (in the case of morbid obesity this will be less) you should calculate the assumed starting blood volume, taking into account pre-theatre losses, to determine the proportion of blood that the woman has lost in order to compare it with the standard haemorrhage classes.

<table>
<thead>
<tr>
<th>Class</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Up to 15%</td>
<td>No change in vital signs; fluid resuscitation not usually necessary.</td>
</tr>
<tr>
<td>Class 2</td>
<td>15-30%</td>
<td>Peripheral vasoconstriction; use crystalloid (and salvaged red cells).</td>
</tr>
<tr>
<td>Class 3</td>
<td>30-40%</td>
<td>Peripheral vasoconstriction no longer compensates, so systolic blood pressure falls; use crystalloid and salvaged red cells, and allogeneic blood may be necessary.</td>
</tr>
<tr>
<td>Class 4</td>
<td>Over 40%</td>
<td>Immediate threat to life with cardiovascular collapse, unconsciousness at 50% loss; immediate transfusion and surgical intervention if not already in progress. May be manageable with salvaged red cells alone if done very well in theatre.</td>
</tr>
</tbody>
</table>

With an arterial line in place you should make serial estimations of the arterial pH, lactate, haemoglobin, haematocrit and base deficit measurements to guide management. Remember to send coagulation samples including fibrinogen levels regularly in communication with the blood bank technician.
Obstetric haemorrhage

Obstetric surgical management

Bimanual compression staunches haemorrhage effectively.

Internal tamponade or packing may precede operative intervention.

If bleeding is excessive or of pharmacological measures fail to control haemorrhage adequately, the obstetrician should consider either embolisation of uterine arteries by an interventional radiologist or further surgical procedures, such as internal iliac ligation, hysterectomy, B-Lynch suture (brace suture) or haemostatic square suture. Any obstetrician who does not feel competent to perform any of the above should immediately call a colleague to assist or, if necessary, a gynaecological or vascular surgeon.

Hysterectomy is indicated if bleeding continues despite deployment of an intrauterine balloon. It should not be delayed until the woman is in extremis or while less definitive procedures with which the surgeon has little experience are attempted [21].

As the obstetric anaesthetist, you should check that the operating obstetric surgeon has requested consultant assistance.

APH (antepartum haemorrhage)

See also ‘Placenta praevia’ on page 261.

Placental abruption

1. Clinical features of major placental abruption are:
   - Abdominal pain and a tense, tender uterus.
   - Shock.
   - Vaginal bleeding in low proportion to the degree of shock.
   - Fetal distress or death.

2. Establish basic measures (see page 51).

3. Coagulation disorders are more common in this condition. You should request fibrinogen and FDPs specifically on the coagulation screen, and you should order two units of fresh frozen plasma immediately on making the diagnosis of major placental abruption. Do not wait for haematological evidence of coagulopathy.
4. Aim to keep the fibrinogen level greater than 2 g L\(^{-1}\); levels less than this are a strong positive predictive factor for worse postpartum haemorrhage (see page 65).

5. DIC or consumption coagulopathy can occur in major abruption and initial coagulation studies must be repeated after 1-2 hours. Platelet transfusion may be required.

6. There is a high risk of postpartum haemorrhage following placental abruption and you should prevent this with a Syntocinon infusion (see page 206).

**PPH (postpartum haemorrhage)**

1. Unexplained tachycardia during caesarean section, even when the patient is awake with a reasonable blood pressure, is an ominous sign that you must act upon. Check and check again whether the patient could be bleeding. During any caesarean section, observe the bleeding and query the uterine tone.

2. Establish basic measures (see page 51).

3. The most common cause is uterine atony. Other causes that you should consider in discussion with the obstetrician are genital tract trauma and retained placenta or other mechanical obstruction to contraction. Less common causes are endometritis or intrauterine sepsis, coagulopathies, and uterine inversion. The obstetricians use the four Ts mnemonic – Tone, Trauma, Tissue and Thrombin. Remember the effect of Temperature.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone: uterine atony.</td>
<td>70%</td>
</tr>
<tr>
<td>Trauma e.g. cervical or vaginal tears, ruptured uterus from previous scars, extension of uterine angles at time of caesarean section.</td>
<td>20%</td>
</tr>
<tr>
<td>Retained tissue e.g. placenta, membranes.</td>
<td>10%</td>
</tr>
<tr>
<td>Coagulopathy – often a late cause.</td>
<td>1%</td>
</tr>
</tbody>
</table>
Obstetric haemorrhage

4. Determine with the obstetrician whether Syntocinon (by bolus or infusion) is indicated and administer it. See below for further drug treatment.

5. Examination under general anaesthesia is indicated by:
   - Failure of uterine contraction with obstetrical methods.
   - Persistent bleeding with uterine contraction.

6. Consider critical care for the postoperative management of patients who have had hysterectomy performed to control haemorrhage. However, this is not always indicated. With prompt and effective prevention of shock (maintenance of arterial pH due to good resuscitation) haemorrhages in excess of ten litres can readily be managed on the labour ward.

Pharmacological treatment of uterine atony

Syntometrine (Syntocinon 5 units with ergometrine 500 mcg) is the standard prophylaxis, given intramuscularly at the delivery of the infant. This is used for most vaginal deliveries although it is possible that it may be replaced by Syntocinon as a result of the 2011 maternal mortality report [20].
**Obstetric haemorrhage**

- **Syntocinon** bolus and infusion

  - **Good tone?**
    - Yes
    - Specific handover to midwife
    - Offer **misoprostol**
  
    - No
    - **Recheck all drug use; repeat** **Syntocinon** bolus carefully and consider increasing infusion rate
    
      - **Good tone?**
        - Yes
        - **Carboprost**; consider escalating case with senior staff; offer **misoprostol**; specific handover to midwife
        
          - No
    
      - **Ergometrine**; repeat as necessary
    
      - **Good tone?**
        - Yes
        - Specific handover to midwife
        
          - No
    
      - **Carboprost**; consider escalating case with senior staff; offer **misoprostol**; specific handover to midwife
Syntocinon should be given by intravenous bolus (5 units; dilute 10 units into 10 mL with saline 0.9%), usually repeated once, (except as below). Follow this with an infusion of 20 units Syntocinon in 50 mL saline starting at 15 mL h⁻¹.

Intravenous Syntocinon, especially but not only in doses above 5 units, can cause hypotension and circulatory collapse if given in the presence of hypovolaemia or any form of shock, through marked reduction in systemic vascular resistance. This drug must be given by infusion at the slowest effective rate in cardiac disease or pulmonary oedema. Oxytocics are however necessary to reduce blood loss. In these cases and if there is no treatment plan in the notes, we suggest making up the standard postpartum infusion, omitting the bolus dose altogether and commencing the infusion at 60 mL h⁻¹ (0.4 i.u. min⁻¹) for a maximum of ten minutes and keep in constant communication with the obstetrician about the state of uterine contraction. Reduce the dose as soon as possible. All such cases must be discussed with a consultant.

Ergometrine 50-100 mcg by intravenous injection (make up 500 mcg to 10 mL with saline; give 1-2 mL at a time repeated as necessary). Intravenous ergometrine will act within 40 seconds; when given intramuscularly (500 mcg) it acts within about seven minutes. Ergometrine is a hypertensive agent and is relatively contraindicated in pre-eclampsia and other hypertensive conditions. This drug is best avoided in severe pre-eclampsia and many cases of cardiac disease; if haemorrhage control is needed nonetheless then use arterial line monitoring and doses of 25-50 mcg.

Carboprost (Hemabate, or prostaglandin F₂α) is indicated for uterine atony unresponsive to ergometrine or Syntocinon. It is given as an intramuscular dose of 250 mcg repeated up to every 15 minutes in severe cases (no more than eight doses or 2000 mcg). Side effects include nausea, vomiting, flushing, bronchospasm, hypoxia (abnormal ventilation-perfusion ratio and intrapulmonary shunt fraction) and hypertension. Excessive dosage may cause uterine rupture. 85% of patients respond to the first dose.
Carboprost is kept in the obstetric theatre refrigerator. **Carboprost must not be given intravenously.** Intravenous administration is associated with severe bronchospasm, systemic and pulmonary hypertension. Intramyometrial injection is not licensed but can be used in severe cases such as first exposure of the uterus at laparotomy for postpartum haemorrhage following failure of pharmacological management; the dose is 500 mcg [21]. Observe the patient carefully: it is possible for an intramyometrial dose rapidly to enter the systemic circulation via uterine venous plexuses.

Maternal asthma is a strong relative contraindication. It may be used with caution in asthmatic patients, weighing the severity of asthma against the urgency of the need to increase uterine tone. Seek senior help and advice.

**Misoprostol** (prostaglandin E$_1$) may be given rectally at a dose of 1000 mcg [21]. Offer this when the surgeon checks the birth canal. It is often used when the patient has had some atony requiring higher dose Syntocinon or another uterotonic agent, to maintain tone in the postnatal period. This will probably cause gastrointestinal symptoms such as diarrhoea.

**Blood component therapy**

The blood bank phone number is 25322 (bleep 2169). Use 25398 for emergency haemorrhage.

Seek the advice of a consultant haematologist in coagulopathy or massive haemorrhage.

Do not attempt to manage massive haemorrhage on your own. Discuss potential cases with a senior colleague and call for help if it happens.

Send samples (FBC and coagulation screen and fibrinogen) every two hours or more often as indicated.

If available, use TEG to guide therapy.
Emergency O-negative blood

Several units are maintained in the blood fridge in labour ward theatres. You must inform blood bank if these units are used, using the form kept with the unit.

Electronic issue of blood (EIB)

Blood issued electronically will be in theatre swiftly. To be suitable for electronic issue of blood, a patient has to fulfil all the following criteria:

1. Two serum samples processed by blood bank, at least one within the previous three days for patients in the third trimester. The antenatal screen (listed as FAN or BAN on CRRS) can be used as a reference sample but the current sample must be a valid ‘group and screen’ (GA) tested here at UHCW within the last three days. The two samples must have been taken by different practitioners.

2. Both samples to agree with each other on blood group.

3. Antibody screen negative on both samples.

In practice, if a recent GA (group and screen) sample and a BAN or second GA sample are on CRRS without an antibody flag then the patient is suitable for EIB. However, this is dependent on their recent history of any blood transfusion.

Rhesus-negative women will very likely have received prophylactic anti-D. This makes them PD-antibody positive and currently unable to have blood electronically issued.

Red blood cells – indications for transfusion

Try to maintain circulating haemoglobin with cell salvage if possible. If it is not, then consider allogeneic blood transfusion.

You must check every transfused unit of blood against the patient’s verified wristband, and verbally if she is conscious. There is detailed advice about managing blood transfusions in the Anaesthetists Handbook. You must make a record of a valid, defined and justifiable indication for every blood transfusion.
The following guideline is adapted from SIGN [22] and the BSH guidelines [23]. It was drawn up for elective surgery in non-pregnant patients but we recommend it for obstetric haemorrhage.

- Transfusion is unlikely to be justified at haemoglobin levels $>100 \text{ g L}^{-1}$.
- Transfusion is almost always required at haemoglobin levels $<70 \text{ g L}^{-1}$.
- Patients with cardiovascular disease, or those expected to have covert cardiovascular disease are likely to benefit from transfusion when their haemoglobin level falls below $90 \text{ g L}^{-1}$.
- Transfusion at levels between $70 \text{ g L}^{-1}$ and $100 \text{ g L}^{-1}$ is at the discretion of the clinician, and should take into account any postoperative symptoms such as tachycardia, dyspnoea and failure to mobilise. You should also consider the preoperative haemoglobin level and all other relevant factors.
- Red cells also contribute to haemostasis by their effect on platelet margination and function. The optimal haematocrit to prevent coagulopathy is unknown, but sufficient red cells will be required to sustain haemostasis in patients with massive blood loss.
- Red cells also contribute to haemostasis by their effect on platelet margination and function. The optimal haematocrit to prevent coagulopathy is unknown, but experimental evidence suggests that a relatively high haematocrit, possibly 35%, may be required to sustain haemostasis in patients with massive blood loss.

Remember that these patients may need critical care and will need postpartum iron therapy.

If there is a central venous pressure line in place, send a mixed venous blood sample to the blood gas machine. If $S_vO_2$ is less than 70% even with tolerable haemoglobin levels, transfuse red cells to improve oxygen delivery.

The blood gas machine will measure lactate: use this with pH for assessing the adequacy of resuscitation.
Obstetric haemorrhage

Maintain continuous observation of haemorrhagic losses and communication with the operating surgeon, and transfuse in anticipation. A further cross-match sample is not required after eight units of blood.

Intraoperative cell salvage in obstetrics (IOCS)

See page 219 for the main chapter on IOCS.

IOCS can be used in the management of obstetric haemorrhage. While it is usually indicated for most caesarean sections, it may be possible to set it up when haemorrhage starts. It can be set up in less than five minutes and is indicated in the emergency setting if bleeding continues and you expect there to be more to salvage and process.

Always send for senior assistance if you are in this position – the patient is haemorrhaging.

Check with the ODP and consider sending for another ODP.

In ongoing massive haemorrhage, do not use the reinfusion filter. The filter will slow reinfusion down so far that it cannot be used for reinfusion as part of intraoperative red cell therapy. In this case the balance of risk favours rapid return of salvaged red cells.

Platelets

Keep the platelet level above $50 \times 10^9 \text{ L}^{-1}$ in acutely bleeding patients [24]. Anticipate need and order early for when required if there is a rapidly falling count on repeat sample, or if a patient blood volume has been replaced (approximately 90 mL kg$^{-1}$). Platelets may need to come from Birmingham. Liaise with the blood bank to ensure that two pools of platelets are available locally and send for them if not; a decision to transfuse can be taken later.

Empirical treatment may be indicated in massive transfusion. Give one pool of platelets with each five units of red blood cells. Liaise with the consultant haematologist.
**Fresh frozen plasma (FFP)**

Aim for prothrombin time less than 20 seconds and activated partial thromboplastin time ratio less than 1.5. Above this level there will be increased surgical bleeding.

Order FFP when you declare massive obstetric haemorrhage and anticipate transfusing more than four units of allogeneic blood or 1200 mL salvaged blood. Allow up to forty minutes defrosting and transport time. FFP is a high volume infusion at 250 mL per unit.

Defrosted FFP can be returned to blood bank so long as it has stayed within the cool chain, and can then be issued to other patients (within 24 hours of defrosting).

In class 4 haemorrhages above 50% and relentless bleeding, transfusing plasma in a 1:1 ratio with red cells may give benefit.

**Fibrinogen**

Fibrinogen is important in primary haemostasis through platelet activation and aggregation and in secondary haemostasis through fibrin polymerisation. Levels rise during the third trimester of pregnancy to twice those of non-pregnant levels. Low fibrinogen levels during operative surgery point to serious trouble with levels below 2 g L$^{-1}$ being a strong positive predictive factor for massive postpartum haemorrhage, transfusion needs, surgical intervention and the need for critical care [25,26]. This work is compelling though it is unclear whether low fibrinogen levels are a causative factor and no intervention studies are reported yet.

**Cryoprecipitate**

Aim for fibrinogen levels greater than 2 g L$^{-1}$ as above. Fibrinogen deficiency develops early when concentrated red cells are used to replace lost whole blood. **Ensure that you request fibrinogen levels with the coagulation screen.** Allow forty minutes defrosting and transport time. Cryoprecipitate has less volume than FFP.

Administer 1-1.5 packs per 10 kg body mass: usually ten packs.
**Obstetric haemorrhage**

If bleeding has progressed so that the uterus is a large bag of blood, it is likely that the uterine contents will be a large fibrin clot. In this case administer twenty units of cryoprecipitate empirically without waiting for the coagulation screen results.

**Haemostatic failure**

If severe pre-eclampsia, consumption coagulopathy or amniotic fluid embolism (AFE) is suspected or there seems to be widespread haemostatic failure not responding to FFP, give six units of cryoprecipitate followed by one adult therapeutic dose of platelets if bleeding persists. Suspected AFE will require larger volumes of cryoprecipitate. Obtain fresh coagulation results and haematology advice.

Consider systemic haemostatic agents as below.

---

**Hypothermia causes and will worsen coagulopathy.**

**Perioperative systemic haemostatic agents**

**Tranexamic acid (Cyklokapron)**

This is an antifibrinolytic agent which stabilises the formation of blood clots, by inhibiting the conversion of plasminogen to plasmin. It is indicated in massive obstetric haemorrhage as a first line measure.

The dose is 15 mg kg\(^{-1}\) repeated every four hours as necessary – in practice a single slow intravenous injection of 1 g (2 × 5 mL) is a suitable dose when you declare massive obstetric haemorrhage. It can be repeated immediately if bleeding is out of control. Start a postoperative infusion of 1 g over eight hours.

Postoperative thromboprophylaxis with enoxaparin should be established in order to prevent further fibrin deposition and an aggravated prothrombotic state. Discuss this with a haematologist.

Tranexamic acid is indicated where the fibrinolytic system has been activated by acute severe bleeding; TEG will demonstrate hyperfibrinolysis.
Recombinant activated Factor VII (rFVIIa; NovoSeven)

If considering the use of rFVIIa you must ensure that consultants in obstetrics, anaesthetics and haematology are aware of the case. See [27]. This drug was thought to show great promise but trial evidence has not emerged to support its place in clinical guidelines. There have been reports of non-responders and thromboembolic complications, predominantly arterial such as myocardial infarction and cerebral thrombosis. It is unlikely to be of use and decisive surgical action may be more important; rFVIIa may only be used in extremis and with the agreement of a consultant haematologist.

Requirements for rFVIIa to work as desired include normothermia, correction of acidosis, and near-normal levels of platelets, calcium and fibrinogen. Correcting these may well eliminate any need for further measures such as rFVIIa.

The mechanism of action of rFVIIa suggests enhancement of haemostasis limited to the site of injury without systemic activation of the coagulation cascade. In multiply transfused coagulopathic patients it is likely to stop diffuse bleeding. One dose is a minimum of 90 mcg kg⁻¹. Further doses will be needed if treatment is successful and these are available from Birmingham.

rFVIIa is used to control unresponsive life-threatening bleeding, when all other measures have failed, pH and temperature are near the normal range, fibrinogen > 2 g L⁻¹, calcium is normal and the platelet level is above 40 × 10⁹ L⁻¹. There is no specific indication on the coagulation screen. It should be considered when blood loss has reached 90 mL kg⁻¹ (approximately seven litres) or general bleeding is out of control, or when emergency hysterectomy is considered.

Effective resolution of bleeding has been reported within minutes of administration. A second dose may be considered one to three hours after the first dose. There is no known benefit from subsequent doses if two doses have failed to produce a response.

This is a measure of last resort. Preliminary results and case reports suggest that it can be used safely and effectively to control life-
Obstetric haemorrhage

threatening bleeding in surgery and trauma, when all other measures have failed, including critical postpartum haemorrhage.

There have been case reports of postoperative thromboembolism.

Recombinant activated Factor VII will cost approximately £4,000 per dose.

Actions when haemostasis is not secure

You should make your best efforts to correct known or suspected coagulopathy, acidosis and hypothermia, in order to maintain an adequate circulation delivering platelets and fibrinogen to the site of bleeding.
Surgical actions | Anaesthetic actions
---|---
1. Call consultant to attend. | 1. Call consultant and labour ward coordinator to attend.
2. Inspect and repair vagina and cervix. | 2. Restore blood volume and oxygen-carrying capacity to keep arterial pH above 7.00.
3. Check uterine cavity for rupture. | 3. Use uterotonics – give oxytocin, ergometrine and carboprost as indicated.
4. Give uterotonics: intramyometrial carboprost or vaginal misoprostol. | 4. Administer tranexamic acid.
5. Tamponade uterine bleeding: uterine packing, Bakri balloon or brace suture as indicated. | 5. Maintain core temperature above 35°C.
6. Surgical haemostasis should be attempted. | 6. Check volatile dose and uterotonics again.
7. Treat coagulopathy if possible:
   a. Keep platelet count above $50 \times 10^9 \text{ L}^{-1}$.
   b. Keep prothrombin time below 16 seconds with FFP.
   c. Keep fibrinogen level above $2 \text{ g L}^{-1}$ with cryoprecipitate.

**Aprotinin (Trasylol)**

The licence for the antifibrinolytic agent aprotinin was withdrawn and then reinstated in controversial circumstances [28]. It is presently available for cardiothoracic surgery only. You should not use it unless under instruction from a consultant haematologist.
Obstetric haemorrhage

Interventional radiology

Bilateral placement of catheters into the internal iliac arteries, with perioperative balloon occlusion or transcatheter arterial embolisation has been used effectively to control massive obstetric haemorrhage.

In this procedure, a radiologist places catheters into the contralateral internal iliac arteries via the femoral arteries. Intravascular balloon inflation provides temporary control and it is possible to use foam embolisation for permanent control.

However, it is a prolonged procedure needing careful planning and taking place in the radiology department. It is very unlikely to be effectively employed in an acute situation if catheters are not already in place.

Indications

Perioperative balloon occlusion is indicated for a high risk of placenta accreta based on a history of previous caesarean section along with sonographic findings pointing to anterior placenta praevia [29]. This probabilistic approach does lead to a high incidence of unnecessary intervention. MRI imaging or transvaginal ultrasound should also be available to augment the diagnosis.

Management

Where a case is being planned, experience has shown that the catheter insertion is quite uncomfortable. The choice of anaesthesia for such a planned case may well be epidural followed by general anaesthesia. It may be worthwhile to consider placing the epidural before the femoral artery catheters. Liaise with the radiologist about timing and dose of any heparin they may wish to use.

Perioperative balloon occlusion is normally performed under angiographic confirmation. This will require that a portable image intensifier is in theatre.

It will not halt blood flow to the uterus, but can be expected to reduce pulse pressure distal to the occlusion, this reducing intraoperative blood loss. This may prevent hysterectomy, or reduce blood flow into the
operative field and reduce the incidence of complications of emergency hysterectomy.

Complications

Thromboembolism of the iliac arteries, bladder and rectal wall necrosis and cauda equina syndrome can result.

Catheter placement can result in uteroplacental insufficiency and fetal compromise [30] – there should be fetal monitoring throughout the procedure. Take terbutaline to fluoroscopy in case of fetal distress due to contractions (250 mcg may be given subcutaneously).

Women who refuse blood transfusion

Refusal of consent can be on religious grounds (Jehovah’s Witness, Rastafarian etc.) or can be because of personal beliefs. You may be asked to speak with a woman who is considering declining blood transfusion. This may be done because of our expertise in running the red cell salvage programme, which is valued by the obstetricians and mothers alike. Give adequate time to discuss these matters with the woman and make sure that the disclaimer is properly recorded, including the various types of blood components available and whether they are acceptable to the patient. Refer to the current hospital guideline on refusal of consent for transfusion and make sure that the paperwork is completed as far in advance as possible.

A substantial number of Jehovah’s Witnesses will accept the use of extracorporeal red cell salvage. Be careful not to promise what cannot physically be delivered; the use of a centrifuge.

It is important for the woman to understand that we cannot guarantee complete continuity of salvaged blood with her circulation. The processing procedure requires the use of a centrifuge, preventing the same sort of vascular continuity as in cardiopulmonary bypass, for example. Some Jehovah’s Witnesses will decline cell salvage for this reason. If cell salvage is accepted, then set it up ‘in continuity’ so that the red cell bag is not physically detached from the circuit at any time.
Obstetric haemorrhage


Local anaesthetic toxicity

Epidural injections and infusions create serious risks for patients if given inadvertently through the intrathecal or intravenous routes. All epidural administrations must be given by doctors, nurses or midwives and in areas where there is immediate availability of an emergency team able to treat subsequent problems.

All these cases must be reported on clinical adverse event forms.

Systemic toxicity to local anaesthetics leads to central nervous excitability and convulsions. Cardiotoxicity also occurs and usually involves *torsade de pointes* – a form of ventricular tachycardia characterised by a polymorphous electrocardiographic appearance, delayed repolarisation and a prolonged QT interval – or refractory ventricular fibrillation [31].

Hypokalaemia and hypomagnesaemia are predisposing factors. Hypomagnesaemia is an occasional finding in late pregnancy.

**Avoid these adverse effects by minimising the use of strong concentrations intended for epidurals (above 0.1%) as far as possible.**

Life-threatening intravenous administration of local anaesthetic can occur at any time that an epidural dose is being given, either down an epidural catheter or wrongly into an intravenous cannula. The NPSA safety alerts requiring incompatible connectors have not yet been implemented. However, when they have, these incidents could still occur, especially during epidural top-up.

For life-threatening cardiotoxicity administer life support as necessary followed promptly by the specific treatment for local anaesthetic toxicity. There is now a professional consensus surrounding the use of intravenous 20% lipid emulsion to treat severe local anaesthetic toxicity with neurological or cardiovascular involvement [32].

**Recognition**

Signs of severe toxicity:
Local anaesthetic toxicity

- Sudden alteration in mental status, severe agitation or loss of consciousness, with or without tonic-clonic convulsions.
- Cardiovascular collapse: sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias may all occur.
- Local anaesthetic (LA) toxicity may occur some time after an initial injection.

Immediate management

- Stop injecting the local anaesthetic.
- **Call for help** and ask someone to get the lipid rescue bag and guideline from the resuscitation trolley in the maternity theatres lobby.
- Maintain the airway and, if necessary, secure it with an endotracheal tube.
- Give 100% oxygen and ensure adequate lung ventilation (hyperventilation may help by increasing plasma pH in the presence of metabolic acidosis).
- Prevent aortocaval compression.
- Confirm or establish intravenous access.
- Control seizures: give a benzodiazepine, thiopental or propofol in small incremental doses.
- Assess cardiovascular status throughout.

Treatment

Check the protocol on the lipid bag.

In circulatory arrest, commence CPR and give lipid rescue continuing CPR throughout.

Without circulatory arrest, treat hypotension, bradycardia and tachyarrhythmia, and consider lipid rescue.
Do not use propofol instead of lipid rescue or lidocaine as an antidysrhythmic agent.

**Lipid rescue**

The use of 20% lipid solution ‘lipid rescue’ has been reported in a small body of animal work and in two published case reports in humans, with apparently dramatic effect. The lipid solution used in the case reports was Intralipid; the effect is thought to be through a ‘lipid sink effect’ whereby the lipophilic local anaesthetic is removed from effector sites by the lipid. The lipid solution available in this trust is Clinoleic 20%. Dose recommendations are the same. A full description of evidence, cases and dose recommendations is at www.lipidrescue.org. It is not appropriate to use propofol or etomidate formulated in lipid.

**Lipid dose**

Give an initial intravenous bolus of $1.5 \text{ mL kg}^{-1}$ over one minute and follow with an intravenous infusion at $15 \text{ mL kg}^{-1} \text{ h}^{-1}$. After five minutes give a repeat bolus, if cardiovascular stability has not been restored or an adequate circulation deteriorates. After a further five minutes a final third bolus can be given. Double the infusion rate to $30 \text{ mL kg}^{-1} \text{ h}^{-1}$ at any time after five minutes if a stable and adequate circulation has not been achieved. Do not exceed a maximum cumulative dose of $12 \text{ mL kg}^{-1}$.

**Magnesium sulfate and amiodarone**

Magnesium sulfate can be used in refractory cases, especially if hypomagnesaemia is present. It is readily available in labour ward, critical care and theatres. Indications and administration are as below.

Amiodarone is also widely available.

Rapid administration of magnesium can cause asystole.

**Torsade de pointes**

1. Activate the emergency call and get someone to call a cardiologist.

2. Apply basic and advanced life support as necessary.
Local anaesthetic toxicity

3. Use the standard magnesium mix as on page 282, making up a 50 mL syringe containing 10 g MgSO₄.

4. Give intravenous magnesium sulfate 2 g over 15 minutes (10 mL from 50 mL syringe).

5. Follow with 1 g h⁻¹ (5 mL h⁻¹).

Refractory ventricular fibrillation

1. This is in the context of ongoing ‘cardiac arrest’.

2. Apply basic and advanced life support as necessary.

3. Do not delay electrical defibrillation and intravenous adrenaline.

4. Give magnesium as above.

5. Intravenous amiodarone has been used successfully.

6. The adult dose of amiodarone is 300 mg made up to 20 mL with 5% glucose. A further dose of 150 mg may be given for recurrent or resistant VT/VF, followed by an infusion of 1 mg mL⁻¹ for six hours.


Other emergencies

Eclampsia

1. This is the occurrence of tonic-clonic convulsions usually but not always in the presence of pre-eclampsia. 40% of cases occur after delivery, almost always within the first week. Always consider epilepsy in the diagnosis of maternal collapse with seizure activity.
2. Ensure that the patient has been placed into the left lateral position and that oxygen therapy and intravenous access have been established.
3. Check the patient’s history and medication for the prior existence of epilepsy or other epileptogenic condition. Check for hypoglycaemia.
4. You should make sure that magnesium therapy is commenced as soon as possible (see page 282).

Uterine inversion

1. You should consider this diagnosis if there is severe abdominal pain after delivery or if there is shock out of proportion to the apparent blood loss. Blood loss is often underestimated.
2. Give oxygen and establish venous access.
3. Diagnose and treat shock with prompt resuscitation for the haemorrhage.
4. Give atropine as necessary for the vagal bradycardia.
5. Prepare for a general anaesthetic in the event of rapid replacement not being possible with tocolytic therapy. Volatile general anaesthesia relaxes the uterus for replacement – you should use a reduced dose of induction agent e.g. thiopental. You may need to use tocolytic drugs e.g. terbutaline 100 mcg intravenous (2 mL when 500 mcg in 1 mL has been diluted to 10 mL with saline).
Other emergencies

6. After replacement of the uterus, give Syntocinon as an intravenous bolus and then an infusion (see ‘Prevention of postpartum haemorrhage’ on page 206).

7. Neurogenic shock is rare but may occur and should not be treated with large volumes of intravenous fluids.

Umbilical cord prolapse

Assess the patient with a view to reassuring her that proper management will protect her and the baby for safe delivery. Traditionally this has been a mandatory indication for general anaesthesia. This has now changed with better management of the presentation and regional anaesthesia is preferred, whether epidural or spinal.

Measures to maintain fetal wellbeing include the examiner keeping their hand in the vagina pushing the fetal presenting part upward until a urethral catheter has been employed. The catheter is used to fill the bladder with up to 500 mL saline and then clamped. The examiner’s hand can then usually be removed without adverse effect on fetal oxygenation. Assessment of the delivery can take place, with forceps in the delivery room if the vertex is below the ischial spines. Otherwise rapid transfer to the operating theatre should allow regional anaesthesia to be employed if the fetal heart rate has recovered. Subcutaneous terbutaline 250 mcg can be used as a tocolytic if there is no bleeding.

The obstetricians will monitor the fetal heart rate during block development, and release the clamp on the catheter to allow safe abdominal incision.

Uterine rupture

1. You should consider this diagnosis if there is sudden cessation of uterine activity or abdominal pain between contractions, sometimes despite the epidural. Fetal distress, vaginal blood loss and shock may all be present.

2. Give oxygen, establish venous access and send serum for issue of four units of type-specific blood.

3. Send for senior help.
4. Diagnose and treat shock. The mother’s welfare is paramount and shock should be treated so as to render induction of anaesthesia safe. However, in extremely rare circumstances operative resuscitation may be required.

5. Prepare for immediate induction of general anaesthesia, using a **reduced** dose of induction agent e.g. thiopental, for caesarean section and repair.

6. Expect massive obstetric haemorrhage and manage accordingly.

**AFE (amniotic fluid embolism)**

This is rare but devastating and may be a misnomer for an anaphylactic reaction of delivery. Before making the diagnosis you should endeavour to exclude pulmonary embolism from other causes, acute left ventricular failure, acid aspiration syndrome; also eclampsia and local anaesthetic toxicity if convulsions feature in the presentation.

Significant premonitory signs and symptoms, i.e. respiratory distress, cyanosis, restlessness and altered behaviour, may give the first clue to diagnosis before collapse and haemorrhage occur. Uterine hyperstimulation with Syntocinon or dinoprostone (Propess) is a risk factor for AFE, and use of a tocolytic such as terbutaline should be considered.

Coagulopathy is present in the majority of cases.

**Diagnosis**

- Acute dyspnoea.
- Profound hypotension.
- Seizures.
- Cyanosis.
- Pulmonary oedema.
- Uterine atony.

The treatment is supportive, starting with Basic and Advanced Life Support. Haemostatic failure is almost certain to develop in survivors - see page 66 for treatment. The patient should be transferred to the ICU.
Other emergencies

Contact the consultant anaesthetist on call for advice when this condition is suspected, and involve the critical care consultant and team early.

In the case of collapse with cardiac arrest, resuscitation should include perimortem caesarean section within five minutes as a maternal resuscitative measure [33] – see below.

Unexplained collapse and cardiopulmonary arrest

**Sudden unexplained loss of consciousness is a good indication of inadequate cardiac output, especially coupled with cyanosis and a profound fetal bradycardia and should mandate immediate CPR.**

1. Ensure that the patient has been placed into the left lateral position (except when external cardiac compression is required) and that oxygen therapy and intravenous access have been established.

2. Commence basic and advanced life support as appropriate. Consider using an intraosseous driver to the humerus if venous access cannot otherwise be obtained.

3. Where the patient is unconscious and has no airway reflexes, protect the airway with a cuffed endotracheal tube.

4. Administer oxygen.

5. Exclude hypoglycaemia.

6. Aortocaval compression will impair the effectiveness of external cardiac compression in late pregnancy such that cardiac output will be reduced to only 10%. If it is necessary to place the woman in a supine position for external cardiac compression, you must ensure that manual left lateral displacement of the uterus is performed [34]. If this cannot be done, a tilt should be applied using an upturned chair or an assistant’s knees, or a left lateral tilt to 15 degrees or an obstetric wedge placed under the pelvis. Soft objects are not as effective as hard objects, but still better than nothing.

7. Request that the arrest team, the consultant anaesthetist and the consultant obstetrician are called immediately. The consultant on call for critical care should be involved sooner rather than later for appropriate cases.
8. Determine the cause. It may fall into **one or more** of three groups.
- Pre-existing maternal conditions e.g. epilepsy.
- Pathological syndromes of pregnancy e.g. eclampsia, embolus.
- Iatrogenic causes e.g. total spinal anaesthetic.

9. Collapse during caesarean section may be related to all the causes above, but in particular local anaesthetic toxicity (page 73) and air embolism should be considered. Subclinical air entry occurs in the majority of caesarean sections, and rarely may progress to cardiovascular collapse. Activate the emergency call and prevent further embolism by returning the uterus to the abdomen, flooding the operative field with saline and positioning the patient head-up. Give supportive treatment as necessary.

10. If the patient is still pregnant > 20 weeks, and unresponsive to resuscitation at four minutes after collapse, with no circulation, consider immediate delivery to aid resuscitation – see below for perimortem caesarean section.

11. Document all events as soon as possible and as accurately as possible. Delegate someone to write down when and what drugs are given. Prepare a report as soon as possible, while events are still fresh in the mind, and ensure that others involved do so too.

12. The decision to terminate Advanced Life Support should only be taken after discussion with the consultant anaesthetist and consultant obstetrician on call, and the senior midwife. The patient’s family must be kept informed, and their wishes ascertained and respected in conjunction with expert medical decisions.

13. In the event of death, you should ensure that an autopsy is requested.

**Perimortem caesarean section**

The welfare of the mother takes precedence over that of the fetus. While perimortem caesarean delivery may aid fetal survival, it is undertaken for the benefit of the mother as a resuscitative measure including where the fetus is known to be dead. Do not waste time confirming fetal viability.
Other emergencies

Pregnant women will swiftly become hypoxic and irreversible brain damage ensues after 4-6 minutes [35]. However, if the gestational age is over 20 weeks and resuscitative attempts fail to revive the mother, then immediate delivery by caesarean section should be performed, within five minutes of the witnessed arrest [36,37].

• Trigger the massive haemorrhage protocol at the time of decision to undertake perimortem caesarean section.
• ALS techniques must be maintained during the delivery.
• Perimortem caesarean section should be undertaken where the resuscitation is taking place. With no circulation, blood loss is minimal and no anaesthetic required. If necessary the woman can be moved to an operating theatre later with anaesthesia, haemorrhage control and so on.

Below 20 weeks it is considered that immediate caesarean section would not be of benefit.


Critical care

High dependency care on labour ward

There are two high dependency rooms next to the operating theatres on labour ward, and on occasion other rooms are pressed into service for the same function. The traditional name ‘high dependency’ should not be confused with the similar traditional name in relation to general adult critical care units. These rooms can offer specialised level 1 and some level 2 care; the midwives have skills and experience in obstetric high dependency care but do not have critical care training and cannot give the staffing levels or skill mix appropriate to level 3 or most level 2 requirements.

With the exception of antihypertensive and magnesium infusions with arterial line monitoring, you should refer level 2 and 3 patients to general critical care for assessment and possible admission [38]. The following table is taken from the RCoA report.

<table>
<thead>
<tr>
<th>Level of care</th>
<th>Maternity example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 0:</strong> normal ward care.</td>
<td>Care of low risk mother.</td>
</tr>
</tbody>
</table>
| **Level 1:** Additional monitoring or intervention, or step down from higher level of care. | • Risk of haemorrhage.  
• Oxytocin infusion.  
• Mild preeclampsia on oral antihypertensives, fluid restriction etc.  
• Woman with medical condition such as congenital heart disease, diabetic on insulin infusion. |
| **Level 2:** single organ support. | *Basic Respiratory Support (BRS)*  
• 50% or more oxygen via facemask to maintain oxygen saturation. |
Critical care

- Continuous Positive Airway Pressure (CPAP), BiLevel Positive Airway Pressure (BIPAP).

Basic Cardiovascular Support (BCVS)
- Intravenous antihypertensives, to control blood pressure in preeclampsia.
- Arterial line used for pressure monitoring or sampling.
- CVP line used for fluid management and CVP monitoring to guide therapy.

Advanced Cardiovascular Support (ACVS)
- Simultaneous use of at least two intravenous, antiarrythmic, antihypertensive or vasoactive drugs, one of which must be a vasoactive drug.
- Need to measure and treat cardiac output.

Neurological Support
- Magnesium infusion to control seizures (not prophylaxis).
- Intracranial pressure monitoring.
- Hepatic support.
- Management of acute fulminant hepatic failure, e.g. from HELLP syndrome or acute fatty liver, such that transplantation is being considered.

**Level 3:** advanced respiratory support alone, or support of two or more organ systems above.

Advanced Respiratory Support
- Invasive mechanical ventilation.

Support of two or more organ systems
- Renal support and BRS.
- BRS/BCVS and an additional organ supported (a BRS and BCVS occurring
simultaneously during the episode count as a single organ support).

