HECTOR

The Heartlands' Elderly Care Trauma & Ongoing Recovery Programme

Course Manual

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Foreword

The Heartlands' Elderly Care Trauma & Ongoing Recovery Programme (HECTOR) started with Paul. Paul was 89 years old when he presented to the Emergency Department with pain in his neck following a fall down five steps on the previous day. Holding his head, he was asked to sit in the waiting room to be called two hours later into a Minors cubicle. On assessment his neck was immediately immobilised and a CT cervical spine requested for a suspected fracture of his odontoid peg.

Paul had no history of: loss of consciousness; amnesia; vomiting; nor did he have any neurological abnormalities on examination. In consideration of such findings, and also due to the fact that Paul wasn't taking anticoagulant medication, there was felt to be no need for a CT Head scan.

The CT scan of Paul's cervical spine revealed a type II fracture of his odontoid peg and following discussion with the regional Neurosurgery team, he was admitted under the local Trauma & Orthopaedic team. Paul died nearly 11 days after his admission. During this time, it was noted that he had an isolated episode of acute confusion and blood tests had shown falling levels in his serum sodium concentration.

Neither of these features were acted upon and a CT scan performed a few hours before his death revealed the presence of large bilateral subdural haematomas. Paul would not have been a candidate for surgery even if such a diagnosis had been made earlier, but nevertheless, the care he received could have been much better.

The HECTOR Programme was established in an attempt to highlight such issues and develop a training programme for clinicians and independent practitioners who are responsible for looking after older people with injuries. The injuries that an individual sustains often plays second-fiddle to the complex co-morbidities, frailty and challenge of being cared for within ever pressured urgent and emergency systems.

The HECTOR symbol is a helmet which represents a protective mechanism against direct trauma. It is designed to highlight the fact that most elderly people sustain their injuries following same-level falls, especially with damage to the head and neck.

The symbol's colour represents vibrancy and the fact that the negative stereotypes that accompany advancing age are outdated – some people continue to lead full, active lifestyles well into their 80s and negative assumptions about quality of life should not be made based on age alone.

This manual has been written for people like Paul in an attempt to ensure that patients of advancing age receive safe and high quality trauma care. This care should focus on them as individuals and be directed towards the following theme:

"To treat patients with injuries and not injuries on patients"

Dr David Raven

This work is dedicated to Jaq, Fin and Henry – the foundations upon which HECTOR was built and the greatest support of all.

AN INTRODUCTION TO HECTOR

PART I: THE IMMEDIATE ASSESSMENT AND TRAUMA SURVEYS

PART II: MANAGEMENT OF SPECIFIC INJURIES IN ELDERLY PATIENTS

PART III: MEDICAL ILLNESS AND CO-MORBIDITIES IN THE INJURED ELDERLY PATIENT

PART IV: ONGOING CARE AND RECOVERY

AN INTRODUCTION TO HECTOR

Chapter 1 – Important Considerations for the Injured Elderly Patient

Introduction

Traditional teaching in trauma care, from ATLS to ETC, remains very injury-focussed. Students are taught how to diagnose and treat life-threatening injuries. For example, they are given the skills needed to insert chest drains into haemothoraces and how best to reduce fractures and dislocations. Such concepts are a crucial part of trauma care and are fundamental for delivering a safe service.

However, this also relies on a "one size fits all approach". For example, the Shock Classification Tool assumes that all individuals will have the same physiological response to blood loss and exhibit specific parameters that define the different degrees of shock[1]. Such evidence is useful as a guide but in practice, may not reflect how ageing physiology manifests itself under different states of stress.

The philosophy for the care of the injured elderly patient should be to **treat a patient with injuries and not injuries on a patient.** This philosophy is based on the fact that a combination of: ageing anatomy and physiology; co-morbidities; and polypharmacy; mean that an individual patient-centred approach is key. All of these factors will affect how an individual responds to trauma both in the acute setting, and in the later stages of their recovery.

This manual aims to introduce concepts of holistic trauma care for older patients and highlight some of the challenges faced when caring for the injured elderly patient.

In order to develop a deeper understanding of the difference in the delivery of trauma care for older patients compared to younger individuals, it is important to take the following into account:

A. Patient Considerations
B. Triage Considerations
C. Training Considerations
D. Recovery

A. Patient Considerations

Outward Appearance

As human beings, we are continuously analysing information placed in front of us and making assumptions and judgements based on that information. The outwardly appearance of individuals may affect how we interpret their state of health. This could lead to assumptions being made about how we might expect a person to respond to injury.

For example, an 80-year-old gentleman who has no significant past medical history may look older, but be healthier than a 65-year old individual with a history of myocardial infarction, diabetes and COPD. Their response to injury may be completely different to that of the younger individual.

In some circumstances, outward appearance is helpful. For example, a clinician can assume that a patient who is observed to have profound hemiplegia, is bed-bound and has rolled out of bed sustaining a femoral shaft fracture presents a high risk for pressure sores and venous thrombo-embolism. Such observations should be balanced against the risk of negative stereotyping.

In the acute setting, it is safer to forgo assumptions made on the basis of outwardly physical appearance and begin to gather more information about the individual (e.g. past medical history, social history). This information can then be used to form a global picture to prevent inaccurate assumptions. **Accurate history-taking, in combination with thorough examination, is an essential and fundamental concept to preventing unnecessary error and avoiding negative stereotyping that can occur with age.**

Anatomy & Physiology

Trauma is a sudden and acute insult to a person's body. When this body is in a prime state of health and functioning at 100%, the individual may respond better to a particular insult. Trauma applied to an ageing body may have a more significant impact.

The ageing process involves the replacement of active parenchymal cells with inactive interstitial cells. This invariably leads to a loss of functional reserve and a decline in organ function. It is important to understand how such processes affect different body systems.

Musculoskeletal System

The ageing skeleton is more vulnerable to traumatic insult than younger bones. The presence of osteoporosis and reduced mineral density makes bones more susceptible to fracture with a given force. Seemingly minor mechanisms of injury that may have had no impact on the younger skeleton, for example a fall from standing, could result in significant fractures in the older individual.

It is therefore important to appreciate that "low energy" mechanisms are more likely to lead to injury in older individuals, and "high energy" mechanisms are more likely to lead to significant and possibly life-threatening multi-system injury.

With an increased likelihood of osteoarthritis with advancing age, degenerative change and osteophyte formation can lead to fixed flexion deformities in the joints, especially the cervical spine. Kinetic energy applied to these more rigid structures is more likely to result in fracture than when applied to flexible structures that can freely flex and extend and thus absorb some of this energy.

Bone-related disease isn't the only issue that can lead to musculoskeletal rigidity. A patient with Parkinsonism may have hypertonia of the neck muscles producing rigidity of the cervical spine. Direct kinetic energy applied to the head of such individuals (e.g. following a fall) may not be absorbed by flexion of the cervical spine without fracture or excessive abnormal movement.

Respiratory System

The ageing lungs undergo changes which will affect their underlying function:

a. Increased chest wall rigidity

b. Loss of muscle mass of respiratory muscles

c. Reduced alveolar gas exchange surface area

d. Reduced central responses to hypoxia and hypercapnia

Overall, elderly patients will have a less compliant chest wall and will need to work harder with each inspiration to open collapsed airways. This may be exacerbated by injury to the chest wall or

lungs, and worsened further by pre-existing lung disease.

A loss of muscle mass will lead to an increased risk of fatigue with lung or chest wall injury. This may produce hypercapnic (Type II) respiratory failure at a much earlier stage and such patients maybe more likely to need supported ventilation.

Cardiovascular System

Taking the cardiovascular system into consideration, a young patient can respond to hypotension by vasoconstriction and increasing their cardiac output. The cardiac output (CO) can be increased by increasing stroke volume (SV) or the heart rate (HR).

CO	=	HR	x	SV

The ageing myocardium is replaced by collagen and fat, leading to stiffer walls and less ventricular compliance. This can limit the heart's contractile ability and lead to a decreased cardiac reserve. Stiffening of blood vessels, desensitisation of baroceptors and impaired autonomic function limits this reserve even further.

An age-related reduction in atrial pacemaker cells can lower the resting heart rate and place a limit on the maximum attainable heart rate. This in turn can place a limit on the cardiac output.

Disease processes affecting the cardiovascular system may further affect its performance when faced by the physiological challenges of traumatic injury. Infiltration by amyloid deposits or pre-existing myocardial damage may impair conduction pathways, predisposing individuals to arrhythmias such as atrial fibrillation.

The presence of atherosclerosis can impair blood flow to vital organs. This in combination with hypovolaemia secondary to traumatic blood loss can have a major effect on auto-regulation and lead to the development of severe organ injury even with a moderate degree of hypotension.

Taking all of these features into consideration, **standard "abnormal" parameters of physiology that are used to define states of shock and cardio-respiratory distress are not always applicable to the elderly patient**.

Co-morbidity

In addition to the ageing process, genetics and/or habits and behaviours acquired over the course of an individual's lifetime may predispose them to illness and deteriorating function, e.g. the smoker with COPD.

Taking a patient who has fallen and sustained a head injury as an example, the ageing brain undergoes a degree of cerebral atrophy, shrinking in the process. This "shrinking effect" pulls the subdural veins taut and leaves them at greater risk of tearing following a fall. A younger individual is extremely unlikely to have such a degree of atrophy so the veins aren't under as much pressure and are thus less likely to tear.

A young patient with rib fractures may fare better than an older patient with COPD. The young patient may be sent home with simple analgesia and chest exercises but the older patient may require admission for oxygen therapy and formal chest physiotherapy to prevent collapse and consolidation.

If the patient has COPD, the delivery of oxygen is determined in terms of whether they retain CO2 and need targeted O2 saturations. This contradicts standard principles of trauma care which recommend the delivery of high flow oxygen to all patients.

All individuals are unique and need a bespoke approach to their care. **HECTOR believes that all clinicians responsible for providing acute trauma care should have a basic understanding of managing acute medical illness.** Without such knowledge, elderly patients are unlikely to receive high-quality care and more likely to be at risk of developing unnecessary complications.

Certain co-morbidities are associated with a higher level of mortality than others. One retrospective review found that previous CVA (p=0.003), a history of CCF (p=0.0009) and a higher number of co-morbidities (p=0.0273) were significantly associated with mortality[2]. Other studies have identified that the presence of hepatic, renal disease or active cancer significantly increase mortality.

HECTOR believes that all elderly patients being admitted to hospital should have a formal review of their past medical history and drug history during the initial stages of resuscitation. All co-morbidities should be documented in the patient's records and this may involve reviewing old clinic letters, discharge summaries or speaking to family members to gain as much information as possible.

Polypharmacy

Elderly patients with underlying illness may be taking a myriad of medicines that can alter their physiology and response to injury.

Beta-blockers are one of the commonest prescribed medicines. They cause a blockade of B-adrenoceptors, leading to blunting of the contractile and inotropic cardiac response. This coupled with age-related densitisation of receptors to sympathetic outflow may conceal an obvious physiological response to injury.

Warfarin and novel oral anticoagulant medications are often prescribed to patients with a risk of thrombo-embolism (e.g. patients with metallic prosthetic heart valves, concurrent or previous DVT/PE or atrial fibrillation). **Any patient who has sustained an injury whilst taking warfarin or one of the novel anticoagulants should be deemed as being at high risk of catastrophic haemorrhage.**

B. Triage Considerations

Pre-hospital triage tools often refer to features such as: abnormal physiology; abnormal anatomy; and mechanism of injury as part of the decision-making process about whether a patient warrants Level I Major Trauma Centre transfer or can be managed in a local unit.

Such tools often use mechanism of injury as a factor but fail to take into account an individual's age. Taking normal physiological and anatomical ageing processes into consideration, an older person struck by a car is more likely to suffer significant injuries than a younger person. **High mechanisms of injury in older individuals therefore warrant a higher degree of suspicion for severe traumatic injuries than in younger patients.**

There are particular mechanisms of injury that cause concern, irrespective of age group:

- High speed Road Traffic Collisions (high speed rollover; ejection; death in same compartment; prolonged entrapment)
- Pedestrian Traffic Accidents;
- Falls from height or down a full flight of stairs;
- Penetrating torso trauma.

One mechanism of injury that is often ignored is a simple fall from standing. **Fall from standing is by far the commonest mechanism of injury in the elderly age group.** A local survey of 195 patients with TARN-qualifying injuries presenting to the HECTOR site found that simple falls were by far the commonest mechanism of injury, (see below).

Such low-energy mechanisms may not alert pre-hospital or in-hospital triage teams to the possibility of severe underlying injury. This could lead to under-triage and delayed care. A 2003 retrospective Pennsylvania-based study[3] found that only 36.6% of patients over the age of 65 were treated in a level 1 centre compared to 47% of those under 65 ($p<0.001$), when adjusted for AIS and ISS.

Another study of the Maryland Ambulance system[4] found that the rate of under-triage (patients not taken to Level I centres despite having significant injuries), was higher for patients over the age of 65 years (49.9% vs 17.8%, $p<0.001$).

Under-triage means that patients are not taken to the most appropriate centre to deal with their injuries. The Maryland paper identified a lack of training, unfamiliarity with protocol and age bias as factors that led to under-triage of elderly patients. **HECTOR believes all sites need to be aware of the risks of under-triage and develop internal triage systems which can cater for such issues.**

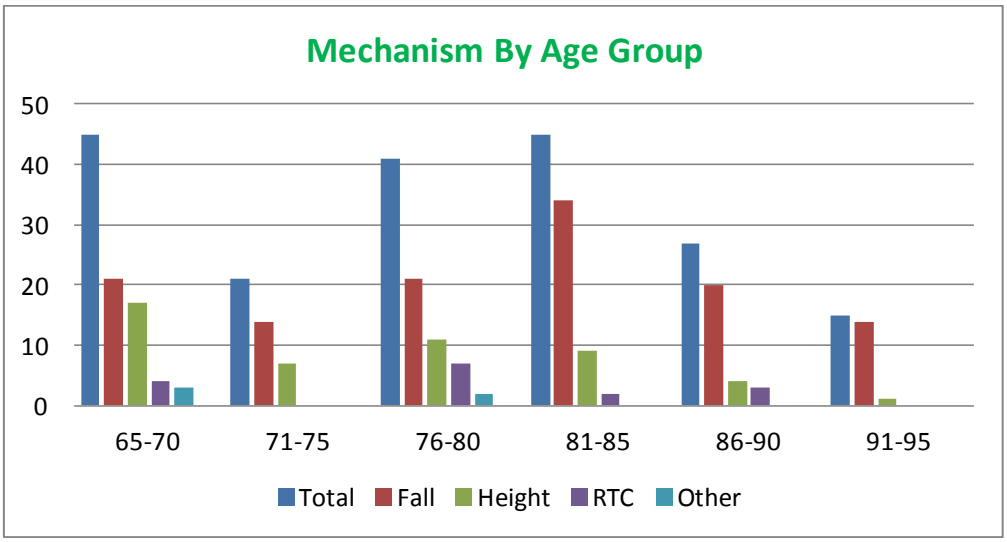

Fig 1. A retrospective survey of injury mechanism for patients over 65 at the HECTOR site

Suggested Adaptation to Pre-Hospital Triage Guidelines

EAST GUIDELINE[5]	OHIO REGISTRY REVIEW[6]
Age >65 and co-morbidity should lower the threshold for Level I Trauma Centre Care	GCS <14 with suspected head injury
	Systolic Blood Pressure < 100mmHg
	Fall from any height with head injury
Severe anatomic injury (AIS >3) in more than one body region should warrant Level I Trauma Centre Care	Multi-system injuries
	Patient struck by moving vehicle
	Long bone fracture after RTC

C. Training Considerations

UK-based trauma training relies heavily on the (ETC) European Trauma Course and ATLS (Advanced Trauma Life Support). Both are unique but both tend to focus on injuries as opposed to the underlying patient with those injuries.

HECTOR acknowledges the skill-set and knowledge that both courses teach and recognises the importance of core principles in the management of any patient with traumatic injuries.

There is very little coverage of trauma care for the injured elderly patient in these manuals, and population-based surveys have shown that this demographic has been increasing over the last few years.

It is just as important to know how to treat complications of injuries as it is the injuries themselves. This is even more relevant if a patient has underlying illness that could leave them vulnerable to future complications, (e.g. diabetes mellitus and infection). Guidance may be taken from the National Institute of Clinical Excellence (NICE), European Society of Cardiology (ESC), British Thoracic Society (BTS), Royal College, and Local Hospital practice.

Specific guidance can be found in the 2012 Silver Book which recommends advanced approaches for the delivery of care to injured elderly patients[7]. Up to date evidence will be used throughout this manual to introduce key concepts in the care of elderly patients.

HECTOR believes that trauma care should be patient-centred, holistic and "total". **Assessment and management should not cease once primary, secondary and even tertiary surveys have been completed. Assessment is an ongoing process and information obtained in the acute stages of presentation can have a major impact on later care.**

D. Considerations for Recovery

Patient-Centred Recovery

Injury-focussed care will look at an individual as having femoral shaft fracture in isolation. Once a patient has been admitted, plans will be taken to fix the

fracture and get the patient mobilising when it is safe to do so.

For the elderly patient, such practice is still required, but requires a higher level of patient-centred care to prevent complications and promote quicker recovery. For example, if this patient receives high levels of opiate analgesia, this may depress their respiratory level, leaving them at higher risk of basal atelectasis, especially if they are bed-bound or unable to expectorate properly.

This may predispose them to developing a hospital acquired infection with the possibility of developing delirium. All of these factors would contribute to an increased length of stay and increased recovery time in the hospital.

Further delays in taking the patient to theatre with prolonged periods spent Nil By Mouth could predispose them to dehydration and renal impairment, which would need medical treatment and lead to a prolonged patient journey.

Individualised, patient-centred care should be adopted to take all co-morbidities into consideration and focus on preventing complications that may result from the injury or as a consequence of the management of that injury.

Multiple elements of care are needed in the day-to-day management of elderly patients with injuries and HECTOR introduces a structured tool that tailors daily ward-based assessment to individualised needs.

Preventing Delirium

Delirium is a common cause of mortality and morbidity for any elderly patient admitted to hospital, affecting between 20-80% of patients. It can increase mortality by 2-5x and lead to prolonged length of stay, increased morbidity and increased discharge to care settings[8].

It is a syndrome characterised by fluctuating levels of consciousness which can lead to a hyperactive or hypoactive state in comparison to the patient's baseline status. It can be due to almost any underlying illness but in general terms, a simple mnemonic can be used to screen for the root cause:

P	Pain
In	Infection
C	Constipation
H	Hydration
Me	Medications

Taking this into consideration, an elderly patient with rib fractures and a femoral shaft fracture may be in pain without appropriate analgesia. They might have basal atelectasis from: supine positioning; reduced cough; and chest wall discomfort thus predisposing them to developing lower respiratory tract infections.

Furthermore, the opiate analgesia given to them in the Emergency Department could leave them vulnerable to constipation. Abdominal bloating and distension from constipation would then discourage them from eating and drinking leading to dehydration and poor nutrition.

All of these features could be prevented by first recognising the effects that injuries have on patients, and by secondly recognising how our treatments and management can also affect an individual.

Any patient with changes in their baseline state at admission should have a formal top-to-toe reassessment, looking specifically for root causes of delirium.

HECTOR will introduce such assessments in later chapters with a view to implementing this in practice

Falls Prevention & Risk Assessment

The majority of elderly patients with injuries present following a simple fall. Just as important as getting patients back on their feet, is ensuring that they are fully assessed for future risk of falls and preventative measures are put in place.

This could involve confidence-building therapy on the wards, adjusted use of mobility aids or changes to the home environment before discharge.

All of these factors need to be taken into consideration at the earliest possible stage and implemented sooner rather than later to prevent unnecessary delays once a patient is fit for discharge.

Equally important is to address issues that may make elderly patients vulnerable once they are discharged. Addiction to alcohol should be addressed and dealt with during admission by appropriate liaison teams. If maltreatment is considered or suspected in the context of this patient group, early safeguarding referrals should be made to local teams to investigate further

Summary

- The main philosophy of HECTOR is the treatment of a patient with injuries and not the treatment of injuries on a patient

- Accurate history-taking, in combination with thorough examination is a fundamental aspect of trauma care. All clinicians responsible for managing such patients should possess a core background knowledge of trauma care **and** acute medical care.

- Standard "abnormal" parameters of physiology used to define states of shock and cardiorespiratory distress may not always be applicable to the elderly patient. Underlying disease, the ageing process and polypharmacy all contribute to varying physiological responses to injury.

- It is important to be aware that "low energy" mechanisms such as simple falls are more likely to lead to injury in older patients. Furthermore, "High energy" mechanisms are more likely to lead to significant and possibly life-threatening multi-system injury.

- All sites managing elderly trauma patients need to be aware of the risks of under-triage and age-related bias for pre-hospital conveyance and develop internal triage systems to manage this risk

- Assessment of the trauma patient does not stop after the acute phase of care. It is an ongoing process and essential for preventing delirium which will delay an individual's recovery.

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PART I: THE IMMEDIATE ASSESSMENT AND TRAUMA SURVEYS

Chapter 2 – Triage

Introduction

Existing trauma courses focus on a vertical or horizontal approach to the ABCDE assessment of an injured patient:

A	**-**	**Airway**
B	**-**	**Breathing**
C	**-**	**Circulation**
D	**-**	**Disability**
E	**-**	**Exposure**

This remains the standard of care, with adjustments made to give greater priority to the assessment of circulation and the cervical-spine on the assessment ladder.

The horizontal approach favours the concurrent assessment of ABCDE normally performed by a team of practitioners. The vertical approach ensures that an assessment of each area occurs in sequence and is usually performed by a sole clinician.

In the Emergency Department, elderly patients may present in one of two ways – they might be alerted in whereby the paramedic team forewarn the ED about their imminent arrival, allowing the department to mobilise a trauma team if required.

Alternatively, elderly patients may be under-triaged, arriving to wait in the same queue as other patients. In this situation, they might be assessed by a single clinician. This circumstance may also arise if a hospital inpatient falls on the ward and sustains an injury – it is more likely that one practitioner will assess the patient and a vertical ABCDE approach is used.

Irrespective of how patients present, the quality of in-hospital triage is crucial in initiating the appropriate hospital response.

Patients with significant mechanisms of injury or severe anatomical and/or physiological derangement are more likely to need a trauma team approach than the patient who presents in a stable condition following a simple fall.

The Trauma Team

Most trauma networks will have a pre-hospital triage tool that Emergency Response Teams use to determine whether patients should be taken to a Major Trauma Centre or Trauma Unit.

An example of such a tool is illustrated below and trauma teams will be activated (or not) on the basis of abnormal physiological signs, abnormal anatomy or mechanism of injury.