You should familiarise yourself with the Dash 3000 and 4000 integrated monitors because the midwives often ask the anaesthetist for advice regarding its operation. When there is a patient on arterial line monitoring, check the line patency on an occasional basis and make sure that the flushing bag does not empty causing line blockage.

**MOEWS charts**

All patients should have Modified Obstetric Early Warning Scores compiled on them through the use of MOEWS charts. These are used as the trigger for urgent medical referral and you must take any referral seriously with full assessment, discussion with obstetric and midwifery professionals and if necessary discussion with the consultant anaesthetist.

**Admission considerations**

You should contact the consultant anaesthetist on call when considering high dependency care. Occasionally an obstetrician-initiated admission may be made without involving you. You should determine whether this is a case that involves obstetric anaesthesia and contact the consultant anaesthetist on call as appropriate. If in doubt, call.

The patient’s care should be planned with the midwives and obstetricians.

Patients should be considered for admission when their care needs exceed those available in a standard delivery room. Indications include:

- Severe pre-eclampsia and its complications, e.g. oliguria, eclampsia and coagulopathy.
- Massive obstetric haemorrhage.
- Pre-existing maternal disease.
- And all the practical elements of care listed in ‘Discharge considerations’ below.
Principles of patient management

• You may ask the labour ward ODP for help with equipment and techniques, particularly those with which the assigned midwife may be unfamiliar.

• High dependency charts are used. In particular, ensure that the fluid balance sections are scrupulously completed.

• In some cases, receipt of high dependency care may allow the use of an epidural infusion for postoperative analgesia. More commonly we use morphine infusions (30 mg made up to 30 mL in saline running at 1-4 mL h\(^{-1}\)); beware of leaving this running at other than low rates overnight or morning sedation can be troublesome.

• Although the patient is formally under the care of the obstetricians, you should take part in a team approach. You should see patients regularly and in particular jointly with the obstetricians and midwives wherever possible; aim to be present on the HDU ward rounds.

• Comprehensive handover of care to the incoming duty obstetric anaesthetist is particularly important and should take place in the patient’s room.

• You should use and make entries in the admission sheets, discharge sheets, ward round sheets and continuation sheets, as required and regularly. Most sections can be completed by any member of the multidisciplinary team.

• Be alert for developments that indicate level 3 critical care such as impending or actual failure of two or more organ systems, or one organ system where this is the respiratory system. See page 87. You should discuss such developments immediately with all appropriate staff including the consultant anaesthetist on call, and if necessary the critical care team.

• You should prescribe oral ranitidine 150 mg bd for any patient who is not yet taking food.
Discharge considerations

Patients may be discharged only in conjunction with the midwives and obstetricians.

In practice, a midwife will probably ask you if it is appropriate for the patient to go to a postnatal ward. This will be appropriate if the patient no longer requires:

- Invasive haemodynamic monitoring including arterial blood gases.
- Regular and frequent blood tests (six hours).
- Close monitoring of renal function with central venous catheter or hourly urine volumes.
- Intravenous vasoactive medications.

You should give formal handover to the ward obstetrician for any woman discharged from high dependency care and ensure that the care plan is documented in the clinical notes.

Humane considerations may suggest that a woman who has lost a baby or is receiving an epidural infusion, for example, be allowed to remain in HDU a little longer if there is no immediate pressure for another admission.

Admission and referral criteria for critical care unit

Some patients have needs exceeding the capacity of labour ward high dependency care. Appropriate patients for critical care are:

Any patient with a threatened or actual failure of one or more vital organ systems that is considered both curable and life-threatening and would likely benefit from the life support techniques available in intensive care.

Critical care starts before the patient arrives on the ICU. Patients should only be transferred when they are physiologically stable enough to withstand transfer without further risk. Resuscitation before transfer is essential. If necessary, take a critically ill patient to the obstetric
operating theatre for resuscitation and the commencement of critical care.

**Referral criteria**

Referral criteria are based on objective physiological and laboratory parameters [39]. They are used to identify those patients who may benefit from critical care i.e. the need for intervention to support a failing organ system.

Any woman who fulfils one or more of the referral criteria outlined below for more than two hours without improvement should be referred for senior clinical opinion.

Abnormal physiology identifies patients who are at risk of sudden deterioration and cardiac arrest. An abnormal respiratory rate is the most common measurable antecedent of impending cardiac arrest.

- Respiratory rate outside the range 5 to 35 breaths per minute.
- Pulse rate outside the range 40 to 140 beats per minute.
- Systemic arterial pressure less than 80 mmHg, or 30 mmHg below patient’s usual pressure.
- Urine output less than 400 mL in 24 hours, or less than 160 mL in 8 hours unresponsive to simple measures (but see page 278 for fluid balance and oliguria in the context of pre-eclampsia).
- GCS less than 8 in the context of non-traumatic coma.
- Any unrousable patient.
- Serum sodium outside the range 110 to 160 mmol L\(^{-1}\).
- Serum potassium outside the range 2.0 to 7.0 mmol L\(^{-1}\).
- pH outside the range 7.1 to 7.7.
- \(P_aO_2\) less than 6.6 kPa and or \(P_aCO_2\) more than 8.0 kPa.
- \(S_aO_2\) less than 90% on supplemental oxygen.

Inform the consultant anaesthetist immediately if they do not know already, and call the critical care resident on bleep number 2592 or 1684.
Examples of admission criteria appropriate to obstetrics

This is extracted and adapted from the list of general admission criteria and indicates the range of conditions that may be seen in obstetrics for which critical care is appropriate.

- Obstetric patients with severe pre-eclampsia, haemorrhage or coagulopathy, pulmonary hypertension, cardiac or renal failure.
- Cardiogenic shock.
- Acute heart failure with respiratory failure or requiring ventilatory or haemodynamic support.
- Post cardiac arrest. Patients resuscitated from cardiac arrest, who remain unconscious, provided there is no underlying incurable or severe, chronic debilitating illness present.
- Acute respiratory failure likely to require or requiring ventilatory support.
- Pulmonary embolus with haemodynamic instability.
- Need for nursing or physiotherapy care not available on the wards.
- Acute severe asthma. There should be a low threshold for admission for any patient with severe, acute asthma especially if it conforms to the BTS definition of severe asthma.
- Coma of any cause if airway reflexes are obtunded or GCS < 8.
- Intracranial haemorrhage with potential for herniation.
- Acute subarachnoid haemorrhage with GCS less than 9.
- Hepatic encephalopathy or fulminant hepatic failure.
- Diabetic ketoacidosis with haemodynamic instability, GCS less than 9, pH less than 7.1 or respiratory insufficiency.
- Symptomatic hypoglycaemia.
- Hypernatraemia or hyponatraemia with altered mental state or fits.
- Hypokalaemia or hyperkalaemia with dysrhythmias or muscle weakness.
Critical care

- Postoperative patients requiring haemodynamic monitoring, ventilatory support or intensive nursing care.
- Septic shock or septicaemia of any cause.
- AIDS patients may benefit from supportive treatment for single organ failure (e.g. pneumocystis pneumonia). Patients with multisystem involvement would not normally warrant admission.

Transfer to the critical care unit

Each year a small number of women are transferred out to the critical care unit for the management of critical illness.

Resuscitate the patient before transfer.

The critical care unit in the University Hospital is about ten metres from the obstetric high dependency rooms. The considerations below are still important.

Inform

You are responsible for informing:

- Consultant anaesthetist, obstetrician and intensivist.
- Any other consultants involved or to be involved.
- The labour ward coordinator.
- The receiving critical care unit.

Keep the relatives informed and reassured at all times.

Accompanying staff

- A midwife will accompany all transferred patients.
- An anaesthetist trained to manage transport cases or a critical care physician will accompany critical cases.
- An ODP will be required to accompany an intubated patient. For transfer between hospitals, a paramedic may take this role.
Monitoring
You should use a high monitoring standard including:

- Pulse oximetry.
- Invasive arterial blood pressure.
- Central venous pressure.
- ECG.
- Expired carbon dioxide.
- Temperature.

Equipment
When working remotely it is particularly important to check equipment, including the following:

- Working batteries.
- Portable ventilator.
- Battery powered syringe drivers for drug infusions.
- Oxygen delivery system.
- Suction equipment.
- Drugs.
- Intravenous fluids.

Records
You should make sure that all notes are completed and taken with the patient.

You should make a comprehensive record of the transfer:

- Recorded observations as would be done on the intensive care unit.
- Clinical notes detailing all significant events.
Critical care

Transport

Transport to another hospital must be in a fully equipped paramedic ambulance. An anaesthetist and a midwife must accompany the patient. It is not necessary for an ambulance service paramedic to accompany you if an ODP goes.

Keep the patient warm at all times.


Sepsis

There is an increasing awareness of the importance of sepsis, associated with its apparently increasing incidence and because it was the most common cause of direct maternal death in the 2006-08 triennium. This reduced significantly in the 2009-12 triennium [40].

Sepsis can be difficult to diagnose in pregnancy. This is because the criteria overlap with the signs and investigation results of healthy pregnant women during the second trimester, third trimester, and in labour for every criterion (respiratory rate, \(P_aCO_2\), heart rate, and white cell count) except temperature [41].

‘Think Sepsis’ at an early stage when presented with an unwell pregnant or recently pregnant woman: take all appropriate observations and act on them [42].

The key actions for diagnosis and management of sepsis are:

- Timely recognition.
- Fast administration of intravenous antibiotics.
- Quick involvement of experts - senior review is essential.

Sepsis is a systemic, deleterious host response to infection leading to severe sepsis and septic shock.

Sepsis is defined as the presence (probable or documented) of infection together with systemic manifestations of infection.

Severe sepsis is defined as sepsis plus sepsis-induced organ dysfunction (such as renal failure) or tissue hypoperfusion (lactic acidosis or hypotension) [43].

Septic shock is defined as severe sepsis plus hypotension despite adequate fluid resuscitation.

Severe sepsis with acute organ dysfunction has a mortality rate of 20% to 40%, increasing to 60% if septic shock develops. Survival rates following sepsis are related to early recognition and initiation of treatment. Disease progress may be rapid and the course may be lethal.
Sepsis

In maternity it is usually caused by bacterial infection and the diagnosis is complicated by the normal physiological response to pregnancy [44,45]. Women may be able to withstand the physiological insult of widespread inflammation for prolonged periods before sudden collapse. Progression can be extremely rapid: Group A streptococcus can typically move from the first sign of systemic inflammatory response syndrome (SIRS) to septic shock in less than two hours for 50% of women and in less than nine hours for 75% of women [46].

Diagnosis of sepsis

Diagnosis of sepsis should be followed by activation of the current sepsis guideline. The following is a set of general principles drawn from national and international guidelines.

The systemic signs and symptoms of sepsis are common in pregnancy and in the puerperium, the main differences being in causative organisms and sites of infection.

Haemorrhage is the most common cause of shock in pregnancy but if it has been excluded or treatment fails to produce the expected improvement then consider sepsis as a potential cause.

Genital tract sepsis will often be due to chorioamnionitis before delivery or surgical infection after delivery. Remember that genital tract infection will predispose to uterine atony and postpartum haemorrhage.

Risk factors

Parturients at higher risk have been identified by NICE[47] as women who:

- Have impaired immune systems because of illness or drugs.
- Have gestational diabetes or diabetes or other comorbidities.
- Needed invasive procedures (for example, caesarean section, forceps delivery, removal of retained products of conception).
- Had prolonged rupture of membranes.
- Have or have been in close contact with people with group A streptococcal infection, for example, scarlet fever.
- Have continued vaginal bleeding or an offensive vaginal discharge.
**Clinical presentation**

The onset of sepsis is characterised by a hyperdynamic circulation, reduced systemic vascular resistance secondary to arteriolar vasodilatation, and increased respiratory rate in association with the development of anaerobic metabolism and lactic acidosis [48].

Clinical signs suggestive of sepsis include one or more of the following: pyrexia, hypothermia, tachycardia, tachypnoea, hypoxia, hypotension, oliguria, impaired consciousness and failure to respond to treatment.

These signs, including pyrexia, may not always be present and are not necessarily related to the severity of sepsis. A widespread rash may be an early sign of toxic shock syndrome.

**Criteria**

Infection, documented or suspected, and some of the following [44]:

- Reduced or absent fetal movement or absent fetal heart.

**General variables:**

- Fever (core temperature $> 38^\circ$C).
- Hypothermia (core temperature $< 36^\circ$C).
- Tachycardia ($> 100$ beats per minute).
- Tachypnoea ($> 20$ breaths per minute).
- Impaired mental state.
- Significant oedema or positive fluid balance ($> 20$ mL kg$^{-1}$ over 24 hours).
- Hyperglycaemia in the absence of diabetes (plasma glucose $> 7.7$ mmol L$^{-1}$).

**Inflammatory variables:**

- White blood cell (WBC) count $> 12 \times 10^9$ L$^{-1}$ (note that a transient leucocytosis is common in labour). Counts up to 20 and even higher can be seen in normal labour.
- Leucopenia (WBC count $< 4 \times 10^9$ L$^{-1}$).
- Normal WBC count with $> 10\%$ immature forms.
- Plasma C-reactive protein $> 7$ mg L$^{-1}$.
Sepsis

**Haemodynamic variables:**
- Arterial hypotension (systolic blood pressure < 90mmHg; mean arterial pressure < 70mmHg or systolic blood pressure decrease > 40mmHg).

**Tissue perfusion variables:**
- Raised serum lactate ≥ 4 mmol L⁻¹.
- Decreased capillary refill or mottling.

**Organ dysfunction variables:**
- Arterial hypoxaemia ($P_{aO_2}/F_{I_O_2} < 40kPa$). Sepsis is severe if < 33.3kPa in the absence of pneumonia or < 26.7kPa in the presence of pneumonia.
- Oliguria (urine output < 0.5mL kg⁻¹ h⁻¹ for at least two hours, despite adequate fluid resuscitation).
- Creatinine rise of > 44.2μmol L⁻¹. Sepsis is severe if creatinine level > 176μmol L⁻¹.
- Coagulation abnormalities (INR > 1.5 or APTT > 60s).
- Thrombocytopenia (platelet count < $100 \times 10^9$ L⁻¹).
- Hyperbilirubinaemia (plasma total bilirubin > 70 μmol L⁻¹).
- Ileus.

**Sepsis Six bundle – actions in the first hour**

If you suspect sepsis you should immediately alert the obstetricians and midwives, and engage the treatment bundle.

1. Take an arterial blood gas and give high flow oxygen if required.
2. Blood cultures before antibiotics.
3. Intravenous antibiotics – broad-spectrum (see below).
4. Fluid resuscitation (see below).
5. Blood haemoglobin and serum lactate measurement.
6. Catheterisation and hourly urine measurement.
**Antibiotic therapy**

The current hospital guideline for sepsis of unknown origin specifies the following intravenous antibiotics. If the source of infection is suspected or known, refer to the appropriate hospital guideline.

- Benzylpenicillin 3 g stat followed by 1.2 g qds. If allergic to penicillin, use vancomycin 1 g bd.
- Gentamicin 5 mg kg$^{-1}$ lean body mass every 24 hours.
- Metronidazole 500 mg tds.

**Fluid resuscitation**

- In the event of hypotension and/or a serum lactate > 4 mmol L$^{-1}$ (indicative of tissue hypoperfusion), deliver an initial 500 mL bolus of Hartmann’s solution over 15 minutes, repeated if there is no improvement [49]. Do not use starch solutions. Human albumin solution 4.5% can be used on specialist advice.
- Apply vasopressors for hypotension that is not responding to initial fluid resuscitation to maintain mean arterial pressure (MAP) > 65mmHg.

**Further resuscitation**

In the event of persistent hypotension (SBP < 90 mmHg) despite fluid resuscitation and/or lactate >4mmol L$^{-1}$, septic shock is likely.

Consider immediate referral to the general adult critical care unit after discussion with the consultant anaesthetist and the consultant obstetrician. These patients are not suitable for management on the labour ward.

- Achieve a central venous pressure of ≥ 8 mmHg.
- Achieve a central venous oxygen saturation ($S_{cv}O_2$) ≥ 70% or mixed venous oxygen saturation ($S_{cv}O_2$) ≥ 65%.
- If Hb < 100 g L$^{-1}$, consider red cell transfusion.
Sepsis

**Indications for transfer to critical care**

<table>
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<tr>
<th>System</th>
<th>Indication</th>
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<tbody>
<tr>
<td>Cardiovascular</td>
<td>Hypotension or raised serum lactate persisting despite fluid resuscitation, suggesting the need for inotrope support.</td>
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<tr>
<td>Respiratory</td>
<td>Pulmonary oedema.</td>
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</tr>
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<td></td>
<td>Hypothermia.</td>
</tr>
</tbody>
</table>

**Anaesthetic considerations**

- Discuss with a consultant anaesthetist if you propose to take a woman with sepsis for anaesthesia.
- Central neuraxial anaesthesia should be avoided in women with sepsis, principally because of the presence of potential infection – the feared epidural abscess or meningitis. The evidence is found only in case reports, but spinal anaesthesia may be acceptable if the intravenous antibiotics have been administered. However, neuraxial anaesthesia will also cause sympatholysis, and so it cannot be recommended in sepsis. General anaesthesia will usually be required for caesarean section, but beware cardiovascular instability with any form of anaesthesia.
- Intramyometrial infection is a strong relative contraindication to the salvage of red blood cells. In this circumstance you will have to weigh the relative benefits of red cell recycling with the potential risk of contamination: discuss with relevant consultants, but
Sepsis

remember that intramyometrial infection is a potent cause of uterine atony and obstetric haemorrhage.

- Administration of antibiotics at the time of caesarean section is an important preventive measure: before the skin incision if possible. At present this is done by the anaesthetist, who administers co-amoxiclav 1.2 g (or alternatives for patients with allergy to penicillin).


Antenatal referral

You may be asked to talk to a mother who is expecting a normal labour or a varyingly complicated delivery, perhaps a caesarean section. Give time to do this properly, remembering to discuss enough information for informed consent, and document this fully in the notes. Occasionally these women will come to labour ward specifically for this purpose. The best place to make sure that your assessment will be recorded is in the narrative section of the green antenatal hand-held notes: there is a dedicated section for anaesthesia in these notes. Cross-refer to the main hospital medical record if more space is needed. For obese mothers find and use the proforma designed for these mothers.

If asked to see a complicated case or any case where you are unsure, discuss the case with a consultant. Document this in the notes. Contact Dr Quasim to generate a clinic letter for these patients.

Referring the case to a consultant does not preclude talking to the woman yourself but you should make the situation clear to the mother.

The following guideline is shared with the obstetricians – last issued July 2007.

The consultant obstetric anaesthetists discuss analgesia and anaesthesia with pregnant women, especially those with complex medical, surgical or anaesthetic problems. We welcome referrals from any of our obstetric and midwifery colleagues. We see patients in a Thursday afternoon clinic or on the labour ward at other times – please use the clinic unless it is urgent.

Using the clinic

The clinic is held on alternating Thursday afternoons in the antenatal clinic area. (The Friday afternoon preoperative caesarean planning clinic is usually reserved for the next week’s caesarean patients only.) Referrals are pooled. Options for referral are as follows.

1. Directly book the patient with clinic staff on fax number 7696 7370 (or on telephone 27350), to the ‘Anaesthetic complex review clinic’.
Antenatal referral

Please leave a referral letter in the notes to let us know why you would like us to see the patient.

2. Refer the patient to us via email to one of the lead consultants who will allocate the referral appropriately.

Indications for antenatal referral to anaesthetists

Any anxiety or desire to consult an anaesthetist, with regard to labour analgesia or caesarean section anaesthesia.

Past history of, or potential for, problems with anaesthesia

- Difficult or failed intubation.
- Anaphylaxis.
- Suxamethonium apnoea. Take a serum sample in a yellow-top bottle and send for dibucaine assay (this must be a sample either before or six weeks after pregnancy) and then refer the patient; this test takes two weeks to come back.
- Malignant hyperthermia susceptibility.
- Porphyria.
- Complications following previous central neuraxial block e.g. nerve injury, epidural haematoma. Worries about back pain.
- Previous painful labour or operation in a patient who fears a repeat experience.
- Problems or complaints after anaesthesia.
- Needle phobia.

Lumbosacral spine problems

- Previous back surgery e.g. Harrington rods, discectomy, decompressive laminectomy.
- Congenital abnormalities e.g. kyphoscoliosis, myelomeningocele.

Neurological disorders

- Multiple sclerosis.
• Myasthenia gravis.
• Spinal cord injury.

Cardiorespiratory disease

Where pregnant women have a history of cardiorespiratory disease there will probably be full documentation available in the clinical records (including CRRS) – make sure the cardiologist is aware of the pregnancy and ask for advice on collaborative management.

Dr Adamson (consultant cardiologist), Professor Quenby (consultant obstetrician) and Dr Quasim run a multidisciplinary clinic once a month.

The following should all be referred to the joint obstetric cardiology clinic.

• Dyspnoea.
• Valvular diseases e.g. mitral stenosis, aortic stenosis, valvular regurgitation.
• Cardiomyopathies e.g. HOCM.
• Pulmonary hypertension.
• Dysrhythmias e.g. atrial fibrillation, supraventricular tachycardia.
• Uncorrected congenital heart disease.

In other cases of cardiorespiratory disease an ECG should be recorded before referral to anaesthesia. Decision on cardiac ultrasound examination will be taken by the anaesthetist.

• Audible cardiac murmurs.

These are common. If more than grade 1, symptomatic or associated with abnormal ECG then cardiac ultrasound is indicated and then referral to anaesthesia.

• Previous heart surgery.

If the woman has been discharged after previous cardiac surgery (except surgery for isolated secundum ASD) she should have a cardiological assessment.
Antenatal referral

Haematological disorders

There is a joint obstetric haematology clinic. There will be a plan in the clinical records, which may include DDAVP, tranexamic acid, factor transfusion and advice about central neuraxial blocks.

• Bleeding abnormalities.
• Von Willebrand’s disease, haemophilia, or other inherited coagulation disorders.
• Platelet deficiencies (thrombocytopenia with count less than 100) or platelet dysfunction.
• Therapeutic anticoagulation (not thromboprophylaxis).
• Sickle cell anaemia.

Other

• Endocrine disease.
• Insulin-dependent diabetes mellitus.
• Systemic disease e.g. systemic lupus erythematosus, rheumatoid arthritis.
• Obesity (BMI > 40 kg m⁻² (or 35 kg m⁻² with comorbidities).
• Refusal of blood products e.g. Jehovah’s Witnesses.
Needle phobia

We recommend antenatal referral to the obstetric anaesthetists so that we can discuss needle-free analgesia for delivery and anaesthesia for surgery.

It is important to determine whether a patient is nervous of needles or has a true phobia. This status, and the delivery plan with its associated contingency plans, should be integrated in order to produce a management plan.

The mainstay of management is the avoidance of the sight and use of needles if possible.

The presence on the labour ward of a patient with needle phobia should be highlighted to the on call obstetrician, anaesthetist and labour ward coordinator, who should discuss and agree the management plan.

Recommended techniques are:

1. To manage the patient’s fears and anxieties; this is essential.
2. To deliver drugs by the oral, rectal and inhalational routes as far as possible.
3. To use local anaesthesia for all needle insertions. Needle insertion (intravenous, subcutaneous or regional block) should be preceded by topical tetracaine (Ametop) application and lidocaine infiltration. Ametop is kept in the labour ward central drug cupboard and midwives may apply this under practice rules without a doctor’s prescription. Record application on the drug chart. Use: apply contents of tube to site of venepuncture or venous cannulation and cover with occlusive dressing; remove gel and dressing after 30 minutes for venepuncture and after 45 minutes for venous cannulation.
4. To use subcutaneous cannulas to replace intramuscular injections for rescue analgesia. Drug absorption is equally rapid by this route and the dose is the same. Midwives may administer subcutaneous
Needle phobia

morphine with a controlled drug prescription. Morphine stings slightly and is best given slowly over ten seconds followed by a 0.5 ml saline flush. Subcutaneous administration is not suitable in patients with significant oedema.

5. To use PCA morphine as postoperative analgesia for patients in high dependency rooms.

Perioperative care for severe needle phobia

This is for patients who will not give consent to the insertion of a needle while they are conscious. (It is not possible to offer needle-free anaesthesia while unconscious.)

Patients classified as high risk in labour should not be forced to have a serum sample for ‘group and save’ taken. This can be done after induction of anaesthesia as below.

If the patient requires or requests general anaesthesia for operation, then a consultant anaesthetist must attend as one of the two anaesthetists required for this procedure.

The risks and benefits of elements of the traditional rapid sequence induction have to be reconsidered in this situation. We suggest an inhalational induction with sevoflurane in oxygen in the head-up position, without cricoid pressure. After induction, a large-bore cannula should be inserted, and a serum sample sent as a dire needs request for ‘group and save’. After this, all other elements of the clinical guideline for general anaesthesia should be followed.

If the resuscitation needs of the patient make this procedure inappropriate, a consultant anaesthetist must be summoned and appropriate care given.
Maternal obesity

Antenatal referral

Women with a BMI greater than 40 kg m$^{-2}$ (or 35 kg m$^{-2}$ with comorbidities) may be referred to the complex antenatal clinic for a discussion with a consultant anaesthetist, but may present to the resident anaesthetist. We are required by national recommendations to provide assessment services for obese parturients [50], and there is good advice available to help us [51].

You should pay attention to:

- Assessment of the airway.
- Potential difficulty of intravenous access.
- Lumbar anatomy for regional block with regard to fat distribution.

Use the acronym CAVE: Comorbidities | Airway | Veins | Epidural.

In talking with the mother it is important to convey the recommendation for regional techniques while not giving the impression that general anaesthesia is not safe – the failure rate for regional techniques will be higher due to difficulty in placement and the extent of subcutaneous fat allowing distraction of the catheter. She should also understand that regional techniques do take additional time to establish when compared with the average, and that therefore it may be useful to request them earlier.

The incidence of most obstetric and anaesthetic complications is higher the more obese a woman is. In particular, the rate of accidental dural puncture varies in close relation to the depth to the epidural space, one major study discovering a 19% increase in risk for each extra centimetre of needle traverse [52].

Nevertheless, epidural analgesia in labour is preferred because it can facilitate the more interventionist delivery experienced by obese women.
Management of morbid obesity in caesarean section

Morbid obesity is defined as a BMI greater than 45. The following are important points:

- You should seek consultant input when referred such women for caesarean section.
- Management by consultant anaesthetists is essential and difficulties with airway management and intubation should be anticipated. The difficult intubation rate is 10% or more. You should use an uncut 7 mm endotracheal tube and we suggest that if you have familiarised yourself with it, the polio blade would be a good choice.
- Positioning the women requires skill and sufficient manpower in the event of a requirement for induction of general anaesthesia. We strongly recommend a ramped position.
- You should consider placing an arterial line as it will facilitate blood pressure measurement and may be the only accurate means.
- The mother will be at greater risk of postpartum haemorrhage and you should anticipate this.
- She is also at greater risk of venous thromboembolism and you may need to seek advice on increasing the heparin dose and duration that you prescribe for the postoperative period.
- There is an ‘obesity box’ in theatres.
- Use a hover mattress to help transfer the patient. This is available outside theatres 11 and 3.


Cardiac disease

Cardiac diseases are the second commonest cause of maternal deaths, killing mothers more commonly than does thromboembolism. Good reviews are available [53].

Patients with known cardiac disease should be referred to and assessed by cardiology and anaesthesia consultants, and a detailed plan made in the clinical records in advance of the expected date of delivery. Find the plan and act on it. If needed, the cardiology resident is on bleep 2199.

However, the unexpected does occur. The main differential diagnoses for acute cardiovascular deterioration in pregnant women include thromboembolism, pre-eclampsia, haemorrhage, cardiac disease and sepsis [54]. Inform a consultant of any case.

The two relatively common emergency presentations, sometimes linked to each other, are of pulmonary oedema and peripartum cardiomyopathy.

Rates for these presentations seem to have decreased recently, possibly linked to a cautious approach limiting intravenous fluids during caesarean section even for mothers with no cardiac conditions.

Do not administer excessive intravenous fluids.

Pulmonary oedema

Learning points

- Listen to the patient complaint: “I can’t lie flat” is the earliest warning.
- Unexplained tachycardia and mild desaturation are early signs.
- Association with pre-eclampsia.
- Furosemide acts rapidly by vasodilatation.
- Morphine is effective at relieving distress and tachycardia.
Cardiac disease

- Vasoconstrictors – noradrenaline and metaraminol – make the condition worse.
- Pulmonary artery catheters are not needed, and may cause morbidity e.g. pneumothorax and chest drain.
- Early echocardiography and cardiology review improve management.
- Pulmonary oedema is not a disease in itself – we need to make a diagnosis.
- There will be a need to counsel the patient about future pregnancy.

Differential diagnosis and causes of pulmonary oedema

Cardiac causes:
- Valvular disease.
- Peripartum cardiomyopathy.
- Other cardiomyopathies.
- Myocardial infarction.
- Thyroid disease.

Non cardiac causes:
- Iatrogenic fluid overload.
- Transfusion related acute lung injury (TRALI).
- Acid aspiration syndrome.
- Thromboembolism.
- Amniotic fluid embolism.
- Severe pre-eclampsia.
- Sepsis.
- ARDS.
- Drugs (including older tocolytics with steroids).
Initial management (ABC)

- Follow ABC principles and observe continuously.
- Involve senior clinicians (obstetrician, anaesthetist, midwife, and cardiologist).
- Sit the woman up.
- Administer high flow oxygen by face mask.
- Monitor ECG, pulse oximetry, blood pressure and fetal heart.
- Site an intravenous cannula or stop intravenous fluid administration.
- Give intravenous furosemide 20 mg.
- GTN may be helpful for pulmonary oedema complicating severe pre-eclampsia, if the systolic blood pressure is above 90 mmHg. (Glyceryl trinitrate: sublingual 400 mcg buccal or intravenous infusion, starting at 0.3 mg h⁻¹.)
- Give intravenous morphine 2 mg boluses to relieve distress.
- Monitor urine output via catheter.
- Perform 12-lead ECG and portable CXR. CXR should be done whether the patient is pregnant or not if you suspect pulmonary oedema.
- Site arterial cannula and measure blood gases, lactate and electrolytes.
- Consider fetal needs – institute obstetric assessment.
- Refer for urgent cardiology opinion about further management – consultant on call.
- Arrange urgent echocardiography (within six hours) – preferably department assessment but bedside assessment may be helpful.
- Seek critical care advice and review – she may require CPAP or IPPV.
- Ensure that there is clear documentation and a clinical adverse event form.
Peripartum cardiomyopathy

Cardiomyopathies are life threatening, and a significant cause of cardiac mortality in pregnancy.

This is otherwise unexplained heart failure secondary to left ventricular systolic dysfunction developing within one month before or six months following childbirth, in the absence of heart disease before this [55]. It is rare at about 1:300 to 1:4,000 pregnancies and is more common in older, obese, multiparous women with hypertension; smoking and diabetes are also risk factors. Left ventricular dysfunction is demonstrated with an ejection fraction less than 45%. It is a form of dilated cardiomyopathy.

Diagnosis of peripartum cardiomyopathy

You should consider diagnosing peripartum cardiomyopathy in patients with:

- Orthopnoea. *
- Tachycardia. *
- Excessive tiredness. *
- Respiratory distress.
- Rapid respiratory rate.
- Desaturation.
- Pallor.
- Clear or pink frothy sputum.
- Chest crackles.
- Hyper or hypotension.
- Peripheral shutdown.
- New cardiac murmurs.
- Hepatomegaly.
- Altered level of consciousness.
- Overwhelming sense of doom and distress.
It is a diagnosis made by exclusion; you should exclude other causes of pulmonary oedema.

**Management**

The initial management is as for acute heart failure: oxygen (if hypoxic), diuretics and vasodilators; opiates and inotropes should be used more selectively. Consider the need for mechanical ventilation in respiratory failure. Activate treatment for acute heart failure by calling for cardiological assistance.

Delivery should be performed according to obstetric indications with vaginal delivery being preferable if there is no obstetric indication for caesarean section. Epidural analgesia should be recommended. Use an arterial line. The principles of anaesthesia and analgesia are as for any patient with cardiac failure: maintain normal to low heart rate to decrease oxygen demand and prevent large swings in blood pressure. Use alfentanil 20 mcg kg\(^{-1}\) to prevent a hypertensive response to intubation if using general anaesthesia.

Institute anticoagulation in patients with massively enlarged cardiac chambers (ejection fraction less than 35%).

**Postnatal course**

- Enalapril is the current drug of choice.
- Peripartum cardiomyopathy is progressive throughout the mother’s obstetric career.
- Half of all patients continue to have heart failure after six months. They are advised against a further pregnancy, as the recurrence risk is high and the mortality if it does occur is nearly 100%.
- If the heart failure has completely resolved the mortality risk in future pregnancies is 15%.

**Known disease**

You should seek senior advice on all cases of known congenital or acquired cardiac disease in pregnant patients that come to your
Cardiac disease

attention. The best current reference is the European Society of Cardiology guidelines on the management of cardiovascular diseases during pregnancy [56]. The risk tables are included below as a guide to the severity of what you may have referred to you in an emergency. Treatment will be bespoke to the patient and her condition.

Lumbar epidural analgesia will be recommended for vaginal delivery in most of these conditions, and may be appropriate for planned caesarean section. It reduces the sympathetic activation consequent upon severe pain, reduces the urge to push and provides anaesthesia for surgery. You should consider carefully whether the other forms of anaesthesia are safe even in category 1 caesarean section. Beware the systemic hypotension that even an uncomplicated epidural can produce. Use with caution in patients with obstructive valve lesions.

Modified WHO classification of maternal cardiovascular risk

### Conditions in which pregnancy risk is WHO 1:

**No detectable increased risk of maternal mortality and no/mild increase in morbidity.**

- Uncomplicated, small or mild:
  - Pulmonary stenosis.
  - Patent ductus arteriosus.
  - Mitral valve prolapse.
- Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage).
- Atrial or ventricular ectopic beats, isolated.

### Conditions in which pregnancy risk is WHO 2 or 3

**WHO 2 (if otherwise well and uncomplicated):**

**Small increased risk of maternal mortality or moderate increase in morbidity.**

- Unoperated atrial or ventricular septal defect.
Cardiac disease

- Repaired tetralogy of Fallot.
- Most arrhythmias.

**WHO 2–3 (depending on individual)**

- Mild left ventricular impairment.
- Hypertrophic cardiomyopathy.
- Native or tissue valvular heart disease not considered WHO 1 or 4.
- Marfan syndrome without aortic dilatation.
- Aorta <45 mm in aortic disease associated with bicuspid aortic valve.
- Repaired coarctation.

**WHO 3:**

Significantly increased risk of maternal mortality or severe morbidity. Expert counselling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth, and the puerperium.

- Mechanical valve.
- Systemic right ventricle.
- Fontan circulation.
- Cyanotic heart disease (unrepaired).
- Other complex congenital heart disease.
- Aortic dilatation 40-45 mm in Marfan syndrome.
- Aortic dilatation 45-50 mm in aortic disease associated with bicuspid aortic valve.

**Conditions in which pregnancy risk is WHO 4 (pregnancy contraindicated):**

Extremely high risk of maternal mortality or severe morbidity; pregnancy contraindicated. If pregnancy occurs termination should be discussed. If pregnancy continues, care as for class 3.
Cardiac disease

- Pulmonary arterial hypertension of any cause.
- Severe systemic ventricular dysfunction (LVEF <30%, NYHA III–IV).
- Previous peripartum cardiomyopathy with any residual impairment of left ventricular function.
- Severe mitral stenosis, severe symptomatic aortic stenosis.
- Marfan syndrome with aorta dilated >45 mm.
- Aortic dilatation >50 mm in aortic disease associated with bicuspid aortic valve.
- Native severe coarctation.

Cardiac murmurs

All patients with cardiac murmurs should be assessed carefully prior to anaesthesia. Most will have a flow murmur associated with the increased cardiac output of late pregnancy. Some may have longstanding, documented, benign murmurs.

Referral to a cardiologist

You should refer patients for an opinion on diagnosis and management rather than just for investigations. This will usually include ECG and cardiac echosonography (ultrasound) examinations – see page 103. Dr Adamson has specific expertise in this area.

Seek senior anaesthetic advice if any abnormalities are discovered on investigation or referral.

Management considerations

Oxytocic drugs

Oxytocics such as Syntocinon or ergometrine can produce adverse cardiovascular effects. They must be given at the lowest effective dose and by infusion, avoiding bolus doses. The mixed preparation
Syntometrine can have unpredictable effects and should usually be avoided.

Always look for the management plan in the antenatal record. If there is no plan, then consider using the following oxytocic regime.

Give Syntocinon slowly and carefully. Run the standard dilution of 20 units in a 50 mL syringe, at 20 mL h⁻¹ for 15 minutes. This will administer two units over the 15 minutes. Then continue at 10 mL h⁻¹.

**Avoid ergometrine** if possible as it will cause an increase in systemic vascular resistance. If needed, use 500 mcg diluted to 10 mL with saline and give 25-50 mcg slowly with vigilance.

**Avoid carboprost** if possible as it will cause an increase in pulmonary arterial resistance and decrease pulmonary artery blood flow.

Patients with cardiac anomalies are often best managed by avoiding caesarean section. The use of early epidural analgesia allows the best management of the stress of labour by reducing the surges in cardiac output seen in contractions. The epidural may also be needed for instrumental delivery to avoid a prolonged second stage and for slow establishment of a caesarean section block if operative delivery is indicated.

**ICD (implantable cardioverter-defibrillator) and pacemaker**

Bipolar diathermy is preferred to monopolar but is not reliably safe. The management plan may include use of a magnet to prevent the ICD firing during anaesthesia and surgery. The magnet is kept in the controlled drugs cupboard of theatre 2, and there is a further magnet in main theatre recovery, in the controlled drugs cupboard. Tape it over the ICD insertion site in an emergency to disable the shock function. Remove it if a shock is required from the device.

Ideally, and with time to plan, call the cardiac devices technician on extension 26417 for help and advice about disabling and re-enabling the device. They can also give guidance about intraoperative placement of external defibrillator pads, usually anterior-posterior; consider their use where an ICD is in place and disabled.
**Cardiac disease**

**Antibiotic prophylaxis**

Antibiotic prophylaxis against infective endocarditis is not recommended for obstetric procedures [57].


Feeding and antacid prophylaxis

Oral intake in labour
Low-risk women may consume light food and drinks. After opioid or epidural analgesia is administered, clear non-carbonated fluids only may be consumed. In cases of complicated pregnancy or labour, water only may be consumed.

**H₂-receptor antagonists (ranitidine)**
All labouring women receiving opioids by any route should be given oral ranitidine 150 mg every six hours. Midwives can prescribe this.

Women having urgent surgery who have not had ranitidine within six hours should be administered oral ranitidine 150 mg (if at least 90 minutes before surgery) or 50 mg very slowly intravenously as appropriate. You should check that this has been done.

We use ranitidine as a premedicant before elective caesarean section. You will occasionally be asked to see such patients. Use ranitidine 150 mg at 22.00 hrs and again at 07.00 hrs on the day of surgery. For those patients going home to await their caesarean you should use the outpatient boxes from antenatal clinic containing two tablets, remembering to sign a prescription sheet for the pharmacy store.

**Sodium citrate**
Sodium citrate 0.3M 30 mL should be given immediately prior to general anaesthesia; usually within 20 minutes. You should check that this has been done.

We do not routinely use it for regional anaesthesia. It may be offered in case of maternal heartburn.

**Oral intake and caesarean section**
Caesarean sections are booked for the morning operating list. This list can be subject to delay because of the pressure of urgent and emergency
Feeding and antacid prophylaxis

work. These delays can, with traditional fasting policies, lead to lengthy fasting periods that are distressing to the mother and can cause dehydration. The administration of sodium citrate can also be unpleasant and is not needed except immediately prior to the induction of general anaesthesia or in the case of actual heartburn.

The anaesthetist must secure the airway using a rapid sequence induction when inducing general anaesthesia in obstetric cases, unless the patient is more than 48 hours postpartum and has no other indication for rapid sequence induction.

Many patients presenting for non-elective caesarean section may have had a complicated pregnancy or labour. While such patients are in labour they may consume only water. Other patients may have had light food during labour.

This guideline applies to both general anaesthesia and regional anaesthesia.

Emergency: immediate threat to life of woman or fetus
Proceed with appropriate anaesthesia as soon as possible.

Urgent: maternal or fetal compromise that is not immediately life threatening
Proceed with appropriate anaesthesia as soon as possible.

Scheduled: needing early delivery but no maternal or fetal compromise
Ideally the patient will not have eaten any solid food in the preceding six hours. Waiting for six hours can cause problems, because the operation may then be delayed into the evening when fewer staff are around or into the night, or may lead to further delay due to other patients needing care. Waiting does not obviate the need for rapid sequence induction in the case of general anaesthesia. The pragmatic solution may be to proceed with appropriate anaesthesia within six hours. Discuss such cases with the consultant anaesthetist if you are in doubt.
Elective: at a time to suit the patient and maternity team

(See the ERAS section on page 201 for details about our enhanced recovery programme.)

- Patients may eat as they wish until midnight on the night before caesarean section.

- Patients are encouraged to consume a drink (coffee or tea with a small amount of semi-skimmed milk, or a fruit squash) on the morning of caesarean section. This drink should be finished by 07:00.

- Patients are encouraged to consume a non-carbonated carbohydrate drink such as *Lucozade Energy* on the morning of caesarean section. This drink should be finished by 07:00. These drinks typically contain 65.4 g carbohydrate giving 266 kcal energy in a 380 mL bottle (similar to glucose tolerance test doses); do not withhold in patients with impaired glucose tolerance or diabetes [58]. They also contain 46 mg caffeine, about the same as a cup of tea.

- Patients may consume unrestricted sips of tap water after this until entering the operating theatre. This measure will increase comfort, aid gastric emptying and prevent an untoward increase in blood viscosity [59,60].

Postpartum fasting status

The gastric emptying time returns to normal in uncomplicated cases from 18 hours after delivery [61]. Within the first 18 hours, treat the patient as you would one in labour – these procedures are going to be urgent. The same criteria as for caesarean section are met. A rapid sequence induction is not necessary unless otherwise indicated.

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58. Gustafsson UO *et al.* Pre-operative carbohydrate loading may be used in type 2 diabetes patients. *Acta Anaesthesiol Scand* 2008; **52**(7):946-51
Feeding and antacid prophylaxis


Thromboprophylaxis

All antenatal and postnatal patients must have a risk assessment for venous thromboembolism and appropriate treatment instituted.

Thromboembolic events occur six times more commonly in pregnancy and eleven times more commonly in the puerperium. There are also special risks of which the most important for an anaesthetist is caesarean section.

The best prophylaxis is mobilisation, and this mandates good pain relief. Remember to use heparin prophylaxis in the obstetric HDU for pre-eclampsia and after haemorrhage where haemostasis has been secured.

There will almost never be an indication to delay thromboprophylaxis until 12 or 24 hours later.

Enoxaparin after caesarean section

All women having caesarean section should receive subcutaneous enoxaparin (Clexane) for the inpatient period or for ten days or six weeks while in hospital [62, 63]. (This was previously seven days.)

The detail in this guideline changes from time to time. Updates will be posted as necessary.

Women should receive postnatal thromboprophylactic enoxaparin (Clexane). Anaesthetists prescribe in-hospital doses. For some women, obstetricians devise a specific plan.

The dose is based on booking body mass, which you must make sure is recorded on the drug chart:
Thromboprophylaxis

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 kg</td>
<td>20 mg once daily</td>
</tr>
<tr>
<td>50 – 90 kg</td>
<td>40 mg once daily</td>
</tr>
<tr>
<td>91 – 130 kg</td>
<td>60 mg once daily</td>
</tr>
<tr>
<td>131 – 170 kg</td>
<td>80 mg once daily</td>
</tr>
<tr>
<td>&gt; 170 kg</td>
<td>0.6 mg kg(^{-1}) once daily</td>
</tr>
</tbody>
</table>

* Available syringes: 20, 40, 60, 80, 100, 120, 150 mg

If enoxaparin is contraindicated or if the patient declines enoxaparin, then offer antithrombotic stockings. Fondaparinux can be used but for any unusual techniques, remember to refer to AAGBI guidelines regarding neuraxial blocks and anticoagulants [64]. In the case of fondaparinux, specific anti-X\(_a\) testing is indicated to undertake a block and it is recommended to delay fondaparinux administration for 12 hours after the block.

Enoxaparin and other unfractionated heparins should only be administered after the following minimum periods, based on a time to peak effect of 3-4 hours with enoxaparin [64,65]. (See page 151 for block delay after heparin.)

- 4 hours after central nerve block placement.
- 4 hours after removal of an epidural catheter.
- 24 hours after a ‘bloody tap’ on epidural insertion.

The second dose of enoxaparin is administered at one of two times: 06:00 or 22:00 – see below. This is to allow for the midwives to train the mother in self-administration. Do not prescribe regular doses at other times.

Except as above:

- Prescribe the first dose of enoxaparin to be given four hours after the time into recovery, as a stat dose on the front page.
- Prescribe subsequent doses to be given at one of two drug round times: **06:00 or 22:00** – see chart.
- Determine with the obstetrician whether prophylaxis is **inpatient only, for ten days or for six weeks**, and write this on the drug chart.
This determination is in conjunction with the VTE risk assessment and is discussed and confirmed at the theatre checklist sign out. ‘Inpatient only’ treatment is now rare; the commonest is ten days and high risk cases get six weeks’ treatment.
### Thromboprophylaxis

<table>
<thead>
<tr>
<th>Time into recovery</th>
<th>First Dose – Front of Chart</th>
<th>Second and subsequent doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>01:00</td>
<td>05:00</td>
<td>22:00</td>
</tr>
<tr>
<td>02:00</td>
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</tbody>
</table>


64. AAGBI, OAA and Regional Anaesthesia UK. Regional anaesthesia and patients with abnormalities of coagulation. (RAPAC) *Anaesthesia* 2013; 68:966-72

Preoperative preparation and assessment

General considerations

Patients for planned caesarean section will normally be seen in the clinic the week before (see below). The midwives will refer some inpatients to you (e.g. transverse lie or placenta praevia on ward 24, or those attending labour ward), in which case you should assess the patient and start a Trust anaesthetic record sheet.

Prescribe ranitidine 150 mg at 22.00 hrs and 07.00 hrs. Do not prescribe metoclopramide unless specifically indicated as this is given intravenously before anaesthesia. Use other drugs (salbutamol for example) where indicated, but remember that any premedicants will be administered while the patient is pregnant and the appropriate guidelines on prescribing in pregnancy must be followed. Only in exceptional circumstances, and after consultation with the consultant anaesthetist on call, should a sedative or opioid be prescribed.

You may also be asked to see patients on the labour ward for later surgery, for example after failed external cephalic version in the Wednesday clinic. Ensure that the following actions have been done:

- Check the infection control alerts. If she has been MRSA or ESBL positive at any time, let the theatre and ward 25 managers know so that a side room can be allocated.

- If no screening has been done in the six weeks prior to caesarean (ES panel on CRRS) then arrange a swab.

- Consider whether a G&S is indicated as below. If so then the sample should be done in the 72 hours prior to surgery. Give the request form to the patient and advise that they may visit the hospital, and also their GP or chemist shop may run a phlebotomy service. The current list of services is at:
www.uhcw.nhs.uk/for-patients-and-visitors/blood-tests-x-rays

• If for G&S on the day of surgery: email the blood bank inbox as below to notify the patient’s hospital number.

• FBC should be within four weeks of the booked date for caesarean.

• Make sure that they get a clinic box of ranitidine tablets to take home along with all the information we use in the clinic.

Planned caesarean sections may be delayed because of more urgent work. Make sure that the mothers are being offered oral water. You should inform the consultant anaesthetist on call of planned cases proposed during on-call periods.

The caesarean section preoperative clinic

This clinic runs every Friday afternoon under the supervision of Dr Mark Porter and Dr Andy Kelly. Patients booked for caesarean section in the following week attend.

Purpose of the clinic

1. To assess mothers scheduled for planned caesarean sections in the following calendar week.

2. To provide information on anaesthesia choices.

3. To complete and file an anaesthesia record sheet.

4. To dispense ranitidine tablets as needed for self-administration.

5. To support a model of care whereby admission for planned caesarean section takes place on the day of surgery.

Running the clinic

The duty obstetric anaesthetist should ensure that the staffing for the labour ward will support the required work on labour ward and in the clinic. The minimum anaesthesia staffing on Friday afternoon is two duty anaesthetists. The anaesthesia department will endeavour to ensure that there is always a consultant allocated to the labour ward on Friday.
Preoperative preparation and assessment

afternoon. This consultant will determine the best disposition of staff to cover commitments.

If there are any problems or concerns in this regard, contact the anaesthesia office or the general consultant anaesthetist on call immediately.

Booking the clinic is done by the midwives and the antenatal clinic staff.

Each mother is allocated 15 minutes for review. The review should be the same as that performed for any preoperative assessment and should incorporate the following elements:

- Check the nature of the booked operation.
- History from mother and examination as required.
- Review of clinical notes.
- Check whether diagnostic blood samples or samples for ‘group and screen are needed and draw blood as necessary.
- Provision of information (a written information sheet reinforces oral information).
- Completion of anaesthesia record sheet – front page.
- Prescription and dispensing of prepared pre-med pack (ranitidine 150 mg x 2) unless there are very good and documented reasons for difference.

Our standard technique for caesarean section is spinal anaesthesia and this should be recommended to the woman if not contraindicated.

You should inform the consultant anaesthetist on call of elective cases proposed during on-call periods. This can happen extraordinarily and is not necessarily wrong. For example, a woman might have an MCDA twin pregnancy and require expedited caesarean delivery on a Sunday when neonatal cots are expected to be available. Always consider such cases sympathetically, remembering to make the care of the patient your first concern, and liaising with a consultant anaesthetist as appropriate.
Contraindications to attendance on the day of surgery

Mothers whose planned care involves admission the evening before surgery may be assessed in the clinic if they present, but they must still attend for admission the evening before surgery. This is very rare.

- Mothers with diabetes mellitus almost always come in on the day. In general, advise them to miss both breakfast and their morning metformin and insulin. Check that there is a plan from the diabetology team in the notes. See page 294.

- HIV-positive mothers often come in on the day. They need an infusion of antiretroviral drugs before surgery (see page 297). The timing of this will need to be closely coordinated with the theatre team and the operation time.

The major group who are not admitted on the day of surgery are those with indications for hospital observation such as antepartum haemorrhage and placenta praevia.

Mothers who do not attend

It may be possible for them to come in on another occasion for an informal appointment on labour ward, and while no guarantee can be made to the mothers, endeavour to see them if asked.

Indications for blood reservation and blood tests

‘Reservation’ refers to the process in which the blood is checked out and placed in the blood fridge in labour ward theatres. The time from this fridge to the bedside is a few minutes faster than EIB (electronic issue of blood) for theatres, and about the same for the antenatal and postnatal wards.

The hospital has implemented the BCSH three-day validity rule for blood samples in pregnancy [66]. This means that EIB is unlikely to be a practicable undertaking in obstetric anaesthesia. At the same time the NICE guidance on caesarean section calls for a reduction in routine testing prior to surgery [67]. Our revised guideline takes these developments into account.
Preoperative preparation and assessment

A formal deviation from the three-day validity rule may be extended to pregnant women with no clinically significant alloantibodies who, for example, require blood standing by for potential obstetric emergencies, e.g. placenta praevia. Fetomaternal haemorrhage constitutes a smaller stimulus than transfusion, because the number of foreign antigens is limited, and in many pregnancies the volume of red cells transferred from fetus to mother is too small to stimulate a primary response. Call blood bank on 25322 in special cases.

Blood transfusion is now rare in theatres. Reinfusion of salvaged red cells happens in 10% of caesarean sections and allogeneic transfusion (including the following day) in 2-3%.

Emergency surgery including caesarean section category 1

In the case of uterine rupture (see page 78) or antepartum haemorrhage (see page 56; and ‘Placenta praevia’ on page 261) request four or more units depending on circumstance.

You may occasionally be requested to proceed without cross-match or known eligibility for electronic issue because of dire emergency. If this happens you should perform the following actions.

• Document the precise nature of the emergency and the name of the operating obstetrician.
• Ensure that a massive obstetric haemorrhage call has gone out if appropriate.
• Ensure at least that a serum sample has gone across to the laboratory, by ‘dire need’ portering arrangements, marked for emergency cross-match and that somebody has telephoned the blood bank technician and impressed the nature of the dire need on them.
• Be prepared to request either group-specific blood or use the O-Rh negative blood stored in the blood fridge depending upon transfusion needs.
All other obstetric surgery

The caesarean planning clinic is on Friday afternoon and so a sample taken then will be valid for Friday, Saturday and Sunday. Day 3 is Monday and it has been agreed that clinic samples will be valid for the elective list on Monday.

Indications for samples are as follows. In each case the responsible anaesthetist or obstetrician may reassess the circumstances and request escalation as appropriate.

Serological cross match for a minimum of two units of red blood cells (to attend the day before surgery, Friday for Monday; speak to blood bank)

Cases with high expectation of heavy postpartum haemorrhage or abnormal antibody screen, for example:

- **Massive obstetric haemorrhage call.**
- Antepartum obstetric haemorrhage or uterine rupture.
- Placenta praevia except low risk as below; placenta accreta or other abnormal implantation.
- Significant fibroids expected to complicate delivery.
- Abnormal antibody screen other than PD antibodies. Note that in the case of PD antibodies alone, repeating the maternal sample before surgery is not required.
- Sickle haemoglobinopathy: SC and SS, (not sickle trait).
- More than one risk factor as below.

Group and save sample

Where there is a confident expectation that group and screen is indicated but that abnormal antibodies are not expected (other than PD antibodies), a serum sample should be sent to the laboratory on the morning of presentation for caesarean section. If this sample is phoned through and received by the blood bank before 08:00 then it will have been analysed by 09:00. Expected attendances should be emailed to blood bank at the conclusion of each clinic by the senior anaesthetist – address is Bloodbank (RKB).
Preoperative preparation and assessment

- All urgent (non-planned) caesarean sections, including planned caesarean section now in labour.
- Multiple pregnancy.
- Low risk placenta praevia (no previous section, not covering os cervix, not anterior).
- Previous abdominal surgery.
- Grand multiparity defined as three or more previous CS or total five or more previous deliveries.
- Maternal anaemia (less than 90 g L⁻¹) uncomplicated by haemorrhage risk factors. In this case the small centrifuge bowl should be used to maximise potential reinfusion.

Antenatal screen only – no repeat sample

Intraoperative blood can be issued urgently as O-negative only or, if there is time, serological or electronic cross match against a serum sample sent at the time of the request for blood.

- PD antibodies as sole complicating factor (electronic cross match cannot be used for these patients).
- Patients for planned caesarean sections not falling into the categories above.

Full blood count

- Where last Hb was less than 105 g L⁻¹ or not done in last four weeks.

Practical management of red cell alloantibodies

As indicated above, PD antibodies are not a concern with regard to blood transfusion, as a positive result indicates that prophylactic anti-D antibodies have been administered to the woman.

You should discuss other antibodies with the blood bank staff as the difficulty in management can vary markedly. The technician or haematologist will advise as to whether the cross matching can be
handled locally in Coventry, or whether the antibody is sufficiently challenging or rare to require blood from the regional blood bank in Birmingham. Very rarely, red blood cells may only be available from the UK National Frozen Blood Bank in Liverpool.


Information and consent for obstetric anaesthesia procedures

General considerations

Professional advice has been issued on consent for anaesthesia [68,69,70]. You should practise according to the following recommendations from the OAA/AAGBI guidance:

There is no difference between the principle of obtaining consent for obstetric anaesthesia and any other medical treatment.

The patient is entitled to receive an explanation of the proposed procedure in appropriate language. Interpreters should be made available to women who do not speak English; if at all possible these should not be family members. The explanation should include the nature and purpose of the proposed procedure, as well as any material risks attached to it. The patient should have the opportunity to ask any questions.

All explanations should be documented. The use of pre-printed labels to insert in the record as confirmation of the explanation is recommended.

Expectant mothers attending the antenatal clinics are given leaflet information regarding the available choices in the labour ward. They are encouraged to form their own choices in advance of labour. Women always retain the right to change their mind, and you should respect this. On occasion this may mean that a woman in labour appears to change her mind in a contrary fashion; she has this right.

Unusual restrictions on treatment should be noted in the antenatal record. Where restrictions on a woman’s treatment inevitably result in danger for the fetus, it is conceivable that an approach to the courts may be made. Such approaches will only be successful where the court is of
the opinion that the woman is no longer a competent person to give or withhold consent; recent decisions have shown that the woman’s autonomy and right to make her own decisions is regarded as having great weight.

**Concerns about patient safety**

You must report immediately to the consultant anaesthetist on call any instance in which you feel that restrictions on consent may lead to harm for the woman.

**Interpreters**

Women who do not speak or understand English should be seen by anaesthetists and counselled after they have been identified. Speak to the midwives about engaging the services of an appropriate interpreter. This will enable timely information provision and discussion with or without an interpreter. Information sheets regarding epidural and spinal for pain relief and caesarean sections in different languages will be available in the anaesthetic office in the maternity unit and online at LabourPains.com.

**Birth plans**

A birth plan is a form of advance statement and must be respected unless the situation falls outside the expected circumstances or there is evidence that the mother may have changed her mind since signing it. “Just as one can give consent, one can also change one’s mind when confronted with the pain of labor” [71]. If confronted with this situation, involve the senior midwife in your discussion with the patient and document the results thoroughly. It may also help to have a postpartum discussion to make sure that any anxieties or questions that the woman might have can be answered.

Scott’s views are widely quoted and respected [72]:

“"It is unethical, I would maintain, to withhold pain relief from a greatly distressed woman, actually begging for an epidural, solely because of a statement written in her
Birth Plan at a time of ‘not knowing’, which states ‘I do not wish to have an epidural in labour’.”

Consent for epidurals

You may be asked to establish epidural analgesia in women whose competence is called into question because of pain, or analgesic or sedative drugs. The process of consent started antenatally as described above, and in the delivery room may be oral and implied. However, all women for whom you propose to establish epidural analgesia must have an explanation at least and be offered the opportunity to refuse or to ask questions. This explanation is documented on the epidural form that you must complete for each woman.

Although you should use your professional skills in making this explanation, we suggest that the following is explained as a minimum:

- An epidural involves the insertion of a catheter near to the spine and is performed by an anaesthetist.
- It is the best method of labour analgesia known, with a success rate of about five in six – the remaining one in six will often respond to further attention.
- The fetus generally benefits and there is no consistent evidence to show that you are more likely to have an operation as a result of the epidural.
- A drip will be required in order to prevent a potential fall in blood pressure.
- Pregnancy and labour cause backache – epidurals do not, beyond minimal discomfort sometimes experienced on the first postpartum day [73,74].
- Your legs may become weak, though we minimise this and you should be able to move comfortably around the bed.
- Severe postpartum headache due to technical difficulties occurs in about 1:100 epidurals. Treatment will be provided if this becomes a problem.
Incidence of complications

The OAA epidural information card [75] gives the following complication incidences:

- Significant drop in blood pressure – 1:50 – occasional.
- Not working well enough for labour – 1:8 – common.
- Not working well enough for caesarean – 1:20 – sometimes.
- Severe headache (epidural) – 1:100 – uncommon.
- Severe headache (spinal) – 1:500 – uncommon.
- Temporary nerve damage – 1:1,000 – rare.
- Nerve damage more than six months – 1:13,000 – rare.
- Epidural abscess – 1:50,000 – very rare.
- Meningitis – 1:100,000 – very rare.
- Epidural haematoma – 1:170,000 – very rare.
- Accidental unconsciousness – 1:100,000 – very rare.
- Severe injury, including paralysis – 1:250,000 – extremely rare.

Many women who are nervous about risk will understand if you explain that just under two thousand people die on British roads every year and that in any one year, one’s chance of being killed in a road accident is 1:30,000. Most people accept this risk and implement strategies to reduce it, e.g. having their car regularly serviced.

Providing information in written form

The Obstetric Anaesthetists Association publishes information for mothers in a wide variety of languages. The principal leaflets are those on ‘Pain relief in labour’ and ‘Caesarean section: your choice of anaesthesia.’ There is also an epidural information card.

Copies of these leaflets are usually available on paper but can be hard to find. Most mothers have world wide web access. The information is available on the OAA-provided web site at LabourPains.com. There is a file of laminated epidural cards in the maternity theatres office.
Information and consent for obstetric anaesthesia procedures

You should take some time to access and read the information provided there.


Management of regional blocks

The majority of your anaesthesia interventions on the labour ward will be central nerve blocks for analgesia or surgery. This section deals with practical management issues for central nerve blocks.

Infection control

Breaching the protections of the central nervous system carries the risk of introducing infection. While the area remains controversial and rigorous evidence is lacking, the Association of Anaesthetists of Great Britain and Ireland has made recommendations [76]. In particular, you should wear a facemask when establishing central neuraxial block.

Maximal barrier precautions involve full hand washing, the wearing of sterile gloves and gown, a cap, mask and the use of a large sterile drape. The skin entry site should be cleaned with an alcoholic chlorhexidine gluconate solution or alcoholic povidone-iodine solution. The antiseptic should be allowed to dry before proceeding.

Certain invasive anaesthetic procedures require this optimum aseptic technique:

- Insertion of central venous catheters
- Spinal, epidural and caudal procedures

The Working Party is aware that many anaesthetists do not employ this level of asepsis for ‘one-shot’ spinals or epidurals but believes when central neural spaces are penetrated full aseptic precautions are required.

Our recommended skin preparation is chlorhexidine 0.5% in 70% alcohol sprayed on the skin and allowed to dry naturally in air.
Management of regional blocks

Monitoring the extent of central nerve blocks

You should monitor immediate effects of administered neuraxial drugs, and their sensory, motor and autonomic effects as the block establishes.

Contact with the mother

Maintain eye and verbal contact during and after any injection, checking for the signs of intrathecal and intravascular placement. You should then assess segmental height of block using two modalities – cold and sharp. See page 145 for detailed assessment of surgical blocks.

Intrathecal placement

This may be diagnosed three to five minutes after administration down an epidural catheter if there is:

- Rapid disappearance of labour pains.
- Hypotension.
- Motor block in the legs (S1 motor block, plantar flexion at ankle).
- Loss of pain sensation on the lateral border of the heel (S1).
- A warm upper foot.

Intravascular placement

This is suggested by:

- A metallic taste in the mouth.
- Tingling of the lips.
- Buzzing in the ears.
- A feeling of light-headedness.

Cardiovascular collapse may follow. See ‘Local anaesthetic toxicity’ on page 73.

Autonomic block

Bilateral warm dry feet are an early sign of a successful epidural block.
You should ensure that there is regular monitoring and recording of the blood pressure. This will allow detection and treatment of hypotension.

Extension of the autonomic block into the segments innervating the sympathetic cardioaccelerator fibres (T1 to T4) may rarely lead to bradycardia requiring glycopyrrolate treatment. This seems to be less common when metaraminol is used as an antihypotensive agent than when ephedrine was used.

**Sensory examination**

The uterine nerve supply is T10 to L1 and perineum S2/3/4

- **C5** area over the deltoid
- **C6** thumb
- **C7** middle finger
- **C8** little finger
- **T4** above nipple – *caesarean section, trial of assisted delivery*
- **T7** xiphisternum
- **T8** epigastrium – *other operative procedures*
- **T10** umbilicus – *epidural analgesia for labour*
- **T12** symphysis
- **L4** medial aspect of the leg
- **L5** space between first and second toes
- **S1** lateral border of the heel
- **S2** posterior aspect of thigh
- **S3** area over the ischial tuberosity
- **S4, S5** perianal region
Management of regional blocks

Motor examination

C5  deltoid – raises elbow to level of shoulder
C6  biceps – flexes forearm
C7  triceps – extends forearm
C8  flexes wrist and fingers
Management of regional blocks

T1  spreads fingers

*Block levels at T1 or above are too high.*

*Block levels below here are acceptable, although for epidural analgesia motor blockade should be minimised.*

L2  iliopsoas – flexes hip

L3  quadriceps – extends knee

L4  tibialis anterior – dorsiflexes ankle

L5  extensor hallucis longus – extends toes

S1  gastrocnemius – plantarflexes ankle

**Assessing the block for surgery**

There is much to be said for simply putting the right dose of the right drug in the right place at the right time: doing this using the guidelines in this book is associated with very high success rates and extremely low rates of emergency intraoperative conversion to general anaesthesia.

However, you must perform block testing in order to determine the chance of block failure, not just at initial incision but also at key points in the operation.

There is no controversy over the statement that a sensory block from T4 to S4 bilaterally provides good anaesthesia for abdominal surgery, peritoneal traction and bladder manipulation. How to assess a block as such is ignored in many textbooks and is the subject of unresolved controversy [77]. Proponents of the use of light touch probably have the theoretical advantage [78] but the drawback of this method is its heavy dependence on operator technique and the difficulty of actually applying it to the mother.
Quadruple test for surgical block

- Loss of SLR (ability to straight leg raise);
- Block to cold sensation;
- Block to sharp sensation;
- Block to surgical stimulation test on the lower abdomen.

*Record the results and relevant dermatomes, along with a statement of no intraoperative complaints or a description of any complaints made by the patient.*

We suggest the following method.

1. **After placing a spinal anaesthetic:**
   
   a. Start the vasopressor infusion.
   
   b. Start frequent blood pressure monitoring.
   
   c. Positioning the patient head down, with the headpiece of the table lifted up from the horizontal, will reduce the time to surgical block and may be of benefit in urgent cases.
   
   d. Apply a left lateral tilt.

2. **Check that the patient is rapidly losing the ability to perform SLR (straight leg raise).** This is an early sign of an effectively developing block. Whatever level you think the block is at, she will have pain during a caesarean section if she can perform any degree of SLR.

3. **Check that the block has risen to the area between the umbilicus and the xiphisternum.** If it has, then remove the head-down tilt. If not, leave the head-down tilt on. (Do not waste time assessing a block before it has had time to work.)

4. **It’s now probably about two minutes on the clock.** Ask the midwives to insert the urinary catheter if not already done.

5. **You should then assess segmental height of block using ethyl chloride spray for cold sensation to map the block approximately and a cocktail stick or non-traumatic forceps for touch sensation.** It is highly unusual (and may be an indication of serious complications)
for the block to rise to T4 before seven minutes. The average time is about ten minutes; twelve is not unusual. If it is longer than this, or the developing block does not follow the expected trajectory, then you should consider encouraging the block as follows.

6. If needed, ask the woman to perform a Valsalva manoeuvre a couple of times. Coughing doesn’t last long enough. You could also elevate her legs with your arm behind her knees and keep them up for two minutes. These manoeuvres will often take a block those crucial two or three segments further up to T4.

7. Check the block up to T4 (classically at the level of the nipple, though with significant overlap towards the sternal angle, towards which the block needs to go to block all of T4; remember that the position of the nipple can vary) and down to S2 (central posterior thigh).

8. Before incising the patient, the surgeon will test with toothed forceps on the lower abdomen and wait for your confirmation. This is an essential component of the block check. There have been known cases where this was not done and it was only discovered on incision that the patient was not anaesthetised.

**Neuraxial opioids and pruritus**

Pruritus can occur quite soon following the neuraxial administration of fentanyl. It is rather less common at this stage when diamorphine is used. Reassure the mother about the cause and that it is likely to resolve spontaneously in a short time. This is usually the only treatment needed. If the pruritus is distressing in recovery and further treatment is needed, administer bolus doses of naloxone 40-80 mcg repeated as necessary to a maximum dose of 400 mcg (dilute one ampoule 400 mcg to 10 mL with saline). Warn the mother that the analgesic effects of fentanyl may be reversed, but this is not likely to be important in the postoperative period as fentanyl is an intraoperative analgesic.

Consider avoiding neuraxial opioids in patients at high risk – those with eczema, psoriasis or a previous history of neuraxial opioids inducing
Management of regional blocks

pruritus. This should be rare set against the better analgesia with diamorphine.

On the postnatal wards, women who have had neuraxial diamorphine may experience pruritus. If needing treatment, recommend the oral chlorphenamine 4 mg up to four times a day that should be written on the drug chart.


Severe postnatal complications of central nerve block

Prevention of severe complications

Infection
Primary prevention of infective complications is essential. In line with national recommendations you must use aseptic precautions for central nerve block, whether in a delivery room or in the theatres (see page 141). This means hand washing with surgical scrub or hand soap as available, cap, mask, gown and gloves.

Vertebral canal haematoma
Vertebral canal haematoma is very rare, especially in obstetric anaesthesia. The incidence is about 1:170,000 for epidurals, and about 1:220,000 for spinals. In the NAP3 study it was found to be 0.85 per 100,000 in all patients, some of whom were very much more ill than most obstetric patients [79]. It is also rare in patients receiving concurrent CNB (central nerve block) and antithrombotic drugs so long as sensible guidelines are followed [80]. This section details our guidelines in Coventry. This section also deals with thrombophilic disorders including those of pregnancy.

Undertaking regional anaesthesia at 6-12 hours after prophylactic antithrombotic injection may be indicated clinically. It is associated with a vertebral canal haematoma risk of less than 1:10,000.

You must discover the patient’s antithrombotic and anticoagulant history prior to undertaking CNB.

Guideline on central neuraxial block and haematoma prevention
Much advice has been published over the years and the current standard reference is in RAPAC 2013 [81]. The advice here is supported by the ASRA
consensus statement [82], the SIGN guideline [83] and the RCOG [84] and by others [85]. It is very rare in our labour ward to use postoperative epidural catheters, or to use any heparin other than thromboprophylactic enoxaparin. Thromboprophylaxis can mistakenly be overlooked in high dependency patients. You should make sure that thromboprophylactic enoxaparin is commenced on time as indicated. Having had a postpartum haemorrhage or having severe pre-eclampsia induce a prothrombotic state in the patient and are not of themselves contraindications to starting enoxaparin injections.

You must weigh relative risks in advising patients on treatment alternatives [81]. The excess risks of the central nerve block are primarily those of vertebral canal haematoma with subsequent cord compression and permanent damage. Realistic alternatives to epidural analgesia exist in labour, but, for caesarean section, the choice is that of general or neuraxial anaesthesia, and the risks of spinal haematoma in patients with abnormal coagulation must be weighed against those of general anaesthesia, especially in patients who are in labour and have a full stomach. These risks include hypoxaemia associated with difficulties maintaining the airway, pulmonary aspiration and thromboembolic complications.

Some patients are known in advance to have coagulation disorders and may have been reviewed in the joint obstetric haematology clinic or the anaesthesia referral clinic. There will be a plan in the clinical records, which may include DDAVP, tranexamic acid, factor transfusion and advice about central neuraxial blocks. If there is no plan, then ask the consultant anaesthetist for advice.

**NSAIDs**

NSAIDs, including aspirin, administered for thromboprophylaxis, post-operative pain or prevention of pre-eclampsia are not a sole contraindication to CNB.

Concurrent use of other medications affecting clotting mechanisms may increase the risk of bleeding complications. See page 154 for ‘Complicating factors’.
Heparins

1. Patients prescribed fractionated or LMWH (low-molecular weight heparins) subcutaneously as thromboprophylaxis.

Our standard fractionated heparin is enoxaparin (Clexane); this is being used more than it has been in the past.

LMWH are used in pregnancy for patients with lupus anticoagulant, antiphospholipid syndrome, a variety of thrombophilias, and as thromboprophylaxis for familial and previous episode risk factors.

- Allow 12 hours after a prophylactic dose of enoxaparin before undertaking a neuraxial technique.
- It is possible to undertake a block at 6-12 hours after discussion with a consultant and having explained the increased but not high risk to the patient, balancing with other risks.

2. Patients prescribed LMWH subcutaneously as treatment, e.g. confirmed VTE, prosthetic heart valves.

The dose is usually 1.5 mg kg\(^{-1}\) every twelve hours subcutaneously, starting 12 hours after catheter removal if relevant.

- Allow 24 hours after a treatment dose of enoxaparin before undertaking a neuraxial technique or removing an epidural catheter.

Anti-factor X\(_a\) estimation may be possible but is usually only available on a planned basis once a week: speak to a consultant haematologist. You should discuss exceptions with a consultant.

3. Patients prescribed subcutaneous UFH (unfractionated heparins) as thromboprophylaxis.

Unfractionated heparins include generic heparin, Calciparine, Minihep and Monoparin, and are indicated where the risk of haemorrhage is higher and there may be need for protamine reversal. This is not a common technique.

- Allow 4 hours after a prophylactic dose of UFH before undertaking a neuraxial technique or removing an epidural
Severe postnatal complications of central nerve block

catheter. We recommend checking that APTT ≤ 1.4 prior to the procedure.

Indications for haematological investigations

With the publication of RAPAC, indications have tightened in pre-eclampsia and in intrauterine fetal death [81].

Platelet count only

A platelet count should be performed within the preceding six hours for any patient in the following groups.

- Those who have received subcutaneous heparin for more than four days, including those who have been on long-term heparin during pregnancy and have now stopped.
- Those who have mild pre-eclampsia with a stable platelet count above $100 \times 10^9 \text{ L}^{-1}$.

The platelet count should be $75 \times 10^9 \text{ L}^{-1}$ or above for CNB to be safely undertaken except as below [86,87].

Blood tests within the last six hours

A full blood count and coagulation screen should be performed within the preceding six hours for all patients in the following groups.

- Platelet count below $75 \times 10^9 \text{ L}^{-1}$.
- Obstetric cholestasis.
- Intrauterine death at any time. CNB is not safe where IUD is accompanied by abruption or overt sepsis.
- Significant placental abruption (causing maternal haemorrhage, fetal hypoxia or death).
- Infection where no other contraindication exists e.g. untreated infection in the bloodstream or localised sepsis at the block site.
- Major or massive haemorrhage, remembering that regional techniques are contraindicated in acute haemorrhage due to the potential for cardiovascular compromise.
- Amniotic fluid embolism.
• Intravenous heparin has been given within the last 24 hours.

Immediately before the CNB

A full blood count and coagulation screen should be performed immediately before undertaking the CNB for all patients in the following groups.

• Any pre-eclampsia where the platelet count is known or expected to be below $100 \times 10^9 \text{ L}^{-1}$. Try to assess the rate of fall and use judgment over when significant thrombocytopenia will occur.
• Severe pre-eclampsia.
• HELLP syndrome.

With a normal coagulation screen, and platelet count $> 75 \times 10^9 \text{ L}^{-1}$ and not falling, CNB may be safely undertaken in these patients.

Relatively safe regional anaesthesia

In order for CNB to be undertaken relatively safely the following conditions should be met.

• The platelet count (if indicated) must be above $75 \times 10^9 \text{ L}^{-1}$.
• The coagulation screen (if indicated) must be normal (see page 315).
• Minimise vessel trauma – consider asking an experienced anaesthetist to perform the CNB in complicated patients.

CNB may be possible in complicated patients; each case will require referral to consultants and a judgment of the risks and benefits.

In idiopathic thrombocytopenic purpura and gestational thrombocytopenia, the reduced numbers of platelets have normal function, and after individual risk-benefit assessment and in the absence of other coagulation abnormalities, CNB may be safely undertaken by experienced practitioners at platelet levels above $40 \times 10^9 \text{ L}^{-1}$.

Consider using a platelet transfusion if the following factors are all true:

• The platelet count is below $50 \times 10^9 \text{ L}^{-1}$.
• The coagulation screen is normal.
Severe postnatal complications of central nerve block

• CNB is strongly indicated.
Seek senior anaesthetic and haematological advice in this case.

Complicating factors
Expert advice should be sought, and haematological tests for coagulation status should be performed, in these cases.
• There is a known thrombocytopenia, coagulopathy or evidence of abnormal bleeding.
• There has been recent therapeutic anticoagulation, including with heparin (whether subcutaneous or intravenous).
• NSAIDs and heparins have been used together within the last week, e.g. aspirin and enoxaparin where risk may increase ten-fold. This will be particularly important in the case of a postoperative epidural infusion for many high-risk cases.
• Patients receiving clopidogrel or other oral anticoagulants, or who have a coronary artery stent in place.
• There are other complicating factors such as trauma, uraemia, liver failure and the aftermath of massive transfusion. Patients with sepsis are also at risk from epidural abscess and meningitis.

Disseminated intravascular coagulopathy is incompatible with safe neuraxial anaesthesia.

Space-occupying lesions in the vertebral canal

Diagnosis – Bromage scores
Failure to achieve recovery from neuraxial block should prompt referral to the obstetric anaesthetist and consideration of the need for further action as below.

Midwives and anaesthetists should check modified Bromage scores to assess recovery of motor power after neuraxial blocks, against the expected recovery by certain times after the last drug administration. The following table is modified from Bromage’s original publication [88].
### Severe postnatal complications of central nerve block

<table>
<thead>
<tr>
<th>Bromage score</th>
<th>Description</th>
<th>Expected by</th>
</tr>
</thead>
<tbody>
<tr>
<td>No block</td>
<td>0 Full flexion of knees and feet</td>
<td>Six hours after block</td>
</tr>
<tr>
<td>Partial block</td>
<td>1 Able to move feet but knees only partially flexing</td>
<td>Four hours after block</td>
</tr>
<tr>
<td>Almost complete block</td>
<td>2 Able to move feet but not knees</td>
<td>Four hours after block</td>
</tr>
<tr>
<td>Complete block</td>
<td>3 Unable to move knees or feet</td>
<td></td>
</tr>
</tbody>
</table>

The postnatal midwives will contact you if the patient does not achieve this recovery schedule.