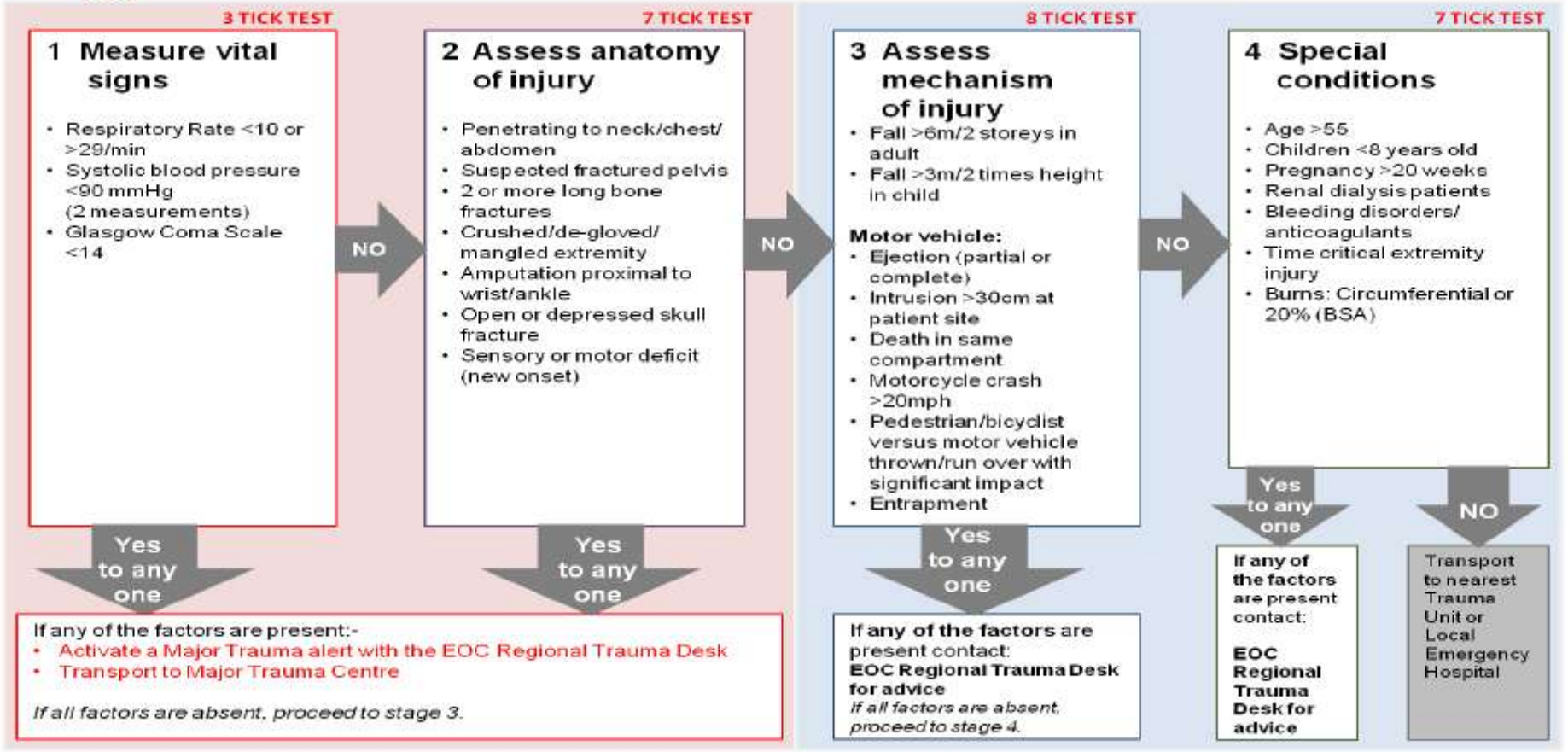
Such tools allow a measured response from hospital teams in the form of mobilising a trauma team. The teams will often consist of: a trauma team leader (usually ED staff); anaesthetists to manage the airway, disability assessment and c-spine; speciality or ED staff to perform BCE assessments; and members of the Nursing team or advanced practitioners for additional support.

This triage system is useful for patients in extremis or with high mechanisms of injury. In-hospital teams should not question the decision or judgement of pre-hospital teams until they have assessed the patients themselves. In short, it is far safer to mobilise the trauma team once requested, assess the patient, and review performance and decisions once patient care has been delivered.

Major Trauma Triage Tool

Entry criteria for this triage is a judgement that the patient may have suffered significant trauma

West Midlands Ambulance Service NHS
NHS Trust



There is a risk of under-triage with tools that are insensitive to age-based differences in physiology and anatomy. Elderly patients may be in hypovolaemic shock with a systolic blood pressure of 110mmHg and yet would not trigger direct transit to a Level I centre.

Understanding Under-Triage

It is important for the triage team to have an understanding about why elderly patients might be under-triaged. This normally occurs as a result of different physiological responses to any given injury hence patients may not activate the pre-hospital triage tools, but can also be due to age-related bias and perceptions in the pre-hospital setting that a patient may not be suitable for MTC/Level I Trauma Care.

A US Study reviewed all patients admitted to a trauma service over a ten-year period and defined under-triage as having an ISS > 15 but not having formal trauma team activation by pre-hospital or in-hospital teams[1]. Of 4534 elderly patients, 15.1% were under-triaged and the study identified that these patients were more likely to die when corrected for GCS, Revised Trauma Score (RTS), the occurrence of >1=complication and whether they were taking warfarin.

Such studies demonstrate the risks of under-triage and highlight the need to understand why it occurs in order to develop mechanisms to manage this risk.

Falls & Under-Triage

Same-level falls are often perceived to be a low mechanism of injury and unlikely to cause significant trauma. One study looked at trauma data and compared patients aged 65 years or less to patients aged over 65 years and found that falls were the injury mechanism in 48% of the older group and only 7% of the younger group ($p<0.05$)[1].

This same study identified that 32% of all falls resulted in serious injury (ISS > 15) for older patients compared to 15% in the younger group ($p<0.05$). Similarly same-level falls led to serious injury 30% of the time in the older group compared to 4% in the younger group ($p<0.05$). The following injury types were also recognised between groups:

	>65 years	65 or less	
Head/Neck	47%	22%	P<0.05
Chest	23%	9%	P<0.05
Pelvic/Extremity	27%	15%	P<0.05

In light of such evidence, it is important that triage teams are aware that same-level falls in elderly patients are COMMON and CAN RESULT IN SERIOUS INJURY.

Physiology & Under-Triage

If pre-existing triage tools list hypotension (systolic blood pressure < 90mmHg) and low GCS (<14) as markers of compromise, this may lead to under-triage of elderly patients.

If an individual suffers from hypertension, they may have a significant drop from their baseline measurement due to haemorrhagic shock, but present with a systolic blood pressure above 90mmHg. It is important in patients with hypertension to evaluate the initial blood pressure measurements in accordance with previous blood pressure (if available from hospital records).

A US Level 1 trauma centre retrospective review identified that mortality increased in elderly trauma patients with a systolic blood pressure of <110mmHg. This same

association was not seen in younger patients until the blood pressure dropped below 95mmHg[3].

A separate study demonstrated that elderly patients appeared less likely to tolerate relative hypotension with higher mortality at initial systolic blood pressures of 90 - 130mmHg[4]. However, this study suggested that if such criteria were to be used as predictors of injury severity, they would need to be adjusted for different age groups.

Both studies highlight the fact that pre-existing triage tools with a systolic blood pressure cut-off of <90mmHg will fail to identify elderly patients with significant injuries who have a higher SBP. It is important for in-hospital teams to be aware of this fact and incorporate a higher index of suspicion for injury at higher SBP levels.

A 2014 UK-based study[5] found that presenting GCS was higher in elderly patients than younger patients for each level of AIS-related head injury. This difference was noted to be more apparent in the presence of the most severe injury types (AIS 5). From this study, it is possible to extrapolate that older patients may have a significant head injury and not trigger the triage tool because they will have a higher initial GCS than younger patients.

Anatomy of Injury & Under-Triage

Patients with penetrating torso trauma are likely to be transferred directly to a Major Trauma Centre unless they require immediate resuscitation at a Trauma Unit prior to transfer. One study reviewed 29,736 patients with vascular injury and identified 2268 elderly patients. This group were less likely to have penetrating injuries (16.1% vs 54.1% in younger group; p< 0.001), yet had a higher ISS (26.6 vs 21.3; p<0.001). Furthermore, the older group had a fourfold increase in mortality following vascular injuries (OR 3.9; 95% CI 3.32-4.58), with a higher incidence of injury to the thoracic aorta than in younger patients[6].

Such studies highlight the fact that older patients may be under-triaged to units without appropriate specialist provision for vascular trauma because they are more likely to be a result of blunt trauma than penetrating injury. In these circumstances, the triage team need to consider high mechanisms of injury (e.g. road traffic collisions, falls from height), as being mechanisms that could precipitate such devastating injuries.

Patients with suspected pelvic fractures are deemed as needing MTC-Level care according to most triage tools. A small US study reviewed 87 patients with severe pelvic injuries and identified that 39% were initially taken to a non-tertiary centre[7]. Of these patients, the two-week incidence of complications was 54% higher in the group of patients who were transferred later to the level I trauma center.

Elderly patients with injuries to the pelvic or groin region are most likely to suffer from pubic rami or neck of femur fractures. Such injuries are extremely common and may lead pre-hospital teams to consider such diagnoses before more significant pelvic injuries. The triage team should manage this risk by evaluating the exact mechanism of injury, with higher mechanisms (e.g. fall downstairs, road or pedestrian traffic collisions), being more likely to cause significant injury.

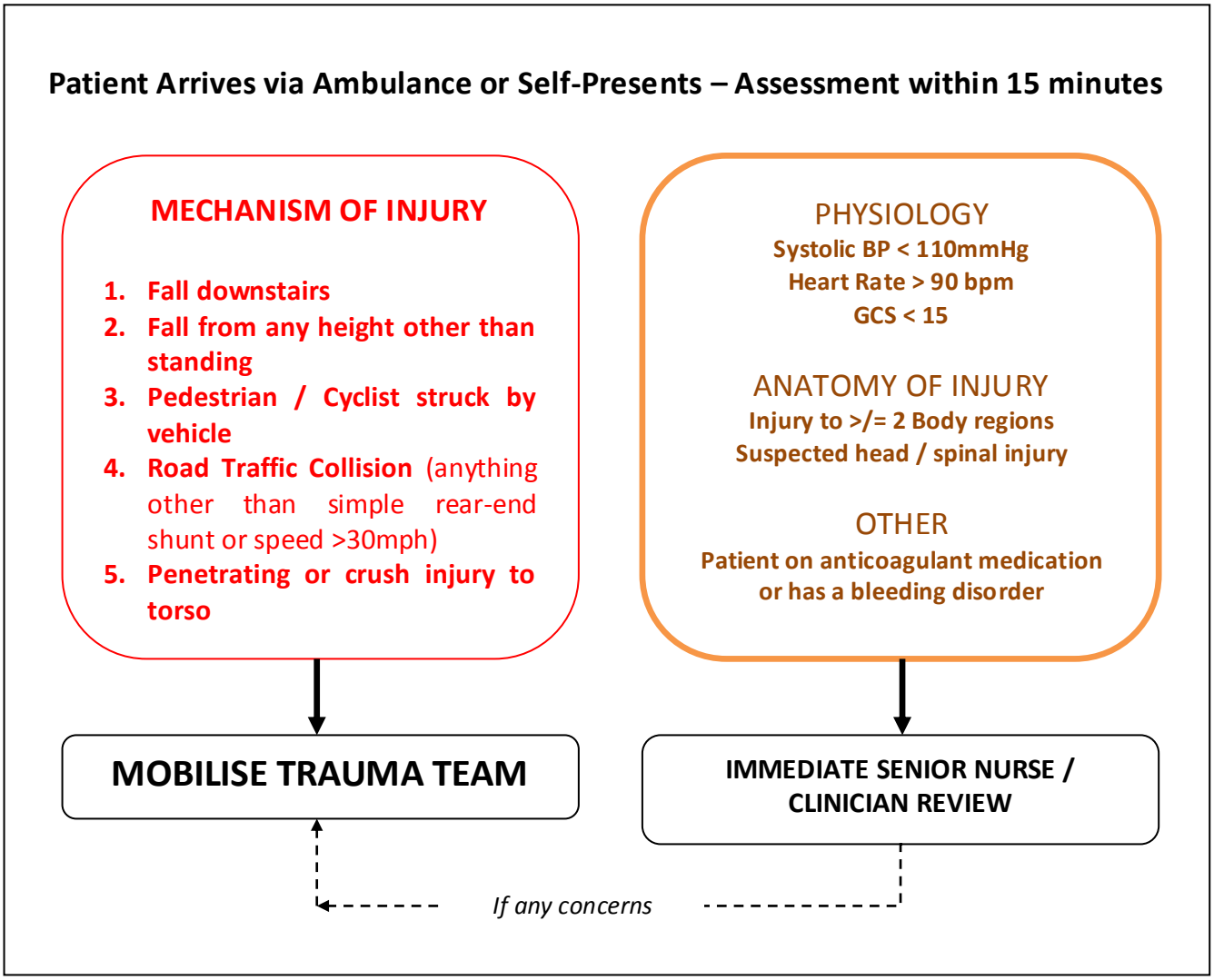
The Triage Team

The maximum time any patient should wait to be triaged is **15 minutes** and there is an expectation on Emergency Departments to tailor their assessment systems accordingly.

Some departments will have an assessment team comprising of: a senior clinician; Nursing staff; and phlebotomists, whereas others will have a Triage desk. Whatever system is in place, there is a need to have a "secondary" filter to manage the risk of under-triaged patients.

HECTOR believes that mechanism of injury plays a pivotal role in determining the correct in-hospital response. Assessment teams can use this in combination with adjusted parameters of physiology and anatomical injury to determine the best course of action.

After the initial assessment, patients will either be assessed by the Trauma Team or by an individual clinician. Irrespective of the individual pathway, all patients should have ABCDE assessed and documented appropriately.



Using Pre-Hospital Information

Most trauma teams will receive direct handover by Paramedic crews. This isn't possible if elderly patients are under-triaged and the crews have already stood down. Attempts should be made to obtain information about the pre-hospital assessment using tools such as the "ATMIST" mnemonic.

ATMIST Handover

A	Age
T	Time of Incident
M	Mechanism of Injury
I	Injuries suspected
S	Symptoms & Signs
T	Treatment

This information can be obtained from ambulance records if ambulance crews have already stood down. It is vital to have a grasp on what occurred to the patient between the point of injury and arrival in hospital.

Even before the primary survey, assessment should be focussed on looking at the "complete picture". For elderly patients, the commonest mechanism is a simple fall – it is important to know why such falls may have occurred and bring this into the primary survey.

Summary

- Individual assessment of patients will either merit a formal trauma-team or individual clinician-led response. As elderly patients are likely to present following low mechanisms of injury, trauma team activations are less likely to occur.
- Underlying knowledge of the reasons for under-triage is an essential component in managing this risk. The team that is aware of the causes of under-triage is more likely to be able to identify the severely injured patient at the point of their arrival.
- Robust triage mechanisms are essential in Emergency Departments to counteract the effects of under-triage from pre-hospital teams – assessment of vital signs, suspected anatomy of injury and consideration of mechanism of injury are key factors in this process.

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Chapter 3: The Primary Survey

The role of the primary survey is to identify immediate life-threatening problems and intervene accordingly. This is one aspect of care that should remain "injury-focussed", but requires tailoring to the elderly demographic.

It consists of the following steps:

- Airway and cervical spine control
- Breathing and ventilation
- Circulation and haemorrhage control
- Dysfunction of the CNS
- Exposure and environmental control

Specific aspects of primary survey management are taught well on traditional courses and won't be covered in full detail. Focus will be placed on the adjustments needed in primary survey assessment when caring for elderly patients.

Airway and Cervical Spine Control

Initial Airway Assessment

Talking to a patient will quickly allow a clinician to establish rapport whilst at the same time allowing them to assess airway patency. Hospitals are unfamiliar environments and patients with dementia may become distressed by such surroundings, especially if they have their neck immobilised.

Clinicians should introduce themselves to patients at the first point of contact and constantly offer explanation and reassurance about what is happening. When a trauma team has been mobilised, the clinician allocated to airway management should be the point of liaison for the patient and establish a continuous dialogue with them where possible.

If a patient is unresponsive or fails to respond appropriately, the airway should be assessed formally:

- **Look** – any signs of obstruction from dentures, foreign bodies, facial fractures
- **Listen** – snoring, stridor, hoarseness
- **Feel** – is there any air movement?
- **Move** – if concerns arise, attempt jaw thrust in the first instance and consider airway adjuncts (nasopharyngeal, oropharyngeal airways)

Advanced Airway Management

Elderly patients may present a greater challenge in terms of rapid sequence induction and intubation. Lifelong development of obesity, altered dentition, reduced neck movement are all predictors of difficult intubation and may develop with advancing age. Once a decision has been made to intubate an elderly patient, it is important that this process is not rushed. Correct procedure should be followed and each patient assessed in terms of predicted difficulty:

LEMON Predictors for The Difficult Airway

LOOK – facial trauma, large incisors, beard or moustache, dentition, large tongue

EVALUATE – 3-3-2 rule (3 fingerbreadths between open incisors; 3 fingerbreadths between chin and hyoid; 2 fingerbreadths between thyroid notch and floor of mouth)

MALLAMPATI SCORE – see below

OBSTRUCTION – presence of any condition that could cause an obstructing airway

NECK MOBILITY – fixed deformity, immobilisation

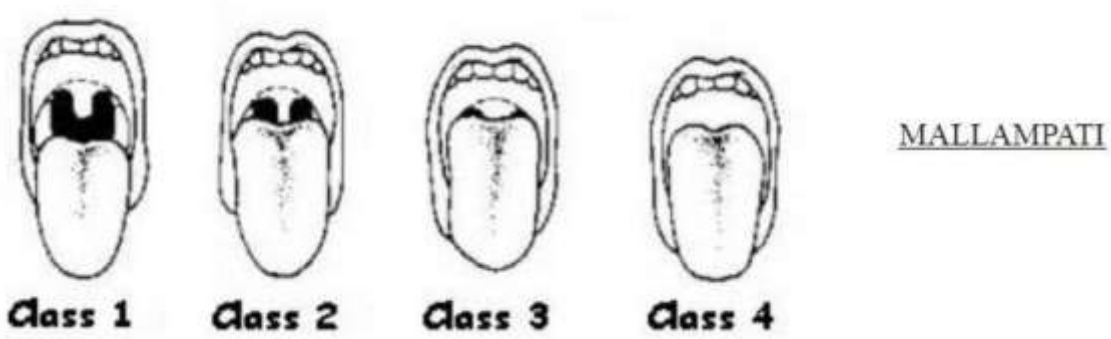
Equipment should be prepared to ensure that rescue devices (e.g. LMA, quicktrach) are available and senior assistance sought earChoice of induction and paralysing agents will depend on user experience and preference. **One of the real concerns for elderly patients is the risk of hyperkalaemia following burns or prolonged immobilisation after a fall**. Tissue and muscle damage leading to rhabdomyolysis can elevate the plasma [K^+] which can be made worse by pre-existing renal impairment or dehydration.

Use of suxamethonium in these patients may cause the potassium concentration to increase by up to 0.5 mmol L^{-1}. Elderly patients should have a venous blood gas performed to estimate the [K+] prior to using suxamethonium or consideration should be given to using a different muscle relaxant like rocuronium.

A 2015 study compared pre-hospital rapid sequence induction of patients using etomidate and suxamethonium against fentanyl, ketamine and rocuronium[1]. Patients in the ketamine group were found to have a higher first pass intubation success (100% vs 95%, p=0.007) and a less frequent hypertensive response to laryngoscopy.

Despite being conducted in the pre-hospital setting, this study suggests that a simple and standardised RSI protocol may improve the safety of the procedure and should be considered to facilitate definitive airway support. It used a 3:2:1 regime for stable patients and a 1:1:1 regime for patients with haemodynamic compromise (see below)

	3:2:1	1:1:1
Fentanyl	3mcg/kg	1mcg/kg
Ketamine	2mg/kg	1mg/kg
Rocuronium	1mg/kg	1mg/kg



Approach to the Cervical Spine

Whilst managing the airway, care must be taken to ensure that the cervical spine is properly assessed. **Any patient over the age of 65 years with head / facial injury following trauma must be considered as being at high risk of having a cervical spine injury.**

The presence or absence of neck pain will vary for different individuals. Some patients may not be able to communicate (e.g. dementia, delirium, aphasia post CVA), in which case the presence of any type of injury above the clavicles should alert the clinician to the possibility of c-spine trauma.

Degenerative arthritic disease, kypho-scoliosis, Parkinsonism with increased rigidity and steroid-associated "buffalo hump" are all examples of conditions that can make cervical spine immobilisation difficult. In the elderly patient, it is not always possible or practical to apply a hard collar. There are case reports of patients being harmed from the forced application of collars[2].

Cervical collars may have the effect of: increasing cerebrospinal fluid pressure; causing pressure sores; reducing tidal volume and affecting breathing; and limiting an individual's ability to swallow. Such complications need to be balanced against the risks of not applying a collar and this need to be assessed on an individualised basis.

HECTOR encourages teams to use collar and block immobilisation if safe to do so and if tolerated by the patient, but if resistance is met by trying to apply such measures. If this is not possible, HECTOR encourages a practice of "*minimal movement*".

"Minimal Movement"

- When a cervical spine injury is suspected and application of a hard collar is not practical, attempts should be made to support the neck in its current position
- **AP Control**: Blankets can be rolled to be inserted behind a patient's neck if the occiput can not lie flat on the trolley.
- **Lateral Control**: blocks, fluid bags or blankets may be used either side of the patient's head, to maintain its current position and be secured with trauma tape.
- Log-rolling should be restricted (i.e to prevent aspiration in the vomiting patient, to change soiled bed sheets).

Clearance of the Cervical Spine

Irrespective of the method of cervical spine control, clearance should be performed by an appropriately trained clinician.

The Canadian Cervical Spine criteria[3] categorises age >65 years as a high risk feature and advocates imaging for any elderly patient where there is clinical concern of injury. By contrast, the NEXUS criterion[4] does not include age but stipulates that if patients meet all of the following low-risk criteria then they do not need imaging:

NEXUS Low Risk Criteria:
a. No posterior midline cervical spine tenderness
b. No evidence of intoxication
c. Normal level of alertness

d. No focal neurological deficit
e. No painful distracting injuries

Clinical acumen is important as distracting injuries, altered conscious levels, previous stroke and neurological deficit can all cloud the decision-making process.

HECTOR advises the following rules be applied for the initial management of cervical spine injury:

1. Assessment of Risk:

A. Any elderly patient with head or facial injury following a fall should be considered at risk of cervical spine injury

B. Any elderly patient with new-onset neck pain following a fall or other mechanism of injury should be considered at risk of cervical spine injury

C. Any elderly patient with a high mechanism of injury (fall from height greater than standing; pedestrian / cyclist vs vehicle collision; road traffic collision) should be considered at risk of cervical spine injury

2. Clearance of the Cervical Spine:

A. If a patient has: a decreased level of consciousness; is intoxicated or confused; has any focal neurological signs or symptoms; or has distracting injuries and has been deemed as being at risk of injury, the cervical spine should not be cleared without imaging

B. Patients without any of these abnormal features should be asked about the presence of neck pain – movement may be assessed in the absence of pain. Restrictions of movement or pain on movement should trigger imaging.

C. CT-Cervical Spine is the imaging modality of choice in the first instance when injury is suspected or can't be excluded.

D. Imaging should be acquired within 60 minutes of request to prevent prolonged lie, immobilisation and distress and be reported within 60 minutes of image acquisition.

Breathing and Ventilation

Life-Threatening Injuries

When breathing is assessed in the primary survey, examination should be focussed on looking for the presence of the following life-threatening chest injuries:

- Tension pneumothorax
- Massive haemothorax
- Open sucking chest wound
- Flail chest
- Cardiac tamponade

Such serious conditions should be treated as they are identified with the use of thoracostomy / tube thoracostomy for tension pneumothoraces and haemothoraces; and 3-sided dressings or Ashermann seals for open wounds.

Respiratory Rate and Ventilation

Respiratory rate and effort of breathing are valuable signs for detecting the presence of serious injury:

- A raised respiratory rate (>20) should alert the examiner to possible injury or illness.

- Slow rates (<12) may uncover fatigue, exhaustion and the possibility of opiate toxicity from drugs administered in the pre-hospital setting.

Arterial blood gas analysis is a fundamental component for assessing ventilation and should be used to guide oxygen delivery. High flow oxygen (15L/min) should be delivered with caution in the presence of chronic lung disease as it may be more appropriate to aim for a lower target oxygen saturation level (88-92%) for such patients.

The vast majority of elderly patients are not admitted following high energy mechanisms and instead attend following simple falls. In these latter and more common circumstances, **high flow oxygen therapy will not be appropriate for every patient.**

Initial oxygen saturations should be targeted to 94-98% for cases of major trauma and adjusted following formal arterial blood gas (ABG) analysis. Addition of supplemental oxygen to patients with COPD has been thought to reduce the "hypoxic drive", thus slowing their respiration and leading to increasing $PaCO_2$.

If a patient is deemed as being at risk of hypercapnic respiratory failure, (see below), oxygen saturations should be targeted to 88-92%.