**Diagnosis – postnatal review**

You should elicit neurological symptoms at the postnatal review visit. A woman with any symptoms should be carefully examined and the results documented. Many of these symptoms may be due to maternal obstetric palsy. Determining the pattern of impairment is important. If the impairment is dermatomal then it may be due to the anaesthetic intervention, and if it follows nerve distributions then it may be due to maternal obstetric palsy.

You should organise an urgent MRI scan for all but trivial and resolving symptoms and signs. Seek senior advice immediately if you suspect neurological damage.

You will have many more patients referred to you than have any complications related to anaesthesia. Some midwives feel that a history of neuraxial block can be more significant than a history of abdominal
Severe postnatal complications of central nerve block

surgery or childbirth in explaining a variety of unusual symptoms. Nevertheless, you should take each referral seriously.

Space-occupying lesions can be caused by haematoma, abscess, or external compression such as prolapsed intervertebral disc. Compression of the spinal cord, cauda equina or isolated nerves or their blood supply may lead to paraplegia, cauda equina syndrome or nerve root damage.

The presence of severe back pain is a sensitive indicator of a serious problem. Its absence does not rule out a serious problem.

Vertebral canal haematoma rarely presents with the classic feature of intense back pain, neurological deficit in the legs being more common. Too often this is assumed to relate to the effects of local anaesthetic administration. Inappropriate motor weakness, even when unilateral, requires urgent assessment and if appropriate investigation to exclude vertebral canal haematoma [79].

Features of a vertebral canal haematoma are:

- Bilateral leg weakness.
- Wide sensory deficit in the legs.
- *Apparent persistence of the central nerve block beyond its expected duration.*
- (Back pain and tenderness.)

Features of a vertebral canal abscess are:

- Back pain – marked local tenderness of the spine at the level of the abscess.
- Fever.
- Malaise.
- Headache.
- Later, bladder and bowel dysfunction, lower extremity pain and neurological signs.
Ominous signs are severe back pain (associated with a neurosurgical cause), progressive neurological deficit (sensory, motor, bladder dysfunction) and fever.

Epidural abscess is very rare, and associated with the duration of epidural catheterisation, although it has been reported after six hours in labour. Presentation may be vague; fever and back pain usually preceding neurological deficit [89].

It is more likely to occur after 4-10 days and is usually due to tracking of a staphylococcus from the patient’s skin. This is associated with prolonged epidural catheterisation, multiple attempts, sepsis, or immunocompromise (diabetes, steroids, AIDS).

MRI is the indicated imaging technique for the diagnosis of spinal epidural abscess, with a sensitivity of close to 100% [90]. A CT scan without myelography is of little diagnostic help, and therefore not the method of choice.

Management

Rapid referral for appropriate management is vital [91].

1. Inform a consultant anaesthetist.
2. Contact the on-call radiologist, and organise an urgent MRI scan that day.
3. Contact the on call neurosurgeon and inform them that the scan is being done.
4. Get blood samples analysed for ESR, CRP, blood cultures and white cell count. These tests are not definitively diagnostic but may be helpful.
5. The definitive treatment for a compressing vertebral canal haematoma is a decompression laminectomy, and for abscess is decompression and debridement. The time between development of thecal compression and surgical treatment determines final neurological outcome and should be within eight hours at most. Refer any pathological findings on the MRI scan immediately to the neurosurgeon on call.
Severe postnatal complications of central nerve block

6. You should report the neurological symptoms and signs, and any diagnosis, as a clinical adverse event.

Delay in examination, MRI investigation and surgery is associated with permanent neurological disability [92].

Spinal cord damage

Epidurals

Cord damage is associated with very poor epidural technique but also with spina bifida or tethered cord syndrome.

Spinals

Cord damage is associated with using too high a space for subarachnoid insertion (see page 232 for technique). Typically, the anaesthetist uses the same interspace for spinal block that they would have used for epidural block without thinking about the different techniques.

Risk factors:

- Inserting too high.
- Abnormally low conus.
- Inserting against pain.
- Injecting against pain.

Prolonged symptoms involving more than one spinal segment point to damage to the spinal cord.

Meningitis

This may be caused by a streptococcus from the anaesthetist’s nose, or the patient’s vagina via the bloodstream. It typically develops 1-2 days after a spinal anaesthetic and presents with severe headache, with other symptoms such as nuchal rigidity, photophobia and pyrexia following later [79]. There are three cases of meningitis death after spinal anaesthesia; all were in healthy parturients [93]. Meningitis can also complicate an epidural.
Severe postnatal complications of central nerve block

The presentation can be hard to distinguish from a post-dural puncture headache. Diagnostic lumbar puncture is essential on suspicion of infective meningitis.

Although evidence of masks preventing meningitis is not robust, the case is logically unanswerable and the national recommendation is to wear a facemask.

**Serious and permanent harm**

Notwithstanding the above, central neuraxial blocks only rarely cause serious and permanent harm. The NAP3 audit of 320,000 obstetric neuraxial blocks in one year in the UK discovered no cases of meningitis and one epidural abscess [79]. The study of rare and catastrophic complications such as infections, bleeding, major nerve damage, wrong route and death concluded that obstetrics has a good safety record. Although 45% of all central neuraxial blocks were conducted in maternity cases, maternity was the source of 4 out of 30 permanent injuries considered pessimistically and 1 out of 14 considered optimistically. However, maternity was over represented for ‘wrong route administrations’, with 6 out of 9 cases. The estimated incidences within this group of paraplegia or death were zero whatever the regional technique, although this complication could not be confidently excluded.

The table gives the incidences of permanent harm with 95% confidence intervals. The pessimistic figures include those cases where causation is certain, likely, possible or unlikely. The optimistic figures exclude the unlikely.

<table>
<thead>
<tr>
<th>Type of CNB</th>
<th>Incidence per 100,000</th>
<th>Incidence per 100,000</th>
<th>NHS procedures – annual estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pessimistic</td>
<td>Optimistic</td>
<td></td>
</tr>
<tr>
<td>Epidural</td>
<td>0.6 (0 – 3.4)</td>
<td>0.6 (0 – 3.4)</td>
<td>161,550</td>
</tr>
<tr>
<td>Spinal</td>
<td>1.5 (1.0 – 5.4)</td>
<td>0 (0 – 2.2)</td>
<td>133,525</td>
</tr>
<tr>
<td>CSE</td>
<td>3.9 (1.0 – 22.0)</td>
<td>0 (0 – 11.8)</td>
<td>25,350</td>
</tr>
<tr>
<td>Total</td>
<td>1.2 (1.0 – 3.2)</td>
<td>0.3 (0 – 1.7)</td>
<td>320,425</td>
</tr>
</tbody>
</table>
Severe postnatal complications of central nerve block

So most of the cases referred to you will be neuropathies as below, and they are rare; but in their management you should consider the above potential rare catastrophes.

Neuropathy on the postnatal ward round

You will find occasional patients referred to you with or complaining of neurological symptoms and signs or apparent nerve injuries in the lower part of the body. All such complaints warrant careful assessment, and then discussion with the consultant anaesthetist, and then the obstetricians and midwives. While it may not be possible to find a definitive diagnosis, you should aim to reassure women authoritatively about the timescale for resolution of their complaint, whether any action is needed and how we will check that resolution has occurred.

The OAA epidural information card lists the chance of temporary nerve damage as 1:1,000 and permanent nerve damage as 1:13,000. The diagnosis is complicated by the much higher incidence at 1:107 of maternal obstetric palsy [94]: the injury caused by compression on the nerve by the fetal presenting part. The median duration of symptoms is about two months. Anaesthetic injury is due to nerve root damage on insertion of needle or to direct injury to the spinal cord; hence the need for careful selection of the site of entry and close attention to complaints of lancinating pain during insertion.

While it is not possible to be definitive, symptoms and signs in a spinal nerve root distribution may be due to an anaesthesia complication (remembering prolapsed intervertebral disc as below) whereas symptoms and signs in a peripheral nerve distribution will likely be due to maternal obstetric palsy.

The commoner sites for maternal obstetric palsy are:

- Lateral cutaneous nerve of thigh (L2, L3 – numbness and paraesthesia on the lateral aspect of the thigh, or meralgia paraesthetica). This nerve can also be stretched during late pregnancy.
- Femoral nerve (L2, L3, L4 – knee extension weakness).
• Lumbosacral trunk (lumbosacral plexopathy L4, L5, S1 – foot drop with sensory loss on the sole of the foot).

These injuries are associated with:

• Short stature.
• Instrumental delivery.
• Delay in the second stage.
• Nulliparity.

A numb line in close relation to the caesarean incision will likely be due to the surgical cutting of somatic sensory nerves. It will often resolve over some months.

**Unilateral foot drop**

This will likely be due to one of the following causes and should be managed in the same way.

• Common perineal nerve – painless.
• L5 root – prolapsed intervertebral disc.
• L5 root due to epidural catheter – rare.

**Management of neuropathies**

Serious symptoms need immediate scan and referral.

In most other cases diagnosis and reassurance about prognosis will suffice, with careful clinical notes and a clinical adverse event report. Most cases are obstetric palsies and you should discuss with midwives and obstetricians to make sure that further appropriate action is being taken, with later review of the patient. In the case that the diagnosis appears to be anaesthetic-related then after discussion with a consultant, making an appointment to review the patient a couple of months later is necessary.

Referral to a neurologist may be warranted with:

• Persistent mononeuropathy.
• Motor dysfunction.
Severe postnatal complications of central nerve block

- Bilateral injury.
- Sphincter dysfunction.

**Acute disc prolapse**

This may occur in approximately 1:10,000 pregnancies and there have been several postpartum cases in the last few years in Coventry. There is usually a history of sciatic pain. The main concern related to immediate needs is whether or not cauda equina syndrome is present. If it is, then immediate MRI and referral to neurosurgery is indicated. The patient will need neurosurgical decompression if neurological symptoms are not resolving quickly.

**Lower back pain**

Half of all pregnant women will have lower back pain in late pregnancy. The prevalence declines after delivery. It occurs no more frequently after epidural blockade and the association with epidurals is not causative; it is another of those things for which anaesthetists can be blamed [95], although popular belief in this regard has declined recently. Mothers can be reassured that it is likely the pregnancy that causes their backache, not the epidural [96]. Long-term backache of three months or more occurs in women after childbirth and is more likely if there has been backache during pregnancy. Short-term backache at the lumbar site may be associated with transient tissue damage as the epidural needle passes, and will resolve in a few days.

Note that mechanical lower back pain during pregnancy is not a contraindication to central neuraxial block.

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Severe postnatal complications of central nerve block

81. AAGBI, OAA and Regional Anaesthesia UK (2013) Regional anaesthesia and patients with abnormalities of coagulation. (RAPAC) *Anaesthesia* **68**: 966-72


Severe postnatal complications of central nerve block


Pain relief for labour

We offer epidural analgesia for relief of pain associated with labour and assisted delivery. Epidurals are described in detail below.

As a matter of routine, we do not offer the combined spinal/epidural technique in labour. We do however aim for sensory and not motor loss, allowing mobility in the bed.

We do not recommend the use of spinal analgesia for pain relief. Conduct of spinal analgesia is contraindicated in places where full monitoring and resuscitation facilities are not available. The risks associated with spinal blockade outside theatre are too high.

Epidural analgesia – general considerations

Response time

We offer a 24-hour on-demand service for pain relief in labour.

The relevant professional standard is: [97]

“When a 24-hour epidural service is offered, the time from the anaesthetist’s being informed that a woman is requesting an epidural and ready to receive one until attending the mother should not normally exceed 30 minutes. This period should only exceed one hour in exceptional circumstances.”

You must attend promptly. If you anticipate that the response time will exceed 30 minutes you should inform the midwife and consider calling the senior resident anaesthetist for assistance. Calls to the senior resident anaesthetist must be made by you or on your express instruction. Do not delay epidural analgesia unnecessarily when there are nearby anaesthetists who could help.
Pain relief for labour

Indications

The most common indication for epidural analgesia is maternal request but there may be instances when epidural analgesia is preferred for medical reasons. These include:

- Prior to starting oxytocin augmentation of labour – an epidural should be offered [98].
- Pre-eclampsia (see page 287).
- Multiple pregnancy.
- Breech presentation for vaginal delivery.
- Diabetes mellitus.
- Respiratory disease e.g. asthma.
- Cardiovascular disease.
- Sickle cell disease.
- Premature labour.
- Prolonged labour.
- Intrauterine growth retardation.
- Intrauterine death (see ‘Indications for haematological investigations’ on page 152).
- Anticipated instrumental delivery.

Contraindications

- Unwilling patient.
- Coagulopathy or anticoagulation (see page 149).
- Local sepsis at the epidural site.
- Septicaemia as evidenced by pyrexia (above 37.5°C or if symptomatic) unless the cause is known (e.g. prostaglandin pessaries). A white cell count above the laboratory reference range is common in labour and does not necessarily indicate systemic sepsis. This is especially so if there are no other signs or symptoms of sepsis. If in doubt discuss with an obstetrician.
- Raised intracranial pressure (not benign intracranial hypertension).
- Uncorrected hypovolaemia.
- Fetal distress until fetal blood sample performed or obstetric confirmation given.
Pain relief for labour

• Inadequate staff to look after the mother.

**Relative contraindications (discuss with a more senior anaesthetist)**

• Technical difficulties e.g. previous back surgery, kyphoscoliosis, and gross obesity.
• Neurological disorders.

A consultant anaesthetist should have seen women with complex medical disorders antenatally, following which a plan is made and recorded in the medical case notes, and summarised in the woman’s hand-held antenatal notes. Find the plan and follow it.

**Desirable block**

You should aim to relieve the pain of labour:

• For humane reasons of itself.
• To reduce maternal anxiety, especially fear of the next pain.
• To reduce the severe physiological stress for mother and fetus that follows pain.

You should aim to avoid:

• Gross motor blockade, unless specifically indicated.
• Complete sensory loss, which interferes with the mother’s ability to be a full partner in the delivery of her child.

The therapeutic target is bilateral sensory block to T10.

*The ideal block relieves that component of pain for which she sought relief in the first place, and no more.*

**Aortocaval compression**

Avoid aortocaval compression. Patients with epidurals are nursed in full lateral position, supine with an obstetric wedge, or sitting up more than 30 degrees.

**Epidural analgesia and the progress of labour**

This has been the subject of much anxiety and continued debate. However, it is possible to come to a modern consensus position [99,100].
Pain relief for labour

- Epidural analgesia does not cause a longer first stage of labour or an increased chance of delivery by caesarean section.
- Epidural analgesia will be accompanied by a more intensive level of monitoring and intravenous access. CTG monitoring is itself associated with significant increases in caesarean section and operative vaginal delivery [101]
- Epidural analgesia is associated with a longer second stage of labour and a 40% increased chance of operative vaginal delivery with forceps or vacuum extraction [102]. This may be through the prolongation of the second stage of labour or it may be because it reduces concerns about the pain of operative vaginal delivery and thus biases obstetricians to the use of instruments.
- There is no evidence to support the withdrawal of the epidural in the second stage. Discontinuing epidural analgesia late in labour is sometimes advocated in order to allow motor strength to return for pushing. With dilute solutions of local anaesthetic there is no longer a justification for this and routine discontinuation leads to an increase in inadequate analgesia [103]. With an epidural, a woman should delay pushing for one hour after full cervical dilatation unless there is an urge to push or the fetal head is visible, though delivery should take place within four hours regardless of parity. Regional analgesia should be continued until after the third stage of labour [104].
- It may be possible to mitigate the impact on the rate of obstetric intervention by keeping the dose of local anaesthetic to the minimum amount required to provide analgesia.
- Neuraxial analgesia is associated with better fetal outcome. Neonatal acid-base status is not only better with epidural than with systemic opioid analgesia, it is also better than with no analgesia [105].
Technique for epidural analgesia in labour

Preparation and trolley stocking
There are two epidural trolleys and you should make sure at the start of each shift that they are adequately stocked from the labour ward store. Sterile gowns are kept in the triage area store, and masks in the theatre store. Drugs and saline are kept in the labour ward pharmacy room. There is a laminated sheet attached to each trolley to tell you where to find the stock.

Fluid loads and infusions
Administration of a fluid preload is a traditional recommendation but it is not necessary to prevent hypotension, particularly with low dose epidurals [106]. Preload may decrease uterine activity [107]. Instead, flush the cannula and if requested, attach fluids after the block has been performed.

Maternal ketosis is an indication for fluid rehydration with isotonic fluids, not an indication for the administration of glucose in labour.

Performing the block
1. When an epidural is requested you should ascertain that there are no contraindications to epidural analgesia, explain the procedure succinctly to the mother and obtain verbal consent consistent with the mother’s condition (see ‘Information and consent for obstetric anaesthesia procedures’ on page 136).

2. Note the blood pressure prior to performing the epidural. Check that a boxed syringe of ephedrine 30 mg is at hand in the cupboard in the labour room or on the epidural trolley.

3. Insert an intravenous cannula (14 gauge or 16 gauge) with lidocaine analgesia and take venous bloods if needed. You may be asked to prescribe an intravenous infusion of Hartmann’s solution (1000 mL) at a rate to go in over about eight hours. Prescribe this but do not set it running; it will interfere with the positioning of the mother for her epidural and also risk decreasing uterine activity as above.
Pain relief for labour

4. The patient should then be positioned either in the left lateral or sitting positions according to the anaesthetist and mother’s preferences. The epidural should be sited using the technique with which you practice safely and effectively.

5. Do not use a green 21-gauge needle to give subcutaneous analgesia – it is 40 mm long. Both intradermal and subcutaneous infiltration can be given with the same blue 23-gauge needle (25 mm long).

6. Loss of resistance to saline is the recommended technique, which you should learn and use. The use of air is associated with an increased rate of accidental dural puncture, ascending back pain, intense and immediate headache, convulsions, patchy block and air embolus [108].

7. You should secure the catheter in place using a Lockit clamp leaving 3-4 cm in the epidural space; 4 cm is preferred. Use a small amount of Opsite spray and allow drying before affixing a transparent dressing, without using swabs. This is secure and allows full inspection of the site. The standard order is for packs with Lockit clamps and you should use these to reduce catheter migration [109]. Take care not to trap the catheter under the clip as this will lead to total obstruction. It is good practice to inject a little of the test dose with the clamp down but without the dressings and tapes.

8. Maintain fetal monitoring using cardiotocography during the insertion of the epidural.

9. Avoid supine hypotension.

10. If you have difficulty siting the epidural, call for help. Do not persist in fruitless attempts.

Test doses

1. Make time and give time for test doses to work. Make time by injecting early; do not delay with lots of careful sticking down instead of giving the test dose. Give time by waiting the recommended periods.

2. Maintain maternal and fetal monitoring during the test dose.
3. See below for recommended test doses. The doses give the same amount of local anaesthetic as should produce subarachnoid block, and will reliably do so [110]. Allow time for it to gain its full effect and to ascertain whether the catheter has inadvertently been placed in the subarachnoid space or a blood vessel. (See ‘Monitoring the extent of central nerve blocks’ on page 142). If the patient can then plantar flex her feet with normal power the test dose has not been accidentally injected intrathecally.

4. Although the catheter should always be aspirated prior to administering a dose, the non-appearance of blood does not exclude intravenous catheter placement.

**PCEA (patient controlled epidural analgesia)**

**Equipment**

We use PCEA with the CADD-Solis pump, using a dedicated giving set. Make sure you know how to operate the equipment and ask if you are not sure. The machine set-up code is 2-4-6; the clinician override code for bolus administration is 1-3-5.

**Drugs for PCEA**

We aim to use levobupivacaine when approved; 250 mL bags and 250 mL drug cassettes will also be introduced in the near future.

For the present we use 500 mL bags of 0.1% bupivacaine with 2 mcg mL$^{-1}$ fentanyl. Discard this into waste when completed using a yellow sharps bin or yellow (not orange) bag.

**PCEA programme for labour**

You should give a loading dose of 10-20 mL from the pump. Withhold the PCEA button for 20 minutes after a loading dose.

Then commence PCEA with programme:

- 5 mL h$^{-1}$ background infusion.
- PCEA 5 mL bolus with 10-minute lockout.
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- The maximum dose per hour, not including the initial loading dose, would then be 25 mL. The machine recording more than 4 activations per hour would indicate a failing epidural.
- Prescribe 10 mL 0.5% bupivacaine bolus to be delivered once only by the midwife, for forceps, ventouse or suturing.
- Prescribe 10 mL 0.25% bupivacaine bolus to be delivered by the midwife for a failing epidural. (Bupivacaine should not be given in concentrations exceeding 0.25% during the first stage of labour unless specifically indicated.)
- Do not allow the bupivacaine dose to exceed 2 mg kg\(^{-1}\) in a four-hour period.
- Notwithstanding the above, if you are able to attend for a bolus the woman is likely to get better pain relief without the use of high concentration local anaesthetic. You can also adjust her position.

Unavailability of PCEA pump or giving set

In the rare and unexpected unavailability of this equipment or the drugs below, call for senior help and advice. On one occasion this happened, we recommended use of infusion epidural as follows. Ignore this if the PCEA sets are available.

Obtain two premixed bupivacaine and fentanyl 10 mL ampoules and one prefilled 50 mL syringe, or make up from constituents. The solution should contain bupivacaine 1 mg mL\(^{-1}\) and fentanyl 2 µg mL\(^{-1}\). Use one 10 mL ampoule for the test dose (ten minutes needed), or 2 mL lidocaine 2% as above, and a further 10 mL ampoule to establish the block [111]. Alternatively use 2 mL lidocaine 2% as above for the test dose followed by 10-15 mL dilute mix.

Attach the syringe using a yellow infusion line; do not use a clear line as it could be confused with a Syntocinon or other intravenous infusion. Give a further 10 mL bolus if the epidural has not produced satisfactory pain relief after ten minutes. Then commence the infusion at 10 mL h\(^{-1}\), and prescribe an allowed range of 0-16 mL h\(^{-1}\). You may need to give further 10 mL bolus doses from the pump if the first 20 mL has not satisfied the
Pain relief for labour

patient, to a total of 40 mL. This would be indicated so long as the initial dosing has some effect but does not produce maternal satisfaction. Generally, breakthrough pain is better treated with a further bolus than with an increase in the infusion rate.

**Continuous postoperative infusion**

Indicated for postoperative patients e.g. caesarean hysterectomy, laparotomy.

- 10-15 mL h⁻¹ background infusion.
- PCEA option of 5ml bolus with 20-minute lockout.
- Maximum dose per hour of 25 mL.

**Documentation and records**

The epidural chart is integral to the Obstetric Neuraxial Procedure and Monitoring Chart. You should record details of the technique used and the prescription made. On the procedure chart, sign for a 10 mL 0.25% bupivacaine bolus, and a single 10 mL 0.5% bupivacaine bolus for instruments or suturing.

**Inadequate epidural analgesia**

Many problems can be anticipated and resolved through regular review of the patient and regular block assessment. You will need to keep in close liaison with the midwife caring for the mother. Missed segments

1. You should consider the diagnosis when there is persistent pain in one place following epidural administration.
2. Inspect the insertion site.
3. Lay the patient on the unblocked side and give a further top-up of 8 mL 1% lidocaine, with up to 100 mcg fentanyl (do not exceed 100 mcg fentanyl in the first two hours and then 100 mcg fentanyl in each four hours). If this is not effective pull out the catheter by 1 cm or until only 3 cm is in the space and top up again.
4. Do not persist in trying to rescue an inadequate epidural. Discuss the situation with the mother and propose resiting the catheter as
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an early option. Record catheter resittings on the Obstetric Neuraxial Procedure and Monitoring Chart.

Unilateral block
For a true unilateral block retract the catheter by 1 cm. If this does not work, then resite a new epidural catheter.

Perineal and suprapubic pain
This can be difficult to treat particularly if the fetus is in the occipito-posterior position. Bolus using 0.1% bupivacaine with up to 50 mcg fentanyl. This may be repeated (do not exceed 100 mcg fentanyl in the first two hours and then 100 mcg fentanyl in each four hours). The mother should be in the left lateral position for the bolus.

If this does not work, then consider resiting the epidural lower down the spine.

Problematic epidurals

Unusually deep epidural space
Extra-long epidural needles, required in about 1:1,000 epidurals, are available: ask the ODP to look in the theatres.

Bloody taps
1. Flush the catheter and withdraw until no further blood appears on aspiration.
2. If there is a sufficient amount of catheter in the epidural space (2.5 to 3 cm) proceed carefully with the test dose.
3. Failing this, resite the epidural either in the same space or another.
4. Two bloody taps in the same space indicate choosing another space.
5. Always aspirate before giving any top-up.
6. Siting the epidural with the mother in the left lateral position can reduce the incidence of bloody tap.
Unintentional dural puncture (‘dural tap’)

These guidelines relate to the management of women in whom inadvertent puncture of the dura has occurred during insertion of an epidural for analgesia or surgery. There are two alternative strategies from which you must choose. You should make the choice in consultation with more senior anaesthetists as described, and after as much discussion with the mother as is appropriate (see page 136).

Recent evidence shows that the choice of neuraxial technique following inadvertent dural puncture does not appear to alter the course of labour and delivery, though intrathecal catheters were associated with a higher rate of failed analgesia [112]. Caesarean delivery decreased the incidence of post-dural puncture headache by 35%.

If the Tuohy needle has caused the tap, consider giving a single bolus of 1.0 mL bupivacaine 0.25% (2.5 mg) with or without 0.5 mL fentanyl (25 mcg). Put the stylet back into the Tuohy needle while you draw up the spinal injection. You must use a filter needle. You may give this single dose without calling senior help so long as you are a specialist registrar of year three or above.

First alternative: resite the epidural

1. Once dural tap has occurred, you should usually site an epidural in an alternative lumbar interspace.

2. In the event of successive dural taps, abandon epidural analgesia and anaesthesia and consider alternative methods including repeated subarachnoid block as below.

3. On resiting the epidural, you should administer a test dose and first top-up dose of local anaesthetic. When you are happy that satisfactory analgesia has resulted and that the distribution of the block, determined by cutaneous testing, is appropriate for the volume of anaesthetic given, the epidural may continue. All bolus top-ups must be administered by an anaesthetist. An acceptable alternative is to use a dilute infusion (no more than bupivacaine 1 mg mL⁻¹) with hourly monitoring by an anaesthetist.
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4. The prescription for local anaesthetic should limit each increment of a top-up to no more than 12.5 mg bupivacaine (12.5 mL 0.1% or 5 mL 0.25%), each increment being separated by at least 5 minutes. Explicit instructions must be recorded indicating when the anaesthetist should be called:
   • If hypotension occurs.
   • If pain disappears too quickly and after a small volume.
   • If the mother complains of any difficulty with breathing or swallowing.

Second alternative: use repeated bolus subarachnoid block

Do not drain more than a few drops of cerebrospinal fluid.

1. Alternatively, deliberately place the catheter in the subarachnoid space, inserted 2 cm into the subarachnoid space, secure it and label it as a spinal catheter. Then proceed as below for a catheter tap.

2. If the catheter causes the dural tap, secure it and label it without giving any drugs. **You must inform the consultant anaesthetist on call** and the senior resident anaesthetist before administering a subarachnoid dose.

3. Remember to fit the particle filter. Check that the intravenous infusion is running and that ephedrine is ready to administer, and that the patient is in the left lateral position.

4. Administer 1 mL bupivacaine 0.25% (2.5 mg) (with fentanyl 25 mcg if this is the first dose) and flush with 1.5 mL 0.9% saline. Achieve satisfactory analgesia (usually S5 to T10) with further flushed increments of 0.5 mL bupivacaine 0.25% at 5-minute intervals with careful monitoring.

5. The maximum subarachnoid dose of fentanyl over any time period is 25 mcg.

6. You must administer all doses and **under no circumstances whatsoever** are you allowed to leave the labour ward while a subarachnoid catheter technique is in progress.
7. **The patient must not be allowed to sit up.** This may result in a high block.

8. For caesarean section or other operative procedures except as below, with the patient in a lateral or wedged supine position, administer 0.5 mL to 1.0 mL increments of **hyperbaric** bupivacaine 0.5% until surgical anaesthesia is achieved. The dose should be adjusted to the existing block. The maximum dose is 4.0 mL bupivacaine and fentanyl may **not** be given.

9. For outlet forceps delivery 1.0 mL to 2.0 mL **hyperbaric** bupivacaine 0.5% should be used in the sitting position. Fentanyl may **not** be given.

**Delivery and the postnatal period**

Once the mother is comfortable, an explanation of the events that have occurred and the implications for her should be given and recorded in the notes. Give her the OAA headache leaflet – you should find a copy in the maternity theatres office. Make a clear plan of action and record it. Communicate with the midwives and the obstetricians.

It is not necessary for the mother to lie on her side throughout labour; she may sit up if she wishes to. Elective instrumental delivery is not specifically indicated following dural tap, although long and strenuous pushing should be avoided.

The duty anaesthetist should review the mother twice daily and advise on further action, including epidural blood patch or NSAIDs, which may be necessary should the mother develop a persistent post-dural puncture headache.

See page 182 for the diagnosis and management of post-dural puncture headache.

**Hypotension and epidural block**

Hypotension is defined as a decrease in systolic blood pressure by 20% from the initial reading and is often accompanied by symptoms of dizziness and nausea in the mother. It is accentuated by aortocaval compression or hypovolaemia from whatever cause (e.g. dehydration,
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blood loss). This guideline is appropriate in the case where a metaraminol infusion is not already in progress during the establishment of regional anaesthesia in theatre.

Hypotension can occur when the mother’s ability to use sympathetic nervous activation to mitigate supine hypotension is suddenly reduced by the epidural bolus dose. Furthermore, supine hypotension can of itself complicate epidural block.

These effects may be seen in the common scenario of placing an epidural and then positioning her semirecumbent at 45° on the bed, perhaps with an inadequate left lateral tilt. A significant drop in blood pressure can be seen on epidural bolus, producing fetal bradycardia in the newly established CTG monitoring and the activation of the alarm.

Consider preventing epidural hypotension by giving any bolus doses with the mother in the left lateral position. This may not only enhance the dermatomal coverage of a bolus dose but also mitigate any hypotensive effects.

On making the diagnosis you should:

1. Place the mother in the left lateral position.
2. Notify the midwife.
3. Administer ephedrine boluses intravenously, starting with 6 mg; there should be a boxed syringe in the cupboard and on the epidural trolley.
4. Check the block level (motor and sensory) and seek other causes of hypotension.
5. If she is still hypotensive, administer supplemental oxygen and run in fluids appropriate to the pulse rate and blood pressure

Do not use metaraminol infusions outside the maternity theatres.

Total spinal block or high block

See page 244.
Subdural block

1. This is indicated by the following signs:
   - The block spreading high over 20-30 minutes, sometimes to cervical dermatomes.
   - Nasal stuffiness and Horner’s Syndrome.
   - Patchy sensory block and sacral sparing.
   - Minimal motor block.
   - Relative maintenance of blood pressure.

2. Respiratory embarrassment may indicate airway support and mechanical ventilation, as for total spinal anaesthesia.

3. Subdural block is due to the separation of the arachnoid mater from the dura mater and is dangerous because a bolus injection down the catheter may rupture the arachnoid and produce a subarachnoid block.

4. You should inform the senior resident anaesthetist and remove the ‘epidural’ catheter. Resite it at a different place.

5. You should administer all further epidural doses, cautiously and with vigilance.

6. In the event that spinal anaesthesia is needed, reduce the dose of bupivacaine by one third unless the effects of the subdural block have completely disappeared. Inform the senior resident anaesthetist prior to doing the spinal anaesthetic.

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Pain relief for labour

100. National Institute for Health and Clinical Excellence (2014) *Intrapartum care: CG190 – 1.5.2*


Post-dural puncture headache

Diagnosis of headache

Headache is a common postpartum symptom – perhaps two in five of all parturients. It is often a benign primary headache caused by sleep deprivation, stress and oestrogen withdrawal. Post-dural puncture headache is classically occipitofrontal, aggravated by sitting or standing, alleviated by lying supine and may be associated with neck stiffness, neck and shoulder ache, diplopia and tinnitus.

Two thirds of post-dural puncture headaches will occur within the first two days and 90% within three days.

It is essential to determine whether standing makes the headache worse. If not, you must exclude another cause for the headache. Tumour, pre-eclampsia or subarachnoid haemorrhage may be present; accidental dural puncture is a known cause of intracranial subdural haematoma. Remember to examine for neck stiffness.

Abdominal compression with the palm of the hand, while the mother is sitting, may relieve the headache during the subsequent couple of minutes – Gutsche’s sign. In order to demonstrate this sign, you must apply very firm pressure, using counter-pressure with your hand behind the patient.

Post-dural puncture headache is rarely immediate unless subarachnoid injection of air has occurred (pneumocephalic headache). It typically develops after the first 24 hours, perhaps later for spinal pencil point needles.

Be vigilant for other causes of postpartum headache, particularly pre-eclampsia, subdural haematoma or cerebral venous sinus thrombosis.

You should remember that intracranial hypotension can lead to intracranial haemorrhage through tearing of bridging dural veins, and a delay in diagnosis and treatment can be dangerous [113]. Diagnoses that may masquerade as post-dural puncture headache include intracranial tumours, intracranial haematoma, pituitary apoplexy, cerebral venous
thrombosis, migraine, chemical or infective meningitis, and non-specific headache.

Assessment of postpartum headache

This flowchart is adapted from Cuypers [114].
Post-dural puncture headache

Aside from the rare but serious complications of subdural haematoma, dural sinus thrombosis, diplopia or other cranial nerve injuries and chromic headache, having a post-dural puncture headache interferes with the activities of daily living to the extent that some women stay in hospital unable to care for themselves or their newborn baby.

Follow-up for patients with post-dural puncture headache

Any pregnant or recently pregnant woman with serious neurological symptoms or signs requires urgent appropriate early referral and imaging.

The 2014 MBRRACE report discussed two women who died after the development of cerebral venous thrombosis and subdural haematomata respectively; neither had had adequate follow up [115]. These are well-recognised complications of dural puncture and pregnancy, respectively. Both should always be included in the differential diagnosis of persistent headache after dural tap or after post-dural puncture headache.

Untreated dural leak can be devastating. Tinnitus may become chronic. Blood patching can be performed as a late treatment. Occasionally, referral to chronic pain management consultants may be warranted.

Any woman who suffers a dural tap or post-dural puncture headache, whether caused by spinal or epidural needles, and whether a blood patch has been performed or not, must be notified to her GP and routine hospital follow-up arranged (postnatal review by a consultant obstetric anaesthetist). This is important in detecting long-term complications.

1. Give the woman the headache leaflet from the blue anaesthesia file in the office; also at LabourPains.com, under ‘Pain Relief in Labour’, title: Headache after an epidural or spinal injection - What you need to know.

2. You should document telephone numbers in the follow-up book too, and ensure that the need for telephone follow-up is handed over.

3. The telephone follow-up is conducted for three days or until the woman reports that her acute headache is resolving. Serious
complications can arise from PDPH and we offer treatment at the earliest opportunity.

4. Make sure that discharge summaries include that the patient has had accidental dural puncture – as we not do write these ourselves, you should write this in the purple postnatal notes as part of the postpartum plan.

5. Dr Reddy performs delayed telephone follow-up 4-6 weeks after the event and we record patient outcomes on a database. Send an email to Dr Reddy, copied to Dr Choksey and Dr Quasim, including the patient’s hospital number only (not the name nor any other details), procedure, date and telephone numbers for follow-up. It is essential that you put in the contact telephone numbers in this email.

6. Complete a clinical adverse event report for the headache.

**Treatment of post-dural puncture headache**

It is traditional to recommend that the patient remains supine in a quiet room, with high fluid intake with paracetamol and NSAIDs. This may help but only with symptoms. The headache is likely to resolve over the next few days or weeks (85% resolve spontaneously within six weeks) but during that time the patient will be incapacitated and risks the development of chronic complications such as subdural haematoma.

Many remedies such as DDAVP, ACTH, caffeine and sumatriptan have been used. All treatments (including epidural blood patch) suffer from lack of robust evidence [116]. Nevertheless, the high success rate and low incidence of complications have established epidural blood patch as the definitive treatment [117]. The use of a 20 mL volume gives the optimal balance between headache resolution and periprocedural back pain [118].

If epidural blood patch is impossible then the treatment used on neurosurgical wards for persistent dural leak could be employed. Place a pressure dressing on the back and lay the patient flat for 48 hours. She must be catheterised. Check and remove on the third day. Ensure that adequate thromboprophylaxis is used.
Post-dural puncture headache

Guidelines for blood patch

Epidural blood patch is used to manage a persistent, incapacitating dural puncture headache; this may occur either as a result of inadvertent dural puncture during insertion of an epidural or after a spinal anaesthetic. The mother must not be pyrexial (temperature > 38°C) or have clinical evidence of current infection, since to introduce infected blood into the epidural space could be disastrous. Do not undertake epidural blood patch in the presence of a space-occupying lesion, increased intracranial pressure or focal neurological lesions.

Blood patch should normally be performed only after the first 24 hours. Patching in the first 24 hours is associated with lower success rates and bacteraemia is often present. We do not support routine prophylactic blood patching as the evidence is conflicting, although this may be considered if the patient has an epidural catheter still in place, thus reducing the risks of the procedure, so long as care is taken never to inject blood into the subarachnoid space.

Always discuss the case with the responsible consultant.

The procedure must be carried out on the labour ward. Two anaesthetists are usually required, or you may enlist the help of another doctor who understands the procedure. A consultant anaesthetist should carry out the epidural component.

1. Explain the procedure carefully to the woman and obtain a written record of consent. The mother should be counselled as to the chances of success and the method of the technique: if a 20 mL volume is injected, the success rate is over 90%. Many patients feel significant immediate relief; most patients feel better within a couple of hours. Occasionally, a patient who is initially helped by a patch will develop a recurrent headache on the second or third day, which may require a second patch to be performed. Although serious complications are unusual, some patients will experience transient backache.

2. The first anaesthetist inserts an epidural needle in the normal manner, using standard equipment that would be needed for any
epidural. Small amounts of CSF may appear at the proximal end of the needle. The first anaesthetist then injects 20 mL of the patient’s blood (provided by the second anaesthetist) into the epidural space, over 30 to 60 seconds. Occasionally, patients complain of dull pain or warmth in the back or between the shoulder blades while the injection of blood is being performed. Often, by pausing for 30 seconds or slowing the rate of injection, you can inject the full amount.