Risks Factors for Type 2 Respiratory Failure

- Severe / moderate COPD
- Previous respiratory failure
- Long term oxygen therapy
- Severe chest wall disease
- Severe spinal disease (e.g. kyphoscoliosis)
- Neuromuscular disease
- Severe obesity
- Bronchiectasis
- Previously unrecognised COPD – lifelong smoker, chronic breathlessness on minimal exertion

HECTOR encourages the initial prescription of high flow oxygen to patients with major trauma (multi-system injuries; high mechanisms), until an ABG can be performed to deliver targeted therapy.

In the absence of COPD and risk of hypercapnic failure, oxygen should be then prescribed to achieve saturations of 94 – 98%.

For patients with injuries following simple falls and low energy mechanisms, high flow oxygen therapy should be stopped completely on arrival to the emergency department and adjusted to according to the presence of chronic lung disease.

Circulation & Haemorrhage Control

Traditional trauma courses like ATLS make reference to the American College of Surgeons classification of shock in terms of clearly defined parameters associated with increasing volumes of blood loss.

The descriptors for Class I, II, III and IV shock are based on an average 70kg patient and are not specific for age. Furthermore, they don't take into account ageing physiology, underlying disease such as hypertension or polypharmacy – all of which can alter cardiovascular physiology.

Existing evidence has suggested that **mortality increases in elderly patients**

when their heart rate increases above 90 beats per minute, an association not seen in younger patients until the rate increases above 130 bpm.

Similarly, **mortality in elderly patients increases when the systolic blood pressure drops below 110mmHg**, although this relationship is seen in younger patients when the blood pressure falls below 90 mmHg.

What this means is that, what in a younger person may be considered as being normal, is abnormal in an older person, and this may lead to a failure to accurately diagnosis shock.

HECTOR believes in a systematic approach for the diagnosis of shock which uses all of the following information:

A. **Mechanism of injury**
B. **Regional clinical assessment**
C. **Occult hypoperfusion**
D. **Assessment of coagulation status**

A. Mechanism of Injury

The majority of injured elderly patients sustain their injuries from same-level falls. For the vast majority of cases, such mechanisms of injury would not alert the assessing clinician to the possibility of major haemorrhage.

Taken in isolation, this may be the case, but if you consider a patient with a fractured shaft of femur who is on warfarin, haemorrhagic shock can develop quickly. **Looking at any of these factors in isolation is meaningless – the global picture is important in assessing the possibility of hypovolaemic shock.**

Higher energy mechanisms of injury such as falls from height; road traffic collisions and penetrating trauma may lead the examiner to be more vigilant for the possibility of major injury and hence have a lower threshold for suspecting shock.

Again, the global picture is essential to determine the underlying state.

Mechanisms of Injury That Cause Concern

- Fall from height
- Fall downstairs
- Vehicular collision >30mph
- Pedestrian vs Vehicle
- Ejection from Vehicle
- Penetrating trauma chest / abdomen

B. Regional Assessment

A set of observations must be taken to ensure that baseline heart rate, blood pressure, respiratory rate and Glasgow Coma Score are documented.

Abnormal vital signs might be difficult to distinguish in the elderly patient. Increases in heart rate may be limited by a lack of sympathetic tone or the prescription of beta blockers. Such patients may not mount a tachycardic response to blood loss and a seemingly normal heart rate could conceal overt blood loss.

In terms of blood pressure, if an elderly patient suffers from hypertension and has a resting systolic blood pressure of 180mmHg for example, a drop in pressure to 150mmHg may not be interpreted as significant yet there could be underlying blood loss.

HECTOR advocates that a lower limit of

heart rate and a higher level of systolic blood pressure be used to highlight concern to the examining clinician:

Consider the Possibility of Overt / Occult Blood Loss if:

Heart Rate > 90 bpm

and / or

Systolic Blood Pressure <110mmHg

In isolation, abnormal observations may be due to trauma but could equally be a consequence of underlying illness which may have precipitated the incident in the first place. This stresses the importance of a global view in the diagnosis of shock and an assessment of its severity.

Other features such as skin colour, clamminess, sweating, and capillary refill time should be considered during an assessment of circulation.

Having performed routine observations, the assessing clinician should perform a head-to-toe assessment of circulation, looking at specific areas of the body.

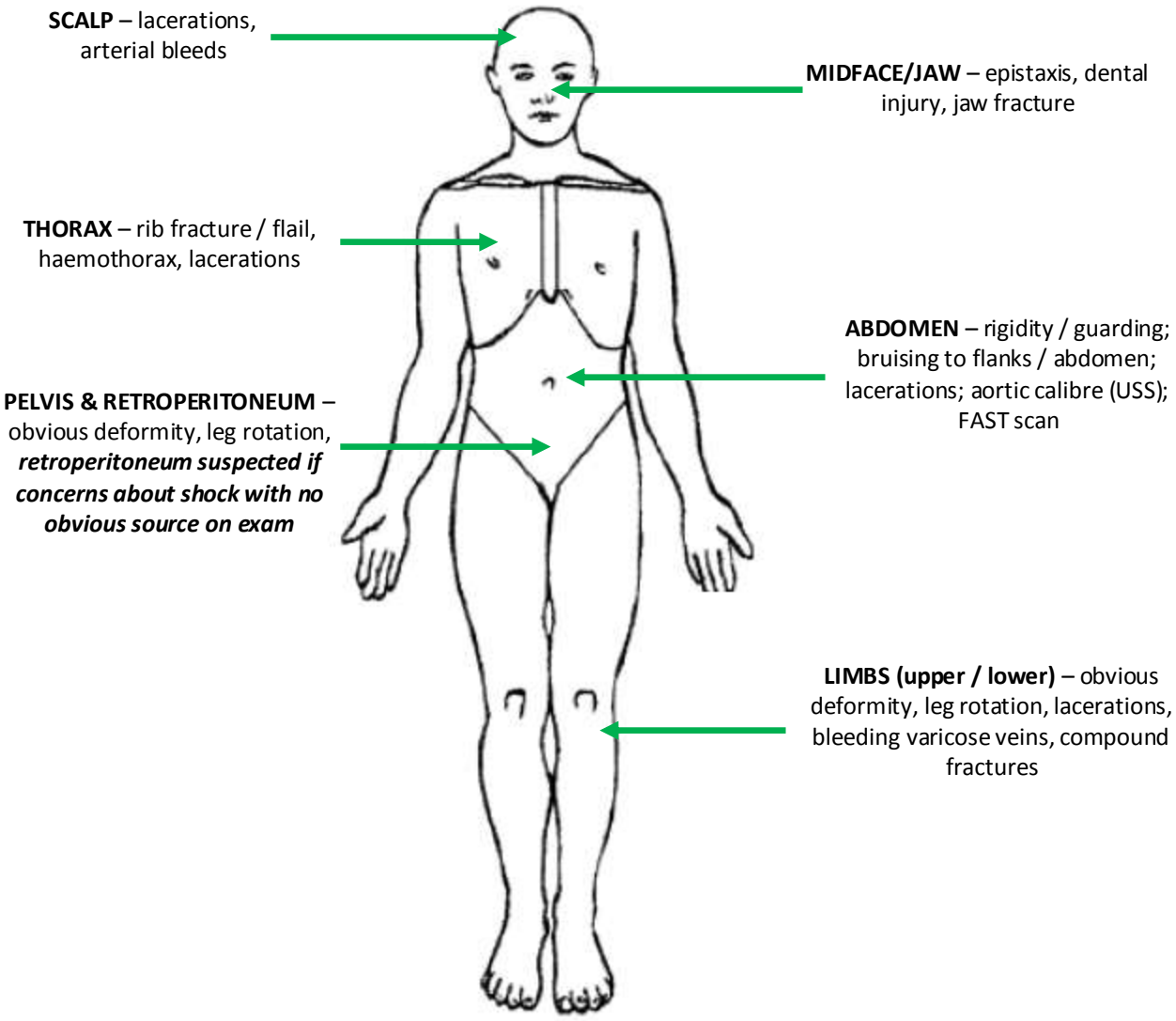
Overt bleeding is relatively straightforward to identify on external examination – this could be from scalp lacerations, deformed limbs or facial injuries (e.g. epistaxis).

As soon as overt bleeding is identified, measures should be taken to halt the bleeding, (i.e. splintage of limbs, suturing of wounds, cautious nasal packing).

Patients with bleeding into the chest, abdomen, pelvis and retroperitoneum might be harder to identify. Ultrasound can be used to assess for free fluid in the chest or abdomen and also to quantify abdominal aortic calibre. HECTOR recommends the visualisation and assessment of the abdominal aorta by trained personnel if FAST is being used.

Extended FAST scanning has high specificity but a low sensitivity which is user dependent. It should only be used as a mode of “rule in” for significant injury and not used for its exclusion.

Retroperitoneal bleeding should be considered if hypovolaemic shock is suspected and no obvious cause is identified. In such circumstances, CT imaging would be appropriate to identify the source of bleeding.



Areas to Assess for Circulation

C. Occult Hypoperfusion

Occult hypoperfusion can be defined as the presence of reduced organ perfusion in the absence of abnormal vital signs. In the context of trauma, this reduced perfusion should be suspected as resulting from haemorrhagic shock until proven otherwise.

A raised venous lactate could predict mortality (OR 2.62; p<0.001) whereas abnormal vital signs (HR >120; SBP <90) and a shock index (HR/SBP) > 1 may not (OR 1.71; p = 0.21 and OR 1.18; p = 0.78 respectively)[5]

A venous lactate > 2.5 equates to a two-fold increase in mortality compared to patients with normal vital signs and a normal lactate.

HECTOR proposes that all injured elderly patients have blood gas analysis to assess lactate. If this is above 2.5, then the initial response should be to seek sources of haemorrhage.

If no sources of haemorrhage are identified, the assessing team should review the patient and assess for the possibility of sepsis, dehydration, and polypharmacy (e.g. metformin), and the patient treated with intravenous fluid rehydration as appropriate.

D. Assessment of Coagulopathy

Iatrogenic Coagulopathy

One of the first questions to ask any injured elderly patient should be: IS THIS PATIENT ON WARFARIN OR OTHER NOVEL ANTICOAGULANT AGENTS? Relatively minor trauma can have a profound effect if a patient has been prescribed warfarin. Any such patient should be deemed as being at *high risk* for occult and overt haemorrhage and vigilance taken for assessing all regional areas.

Warfarin is a coumarin that is commonly prescribed for: stroke prevention in patients with atrial fibrillation; patients with metallic heart valves; and for patients with a history of DVT / PE. Warfarin inhibits the vitamin K-dependent synthesis of clotting factors II, VII, IX and X. The International Normalised Ratio (INR), is used to measure dose adequacy with high levels corresponding to risk of bleeding and low levels increasing the risk of thrombosis.

Warfarin may be reversed through the use of intravenous vitamin K, Fresh Frozen Plasma or Prothrombin Complex Concentrate (beriplex, octaplex). In the context of acute trauma with major or life-threatening bleeding identified, a target INR < 1.5 should be maintained. The risk of acute bleeding should supersede the risk of thromboembolism in acute situations as this risk can be mitigated later.

Anticoagulant	Indication	Monitoring	Reversal Agent
Warfarin Vitamin K recycling antagonist Affects Vitamin K-dependent factors II, VII, IX, X Half-life 20-60 hours	Stroke Prevention in Atrial Fibrillation; Metallic heart valves; History of DVT / PE	INR	Life-Threatening Bleed *(e.g. intracranial, intra-abdominal/thoracic):* - Vitamin K 5mg iv - Prothrombin complex concentrate (as per INR): *e.g. beriplex* INR 2- 3.9 25 u/kg INR 4- 5.9 35 u/kg INR >/= 6 50 u/kg Major Bleed - Vitamin K 5mg iv - Fresh Frozen Plasma (15mls/kg)
Dabigatran Direct Thrombin Factor IIa inhibitor	Recent Acute Coronary Syndrome	None available	No reversal agent but consider PCC

Half-Life 12-17 hours	Stroke Prevention in Atrial Fibrillation Thromboprophylaxis in Total Hip / Knee Replacement		
Rivaroxaban Direct factor Xa inhibitor Effects last 8-12hrs Xa levels normalise within 24 hours	Stroke Prevention in Atrial Fibrillation; Thromboprophylaxis in Total Hip / Knee Replacement	None available	No reversal agent
Enoxaparin Binds to antithrombin III, thus inhibiting factors Xa and IIa Half-life 4.5 hours	Thromboprophylaxis and Treatment of Thrombo-embolism; Acute Coronary Syndrome; Abdominal Surgery	Anti-Factor Xa not usually recorded	Protamine can cause ~60% of antithrombin III effect

Acute Traumatic Coagulopathy

A high proportion of patients present to major trauma centres with established coagulopathy on their arrival. Trauma leads to tissue factor exposure and a subsequent cascade of coagulopathy. Different models exist but essentially comprise a mixture of clot formation, clotting factor consumption and hyper-fibrinolysis.

Coagulopathy is worsened in the presence of the "lethal triad" of:

- hypothermia,
- acidosis and
- worsening coagulopathy.

Attempts should be made to limit the detrimental effects of this "lethal triad" by a combination of the following actions:

A. Rapidly identify any haemorrhagic focus and control this appropriately;

B. Warm the patient by removing wet clothes, using Bair huggers / blankets and using warm intravenous fluids;

C. Correcting acidosis whether due to respiratory or metabolic causes

All elderly patients should have a temperature recorded in the primary survey with the aim of targeting an ideal temperature range of 35 – 37^{O}C. Some elderly patients may present following a long-lie and may have become hypothermic due to immobility or underlying conditions such as hypothyroidism. In such circumstances, clinical staff must ensure that warming occurs as soon as possible.

Diagnosis of Coagulopathy

In order to recognise the possibility of acute traumatic coagulopathy, all patients should have standardised tests performed with the aim of targeting specific levels.

Parameter	Target
Haemoglobin	**> 80 g/L**
Platelets	**>100 x 10^9/L**
INR	**< 1.5**
Fibrinogen	**>2.0 g/L**

Patients with blood results outside these parameters should be discussed with the on-call haematologist. If massive transfusion protocols are not being activated, targeted transfusion regimes may lessen the impact of coagulopathy.

Responding to Hypovolaemic Shock

If haemorrhagic shock has been identified, immediate action should be taken to arrest the source of bleeding whilst ensuring adequate resuscitation. Haemodynamic instability and/or occult hypoperfusion with evidence or suspicion of major bleeding should merit massive transfusion activation.

All patients needing blood transfusion following trauma should be given 1g tranexamic acid iv, (unless contra-indicated), within 3 hours of the injury. This initial bolus may need to be followed by a further infusion over 8 hours.

Blood products should be given as per regional guidelines, with some centres offering a ratio 1 PRC: 1 FFP: 1 Platelets and some offering 1.5 PRC: 1 FFP with platelet infusion dependent on initial levels. Such processes may be stood down or altered in light of haematological parameters and the patient's underlying status.

Methods of stemming sources of bleeding include anything from: simple pressure to tourniquets to sutures for external wounds; splinting of long limb fractures; pelvic splintage; interventional radiology for internal bleeding; and damage control surgery.

Primary Survey Assessment of Circulation in the Injured Elderly Patient

Assessment of circulation must take into account the following features in combination

A. MECHANISM OF INJURY

- Higher mechanisms of injury should warrant higher levels of vigilance for the possibility of major haemorrhage
- Low mechanisms of injury may be significant if the individual has coagulopathy (e.g. warfarin, anticoagulant use)

B. REGIONAL ASSESSMENT:

- Baseline observations should be performed for all patients as soon as possible
- Heart Rate > 90 bpm should be considered significant
- Systolic Blood Pressure < 110 mmHg should be considered significant
- An ECG must be performed if any arrhythmias are identified
- All body regions should be examined for occult and overt haemorrhage and any bleeding source controlled as soon as it is identified
- A suspicion of haemorrhagic shock and no obvious source should raise concerns about retroperitoneal and/or pelvic bleeding

C. OCCULT HYPOPERFUSION:

- A raised lactate (>2.5) in the presence of trauma should alert the examiner to the possibility of haemorrhage
- After thorough assessment and imaging, if haemorrhage is not identified, alternative causes for raised lactate should be sought – sepsis, dehydration, pharmacy (metformin)

D. COAGULOPATHY:

- The following question must be asked "Is The Patient On Anticoagulant medication?"
- All patients to have Hb, Platelets, INR and Fibrinogen levels assessed and acted on appropriately.

Disability & Environmental Control

In the primary survey, the clinician responsible for airway assessment should record pupil size, reactivity and Glasgow Coma Score. Attempts should be made to clarify if there are any pre-existing disease states that have affected pupillary size / response, (e.g. cataracts).

A gross neurological examination should be conducted to look for any signs of weakness, with the caveat of questioning for the presence of existing weakness and previous stroke / degenerative conditions.

All patients should be placed in hospital gowns and have wet clothes removed. Temperature control is vital at this point and all elderly patients should have blankets to maintain an adequate

temperature.

A significant proportion of elderly patients may have been exposed to low ambient temperatures after a fall, or their level of activity may have been significantly reduced causing a drop in their core temperature. Hypothyroidism and myxoedema coma are diagnoses that should be considered if patients present following a fall with a low core temperature.

Efforts taken to raise the core temperature above 35°C, (ideally 36°C – 37.4°C) should start early during the primary survey. Blankets and Bair Huggers may be used and efforts taken to ensure that patients are not left exposed on a hospital trolley for longer than is necessary.

Summary

- The Primary Survey is conducted to identify any immediately life-threatening conditions and to manage them as they are found.

Airway

- Patients needing definitive airway management should be managed in a controlled manner. Recent pre-hospital evidence suggests that standardised RSI protocols (fentanyl, ketamine, rocuronium), can help to provide safe and effective care.

- Elderly patients with injuries in need of RSI are likely to have multi-system or head and neck trauma. They should be assumed to have a cervical injury until proven otherwise and care should be taken to minimise neck movement during the intubation process. Difficult airway equipment should be at hand for any elderly patient requiring urgent or immediate intubation.

Cervical Spine

- Cervical spine injuries may arise from relatively low mechanisms of injury. Patients with new onset neck pain; midline tenderness; facial / head trauma; and high mechanisms of injury should be considered as being at risk of cervical spine injury.

- CT-cervical spine is the imaging modality of choice for elderly patients with suspected neck injury.

- Cervical spine immobilisation may be impractical in patients with underlying disease causing musculoskeletal rigidity. Patients should never be forced into movements just to position a cervical collar.

- The process of “Minimal Movement” should be adopted to prevent unnecessary collar application whilst ensuring attempts are made to limit movement of the cervical spine.

Breathing

- High flow oxygen is appropriate in the early stages of care for patients with the potential for major multi-system trauma (e.g. following a road traffic collision), but may not be appropriate for all patients following same-level falls.

- Oxygen delivery should be adjusted to take into account the risk of type II respiratory failure. Oxygen saturations should be targeted to 88-92% in such circumstances

Circulation

- Assessment of circulation requires a global oversight into features that

could herald underlying haemorrhagic shock.

- A systematic approach that assesses the following areas should be adopted for all patients, irrespective of mechanism of injury:

  A. MECHANISM OF INJURY
  B. REGIONAL ASSESSMENT (& VITAL SIGNS)
  C. OCCULT HYPOPERFUSION
  D. COAGULOPATHY

- All four categories should be considered concurrently, and not in isolation.

- Crystalloid infusions should be restricted and if volume replacement is needed for acute haemorrhage, blood products should be used in the first instance.

Disability & Environmental Control

- In addition to recording GCS and blood glucose, attempts should be made to correct core temperature to between 35-37^{o}C as soon as possible

- Patients may present in a hypothermic state due to a long lie, underlying disease (e.g. myxoedema coma), or external environmental conditions and the assessing team should be aware that they will be at risk of trauma coagulopathy. Such patients should be actively rewarmed as soon as possible and not be left exposed on the hospital trolley.

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Chapter 4: Imaging after the Primary Survey

The approach to requesting specific imaging after the primary survey will vary according to the mode of presentation and mechanism of injury for the elderly patient.

Traditional ATLS teaching has taught that plain film radiography of the cervical spine, chest and pelvis are suitable first-line imaging modalities for patients with acute injuries.

Whilst important, this "one size fits all" approach to imaging is not suitable for all patients. The plain film cervical spine has low sensitivity in the elderly patient with degenerative bone disease[1]; and the supine chest X-Ray has a low sensitivity for small pneumothoraces and rib fractures[2].

Advances in ultrasound imaging and easier access to CT scan in Emergency Departments mean that different centres may have different policies about imaging elderly patients.

HECTOR believes that such variations in practice can be avoided by implementing a standardised and structured approach to CT requesting.

Role of Plain Film Radiography

The majority of elderly patients present following a simple fall and in a lot of cases, plain film radiography may be appropriate as a first-line imaging modality. If a patient if suspected of having a fractured neck of femur or femoral shaft fracture following a fall, then plain film imaging of those areas will normally suffice in obtaining a diagnosis.

Cervical Spine X-Ray

Interpretation of the plain-film cervical spine X-Ray can be complicated by pre-existing bone disease, osteophyte formation and previous neck surgery. Clinicians must judge the likelihood of obtaining adequate views on plain films against the risks of double radiation exposure if plain films are insufficient and the patient then requires a CT scan.

The 2014 NICE Guidance for investigating cervical spine injuries advocates the use of CT imaging as opposed to plain film radiography for patients aged 65 years and over[3]. HECTOR suggests that this is the most appropriate policy. Where access to CT imaging is difficult, local discussion is warranted to prioritise CT imaging over plain film radiography.

Chest X-Ray

Plain Film Chest radiography has its uses in determining the presence of additional pathology (e.g. consolidation with pneumonia), and in needing to make quick decisions about the presence of large pneumothoraces / haemothoraces which will determine the appropriateness of thoracostomy.

With a more widespread use of ultrasonography in emergency departments, pneumothoraces and haemothoraces can be relatively straightforward to identify depending on the expertise of the examiner. Ultrasound may yield a higher sensitivity than the supine chest X-Ray for such diagnoses but it will depend on the skills and experience of the examiner[4].

Clinical suspicion of multiple rib fractures is better identified with CT imaging, as this can determine the presence of flail

segments, underlying contusion and associated haemo/pneumothoraces in a more appropriate manner.

Pelvis X-Ray

At times, Pelvis X-Rays may be insufficient in diagnosing injuries such as a neck of femur fracture, pubic rami fractures and subtle sacroiliac injuries. Where clinical concern remains high, (for example, in the patient with ongoing pain and an inability or difficulty in weight bearing), CT or MRI imaging of the pelvis may be required[5].

Role of Ultrasound

The Extended FAST Scan

In the context of trauma, FAST scans (Focussed Assessment Sonography in Trauma), can be used to identify the presence of intra-thoracic and intra-abdominal free fluid. With advancing age, the likelihood of liver failure, congestive cardiac failure, and malignancy increases, as does the possibility that free fluid on FAST scanning may represent ascites. False positive results are likely to increase with advancing age.

FAST results have to be taken into clinical context. A patient with gross haemodynamic instability with a positive FAST scan and a significant mechanism of injury should trigger immediate senior surgical review.

A patient with haemodynamic stability, a lesser mechanism of injury and FAST positive scan *with* a history of malignancy may or may not need a CT scan for further clarification.

As a rule, the following patients with free fluid identified on FAST scan merit immediate senior surgical review:

- **Haemodynamic instability;**
- **Significant mechanism of injury;**
- **Suspicion of bleeding in the absence of haemodynamic instability (lactate >2.5; Base Deficit >5)**

Standard FAST scans acquire images in the right and left upper quadrants (Morrison's pouch and lienorenal angle respectively); the pelvis (transverse and longitudinal views of the bladder); and subxiphoid area (pericardial sac). Extended imaging to include the lung bases can be used to identify pleural effusions.

Pleural effusions may be present for a number of reasons, commonly including infection and malignancy and may not represent blood, (haemothorax). If there is doubt about the nature of an effusion, an ultrasound-guided pleural tap could be performed. If blood is evacuated, then the examiner should proceed to performing a tube thoracostomy. In the absence of blood, progression to tube thoracostomy should cease and the patient re-evaluated.

The Aortascan and Bladder Scan

When elderly patients present following a fall, the clinician should also think about what led up to the patient falling in the first instance. Sudden onset back pain followed by collapse may herald the presence of an underlying ruptured abdominal aortic aneurysm.