3. The second anaesthetist is responsible for drawing blood from the patient. Full aseptic precautions should be taken. The following items are needed:
   • A large intravenous cannula (14 or 16 gauge).
   • A regional anaesthesia dressing pack, sterile gloves etc.
   • Skin preparation solution.
   • 2 mL and 20 mL syringes.
   • 25-gauge needle.
   • Lidocaine 1%, 5 mL.

4. The second anaesthetist inserts the cannula into a large vein in the arm and when the epidural needle is sited, hands over the 20 mL blood to the first anaesthetist. We do not recommend the sending of blood culture specimens.

5. Small dressings are placed over the puncture sites. The patient should stay on the labour ward for at least an hour, during which time she should stay on the bed; no special observations are needed. Repeated clinical assessment and contact is important. Lactulose should be prescribed for any constipation.

6. It is important that the patient is seen on the daily ward round during the next day if she remains in hospital.

7. Many women will go home after the blood patch as the headache was the only thing keeping them in hospital. If she goes home, reinforce the advice that she should contact labour ward immediately in the case of any complications. Take her telephone contact numbers in the ward round book and make sure that she is telephoned every day for three days to assess progress.
Post-dural puncture headache

Make full clinical records; complete a clinical adverse event form reporting the headache and its treatment. Make sure that follow-up has been arranged as on page 184, and repeat the notification for blood patches that have been undertaken.


120. Royal College of Obstetricians and Gynaecologists (2011) *Tocolysis Women in Preterm Labour*. (London: RCOG Clinical green top guideline number 1B)
Tocolytic drugs

See page 205 for uterine relaxation during caesarean section.
See page 200 for intrauterine fetal resuscitation.
You may be asked to use tocolytic drugs or to anaesthetise a patient who has had them administered. Indications include:

- Preterm labour.
- Intrauterine fetal resuscitation.
- External cephalic version.
- Uterine hypertonicity.
- Retained placenta.
- Uterine inversion.

The RCOG recommends atosiban or nifedipine [120] as comparably effective with relatively few side effects. Some consultant obstetricians use terbutaline or glyceryl trinitrate.

In our unit the commonest drug used for acute tocolysis is subcutaneous terbutaline, with a few cases where inhaled salbutamol is used during a caesarean section.

Atosiban
This is an oxytocin-receptor antagonist. Side-effects are rare; nausea, tachycardia and hypotension may occur.

Nifedipine
Nifedipine may be used by the obstetricians to treat premature contractions. The dose is 20 mg orally before conversion to a slow-release preparation.

It may cause profound hypotension secondary to vasodilatation. If you are asked to see a patient for this, make sure that intravenous access is patent and commence fluid resuscitation.
Tocolytic drugs

β₂-adrenergic agonists
The most common agents are terbutaline and salbutamol.

Terbutaline 250 mcg may be given subcutaneously. At this dose significant side effects are very rare.

Terbutaline or salbutamol boluses may be given intravenously with caution (100 mcg to 250 mcg).

Potential side effects are tremor, hypotension, tachycardia and pulmonary oedema. Hypokalaemia and hyperglycaemia may be seen with prolonged administration.

Anaesthetic management following the use of β₂-adrenergic agonists involves the careful avoidance of excessive fluid administration. Monitor the patient and observe closely. You should be careful if using ephedrine because of the risk of excessive tachycardia.

Glyceryl trinitrate
Glyceryl trinitrate will reliably give brief uterine relaxation, especially for procedures such as external cephalic version or retained placenta. With careful monitoring give intravenous boluses of 50 mcg or one dose of sublingual spray (most preparations are 400 mcg per dose).

Glyceryl trinitrate may cause severe hypotension and a throbbing headache. Rapid intravenous injection may also cause nausea and retching, and palpitations.

Magnesium
Magnesium has tocolytic effects although it is rarely used for this purpose.

Magnesium infusions are used in preterm labour (from 23 to less than 30 weeks) to reduce the risk of neonatal cerebral palsy [121], at the same dose as for severe pre-eclampsia. See page 282 for general information and warnings about magnesium.
Tocolytic drugs

120. Royal College of Obstetricians and Gynaecologists (2011) Tocolysis Women in Preterm Labour. (London: RCOG Clinical green top guideline number 1B)

Common obstetric problems

Malpresentations and malpositions
These problems recur time and time again. You should be aware when they happen on the labour ward. Many problems can be anticipated satisfactorily with:

- Vigilance.
- The timely establishment of a good regional block.
- Your presence on the labour ward during the second stage of labour for some problems.

Occipito-posterior presentation
This happens in about 10% of term pregnancies. There is slow progress with severe pain in the mother’s back – often resistant to epidural blockade. Manual or forceps rotation may be attempted in order to bring the fetal head into the occipito-anterior position.

You should ensure that a good epidural block is established and that the mother has received fentanyl either by recent bolus or by infusion. You may need to use a more concentrated local anaesthetic solution.

Sacral or pelvic pain is most effectively treated with bolus epidural doses in the left lateral position.

Breech presentation
This happens in about 4% of term pregnancies. Caesarean section is a common delivery option but some are delivered vaginally, and unexpected breech presentation can occur. You should, in cooperation with the mother and the midwife, ensure that a good epidural block is established.

The midwives will inform you when a mother is in the second stage of labour in vaginal breech delivery. You should be present on the labour ward.
External cephalic version

This is offered to mothers with uncomplicated breech presentation between 37 and 42 weeks. They will be prepared as for caesarean section and booked in the labour ward diary. You should be present on the labour ward during the version because an emergency caesarean section may be needed. This is rare, about 0.9%.

Some obstetricians may ask you to administer intravenous tocolytic drugs (see page 189). This is very rare. Monitor the patient carefully, especially pulse rate and blood pressure.

There is no indication for regional anaesthesia for ECV.

Multiple pregnancy

Vaginal delivery may be offered if the first twin is in a cephalic presentation.

You should become aware of all labouring mothers with multiple pregnancy (and be prepared to recommend epidural analgesia). You should be present on the labour ward during the second stage of labour in cases of multiple pregnancy. Although the need for caesarean section for the second twin is rare, there are a number of complications that could arise for which you may be needed immediately, including postpartum haemorrhage. You should also ensure that the epidural block is adequate for the manipulations that may be needed to extract the second fetus.

You should take special care to avoid supine hypotension as this is more common with multiple pregnancies.
General considerations for caesarean section

Choice of technique

The preferred technique where not contraindicated is spinal anaesthesia (or epidural extension where appropriate), including for category 1 caesarean sections if appropriate. General anaesthesia is associated with more bleeding [122] and postoperative analgesia that does not reach the same high standard.

There are a number of obstetric conditions which indicate general anaesthesia, most of which are discussed further in relevant sections of this handbook, including for example:

- Actual or anticipated massive haemorrhage.
- Fibroid uterus.
- Placenta praevia in some cases (see page 264).
- Other conditions of morbid placental adherence e.g. placenta accreta, increta or percreta.
- Inverted uterus (see page 77).
- Ruptured uterus (see page 78).
- Some cases of severe pre-eclampsia – (see page 288).
- Transverse lie with oligohydramnios.
- Profound fetal bradycardia or acidosis is a relative indication – see below.

Always consult with the operating obstetrician to formulate a plan and seek senior help early if you are in any doubt.

Techniques for urgent caesarean sections

This gives a brief summary of important advice; the details of techniques are listed in other chapters.
Emergency de-novo spinal

The normal intrathecal opioid is 400 mcg diamorphine, same as in elective cases. (300 mcg in patients with booking weight under 50 kg.)

In the Category 1 CS, be aware that diluting and drawing up diamorphine takes a little longer than drawing up fentanyl. Communicate to the ODP on entering theatre if you intend to use fentanyl (the recommended intrathecal dose is 25 mcg) rather than diamorphine.

Emergency epidural top-up

Use an appropriate dose of ‘Quickmix’ including fentanyl not diamorphine (see page 241 for details). The fentanyl is important for enhancing the quality of the intraoperative epidural anaesthesia.

We recommend 3 mg diamorphine (2.5 mg if booking weight < 50 kg) injected down the epidural catheter at the end of operation, followed by removal of the epidural catheter.

Failed emergency epidural top-up, followed by spinal

This will be a rare occurrence: most will be converted to GA after failed full-dose epidural top-up. If the top-up with ‘Quickmix’/Fentanyl has completely failed, you can consider performing a reduced dose spinal with 400 mcg diamorphine (see page 250 for recommended doses of heavy 0.5% bupivacaine).

De novo general anaesthesia

There is no place for diamorphine in these cases. Use intraoperative intravenous morphine as the opioid of choice, together with either TAP block or surgical site infiltration of up to 40 mL levobupivacaine 3.75 mg mL⁻¹ in total.

Conversion to GA after neuraxial technique

Spinal to GA:

If fentanyl has been used as an intrathecal opioid, use only intravenous morphine intraoperatively; there is no place for diamorphine.
General considerations for caesarean section

If diamorphine has been used in the spinal, the dose of intravenous morphine to use intraoperatively (if at all) depends on what type of block was achieved. Exercise extreme caution if giving intravenous morphine after intrathecal diamorphine.

Epidural top-up to GA:

If top-up fails with ‘Quickmix’/Fentanyl, it is reasonable to give intraoperative morphine 10-20 mg, depending on the extent of the failure.

If intravenous morphine has been given, you should not give epidural diamorphine at the end of the procedure without taking senior advice. Exercise extreme caution if giving epidural diamorphine after intravenous morphine.

Time standards

The obstetrician is responsible for diagnosing the indications for caesarean section and for ensuring that all staff concerned know the indication and any implications for the urgency of surgery. This communication is vital for the achievement of the time standards. Furthermore, we should undertake regular audit of our performance against the locally agreed standards. This is considered to be a communications audit.

The Royal College of Anaesthetists, the Royal College of Obstetricians and Gynaecologists, the Obstetric Anaesthetists Association and the CEMACH have all adopted a physiologically based classification for research and reporting purposes [123,124].
Classification relating the degree of urgency to the presence or absence of maternal or fetal compromise

<table>
<thead>
<tr>
<th>Risk</th>
<th>Urgency</th>
<th>Definition</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>➣</td>
<td>Maternal or fetal compromise</td>
<td>Immediate threat to life of woman or fetus</td>
<td>1</td>
</tr>
<tr>
<td>➤</td>
<td>No maternal or fetal compromise</td>
<td>No immediate threat to life of woman or fetus</td>
<td>2</td>
</tr>
<tr>
<td>➤</td>
<td>Requires early delivery</td>
<td>Requires early delivery</td>
<td>3</td>
</tr>
<tr>
<td>➣</td>
<td>At a time to suit the woman and maternity services</td>
<td>At a time to suit the woman and maternity services</td>
<td>4</td>
</tr>
</tbody>
</table>

Controversy remains over the contribution of time standards to neonatal outcome and there is little evidence of a thirty-minute critical threshold in intrapartum hypoxia [125,126].

**Labour ward guideline on urgent caesarean section**

The obstetrician is responsible for diagnosing the indications for caesarean section and for ensuring that all staff members concerned know the indication and any implications for the urgency of surgery. This communication is vital for the achievement of the time standards. All urgent caesarean sections should be conducted rapidly but without haste. From time to time audits are done against a standard of 30 minutes from decision to delivery in category 1, and 75 minutes in category 2.
When a category 1 or category 2 caesarean section is called it must go out over the emergency bleep system.

Urgent caesarean sections warrant the opening of the second theatre to achieve delivery within the time standards, if staff can be mobilised. Urgent caesarean sections scheduled while an operative case is proceeding may be able to wait until the theatre and theatre staff team members become available.

You must endeavour to maintain appropriate time standards and in order to do so:

- The obstetrician who requests anaesthesia for caesarean section must determine the urgency at the time of decision, and ensure that this is promptly communicated to the obstetric anaesthetist.
- The patient must be promptly presented to the operating theatre, within five minutes for delivery inside twenty minutes, and within ten minutes for delivery inside thirty minutes.
- The obstetrician should accompany the mother to keep her condition and that of the fetus under continual review. It may be that the categorisation will change, or the recommended form of anaesthesia changes from GA to spinal or vice versa.
- Preparatory actions for caesarean section should be undertaken in theatre prior to induction of general anaesthesia or awaiting onset of spinal anaesthesia.

You should remember that your prime duty is to the mother and it is not appropriate to take untoward and excessive risks with her life in an attempt to prevent harm to the fetus. The times listed above are not thresholds or deadlines; they are audit criteria [127]. There can be risks when haste and rush occur, and in particular very rapid delivery is associated with poor maternal and fetal outcome [128]. (In a study of 18,000 deliveries, the composite outcome was that delivery within 30 minutes conferred no significant benefit for the fetus and maternal outcomes were worse.)

Regional anaesthesia (spinal or epidural extension, where not contraindicated), is the anaesthesia method of choice for urgent
caesarean sections. However, audit figures show that we cannot normally expect to deliver a woman for a category 1 caesarean section using regional anaesthesia. Where the obstetrician determines that immediate delivery is required and the mother gives consent then we recommend general anaesthesia.

General anaesthesia is also indicated for the following.

- Severe maternal anxiety.
- Difficulty with the regional technique leading to serious delay and imperilling achievement of appropriate care. Have someone watch the clock for you.
- Serious delay in presenting the patient to you for anaesthesia.

Close liaison with the obstetrician is imperative. Retain your sense of situation awareness and be prepared to call for help or change your plan if your first plan does not work. You may need, for example, to change the plan to general anaesthesia if you cannot establish regional anaesthesia in a sufficiently short time.

CTG monitoring should be continued during establishment of neuraxial anaesthesia; for spinal anaesthesia the midwife will need to hold the cardiac ultrasound probe by hand.

**Identity and safety checks**

The patient must be transferred rapidly to theatre for an urgent or emergency caesarean section. Maintaining safety is essential. We use the WHO / NPSA surgical safety checklist modified for maternity cases. You must make sure that the surgical safety checklist has been completed for every case in maternity theatres without exception.

**Managing intrapartum fetal hypoxia**

While the obstetrician may determine that delivery should take place as soon as possible in cases of fetal distress, the traditional calling of a caesarean section may not take developments in intrauterine fetal resuscitation into account. Where intrapartum fetal hypoxia is diagnosed and operative delivery indicated, fetal resuscitation should be
Intrauterine fetal resuscitation

The purpose of this bundle of therapies is to reverse fetal acidosis due to hypoxia. The acronym SPOILT can be used [129].

- **S**yntocinon off; stop antepartum infusion.
- **P**osition full left lateral.
- **O**xygen for the woman.
- **I**ntravenous fluids: consider increasing the rate of administration of intravenous fluids (not in pre-eclampsia).
- **L**ow blood pressure: treat any systemic hypotension with a systemic vasopressor such as ephedrine. Boxes of ephedrine (30 mg in 10 mL syringe) should be in every labour room.

**T**ocolysis: administer subcutaneous terbutaline 250 mcg. Administration of oxygen remains a subject for debate in emergency caesarean section. It probably causes no harm but clear evidence of benefit is lacking [130,131].
General considerations for caesarean section

Attempting to maintain increased inspired $F_iO_2$ during theatre transfer can be seriously distracting.

There is some evidence that terbutaline reduces fetal morbidity and mortality and does not cause a significant increase in the risk of postpartum haemorrhage.

**ERAS (enhanced recovery after surgery)**

The core ethos of enhanced recovery is to speed up a patient’s recovery after surgery and improve patient outcomes, with associated benefits for staff and healthcare systems.

Enhanced recovery pathways are underpinned by four principles [132]:

- To enhance their recovery, all patients should be on a pathway that minimises physical and psychological stress responses.
- Preoperative preparation should ensure that the patient is in the best possible condition before surgery and that rehabilitation is ideally commenced before admission.
- Proactive patient management components of enhanced recovery are embedded across the entire pathway.
- Before, during and after the operation or treatment, patients have an active role and take responsibility for enhancing their recovery.

We have now adopted these principles as a programme for planned caesarean sections, aiming for a standard discharge time of the late afternoon on the first postoperative day: the women spend only one night in hospital as a standard. We continue to use components of the programme as may be possible for the benefits that they bring for patients undergoing urgent caesarean section [133]. However, the demands of labour and the certainty of changing plans mean that women who labour but then deliver by caesarean section will usually need to spend longer in hospital postpartum.

Over the years we introduced each of the following components that are directly under the control of anaesthetists. They have now been wrapped in information and education for patients so that they expect to go home after one night in hospital if possible. Your role is to make sure that this
General considerations for caesarean section

programme continues to offer its benefits to individual women, allowing them to have this expectation, and to apply these components where possible for women undergoing urgent caesarean section.

Before delivery

• Provision of information about perioperative experience.
• Haemoglobin optimisation.
• Start breastfeeding teaching.
• Antenatal education about postoperative analgesia and thromboprophylaxis.

At delivery

• Minimise starvation times, use carbohydrate drinks and do not withhold water.
• Dedicated elective caesarean section lists.
• Underbody heating mattress.
• Anaesthetic to include intrathecal or epidural opioids.
• Prophylactic antibiotics before incision.
• Skin to skin contact for mother and baby commenced in theatre, with breastfeeding if possible.

After delivery

• Venous thromboembolism prophylaxis prescribed by anaesthetist.
• Prophylactic antiemesis.
• Regular prophylactic analgesia including NSAIDs with minimal discretionary components.
• Early re-establishment of eating and drinking enabling removal of intravenous cannula.
• Early removal of urinary catheter to facilitate mobilisation.
• Support to establish breastfeeding.
• Good community support.

**Handover of care to another anaesthetist**

You are permitted to hand over care to another anaesthetist at the end of your shift so long as the patient is stable and the other anaesthetist is fully ready to devote themselves to the theatre case. You must conduct a full professional handover of care and document the handover as necessary on the anaesthesia chart.

**Human immunodeficiency virus (HIV)**

HIV+ women are in general managed as for any obstetric patient (they may be taking polypharmacy), unless they have acute infection in which case organ-specific supportive management by relevant consultants is mandatory.

There is no specific contraindication to central neuraxial analgesia or anaesthesia.

HIV+ women are occasionally booked for elective caesarean section. To reduce the risk of vertical transmission, they may be given a preoperative zidovudine infusion that should run for about three hours prior to operative delivery, and not too much longer. You must make sure that the infusion times are coordinated with the operation time.

See page 297 for further details.

**Chaperones**

A midwife will be assigned to accompany the patient to theatre. This is a very important function, enhancing patient safety and reducing maternal anxiety. You should ensure that the chaperoning midwife is not distracted from this function, for example by being asked to be a theatre runner.

**Presence of birth partner in theatre**

For planned surgery we encourage the birth partner to be with the woman from entry to theatre: do not wait until after the block has been inserted.
General considerations for caesarean section

For urgent cases you should use your discretion as to what is appropriate while remembering to accommodate a woman’s expressed wishes.

For general anaesthesia, if the partner is present in theatre you should ask them to leave just before starting pre-oxygenation.

Antibiotics

All patients undergoing caesarean section should have a single dose of antibiotic prophylaxis against wound infection, administered by you before skin incision. The unit guideline currently recommends co-amoxiclav [134], balancing the risk of fetal necrotising enterocolitis against wound infection. This area remains under consideration and any change in unit policy will be publicised.

Give one dose of co-amoxiclav 1.2 g (dilute this in a 10 mL syringe to avoid confusion with thiopental); if the patient is sensitive to penicillin, use single doses of clindamycin 900 mg (diluted to 50 mL with saline and infused over thirty minutes) and gentamicin 120 mg. Separate anaerobic cover is not needed unless specifically indicated in an individual case; if so, administer intravenous metronidazole 500 mg.

Uterine displacement

Women undergoing caesarean section should be managed with aortocaval decompression through tilting the operating table 15 degrees to the left [135]. This is crucial to the objectives of maintaining maternal cardiac output and uteroplacental perfusion. In practice achieving a full 15 degrees is difficult when tilting the table as opposed to using a pelvic wedge, without making the woman feel that she is about to fall, and each woman has a different response to tilt. She may feel much more comfortable and secure if asked to place her left hand on the back of her partner’s chair alongside. If you are in doubt as the effectiveness of the decompression, ask the midwife to check the fetal heart rate.

You should remove the tilt after delivery and after warning the surgeon.
**Uterine relaxation**

The surgeons may anticipate difficulty with operative delivery, which can be reduced by uterine relaxation.

- Prematurity.
- Breech in labour.
- Transverse lie with ruptured membranes.
- Oligohydramnios.

You can help to relax the uterus for delivery by administering:

- The drug of choice is subcutaneous terbutaline 250 mcg. Terbutaline may be given intravenously with caution. Dilute one 500 mcg ampoule to 10 mL and give 2 mL or 100 mcg.
- GTN sublingual spray 400 mcg, repeated once if needed.
- Salbutamol inhalation or sublingual spray 200 mcg.
- Additional volatile anaesthetic (if the patient is under general anaesthetic).

These should be given well before uterine incision if possible.

Administer a postpartum Syntocinon infusion after use of uterine relaxants.

**Bleeding at caesarean section**

**Check the blood loss**

The median blood loss at caesarean section is about 500 mL. Sometimes it can rapidly transform into massive haemorrhage.

> **Check blood loss at delivery immediately after giving Syntocinon, and frequently thereafter.**

Look into the wound from the surgical end of the table. Ask the scrub midwife how much liquor there was, and estimate the contents of the cell salvage reservoir. Check the swabs and ask for them to be weighed if there is significant blood on them.
Prevention of postpartum haemorrhage

In all cases of operative delivery in which you are involved you should, after checking with the obstetrician, administer 5 units of Syntocinon intravenously following severance of the umbilical cord, unless contraindicated. Beware of the expected reduction in systemic vascular resistance. Do not use ergometrine or Syntometrine unless otherwise indicated. You should draw up Syntocinon 10 units in 1 mL diluted to 10 mL with saline 0.9%. The dose is then 5 mL, and may be repeated a few minutes later on request.

Following the first bolus dose, you should set up and administer a Syntocinon infusion (of 20 units made up to 50 mL with saline 0.9%) by infusion pump, starting at 15 mL h⁻¹. This may be increased to 20 mL h⁻¹ or 25 mL h⁻¹ if the uterine tone is too lax. This is prescribed on the intravenous fluid chart.

Always check uterine tone with the operating obstetrician. Repeat the Syntocinon dose after five minutes if the tone is not acceptable. Remember that a bolus dose of Syntocinon will have a rapid, dramatic and short-lived effect in reducing vasomotor tone.

The infusion usually runs for about two hours postoperatively.

If the surgeon reports that the uterus is contracted and there is no significant haemorrhage, reduce the infusion rate to 10 mL h⁻¹ before transfer to recovery. This will speed the mother’s passage back to the postnatal ward.

See page 58 for ‘Pharmacological treatment of uterine atony’.

Treatment of major obstetric haemorrhage

This is defined as blood loss in excess of 1000 mL without being massive haemorrhage. Some haemorrhages of slightly over 1500 mL can be treated like this if the bleeding has completely stopped and there are no complications.

- Treat blood loss as appropriate.
- Inform the senior midwife on duty.
General considerations for caesarean section

- Retain the patient on labour ward for about six hours (as opposed to two to three hours for normal postoperative recovery). She will need a room rather than remaining in the recovery area.
- Put the urinary catheter onto hourly monitoring. You will need to ask for the drainage bag to be changed for an urimeter.
- Check the uterotonics.
- Use bedside haemoglobin testing (Hemacue, or blood gas machine with venous or arterial sample). You should interpret this intelligently in view of the preoperative haemoglobin level, potential haemodilution and consider blood transfusion.

Perioperative and postoperative fluids

The patient will usually have received about a few hundred mL Hartmann’s solution post load with the vasopressor infusion. Further fluids are most critically dependent on blood loss.

You should check the blood loss at surgery by going to the surgical end of the table immediately after delivery and administration of Syntocinon and other drugs. Check the salvage suction canisters and swabs, and look into the wound. Discuss and agree a provisional estimate with the midwife and ODP.

Blood loss above about 500 mL should be matched with an equal volume of Hartmann’s solution. As it rises towards and above 1000 mL you may need to consider use of blood components.

At the present time we recommend crystalloid fluids for any resuscitation in preference to colloids. About one woman in ten loses enough blood that salvaged blood can be processed, and if processed you should usually reinfuse it. It is rare to transfuse donor blood at caesarean section and usually only in the context of massive obstetric haemorrhage.

Blood losses should be corrected before the end of the operation.

Postoperative fluids should only be prescribed for ongoing losses or continuing inability to take oral fluids, for example in severe pre-eclampsia or after prolonged surgery such as hysterectomy, where the mother is to be admitted to the high dependency unit. Mothers should be
General considerations for caesarean section

encouraged to eat and drink in recovery as a rule and should not need postoperative intravenous fluids; take down the intravenous fluids before the mother leaves theatre. This is an important element in enhanced recovery.

If fluids are indicated when the patient is nil by mouth, we suggest Hartmann’s solution at 80 mL h⁻¹ or 1000 mL in 12 hours.

Postoperative analgesia and antiemesis

We use combination therapy, by different routes and using different types of drug, to control postoperative pain, nausea and vomiting. The Anaesthesia Department has a clinical guideline for PONV prophylaxis that is aimed principally at general anaesthesia. We have decided to keep with the guideline below for maternity patients because the alternative drug, cyclizine, is associated with sedation and dizziness, tachycardia and dysphoria – most maternity patients are conscious when the drugs are administered. Dexamethasone has been associated with perineal burning sensations.

Intraoperative antiemesis

You should administer a single dose of ondansetron 8 mg intravenously to all patients after the umbilical cord has been cut. This dose may be repeated once if nausea and vomiting develop. This will also reduce the severity of postoperative pruritus and the need for treatment [136].

Analgesia

Give intravenous morphine during caesarean sections under general anaesthesia. (If the caesarean is being undertaken after a neuraxial procedure inadequate for surgical anaesthesia but adequate for postoperative analgesia, then use a reduce dose or omit morphine altogether.)

There is strong evidence that NSAIDs reduce opioid requirement after caesarean section [137]. A combination of regular paracetamol and diclofenac is more effective still [138].
We use diclofenac in suppository form because it provides a strong analgesic boost to assist with mobilisation. This is important in the prevention of thromboembolic disease.

Women who have had operative procedures and are prescribed rectal diclofenac should have it given in theatre. This is usually done when the birth canal is checked at the end of the case. The administering person should sign for it at that time but they will usually still be scrubbed; be vigilant for it having been done and annotate the drug chart accordingly. The anaesthetic cupboard in theatre will contain stock of diclofenac suppositories. Part of anaesthetic handover in the recovery room should include what drugs should be administered and in most cases, this will be only paracetamol, and then enoxaparin 4 hours later.

Oral diclofenac is no longer in use in our hospital and so generally you should prescribe two rectal doses followed by oral ibuprofen as below.

If diclofenac is not being given for any reason, or its administration is being delayed, this should be discussed at ‘sign out’ and documented in the relevant notes (usually the purple postnatal notes). Prescribe a suitable alternative drug: dihydrocodeine 30 mg qds.

Patients who have asthma should be asked if they have taken NSAIDs in the past. Diclofenac is contraindicated if the patient relates a history of intolerance to NSAIDs. (Paracetamol will usually be safe.)

Diclofenac should not be administered in rectal or oral form to patients who are recovering from severe pre-eclampsia until at least 24 hours after delivery. These patients will often be receiving an epidural infusion or intravenous opioids. NSAIDs should also not be used in patients who are hypovolaemic or have raised plasma creatinine.

We avoid intramuscular analgesia unless essential, for example after general anaesthesia without neuraxial diamorphine. Regular oral treatment with morphine and paracetamol, augmented with rectal diclofenac, is the main treatment. If rescue analgesia is needed, indicated by a high demand for oral morphine or pain that cannot be controlled otherwise, then you should see the patient and treat appropriately, usually with intravenous morphine in adequate doses.
General considerations for caesarean section

While mothers and their babies should always be monitored for the effects of drugs administered to the mother, breastfeeding is safe on this postoperative regime with morphine, paracetamol, diclofenac, ibuprofen and (if NSAIDs are contraindicated for other reasons) dihydrocodeine [139,140].

Codeine is now contraindicated in breastfeeding as it has been implicated in a small number of neonatal respiratory arrests and has been eliminated from our guideline [141].

You must determine a reasonable estimate of the patient’s booking mass – it will usually be recorded on the growth chart in the hand-held antenatal notes – and base the drug doses on this weight appropriately. Record the booking mass on the drug chart.

Guideline for analgesia and other drugs

This guideline is more complex than a simple ‘as needed’ set of drugs. It is deliberately designed to support better prescription and administration practices on the postnatal wards, and address some of the problems that have been shown in clinical audits while retaining the excellent record on postnatal analgesia.

Always ensure prescribing is adjusted according to whether you have used neuraxial fentanyl or diamorphine. This must be communicated in handover to the midwife in recovery.

In theatre

- Intravenous metoclopramide 10 mg.
- For intrathecal diamorphine see ‘Technique for spinal anaesthesia’ on page 232.
- Antibiotics (see page 204).

After delivery

- Uterotonics (see page 206).
- Intravenous ondansetron 8 mg.
General considerations for caesarean section

- General anaesthesia only: intravenous morphine 15 mg; consider 20 mg if very large and reduce the dose only in the very small mother.
- General anaesthesia only: surgical site infiltration of up to 40 mL levobupivacaine 3.75 mg mL\(^{-1}\).

Prescriptions for drugs

On the front of the drug chart (single doses)

- Oral paracetamol loading dose.
  Booking weight ≥ 70 kg: 2 g oral paracetamol.
  Booking weight 50-70 kg: 1.5 g oral paracetamol.
  Booking weight < 50 kg: 1 g oral paracetamol.
- Rectal diclofenac 100 mg if not contraindicated and a second dose of 100 mg at the following times, to give at least 12 hours between doses.
  In recovery after 10:00: second dose at 08:00 on the first postoperative day.
  In recovery after 20:00: second dose at 14:00 on the first postoperative day.
  In recovery after 00:00: second dose at 18:00 same day.
  In recovery after 06:00: second dose at 22:00 same day.
- If neuraxial diamorphine not used: 15 mg intramuscular morphine.
- Enoxaparin (see page 123).

Inside the drug chart (regular doses)

- Enoxaparin (see page 123) remembering to discuss the length of the course with the surgeon at ‘sign out’.
- Oral paracetamol 1 g four times a day starting at least six hours after loading. Block out all oral doses before this one. Reduce the dose appropriately if the woman has a low booking weight below 50 kg.
**General considerations for caesarean section**

- Oral ibuprofen 400 mg four times a day starting at the following times, to give at least 12 hours after the last rectal dose of diclofenac.
  
  In recovery after 10:00: first oral dose at 22:00 on the first postoperative day.
  
  In recovery after 20:00: first oral dose at 08:00 on the second postoperative day.
  
  In recovery after 00:00: first oral dose at 08:00 on the first postoperative day.
  
  In recovery after 06:00: first oral dose at 14:00 on the first postoperative day.
  
  The postnatal midwives need to know when to convert from rectal to oral dosing. Block out all oral doses before the next prescribed dose.

- Oral ferrous sulfate 200 mg bd for 28 days if indicated (see below).

**On the back of the drug chart (doses as needed)**

- Oral morphine on patient request as below. Do not specify a minimum time before oral morphine can be given.

  Booking weight ≤ 50 kg: 10 mg hourly to a maximum of five doses in each 12 hours. Consider 20 mg dose if not able to take NSAIDs.

  Patient > 50 kg: 20 mg hourly to a maximum of five doses in each 12 hours.

- Buccal prochlorperazine 6 mg twice a day as needed for nausea and vomiting.

- Oral chlorphenamine 4 mg four times a day as required for itching.

**On the fluid chart**

- Hartmann’s solution administered in theatre – record the amount actually given rather than just ‘1000 mL’, as very few patients will need a full bag and even fewer will need postoperative intravenous fluids.

- Saline containing the Syntocinon for continuing postoperative infusion.
Iron treatment for postoperative anaemia

Take a proactive approach to making sure that patients who need oral iron treatment are prescribed it to aid recovery. The standard prescription is oral ferrous sulfate 200 mg bd for 28 days. The approach below may need to be altered in circumstances such as very small maternal booking weight.

1. If the patient has **clinical signs or symptoms of significant anaemia** then postoperative instructions should include checking FBC at 06:00 on the first postoperative day and acting on the result.

2. If the estimated blood loss agreed at ‘sign out’ **EBL ≥ 1000 mL** then postoperative instructions should include checking FBC at 06:00 on the first postoperative day and acting on the result.

3. Check the preoperative haemoglobin level.
   a. If preoperative **haemoglobin > 120 g L⁻¹**, and **EBL 0-500 mL**, and the patient is asymptomatic, then no postoperative FBC and no oral iron is indicated.
   
   b. If preoperative **haemoglobin > 120 g L⁻¹**, and **EBL 500-1000 mL**, and the patient is asymptomatic, then no postoperative FBC is indicated. Prescribe iron for 28 days. The obstetrician will arrange GP follow up for anaemia.
   
   c. If preoperative **haemoglobin was 95-120 g L⁻¹**, and **EBL 0-1000 mL**, and the patient is asymptomatic, then no postoperative FBC is indicated. Prescribe iron for 28 days. The obstetrician will arrange GP follow up for anaemia.
   
   d. If preoperative **haemoglobin < 95 g L⁻¹**, then postoperative instructions should include checking FBC at 06:00 on the first postoperative day and acting on the result. The obstetrician will arrange GP follow up for anaemia.
General considerations for caesarean section

Flowchart for these decisions

- **Clinical anaemia**
  - Check FBC 06:00; act on result

- **EBL ≥ 1000 mL**
  - Check FBC 06:00; act on result

- **Hb > 120 g L⁻¹**
  - EBL 0-500 mL
    - If asymptomatic, no FBC postop
      - Do not prescribe iron TTO
  - EBL 501-1000 mL
    - If asymptomatic, no FBC postop
      - Prescribe iron TTO 28 days
      - Follow up for anaemia with GP
  - EBL 0-1000 mL
    - Hb 95-120 g L⁻¹
      - Check FBC 06:00; act on result
      - Prescribe iron TTO 28 days
      - Follow up for anaemia with GP

- **Hb < 95 g L⁻¹**
  - Check FBC 06:00; act on result
  - Prescribe iron TTO 28 days
  - Follow up for anaemia with GP

Patents admitted to the obstetric high dependency unit

These patients may be ‘nil by mouth’ in the early postoperative period and diclofenac may be contraindicated. Most of the analgesic regime cannot be given. Use a morphine infusion of 60 mg made up to 60 mL with saline and titrate against pain. Be careful not to give too much morphine; for example, the infusion rate should be reduced during sleep.

Intravenous paracetamol is indicated where nil by mouth and no hepatic involvement in pre-eclampsia.

Postoperative care

Handover to the recovery staff

There will be a midwife and a theatre recovery practitioner caring for the patient in postoperative recovery; make sure your handover is to both of
General considerations for caesarean section

them. Except in the case of urgent clinical need or emergency, you should not leave a patient without handing over to the recovery staff.

Your handover to the recovery staff for postoperative care should include at least the following points.

2. Details of anaesthesia procedure including drugs administered.
3. Block times for Bromage score monitoring.
4. Transfer to high dependency care if indicated.
5. Postoperative prescriptions for indicated drugs:
   - Analgesia and anti-emetics.
   - Fluids and blood.
   - Syntocinon infusion.
   - Heparin thromboprophylaxis.
   - Supplemental oxygen after general anaesthesia.

Make sure that she knows which drugs are to be administered and when, including whether the woman has received intrathecal fentanyl or diamorphine. It is particularly important to be clear in the prescriptions for the drugs usually given later on the postnatal ward.

- First enoxaparin dose. You should prescribe thromboprophylaxis for all patients (see page 123) and tell the midwife when the first dose is due.
- Second diclofenac suppository, and confirm that the first dose has been administered and signed for.
- First regular oral NSAID – block out doses before this.
- Next paracetamol dose – block out doses before this.
- Timing and length of treatment for prophylactic enoxaparin.

Common problems on clinical adverse event reports

The following come up regularly as reported incidents relating to post-operative prescriptions.
General considerations for caesarean section

- Drug prescribing errors leading to administration errors or non-administration due to unanswered concerns.
- Doses not blocked out on the drug chart, if your intention is to omit that dose.
- Departure from clinical guidelines. Please stick to prescribing guidelines and timings unless the patient’s clinical situation dictates otherwise, in which case clearly record the reason for deviation.
- Communication between staff and incomplete documentation of handover.

Analgesia in recovery

It is our standard of care that all patients receive excellent postoperative analgesia.

To this end all patients receive intravenous morphine if they have severe pain in recovery and do not leave until successful analgesia is achieved. See additional measures on page 257.

Postoperative follow-up

The patient will be followed up by the duty obstetric anaesthetist the next day (in the case of epidural and general anaesthesia) and for up to two days (in the case of spinal anaesthesia; many women will go home before the second postoperative day). If problems develop the patient may need to be seen for longer or more frequently, or a referral made to a consultant anaesthetist.


124. Royal College of Obstetricians and Gynaecologists and the Royal College of Anaesthetists. *Classification of urgency of caesarean section – a continuum of risk.* Good Practice number 11, April 2010


132. NHS Enhanced Recovery Partnership (2012) *Fulfilling the potential: A better journey for patients and a better deal for the NHS.* (NHS Improvement; Leicester)


General considerations for caesarean section


Intraoperative cell salvage in obstetrics

This has now become a standard technique in our maternity theatres. It is set up as a matter of routine; the maternity theatres are used as a training resource for the main theatres in this regard. Two thirds of the usage at our hospital is in maternity, with most of the remainder being in cardiac theatres. Cell salvage can reduce the need for allogeneic transfusion and postoperative anaemia after caesarean section [142].

Intraoperative cell salvage (IOCS) in obstetrics is a process of apheresis; it returns only concentrated red blood cells to the mother, and plasma proteins and platelets are not recovered in significant amounts. This can lead to dilutional coagulopathy in cases of massive obstetric haemorrhage. She may still need isotonic crystalloids and coagulation products (FFP, cryoprecipitate and platelets) as indicated.

Salvaged red cells will normally be ready for reinfusion at the end of a normal caesarean section, and can be continued through into the recovery room. The unit must not be kept for more than four hours after preparation. Larger volumes lost can be processed more quickly. Our experience has shown that active massive haemorrhage can readily be managed with volume replacement and IOCS without donor red cell transfusion.

IOCS is indicated for all caesarean sections and laparotomies. Our normal standard is that if blood is processed and red blood cells salvaged, then they should be reinfused. A little under 10% of mothers having caesarean section will have salvaged red cells reinfused, with donor blood transfusion rates in the 2-3% range.

Some patients who, for moral, religious or other reasons, are unwilling to receive allogeneic blood, may be willing or eager to have their blood collected for IOCS. They will sometimes express a higher threshold for receiving autologous reinfused blood and so you should not assume an automatic reinfusion in such cases. All such decisions should be documented.
Contraindications

- Sickle cell disease - this is an absolute contraindication.
- Sickle cell trait – if IOCS is otherwise indicated and requested in a patient diagnosed as having sickle cell trait the opinion of a consultant haematologist must be sought. Check the patient record first; all mothers have a haemoglobinopathy screening at booking, which is listed on the record as an HBE panel. The percentage level of HbS is listed here. The typical woman with sickle trait has an HbS level of about 30-35%. It is likely that IOCS will not be suitable in the presence of HbS, though there are some case reports of use in high-risk cases [143]. Some sickle cell trait women are so labelled although they have no HbS. All such cases must be discussed with a consultant haematologist. We have reinfused salvaged red cells where the patient has bled heavily and the alternative is donor transfusion.
- Malignant disease in the operative site. This is thought to be safe but must be a joint decision by the surgeon, anaesthetist and patient.
- Faecal contamination or other infected material at the operative site. This does not include meconium.
- Topical procoagulant agents, alcohol or iodine solutions in the operative site.

Controversies

Two issues in particular have been discussed with regard to IOCS in caesarean section, both related to the presence of amniotic fluid in the operative field. While there is no definitive answer to either, our technique is regarded as responsible [144]. Amniotic fluid transfer occurs in all deliveries and the risk is not increased by IOCS.

One sucker or two?

Some techniques involve the use of two surgical suckers, before and after delivery, with the suction fluid that may be heavily contaminated with
amniotic fluid being discarded. **We use one sucker**; the advantage is that the blood lost in the early part of the operation is not lost with the discarding of that which contains a greater concentration of amniotic fluid. Amniotic fluid and its components are removed effectively at spinning and washing. Direct suction gives the best quality of salvaged red cells, but swabs with significant blood on them should be washed and the fluid aspirated into the salvage sucker.

**Use of leucocyte depletion filter**

The IOCS process reduces amniotic fluid component contamination of the reinfused blood to insignificant levels. The Pall RS leucocyte depletion filter provides second line risk minimisation and can be used. However, it provides a significant resistance to reinfusion and can delay reinfusion to the extent that salvaged blood has to be discarded. Further, there have been a small number of reported cases where refractory hypotension has been closely associated with the use of a leucocyte depletion filter [145], initially concentrated in urology but also in obstetric cases. Stopping reinfusion usually produced rapid resolution of the hypotension but potent vasoconstrictor use has been necessary. **We recommend against the routine use of a leucocyte depletion filter.**

**Consent**

This should be explained as a safe and reliable process in which we have gained much experience. We are doing it to make the best use of the patient’s own blood, reduce the potential need for her to have a transfusion and save scarce resources in our blood bank. A signed and witnessed record of consent is not required for donor blood transfusion or for transfusion of salvaged cells.

- If the mother does not bleed very much or we have a process failure, we may not return salvaged cells to her; in the case of process failure we may need to offer donor blood transfusion though this is rare.
Intraoperative cell salvage in obstetrics

- Mothers who have Rhesus-negative blood group may need a slightly larger dose of anti-D immunoglobulin than they would otherwise receive.
- If some amniotic fluid is accidentally returned to the mother, then she would have a severe reaction similar to that when receiving mismatched blood.

Some Jehovah’s Witnesses and other people who refuse donor blood transfusion may be content to receive cell salvage. Explain the process to them and check. The cell saver can be set up in closed circuit for such indications if requested. This means that the whole circuit is run through with saline; the reinfusion bag is connected to the intravenous cannula before starting the salvage aspiration, thereby establishing a potentially continuous circuit between the blood in the surgical field and the recipient vein. We cannot warrant religious acceptability of this technique. Some will be content with open circuit.

Where consent for receipt of allogeneic blood products is absent or conditional, consent for IOCS cannot be extended to other blood components.

In the case of emergency when the patient is not capable of giving consent, the surgeon and anaesthetist must proceed jointly in accordance with the patient’s best interests and known wishes.

Process

1. Shed blood is collected by vacuum aspiration (directly from the operative site, and indirectly by washing of swabs), mixed with ACD anticoagulant and carried to a sterile container.

2. When an adequate amount of whole blood has been collected, it is transferred to a spinning centrifuge bowl where red cells are concentrated. If blood loss turns out to be insufficient for processing, then it should be discarded as per normal theatre practice.

3. After concentration saline is pumped through the spinning centrifuge bowl to suspend the red blood cells.
4. Concentrated red cells are then pumped to a transfer pack for reinfusion.

5. The machine operator must complete the patient identity label on the bag, checking this identity with the patient’s checked identity, and should remove as much air as possible from the bag.

6. The anaesthetist must decide whether to run the machine in open circuit or closed circuit. Closed circuit is appropriate where haemorrhage, collection and processing are ongoing processes, or for some religious indications; open circuit is appropriate where the maximum expected collection volume is one bag which can contain up to one litre.

7. If red cells are to be reinfused, attach the identity label to the blood bag, with expiry time written on it, before the patient leaves theatre.

8. Before attaching the blood bag to the patient, you must complete an identity check of the blood bag against the patient’s identity. Attach the blood bag to the patient before leaving the operating theatre environment. Put the green sticker on the anaesthesia chart (or the fluid chart if the patient is going to HDU).

9. Reinfusion should be completed in theatre or immediate theatre recovery and within a maximum of four hours of collection. Monitor the patient to make sure that the reinfusion is complete within this time. The patient may not leave the labour ward with a reinfusion bag connected and all such bags should be discarded on transfer.

10. Normal perioperative observations should be recorded.

**Points to note**

- For most uses, the usual complement of theatre staff will be sufficient; our ODPs are well practised with IOCS. In the case of massive haemorrhage, a further ODP dedicated to the cell salvage process and a scrub person dedicated to blood aspiration should be called.
Intraoperative cell salvage in obstetrics

- Surgeons should use vacuum aspiration for recovery of as much shed blood as possible. Blood removed using swabs may be lost to collection and processing. It is recommended but not mandatory that a scrubbed person should be solely responsible for operating the vacuum aspiration.
- In the case of massive haemorrhage with IOCS a second ODP should be called along with additional surgical, anaesthetic and midwifery staff as required.
- Records of the amount of blood recovered and reinfused, with haematocrit, must be kept on the anaesthesia chart. The reasons for any transfusion or reinfusion should be documented in the notes.
- Standard caesarean postoperative observations should be used.
- If the patient is Rhesus negative, a Kleihauer test should be performed and anti-D given as appropriate within 72 hours (the cell saver does not remove fetal red cells, which will be infused with the salvaged maternal blood). The sample for Kleihauer testing must be taken after the completion of reinfusion.
- The reinfusion bag should not need to be pressurised as the fluid viscosity is much lower than for banked refrigerated blood. It can be, but does not have to be, given through a blood warmer.
- All blood products should be treated as potentially infectious. Donor blood has been tested for many viral infections; salvaged blood has not.
- As with the transfusion of large volumes of allogeneic red cells, the return of large volumes of salvaged red blood cells will coincide with the depletion of platelets and clotting factors associated with massive blood loss. In the event of a massive reinfusion of salvaged red blood cells, clinicians must consider the need for additional appropriate transfusion support e.g. platelets, fresh frozen plasma and cryoprecipitate.
- All staff must retain vigilance towards the current extent of the blood loss into the collection reservoir.
Intraoperative cell salvage in obstetrics

- NICE guidance requires continuous audit of IOCS. The operator must complete the audit form for every case. Make sure that as part of the ‘sign out’ procedure you check the EBL (estimated blood loss) and that it is being recorded on the appropriate forms.
- Salvaged red cells must never be placed into a refrigerator.
- Only trained ODP operators can use the technique; the maternity theatres are used as the hospital’s training facility for cell salvage.


Other operative procedures

Retained placenta

You should respond to a request for anaesthesia within thirty minutes; the risk of postpartum haemorrhage increases hugely with time. The delivery standard for a retained placenta is one hour after fetal delivery, or if excessive bleeding occurs.

Regional methods are preferred if not contraindicated (epidural or spinal with range from S5 to T8), although some patients will choose general anaesthesia after assessment. You should consult with the obstetrician however and use general anaesthesia if there is a significant risk of morbid placental adherence e.g. placenta accreta, increta or percreta, or excessive blood loss.

You should assess the volume status of the patient with care, resuscitating the patient by replacing any known blood losses prior to induction of anaesthesia.

If uterine relaxation is required you should administer tocolytics, remembering to do so well in advance of the need. See page 205 for details.

Antibiotics for manual removal of placenta

Use the same antibiotics as for caesarean section (see page 204). The operating surgeons often request intravenous metronidazole 500 mg in addition.

Pain relief for instrumental delivery, perineal repair and manual removal of placenta

Analgesic needs may not be as great as after caesarean section but good analgesia at the end of the operation may prevent chronic perineal pain. In any procedure involving perineal repair, consider using intrathecal diamorphine in the spinal anaesthetic or down the epidural catheter at the end of the operation.
On the front of the drug chart (single doses)

- Rectal diclofenac 100 mg if not contraindicated.
- Loading dose oral paracetamol (based on booking weight and only if paracetamol not given within previous 6 hours during labour).
  Booking weight ≥ 70 kg: 2 g oral paracetamol.
  Booking weight 50-70 kg: 1.5 g oral paracetamol.
  Booking weight < 50 kg: 1 g oral paracetamol.

Inside the drug chart (regular doses)

- Oral paracetamol 1 g qds (to start at least 6 hours after previous dose).
- Oral ibuprofen 400 mg qds (to start at least 16 hours after loading rectal dose of diclofenac).

On the back of the drug chart (prn doses)

- Buccal prochlorperazine 6 mg bd for nausea and vomiting.
- Oramorph 10-20mg based on booking weight (see below) hourly (maximum 5 doses per 12 hours).
- If neuraxial diamorphine has been used, prescribe oral chlorphenamine 4 mg prn qds for itch.

Postpartum evacuation

Women may very rarely come back to the labour ward up to six weeks after delivery for uterine evacuation. Although this is an urgent procedure, it is not an emergency and the care of labouring women takes priority e.g. responding to requests for epidural analgesia.

Surgery on pregnant women

Surgical procedures may be proposed in pregnant women where they remain pregnant following surgery. You must seek senior help in all such cases including that of cervical cerclage. Other procedures may be proposed to you and they should usually be undertaken in the main
Other operative procedures

theatre suite. Refer all non-obstetric cases to the senior resident anaesthetist.

Cervical cerclage

This is also known as a McDonald’s or Shirodkar suture. The procedure is performed on a pregnant patient in the second trimester in order to reduce the rate of spontaneous miscarriage. Some patients under 22 weeks of pregnancy will be listed in gynaecology theatres, but they do occasionally present to labour ward. As an urgent procedure with bulging membranes this may prolong pregnancy by a week or two. These patients will stay in hospital. When undertaken as a planned procedure for previous miscarriage, the patient will usually go home after the cervical suture.

We prefer a spinal anaesthetic as this keeps placental transfer of drugs to a minimum and greatly reduces the risk of pulmonary aspiration. Aim for anaesthesia from S5 to T8. Some cerclage operations require the use of general anaesthesia; the cervix may be very unfavourable and considerable uncomfortable manipulation required.

The obstetrician may request uterine relaxation during this procedure. You should discuss appropriate methods with them (see page 205).

If general anaesthesia is preferred by the patient, or considered essential to the successful performance of the operation, then a rapid sequence induction is mandatory for patients in the second or third trimester of pregnancy.

Prescribe paracetamol 1.5-2.0 g in recovery.

Cervical sutures are usually removed without anaesthesia. Removal of some Shirodkar sutures may require spinal anaesthesia if exploration is needed.
Regional blocks for surgery

The techniques are described below. The majority of caesarean sections are performed with a spinal technique. Epidural block placed for labour can usually be extended if required. It has the great virtue of being in place when needed, and takes about the same amount of time as a new spinal anaesthetic to reach surgical anaesthesia, but has the great disadvantage of being less reliable in achieving full anaesthesia.

Occasionally, epidural anaesthesia is indicated for surgery – you should discuss such cases with a senior anaesthetist.

Regional blocks for surgery must be performed in the operating theatre with skilled assistance. We do not support the establishment of regional anaesthesia in delivery rooms.

The combined spinal/epidural technique should not be used for surgery other than in exceptional cases, which should be discussed with a senior anaesthetist. Examples would include:

- Expected prolonged surgery.
- Planned caesarean hysterectomy.
- Postoperative epidural infusion after caesarean section for pre-eclampsia.

When we use CSE we usually give our standard dose for spinal anaesthesia (see below) and place an epidural catheter that can be used later if surgery is prolonged or in the postoperative period. It is important not to give a volume dose down the epidural catheter as the risk of high spinal is too great.

Information and consent

We prefer regional blocks, but the choice is that of the mother.

A potential trap when talking to a patient is to refer to general anaesthesia as unsafe, or to imply that general anaesthesia is an inferior and dangerous method compared to the more modern regional anaesthesia. Firstly, this may not be true; and secondly, you may have
Regional blocks for surgery

cause to recommend conversion to general anaesthesia, or the mother may choose general anaesthesia in the first place. The results of falling into the trap are to make the mother much more anxious and also to cause serious embarrassment to the anaesthetist who later recommends a general anaesthetic.

So beware the trap. Recommend regional anaesthesia if indicated, but do not create unwarranted concerns over a method you may need to use. It is not possible to state that one type of anaesthesia is safer for mother or neonate without considering the complete clinical scenario.

Monitoring and patient contact

You must maintain the required standard of monitoring during regional anaesthesia for surgery. The AAGBI has issued clear advice [146]:

"An anaesthetist of appropriate experience must be present throughout general anaesthesia... The anaesthetist must undertake frequent clinical observations as well as reviewing the information provided by monitoring devices. The same standards must apply when an anaesthetist is responsible for a local anaesthetic or sedative technique for an operative procedure."

Patients undergoing regional techniques have limited experience of the operating theatre routines and have limited vision. You must maintain contact with the patient in order to reassure her and to detect any problems immediately - such as inadequate anaesthesia. In particular, you must not allow the patient to feel that you have left her alone (or with her partner: partner presence during regional anaesthesia is encouraged if circumstances allow).
Oxygen administration to conscious patients

We do not recommend administering supplemental oxygen to an awake patient, as there is equivocal evidence of benefit and there are some risks [147,148], unless:

- The indication for caesarean section is serious fetal distress or bradycardia, in which case oxygen can be administered on the journey from the delivery room to the operating theatre.
- The patient has been sedated.
- The patient is hypoxic as shown by pulse oximetry. Your clinical judgment is important here but if the $S_pO_2$ is lower than 96% then you should consider oxygen. Remember that this may resolve simply with the mother taking a deep breath.

If oxygen is administered, use nasal cannulas. This aids maternal communication, and does not impede retching if it occurs.

The anaesthesia machines in the obstetric operating theatres are fitted with a fresh gas flow outlet for connection to the anaesthesia circuit, and a separate oxygen outlet for open mask or nasal cannulae. Do not disconnect the fresh gas flow outlet from the anaesthesia circuit – this is associated with death from failed pre-oxygenation in general anaesthesia cases.

Spinal anaesthesia – general considerations

Indications

- Elective caesarean section.
- Emergency caesarean section not in labour.
- Emergency caesarean section with no regional analgesia in place.
- Emergency caesarean section with non-working epidural in place.
- Trial of assisted delivery (particularly Kiellands’ forceps).
- Perineal repair.
- Evacuation of retained products of conception.
- Cervical cerclage (insertion of Shirodkar suture).
Regional blocks for surgery

Contraindications

- Unwilling patient.
- Coagulopathy or anticoagulation.
- Sepsis.
- Hypovolaemia or active bleeding.
- Cardiac disorders with restricted cardiac output or shunt.

Relative contraindications

- Need for immediate caesarean section, e.g. scar dehiscence or profound fetal bradycardia (see ‘Time standards’ on page 196).
- Neurological disorders.
- Spinal deformity or surgery.
- Obstetric requirement for general anaesthesia.
- Risk of haemorrhage e.g. placenta praevia, fibroid uterus.

Block required

- Caesarean section or trial of assisted delivery – S5 to T4 bilaterally.
- Other surgery (e.g. manual removal of placenta, perineal repair or postpartum evacuation) – S5 to T8 bilaterally. The xiphisternum is an easily palpable landmark at T7 and a block to this level will be more than adequate.

Technique for spinal anaesthesia

Before the block

1. Explain the procedure and possibility of low-pressure headache (1 in 500).
2. Ensure that intubating equipment is always present whenever spinal anaesthesia is performed.
3. Check that ranitidine has been given as appropriate.
4. Note the preoperative blood pressure, taking into account anxiety levels and booking blood pressure.
Intravenous access and fluids
5. Establish intravenous access (16 or 14-gauge cannula to a large vein) and connect an infusion attached to non-return valves. We currently use the ‘Coventry valve’. You should use a metaraminol infusion instead of a volume preload technique [149] – see page 238.
6. Connect a litre of Hartmann’s solution and check that it can run freely.

Drugs before the block
7. Administer antibiotics at this point if practicable.
8. Administer metoclopramide 10 mg intravenously unless given recently as a premedicant. This will act as a prokinetic agent and increase lower oesophageal sphincter tone, and will counteract nausea and vomiting following the regional block [150].
9. Connect a metaraminol syringe (10 mg diluted in 50 mL saline). This should be ready to run at 50 mL h⁻¹ immediately the spinal anaesthetic has been inserted when using a bupivacaine dose of 15 mg. Be careful not to infuse it beforehand.

Spinal block technique
10. Position the patient, usually in the sitting position. Prepare the area with alcoholic 0.5% chlorhexidine delivered from a spray bottle and allow it to dry spontaneously in air. Infiltrate the interspace with lidocaine.
11. Remember to ‘stop before you block’ and check the dose and proposed surgery with the ODP. Draw up hyperbaric bupivacaine into a 5 mL syringe through the filter needle. The following doses should be used unless there are clinical reasons to vary them. In the case of existing regional block, see page 250. There is no significant correlation between patient height (unless pathological) and the spread for a spinal dose, as most height variation is in long bones and not the spine [151].
   • For T8 block: 2.0 mL or 10 mg.
Regional blocks for surgery

Run the metaraminol infusion very carefully if at all; it probably won’t be needed unless the woman is dehydrated.

- For T4 block: 3.0 mL.

The ED$_{95}$ of hyperbaric bupivacaine is the dose below which there may be a 5% block failure rate for operation. It has been variously reported as 11.2 mg [152] or 15 mg [153]. Long experience has shown us that a 15 mg dose with fentanyl or diamorphine is effective in preventing pain during uterine exteriorisation and cleaning of the paracolic gutters, and does not increase the risk of total spinal block. This dose is an indication for using a proactive approach to preventing spinal hypotension. Using lower doses will improve maternal haemodynamic instability but at the cost of incomplete motor block, limited anaesthesia duration and a higher chance of inadequate anaesthesia [154].

12. Add diamorphine as the neuraxial opioid.

**Diluting diamorphine for neuraxial use**

Having drawn the appropriate dose of heavy bupivacaine into a 5 mL syringe, use a 10 ml syringe (to avoid confusion with the bupivacaine) and draw up 5 mL 0.9% saline from an ampoule held by ODP. Use this to dilute the diamorphine from a 5 mg diamorphine ampoule using the filter needle. You now have a 1 mg mL$^{-1}$ solution of diamorphine.

To administer 400 mcg in a spinal anaesthetic you will need 0.4 mL. Use a 1 ml syringe to draw up > 0.4 mL diluted diamorphine from the 10 ml syringe containing 1 mg mL$^{-1}$ solution. Discard the excess via a clean needle attached to the syringe until exactly 0.4 mL (400 mcg) is contained in the syringe and use this needle to inject into your usual dose of heavy bupivacaine contained in the 5 ml syringe (this ensures that the dead space of the syringe contains diluted diamorphine, rather than air). Discard the rest of the diamorphine from the 10 ml syringe in the manner recommended for all controlled drugs.
13. Insert the spinal needle (atraumatic pencil point needle; 24 gauge with introducer) at the L3/4 interspace or lower. Insertion at L2/3 is associated with direct injection into the spinal cord and syrinx formation [155]. Identification of the lumbar interspaces is reliably poor when an anaesthetist uses external landmarks to identify a numbered space [156]. The point is to not impale the conus medullaris; the intercristal line or Tuffier’s line has a described relationship here. The conus medullaris is reliably found more than 1.75 vertebral segments cranial to Tuffier’s line (a line joining the most superior part of both iliac crests, defined radiologically in this study), and nineteen times out of twenty it is more than 2.5 vertebral segments cranial to Tuffier’s line [157]. It should be safe to insert the spinal needle at or below this line.

14. In the case of difficulty inserting the spinal needle, there are extra-long spinal needles and combined spinal/epidural sets available. Call for assistance as an early move. A useful technique is to insert an epidural needle to the epidural space and then use a 120 mm spinal needle through the Tuohy needle.

15. Ensure the syringe is firmly placed into the hub of the spinal needle to avoid spillage. Use a gentle technique and ensure that cerebrospinal fluid flows freely before injecting anything [158]. Do not start or continue the injection if the patient experiences pain on injection. Aspirate before and after injection to ensure the needle is still in the subarachnoid space.

16. Ask someone to start the theatre clock so that you can keep an eye on the time from block.

Prevent hypotension

17. Ask the ODP to commence the metaraminol infusion to prevent spinal hypotension – see page 238. If using 10 mg bupivacaine you may not need the metaraminol infusion and if you do, use lower doses for a shorter time.

18. Lie the patient down if sitting, with a pillow under the shoulders and the headpiece of the table elevated, and tilt the table to the left if
Regional blocks for surgery

supine. A small degree of head-down tilt will not produce excessive cephalad spread or hypotension [159]. It will help to achieve a surgical block promptly in emergency cases.

Block assessment

19. Assess the block carefully and ensure that it is satisfactory for surgery to commence (see page 145 for the quadruple test; record the block). If the block is not satisfactory, see page 249 for advice.

20. Explain to the woman that she will not feel the pain of cutting or stitching, but that she may feel a brief sense of pressure, or being pushed and pulled around, during certain points in the operation – typically on delivery of the baby. Tell her that you will be with her should she need any additional pain relief at this point although almost nobody does need it. This may help to reduce anxiety about pain during surgery, a principal concern of women undergoing caesarean delivery [160].

Perioperative and postoperative

21. Intravenous fluid treatment is divided into two phases. The first phase takes about twenty minutes, usually until delivery of the fetus. During this phase you are using metaraminol to maintain blood pressure and cardiac output against the sympatholytic effects of spinal anaesthesia.

22. The second phase runs approximately from delivery until the end of the operation. During this phase the sympatholytic effects are less important and you will be maintaining blood pressure and cardiac output against the fluid losses of surgery. At delivery you should check the blood and amniotic fluid losses with the scrub midwife and switch the intravenous fluid to an appropriate replacement for the blood loss. See page 207.

23. Follow up for 2 days minimum. If the patient wishes to go home prior to this try to make sure that she knows how to contact us through labour ward triage area if she develops a bad headache.
Tips for success in spinal anaesthesia

1. The technique of placing a needle is a very small part of the technique when compared to the greater importance of gaining the woman’s confidence and assistance, and having an engaged assistant (such as a member of theatre staff) who is encouraging the woman to cooperate.

2. Have alcoholic chlorhexidine sprayed on the skin before scrubbing; insert lidocaine before drawing up bupivacaine. Every minute helps achieve a swifter block.

3. Have a wide vocabulary for what you are asking. Some women have no idea what ‘arch your back like an angry cat’ or ‘slouch like your mother told you not to’ means.

4. Having the woman curl forward and relax is of great importance. In the sitting position, she will do this most effectively if the table is at its lowest height and thus her legs are being pushed upwards – just like asking someone to curl more when in the lateral position. You may therefore prefer to sit to do a spinal.

5. Assuming the woman is sitting, in tricky cases have the operating table tilted towards you, encouraging the woman to curl forwards even more.

6. Don’t go in the vertical centre of the space. Aim for the upper third of the interspace, perpendicular to the skin. (Think of the distance between the upper and lower spinous processes as being divided into three parts, and aim for the centre of the top third). This is likely to give the straightest and easiest path to the central neuraxis. Hitting bone superficially indicates that you are a little too high, whereas hitting bone deeply indicates that you are a little too low. In either case withdraw a little and angle gently in the opposite direction.

7. Stay rigorously in the midline (unless doing a paramedian approach). This means putting your lidocaine in with the needle in the median or mid-sagittal plane, and being able to construct an imaginary line.
Regional blocks for surgery

down the spinous processes to where you are. This is especially important in a block below L4 as the intrathecal target is smaller.

8. If you can’t feel what is under the skin, and keep hitting resistance or bending thin spinal needles, consider using an epidural needle to identify the epidural space. Then use a 120 mm spinal needle through the epidural and about 5-10 mm further for dural tap.

9. Keep an eye on the time and the urgency of the case. Be prepared to call for help in good time.

10. Check the block properly. This means multimodal testing (see page 145). Having started the clock keep an eye on how quickly the block is developing and intervene in good time if necessary.

Prevention of spinal hypotension

We take a proactive approach to preventing spinal hypotension. The clinical evidence for this is quite clear; vasoconstrictor agents are needed prophylactically titrated against the blood pressure response in elective [161,162] and emergency cases [163]. The traditional agent used has been ephedrine, based on animal studies decades ago in which it was demonstrated that ephedrine does not reduce blood flow to the ovine uteroplacental unit [164]. Though better than not using vasopressors, ephedrine is associated with maternal tachycardia, anxiety and palpitations, and fetal acidosis; we recommend the use of α-sympathomimetics [165]. Metaraminol is the most conveniently presented drug in this class.

Indication: for the prevention and treatment of hypotension and nausea induced by spinal anaesthesia for a T4 block (use lower doses for a shorter time if using less than 15 mg bupivacaine). This method should also be used in patients with pre-eclampsia. For severe pre-eclampsia, where blood pressure is labile or high, use this technique with an arterial line for monitoring, and seek senior advice and help.

1. Start the NIBP on the ‘stat’ setting. This will run for five minutes and then default to your auto setting – 2.5 minutes is suggested. Alternatively, use the ‘one-minute’ setting until blood pressure
stabilises and then measure blood pressure as needed (minimum five-minute intervals).

2. **Start the metaraminol infusion immediately at 50 ml h\(^{-1}\)**
   
   (0.167 mg min\(^{-1}\), or 1 mg in 6 minutes).
   
   a. The aim is to maintain maternal blood pressure at the baseline pressure. Continue to infuse metaraminol at the same rate if the SBP is less than or equal to the baseline SBP; stop the infusion if the SBP is greater than baseline.
   
   b. You should normally continue metaraminol for about twenty minutes until delivery, then wean it off. It cannot be used outside theatres.
   
   c. Watch the pulse rate and blood pressure. A pulse rising above 100 bpm or a systolic blood pressure that does not rise to baseline may indicate the need for a 0.5-1.0 ml bolus (100-200 mcg) from the pump; a pulse falling towards or below 60 bpm may indicate stopping the infusion. (Maternal heart rate can be a good surrogate measure for cardiac output with vasopressor infusions [166].)
   
   d. In the event of bradycardia (<60 bpm) without hypotension, stop the metaraminol infusion. This will almost always resolve the bradycardia. If bradycardic with hypotension give glycopyrrolate 200 mcg.

3. **Do not use metaraminol to treat hypotension secondary to hypovolaemia (postpartum haemorrhage).** The treatment for haemorrhage is to stop the bleeding and replace blood lost, not to use vasoconstrictors (although these drugs have a role in patients whose blood volume has been restored, to promote organ perfusion). If the patient is bleeding heavily call for help.

4. **Do not use metaraminol infusions on the obstetric high dependency unit.** Patients who remain persistently hypotensive
Regional blocks for surgery

should be diagnosed and treated; they may be haemorrhaging. It is not safe to expect midwives to manage metaraminol infusions.

Using labour epidurals for operative surgery

Is the epidural suitable?

In every case where you propose to extend a labour epidural for use in operative surgery you must assess the suitability of the block and decide whether extension to an anaesthetic block is likely to work.

It is not possible to give a definitive prospective answer to the question. The risk of failed conversion of labour epidural analgesia to anaesthesia is increased with an increasing number of boluses administered during labour, an enhanced urgency for caesarean delivery and an increased length of labour infusion, among other factors [167,168].

Epidurals not providing adequate labour analgesia cannot be expected to provide successful caesarean anaesthesia. The most consistent predictor of failed top-up is prior maternal request for additional epidural boluses to treat labour pain [169], and we should remember that this author is concerned to warn about the unpredictability of spinal dosing after an epidural.

Accordingly, you should consider these factors when recommending a type of anaesthesia, although it is not possible to give a definitive threshold-based answer to the question. Taking a proactive approach to the management of labour pain, assessing analgesia and replacing catheters as necessary, will give you better information in advance.

What to do

• **Stop the epidural infusion on entering the room.** Dilute epidural mix is no use for operative surgery. This may help in limiting high blocks on epidural or spinal injection in theatre.
• Rapidly assess the mother and the block records.
• If you are not confident that the epidural is capable of reliable extension, then recommend its removal and replacement with a spinal anaesthetics.
• Ensure that the mother is transferred to the operating theatre promptly.
• You will not get every decision right. Be aware of the need to check and monitor the regional block and be prepared to recommend and implement alternatives as appropriate.

Instrumental delivery or manual removal of placenta

Muscle relaxation is mandatory particularly in the case of a rotational (high or Kiellands’) forceps. A sensory level from S5 to T8 with motor blockade is ideal (uterine nerve supply is T10 to L1 and perineum S2/3/4). For vacuum extraction (‘ventouse’) or for low forceps a normal epidural top-up may be administered in the delivery room, usually with incremental doses of 0.5% bupivacaine and fentanyl to a maximum of 10 mL. Document the anaesthetic levels attained, and the effect, on the epidural chart.

For rotational (high) forceps and for ‘trial of assisted delivery’ the top-up should be given as for caesarean section. Document doses, levels and effect on the pink anaesthetics chart. Use of ‘Quickmix’ (see below) is advised and you should place yourself in a position to provide caesarean section anaesthesia immediately. This may mean accepting (with the consent of the patient) a target block height higher than T8 so that the last increment provides a satisfactory block for caesarean section.

Extending the epidural for a caesarean section

1. This is only reliably effective when the epidural is problem-free. Look at the block history and examine the patient. Consider removing it and siting a spinal anaesthetic if this is not the case (see page 250).

2. Vigilance for complications is essential. If a spinal anaesthetic is performed with an inadequately functioning epidural, the risk of high block can be about one in fifty.

3. You should aim for anaesthesia from S5 to T4 along with motor blockade. You should determine the upper and lower extent of the
Regional blocks for surgery

block. Use the ‘Quickmix’ outlined here unless you have a specific reason for not doing so.

4. Exercise caution when opioids have been administered recently to the patient.

5. You should use the following ‘Quickmix’ for caesarean section anaesthesia, in divided and carefully monitored doses as below, and in the operating theatre. This is rapidly effective [170].
   - When available, 1 mL 8.4% bicarbonate [171] (total dose 84 mg, or 4.2 mg mL\(^{-1}\) in the 20 mL).
   - 0.1 mL ‘1 in 1000’ adrenaline using a 1 mL syringe (total dose is 100 mcg, or 5 mcg mL\(^{-1}\) in the 20 mL). Use of adrenaline not only limits systemic absorption of local anaesthetic, it is associated with reduced risk of block failure [172].
   - 20 mL 2% lidocaine.

You should give fentanyl separately to the lidocaine, bicarbonate and adrenaline mix, usually after 10 mL ‘Quickmix’. The usual dose is 100 mcg. Remember to flush it in. Separate administration is particularly important if you do not anticipate using the whole dose of either local anaesthetic or fentanyl:
   - If fentanyl has been given to the patient recently.
   - If the existing block is quite high.

6. Have a metaraminol infusion available (see page 238). Check the fluid balance during labour. Determine whether the patient is going to need further fluids.

7. You must not commence anaesthesia for caesarean section in the delivery room. This practice entails too much risk, principally due to the difficulty of monitoring the mother for high block and hypotension during transfer. You should instead ensure that the patient is taken to theatre promptly once the decision to operate has been made [173].

8. The patient should be placed in the left lateral position, in the operating theatre, and metoclopramide 10 mg administered if it has
not been given recently. Give the intravenous antibiotic at this stage if practicable.

9. Use a 3 mL test dose before a concentrated bolus. The main dose should be administered over a ten-minute period with careful observation of the patient. As a guide, you might expect good anaesthesia with 20 mL in a patient whose pre-theatre block was below the umbilicus, and 15 mL if above the umbilicus. Doses should be adjusted to patient response up to a maximum of 30 mL.

10. During dosing, measure the blood pressure and sensory levels at 1-minute intervals; record these at 5-minute intervals on the pink anaesthetic sheet.

11. If satisfactory operating conditions are not obtained after 20 mL ‘Quickmix’ has been administered, you must carefully consider other options with the obstetrician and the patient. A further 10 mL lidocaine with adrenaline may be given if the block is rising but not yet sufficient. See the advice for ‘Failure of regional anaesthesia’ on page 249.

12. Partners are usually allowed into theatre during the top-up. They should be spoken to before coming into theatre, and understand that it may be necessary for them to leave swiftly.

13. You should ensure that the block extends bilaterally from S5 to T4 prior to the commencement of surgery (see page 145). If it does not, or if either the patient or you are not confident that a satisfactory block exists, see the advice on page 249. Generally, if there is no change in the block after 15 ml and 15 minutes the procedure should be abandoned in favour of a spinal or general anaesthetic.

14. Record the extent of the block (upper and lower levels) on the anaesthesia chart, and when the operation is finished record the patient’s satisfaction with the block.

15. Administer diamorphine down the epidural catheter at the end of the operation. We recommend 3 mg diamorphine (2.5 mg if booking weight < 50 kg).
Regional blocks for surgery

Remove the epidural catheter in theatre unless extended surgery is to be followed by critical care.

Neuraxial block records

Make sure to complete two different records for neuraxial blocks. The main one on the anaesthesia chart will contain the description of the procedure itself. The separate follow-up chart used only in obstetrics is also essential as this will be the guide for specific midwifery postnatal care and for your postnatal review rounds. Make sure you complete the section on the back dealing with Bromage score recovery times, so that appropriate recovery from the block can be monitored (see page 154).

Total spinal block or high block

An unrecognised ‘dural tap’ or a catheter that migrates subsequent to insertion may result in a high block leading to difficulty with breathing particularly if the block reaches cervical level and causes diaphragmatic impairment. Total spinal can of course occur as a complication of spinal anaesthetics, either de novo (this is very rare) or when performed after an epidural block.

High block (block above T4) can occur in 1:100 women when you administer either a spinal anaesthetic or an epidural anaesthetic in theatre, on top of an existing epidural block. Be careful with doses and be prepared to reduce them if the epidural is nearly at the T4 level but you need to extend it.

1. You should notify the consultant anaesthetist or senior registrar on call, of all cases where breathing is significantly impaired.

2. Your first concern should be to protect and secure the airway and prevent respiratory failure. High block can provoke great anxiety in the patient, which must not be confused with respiratory failure. Establish whether diaphragmatic weakness exists. If the diaphragm is not weak, then the patient will probably not need intubation. Advise her to take a breath in and out, and if she can do this counsel her that she is able to breathe.
3. In the event that intubation is needed, you should intubate and ventilate the patient until the block has worn off, usually about two hours. Although muscle relaxation is not essential it is humane to provide amnesia and a routine rapid sequence induction of anaesthesia in theatre is the safest method of attaining ideal intubating conditions. Sedation can be maintained by the use of propofol or inhalational anaesthesia.

4. However, the situation may require immediate intubation or assisted ventilation.

5. Prevent aortocaval compression.

6. Any hypotension must be treated; employ the standard metaraminol infusion but be prepared to run it at a higher rate for longer with close monitoring of the blood pressure.

7. Fetal distress may indicate caesarean section, but otherwise a total spinal does not rule out a normal delivery. Prompt recognition and treatment of the condition should ensure that neither child nor mother come to any harm. Continuous CTG must be used.

References:


Regional blocks for surgery


Regional blocks for surgery


Regional blocks for surgery

Failure of regional anaesthesia

Blocks sometimes fail. This happens in the hands of all anaesthetists. The point is for it not to happen too often and for you to be able to maintain the safety and quality of anaesthesia.

There are a variety of actions that can be taken. You have two priorities and you must keep them at the front of your mind at all times.

1. Ensure the safety of your patient.
2. Deliver an appropriate and satisfactory anaesthetic for the surgical procedure.

Problems with inadequate anaesthesia will be rare if:

- The block appeared technically satisfactory.
- A neuraxial opioid (fentanyl or diamorphine) has been used.
- Block testing was satisfactory. The purpose of testing is to predict the likelihood of failed block.

Satisfactory block testing is mandatory before allowing surgery to commence (see page 142). It is not possible to repeat a spinal block once surgery has commenced, and epidural supplementation may not be fast enough. The only options will be analgesic supplementation or conversion to general anaesthesia.

Breakthrough intraoperative pain is rarely seen but can happen during obstetric regional anaesthesia. You should ensure that all patients are forewarned, and that you respond to complaints of pain. Unrelieved pain causes anxiety. Poor communication, and especially failure to act promptly on complaints, may lead to formal complaints and litigation.

- Manage the patient sympathetically and expectantly.
- If the patient complains of pain during the operation, note the time and consider offering a general anaesthetic in addition to analgesia.

The best time to convert regional anaesthesia to general anaesthesia is before the start of surgery.
Repeating a block

Repeating a block may be an appropriate course of action. Mothers are usually highly motivated to be awake at the delivery of their child and with honest, careful explanation will understand the reasons for failure and the possibilities for remaining awake.

Seek senior advice and help if you are thinking of repeating a block. You may need to discuss the dose or ask for technical help.

The final height of a spinal block after recent epidural is difficult to predict and a high block is more likely to result.

In all cases of repeating a block, you should observe for the side effects of central neuraxial block. In particular, observe for respiratory depression and hypotension. Monitor the progress of the block closely and maintain close verbal contact with the mother.

The most difficult decision follows the finding of an upper limit to the block of T5 to T7. This block will be inadequate for caesarean section but is not far off. We do not recommend repeating a block in these circumstances due to the risk of complications. General anaesthesia is probably the best course if 30 mL of local anaesthetic has already been given. Seek senior advice.

After an epidural anaesthetic

If the epidural dose has been given more than one hour before, and there is no sensory effect, then proceed with spinal anaesthesia in the usual way.

After giving an epidural anaesthetic dose for caesarean section, and determining that the block is insufficient for surgery, a reduced-dose spinal anaesthetic can be used with extreme care. **Leave thirty minutes between the epidural bolus and the intrathecal injection.** Sit the patient upright for two minutes after the injection into cerebrospinal fluid [174].