These patients may have injured themselves during the collapse and it would be very easy for the clinician to focus on injuries and ignore underlying

pathology.

HECTOR advises that if FAST scanning is being used for elderly patients with injuries, or if the presenting history and patient details (e.g. white, male, smoker, peripheral vascular disease) make the diagnosis of AAA a possibility, FAST scanning should include an assessment of aortic calibre.

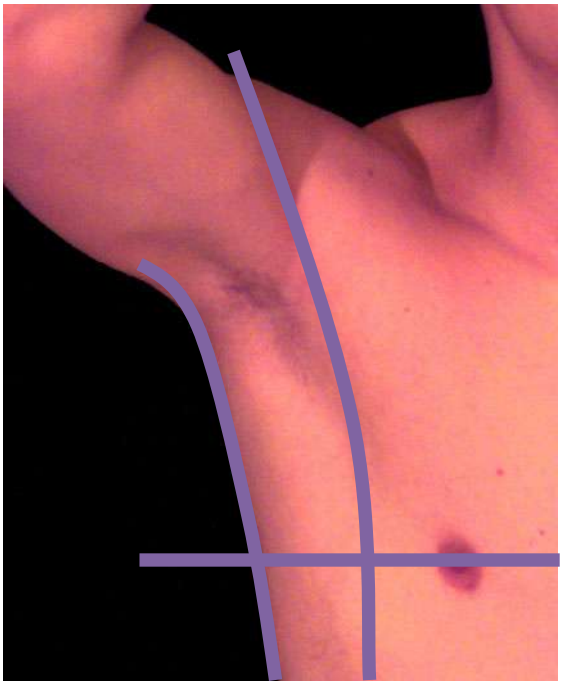
The aorta should be visualised down its length from the superior mesenteric artery to the iliac bifurcation. Two transverse measurements and one longitudinal measurement should be used to assess aortic calibre.

Ultrasound may also be of use in assessing bladder volume. If a patient suffers from dementia and has been collared and boarded, they may become increasingly agitated if they have a full bladder. Some patients may not be able to communicate the need to pass urine. Ultrasound may be used in such circumstances to determine the need to assist the patient in voiding urine, or if a urinary catheterisation is appropriate.

Chest Ultrasonography

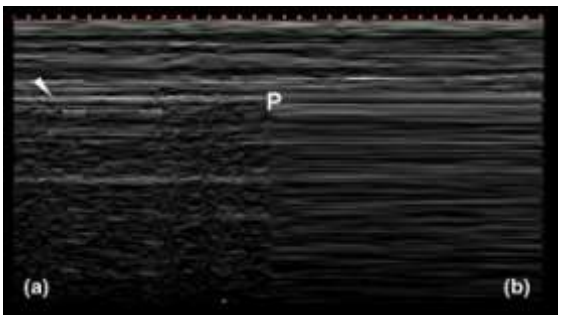
The use of ultrasound in the assessment of chest injuries could be considered as being like a "visual stethoscope". Traditional stethoscopes transmit sound-waves from the chest to the ear of the examiner. Ultrasound uses sound waves to create a visual image that can be interpreted by the examiner looking at the pictures, hence the "visual stethoscope".

Chest ultrasound can be structured by drawing a horizontal line between the nipple and scapula and two vertical lines on the anterior and posterior axillary borders. This creates six segments that should be analysed to detect the presence of pneumothoraces.



Pneumothoraces can be detected by the following signs[6]:

- The absence of pleural sliding;
- Prominent A-lines;
- The presence of a lung point (the interface between moving and non-moving lung);
- Stratosphere sign on M-mode, (commonly described as the "tide coming in").



a. Normal Lung
b. Stratosphere sign (pneumothorax)

Computerised Tomography

Acquisition of CT scans following trauma has become commonplace over the last few years. CT scans offer higher resolution images than plain film radiography and multi-slice scans improve sensitivity further[7].

CT scans allow the trauma team to establish diagnoses quickly and with a high degree of confidence, whilst also providing a means to structure future management plans (i.e. surgery, interventional radiology, conservative approach).

For the elderly patient with injuries, CT scans can help identify subtle injuries (e.g. transverse process fractures, rib fractures), that may not warrant any immediate intervention, but which could lead to uncontrolled pain and the onset of delirium after admission.

It is important to take a rational approach to CT acquisition and not utilise a blanket approach of scanning every individual who presents with traumatic injuries. Even though there is little evidence to demonstrate a high prevalence of renal failure, the use of contrast in CT scans can in theory worsen a patient's underlying renal function. The risks of this occurring must be balanced against the perceived benefits of performing a CT scan.

Whole Body CT Scanning (WBCT)

This approach to imaging should be reserved for patients with suspected major injuries and with major mechanisms of injury. It involves acquiring images from the vertex (top of skull) down to the pelvis or mid-femoral region and as a result, involves the highest dose of radiation and highest exposure to contrast.

The WBCT serves to identify all possible major injuries that would need immediate intervention or management, whilst at the same time highlighting injuries that could have an impact following admission.

HECTOR advocates the following indications for WBCT:

1. Obvious severe injury on clinical assessment – e.g. > 2 long limb fractures; pelvic fracture; amputation

2. Haemodynamic instability or the presence of occult hypoperfusion with high mechanism of injury

3. Suspicion of severe injury to more than one body region

4. Significant mechanism of injury:

a. Vehicular collision:

i. Ejection from vehicle
ii. Entrapment in vehicle > 30 mins
iii. Fatality at scene of vehicular collision
iv. High speed rollover

b. Fall from >3M (10 foot)

c. Pedestrian hit by car

d. Fall downstairs

Focussed CT Scanning

If patients don't fulfil the above criteria for WBCT, they may still need focussed CT scans to identify the exact nature of their injuries.

Regional scanning includes head, neck,

chest, abdomen and pelvis, either in combination or as an isolated scan.

CT Head Scan

The National Institute of Clinical Excellence in the United Kingdom has highlighted the following as indications for performing a CT Head scan for suspicion of traumatic injury:

1. GCS < 13 on initial assessment
2. GCS < 15 after 2 hours of observation
3. Open or depressed skull fracture
4. Signs suggestive of basal skull fracture
5. Post-traumatic seizure
6. Focal neurological deficit
7. >1 episode of vomiting
8. Loss of consciousness or amnesia (>65 years old)
9. Any patient on anticoagulant medication

Any patient aged 65 years and over with loss of consciousness or amnesia after head injury should have a CT Head scan. Furthermore, any patient on warfarin, any other anticoagulants or with bleeding disorders like haemophilia should also have a CT Head scan.

A 2012 study[8] observed different cohorts of patients for the risk of traumatic intracranial haemorrhage and found that higher proportion of patients on clopidogrel (12%) had an abnormal CT scan than patients taking warfarin (5%). Patients taking clopidogrel had a relative risk for traumatic intracranial haemorrhage of 2.31 (95% CI 1.48-3.63, p<0.001) compared to patients taking warfarin[9]. Such findings suggest that patients taking clopidogrel and not just those on anticoagulants may benefit from CT Head Scan in the context of trauma.

Once the need to perform a CT Head scan has been identified, efforts should be taken to ensure that this occurs within one hour.

CT Cervical Spine

If there is a suspicion that an elderly patient has injured their neck following trauma, NICE recommends the use of CT imaging to detect underlying fracture.

CT Thorax

Focussed scans of the thoracic cavity can be performed to assess for the presence of flail segments or haemo-pneumothoraces. If there is no suspicion of arterial injury and the only question is about the bony skeleton or lung tissue following blunt trauma, then a contrast-enhanced scan may not be required.

Contrast-enhanced scans may be of use if there is a suspicion of pulmonary embolism as a precipitant for a fall, or where there is a suspicion of mediastinal injury or penetrating trauma.

Non-contrast scans will identify bony injury including multiple rib fractures and/or flail segments. Such scans may be indicated following a fall whereby the chest wall has made contact with a hard object and the patient has ongoing pain and difficulty in breathing. This will aid in the decision-making process about the

indications for epidural analgesia.

CT Abdomen

Isolated scans of the abdomen may help identify the presence of solid organ and bowel injury. The use of contrast is recommended to ensure that minor or major vessel leaks are identified and can be managed accordingly.

Patients on warfarin with blunt abdominal trauma are particularly susceptible to significant injury (e.g. retroperitoneal bleeding, soft tissue bleed), so the threshold for scanning such patients should be lowered.

CT Pelvis

Focussed pelvic scans may be useful if a patient has had an apparently normal Pelvis X-ray but continues to have pain in the pelvic area or is unable to weight bear. This may help to identify minimally displaced fractures of the femoral neck.

Patients with pubic rami fractures with persistent hypotension or falling Hb levels may benefit from a contrast-enhanced CT of the pelvis to identify the presence of local haematomas are actively bleeding vessels. This is particularly relevant for patients taking warfarin who present with these injuries.

Summary

- The majority of elderly patients with traumatic injuries present following a simple fall and plain film radiography may be sufficient to diagnose their injuries

- Advances in ultrasound and access to computerised tomography has rendered the traditional method of "Primary Survey" films (chest, pelvis, cervical spine), less relevant

- When requesting any CT scan, the trauma team leader / assessing clinician should make a judgement of risk based on exposure to radiation and contrast, against the perceived benefit of the scan

- WBCT scans should be reserved for patients with high mechanisms of injury, or where there is a suspicion of severe injury.
- Focussed CT scans may be of use for patients with simple falls provided the assessing clinician has a specific question in mind about what they hope the CT scan will reveal.

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Chapter 5: The Secondary Survey

Following the primary survey and associated imaging, a top-to-toe assessment should be performed to identify **additional injuries and illness** that could have precipitated the traumatic event.

The Structured Approach

The assessing clinician should adopt a structured approach to the secondary survey covering the following areas:

1. **Scalp, Eyes, Face, Jaw**
2. **Upper Limb** – sternoclavicular joint to distal phalanges, (including formal neuro-vascular status)
3. **Chest** – Formal cardio-respiratory assessment with ECG.
4. **Abdomen & Pelvis** – formal gastrointestinal examination (including rectal examination) and urinalysis
5. **Lower limb** – greater trochanters to distal phalanges (including formal neurovascular status)

Each area should be assessed externally with any deformities or skin abnormalities being documented in the notes and then a more detailed examination conducted.

1. Scalp, Eyes, Face, Jaw

Scalp

At this point, efforts should be made to examine the entire scalp for obvious lacerations and bleeding points, if not conducted as part of the primary survey.

Injuries should be treated as they are found with lacerations being closed through appropriate techniques, (sutures, wound glue, staples). Actively bleeding vessels should be treated with greater urgency and the following techniques may be used to manage arterial vessels:

a. Local pressure with adrenaline-soaked gauze

b. Injection of combined local anaesthetic and adrenaline

c. Vicryl suture to achieve haemostasis to bleeding vessel

d. Use of haemostatic agents (e.g. Celox) in the patient with agitation or delirium if formal closure is impractical

e. Formal wound closure with subsequent compression bandage

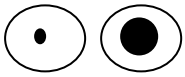
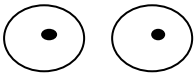
Eyes

Assessment of pupillary reflexes and size should have occurred during the primary survey and should be repeated again. Unilateral irregularities of pupil size and/or reactivity may not be related to trauma and may have resulted from previous eye surgery, (e.g. cataracts), or underlying disease.

Aniscoria is when one pupil is different in size to the other. In the context of trauma, this could herald severe brain injury. It may also be caused by hypoglycaemia, acoustic neuromas and other diseases such as optic neuritis.

Small pupils may follow excessive opioid administration especially if high doses have been given to elderly patients who may not have the same capacity for renal

clearance. If such findings are associated with bradypnoea and/or reduced GCS, consideration should be given to the administration of 400mcg naloxone iv/im.

Abnormality	Causes (non-exhaustive)
Unilateral dilated pupil 	• Congenital, post Cataracts surgery • Intracerebral haemorrhage; Raised ICP • Giant cell arteritis • Myasthenia gravis • Thyroid eye disease • Inter-nuclear ophthalmoplegia
Bilateral constricted pupils 	• Opioid toxicity • Organophosphates
Horner's Syndrome Partial ptosis Anhidrosis Miosis (small pupil) Enophthalmos	• Trauma to base of neck • Carotid artery dissection • Thoracic aortic aneurysm & dissection • Bronchogenic carcinoma
Acutely Red, Painful Eye	• Corneal foreign body / abrasion • Retrobulbar haemorrhage (severe eye pain, progressive visual loss, ophthalmoplegia, proptosis). • Penetrating eye injury (irregular pupil, hyphaema) • Acute glaucoma from blunt trauma and ciliary body injury

Abnormalities on Eye Examination

If significant injury to the eye is suspected, a formal ophthalmogical examination should be performed at the earliest and safest opportunity. This should include measurement of visual acuity and fundoscopy.

Face

The face should be examined from the forehead to the maxillary region. All bony prominences should be felt to assess for any focal tenderness and crepitus. The examiner should palpate around both orbital rims and along the zygomatic arches. Any bruising below the eyes should warrant formal assessment of eye movements and consideration of imaging to assess for the presence of an orbital floor fracture. Such plain film imaging may have to be delayed until the patient can sit upright, or can be expedited if performed using CT imaging.

Careful attention should be paid to any injury to the mid-face region as this may point to underlying cervical spine injury (see earlier).

Significant epistaxis should be controlled as per any overt haemorrhage. Care must be taken prior to the insertion of nasal packing, especially if there is a suspicion of basal skull fracture, (see below). In such circumstances, the assessing clinician should balance the risk of causing damage against the benefits of controlling haemorrhage.

Methods to control epistaxis are not confined to Merocel or Rapid Rhino Packs. Posterior nasal packing with urethral catheters secured in position with umbilical clips and BIPP ribbon packing may be of use but require expertise to insert.

Signs of Basal Skull Fracture

1. Haemotympanum
2. CSF Otorrhoea
3. CSF Rhinorrhoea
4. Racoon eyes
5. Battle's sign (mastoid bruising)

If there is a suspicion of fracture of the nasal bones, the nose should be examined for the presence of septal haematoma and if identified, should prompt urgent ENT referral.

The Jaw & Teeth

The jaw should be palpated from both temporo-mandibular joints medially. Any tenderness should raise suspicion of underlying injury and a bimanual oral examination should be performed to assess for any loose or missing teeth/dentures, and any obvious gingival lacerations.

2. The Upper Limb

Examination of the upper limb should start at the sternoclavicular joint working distally, and should only be considered as complete once the distal phalanges have been assessed.

In general terms, the assessment should comprise a basic examination consisting of:

- INSPECTION
- PALPATION
- MOVEMENT
- ASSESSMENT OF NEUROVASCULAR STATUS

The clinician should inspect the limb for any obvious anatomical deformity, obvious skin lesions and lacerations/abrasions, and ensure any findings are documented.

Obvious anatomical deformity should prompt the assessor to review the administration of analgesia and whether limb splintage should occur before or after correction of the deformity.

With most mechanisms of injury being simple falls, attention should be paid to the nature of the fall and how the patient landed.

Falls onto the shoulder may result in

clavicle, neck of humerus fractures or glenohumeral dislocation. Falls onto the outstretched hand may lead to scaphoid, distal radius (Colles'/Smith's), and head of radius fractures.

Each MCPJ, phalanx and inter-phalangeal joint should be assessed in turn, and attention paid to the presence of flexor/extensor tendon involvement that could lead to Mallet and Boutonniere's deformity. The presence of existing osteoarthritis may make deformities more likely, and in these circumstances the patient should be asked whether any anomaly is new or old.

Assessment of Upper Limb Neurology

Each upper limb should be assessed for central and peripheral neurological signs and symptoms. The examiner should be mindful of the patient's normal level of function as a history of previous stroke may lead to asymmetrical findings.

a. GENERAL INSPECTION & TONE

Upper limb muscles should be inspected for symmetry, looking for wasting, fasciculations and involuntary movements:

Involuntary Movements

i. Tremor – oscillatory movement around a joint (e.g. "pill-rolling" tremor of Parkinson's disease; intention tremor of cerebellar damage)

ii. Myoclonic jerks – sudden, shock like contractions in muscles

iii. Chorea – irregular, brief writhing movement

Muscle tone may be decreased in the presence of lower motor neurone lesions (e.g. spinal injury), but in elderly patients, may be increased as a result of previous upper motor neurone lesions (e.g. stroke), or Parkinson's disease. Cog-wheel rigidity may be present in association with increased rigidity and underlying tremor.

b. POWER & REFLEXES

Upper limb power should be tested in a symmetrical fashion and measured using the MRC scale:

0	No muscle contraction visible
1	Flicker of contraction but no movement
2	Joint movement when effect of gravity eliminated
3	Movement against gravity but not against examiner's resistance
4	Movement against resistance but weaker than normal
5	Normal power

As a minimum, the following movements should be assessed:

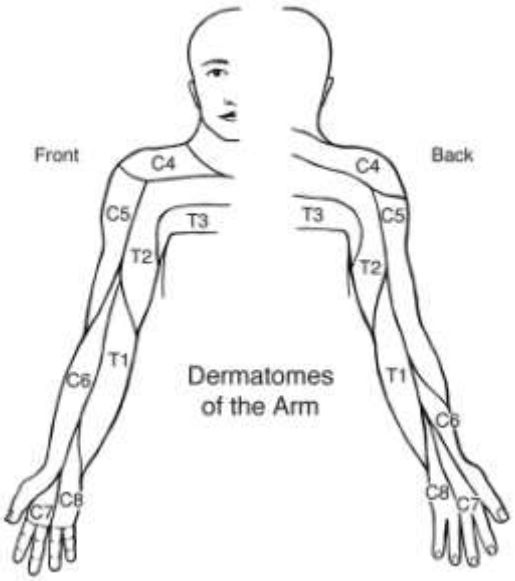
C4,C5	Shoulder Abduction
C5,C6	Elbow Flexion
C7,C8	Elbow Extension
C6,C7	Wrist Flexion (volar)
C8	Finger flexion
T1	Finger Abduction

Following assessment of power, the biceps, triceps and supinator reflexes should be assessed and both sides compared to each other.

c. SENSATION & COORDINATION

By assessing a gentle pain sensation, the examiner can assess the function of the spinothalamic tracts. Examination of proprioception can aid in the assessment of the dorsal columns. Each of these

modalities should be assessed for each dermatome (see below):



Assessment of coordination can aid in the diagnosis of underlying cerebellar dysfunction and prompt the examiner to complete a formal examination of cerebellar dysfunction, (see below).

Assessment of Cerebellar Function

i. Disdiadochokinesis
ii. Ataxia
iii. Nystagmus
iv. Intention Tremor
v. Speech disturbance
vi. Hyper-reflexia

d. PERIPHERAL NERVES

The peripheral nerves of the upper limb should be assessed as part of the secondary survey. If it is not possible to assess each peripheral nerve at this stage, then it may be delayed until later.

Each nerve should be assessed in terms of inspection of the relevant muscles, assessment of power and sensation. A basic knowledge of anatomy is needed to conduct a formal assessment.

Axillary			
INSPECT: Deltoid wasting	MOTOR: Shoulder abduction	SENSORY: Regimental badge area	SITES AFFECTED: Glenohumeral dislocation
Radial			
INSPECT: Wrist drop	MOTOR: Supinator (supinate hand against resistance with elbow in extension) Brachioradialis (flex elbow against resistance with forearm in mid-prone position) Triceps (extend elbow against resistance)	SENSORY: Dorsal aspect of hand Dorsal forearm	SITES AFFECTED: Axilla Mid-humeral fracture Elbow dislocation
Ulnar			
INSPECT: Claw hand (flexion of PIPJ of little finger)	MOTOR: Interossei (adduction of ring and little finger) Adductor Pollicis (Froment's test) Flexor carpi ulnaris (resist attempted dorsiflexion of wrist held in volarflexion)	SENSORY: Volar and dorsal aspect of little finger	SITES AFFECTED: Medial epicondyle Forearm fracture Wrist laceration

Median			
INSPECT: Nil acute	MOTOR: Flexor carpi radialis (place hand on flat surface palm up. Hold fingers and ask to flex wrist) Flexor pollicis longus (flexion of thumb DIPJ) Abductor pollicis longus (thumb abduction)	SENSORY: Thenar eminence	SITES AFFECTED: Supracondylar fracture Deep wrist laceration

3. Chest

Assessment of life-threatening chest injuries would already have been performed during the primary survey. **The secondary survey should be used to assess for the presence signs that may suggest cardio-respiratory illness.**

Only a formal respiratory examination will be helpful in detecting the presence of underlying illness. This includes assessment of chest expansion, percussion, auscultation of breath sounds, and vocal resonance. Attention should be paid to the presence of added sounds and at which phase they occur in the respiratory cycle.

Cause of Crackles	
Phase of Inspiration	Cause
Early	Small airway disease (bronchiolitis)
Middle	Pulmonary oedema
Late	Pulmonary fibrosis Secretions in COPD, Pneumonia etc..
Biphasic	Bronchiectasis

Wheeze commonly occurs during the expiratory phase as airways narrow on breathing out. Inspiratory wheeze may be indicative of severe airway narrowing, but in general, wheeze is a poor indicator of the severity of airflow obstruction. Wheeze in the presence of known COPD or asthma may prompt the examiner to prescribe nebulisers such as short acting or long-acting beta-agonists (5mg salbutamol, 500mcg ipratropium bromide).

The presence of added breathing sounds on secondary survey should prompt the examiner to review observations and investigation findings. Suspicion of lower respiratory tract infection should lead the examiner to consider the prescription of antibiotics for example.

Assessment of the cardiovascular system should include listening to the heart sounds for murmurs. In the context of trauma and the elderly patient, members of the trauma team should have a basic knowledge of ECG interpretation and be able to manage common anomalies. This will be covered in Chapter 14.

4. Abdomen

During the secondary survey, the examiner should inspect the abdomen and document the presence of any scars, abrasions / lacerations, and distension.

Examination should include an assessment of the bladder to look for the presence of urine retention, and a rectal examination to assess for constipation. Both of these features may lead to acute or delayed delirium and lead to worsening

outcomes.

The examiner should review baseline blood tests that were sent during the primary survey and pay close attention to the underlying renal function. Acute kidney injury may be precipitated by dehydration and/or a long lie on the floor with associated rhabdomyolysis and raised creatine kinase. Early institution of intravenous rehydration should commence early with the aim of maintaining urine output (>0.5ml/kg/hr).

The assessing clinician should have a low threshold for CT imaging in the presence of abdominal / back pain for any patient on warfarin or anticoagulation. Risks of scanning should be balanced against the risks of spontaneous bleeding (retroperitoneal or intra-abdominal) in such patients.

5. Lower Limb

Secondary survey assessment of the lower limbs should aim to identify any obvious anatomical deformity before moving onto a formal neurological assessment.

Shortening or rotation of the legs may indicate the presence of underlying fracture. Patients with fractures of the femoral neck may present with groin pain and shortened, rotated lower limbs. Review of primary survey films may identify such injuries, or may reveal injuries such as pubic rami fractures.

Patients with gross swelling and deformity to the mid-thigh may have underlying shaft of femur fractures and in such circumstances will need plain film radiography to assess for these injuries. On diagnosis, traction should be applied for bony realignment and pain relief.

Pain and deformity over the shin should prompt further imaging of the affected area to assess for underlying fracture. Compound fractures should be assessed for size and depth of wound, as per Gustilo grading and if found, be immobilised after application of a saline soaked gauze and the patient be prescribed intravenous antibiotics.

Grade	Description
I	Wound <1cm and clean
II	Wound >1cm without extensive soft tissue damage
IIIA	Adequate soft tissue coverage in spite of soft tissue damage or high energy trauma
IIIB	Contamination; extensive soft tissue loss; periosteal stripping; bone exposure
IIIC	Associated arterial injury

Assessment of the neurological status of the lower limb should follow similar principles to those used in the assessment of the upper limb. After inspection, tone, power, reflexes and sensation should be examined to identify underlying abnormalities.

a. TONE

As per upper limb assessment

b. POWER & REFLEXES

Power should be graded as per the MRC scale and as a minimum, the following muscle groups should be examined:

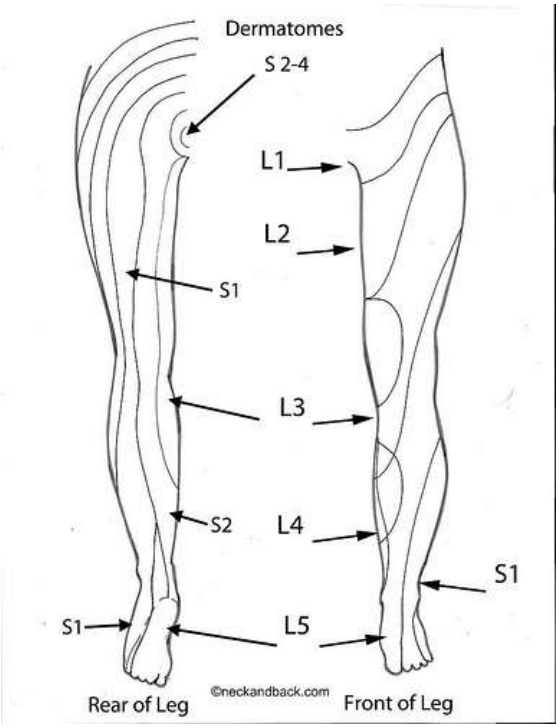
L2, L3	Hip Flexion
L3,L4	Knee extension
L4, L5	Knee flexion
S1	Ankle plantarflexion

The knee and ankle jerk reflexes should be examined and compared with each other, followed by assessment of the plantar response.

c. SENSATION

The lower limbs should be assessed for nociception and proprioception as per the specific dermatomes (see below). The examiner should consider the presence of diabetes and peripheral vascular disease when assessing neurovascular status as both can contribute to abnormal findings.

Lower limb pulses (femoral, popliteal, dorsalis pedis, posterior tibial), should all be palpated and any asymmetrical findings or absence of pulsation should be documented in the notes.



Summary

- A secondary survey assessment should be performed for all elderly patients with traumatic injuries

- A structured approach to this process will allow the examiner to identify any significant injuries and/or fractures in each body region

- The assessing clinician should always keep in mind the presence of pre-existing disease states that may contribute to abnormal findings on clinical examination and be able to treat findings appropriately

- Specific injuries should be treated as they are identified (e.g. lacerations, fractures), and consideration given to pain relief and additional therapy (e.g. antibiotics)

Chapter 6: The Silver Survey

Established trauma courses will cover trauma care up until the point when decisions are made about definitive management strategies for patients and their injuries.

This is inappropriate for elderly trauma patients as the very nature of their injuries predisposes them to developing delirium.

Delirium may be defined as a clinical syndrome characterised by disturbed consciousness, cognitive function, or perception, which has an acute onset and a fluctuating course[1]. It is important to prevent the onset of delirium as it is an independent risk factor for increased mortality and length of stay[2].

Management and prevention of delirium requires a multifactorial, patient-centred assessment. HECTOR introduces the "Silver Survey" as a means of identifying risk factors for the development of delirium (see opposite)

PINCHME	
P	Pain
In	Infection – chest, wound, urine, skin
C	Constipation & urinary retention
H	Hydration (i.e. dehydration)
M	Medication (prescribed or illicit; alcohol / benzodiazepine withdrawal; opiates; sedatives; anticholinergics
E	Electrolytes (hypo-hyperglycaemia; hyponatraemia; hypercalcaemia; hyper-or hypothyroidism)

Causes of Delirium

The Silver Survey

The purpose of the Silver Survey is to consolidate the findings of the primary and secondary surveys as well as identifying any individual risk factors for the development of delirium.

This aims to ensure that anything that could precipitate the onset of delirium is managed early and in an appropriate manner. It also ensures that ward-based teams have a greater understanding of the patient's presenting state and can assess for any subtle changes that may occur following admission.

During the Silver Survey, it is important for the lead clinician to be able to step back from the acute aspects of trauma care that can feel rushed or pressured, and adopt an individualised focus towards the patient.

It may not be possible to conduct such an assessment in the Emergency Department, especially if the patient is due to be transferred to theatre or critical care. However it should be completed as soon as it is safe to do so.

The Silver Survey involves obtaining as accurate a history as possible from the patient, or from members of their family or carers to establish their pre-injury status from a medical and societal perspective, (see below)

The Silver Survey

<table>
<tr><td>A</td><td>• Missing or Broken Teeth / Dentures
• Swallowing difficulties that could limit nutrition
• Is SALT assessment needed before oral hydration / feeding</td><td>☐
☐
☐</td></tr>
<tr><td>B</td><td>• Underlying respiratory disease (e.g. COPD; Asthma; UIP; TB)
Baseline ABG and correct hypoxia
If risk of CO2 retention, aim sats 88-92% or >94% if normal CO2/HCO3-
Review CXR for presence of consolidation, pulmonary oedema and treat
• >2 rib fractures or undrained pneumo/haemothoraces
Ensure patient has adequate pain-relief prescribed</td><td>☐

☐</td></tr>
<tr><td>C</td><td>• Review blood results and clotting profile
• Prescribe TED stockings
• Prescribe 40mg enoxaparin (or 20mg if renal impairment), unless any of the following are present:
<table>
<tr><th>Patient Related</th><th>Admission Related</th></tr>
<tr><td>Active bleeding; acquired bleeding disorder; use of anticoagulants with INR>2; acute stroke; platelets <75; uncontrolled systolic BP >230mmHg; untreated inherited bleeding disorder</td><td>Intracranial haemorrhage or spinal surgery planned; procedure planned with high risk of bleeding</td></tr>
</table></td><td>☐
☐
☐</td></tr>
<tr><td>D</td><td>• Patient has visual aids
Document if broken or not present
• Patient has auditory aids
Document if broken or not present
• Calculate 4-point abbreviated mental test score (1 point each)
A. YEAR B. PLACE C. AGE D. BIRTHDAY
• Assess pain and offer analgesia if in discomfort
• Perform baseline RASS assessment</td><td>☐
☐
/4
☐
</td></tr>
<tr><td>E</td><td>• Reassess temperature and aim >36^{O}C
• Assess continence status
Continent; catheterised; incontinent of faeces; urinary incontinent; doubly incontinent
• Assess skin integrity / tissue viability of pressure areas
Healthy; tissue-paper like; clammy; grade 1 erythema; grade 2 or above</td><td>☐
☐
☐</td></tr>
</table>

HISTORY OF INJURY:

PAST MEDICAL HISTORY:

Hypertension		CVA / TIA / SAH		Cancer	
Peripheral vascular disease		DVT / PE		Dementia	
Ischaemic heart disease / MI		Renal Impairment		Parkinsonism	
CCF / LVF		COPD		Mental Health	
Atrial fibrillation / flutter		Asthma		Drug / Alcohol Abuse	
Pacemaker / ICD		Diabetes			

Other:

DRUG HISTORY:

ON WARFARIN OR OTHER ANTICOAGULANTS? Y / N

CVS: (HTN, IHD, statins etc..)
RS: (COPD, Asthma etc..)
NEURO: (Parkinson's, epilepsy etc..)
ENDOCRINE: (diabetes, thyroid etc..)
ALLERGIES:

SOCIAL CIRCUMSTANCE:

Accommodation

Own Home		Sheltered / Warden Controlled	
Residential Home		Nursing Home	

Level of Dependency

Independent		Mobile with carer assistance	
Walks with one aid		Chair Bound	
Walks with two aids or a frame		Bed Bound	

Pre-Injury Walking Distance

metres

FAMILY / PATIENT CONCERNS:

Any increasing confusion or illness that has been a concern? Y / N

Any underlying diagnosis of dementia or interactions with GP for this diagnosis? Y / N

Any other falls in the last twelve months? Y / N

Any pre-existing documentation or discussion about end-of-life status Y / N

Any concerns with current accommodation status? Y / N

Components of the Silver Survey

A – AIRWAY

Airway is formally assessed during the primary survey. **For the Silver Survey, the assessment requires review of dentitions and swallowing function that could otherwise hinder adequate nutrition.**

The assessing clinician should document the presence of any missing / broken teeth and whether or not the patient uses dentures. Following this, the patient should be asked about swallowing problems or pre-existing use of PEG-feeding etc..

Patients with injuries may have had a stroke that precipitated the event and may require formal SALT assessment before oral hydration and nutrition can be commenced – failure to do so may lead to aspiration. A simple trial of oral liquid could be instituted in the Emergency Department, provided the patient is not being kept Nil by Mouth for definitive surgical care. Inability to swallow or coughing at this point may trigger formal SALT assessment.

B – BREATHING & RESPIRATION

The Silver Survey should be used to establish an accurate goal for oxygen saturations. This takes into account BTS guidance on management of COPD and guidance on oxygen delivery[3]. All oxygen should be prescribed as per any other drug.

The ABG taken during primary / secondary survey should be analysed to assess the patient's risk of type II respiratory failure. Those with high CO_2 levels or high HCO_3^- (a marker of chronic renal compensation for respiratory acidosis), should have a target oxygen saturation of 88-92%. Those patients without such risks may have oxygen prescribed to target saturations above 94%.

Elderly patients with >2 rib fractures should be identified as being at risk of delirium from pain and possible hypoxia due to under-ventilation. Careful pain management can promote adequate ventilation and prevent underlying atelectasis due to a poor cough or hypoventilation.

These patients should be alerted to inpatient teams as being at risk of progressive respiratory failure, and be seen by a Respiratory Physiotherapist soon after admission. Pain management may involve epidural analgesia or patient-controlled analgesia (PCA), and such requirements should be flagged up as soon as possible on the patient's journey.

C – CARDIOVASCULAR

The Silver Survey aims to review coagulation status and prevent venous thromboembolism.

All patients should have their blood tests reviewed to assess for baseline haemoglobin, platelets and INR. Traumatic coagulopathy may be a continuing process in the event of undiagnosed injuries and the assessing team should ensure that haematological parameters are within acceptable limits.

Injuries that appear to be of low significance (e.g. pubic rami fractures) could be significant for patients taking oral anti-coagulants or for those with established coagulopathy. Again, admitting teams should be alerted to the possibility of clinical deterioration in the presence of such injuries.

Patients with falling blood pressure or rising heart rate in the presence of injury and abnormal clotting, (Hb <8; Platelets <100; INR > 1.5), should be reassessed and considered for further CT Imaging.

The prescription of TED stockings and subcutaneous heparin is standard practice for patients being admitted to hospital. The Silver Survey allows the assessing clinician to review patient-related and injury-related contra-indications for chemical thromboprophylaxis in accordance with NICE guidelines[4].

D – DISABILITY & NEUROLOGICAL STATUS

The Silver Survey is used to assess for the presence, absence or damage of audiovisual aids. Without such devices, patients who rely on them could become quickly disorientated or confused. Attempts should be made to ask family members or carers to bring these devices to hospital if not present.

Following this, the assessing clinician should document:

- A Four Point AMT score
- Assess pain and manage appropriately
- Perform a RASS (Richmond Agitation Sedation Scale) assessment.

By assessing each of these areas in turn, the clinician can establish the patient's baseline level on admission and document this in the notes. If the patient were to deteriorate further, the team responsible for their ongoing care will have this as a reference point.

The Four-Point AMT Score

This assessment is quick to perform and easily reproducible. The examiner asks the patient four questions and marks them on a scale of four, (i.e. one point per question).

i. What year is it?
ii. Where are you now?
iii. How old are you?
iv. When is your birthday?

A score of less than four may be normal for that patient, especially if there is a background history of dementia. What remains important is whether this score deteriorates following admission. If so, this should prompt a formal reassessment of risk factors for delirium.

Alternative measurements include the 4-AT score and CAM-ICU assessment tool. The 4-AT is an assessment test for delirium and cognitive impairment which looks at four separate components:

A Alertness
A AMT4
A Attention
A Acute change or fluctuating course

The 4-AT tool has been found to have a 89.7% sensitivity and 84.1% specificity for delirium from a previous study[5].

The CAM-ICU assessment tool suggests that a patient may have delirium if they have two core features and one of two other features:

CORE COMPONENT (both must be present):
1. Acute Onset of Change or Fluctuating Course
2. Inattention

OTHER COMPONENT (one of the following):

1. Disorganised thinking
2. Altered level of consciousness

This method of assessment was created in 1990 and intended to be used as a bedside assessment tool by non-psychiatrists to assess for delirium, (Confusion Assessment Method, CAM). The CAM-ICU tool was created as an adaptation of the CAM tool for use in ICU patients and studies have shown it to have a high sensitivity and specificity (93-100% and 98-100% respectively)[6].

For the purposes of the HECTOR Course, the AMT-4 tool has been utilised for its ease of use and practical application. HECTOR does support the use of other assessment tools but acknowledges the difficulties in implementing their effect through wider training and education.

Assessment of Pain

There are many different tools for assessing a patient's degree of pain. If a patient is fully coherent, the ideal method is whichever one can be used consistently and with which the patient becomes familiar. Asking a patient to score their level of pain from 0 to 10 (with 0 being no pain and 10 being the most severe pain), allows patients to describe their experience in a subjective manner and for clinicians to assess this objectively.

Fluctuations in pain scores may be useful in detecting progression of illness (e.g. developing hospital acquired lower respiratory tract infection, pulmonary embolus), but also progression of injury, (e.g. expanding pelvic haematoma from pubic rami fractures).

The clinician should reassess the patient whenever their pain score increases in a subjective manner and act accordingly. This may involve prescribing analgesia, or it could also involve splinting undiagnosed fractures or treating previously undiagnosed illness.

The prescription of analgesia should follow standard practice of "climbing the analgesic step-ladder"[7]. Simple analgesics such as paracetamol are prescribed in the first instance, followed by non-steroidal anti-inflammatory agents and then opioids / opiates.

Care must be shown in elderly patients, as NSAIDs may cause renal impairment and worsen peptic ulcer disease. Similarly, opioids prescribed to opioid-naive patients could have a significant effect on cardiorespiratory systems, especially in the presence of underlying renal impairment leading to reduced clearance.

Drugs such as codeine phosphate can lead to increased confusion or constipation, both potentially leading to acute delirium.

Where possible, regional nerve blockade with local anaesthetic agents can limit these side-effects or lead to lower dosages of opioids / opiates.

In the situations where patients are unable to verbalise their levels of pain, the Abbey Pain Scale should be used to determine the need for additional analgesia[8].

The Abbey Pain Scale

For measurement of pain in patients who cannot verbalise

Name and designation of person completing scale: _____

Date: Time:

Latest pain relief given was at: : hrs

Q1 VOCALISATION Absent 0 Mild 1 Moderate 2 Severe 3 ☐
e.g. whimpering, groaning, crying

Q2 FACIAL EXPRESSION Absent 0 Mild 1 Moderate 2 Severe 3 ☐
e.g. looking tense, frowning, grimacing, looking frightened

Q3 CHANGE IN BODY LANGUAGE Absent 0 Mild 1 Moderate 2 Severe 3 ☐
e.g. fidgeting, rocking, guarding of body, withdrawn

Q4 BEHAVIOURAL CHANGE Absent 0 Mild 1 Moderate 2 Severe 3 ☐
e.g. increased confusion, refusing to eat, alteration in usual patterns

☐
Q5 PHYSIOLOGICAL CHANGE Absent 0 Mild 1 Moderate 2 Severe 3
e.g. temperature, pulse or blood pressure outside normal limits, flushing, pallor, perspiring

Q6 PHYSICAL CHANGE Absent 0 Mild 1 Moderate 2 Severe 3 ☐
e.g. skin tears, pressure areas, arthritis, contractures, previous injuries

Add Scores for Q1 to Q6 and record total pain score here: ☐

Now tick the box that matches the total pain score:

0-2 NO PAIN	3-7 MILD PAIN	8-13 MODERATE PAIN	14+ SEVERE PAIN

Finally tick the box that matches the type of pain:

CHRONIC	ACUTE	ACUTE ON CHRONIC

Abbey J, De Bellis A, Piller N, Esterman A, Giles L, Parker D, Lowcay B. The Abbey Pain Scale. Funded by the JH & JD Gunn Medical Research Foundation 1998-2002

The Richmond Agitation Sedation Scale

The RASS Score can be used to assess whether a patient is alert, agitated or hypoactive[8]. It is easily reproducible and can be used to assess for rapid deteriorations in behaviour.

Patients are scored on a linear scale with 0 representing an alert and calm state and scores above this reflecting increasing agitation, and those below it reflecting increasing sedation.

Richmond Agitation Sedation Scale (RASS)

1. OBSERVE THE PATIENT – score 0-4 if alert, restless or agitated

SCORE	TERM	DESCRIPTION
+4	Combatative	Overtly combatative, danger to staff
+3	Very Agitated	Pulls tubes, aggressive
+2	Agitated	Frequent, non-purposeful movement
+1	Restless	Anxious but movements not aggressive or vigorous
0	Alert & Calm	

2. IF NOT ALERT, STATE PATIENT'S NAME AND ASK THEM TO OPEN THEIR EYES

-1	Drowsy	Eye Open to Voice with prolonged eye contact >10 secs
-2	Light Sedation	Awakens to voice with non-sustained eye opening <10 secs
-3	Moderate Sedation	Movement or eye opening in response to voice but no eye contact

3. IF NO RESPONSE TO VOICE, RUB THE STERNUM

-4	Deep Sedation	Any movement or response to physical stimulation
-5	Unrousable	No response to voice or physical stimulation

The RASS score requires the examiner to establish a baseline level of alertness for patients that can be used to assess for improvements or deteriorations following admission.

It has the advantage of determining the presence of hypoactive states as well as hyperactive, agitated states that are more obvious to the assessing clinician. Furthermore, it can be used to describe a patient's normal resting state, (i.e. patient's with dementia may be restless in unfamiliar environments and this may be unlikely to improve until they are restored to their normal accommodation.

The linear scoring system allows clinicians to identify subtle changes in a patient's underlying state that could pre-empt the onset of established delirium and trigger a formal review for underlying risk factors / causes of delirium.

E. ENVIRONMENTAL / EXPOSURE

All patients should have their temperature, continence status and skin integrity recorded during the Silver Survey. Hypothermia contributes to the lethal triad and if not treated, can worsen coagulopathy. A core temperature above 36^{O}C should be targeted and measures taken to ensure patients are not left exposed to the cold conditions of Emergency Department trolleys.

Persistent hypothermia may exist in extreme states of hypothyroidism and myxoedema coma. Similarly, ingestion of alcohol or other toxic substances can lower temperature through inactivity. All measures should be taken to ensure any reversible causes are treated (including sepsis), and that patients are warmed to appropriate temperatures as soon as possible.

Continence status is an important step in the assessment process. Patients who are incontinent, or who have trouble passing urine / faeces, are at increased risk of falls and delirium. Unnecessary urethral catheterisation should be avoided but in patients with injuries that limit rolling, (e.g. unstable vertebral body fractures), catheterisation of patients with urinary incontinence may help prevent skin complications.

Skin integrity is important to assess as the presence of pre-existing pressure sores / ulcers must be documented. These can be made worse by poor nutrition or infection so a documentation of baseline status can help assess what type of mattress a patient needs, and whether or not such areas have progressed after admission.

F. STANDARD HISTORY

All patients should have a formal history of injury documented in the notes. It is important for the assessing clinician to document the precise nature of any falls – including mechanism of injury, footwear / lighting at the time of fall, pre-injury weakness or illness, chest pain / palpitations.

It is crucial to determine the exact nature of the injury mechanism and be able to make a judgement on any underlying disease process that could have contributed to the injury.

Past medical history should be documented in a formal manner so that pre-existing conditions such as atrial fibrillation, chronic obstructive pulmonary disease etc.. can be taken into account when treating specific injuries.

A documentation of drug history (including allergies), is useful in determining whether a patient is taking medication that could predispose them to sudden drops in blood pressure, (i.e. anti-hypertensives). It is important to document doses of medications accurately as drugs such as co-beneldopa and levodopa should be prescribed at consistent times to prevent worsening of Parkinsonian symptoms.

Social history is necessary to determine a patient's pre-injury status. This combined with carer / family concerns can be used to target specific outcomes for the patient. For example, if the family or patient believes that they are not coping and need additional / new carer support, this should be coordinated at as early a stage as possible in the patient's journey to ensure that delays do not occur once the patient is deemed fit for discharge.

End of Life / Do Not Attempt Resuscitation Decisions

Patients and their families should be involved in any discussion that centres on the futility of treatment in the presence of overwhelming injuries.

Such discussions need to be as honest as possible and respect a patient's wishes. Some patients may have pre-existing DNAR orders or may refuse further intervention in the wake of perceived poor outcomes.

HECTOR believes that such discussions should occur as early as possible in the patient journey to minimise distress and unnecessary and / or unwanted resuscitation following admission.

Summary

- The purpose of the Silver Survey is to consolidate the findings of the primary and secondary surveys as well as identifying any individual risk factors for the development of delirium.
- It is important for the lead clinician to be able to step back from the acute aspects of trauma care and adopt an individualised focus of care towards the patient.
- The Silver Survey follows a structured approach, ABCDE, and established baseline and pre-injury status for injured patients
- This baseline status can be used to identify early improvements or deteriorations in patients following admission so that admitting teams can reassess and act according to findings.
- Baseline AMT, Pain and RASS scores are the most useful systems for establishing objective and subjective parameters for injured patients
- A formal history as per standard medical practice should be conducted as part of the Silver Survey to ensure that any pre-existing illnesses or features that may contribute to delirium can be addressed as early as possible.
- Assessment of social circumstances and consideration of family / carer concerns can help establish early targets of therapy and discharge planning as opposed to creating delays later on in the patient journey that leaves patients vulnerable to hospital acquired illness.
- Frank and open discussions should be made with the patient and family about realistic outcomes in the event of patients sustaining significant, life-threatening injuries. Specialist advice should be sought about the appropriateness of escalation in care.

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PART II: MANAGEMENT OF SPECIFIC INJURIES IN ELDERLY PATIENTS

Chapter 7: Head Injuries

Introduction

Same level falls represent the commonest mechanism of injury for elderly patients and these falls can have a devastating impact on the individual if associated with a traumatic brain injury.

Traumatic brain injury can be a challenge to diagnose and manage in the elderly patient, especially if they have: declining cognitive function; pre-existing neurological signs; or where in normal circumstances, they have a reduced level of consciousness.

The management of elderly patients with traumatic brain injury often follows conservative pathways. As age increases, a dichotomy exists whereby patients are managed with comfort measures on a "wait and see basis", or are managed aggressively with surgical intervention but may be left living with serious neurological impairment.

Taking all of this into account, it is important to have a basic understanding of the different types of brain injury, the cause and acute and prolonged response to injury, and prognosis.

Head Injuries in the Elderly

With current trauma training, a trauma moulage for the head-injured patient is often taught whereby they will present with a clear mechanism of injury, a reduced GCS and additional injuries that require management.

In practice, elderly patients often sustain head injuries following simple falls or trips. Such mechanisms may not alert first responders to the possibility of serious injury. Furthermore, patients with memory impairment may not recall why, how or when they have fallen, thus making assessment even more difficult.

A UK-based study[1] found that for any given AIS score related to a head injury, older patients had a higher presenting GCS than their younger counterparts. This would leave them more vulnerable to under-triage as they would not present with the reduced GCS that mandates direct MTC transfer.

As nearly all neurosurgical centres in the UK are based within major trauma centres, this patient group not only face the risk of delayed diagnosis because of a higher presenting GCS, but also face the risk of being managed in non-specialist centres despite having significant injury.

A Canadian-based study[2] identified that for patients with severe brain injury in a level II trauma unit, 81% of young patients compared to 71% of those aged 65 years and over were transferred to a specialist centre ($p<0.0001$). When "time is brain" and time to definitive care can affect outcome, such issues may deprive elderly patients from being given the option of aggressive intervention.

It is important for the trauma clinician to be aware of such evidence to appreciate that an elderly patient with significant brain injury may present in a stable, fully conscious state. If extra vigilance is not used at this time and if a diagnosis is not made, the management needed to prevent secondary brain injury may not be implemented, leading to further deterioration. By this stage, treatment options will be even more limited.

Types of Brain Injury

It is important for the trauma clinician to have a basic understanding of primary and secondary brain injury in order to prevent deterioration.