Clinical judgment and skill will be required. Suggested doses are:

- Block below T10: give 2.5 mL hyperbaric bupivacaine 0.5% without further opioid.
• Block T10 to T8: give 2 mL hyperbaric bupivacaine 0.5% without further opioid.

Observe carefully for signs and symptoms of a high block such as cardiovascular, respiratory and neurological depression.

**After a spinal anaesthetic**

There are two options; use only one.

1. Wait twenty minutes after the first dose. Repeat the spinal anaesthetic. Do **not** add more opioid. Suggested doses are:
   - No sensory effect or lumbosacral only: give bupivacaine 15 mg.
   - Block below T10: give bupivacaine 12.5 mg.
   - Block T10 to T8: give bupivacaine 10 mg.

2. Insert an epidural anaesthetic. The principal early effect will be to reduce the volume in the spinal part of the subarachnoid space by expanding the epidural space. This may ‘squeeze’ the block upwards [175] and can convert an apparently well delivered spinal in which the drug had no effect, to a block suitable for surgery. Use a reduced volume of epidural injection – usually no more than 10 mL. This technique is known as EVE (epidural volume extension). If using it, be aware that it may be ineffective more than thirty minutes after inserting the spinal anaesthetic due to fixing of the spinal dose [176].

**Perioperative pain and analgesic supplementation**

This should not be needed with proper preparation, dose and assessment, but it can happen and you should act swiftly when the mother complains of pain during caesarean section. Untreated pain is a leading cause of litigation.

Reassure the mother and partner that action will be taken and communicate with the surgeon. Check the nature of the sensation – is it pain or a general sense of rummaging?
Failure of regional anaesthesia

Pain before operation or before delivery
Conversion to general anaesthesia may be the only viable option.

Pain after delivery
Offer Entonox and alfentanil; consider general anaesthesia.

- Entonox or nitrous oxide in equal volume with oxygen by face mask. Do not use a volatile agent.
- Intravenous alfentanil 5-10 mcg kg\(^{-1}\) or fentanyl 1-2 mcg kg\(^{-1}\); warn the paediatrician. Alfentanil is the more rapidly effective and is recommended.
- Midazolam 1-3 mg. This is not an analgesic and should be used only if anxiety is a major factor.

Pain towards the end of surgery
Offer surgical infiltration of local anaesthetic directly into the wound or the peritoneal cavity. Entonox or alfentanil may be useful in addition.

Do not allow too long a time period attempting to resolve a failed regional anaesthetic. The most reliable method is conversion to general anaesthesia, though it carries serious risks. Document your diagnosis and actions. Review your patient in recovery and explain fully.

Converting from regional to general anaesthesia
Conversion rates from epidural to general anaesthesia are reported to fall in the range 4-13%; for spinal anaesthesia this is 0.5-4%. In Coventry the rate is less than 1:500 when the recommended technique for spinal anaesthesia is used.

Converting to general anaesthesia is more difficult and carries much higher risks to the mother if the operation has already started. It is important to make a proper assessment of the block and if in doubt do not commence surgery.

The key to safety in converting is communication. Make sure that the mother, the operating surgeons, the midwives, the ODP and you know exactly what is going to happen. Act promptly, but when your decision...
Failure of regional anaesthesia

has been made, do not hurry or make undue haste. You must maintain an air of professional authority and calm demeanour.

Check the patient’s anaesthetic and medical history again. It is possible to forget details relevant to general anaesthesia when embarking on a regional technique.

In order to do induce anaesthesia safely you must communicate effectively with the surgeons and have them cease operating temporarily.

Follow the technique described on page 254. In particular, position the patient perfectly for intubation. Ask the surgeons to cover the wound if there is one, and withdraw from the table. Remove the bar that holds up the screen. Raise the table to the correct height and adjust the pillow and head-piece in the same way as you would for elective surgery elsewhere. Failure to do this is associated with failed intubation.

We suggest giving less than the full dose of intravenous morphine recommended for caesarean section under general anaesthesia. The failed regional block is likely to have some effect in reducing morphine requirements and 5 or 10 mg morphine is likely to be a safer dose. Further doses of intravenous morphine can be titrated in the recovery room for postoperative pain relief.


General anaesthesia for caesarean section

Practical points to remember

- Assess the patient’s airway before inducing anaesthesia (see page 37). Seek help from the senior resident anaesthetist if you anticipate difficulty intubating the patient.

- Administer the sodium citrate and also metoclopramide 10 mg intravenously as a prokinetic before induction.

- Give antibiotics before induction if possible (see page 204).

- Emergency cases would probably benefit from having the urinary catheter and shave performed before induction of anaesthesia. Consult with the obstetrician.

- For planned or elective cases, offer intrathecal diamorphine prior to general anaesthesia. These cases will be rare but the benefits of diamorphine should not be withheld where the woman has chosen to be unconscious during the delivery itself.

- You must preoxygenate the patient before inducing anaesthesia. Use at least two minutes of tidal volume breathing or seven vital-capacity breaths with the oxygen flush button held down if the case is for immediate delivery [177]. Arterial saturations will fall alarmingly fast in parturients [178] and you must memorise and practise according to the guideline for difficult intubation on page 37.

- You must induce anaesthesia in all patients in theatre with ECG, blood pressure cuff, oxygen and carbon dioxide analysis and pulse oximeter attached.

- The recommended dose of thiopental is 6-7 mg kg\(^{-1}\) of the booking mass up to 500 mg; consider more than 500 mg if the woman is very large. (Watch for patients who may be significantly larger than their booking mass.) For example, body mass of 60 kg indicates 390 mg
thiopental, and 80 kg indicates 500 mg. The dose should be no less than 5 mg kg$^{-1}$ [185].

- Use 3 mg kg$^{-1}$ or ketamine 1 mg kg$^{-1}$ if reduced dose is indicated such as in massive obstetric haemorrhage.

- **Suxamethonium** is our present standard neuromuscular blocker in RSI. The recommended dose of suxamethonium is 1.5 mg kg$^{-1}$. In some cases, that will mean using more than 100 mg, to a maximum dose of 150 mg.

- **Rocuronium** is an acceptable alternative drug for rapid sequence induction following discussion with a senior colleague. This will probably be in the context of anticipated difficult intubation, with oxygen by nasal cannula by in addition to standard preoxygenation (see page 41). The dose is 1 mg kg$^{-1}$. This dose is likely to produce intubating conditions inside 60 seconds and have a duration of action of up to an hour. You may need to reverse its action swiftly with an escape bolus of sugammadex; this is available in maternity theatres in 200 mg and 500 mg ampoules. These are very expensive and you should not use them routinely. The escape bolus dose for dense block is 16 mg kg$^{-1}$: typically, 1000 mg for a woman with a body mass of 60 kg and 1500 mg for a woman with a body mass of 90 kg. Spontaneous respiration should commence two to seven minutes after administration [179].

- After rapid sequence induction, change the inspired gas mixture to 33% oxygen in 66% nitrous oxide and isoflurane. We do not recommend a 50:50 mix.

- Do not try to reduce fresh gas flows below 6 L min$^{-1}$. Isoflurane is both relatively cheap and relatively soluble. Trying to achieve low flows during caesarean section risks accidental awareness in general anaesthesia for little if any material gain.

- Isoflurane should be a minimum of 0.8% at end expiration to reduce the incidence of awareness [180]. The obstetrician may request uterine relaxation, in which case more can be given as an alternative to using terbutaline. This may be required in premature delivery.
General anaesthesia for caesarean section

where there is little or no lower segment, breech in labour, transverse lie etc. Record the class of emergency, the ‘decision to delivery’ interval, and the time of delivery.

• Use a nerve stimulator to monitor the neuromuscular block. Use atracurium (15 mg to 25 mg) when you have observed the suxamethonium to have worn off. Some operations will be conducted without atracurium. One in twenty-five patients will exhibit prolonged effect of suxamethonium due to heterozygosity.

After delivery:

• Give 5 units Syntocinon intravenously – slowly. Syntocinon will reduce systemic vascular resistance transiently but markedly.
• Commence a Syntocinon infusion (see page 206).
• Check the blood loss and start volume replacement.
• Give intravenous morphine in appropriate doses as indicated. We recommend morphine 15-20 mg.
• Give ondansetron 8 mg.
• Give intravenous paracetamol 1 g (and omit oral paracetamol).
• Prescribe thromboprophylaxis (see page 123).
• Ask the obstetrician to infiltrate up to 40 mL levobupivacaine 3.75 mg mL⁻¹ to the wound if no regional technique was used. This is two levobupivacaine ampoules 2.5 mg mL⁻¹ and two ampules 5 mg mL⁻¹.

Complete the following documentation:

• Pink anaesthetic record.
• Obstetric Neuraxial Procedure and Monitoring Chart including Bromage score times (and enter in the index list).
• Fluid chart.
• Drug chart.
Postoperative period

This is similar to recovery from regional anaesthesia. You should bear in mind the possibility of excessive sedation and airway problems: inadequate postoperative care has been reported as a recurring factor in maternal deaths [181] and patients should receive the same standard of care as required for any postoperative patient [182]. Hand the patient over to recovery staff only when you are confident that they no longer need anaesthesia care.

You should prescribe supplemental oxygen 2 L min⁻¹ by nasal cannula.

Postoperative pain

Pain after a general anaesthetic caesarean section can be severe despite the use of intravenous morphine after delivery. You should assess the patient in recovery and be prepared to titrate intravenous morphine or other strong analgesics.

- Midazolam 1 mg is useful in a patient who has intractable pain despite large doses of morphine, to reduce anxiety and allow the analgesia to work.
- Clonidine can also be useful. Make 150 µg up to 10 mL with saline and give repeated doses of 2 mL.
- Ketamine 10-20 mg intravenous bolus can be useful in a patient who has intractable pain despite large doses of opioids. However, in some patients it can cause distressing dysphoria even in low dose.
- Magnesium sulfate is a good rescue drug for otherwise intractable pain, although it is not universally effective in augmenting postoperative opioid analgesia [183,184]. Doses of 30-50 mg kg⁻¹ have been used as sole therapy. For rescue after high opiate usage, administer a slow intravenous bolus dose of 2 g. Be vigilant for potentiation of any residual neuromuscular blockade, and for potentiation of the sedative effect of opioids and residual anaesthesia. Both these can exacerbate respiratory depression.
General anaesthesia for caesarean section

AAGA (accidental awareness under general anaesthesia)

From NAP5, AAGA is more common in obstetric anaesthesia than any other specialty [185], with an audited rate of about 1:670. It will also happen during obstetric procedures other than caesarean section.

“Obstetric general anaesthesia includes most of the risk factors for AAGA, including use of rapid sequence induction with thiopental and neuromuscular blockade during maintenance, in a population with a relatively high incidence of obesity and difficult airway management. The urgency of the situation frequently necessitates surgery beginning within moments of induction.”

Use of thiopental seems associated with AAGA but this is not presently possible to disentangle from other factors and indeed the probability that a rapidly administered dose of 200 mg propofol may cause more hypotension and less unconsciousness than 500 mg thiopental in the absence of opioid analgesia.

Most episodes of awareness now occur between skin incision and the delivery of the baby, and result from the short period between induction of anaesthesia and the start of surgery, and reluctance to use ‘overpressure’ to achieve a rapid increase in the concentration of volatile agent in the blood and brain [186]. Patients are often anxious and have not received sedatives or opioids as part of the induction.

NAP5 and clinical experience would suggest that:

- Many AAGA cases will be multifactorial and have no single underlying error, and may not have any identifiable underlying error.
- The incidence may be reduced by attention to adequate dosing with thiopental, nitrous oxide and isoflurane, and not reducing the fresh gas flow below 6 L min\(^{-1}\).
- Anaesthetists should beware the fact that some thiopental and some co-amoxiclav bottles look very similar with yellow plastic caps, and in solution the drugs look similar.
• Anaesthetists should ‘mind the gap’: after induction and intubation, (where most AAGA cases will occur), ensure that you swiftly achieve adequate volatile anaesthetic and nitrous oxide concentrations.

• Similarly, after delivery of the fetus, administer any indicated intravenous morphine without delay.

You should manage any AAGA cases that you find on follow up as in the guideline on such cases occurring elsewhere in the hospital, starting with immediate referral to the consultant on labour ward or on call for emergencies.


General anaesthesia for caesarean section


Placenta praevia

Placental implantation in the lower uterine segment – placenta praevia – presents a particular challenge due to the risk of uncontrollable haemorrhage at delivery. Uterine blood flow at term is about 700 mL min$^{-1}$ and you should be prepared for heavy bleeding.

The incidence of placenta praevia is 0.1% to 1% in the third trimester, increasing with maternal age, parity and the number of previous caesarean sections. Most cases are managed by caesarean section. The maternal mortality rate in third-trimester placenta praevia can be up to 1%.

Placenta accreta is a condition in which there is no plane of cleavage for the placenta – it is morbidly adherent to the myometrium. In the presence of placenta praevia, the risk of placenta accreta varies according to the number of previous caesarean sections.

- 5% if no previous caesarean sections.
- 24% with one.
- 50% with two.
- 67% with four or more.

Bleeding will usually be greater in the presence of placenta accreta. Imaging techniques are not reliable in diagnosing or excluding morbid placental adherence [187].

The two most ominous risk factors for the mother are active bleeding (risk of haemodynamic instability) and previous caesarean section (risk of placenta accreta).

The basic principles of management are:

1. Collaborative management with the midwives and obstetricians.
2. Assessment of the obstetric and physiological status of the patient.
3. Consultation with senior colleagues.
4. Assess the risk of massive haemorrhage when considering the anaesthetic management.

**Care bundle for placenta praevia and previous caesarean section**

This was developed to describe a collection of interventions necessary for the effective and safe care of patients and should be applied to every patient, every time [188]. These cases will almost always appear on planned caesarean lists but may present with antepartum haemorrhage necessitating emergency surgery.

1. Consultant obstetrician planned and is directly supervising delivery.
2. Consultant obstetric anaesthetist planned and is directly supervising anaesthetic at delivery.
4. Multidisciplinary involvement in pre-operative planning.
5. Discussion and consent includes possible interventions (such as hysterectomy, leaving placenta *in situ*, cell salvage and interventional radiology).
6. Local availability of a level 2 critical care bed.

In relation to the availability of critical care, this will usually be satisfied with the provision of obstetric high dependency care.

**Patient assessment and stabilisation**

When presented with a diagnosed case of placenta praevia, determine basic information:

- Amount of blood lost.
- Amount and type of fluid replaced.
- Physiological status of the patient.
- Decide if hypovolaemia is present, and commence resuscitation if it is.
- Degree of urgency of surgery.
• Position of placenta – find out whether it lies between obstetrician and fetus.
• Whether there has been previous surgery to the uterus – caesarean section or hysterotomy.

The placental position is diagnosed definitively by ultrasound and, if necessary, MRI examination. Placenta praevia can be classified into grades 1 to 4 and the position of the placenta can be assessed (see below). The position may determine whether it will be possible to deliver a non-accrreted placenta.

Always talk to the obstetrician about this.

**Classification of placenta praevia**

Grade 1: Low-lying placenta.
Grade 2: Marginal approach to internal os.
Grade 3: Partial coverage of internal os.
Grade 4: Complete coverage of internal os.

Position: Anterior or posterior.

**Senior assistance**

You must seek the assistance of the consultant anaesthetist responsible for the labour ward, when anaesthetising for placenta praevia. Assess the patient, formulate a provisional plan and then discuss the case.

Although advance planning is essential, you should warn the patient that the senior anaesthetist on the day may change the anaesthesia plan.

A consultant anaesthetist should be present for all operative cases of placenta praevia.

**Blood provision**

Referenced to page 131.

• Low risk placenta praevia (none of the following risk factors: grade 4, previous caesarean section or anterior placenta) or similar
Placenta praevia

threatened antepartum haemorrhage – maintain suitability for EIB, reserve four units in the fridge if not suitable for EIB.

- High risk placenta praevia (one or more of grade 4, previous caesarean section or anterior placenta) or similar condition for operation including fibroid uterus – reserve four units in the fridge using EIB or cross match as appropriate.

Anaesthetic management

The following guideline is relevant to placenta praevia. Other factors may be important such as a history of relevant allergies or coagulation disorders. Remember that the patient’s consent should be informed by a discussion of all relevant factors. You should assess the risk of massive haemorrhage when considering the anaesthetic management.

See page 52 for recommendations for the care of women at known risk of massive obstetric haemorrhage.

See page 70 for recommendations about transcatheter arterial embolisation. It is likely that this will only be possible if placed in advance, usually because morbid placental adherence or another complication has been diagnosed.

Anticipate a minimum blood loss of 1500 mL in cases of anterior placenta praevia, for example. All patients should have at least two large-bore (14 gauge) cannulae in place prior to induction of anaesthesia, with infusion warmers connected and a patient warming system in place. Monitor the patient’s temperature and urine output carefully. Drugs for myometrial stimulation must be readily available – see page 57.

Regional anaesthesia is as safe as general anaesthesia when administered properly, and is associated with a significantly reduced blood loss and need for transfusion [189,190,191]. All its other advantages also apply here. Against this should be balanced the impairment of sympathetic reflexes, and the difficulty of managing prolonged surgery and heavy blood loss in a conscious patient.

Present the patient with full information about risks and benefits and make a recommendation. Her choice should be presented as being reliant
on what she sees as the most important consideration – being awake when the baby is born, or avoiding witnessing a massive obstetric haemorrhage from the table. Reassure her that whatever her choice we can and will deliver professional anaesthesia and, if necessary, resuscitation.

**Regional anaesthesia**

The indications are those associated with a low risk of massive haemorrhage or other complications:

- There is no active bleeding.
- The patient is normovolaemic, and haemodynamically stable.
- Posterior placenta praevia.
- No previous caesarean sections – low risk of placenta accreta.
- Singleton pregnancy and no history of postpartum haemorrhage.
- Previous haemorrhage and transfusion have not impaired the patient’s coagulation ability. This would be unusual but you should check.

In the absence of randomised controlled trials, there is debate about the place of regional anaesthesia in high-risk cases. We believe that regional anaesthesia is contraindicated if any of the indications for general anaesthesia are present.

Consider using either epidural or combined spinal-epidural anaesthesia – whichever will be more reliable in your hands. Although spinal anaesthesia can be used successfully, there is a significant risk that the operation will outlast the anaesthetic. Placement of an epidural catheter prevents this problem.

Counsel the patient about the potential difficulties involved in proceeding under regional anaesthesia. Ensure that she is able to give informed consent.

- Regional anaesthesia is our normal method of choice, including in low-risk cases of placenta praevia.
Placenta praevia

- Although low, the risks of haemorrhage or extended surgery are present.
- In that case the safest option would be to continue with regional anaesthesia unless there is a strong reason to convert to general anaesthesia.
- There is a potential need for rapid fluid and blood administration.

General anaesthesia

This has advantages for the patient and the anaesthetist, allowing theatre staff members to focus on the operation and not the partner. It may be less distressing for the mother if disappointing, given that most mothers now expect to be awake for their caesarean sections. Conversion to general anaesthesia will not be needed.

Indications:

- Active bleeding.
  You should resuscitate the patient and manage as for massive haemorrhage on page 51. Use a reduced dose of thiopental, or as an alternative ketamine (1 mg kg\(^{-1}\)) as an induction agent. Establish arterial line monitoring before induction. Use the pulse rate, arterial pH, blood pressure, and urine output to guide fluid replacement. Consider the early use of cardiac output monitoring such as LiDCO or oesophageal Doppler. Central venous pressure monitoring is not recommended now.
- Anterior placenta.
- Grade 4 placenta praevia.
- Previous caesarean section.
- Planned caesarean hysterectomy (gravid hysterectomy).

Intraoperative haemorrhage and extended surgery

Do not attempt to manage massive intraoperative haemorrhage as a single anaesthetist, particularly under regional anaesthesia – always send
for help from another anaesthetist. See page 51 for ‘Obstetric haemorrhage’.

Haemorrhage or extension of surgery occurring after embarking on regional anaesthesia poses a dilemma of management. Continuing under regional anaesthesia has been safely used [192] and avoids the definite risks of emergency conversion. It is important to understand that the sympatholytic effects of regional anaesthesia are not abolished by induction of general anaesthesia, but rather can contribute to haemodynamic instability.

Consider converting from regional to general anaesthesia if the patient is seriously distressed, uncomfortable or nauseated. If this action is chosen, important considerations are:

- Restoration of circulating fluid volume.
- Continuous patient monitoring.
- Preparation for difficult intubation.

See page 252 for advice on converting to general anaesthesia.


Placenta praevia

Hypertension in pregnancy including pre-eclampsia

Hypertension is the most common medical disorder of pregnancy. Pre-eclampsia is a form of hypertension in (and immediately after) pregnancy [193].

New hypertension can occur in pregnancy without significant proteinuria (gestational hypertension) or with significant proteinuria (pre-eclampsia). Hypertensive disorders usually arise for the first time in the second half of pregnancy but can occur in women with pre-existing hypertension. They are among the leading causes of maternal death and carry risks for the fetus including preterm birth, intrauterine growth restriction and death.

Anaesthetists are rarely called on to be involved in the management of chronic hypertension or the mild end of the spectrum of pre-eclampsia. Recent confidential enquiries into maternal deaths emphasise that inadequate treatment of systolic hypertension is a serious failing. Systolic hypertension can result in fatal intracranial haemorrhage and has contributed to deaths from aortic dissection. The long-term consequences include chronic hypertension and an increase in lifetime cardiovascular risk.

The remainder of this section is concerned with pre-eclampsia, or gestational proteinuric hypertension. Oedema may be seen as an associated feature; the incidence is 85% but it is not diagnostic.

Aetiology of pre-eclampsia

Pre-eclampsia is the extreme end of the continuum of a maternal systemic inflammatory response causing endothelial dysfunction [194]. Placental factors are secreted in response to a deficient placentation process (poor decidual invasion, in which fetal syncytiotrophoblasts fail to invade beyond the superficial uterine decidua to establish an efficient placental blood supply) combining restriction of uteroplacental blood flow through lack of structural remodelling with spiral artery atherosis, both of which lead to placental ischaemia. Overt maternal disease
Hypertension in pregnancy including pre-eclampsia

develops when uteroplacental hypoxia stimulates the release of antiangiogenic factors that injure the placental and maternal vasculature [195].

Diagnosis and definitions

**Chronic hypertension** is hypertension that is present at the booking visit or before 20 weeks or if the woman is already taking antihypertensive medication when referred to maternity services. It can be primary or secondary in aetiology.

**Eclampsia** is defined as convulsions in addition to pre-eclampsia with no pre-existing neurological dysfunction.

**HELLP syndrome** is haemolysis, elevated liver enzymes and low platelet count.

**Gestational hypertension** is new hypertension presenting after 20 weeks without significant proteinuria.

**Pre-eclampsia** is new hypertension presenting after 20 weeks with significant proteinuria.

**Severe pre-eclampsia** is pre-eclampsia with severe hypertension and/or with symptoms, and/or biochemical and/or haematological impairment.

**Significant proteinuria** is defined as follows:

Use an automated reagent-strip reading device or a spot urinary PCR (protein:creatinine ratio) for estimating proteinuria. If an automated reagent-strip reading device is used to detect proteinuria and a result of 1+ or more is obtained, use a spot urinary PCR or 24-hour urine collection to quantify proteinuria. Diagnose significant proteinuria if the urinary PCR is greater than 30 mg mmol\(^{-1}\) or a validated 24-hour urine collection result shows greater than 300 mg protein.

You should determine whether a patient with pre-eclampsia has severe disease. This is essential in order to determine appropriate management.

**Severe pre-eclampsia** is diagnosed when pre-eclampsia exists along with any one or more of the following complications:
Hypertension in pregnancy including pre-eclampsia

Severe hypertension and proteinuria

- Immediate diagnosis if diastolic blood pressure $\geq 110$ mmHg.
- Blood pressure $\geq 160$ mmHg systolic on two occasions at least six hours apart.

Pulmonary oedema

- Diagnosis of pulmonary oedema or cyanosis.

Abdominal pain

- Epigastric or right upper quadrant pain (hepatic capsule stretching or hepatic necrosis) or vomiting.

Cerebral or visual disturbances due to ischaemia

- Symptoms of severe headache.
- Visual disturbance with blurring or flashing lights.
- Clonus of three beats or more.
- Loss of consciousness (including convulsion which defines eclampsia).

HELLP syndrome

- Haemolysis, Elevated Liver enzymes, Low Platelets – see page 285.

Blood tests

You should review the patient’s blood test results: she will be having repeated blood tests if she has moderate or severe hypertension, monitoring hepatic and renal function.

Urate levels

Urate levels (uric acid levels) are raised in pre-eclampsia. This is because of both renal dysfunction and the oxidative stress associated with pre-eclampsia. Higher urate levels are associated with a worse prognosis. Repeating the estimation of urate levels does not provide information that should influence the management of pre-eclampsia. Urate levels are not diagnostic.
Hypertension in pregnancy including pre-eclampsia

The normal level rises during pregnancy and is approximately:

<table>
<thead>
<tr>
<th>Weeks</th>
<th>µmol L⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>300</td>
</tr>
<tr>
<td>32</td>
<td>350</td>
</tr>
<tr>
<td>36</td>
<td>400</td>
</tr>
<tr>
<td>40</td>
<td>450</td>
</tr>
</tbody>
</table>

Management aims

The disease-modifying treatment is delivery of the placenta. All other treatments are supportive or aimed at preventing complications.

The primary aims in the management of pre-eclampsia are:

- To deliver the fetus in optimum condition.
- To control maternal hypertension.
- To prevent eclampsia and the other complications.

Anaesthetists may become involved for:

- Epidural analgesia in labour.
- Urgent control and reduction of arterial blood pressure.
- Invasive monitoring of arterial blood pressure.
- Anaesthesia for caesarean section.
- High dependency care.
- General advice and support.

Severe pre-eclampsia must be managed in a high dependency environment.

Case responsibility

Management of severe pre-eclampsia is a team effort involving senior obstetricians, anaesthetists and midwives.

All cases of severe pre-eclampsia are under the care of a consultant obstetrician. All significant events, decisions and actions should be notified to or made by the consultant – usually by the duty obstetrician.
Hypertension in pregnancy including pre-eclampsia

You must also ensure that you have appropriate senior anaesthetic input as required. Any conflicts of opinion in management should be resolved through joint senior review of the patient.

High dependency care in pre-eclampsia

See page 83 for general points about critical care.

Indications

Severe pre-eclampsia – the treatment recommendations in this section are not appropriate for mild pre-eclampsia, which is usually managed more conservatively.

Immediate actions

- Apply monitoring of blood pressure (arterial line when possible), pulse and oxygen saturation.
- Administer supplemental oxygen if $S\text{p}O_2 < 96\%$, usually through nasal cannulae.
- Check that the laboratory samples have been sent (FBC, coagulation screen, cross-match, biochemistry including liver function tests – all repeated at least every 12 hours and usually every 6 hours; group and screen).
- Institute a 15-minute observations chart and fluid balance chart with hourly urine volumes. Use a HDU chart.
- Auscultate the patient’s chest for pulmonary oedema and repeat this examination regularly every four hours. Ensure that the respiratory rate is being recorded.
- Patient on monitored sips of water only with ranitidine 150 mg given at six-hourly intervals.
- Neurological assessment using AVPU (alert, responding to voice, responding to pain, unresponsive).
- Thromboprophylaxis with antiembolism stockings, encouragement of leg movement and (if delivery is not indicated) enoxaparin.
Hypertension in pregnancy including pre-eclampsia

Further actions
Discuss with the obstetricians and midwives. Formulate a plan for delivery of the fetus and placenta with the obstetrician. This plan should include consideration of all the sections in this chapter on pre-eclampsia.

Timing of delivery
In severe pre-eclampsia delivery should take place after stabilisation with antihypertensives and anticonvulsants. Delivery is need as soon as possible if convulsions have occurred. Before 34 weeks caesarean section is the preferred option; after 34 weeks delivery can be vaginal if the presentation is cephalic, with epidural analgesia recommended to improve placental perfusion.

Caesarean section should be expedited if severe pre-eclampsia worsens in its signs or symptoms, if the cervix is unfavourable or if fetal compromise supervenes.

Indications for referral to general adult critical care unit
The following indications should prompt a discussion between you and the obstetrician and midwife coordinator as to whether referral to the critical care unit is appropriate. While the labour ward HDU is an appropriate location for patients with a restricted range of single disorders, you should consider whether the patient’s needs have become more complex when one or more of the following complications arise.

- The patient needs level 3 care including ventilation.
- Step-down from level 3, or severe pre-eclampsia with any of the following complications:
  - Eclampsia.
  - HELLP syndrome.
  - Haemorrhage.
  - Hyperkalaemia.
  - Severe oliguria.
  - Coagulation support.
Hypertension in pregnancy including pre-eclampsia

- Intravenous antihypertensive treatment.
- Initial stabilisation of severe hypertension.
- Evidence of cardiac failure.
- Abnormal neurology.

Antihypertensive treatment

Extreme pre-eclamptic hypertension causes direct arterial injury that predisposes the patient to intracranial haemorrhage, one of the main causes of death in the hypertensive diseases of pregnancy. Antihypertensive treatment will prevent haemorrhage but not disease progression or eclampsia.

Oral labetalol as a first-line treatment is used to keep the diastolic blood pressure in the 80-100 mmHg range and systolic blood pressure less than 150 mmHg.

Oral methyldopa has been used for many years for chronic control and is known to be safe in pregnancy. Methyldopa and nifedipine can be used. Labetalol, nifedipine and sometimes enalapril are used after delivery. Other drugs may be added for acute control.

Epidural analgesia is indicated in pre-eclampsia. It is useful to reduce fetomaternal stress and to prevent pain-induced hypertension, and it decreases the chance that general anaesthesia will be needed for caesarean section. It is not effective as an antihypertensive agent in itself.

The treatment aim has been defined [198] in order to prevent death from intracranial haemorrhage and aortic dissection:

“Recommendation 7: Systolic hypertension requires treatment

“All pregnant women with pre-eclampsia and a systolic blood pressure of 150-160 mmHg or more require urgent and effective antihypertensive treatment in line with the recent guidelines from the National Institute for Health and Clinical Excellence (NICE). Consideration should also be given to initiating treatment at lower
Hypertension in pregnancy including pre-eclampsia

pressures if the overall clinical picture suggests rapid deterioration and/or where the development of severe hypertension can be anticipated. The target systolic blood pressure after treatment is 150 mmHg.”

You should use an arterial line for invasive blood pressure monitoring in any woman who fits this definition, or who is receiving intravenous vasoactive medications.

Do not cause the systemic blood pressure to fall precipitately and keep both mother and fetus under continuous monitoring, including blood samples every twelve hours at least.

In the acute situation, mean arterial blood pressure should be maintained below 140 mmHg. Give urgent and effective treatment if this level is repeatedly attained, as cerebral autoregulation may be lost. Do not allow the mean blood pressure to fall below 100 mmHg as this may compromise placental perfusion.

Severe hypertension refractory to treatment is an indication for expedited or operative delivery.

Monitoring blood pressure non-invasively

Automated oscillotonometers may significantly underestimate the diastolic blood pressure, particularly in severe pre-eclampsia. Non-invasive blood pressure readings should be taken with the arm at the level of the heart, using or a validated automated oscillotonometer with a cuff of adequate size: 1½ times the arm circumference. Use Korotkoff phase V (disappearance) if checking blood pressure manually.

Choice of drug for acute hypertension

Oral labetalol is the preferred drug. Use hydralazine in women with asthma, or added in those who do not respond. Women of African or Caribbean origin may be less responsive to labetalol alone.

The treatment aim is a systolic blood pressure reliably under 150 mmHg with maternal and fetal stabilisation.
Avoid ACE inhibitors, as they are associated with fetal hypotension and irreversible renal failure. Avoid esmolol because it is associated with fetal bradycardia.

When emergency intravenous treatment is needed, for a systolic blood pressure above 150-160 mmHg and with an arterial line in place, we recommend intravenous labetalol given by an anaesthetist.

**Labetalol** is started orally in the dose of 100 mg twice daily; doses of 200 mg four times daily may be required. The obstetricians will give a stat dose of 200 mg orally in severe pre-eclampsia. Acute control of severe hypertension is achieved with 50 mg intravenously over at least five minutes, repeated to a maximum dose of 200 mg. Maintenance therapy is with intravenous labetalol (neat solution via syringe driver only – 100 mg in 20 mL, or 5 mg mL\(^{-1}\)) at a dose of 20 mg h\(^{-1}\) doubled every thirty minutes to a usual maximum of 160 mg h\(^{-1}\). 10% of patients may be resistant to its effects and in these cases or when the dose is high, intravenous hydralazine should be used in addition, as it is synergistic.

The most important contraindication to labetalol in the labour ward is maternal asthma (use nifedipine instead), but you should remember that it is a potent β-blocker. Hyperglycaemia or hypoglycaemia can occur and it should be used with care in diabetes.

**Hydralazine** is given as a first treatment of intravenous hydralazine 5 mg (10 mg may be given), administered slowly. Observe the effect over 20 minutes. Do not give further doses in this time, as hydralazine does not act immediately. Then set up an infusion of 40 mg made up to 40 mL with saline 0.9%, given via syringe pump. Infusion rates are typically around 1-5 mL h\(^{-1}\).

Hydralazine may cause tachycardia; nifedipine may be used to reduce the hydralazine dose and any complicating tachycardia. Hydralazine can cause headaches, anxiety and hyperreflexia, mimicking deteriorating pre-eclampsia [199]. Intravenous hydralazine should not normally be used for more than six hours before switching to oral or intravenous labetalol. Intravenous treatment can cause a sudden drop in arterial blood pressures due to the revealed hypovolaemia. 500 mL of Hartmann’s solution will help prevent damaging hypotension and fetal distress (do
**Hypertension in pregnancy including pre-eclampsia**

not use unless hydralazine is used). Use continuous cardiotocographic monitoring.

**Nifedipine** is useful with hydralazine, instead of labetalol or occasionally as sole treatment while awaiting intravenous treatment. Sublingual nifedipine causes too rapid a fall in blood pressure and uteroplacental perfusion and the oral form should be used. The dose is 10-20 mg. Nifedipine may cause profound hypotension with magnesium therapy.

**Fluids in pre-eclampsia**

See [200] for a discussion. Fluid overload is a contributing factor in up to one in two deaths from pre-eclampsia. Iatrogenic pulmonary oedema is much more common than renal failure: run these patients on the dry side.

**General principles**

- Careful control of fluid balance is of paramount importance.
- Immediate postpartum oliguria must not be treated with aggressive fluid therapy.
- Do not preload with intravenous fluids before establishing low-dose epidural analgesia [201].
- Do not use volume expansion unless hydralazine is used as an antenatal antihypertensive agent.
- Perform frequent clinical assessment.
- Transient oliguria occurs regularly in pre-eclampsia and is only rarely complicated by acute renal failure. Fluid management of oliguria need not be as aggressive as in general surgical patients. Indeed, it may be useless, as oliguria arises from glomerular structural problems not adverse haemodynamic factors.
- Avoid fluid challenges. Diuretics are only indicated in overt fluid overload or pulmonary oedema.
- The reduced colloid osmotic pressure found in association with severe pre-eclampsia increases the risk of pulmonary oedema at
Hypertension in pregnancy including pre-eclampsia

‘normal’ filling pressures. Pulmonary oedema is usually associated with fluid therapy. The peak incidence is at 48-72 hours postpartum.

- The pulmonary capillary wedge pressure is significantly greater than the CVP in severe pre-eclampsia.
- Hypovolaemia due to obstetric haemorrhage must be corrected, carefully so as not to cause pulmonary oedema.
- For management of pulmonary oedema see page 109.

Fluid balance

You should maintain strict fluid balance control with hourly urine measurement. The usual fluid regime for maintenance is Hartmann’s solution at 60-80 mL h⁻¹, adjusted for other fluid inputs, to a maximum of 1 mL kg⁻¹ h⁻¹ when adjusted for low body mass.

Observe for the onset of pulmonary oedema. Auscultate the chest regularly (every four hours) for signs. Mild hypoxia is a useful early marker, although other causes such as infection must be excluded. Continuous pulse oximetry must be used.

Central venous pressure monitoring in severe pre-eclampsia

CVP monitoring is rarely used today and usually only when intravenous access is not possible by another route.

Management of postpartum oliguria

Antepartum oliguria should not precipitate any specific intervention other than to encourage early delivery.

Ideally, the patient’s urine output will be at or above 0.4 mL kg⁻¹ h⁻¹. You should usually wait to see if the urine output is low over a four-hour period – as a guide, expect 100 mL urine in 4 hours. If you are in any doubt, seek advice from the obstetricians and from senior anaesthetists. Remember oliguria is common for six hours postpartum in a normal pregnancy, especially when Syntocinon has been used. Management is expectant.
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If the patient is oliguric (urine output < 0.4 mL kg\(^{-1}\) h\(^{-1}\)), determine the fluid balance over the last 24 hours and correct any fluid deficits due to long labour or operative delivery etc. Do not however give fluid challenges – this may precipitate pulmonary oedema. The albumin level should be measured urgently.

Check the arterial blood gases to determine whether metabolic acidosis is present.

If the plasma creatinine level is less than 100 µmol L\(^{-1}\), and there is no HELLP and no bleeding, oliguria will be transient and self-limiting.

Oliguria is dangerous when creatinine rises above 125 µmol L\(^{-1}\). Complete anuria for more than one hour is very rare and may herald total renal failure.

Furosemide is usually reserved for treatment of heart failure or pulmonary oedema.

The management of oliguria in pre-eclampsia with an adequate fluid status involves consultant-level discussion and cannot be safely determined in a fixed protocol. You should ensure that appropriate advice is available to the team. A renal physician should usually be involved in the multidisciplinary team.

Pulmonary artery pressure monitoring in severe pre-eclampsia

Pulmonary artery catheters can only be used in the intensive care unit, usually for postoperative monitoring. Do not use them in the labour ward.

Pulmonary capillary wedge pressure monitoring is only rarely required, because left ventricular dysfunction is rare, and may be indicated for the management of:

- Pulmonary oedema unresponsive to diuretics, morphine, and oxygen.
- ARDS.
- Severe or malignant hypertension unresponsive to treatment.
- Persistent arterial desaturation when the origin is not clear.
- Shock of unknown cause.
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- Persistent oliguria.

For management of pulmonary oedema see page 109.

**Anticonvulsant treatment**

The proven anticonvulsant therapy required in pre-eclampsia is to control systemic blood pressures. Signs of cerebral irritability should be repeatedly sought: presence of headaches or flashing lights, ankle clonus of more than three beats or an aura of convulsion. Magnesium sulfate infusions are now being used almost routinely in addition.

Magnesium sulfate may be considered for primary prevention of convulsions in severe pre-eclampsia, but only after consultation with the consultant obstetrician. The MAGPIE trial showed some benefit [202] but the results are believed to be equivocal due to the very high number needed to treat (63 for severe pre-eclampsia at best) in order to prevent one seizure [203]. The primary action of magnesium is to relieve cerebral vasospasm. It is useful especially when signs of cerebral ischaemia are present. If the infusion is commenced, it should be continued for twenty-four hours. Magnesium infusions halve the risk of eclampsia in these circumstances.

The occurrence of tonic-clonic convulsions makes the diagnosis of **eclampsia**. Ensure that the patient has been placed into the left lateral position and that oxygen therapy and intravenous access have been established. Check the patient’s history and medication for the prior existence of epilepsy or other epileptogenic condition. Check for hypoglycaemia.

Administer a bolus of intravenous magnesium sulfate if it has not already been given. Magnesium should be given for at least twenty-four hours after the convulsion. Evidence from the Collaborative Eclampsia Trial clearly shows that magnesium sulfate is the treatment of choice for the primary treatment and secondary prevention of eclamptic convulsions [204]. 10% of women will convulse again on magnesium therapy. The consultant anaesthetist on call must be informed.

Eclamptic convulsions are usually self-limiting and will terminate after about ninety seconds. They may eventually be lethal if left untreated.
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The traditional use of diazepam in acute control of convulsions is no longer supported. There is robust evidence indicating that magnesium sulfate is the treatment of choice [205]; the focus of treatment priorities is to start magnesium promptly.

Magnesium emergency administration

Remember that magnesium sulfate is synergistic with non-depolarising neuromuscular blocking drugs and their action will be potentiated. Use them only in reduced doses with careful neuromuscular monitoring – it is better to give more suxamethonium if muscle relaxants are needed, together with atropine to counteract potential bradycardia. Fasciculations with administration of suxamethonium may not occur after magnesium treatment.

Magnesium therapy is associated with an increased incidence and severity of obstetric haemorrhage.

Flushing and a feeling of surface heat are common with magnesium treatment. Nausea, vomiting and flushing are early signs of magnesium toxicity. ECG signs can occur: PR and QRS prolongation. Deep tendon reflexes disappear and apnoea and cardiac arrest may follow.

Rapid administration of magnesium can cause asystole.

The antidote for magnesium overdose is 10 mL of 10% calcium gluconate given by slow intravenous bolus.

There is a box on the resuscitation trolley on labour ward containing everything you need to commence magnesium treatment.

1. Magnesium sulfate (MgSO₄) is presented as 10 mL ampoules of 50% concentration (0.5 g mL⁻¹) that contain approximately 2 mmol Mg²⁺ mL⁻¹.

2. Make up 50 mL 20% MgSO₄ (contains 10 g MgSO₄):
   - 2 x 10 mL MgSO₄ (5 g per ampoule).
   - 3 x 10 mL saline.

   5 mL solution now contains 1 g MgSO₄ (equating to 200 mg mL⁻¹). The syringe should be mounted into an infusion pump.
3. Give 4 g (20 mL) MgSO₄, over 10 minutes (i.e. set the pump with a volume to be infused of 20 mL at a rate of 120 mL h⁻¹).

4. Observe for cardiac or respiratory arrest while loading – this can occur with rapid bolus infusion.

5. Maintain an intravenous infusion at 1 g h⁻¹ MgSO₄ (5 mL h⁻¹).

6. Clinical monitoring is sufficient when this dose regimen is used.
   - The respiratory rate should be checked before treatment and every 15 minutes during treatment, and should be 10 per minute or more.
   - Patellar reflexes should be checked before treatment, 30 minutes after the loading dose and hourly thereafter (use biceps tendon if epidural block established), and should be present.

7. **If convulsions persist**, give a further bolus of 2 g (10 mL) over 5 minutes (i.e. set the pump with a volume to be infused of 10 mL at a rate of 120 mL h⁻¹).
   - Then increase the rate of infusion to 1.5 g h⁻¹ MgSO₄ (7.5 mL h⁻¹).
   - If possible, take blood for magnesium levels prior to giving the bolus dose.
   - Consider alternative diagnoses for seizures.
   - She may need CT scan or ventilation.

8. If the woman is still antenatal, stabilise her condition before making plans for birth.

**Magnesium therapy and oliguria**

The kidney excretes magnesium and toxicity is more likely if the renal output is poor. If the urine output is less than 20 mL h⁻¹ the MgSO₄ should be guided by plasma creatinine.

- Creatinine < 100 µmol L⁻¹ Continue as above.

Check Mg²⁺ every 2 hours.
Hypertension in pregnancy including pre-eclampsia

Creatinine 100-150 µmol L\(^{-1}\)
- Reduce MgSO\(_4\) infusion to 1 g h\(^{-1}\) (5 mL h\(^{-1}\)).
- Check Mg\(^{2+}\) every 2 hours.

Creatinine > 150 µmol L\(^{-1}\)
- Stop the MgSO\(_4\) infusion.
- Check Mg\(^{2+}\) immediately and every two hours.
- If Mg\(^{2+}\) concentration is under 3.5 mmol L\(^{-1}\), infuse MgSO\(_4\) at 0.5 g h\(^{-1}\) (2.5 mL h\(^{-1}\)). Seek advice from the consultant obstetrician.

If the urine output is less than 10 mL h\(^{-1}\) do not use MgSO\(_4\). Call the consultant obstetrician.

Although magnesium toxicity is very rare with this dosing regime, the use of magnesium in severe renal impairment is associated with irreversible cardiac arrest.

**Magnesium toxicity**

1. If signs of toxicity (respiratory rate below 10 or absent deep reflexes) are found the infusion should be halted, supplemental oxygen administered if not already given and a blood sample for magnesium level taken. If there is no rapid clinical improvement, consider administering intravenous calcium gluconate 1 g slowly, especially if tendon reflexes are absent.

2. Check the blood magnesium concentration if you are concerned that it lies outside the therapeutic range, (symptoms or signs of toxicity or recurrent seizures); if using a different regimen than the one above; or if renal function is impaired (urine output less than 100 mL in four hours or urea level above 10 mmol L\(^{-1}\)). Check levels at one hour, four hours, and then six hourly.

3. The therapeutic range is 2.0-3.5 mmol L\(^{-1}\).
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4. Serum Mg\(^{2+}\) levels:

- **> 5.0 mmol L\(^{-1}\)** Stop MgSO\(_4\) infusion.
  - Ask for consultant advice.
  - Give 1 g calcium gluconate over 10 minutes (10 mL of 10% solution, or 2.2 mmol Ca\(^{2+}\)).
- **3.5-5.0 mmol L\(^{-1}\)** Stop the MgSO\(_4\) infusion for 15 minutes.
  - Restart at half previous rate if urine output > 20 mL h\(^{-1}\).
  - If urine output < 20 mL h\(^{-1}\) ask for consultant advice.
- **2-3.5 mmol L\(^{-1}\)** Therapeutic range.
- **< 2 mmol L\(^{-1}\)** Increase the infusion rate to 3 g h\(^{-1}\)
  - (15 mL h\(^{-1}\)) for 2 hours.
  - Re-check serum concentration and clinical state.

**HELLP syndrome**

This is characterised by:
- Haemolysis.
- Elevated Liver enzymes.
- Low Platelets.

It is an ominous form of severe pre-eclampsia – the extreme end of the continuum of liver complications, with an incidence of less than 0.5%. Clinical features are:

- Epigastric pain.
- Right upper quadrant tenderness.
- Nausea and vomiting.
- Signs and symptoms of pre-eclampsia.

The commonest associated complications (more than 5%) of HELLP syndrome are disseminated intravascular coagulation (consumption...
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coagulopathy), placental abruption, acute renal failure, pulmonary oedema and pleural effusion. Mortality is more than 1%.

Diagnosis can be made when:

• Serum bilirubin and transaminases are elevated (ALT or AST rising to above 70 iu L$^{-1}$).
• Haemolysis is seen on abnormal peripheral blood smear.
• The platelet count is below $100 \times 10^9$ L$^{-1}$.

The transaminase rise indicates hepatic ischaemia. The haematology department may be able to run a haemolysis screen. Ask for a screen with manual differential and biochemical estimation of haptoglobin.

All cases must be managed at consultant level.

Specific points

• Management is supportive. Discuss the case with the Liver Unit at Queen Elizabeth Hospital in Birmingham, particularly if liver function does not steadily improve over a few days, or if transaminases are rising rapidly.
• Ultrasound or MRI scanning can show haemorrhage or ischaemia.
• Platelet transfusion should be arranged if the count is below $20 \times 10^9$ L$^{-1}$ for vaginal delivery and $50 \times 10^9$ L$^{-1}$ for caesarean section. Extra blood should be ordered. (HELLP is not an indication for immediate operative delivery.)
• Coagulopathy will normally need treatment with fresh frozen plasma. Discuss with a consultant haematologist.
• Regional techniques are contraindicated due to the risk of bleeding. If there is a labour epidural in place, remove it as soon as possible after delivery. The platelet count nadir is likely to be at 24-72 hours postpartum.
• Fluid balance must be strictly controlled. Guidelines may be varied depending on the extent of hepatic impairment. For example, saline may be indicated rather than Hartmann’s solution.
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- The risk of thromboembolic disease is increased and heparin should be administered regularly.
- All drugs administered should have minimal hepatic and renal metabolism.
- Severe hypoglycaemia may occur and should be sought vigilantly.
- HELLP syndrome may occur in the postpartum period and this is particularly associated with pulmonary oedema and acute renal failure.

The continuum of hepatic disease associated with pre-eclampsia includes acute fatty liver of pregnancy. This is rare and dangerous. Differentiation from HELLP syndrome is through profound hypoglycaemia and marked hyperuricaemia. Hepatic failure may follow. Treatment is supportive with consideration of transfer to the regional liver unit.

**Epidural analgesia in pre-eclampsia**

Epidural analgesia is indicated for patients with pre-eclampsia:

- Good analgesia reduces the swings in blood pressure that are otherwise seen during contractions due to catecholamine release.
- Uteroplacental perfusion is improved so long as hypotension does not occur.

Epidurals used in this situation are managed much as any other. However, there are some caveats.

- There is a higher risk of coagulation problems, including vertebral canal haematoma, due to pre-eclampsia and its treatment. In general, with a normal coagulation screen, and platelet count $>75 \times 10^9 \, \text{L}^{-1}$ and not falling, CNB may be safely undertaken in these patients; see ‘Indications for haematological investigations’ on page 152 for details. Many patients with mild pre-eclampsia will not need further investigations before an epidural.
- Do not preload with intravenous fluids before establishing low-dose epidural analgesia [193]. Beware fluid overload in these patients: their albumin concentration and thus colloid osmotic pressure is
Hypertension in pregnancy including pre-eclampsia

- Pre-eclamptic patients are more sensitive to the effect of vasopressor drugs such as ephedrine and metaraminol. However, vasopressors should be used as indicated to prevent and treat hypotension.
- The use of hypotensive drugs in labour may exacerbate the vasodilator effects of an epidural and the dose may need to be reduced. Epidural analgesia by infusion may be preferable, especially in severe pre-eclampsia.

Anaesthesia for caesarean section in pre-eclampsia

Assessment and choice of technique

You should assess as for any operative procedure, paying particular attention to:

- Laboratory results, including platelets and coagulation studies as indicated (see page 152).
- Facial oedema, dysphonia, stridor or respiratory distress – these signs are associated with glottic oedema and difficult intubation.
- Cerebral irritability (visual disturbances, hyperreflexia and clonus).
- Urine output.
- The extent to which the patient has been resuscitated and hypertension controlled.

The patient should give informed consent but since choice of technique is more likely to be modified by medical advice, you must be prepared to make a firm recommendation to the patient.

The quick onset of vasodilation in a patient who is relatively hypovolaemic may give rise to marked hypotension – a disaster for a compromised fetus. Traditionally this has contraindicated the use of spinal anaesthesia. We believe however that carefully managed, the
Hypertension in pregnancy including pre-eclampsia

benefits of spinal anaesthesia outweigh the risks where it is otherwise indicated, for both mild and severe pre-eclampsia except as below.

Choice of technique: mild and moderate pre-eclampsia
You should proceed with anaesthesia for caesarean section as otherwise indicated. The preferred technique is spinal anaesthesia.

Choice of technique: severe pre-eclampsia
You should inform the consultant anaesthetist on call about any patient with severe pre-eclampsia who needs a caesarean section.

The preferred technique is spinal anaesthesia but there a number of specific caveats:

- Risk of vertebral canal haematoma (see page 152).
- Stabilisation on antihypertensive regimens.
- Cerebral irritability or eclampsia.

You should make every effort to control hypertension prior to anaesthetising the patient. This may mean placing the fetus’ needs after those of the mother. If it is imperative to proceed prior to stabilisation on an antihypertensive regimen, then general anaesthesia is the preferred technique.

In the presence of cerebral irritability or recent eclampsia, general anaesthesia is the preferred technique, although regional anaesthesia is not absolutely contraindicated. You must call for senior help in these circumstances and notify the consultant anaesthetist on call.

Sensitivity to intravenous drugs
Pre-eclamptic patients are more sensitive to the effect of vasopressor drugs such as ephedrine and metaraminol. However, vasopressors should be used as indicated to prevent and treat hypotension.

You should use arterial line monitoring for induction in all cases of severe pre-eclampsia whether using general or regional anaesthesia.
Hypertension in pregnancy including pre-eclampsia

Use ergometrine or Syntometrine only if essential and then with arterial line monitoring and dose reduction.

Syntocinon has a less predictable pharmacodynamic profile in severe pre-eclampsia [206]. While it should always be used with care when given as an intravenous bolus, use additional caution in severe pre-eclampsia.

General anaesthesia and pre-eclampsia

It is important that the blood pressure is controlled prior to induction if at all possible. An acceptable level is 150/95; certainly a diastolic below 100 mmHg should be the target. This may require the use of labetalol and/or hydralazine and necessitates close monitoring of blood pressure.

In patients with severe pre-eclampsia, once the blood pressure is controlled, you should anticipate the hypertensive response to laryngoscopy by giving 20-30 mcg kg\(^{-1}\) of alfentanil one minute prior to induction. (20 mcg kg\(^{-1}\) if magnesium is being used, 30 mcg kg\(^{-1}\) if not.) You must inform the paediatrician if alfentanil is used.

An otherwise standard technique should then be used. Ensure that small endotracheal tubes are available prior to induction.

Postoperative high dependency care

You should consider certain patients for postpartum high dependency care.

- Eclamptic patients – these patients may require a period of ventilation on the intensive care unit after caesarean section.
- Patients with severe pre-eclampsia.
- Patients who are oliguric before delivery, even if they have only mild pre-eclampsia.
- Patients with mild pre-eclampsia who, after a period of two hours observation in recovery post-delivery are seen to be oliguric or require parenteral hypotensive or anticonvulsant treatment.
- Patients with coagulopathy.
- Other patients about whom you are concerned.
Consult with the obstetrician to determine a plan for the patient.

**The postpartum period in pre-eclampsia**

Although delivery of the placenta results in resolution of pre-eclampsia, and mothers are usually better within 48 hours of delivery, they may still deteriorate.

- The peak incidence of pulmonary oedema is in the postpartum period.
- Eclamptic convulsions occur most frequently after delivery.

**General principles of management**

**Work as a team with the obstetricians and midwives.**

- Fluid balance and the management of oliguria are as important in the postnatal period as in the antenatal period.
- Antepartum magnesium sulfate is usually continued for 24 hours after delivery, longer if indicated.
- Monitor the blood pressure and use continuous pulse oximetry. Treat hypertension.
- Observe for the onset of cerebral irritability and treat accordingly. Magnesium sulfate is the treatment of choice.
- Give analgesia as indicated; give epidural diamorphine if the caesarean section was under epidural, or use an intravenous morphine infusion if no diamorphine has been given. Diclofenac should not be given for 24 hours after delivery in severe pre-eclampsia.
- The patient should be ‘nil by mouth’ for 24 hours after a caesarean section in pre-eclampsia. Continue ranitidine intravenously or orally until the mother is eating and drinking normally. This may be delayed further owing to the development of paralytic ileus. Check for bowel sounds when assessing for pulmonary oedema.
Hypertension in pregnancy including pre-eclampsia

- Thromboprophylaxis: ensure that subcutaneous heparin has been prescribed. Do not delay giving thromboprophylaxis unless the coagulation times are proven to be significantly prolonged.
- Continue observations and investigations from the antenatal period until it is agreed by the responsible consultant that the high-risk period has passed.
- Oral antihypertensives are usually started 24 hours after delivery.


Diabetes in pregnancy

Pregnancy has profound effects on carbohydrate metabolism and hence control of blood sugar is more difficult for mothers who have diabetes mellitus than in the non-pregnant state. Usually there is a progressive and unpredictable increase in insulin requirement after the first trimester. The patient is managed jointly between the diabetologists and obstetricians. The medical notes will contain a suggested insulin prescription for the delivery period including a continuous infusion of insulin.

Maternal normoglycaemia is the target during labour or caesarean section, minimising the risk of neonatal hypoglycaemia associated with maternal hyperglycaemia.

**Planned caesarean section**

The mother should have her normal hypoglycaemics and food on the evening before planned delivery. Omit hyoglycaemics and food on the day of surgery. The patient should be first on the operating list. Make sure that her blood glucose level has been checked before going to theatre. She should not normally need an intravenous insulin infusion as it will complicate care; it is indicated where glycaemic control has been poor. Take her to theatre promptly, and make sure that her blood glucose is checked immediately after delivery in recovery, food and drink is offered promptly (with glucose check before and after) and that she is content to manage her own insulin if needed after delivery.

If there is delay to surgery or her blood glucose is elevated then start the insulin infusion according to the procedure in the medical records.

**Glycaemic control with insulin – pre-existing diabetes**

An individualised plan may be in the mother’s medical records. If you do not find one there, then follow the following steps.

- Intravenous fluid: 5% glucose, 85 mL h⁻¹.
• Insulin infusion (50 units Actrapid to 50 mL with 0.9% saline) from infusion pump into the glucose infusion line. Use a one-way valve on the bag.

• Monitor blood glucose at least hourly during labour or operative delivery, and adjust the insulin infusion rate with the patient’s individual pre-planned regime (in the patient’s notes) as a guide to initial therapy. This must be adjusted as necessary for the individual case, aiming to keep blood glucose between 4 and 7 mmol L\(^{-1}\).

• When the patient is under general anaesthesia you should monitor the blood glucose concentration every thirty minutes or more often. This will reduce the likelihood of undetected hypoglycaemia.

• If labour lasts more than 12 hours check urea and electrolytes; consider a K\(^+\) infusion (add 20 mmol K\(^+\) to the bag).

• At delivery the insulin rate should be halved immediately. Check blood glucose one hour later.

• Once the blood sugar concentration is stable after delivery, 2 to 4 hourly glucose estimations are sufficient.

• Continue insulin infusion until the mother is eating normally.

**Analgesia and anaesthesia**

Epidural analgesia for labour is the technique of choice. It reduces the acidosis of labour, reduces the stress response and consequent hyperglycaemia, and detection of hypoglycaemia is easier in the alert patient. It also facilitates anaesthesia for caesarean section, which is indicated more commonly in women with diabetes. Fluids administered for the epidural should be through a separate intravenous line from the glucose. Hartmann’s solution is suitable.

Regional techniques should also be chosen for caesarean section in the absence of contraindications.

**Gestational diabetes**

Patients with gestational diabetes (often a diagnosis made in retrospect) should be managed as for a normal mother except where glycaemic
Diabetes in pregnancy

to the use of insulin. They should then be managed according to the guideline above, except that continued infusion of insulin is not necessarily indicated. The obstetricians will normally take this decision prior to admission onto the labour ward.
Human immunodeficiency virus (HIV)

Management of women with HIV has been revolutionised by the use of effective ART (anti-retroviral treatment) that is able to achieve low viral loads for vaginal delivery. The mode of delivery for HIV-positive women who cannot achieve a low viral load on antiretroviral therapy is elective caesarean section. This will most effectively reduce the risk of vertical transmission to the child. Patients with an acute infection are managed by a multidisciplinary team.

HIV-positive mothers having caesarean section for high viral load or untreated women presenting in labour or with ruptured membranes in whom the current viral load is not known receive peripartum intravenous zidovudine (azidothymidine, AZT) [207].

Preoperative assessment

Make sure that you are not overheard so as to compromise confidentiality (see page 24).

Caesarean section

For elective caesarean section, a zidovudine infusion will usually be commenced by the midwife or obstetrician. It should continue for an optimum period of three hours and until delivery to reduce vertical transmission.

There is no specific contraindication to central neuraxial analgesia or anaesthesia [208], or the use of intraoperative cell salvage.

You must coordinate the infusion times with the operation time.

Protection of staff

The normal universal infection control precautions protect against HIV and other infection. In the case of needlestick injury you should immediately activate the standard trust policy as detailed in the Anaesthetists Handbook.

Information recording

Clinical Adverse Events

There is a Trust procedure in operation for clinical adverse events. The obstetric CAE meeting takes place every week and aims to capture and learn from all adverse events.

The following clinical and non-clinical events (that may or may not have led to actual harm) are reportable. The list is available as a card if you ask the midwife coordinator.

Maternal incident

- Blood loss > 1500 mL.
- Damage to visceral/vascular structure.
- Eclampsia.
- Failed or double instrumental delivery.
- Hysterectomy or laparotomy.
- Intensive care admission.
- Maternal death.
- Obstetric emergencies.
- Pulmonary embolism.
- Readmission of the mother.
- Screening incidents.
- Sepsis.
- Third and fourth degree tears.
- Undiagnosed breech in labour.
- Uterine rupture.
- Venous thromboembolism.

Organisational incidents

- Unavailability of health records.
- Delay in responding to call for assistance.
- Unplanned home birth.
Information recording

- Faulty equipment.
- Conflict over case management.
- Potential service user complaint.
- Medication error.
- Retained swab or incident.
- Hospital-acquired infection.
- Violation of local protocol.
- Security / verbal abuse / violence / accidents.

Fetal or neonatal incidents

- Apgar score < 7 at five minutes.
- Birth trauma.
- Cord pH < 7.05 arterial or < 7.1 venous.
- Fetal laceration during any operative procedure.
- Neonatal death.
- Neonatal seizures.
- Stillbirth > 500 g.
- Unexpected admissions to neonatal intensive care: where Apgar scores remain < 4 at ten minutes or the baby has already required intubation.
- Undiagnosed fetal anomaly.
- Unidentified IUGR.
- New patient registration errors.

Anaesthetic incidents

- Dural tap.
- Failed intubation.
- High blocks (epidural and spinal).
- Accidental intravenous injection of local anaesthetic.
- Anaphylaxis.
- Hypoxia ($S_pO_2 < 90\%$), any cause.
- Pulmonary oedema.
**Other reportable incidents**

Aside from the trigger list there are other incidents that we should seek to capture.

- Aspiration of gastric contents.
- Conversion from regional to general anaesthesia during caesarean section.
- Persistent neurological deficit.
- Vertebral canal haematoma.
- Other events you consider reportable.

Comprehensive records must be made in the medical notes if appropriate. You should report the incident to the daytime consultant anaesthetist as well as, if the incident is sufficiently urgent, report to the consultant anaesthetist on call.

**Patient records**

**Operative obstetrics**

You must complete a standard Trust anaesthesia chart for all cases in the operating theatre, including ‘trial of assisted delivery’ for which you provide surgical anaesthesia but no caesarean section is performed. A drug chart will be required as will a fluid chart.

**Obstetric Neuraxial Procedure and Monitoring Chart**

One of these records should be completed for every obstetric anaesthesia case, including those for whom a Trust anaesthesia chart is also completed. The Obstetric Neuraxial Procedure and Monitoring Chart contains basic procedural information and follow-up data on the front, and the standard epidural analgesia record chart for use by anaesthetists and midwives, on the back.

All cases recorded on procedure charts should be assigned a number – starting at 0001 at each New Year. This number must correlate with the number on the index list.
**Information recording**

Procedure records should be filed in the patient’s medical record, in the *Anaesthesia* section. They should not be retained as a separate piece of paper or kept in the doctors’ office.

**Epidural analgesia**

You must complete the record and prescription chart for epidural analgesia in the Obstetric Neuraxial Procedure and Monitoring Chart. File this chart in the patient’s medical record in the *Anaesthesia* section.

In the case of extension to surgical anaesthesia, a standard Trust anaesthesia chart must also be completed.

**Index list**

Procedure records are filed in the patient’s notes. You should maintain an index list in the doctors’ office that correlates with the numbers on the procedure records. This index list is used in following up the patients (see page 303).

**Entries in the main patient record**

There will be occasions when you should make entries in the main patient record. Always cross-refer these entries to any anaesthetics documentation, and ensure that the notes are continuous with those made by the midwife and the obstetrician.

**Identifying yourself**

Always use black ink and print your name, grade and GMC number on all notes entries. The Anaesthesia Office will supply a stamp for this purpose.
Clinical audit

Postnatal review

The department undertakes continuous outcome audit of the provision of obstetric anaesthesia. All anaesthetists conducting cases must commence an Obstetric Neuraxial Procedure and Monitoring Chart (see page 301), cross-referencing this with the patient index list kept in the office.

As the duty obstetric anaesthetist it is your duty to complete the follow-up components of this audit. This is best done in the morning because discharges tend to occur in the early afternoon, and in any case you should finish the follow-ups before 15.00 hrs so that any diagnosed complications may be treated during normal hours.

The index list is the key to co-ordinating the follow-up process successfully.

Each day you should update the index list for the patients who have not yet been reviewed. Take the folder with the index list to the postnatal ward, find and review the patients. Postnatal review information should be recorded on the procedure records.

When patients are discharged from follow-up, tick the appropriate box on the procedure chart, and tick the row on the index list.

Audit projects

While attached to the labour ward you have an ideal opportunity to carry out audit projects. You will be working as a member of a small group of residents and consultants, on a more regular basis than is the case in much of anaesthesia. There is a systematic program of audit, in which you may be invited to participate, but the best way of becoming involved is to originate your own project – and to do so in advance of your rotation through the labour ward. Planning for a multidisciplinary audit that runs during your two-month attachment is a reliable path to success.

The Royal College of Anaesthetists has published a recipe book for carrying out audit, which contains detailed advice for conducting general
Clinical audit

audits and those specific to obstetric anaesthesia [209]. Suggested audits include:

- Timely anaesthetic involvement in the care of high-risk mothers.
- Adequacy of staffing.
- Consent given by women during labour.
- Response times for epidural requests.
- Response times for operative delivery.
- Monitoring of mother and fetus before and during regional analgesia.
- Dural puncture rates.
- Technique of anaesthesia for caesarean section.
- Failed and difficult intubation in obstetrics.
- Monitoring for caesarean section.
- Awareness during obstetric anaesthesia.
- Monitoring of obstetric patients in recovery and HDU.
- Adequacy of post caesarean section pain relief.
- Record keeping for caesarean section.

There is an annual joint audit meeting with the obstetricians and midwives at which you could make presentations.

Training and assessment

Training opportunities
There are seventeen consultant sessions per week on average across wards, theatres and clinics, excepting leave for which a replacement cannot be found, and you should be able to develop your skills and knowledge while attached to the labour ward, in addition to the experience that you will gain. You have a great responsibility in ensuring that this happens satisfactorily. You should raise any concerns at an early stage.

The knowledge and skills syllabuses are listed in the assessment documentation. During quiet times on the labour ward read around the subject, and request any more senior anaesthetists to teach you about the subjects listed. Pick a subject and challenge your supervisor.

Obstetric anaesthesia textbooks are available for consultation and we recommend that you use them for your learning.

Clinical audit
Before and during your placement you will be well positioned to carry a clinical audit project through to completion. See pages 303 and 308.

Guideline review
This handbook contains many clinical guidelines, which should be the subject of regular review as is the case with other such guidelines within the Trust. During your block you may be asked to conduct one of these reviews, or may identify a guideline that you are interested to review. Help is always welcome.

Service developments
The service we offer to patients is comprehensive, satisfactory and safe. However, obstetric anaesthetists, registrars and consultants, aspire to continuous improvement although change can be difficult to coordinate. If you have an idea for a service development you are welcome to discuss
Training and assessment

this with any of the consultants. If supported by the group, we will help you to take it forwards.

Workplace training objectives

Within the obstetric team, the registrar should play a full part; communicating effectively about anaesthetic and analgesic techniques used in obstetrics and developing organisational skills. They should consolidate clinical management of common obstetric practice but recognise and treat common complications exercising proper judgement in calling for help.

Assessment

It is your responsibility as a registrar to make sure that your assessments are completed. In order to do this, you need to:

- Obtain the documents.
- Have consultants sign for observed procedures.
- Complete the logbook.
- Attend the oral interview (dates from Dr Choksey).

The assessment pack contains the documentation necessary for completing and passing the competency-based assessment in obstetric anaesthesia. If you do not get the paperwork completed, you cannot pass your obstetric assessment.

Preparatory assessment

This must be taken and passed before a specialty registrar is permitted to hold the responsibility of being the resident obstetric anaesthetist in Coventry. The syllabus for the preparatory assessment is taken from the Royal College of Anaesthetists’ CCST document.

Specialist registrars, who have not previously worked in the UHCW delivery suite, must pass the interview assessment. Supporting information will be the logbook record.
The interview may include the epidural viva questions that are taken by the midwives as part of the competency assessment for managing epidural analgesia.

**Basic assessment**

A pass at this assessment satisfies the requirements for competency-based training of the Royal College of Anaesthetists. There is no distinction between employment grades in the satisfactory level of performance for basic assessment.

**Advanced assessment**

We are happy to undertake advanced assessment for specialist registrars who wish to develop an interest in obstetric anaesthesia. We will usually assume that post-FRCA registrars want an advanced assessment. Advanced assessment will be based on the Royal College of Anaesthetists’ post-fellowship curriculum.

**Documentation and interview**

Both assessments combine observed supervised practice with case reports for high dependency management. A forty-minute interview is held to test theoretical and practical knowledge.
## Obstetric anaesthesia structure

<table>
<thead>
<tr>
<th>Lead Obstetric Anaesthetists</th>
<th>Dr Falguni Choksey (1485)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dr Seema Quasim (4327)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Obstetric Anaesthetists with regular or flexible sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Anuji Amarasekara (1232)</td>
</tr>
<tr>
<td>Dr Carol Bradbury (4323)</td>
</tr>
<tr>
<td>Dr Veena Daga (4661)</td>
</tr>
<tr>
<td>Dr John Elton (2855)</td>
</tr>
<tr>
<td>Dr Clare Ingram (1358)</td>
</tr>
<tr>
<td>Dr Andy Kelly (2112 / 24477)</td>
</tr>
<tr>
<td>Dr Richard Jackson (4321)</td>
</tr>
<tr>
<td>Dr Antonia Mayell (1881)</td>
</tr>
<tr>
<td>Dr Jaison Paul (4664)</td>
</tr>
<tr>
<td>Dr Mark Porter (1486 / 24462)</td>
</tr>
<tr>
<td>Dr Megha Reddy (4385)</td>
</tr>
<tr>
<td>Dr Meghna Sharma (4670)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>High Risk Anaesthesia Clinic</th>
<th>Dr Elton (alternate Thurs pm); backfill by AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multidisciplinary Cardiac Clinic</td>
<td>Dr Quasim (Wed am monthly)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality of Care Meeting (Wd 24 Seminar Rm)</th>
<th>Weekly Tues 13:00 – 14:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAE Meeting (Wd 24 Seminar Rm/Teaching Rm)</td>
<td>Weekly Tues 14:00 – 15:00</td>
</tr>
<tr>
<td>Labour Ward Forum (Wd 24 Seminar Rm)</td>
<td>Monthly Tues 15:00</td>
</tr>
</tbody>
</table>
**Obstetric anaesthesia structure**

<table>
<thead>
<tr>
<th>Role/Activity</th>
<th>Responsible Parties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trainees</td>
<td>Dr Amarasekara (&amp; College Tutors)</td>
</tr>
<tr>
<td>Research – MRiADP Site Principal Investigator</td>
<td>Dr Quasim</td>
</tr>
<tr>
<td>Research – RESPITE Site Principle Investigator</td>
<td>Dr Reddy</td>
</tr>
<tr>
<td>HDU lead</td>
<td>Dr Amarasekara/Quasim</td>
</tr>
<tr>
<td>NOAD Reporter</td>
<td>Dr Quasim</td>
</tr>
<tr>
<td>UKOSS Reporter</td>
<td>Dr Choksey</td>
</tr>
<tr>
<td>Epidural Teaching/Vivas for Midwives</td>
<td>Dr Elton (et al)</td>
</tr>
<tr>
<td>Mandatory Obstetrics Training (MOT) Day (Feb/Aug)</td>
<td>Drs Sharma/Elton (et al)</td>
</tr>
<tr>
<td>Practical Obstetrics MultiProfessional Training (PROMPT) Course (one day; several per year)</td>
<td>Drs Kelly/Quasim (et al)</td>
</tr>
<tr>
<td>Midwife Mandatory Training</td>
<td>Dr Quasim coordinating speakers from Group</td>
</tr>
<tr>
<td>Post Dural Puncture Headache Follow-up</td>
<td>Dr Reddy</td>
</tr>
<tr>
<td>- Complete CAE</td>
<td></td>
</tr>
<tr>
<td>- Ensure headache leaflet given to patient</td>
<td></td>
</tr>
<tr>
<td>- Email with Patient ‘phone number to Dr Reddy</td>
<td></td>
</tr>
<tr>
<td>Obs Anaes Handbook and Updates</td>
<td>Dr Porter/Leads</td>
</tr>
<tr>
<td>Medical Students’ lecture</td>
<td>Dr Porter (with backfill from AK/SQ)</td>
</tr>
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</table>
### Audits

<table>
<thead>
<tr>
<th>Audit</th>
<th>Lead Consultant</th>
</tr>
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<tbody>
<tr>
<td>Epidural Charts/Documentation Audit</td>
<td>Dr Choksey</td>
</tr>
<tr>
<td>Recovery Observations Audit and Guideline</td>
<td>Dr Elton</td>
</tr>
<tr>
<td>Thromboprophylaxis Audit</td>
<td>Dr Amarasekara</td>
</tr>
<tr>
<td>Pain Relief/Post-operative prescribing Audit</td>
<td>Dr Quasim</td>
</tr>
<tr>
<td>Cell Salvage Audit and Guideline</td>
<td>Dr Choksey</td>
</tr>
</tbody>
</table>

Only rolling audits are included here.

There are many other opportunities to get involved with obstetric anaesthesia – please ask for details

There is a blue Anaesthetic information file and a file containing laminated language epidural cards in glass cabinet.
Further reading

The following publications are recommended to you for further reading or reference.

For a relatively small specialty within anaesthesia there are many authors who have produced good books even when restricted to the English language. They are not all listed here.

Core standards texts – free downloads


Recommended books

Further reading


Current textbooks


Specialised books

Further reading

- Donald Caton (1999) *What a blessing she had chloroform: the medical and social response to the pain of childbirth from 1800 to the present.* (Yale University Press)

Web sites

- Obstetric Anaesthetists Association – www.oaa-anaes.ac.uk
- Royal College of Anaesthetists – www.rcoa.ac.uk
- Association of Anaesthetists of Great Britain and Ireland – www.aagbi.org
- Society for Obstetric Anesthesia and Perinatology – www.soap.org
- Royal College of Obstetricians and Gynaecologists – www.rcog.org.uk

Gone but not forgotten

Further reading


Normal laboratory values in pregnancy

Haematology

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td>&gt; 105 g L(^{-1})</td>
</tr>
<tr>
<td>White cell count</td>
<td>5-15 × 10(^9) L(^{-1}) (up to 25 during labour)</td>
</tr>
<tr>
<td>Platelets</td>
<td>150-450 × 10(^9) L(^{-1})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>APTT</td>
<td>0.8-1.2</td>
</tr>
<tr>
<td>INR</td>
<td>1.0-1.3</td>
</tr>
<tr>
<td>PT</td>
<td>10-13 seconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrinogen</td>
<td>4-5 g L(^{-1})</td>
</tr>
<tr>
<td>FDP</td>
<td>&lt;0.6 mg L(^{-1})</td>
</tr>
</tbody>
</table>

Biochemistry

<table>
<thead>
<tr>
<th>Test</th>
<th>Pregnancy</th>
<th>UHCW adult range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>133-147 mmol L(^{-1})</td>
<td>135-143</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.5-5.1 mmol L(^{-1})</td>
<td>3.7-5.0</td>
</tr>
<tr>
<td>Urea</td>
<td>1.5-4.5 mmol L(^{-1})</td>
<td>2.6-6.6</td>
</tr>
<tr>
<td>Creatinine</td>
<td>40-70 µmol L(^{-1})</td>
<td>50-90</td>
</tr>
<tr>
<td>Albumin</td>
<td>25-42 g L(^{-1})</td>
<td>34-48</td>
</tr>
<tr>
<td>Urate</td>
<td>see page 271.</td>
<td></td>
</tr>
<tr>
<td>Bilirubin</td>
<td></td>
<td>4-20</td>
</tr>
<tr>
<td>Alkaline Phosphatase</td>
<td>90-600 u L(^{-1})</td>
<td>30-120</td>
</tr>
<tr>
<td>AST</td>
<td></td>
<td>8-40</td>
</tr>
<tr>
<td>ALT</td>
<td></td>
<td>5-38</td>
</tr>
<tr>
<td>Lactate</td>
<td></td>
<td>0.4-2.2</td>
</tr>
</tbody>
</table>
Normal laboratory values in pregnancy

Arterial blood gases

- pH: 7.44
- pCO₂: 4.1 kPa
- pO₂: 13.6 kPa
- BE: 0-3.5 mmol L⁻¹

Fetal blood gases

Blood is taken for cord gases at emergency caesarean sections, as a measure of the fetal state at the time of delivery. The umbilical artery specimen reflects the state of the fetus and the umbilical vein specimen that of the placental perfusion. It is not easy to quote normal values, as the fetus whose mother has been in labour will be more acidotic than the one delivered by caesarean section. The values quoted below are a guide only. The pH and base deficit are used more in clinical practice than the pO₂ and pCO₂.

The concept of respiratory and metabolic acidoses may be helpful. Diagnosed in the same way as with ordinary arterial blood gases, a fetoplacental perfusion problem initially manifests as a respiratory acidosis. When significant hypoxia becomes established, then a metabolic acidosis picture emerges.

<table>
<thead>
<tr>
<th></th>
<th>Umbilical artery</th>
<th>Umbilical vein</th>
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Fetal scalp sampling

A pH > 7.25 is reassuring. Between 7.21 and 7.25 close observation and further testing in thirty minutes is indicated. A pH reading ≤ 7.20 indicates urgent delivery in order to prevent the risk of a pH ≤ 7.00 in cord gases at delivery.
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