PRIMARY – This is the damage sustained at the time of injury. Elderly patients are particular vulnerable to subdural haematomas owing to greater tension on the bridging veins connecting the subdural surface to the ageing brain with cerebral atrophy. Low mechanisms of injury can tear these taut veins leading to slow venous bleeding and the development of a subdural haematoma.

Subdural haematomas may also be associated with additional injuries such as cerebral contusions / intraparenchymal haemorrhage. Extradural haematomas are often associated with arterial injury and tend to be confined to younger patients following high mechanisms of blunt trauma or penetrating injury.

Irrespective of the type of injury, this may not be obvious at the time of first presentation because the speed of progression and development of volume expansion within the cranium is slow. An altered level of consciousness or drop in GCS may take days to develop – such patients may therefore benefit from prolonged periods of observation and / or careful discharge advice about progression of symptoms.

SECONDARY – This damage occurs after the initial traumatic insult and is often the result of the following physiological states:

i.	**Hypoxia (PaO2 <10kPA)**
ii.	**Hypotension (SBP <90mmHg)**
iii.	**Delayed diagnosis**
iv.	**Raised intracranial pressure (ICP)**

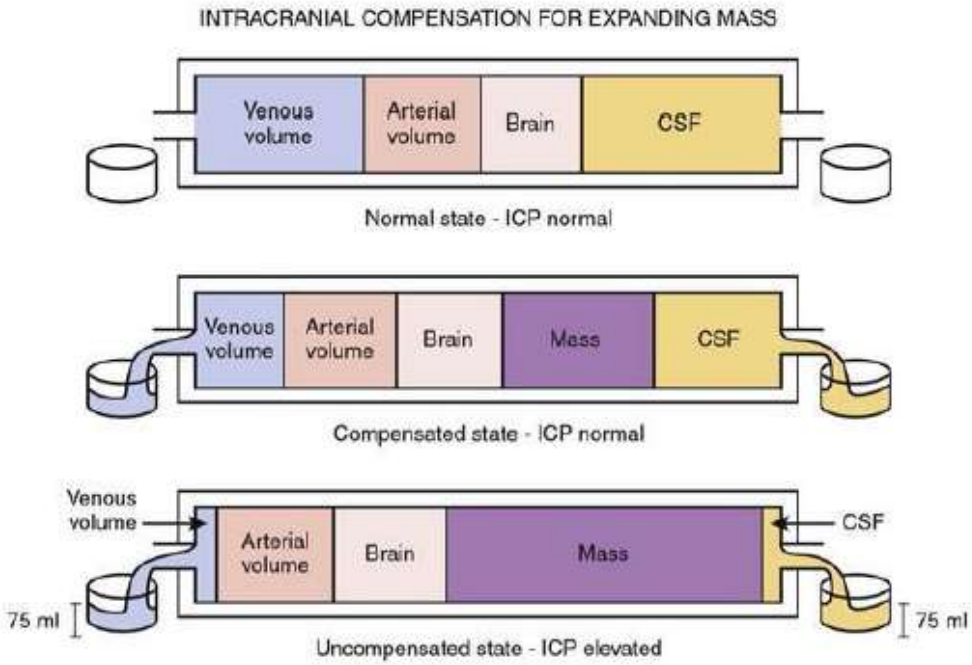
The skull should be regarded as a rigid box that contains brain, blood and cerebrospinal fluid (CSF). In a normal state, these components fill the skull to produce a small positive pressure, known as the ICP which is between 5-13mmHg. The presence of additional contents (e.g. haematoma), would cause the intracranial pressure to increase were it not for the displacement of blood and CSF. This principle is known as the Monroe-Kellie doctrine[3].

The ageing brain undergoes cerebral atrophy, thus resulting in it occupying a lower volume within the skull. This may explain why older patients with the same intracranial injury as younger patients present with a higher GCS – the brain does not occupy as much volume so any additional increase can be accommodated to a point, without pressure on the reticular system.

As pressure within the intracranial compartment increases, blood and CSF are displaced, resulting in reduced cerebral perfusion and hypoxia of brain tissue. With further expansion of pressure, patients develop ipselateral IIIrd nerve palsy manifested as a unilateral fixed, dilated pupil. This can be accompanied by contralateral hemiparesis due to compression of corticospinal tracts crossing at the midbrain.

If bleeding continues and pressure rises, the patient may develop the Cushing's reflex (bradycardia and hypertension).

Further volume expansion results in brainstem herniation or “coning”.



Cerebral Perfusion Pressure

The cerebral perfusion pressure represents a careful balance between the blood flowing into the brain (mean arterial pressure, MAP) and the pressure opposing the flow of this blood into the brain (ICP).

CPP = MAP – ICP

If CPP falls, delivery of oxygen and glucose to neuronal axons diminishes and these neurones start to fail. The ideal CPP should be >70mmHg. Falls in blood pressure will lead to reduced MAP and a smaller difference between MAP and ICP, thus leading to reduced CPP. In the presence of a raised ICP, CPP can be managed by raising the MAP, although this should be in a high dependency setting.

Approach to the Patient with Suspected Head Injury

As a guide, HECTOR suggests that a head injury be suspected for any patient above 65 years with any one of the following features:

THINK HEAD INJURY

1. Bruising above the neck / chin
2. Traumatic epistaxis
3. Fall and altered GCS or new onset headache
4. Loss of consciousness and amnesia (irrespective of history of dementia)
5. High mechanisms of injury (fall downstairs, fall from height, road traffic incident)
6. Any possibility of trauma to the head in a patient on anti-coagulant medication

..AND IF YOU THINK HEAD, THINK NECK!

Triage

Most elderly patients with traumatic head injuries will present following a simple fall from standing. As discussed already, if these patients are brought to hospital via ambulance, they may not trigger pre-hospital trauma triage tools on the basis of mechanism or physiology. Such patients could also self-present or attend hospitals via GP referral.

It is important that the first steps of assessment and triage are performed properly. Any elderly patient who attends after a fall or with any other injury to the head region (e.g. assault) should be examined for bruising / haematoma above the neck and also have a formal assessment of their cervical spine. Ideally this should be done by a senior clinician.

Any bruising above the level of the neck should immediately raise concern about the possibility of intracranial injury. Similarly any neck pain, limited range of movement of the cervical spine, reduced GCS or presence of distracting injury should warrant formal radiological investigation as cervical injuries can be difficult to detect in such groups.

The process of triage should include a review of the following as a minimum:

- Mechanism of injury;

- If high energy, move to Resuscitation Room and consider trauma team activation.

- The recording of a full set of observations (HR; BP; O2 sats; RR; GCS; BM)
- A 12-lead ECG.
- Brief assessment for major injury (head, neck, pelvis, long limbs)

Any abnormalities in the observations should prompt a quick review for concurrent illness and injury.

Summary of Priorities for Triage

- Careful documentation of mechanism of injury
- Review of possible causes for any falls (*include full set of obs and ECG*)
- Any bruising above the neck to prompt clinical assessment for intracranial injury
- Any neck pain, restricted range of movement, reduced GCS or distracting injury to necessitate immediate clinical review for immobilisation ("Minimal Movement" philosophy), and imaging
- Prioritise clinical review for any patient with abnormal observations (GCS <15; HR >100; Altered Temperature)

Primary Survey

Clinical assessment should follow a formal ABCDE. Any elderly patient with reduced GCS or bruising above the neck following a road traffic collision or a fall downstairs / from height should warrant full trauma team activation and standard CT protocols should be followed, (ideally a WBCT).

High energy mechanisms should warrant formal trauma team activation as per local guidance with the trauma team leader managing the operational oversight of the team and instructing on immediate therapy / imaging as soon as possible.

In these situations, patients who have a reduced GCS (8 or less) or who are

agitated should be intubated to facilitate the acquisition of CT imaging. Decisions about whether a patient is suitable for intubation / critical care management are inappropriate in this hyperacute setting. This will delay care. Such decisions can be made later following discussion with the patient's family.

The practice of using sedation to keep a patient still for CT imaging should be avoided in patients with high energy mechanisms. Agitation or reduced GCS often occurs for a reason and the use of benzodiazepines could lower blood pressure, lead to a fall in GCS and an increased risk of aspiration of stomach contents.

For patients with normal physiological parameters and a low mechanism of injury, a full trauma team response will not be required. Assessment of these patients should follow the same principles of the Primary Survey (Chapter 3) but also aim to identify any underlying illness or precipitating factor that could have caused the injury.

The ABCDE approach remains fundamental to assessment to identify additional injuries and illness and be able to treat them as they are found (e.g. associated cervical spine trauma; cardiac arrhythmias etc..).

Secondary Survey

The assessing clinician should perform a formal neurological examination at this point and look for any signs suggestive of a basal skull fracture:

a. Racoon Eyes
b. Battle's sign
c. Haemotympanum
d. CSF otorrhoea / rhinorrhoea
e. Traumatic epistaxis*

*in the context of an unprotected fall onto the face

If not already identified during the primary survey, the following criteria should be used to determine the need for CT Head scan:

i. GCS < 13
ii. GCS <14 2 hours after injury
iii. Signs of basal skull fracture
iv. Post-traumatic seizure
v. Focal neurological signs*
vi. Loss of consciousness
vii. Amnesia
viii. Patient taking anticoagulants (consider use of clopidogrel)
ix. Suspected skull fracture

**Patients who are known to have pre-existing abnormal neurological signs may still benefit from CT scan if there is a clear history of trauma*

Patients with pre-existing dementia or previous stroke may be difficult to assess as their baseline GCS might be less than 15, and they could have pre-existing focal neurological signs. A senior clinician should review these patients and determine the need for immediate imaging or observant management with a decision to scan based on clinical deterioration.

Preventing Secondary Brain Injury and Neurosurgical Referral

Following the diagnosis of intracranial haemorrhage, efforts should be made to prevent secondary brain injury through a combination of the following actions:

- Ensure adequate oxygenation (aim PaO_2 >10 kPa unless patient has COPD with Type II Respiratory failure in

which case tolerate $Pa0_2$ >8 kPA or O_2 sats 88-92%)

- Head Up tilt (15-30^o)
- Remove or reduce tightness of cervical neck collar
- Avoid dextrose-containing infusions

At this point, the need for intubation for patients with reduced GCS will be influenced by decisions about neurosurgical intervention. One could argue that endotracheal intubation for a patient with a low GCS <8 who is not for neurosurgical intervention is inappropriate.

Each patient should have this decision reviewed on a case-by-case basis following discussion with senior decision makers involved in the patient's ongoing care and the patient's family.

Imaging

NICE guidance provides clear criteria for which patients require a CT Head Scan following trauma. This imaging modality has become increasingly common in modern Emergency Departments and as such, HECTOR believes that clinicians should be able to identify significant abnormalities prior to an official report being available.

The following system could be used to structure a review of CT Head scans:

A – Adequacy: check patient details; date of scan; rotation; movement artefact

B – Blood: areas of acute bleeding in the form of bright white signal; chronic bleeding with dark grey signal (primarily around the edges)

C – Contour / Cortex – cortical tissue abnormalities; contour of bleeding around rim of brain to differentiate between extradural and subdural

D – Deviation – midline shift and / or blood in ventricles

E – Extracranial – bony skull for any fractures / deformity; inspect for large extra-cranial haematoma / foreign body.

A – Adequacy

Before attempting to interpret any form of imaging, the clinician should ensure that the images relate to the right patient from the right period of time. Elderly patients may have had previous CT scans and it is important to ensure that the most recent image is the one being interpreted.

The clinician should check the patient's details and date / time of the scan. Following this, the images should be viewed for any rotation or movement artefact that could affect the accurate interpretation of films. Additional artefact may be witnessed from metallic fillings / dentures or previous surgery.

B – Blood

The clinician should assess the rim of the cerebral cortex and cortical tissue for any white (acute) or dark grey (chronic / oedema) discolouration. This should be relatively straightforward to assess although calcification within the brain may lead to a false interpretation as being an acute bleed.

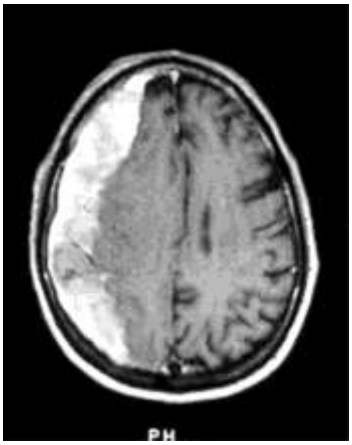


Image – acute subdural (bright white hyperdensity)

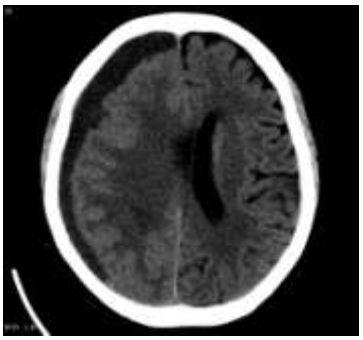


Image – chronic subdural (dark grey discolouration)

C – Cortex

The cerebral cortex should be examined for any gross asymmetry and likely haemorrhage. Cerebral tumours may be difficult to identify on non-contrasted CT Head scans and if such anomalies are suspected, the clinician should take the advice of the radiologist if any further imaging is warranted.

Some patients may present with focal neurology or reduced GCS in the absence of gross intracranial haemorrhage. This could represent the presence of an acute ischaemic stroke (CVA), in which case CT findings may be normal in 50-60% of cases[4]. In the absence of any obvious bleeding but with a patient with focal neurological signs, subtle changes to suggest CVA may be seen on a CT:

i. Hyperdense artery (dense MCA sign)

ii. Obscuration of the lenticular nucleus

iii. Loss of grey-white interfaces (insular ribbon signs)

C-Contour

The contour of any suspected bleeding can aid the clinician in determining whether a patient has a subdural or extradural haemorrhage. Subdural

haemorrhage is most likely to adopt a crescent-shaped appearance compared to a biconvex appearance of an extradural haemorrhage (see below):

Subdural Haemorrhage – crescent-shaped

Extradural haemorrhage – biconvex-shaped

D – Deviation

In the presence of any suspected haemorrhage the clinicians should look for midline shift – a sign of increased pressure within the brain. Structures of the midline include the septum pellucidum, the third ventricle and the pineal gland.

For ease of use, the clinician should draw an imaginary line between the falx cerebri (anterior) and middle of the occiput. Midline shift will be demonstrated by divergence of the midline structures away from this imaginary line.

E – Extracranial

Having assessed the brain tissue, the clinician should view the bony windows of the CT Images and assess for any obvious pneumo-cranium (air underneath the skull). Clinical findings (i.e. scalp lacerations; point tenderness) should be used to direct focus towards specific areas of the cranium to assess for the presence of fractures.

HECTOR advises that protocols for CT Head scanning in the elderly include the odontoid peg and base of C2 vertebral body as a minimum. This ensures that any injury to this region is identified and used to direct any further imaging requests.

Monitoring of Elderly Patients with Head Injury

The following group of patients should be admitted to hospital following head injury[5]:

- Patients with new, clinical significant abnormalities on imaging
- Patients whose GCS has not returned to their normal GCS, irrespective of the CT result
- Continuing worrying signs (persistent vomiting, severe headache) or illness

After admission, patients need to have minimum acceptable documented observations which include: GCS; pupil size and reactivity; limb movements;

respiratory rate; heart rate; blood pressure; temperature and blood oxygen saturation.

These observations should be recorded on a half-hourly basis until the patient has returned to their normal GCS level. After this point, observations should be recorded along the following schedule:

- Half-hourly for 2 hours
- Hourly for 4 hours
- Two-hourly thereafter

Any deterioration in GCS during this period mandates a return to half-hourly observations and urgent clinical reassessment.

A repeat CT scan is indicated if any of the following are observed (unless there has already been an agreement that escalation of care and resuscitation in the event of cardiorespiratory arrest is inappropriate):

Indications for Repeat CT Head Scan

1. Development of agitation or abnormal behaviour

2. Any drop of 3 points in eye-opening or verbal response scores, or 2 or more points in the motor response score

3. Development of severe or increasing headache or persistent vomiting

4. New or evolving neurological symptoms or signs

Prognosis and Traumatic Brain Injury

Prognostication may be difficult for patients aged 65 years and over – pre-existing co-morbidity and frailty, concomitant use of anti-coagulants and limits of daily functioning will all aid in the decision-making process. In many circumstances, decisions about how to manage an injury (and not the patient with the injury) are made with the neurosurgical teams via a remote process.

This relies on the provision of accurate and detailed information from the referrer. Omission of important information such as pre-morbid status may influence the decision about whether or not a patient is considered for aggressive intervention.

Each patient with a severe head injury should be managed on an individualised basis. Having an understanding of some elements of the evidence for prognosis may prove to be useful in the decision-making process.

Prognosis and Advancing Age

In a prospective study of the Traumatic Coma Data Bank (TCDB), there was a significantly increased percentage of poor outcomes (death and vegetative) in patients with pre-existing co-morbidity in ages above 56 (86% vs 50%)[6].

The same study identified that a poor outcome was associated with patients who had: intra- or extra-cerebral haematomas greater than 15cc, subarachnoid haemorrhage; midline shift or compressed cisterns.

The Brain Trauma Foundation identified Class I studies which demonstrated a

mortality of greater than 75% in severely brain injured patients older than 60 [7].

A study of 11,772 patients compared patients aged 65 years and over with similar brain injuries to younger patients (<65 years). Mortality was 24% in the elderly population compared to 12.8% in the younger population. The elderly non-survivors were statistically older, with mortality rate increasing with age[8].

Prognosis and Type of Injury

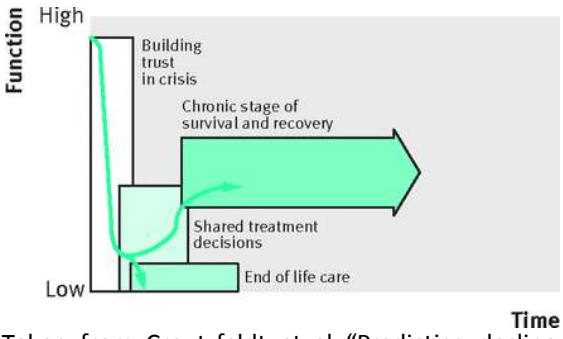
A 2015 meta-analysis[9] looking at patients with bilateral fixed dilated pupils identified that mortality rates were different for patients with extradural haematoma compared to subdural haematoma (29.7% vs 66.4%). This same study also found that of the survivors with subdural haemorrhage, only 6.6% had a good functional recovery.

For patients with cerebral contusions, a review of the TARN database was conducted in 2013 which assessed outcomes for patients with cerebral contusions (AIS 3 or more).[10] Of 4387 patients, mortality was found to increase with increasing age. The study also identified that the likelihood of not being transferred to a neurosciences centre also increased with advancing age.

Prognosis and Trajectory of Illness after Traumatic Brain Injury

Three main illness trajectories exist that attempt to describe how function declines as life-limiting diseases advance a patient towards death. These trajectories include a rapid decline in function (as observed in cancer); an episodic decline (e.g. heart failure); and a prolonged decline (e.g. dementia).[11, 12]

For elderly patients with severe brain injury, a further trajectory has been proposed that describes either a rapid decline (early death after a decision to withdraw life sustaining treatments), or a chronic stage of survival with a high degree of disability.[13] This latter stage may enter a trajectory of chronic illness, with repeated exacerbations of worsening health until eventual death. (see below)



Taken from Creutzfeldt et al "Predicting decline and survival in severe acute brain injury: the fourth trajectory"[13]

With severe brain injury, the patients themselves are often too impaired to express the preference for their treatment, with decisions often falling upon clinicians and the patient's family. These decisions often focus on measures to maintain comfort, or for aggressive intervention (with life-saving intervention being offered but at the compromise of quality of life).

In the emergency setting, these decisions are often made rapidly, in contrast to patients with chronic illness where management options can be discussed, absorbed and decided upon over a longer period of time.

For the majority of patients over 65 years of age, neurosurgical intervention will not be an option or may not be offered by regional teams. In such circumstances, it is vital that the clinical team responsible for ongoing care have an honest discussion with the patient and their family as soon

as possible. These discussions need to continue on a periodic basis as the patient's trajectory of illness progresses.

Patients may recover or deteriorate unexpectedly and their family need to be made aware of this fluctuating course. The lack of information may lead to conflict or confusion about management goals, but such issues can have their impact lessened with clear, open and honest communication.

Some patients will die whilst staying in hospital, whilst others will make some recovery with a possible impact on their activities of daily living. This will require family members and/or carers to adapt changing roles and this will require time to occur.

HECTOR believes that elderly patients with conservatively-managed traumatic brain injury should be managed jointly by specialists who can monitor for acute deteriorations and elderly care physicians who can take responsibility for ongoing care if patients enter a chronic stage of survival and recovery.

Summary

- Elderly patients with serious head injury are at higher risk of under-triage than younger patients. This occurs for different reasons but mainly because they will have a lower energy mechanism of injury (e.g. simple fall), and will have a higher GCS for any given injury.

- Clinicians should have an understanding of basic neuroanatomy and the relevance of primary brain injury and the importance of preventing secondary brain injury.

- All patients should be assessed with a high degree of vigilance, especially if they have evidence of any injury above the clavicles and are taking anticoagulant medication. Assessment should follow Primary Survey guidance in previous chapters, either through a trauma team response (high-energy mechanism), or lone assessor (low-energy mechanism)

- Clear indications for CT imaging exist and clinicians should have a basic understanding of these rules and how to interpret CT films for gross abnormalities.

- Prognostication should occur on an individual basis and referrals to neurosurgical teams should provide core information on a patient's pre-morbid level of functioning to aid decision-making.

- The trajectory of illness may be rapid with death within a few days, or enter a prolonged trajectory of recovery and episodic ill health. After the acute phase, patients will benefit by being cared for by specialists in elderly care.

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Chapter 8 Cervical Spine Injuries

Introduction

Approximately 5% of unconscious patients who present to the ED following trauma have an injury to the cervical spine. Most fractures occur at two levels with 33% occurring at the level of C2 and 50% affecting C6 or C7[1].

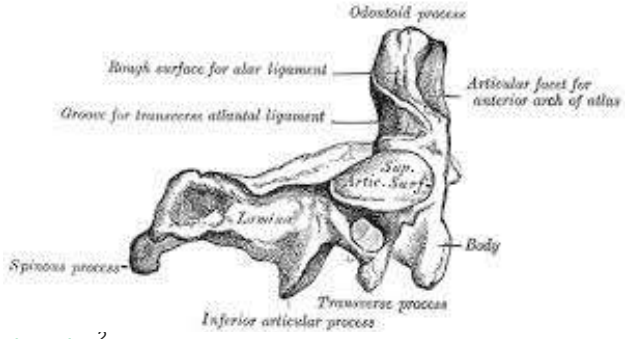
Elderly patients with pre-existing joint disease (e.g. osteoarthritis, ankylosing spondylitis), or reduced movement in the neck (e.g. Parkinson's disease), are particularly vulnerable to fractures of the cervical spine following relatively low mechanisms of injury (see below).

The main principles of management rely on **having a lower index of suspicion for injury than in younger patients**. High mechanisms of injury such as fall from height (including downstairs), road traffic collisions and pedestrian traffic accidents should all warrant careful assessment for injury. Any patient with a history of fall and bruising / injury above the neck or neck pain should be considered as being at high risk for having a cervical spine injury.

Cervical Spine Anatomy

The cervical spine consists of seven vertebra (C1-C7), with the first two called the atlas and axis, respectively. C3-C7 all have a body, pedicles, laminae, facet joints and spinous processes. The cervical spine provides stability and mobility to the head whilst connecting it to the more fixed thoracic spine.

Odontoid peg fractures represent the most common cervical spine fracture in patients over 70, primarily due to how the axis (C2) articulates with the atlas (C1). The peg (axis) forms the pivot upon which the atlas rotates. The odontoid peg is held in position by the transverse atlantal ligament and alar ligaments which connect the peg to the occipital bone.



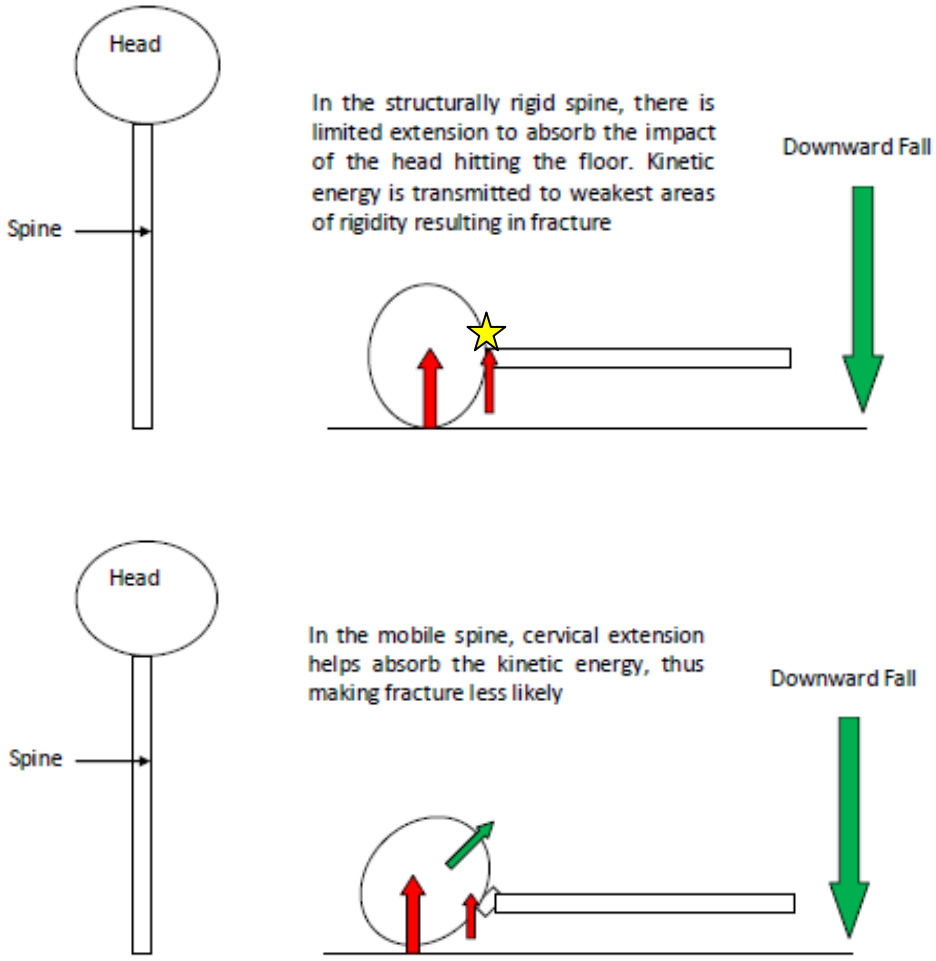
The atlas[2]

The atlantoaxial joint is responsible for 50% of all cervical rotation, with the atlanto-occipital joint being responsible for 50% of all rotation. With such a degree of movement permitted across these joints, the kinetic energy generated by direct trauma to the head will be transmitted to these areas.

Mechanism of Injury

Restricted neck movements that have been caused by underlying disease processes make elderly patients particularly vulnerable to injuries to the odontoid peg. A lack of movement in flexion / extension that occurs following falls with a direct blow to the head will place a greater strain on the ascending odontoid peg, thus rendering it more vulnerable to the forces involved. (see below).

Consideration should also be given to the risk of injuries to the stabilising ligaments, spinal cord and intervertebral discs. Decreasing nutrition of the central disc that occurs with age can make prolapse highly likely with consequential effects on the spinal cord.



Mechanism of Injury and the Cervical Spine – Energy Transfer in the Rigid and Flexible Skeleton

Triage

The initial triage of any elderly patient is the most important step for picking up concerns about underlying neck injury. A low index of suspicion is needed for any elderly patient who has presented following a fall. **As soon as direct trauma to the head has been identified, the cervical spine should be assessed for injury**.

Elderly patients with high mechanisms of injury (pedestrian vs car; high speed RTC; fall from height; fall downstairs) should have formal imaging of the neck to exclude injury. In these circumstances, decisions to clear the patient's cervical spine at triage without imaging should only be made by the skilled and trained clinician.

Elderly patients with a history of a fall / collapse and injury above the clavicles should be considered as being at risk of cervical spine injury.

If a cervical spine injury can not be excluded and if the patient has not already been immobilised, the triage team should consider the best methods of immobilisation at this stage, (i.e. using the "Minimal Movement" Philosophy). If collars and head blocks can be applied this

should be done. If this is not possible (i.e. an agitated patient; significant kyphoscoliosis), pillows or rolled blankets can be applied behind the head / neck and on either side.

Semi-rigid cervical collars should never be forcibly applied to patients. If a collar can not be found that fits, the triage team should use methods as described above prior to formal imaging.

Initial Assessment & Primary Survey

A structured <C>ABC approach should be used for the assessment of all elderly trauma patients with suspicion of cervical spine injury.

<C> Catastrophic Haemorrhage – Scalp Lacerations and Epistaxis

Neck injuries can often be associated with direct trauma to the mid-face and/or scalp. Seemingly minor injuries can have devastating consequences if they are not identified and managed immediately. Patients may develop haemorrhagic shock if scalp lacerations continue to bleed whilst a patient waits for a CT scan, and continues to wait in an immobilised state, until results are available.

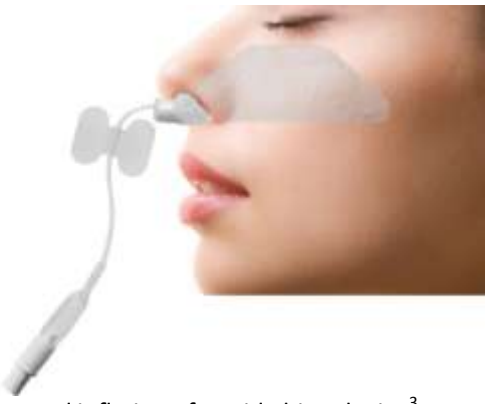
Management of catastrophic haemorrhage may include immediate control of epistaxis as well as scalp lacerations and if required, the clinician should aim to preserve alignment of the cervical spine whilst this is being done. This may require manual in-line stabilisation provided by an assistant.

Haemorrhage from lacerations may be difficult to control if located in the occiput. These can either be sutured during a log-roll after local anaesthetic instillation or consideration should be given to the use of haemostatic agents like Celox with direct pressure as a temporary measure.

Traumatic nasal injuries can lead to catastrophic haemorrhage if not controlled. Friable blood vessels, hypertension and concomitant used of anticoagulant therapy will make control even more pertinent.

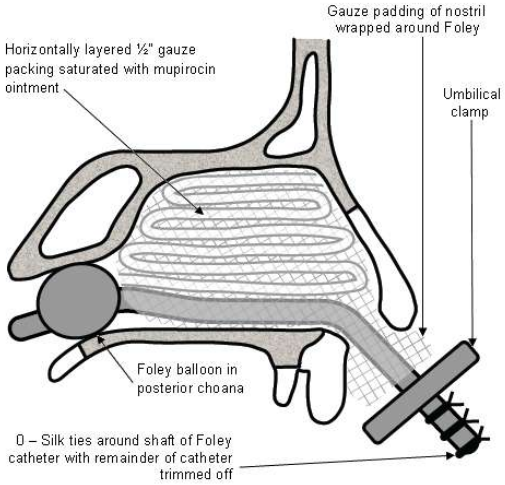
Patients kept lying flat will also be at risk of aspiration from posterior haemorrhage so the decision to provide nasal packing should be weighed up against the risks of aggravating any high cervical spine injury or basal skull fracture.

The following techniques can be used to provide haemostasis of epistaxis:



Insertion and inflation of Rapid Rhino device[3]

Merocel Nasal Tampon[4]



Foley catheter insertion and BIPP (bismuth subnitrate – iodoform) packing[5]

Airway and Cervical Spine

Management of the airway should occur in tandem with management of the cervical spine. Any concerns about airway patency should warrant formal assessment and consideration of the need for definitive care.

If a patient is being intubated, manual in-line stabilisation should be used to prevent excessive neck movement. Such patients should be considered as being at high risk of difficult intubation (due to their restricted neck movement). The clinical team should ensure that rescue devices and difficult airway equipment are available for any intubation attempt.

Breathing & Circulation

All patients should have their respiratory rate, oxygen saturations, heart rate and blood pressure recorded as a minimum. If there is a history of fall, patients should have a blood glucose checked and a 12-Lead ECG performed.

The chest and abdomen should be examined for any additional injury with close attention paid to the chest wall and groin / pelvic area in the event of a fall.

Disability

The assessing clinician should document pupillary size and presenting GCS. Every patient should have a formal neurological examination incorporating all myotomes and dermatomes. In the event that a patient has any back pain or is unable to communicate such symptoms, a log-roll should be performed (if safe to do so), to palpate for any spinal tenderness.

Spinal tenderness or abnormal neurological signs / symptoms should lead the examiner to coordinate additional spinal imaging.

Imaging of the Cervical Spine

The following criteria can be used to determine which patients will require radiological clearance:

a. Fall from standing and neck pain
b. High mechanism of injury (high speed RTC – rollover, ejection, death in same passenger compartment; fall downstairs; fall from height)
c. Injury above the clavicles if GCS < 15
d. Injury above the clavicles if GCS > 15 and patient complains of neck pain
e. Distracting injury
f. New-onset focal neurological signs

CT-Cervical Spine is the imaging modality of choice as it will help differentiate between degenerative change (e.g. osteophytes) and acute injury. In centres where CT is not readily available, plain film radiography should be performed as a

minimum (AP, lateral, Open-Mouth Peg view).

Interpretation of Plain Film Cervical Spine X-Rays

HECTOR makes the recommendation that CT-scanning is the imaging modality of choice for injury to the cervical spine. Although MRI has a higher sensitivity and specificity, it is less accessible than CT imaging and may not be tolerated by the agitated or confused patient.

HECTOR also believes that clinicians should possess the skills needed for interpretation of plain film imaging of the cervical spine. These skills are partially transferable to a gross review of sagittal and coronal CT slices to identify obvious (but not subtle) injury.

Inadequacy of cervical spine plain films and incorrect interpretation are key causes for error in the assessment of the patient with suspected spinal injury. The additional presence of degenerative skeletal change (e.g. osteophytes), and chronic injuries can make adequate assessment even more difficult.

It is important to have a system for interpreting plain film imaging that is structured, reproducible and covers enough depth of assessment to ensure that common injury patterns can be identified.

HECTOR recommends using a system similar to the one outlined below:

AAABCS

A	Accuracy
A	Adequacy
A	Alignment
B	Bones
C	Cartilages and Joints
S	Soft Tissues

Accuracy:

- Are the patient details correct? Check the patient's name, PID, date of birth to ensure that the correct patient is being reviewed.
- Were the images taken today? Elderly patients may have more historical imaging studies than younger patients and it is important that the right images are being reviewed.

Adequacy:

- Have AP / Lateral / PEG views been taken? All three views need to have been performed and all need to be adequate.
- Is the odontoid PEG in the middle of the image and is it clearly visible? Check this by drawing an imaginary line between the upper and lower middle teeth and the middle of the peg should pass through this line. If the entirety of the PEG is not visible, the image is inadequate.
- Has the lateral c-spine been imaged down to the C7-T1 junction? If not the spine can't be cleared with this view.

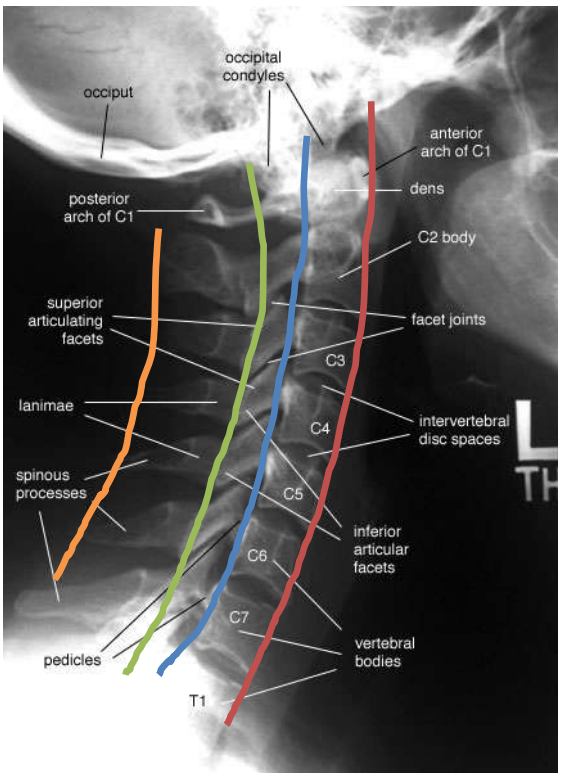
Alignment:

There are four longitudinal contours present on the lateral cervical spine film – by ensuring that all contours are smooth and don't have any obvious steps, one can comment on the alignment.

If there appears to be a step in any of these contours, this should be discussed

immediately with a senior clinician and plans made to perform CT imaging.

Steps in the anterior or posterior longitudinal line may be due to facet dislocation. Simple unifacet dislocation is often a stable injury – it may be evidenced by anterior subluxation of one vertebral body on top of another by less than half the antero-posterior length of that vertebral body.



Anterior Longitudinal Line:
-A line drawn over the anterior aspect of the vertebral bodies

Posterior Longitudinal Line
-A line drawn over the posterior aspect of the vertebral bodies

Spinolaminar Line:
-A line drawn along the laminae and anterior aspect of spinous process

Spinous Processes:
-A line drawn along the most posterior aspect of the spinous processes

Bones

Trace around all the bones of the cervical spine to include vertebral bodies, facets and spinous processes at each level, to ensure there are no fractures or deformities.

Unless each bone is traced individually, there is a high risk of missing fractures. Careful attention should be paid to the odontoid PEG during this part of the interpretation.

Cartilages & Joints

Having assessed each bone, it is important to assess each intervertebral space, (space between each vertebrae) the interspinous gaps (space between each spinous process) and the C1-odontoid gap. This is the space between the anterior aspect of the odontoid process and C1.

The C1-odontoid gap should be less than three millimetres. Steele's Rule of Thirds[6] comments that in this area, 1/3rd of space is spinal canal, 1/3rd is odontoid peg and 1/3rd is space. Any increase in this space could jeopardise the spinal cord at this level.

Soft Tissues

In some situations, this will be the only marker of acute injury. It is a similar concept to the recognition of the anterior fat pad sign of the elbow, i.e. acute fractures will bleed and will result in soft tissue swelling.

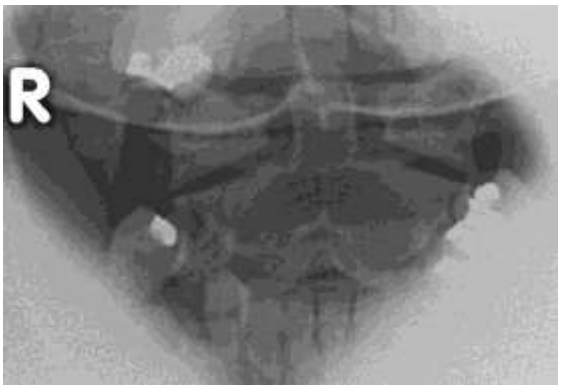
There are three distinct areas in which to look at the soft tissues – the level of the odontoid peg; C2-C3; and C4-C7. Any enhanced swelling of the soft tissues anterior to the PEG with suspicion of injury at this level should lead the clinician to consider other imaging, CT or MRI.

Anterior to the vertebral body of C2 and C3, the distance between the anterior border of the vertebral body and the soft tissue shadow directly in front of it should be <7mm, or roughly half the antero-posterior length of the vertebral body itself.

At the levels below C4, this distance (anterior border of vertebral body to soft tissue shadow), is slightly longer and equivalent to the entire A-P length of the corresponding vertebral body, or less than 21mm.

Interpretation of the Open Mouth Odontoid Peg View

This view can only be obtained when the patient is able to follow instructions. It may not be possible to obtain such images for patients with dementia or in hypoactive or hyperactive states of delirium. In such circumstances, CT cervical spine should be the imaging modality of choice.



The Open Mouth Odontoid Peg View

A similar AAABC approach can be used for interpreting this view:

Accuracy: Is this the right film for the right patient? (see above)

Adequacy:

- Is the tip of the peg visible? The whole of the odontoid process should be visible on this image. Without it, type I fractures could be missed.
- Are all the lateral masses visible? Assessment of this image requires review of the alignment of the lateral masses. Without these being present on this image, interpretation will be compromised.
- Is the odontoid peg central on the image? If it is not central (see before), the film is likely to be rotated and interpretation of alignment will be inaccurate.

Alignment:

- Are the lateral masses aligned?
- Is there symmetry between the peg and the lateral masses? Ensure that the lateral masses of C1 do not overhang the most lateral aspects of the C2 vertebral body.

Bones: Check the peg to ensure there is no fracture through it.

Cartilage & Soft Tissues: Check for any gross abnormalities in the soft tissues.

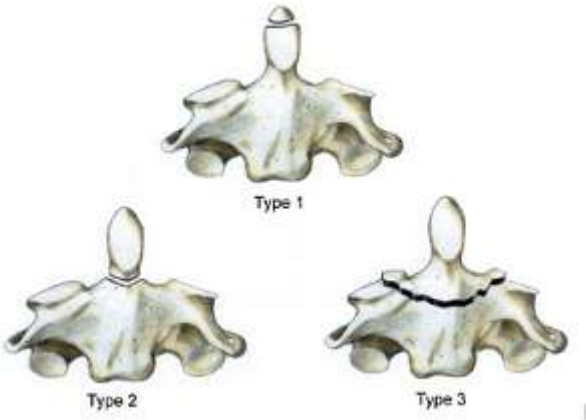
Classification of Fractures of the Odontoid Process

Injuries at this level can be classified using the Anderson – D'Alonso system[7]:

TYPE I: Extends through the tip of the peg (usually stable)

TYPE II: Extends through the base of the peg (unstable)

TYPE III: Extends through the vertebral body of C2 and may be stable or unstable.



Anderson – D'Alonso Classification of Odontoid Peg Fractures[8]

General Management of Patients with Cervical Spine Injuries

Most elderly patients with injuries to the cervical spine will be treated with a semi-rigid collar. The most commonly-utilised collars are the Aspen, Philadelphia and Miami-J collars (see below):

The Miami J Collar[9]

The Aspen Collar[10]

The Philadelphia Collar[11]

Collar application will be dependent on local availability but studies have shown that the Miami J and Philadelphia collars generate the lowest pressure on occipital and mandibular areas and may be of benefit to elderly patients with fragile skin[12]. Most collars are worn for between 6-8 weeks following the injury. Patients with unstable injuries may require up to two weeks hospital admission before discharge.

Once an injury to the cervical spine has been identified, clinicians should discuss the most appropriate management with their local spinal service, (commonly neurosurgeons). Most specialists will request MRI prior to definitive management planning and this may prove to be a challenge in the agitated patient.

Consideration should be given to the risks of MRI against its possible benefit. If a patient is unlikely to be fit for surgery and likely to not tolerate an MRI, this becomes an unnecessary investigation in the patient with no abnormal neurological signs / symptoms.

MRI is appropriate if a patient has developed new neurological signs/symptoms in the presence or absence of cervical spine fracture. MRI will aid in the diagnosis of acute cord injury (e.g. central cord syndrome), and intervertebral disc prolapse.

Management of Specific Fractures of the Cervical Spine

Type I Odontoid Peg Fracture

This fracture occurs at the tip of the odontoid peg, is rare, and is often caused by an avulsion of the alar ligament. Most of these injuries are stable but they can be an unstable injury if associated with occipito-atlantal dissociation which may be present on CT or dynamic flexion / extension views of the cervical spine.

Patients can be treated with a semi-rigid collar (e.g. Miami J or Philadelphia) for 6-8 weeks. Unstable injuries should be discussed with neurosurgical specialists.

Type II Odontoid Peg Fracture

These fractures occur at the base of the dens and the blood supply is often compromised. The rate of non-union is 30-50%, and related to the following factors[13]:

- Older age groups;
- >5mm displacement;
- Angulation >10^{O};
- Delayed start of treatment (>4 days).

Management of these types of injury in elderly patients remains controversial. Elderly patients demonstrate poor long-term functional outcomes, and high rates of morbidity and mortality with non-operative management. Many elderly patients will also have non-union of their injuries but at the same time can achieve an asymptomatic stable fibrous union (non-bony).

Surgical intervention includes anterior odontoid screw fixation and posterior C1-C2 fusion and is often reserved for patients with neurological deficit, symptomatic non-union and unstable non-union. In the event of surgery being considered, factors to take into account will be an individual's pre-morbid functioning and co-morbid state. It is likely that these decisions will be made on an individual basis.

Type III Odontoid Peg Fracture

These fractures involve the C2 vertebral body. Like Type I fractures, semi-rigid collars have been shown to be the most appropriate form of management for elderly patients with these injuries. These patients require frequent follow-up and most heal by bony union within 12 weeks of immobilisation.

Hangman's Fracture

This type of fracture involves a fracture of the pars interarticularis of C2 and results in the disruption of the C2-C3 junction. It usually results from forced hyperextension (i.e. forced extension such as a blow to the head on an already extended neck). They are often associated with facial injuries.

These injuries are classified according to the degree of translation and angulation. Most require some form of neurosurgical input (e.g. cervicothoracic brace; halo vest; fixation), but are not tolerated particularly well by elderly patients, especially with pre-existing respiratory conditions. All patients should be discussed with the specialist teams to plan the most appropriate form of management.

Hangman's Fracture[14]

Cervical Spine Facet Dislocation

Cervical dislocation may be present in patients with minimal or no neck pain, following seemingly minor trauma (e.g. same-level falls). It rarely occurs without subsequent insult to the spinal cord but at the time of the original injury, pain in the neck may be minor and occurs due to impingement on cervical nerves or joints.

A progressive development of paralysis can occur within 48 hours due to ongoing oedema of the cord within the narrowed canal[15]. This oedema can be associated with vascular cord compromise and a poor prognosis.

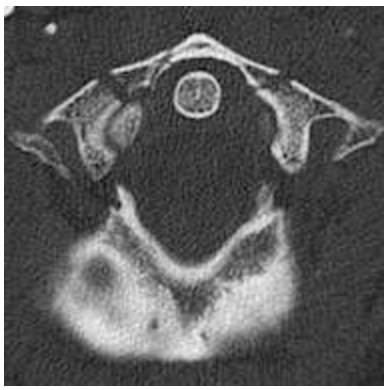
Bifacet dislocations are inherently unstable and have associated disruptions of the middle and posterior ligamentous structures. Up to 10% of patients may have associated disc herniation which can cause catastrophic compression of the spinal cord.

Once these types of injury have been identified on imaging, MRI should be performed to assess for cord involvement/oedema. Patients with this type of injury can be treated in a semi-rigid collar with neurosurgical referral to discuss the need for operative intervention.

Jefferson Fracture

The Jefferson fracture is a burst fracture of the atlas (C1) and most commonly occurs after axial compression. In the elderly population, this is most likely to occur following a significant fall (i.e. downstairs) with direct trauma to the skull vertex.

It is important to note that 50% of these injuries are associated with other injuries to the cervical spine and that 33% are associated with fractures to C2.



Jefferson Fracture[16]

The Odontoid PEG view on plain film imaging is likely to reveal displacement of the lateral masses and a more accurate classification of injury will be apparent on transverse CT sections. Patients should be treated in semi-rigid collars for 6-8 weeks.

Vertebral Body Injuries

These type of injuries will most likely be related to anterior tear-drop fractures or fractures from osteophytes. The majority will be stable but MRI may be required to asses for ligamentous injury or disc prolapse.

Patients can be treated in semi-rigid collars and if the injury is deemed stable, should be mobilised early to prevent further complications.

Central Cord Syndrome and Cord Injury

Central cord syndrome usually presents in patients over 50 with pre-existing cervical spondylosis who have sustained a hyperextension injury to the neck. The spinal cord may be pinched between a thickened ligamentum flavum located behind the cord and a protruding osteophyte or disc.

Most patients will present with:

- Incomplete quadriplegia affecting the upper more than the lower limbs;
- Variable sensory impairment
- Bladder dysfunction.

MRI imaging will reveal high signal change in the centre of the spinal cord and most patients can be treated with a semi-rigid collar with management of possible complications:

a. Autonomic dysreflexia – nifedipine may be used to control hypertension resulting from generalised sympathetic activity.

b. Neurogenic bladder – urethral catheterisation should be performed and bladder function usually returns within 6 months.

c. Spasticity – proper bed positioning and a regular stretching programme can reduce spasticity and the development of contractures. Baclofen may be of use if spasticity develops.

d. Pressure Ulcers (Decubitus) - If patients develop sensory loss, they may have a reduced awareness of continued forces on the skin, leaving them prone to pressure ulcers. Special pressure-relieving mattresses and regular turning should be employed to eliminate the risk of such ulcers.

e. Neurogenic Bowel – patients should be started on a regular bowel programme to avoid incontinence and have adequate intake to avoid constipation.

Summary

- All elderly patients with either a high mechanism of injury or history of fall with injury to the head/above the clavicles should be considered as being at risk of having a cervical spine injury

- One of the most vital steps in a patient's journey is in their initial assessment and triage. If cervical spine injury is not suspected or considered at this stage, it may be missed later.

- All patients with suspicion of injury should have a formal primary survey and management of significant

haemorrhage should be addressed as early as possible.

- CT imaging is the modality of choice although clinicians should have a basic knowledge of plain film interpretation for when CT is not readily available

- Most patients will be treated conservatively in a semi-rigid collar (Miami J or Philadelphia) for 6-8 weeks, and many will require an MRI to investigate for associated disc, cord and ligamentous injury.

- Early mobilisation whilst wearing a collar is important but patients with unstable fractures or cord involvement may require a prolonged period of bedrest (1-2 weeks) before this occurs.

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Chapter 9 – Injuries to the Thoracic and Lumbar Spine

Introduction

Patients with simple falls may be vulnerable to fractures of the thoracic and lumbar spine, especially in the presence of osteoporosis. Osteoporosis may only become evident when a fracture occurs after relatively trivial mechanisms of injury. In general terms, osteoporosis is a systemic skeletal disease characterised by low bone mass, deterioration of bone tissue and increased bone fragility.

Osteoporosis can be divided into different classifications according to its aetiology. Primary osteoporosis occurs when a secondary cause is not identified (e.g. juvenile; idiopathic; postemenopausal; age-associated). Secondary osteoporosis occurs when an underlying disease, drug or deficiency causes osteoporosis (e.g. porphyria; panhypopituitarism; diabetes; pregnancy; calcium deficiency; inflammatory bowel disease; anticonvulsants; furosemide; alcoholism).

Most fractures of the thoracic and lumbar spine in elderly patients will result from simple falls and be a consequence of underlying osteoporosis and bone fragility.

Patients who present following higher mechanisms of injury should be treated carefully – these injuries are more likely to be unstable and possibly associated with involvement of the spinal cord.

Initial Assessment

Elderly patients with injuries to the thoracic / lumbar spine may present following low or high mechanisms of injury and as such, may arrive via emergency ambulance or could self-present to the emergency department. At initial assessment or triage, it is important to assess an individual in the context of their mechanism of injury. Patients with simple falls and no focal neurology may be managed alongside other Majors / Minors patients, whereas patients with back pain and/or neurological symptoms following RTC / falls from height or downstairs may merit formal trauma team activation.

Primary Survey

The primary survey should follow an individual ABCDE approach where systems are assessed successively, or a horizontal approach whereby the trauma team, led by the team leader, assesses each area concurrently.

Airway & Cervical Spine

Patients with a history of trauma and pain to the thoracic or lumbar areas should also be considered as being at risk of cervical spine injury – injuries to the thoracic and lumbar areas could distract attention away from the cervical spine.

B – Breathing

In the context of thoracic pain, clinicians should pay close attention to the possibility of additional thoracic trauma. Elderly patients who have fallen against hard objects should be examined for the possibility of rib fractures, flail segments and associated haemothoraces, pneumothoraces and lung contusions.

The anterior and posterior aspects of the thoracic wall should be examined for any focal tenderness, crepitus and surgical emphysema. This may have to be done when it is safe to perform a log-roll.

C – Circulation

Blood pressure, heart rate and skin colour / warmth should all be documented. Patients with neurogenic shock will develop hypotension, bradycardia and peripheral vasodilatation in response to a loss of sympathetic vascular tone with traumatic lesions higher than the level of T6.

For elderly patients with a history of fall / collapse, thoracolumbar pain could also be attributed to vascular events such as ruptured AAA or thoracic artery dissection / aneurysm. The assessing clinician should take into account these possible diagnoses and examine the patient accordingly.

Formal assessment for abdominal and pelvic injuries should be completed in the context of mechanism of injury.

D – Disability

All patients should have GCS and pupillary size and reaction documented. A formal neurological assessment will be required but this can be conducted within the secondary survey.

Imaging of the Thoracic and Lumbar Spine

If there is a suspicion of injury to the thoracic and / or lumbar spine, the most appropriate imaging modality will depend on mechanism of injury and any suspected associated injuries.

Patients with high energy mechanisms such as falls from height / downstairs or high-speed road traffic collisions (pedestrian vs car; rollover; ejection; death in same compartment; prolonged entrapment), are best imaged using WBCT or focussed CT.

Patients with injuries to the thoracic cage and/or spine are best imaged using CT thorax imaging but plain film CXR and plain film thoracic AP/Lat views may be appropriate in some centres without early access to CT.

Patients who present following: simple falls; with thoracic spine or lumbar spine tenderness, (in isolation or combined), could be imaged using AP/Lat plain film radiography in the first instance. Any abnormality on plain films should warrant further CT / MRI imaging if the fractures look unstable (see below) and represent more than simple osteoporotic crush injuries.

When interpreting plain films, it is often useful to access old images for comparison – osteoporotic fractures may be longstanding and patients may have acute pain on the background of chronic injuries.

Assessment of Thoracic and Lumbar Spine Stability

When interpreting X-Rays, it's important to consider the spinal column as having three separate sections:

ANTERIOR COLUMN – anterior longitudinal ligament and anterior half of the vertebral body

MIDDLE COLUMN – posterior half of vertebral body, disc, annulus and posterior longitudinal ligament

POSTERIOR COLUMN – facet joints, ligamentum flavum and the posterior elements.

A fracture is generally considered stable if only the anterior column is involved, (e.g. most wedge fractures). However, if there is loss of >50% vertebral body height, this could be a marker of instability. Other fractures that involve two or more columns are considered unstable and merit further imaging, preferably MRI to assess cord integrity.

Types of Fracture & Management

Wedge Fractures

Wedge fractures occur when the anterior aspect of the vertebral body is crushed, forming a wedge shape. X-Ray findings will demonstrate a loss of height in the anterior margin of the vertebral body in comparison to the posterior margin.

The amount of wedging should be assessed and the fracture could be considered stable if the following are present:

a. Height of the anterior margin of the vertebral body is two-thirds or more of the posterior margin.

b. The degree of wedging is less than 15^{o}

c. The depth of the vertebral body divided by the difference in the heights of the anterior and posterior margins is greater than 3.75.

Patients with stable injuries should be managed with analgesia and complete bed rest in recumbency for one week or until the symptoms have settled. Thereafter, extension exercises will promote a better functional outcome.

Patients with unstable injuries should have further imaging (CT or MRI), and be managed in recumbency or with a TLSO brace (thoracolumbar spinal orthosis) in extension.

Burst Fractures

Burst fractures occur when the vertebral body is crushed in all directions, potentially causing bony fragments to undergo retropulsion into the spinal canal.

If any disruption to alignment exists, or if there is reduction in the height of the posterior margin of the vertebral body, focussed CT imaging or MRI should be performed assess stability and encroachment into the spinal canal.

Any patient with an unstable injury should be discussed with local spinal / neurosurgical specialists to determine appropriate management.

With both types of fracture, elderly patients are often nursed in a supine, bed-bound state. They will be at increased risk of pressure sores, thrombo-embolic events and noscomial infections. High levels of vigilance and daily monitoring will be needed to ensure that preventative measures can be utilised to prevent such events.

Secondary Survey & Cord Injury

All patients should have a formal neurological examination completed as part of the secondary survey (see Chapter 5). Any abnormal neurological signs / symptoms should lead the clinician to consider the possibility of spinal cord injury.

The American Spinal Injury Association has published international standards for neurological and functional classification of such injuries and it is important for

admitting teams to have a basic understanding of these concepts.

Definitions

Tetraplegia refers to impairment or loss of motor and/or sensory function in the cervical segments of the spinal cord due to damage of neural elements within the spinal canal. It results in impairment in the arms, legs, trunk and pelvic organs.

Paraplegia refers to impairment or loss of motor and/or sensory function in the thoracic, lumbar or sacral (but not cervical) segments of the spinal cord. Arm functioning will be spared.

Neurological Level refers to the most caudal segment of the spinal cord with normal sensory and motor function on both sides of the body.

Sensory Level refers to the most caudal segment of the spinal cord with normal sensory function on both sides of the body.

Motor Level refers to the most caudal segment of the spinal cord with normal motor function on both sides of the body.

Definitions of Injury

Incomplete Injury occurs if partial preservation of sensory and/or motor function is found below the neurological level AND includes the lowest sacral segment (anal sensation and tone)

Complete Injury occurs when there is absence of sensory and motor function in the lowest sacral segment.

Elements of Sensory Assessment

Sensation should be examined at 28 key points on the left and right hand side of the body. Sensitivity to light-touch and pinprick should be assessed and graded as follows:

0	Absent
1	Impaired (includes hyperaesthesia)
2	Normal
NT	Not testable (e.g injury present)

The following 28 key points should be assessed and examination completed with perceived sensation at the external anal sphincter, graded as present or absent:

C2	Occipital protuberance
C3	Supraclavicular fossa
C4	Top of acromioclavicular joint
C5	Lateral side of antecubital fossa
C6	Thumb
C7	Middle Finger
C8	Little Finger
T1	Medial side of antecubital fossa
T2	Apex of axilla
T3	Third intercostal space (IS)
T4	Fourth IS (nipple line)
T5	Fifth IS
T6	Sixth IS (level of xiphisternum)
T7	Seventh IS
T8	Eighth IS
T9	Ninth IS
T10	Tenth IS (umbilicus)
T11	Eleventh IS
T12	Inguinal ligament at mid-point
L1	Half the distance between T12 and L2
L2	Mid-anterior thigh
L3	Medial femoral condyle
L4	Medial malleolus
L5	Dorsum of foot at third metatarsal-phalangeal joint
S1	Lateral heel
S2	Popliteal fossa in midline
S3	Ischial tuberosity
S4-5	Perianal area

Elements of Motor Assessment

Motor examination is performed by assessing a key muscle in each of the 10 paired myotomes, with strength being graded on a six-point scale:

0	Total paralysis
1	Palpable or visible contraction
2	Active movement, full range of motion with gravity eliminated
3	Active movement, full range of motion against gravity
4	Active movement, full range of movement against moderate resistance
5	Active movement, full range of movement against full resistance
NT	Not testable

The following muscle groups should be tested:

C5	Elbow flexors (biceps, brachialis)
C6	Wrist extensors (extensor carpi radialis longus and brevis)
C7	Elbow extensors (triceps)
C8	Finger flexors (flexor digitorum profundus) to the middle finger
T1	Small finger abductors (abductor digiti minimi)
L2	Hip flexors (iliopsoas)
L3	Knee extensors (quadriceps)
L4	Ankle dorsiflexors (tibialis anterior)
L5	Long toe extensors (extensor hallucis longus)
S1	Ankle plantarflexors (gastrocnemius, soleus)

When assessing power, the examiner needs to be aware that the motor level will be defined by the lowest key muscle that has a power grade of at least 3, providing that the key muscles represented by segments above that level are judged to be normal.

The ASIA Impairment Scale

The ASIA classification system should be used for grading the degree of impairment:

A	Complete	No sensory or motor function is preserved in sacral segments S4-S5
B	Incomplete	Sensory but not motor function is preserved below the neurological level and includes S4-S5
C	Incomplete	Motor function is preserved below the neurological level and more than half of key muscles below the level have a muscle grade of less than 3
D	Incomplete	Motor function is preserved below the neurological level and at least half of key muscles below the level have a muscle level greater than or equal to 3
E	Normal	Normal sensory and motor function

ASIA Classification System

Clinical Syndromes

Central Cord Syndrome occurs when a lesion occurs in the cervical region and produces sacral sensory sparing and greater weakness in the upper limbs than in the lower limbs.

Brown-Sequard Syndrome occurs when a lesion produces greater ipselateral proprioceptive and motor loss and contralateral loss of sensitivity to pain and

temperature. This is extremely rare in the elderly population and is most often due to penetrating trauma (e.g. stabbing) with resultant hemisection of the spinal cord.

Anterior cord syndrome occurs when a lesion produces variable loss of motor function and sensitivity to pain and temperature whilst proprioception (dorsal columns) is preserved. It can occur when blood flow is reduced or interrupted in the artery that runs along the anterior portion of the spinal cord.

Conus medullaris syndrome is when injury to the sacral cord (conus) and lumbar nerve roots within the spinal canal results in an areflexic bladder, bowel and lower limbs.

Neurogenic Shock

This state can occur following injury to the spinal cord above T6 and is defined as vascular hypotension with bradycardia. This is mainly due to a loss of sympathetic outflow and is associated with reduced central venous return to the heart which may not be well tolerated by elderly patients with pre-existing cardiac conditions.

Inotropic support of the circulation will be required at an early stage and intensive monitoring will depend on the patient's pre-morbid status. Invasive fluid balance monitoring may be required to prevent pulmonary congestion.

Spinal Cord Injury in the Older Patient

Older patients should still have the same level of access to specialist services (e.g. inpatient rehabilitation, outreach services etc..) as younger patients. Each patient should be managed as an individual with their pre-morbid status and level of functioning being used to target ongoing treatment schedules.

In order to fully appreciate the impact of spinal cord injury on patients and evaluate their progress / deterioration, the Functional Independence Measure (FIM) could be used. The FIM focuses on six areas of functioning and evaluates specific items using a seven-point scale (see below):

Core Themes	
Self-Care Sphincter Control Mobility Locomotion Communication Social cognition	
Grade	**Description**
7	Complete independence
6	Modified independence – activity being assessed requires assistive device; more time and/or is not performed safely
5	Supervision or setup – no physical assistance is needed but cuing, coxing or setup is required
4	Minimal contact assistance – subject requires no more than touching and expends 75% or more of the effort needed for the activity
3	Moderate assistance – subject requires more touching and expends 50-75% of the effort required in the activity
2	Maximal assistance – subject expends 25-50% of the effort required in the activity
1	Total assistance – subject expends 0-25% of the effort required in the activity

Functional Independence Measure (FIM)

Continence

Elderly patients with spinal cord injury will need careful evaluation of their continence status and consideration given towards urethral catheterisation and bowel management strategies following admission.

Whatever management method is used, patients should be included in all decisions and plans should be acceptable to the patient and be transferable to the community setting after discharge.

Some patients may benefit from suprapubic catheterisation as opposed to intermittent urethral catheterisation but each patient should be managed on an individual basis.

Nutrition and Toileting

Patients should be toileted using low-impact transfer techniques and this may involve a plan for bowel opening on the bed as opposed to on the toilet/commode.

Depending on the neurological level, some patients will be at risk of paralytic ileus and aspiration pneumonitis and may benefit from early nasogastric tube insertion.

In the later stages of recovery, some patients with good degrees of cognitive functioning may benefit from surgical review to consider the risks versus benefits of colostomy. This will depend on the individual and may be more socially acceptable to some patients more than others.

Skin Hygiene and Pressure Sores

All patients should have a regular assessment of pressure areas to include the sacrum, heels, buttocks and occipital areas. Regular turning should be instituted provided any unstable injuries are being managed appropriately.

Prognosis

Once damage to the spinal cord has occurred, prognosis is generally good if recovery is evident during the first 24 hours. Functional recovery is poor if no signs of sacral sensation to pinprick or temperature are present after 24 hours.

In these instances, patients will require formal care bundles for spinal injury to manage pressure ulcers, neurogenic bowel etc... Early referral to specialist spinal rehabilitation teams will help guide the most appropriate management of patients.

Summary

- Elderly patients with thoracolumbar pain may have pre-existing, chronic back problems and it is important to establish whether an injury is new or not. Patients should be considered as having a new injury if they have a new onset of symptoms following trauma.

- Clinicians should be aware of the markers of instability on plain film radiography and be able to determine which patients warrant further imaging (CT/MRI).

- Assessment of spinal cord injury should follow a standardised process that examines motor and sensory function and referrals should be made as soon as possible to specialist units.

- The ongoing care of elderly patients with spinal cord injuries will depend on the individual and is best served with specialist input which can be delivered on an outreach basis.

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Chapter 10 – Thoracic Injuries

Introduction

Thoracic injuries in elderly patients are mainly due to blunt trauma with same-level falls being the most common mechanism. They comprise a wide spectrum of injury ranging from simple bruising to multiple fractures and underlying lung injury.

Rib fractures have been documented in up to two thirds of cases of chest trauma. There exists an increasing incidence of isolated or multiple rib fractures with increasing age[1]. Such injuries may be associated with pulmonary complications in more than one-third of patients, and pneumonia in up to 30% of cases.

One 2009 study[2] identified the following criterion as having 100% sensitivity to developing complications after thoracic trauma (95%CI 79.4 - 100%):

- Age >85 years;
- Initial systolic blood pressure <90mmHg; Haemothorax;
- Pneumothorax;
- Three or more unilateral rib fractures;
- Pulmonary contusion.

Thoracic trauma is common in the elderly and associated with high morbidity. It is important for the assessing clinician to be able to correctly diagnose injury and institute appropriate management to prevent future complications.

Furthermore, injuries that could be treated in a conservative manner in younger patients, (e.g. rib fractures), may need more aggressive intervention in the elderly population. Getting things right starts at the point of initial assessment and continues until discharge.

Ageing of the Respiratory System

The respiratory system comprises the thoracic cage, lungs and diaphragm. It undergoes structural and physiological changes with age but there are large differences between individuals, especially in the presence of co-existing disease.

It is important to appreciate how this system changes with advancing age as patients will respond differently to thoracic injury. With declining physiological reserve and anatomical changes, patients may deteriorate rapidly hence the need to have higher levels of vigilance when managing patients with these injuries.

Mechanics of the Respiratory System

Compliance refers to the change in volume in relation to a change in pressure. Lung compliance determines the rate and force of expiration whilst chest wall compliance determines the elastic load that builds within the chest during inspiration.

Chest wall compliance is lessened by the following changes that can occur with age[3]:

- Osteoporosis of vertebral bodies and loss of height of thoracic vertebrae.
- Kyphosis in the ageing skeleton
- Calcification of the rib cage causing stiffening and reduced range of motion.

Reduced compliance means that the chest wall is effectively “stiff” and more effort is needed to generate a given volume of

inhaled air. This would put extra pressure on the diaphragm.

Studies have shown that people with low chest wall compliance will have a higher residual volume (RV)[4]. This is the volume remaining in the lungs at the end of expiration and the stiffened chest wall acts as an obstacle to complete emptying of the lungs.

Changes in Anatomy

With lifelong non-smokers, autopsy specimens have demonstrated an increase in airspace size with increasing age[5]. This has been thought to be related to degeneration of elastic fibres around the alveoli. It is thought that this leads to premature closure of the small airways during normal breathing, leading to hyper-inflation. This can impede gaseous exchange and lead to higher levels of $PaCO_2$. The normal response would be to increase the respiratory rate, leading to higher levels of fatigue and eventual exhaustion.

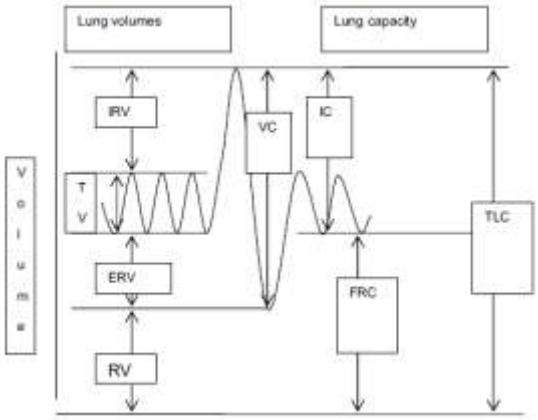
As mentioned previously, changes to the thoracic vertebrae, calcification in the costal cartilages and arthritic changes reduce the efficiency of breathing. In the context of injury, ribs with lower mineral density and osteoporosis will be at greater risk of fracture to increasing levels of kinetic energy. Older patients are therefore at greater risk of multiple rib fractures and injuries such as flail chest.

Respiratory Muscle Function

With increasing age there is an age-related decrease in fast twitch fibres of the diaphragm and overall muscle atrophy. Such changes also exist within intercostal musculature. This can predispose individuals to a more rapid onset of fatigue when extra load is place on the respiratory system. Respiratory failure will ensue and patients can deteriorate rapidly without appropriate intervention and possibly mechanical ventilation.

Lung Function

Dynamic flow rates such as forced expiratory volume (FEV1) and forced vital capacity (FVC) are dependent on lung volumes. FEV1 refers to the forced expiratory volume in one second whereas FVC is the total forced volume on expiration.



ERV, expiratory reserve volume; FRC, functional residual capacity; RV, residual volume; VC, vital capacity; TV, tidal volume; TLC, total lung capacity

There is a huge degree of variability in lung function amongst older individuals but overall, there is a decline in FEV1 that occurs with age. Functional residual volume and residual volume increase with age, leading to a lower vital capacity.

When looking at the FEV1:FVC ratio, which refers to the proportion of a person's vital capacity that they are able to expire in the first second of forced expiration, this will be reduced when there is an obstruction to air escaping the lungs (e.g. COPD, asthma).

In the individual with normal lungs, FEV1 and FVC are likely to both decline with advancing age, leading to a relatively constant FEV1:FVC ratio. Such a pattern is seen in restrictive lung disease but also serves to augment the effects of reduced chest wall compliance as discussed earlier.

Initial Assessment & Triage

As with most elderly patients, injuries may present in a relatively innocuous manner and only become clear after clinical assessment. Patients involved in high energy mechanisms merit a formal trauma team response whereas other patients arriving by ambulance or those who self-present warrant a more detailed assessment at triage.

Observations should be recorded for all patients at initial assessment and **any patient with a history of chest pain that starts after a fall should be deemed to be at risk of thoracic wall / intra-thoracic injury**.

Where possible, all elderly patients presenting with chest pain should have a 12-lead ECG recorded during the initial assessment process.

Features of concern at the point of initial assessment would be any of the following:

- Low oxygen saturations (<92%)
- Raised respiratory rate (RR>25)
- Reduced respiratory rate (RR<12)
- Reduced GCS
- High mechanism of injury (road traffic collision; pedestrian vs car; fall from height or downstairs)
- Same-level fall but with blunt trauma between chest wall and a hard object (e.g. concrete kerb; furniture)

Primary Survey

A – Airway & C-Spine

Close attention should be paid to the presence of surgical emphysema that extends from the chest into the soft tissues of the neck and face.

Surgical emphysema to the face

Air in the soft tissues of the neck can quickly cause compression of vital structures so the source for any air leak needs rapid identification and if suspected as coming from the chest, thoracostomy should be performed as a priority.

Any injury above the clavicles, or where clavicular fractures are noted with high mechanisms of injury, should lead the examiner to consider cervical spine immobilisation and formal imaging (see before).

Whilst assessing a patient's airway, the neck should be examined for any midline shift of the trachea and the presence of distended neck veins. Both signs could herald the presence of tension within the chest (either caused by pneumothorax, haemothorax or pericardial effusion).

B – Breathing and Ventilation

Observations should be performed for all patients as soon as they arrive to include

respiratory rate, heart rate, blood pressure, oxygen saturations and GCS as a minimum. In the presence of suspected thoracic trauma, an arterial blood gas should be performed immediately to assess the patient's underlying ventilatory performance.

Supplemental oxygen should be delivered if oxygen saturations fall below 94%, but patients with a history of COPD and saturations of 88-92% without obvious respiratory distress may not benefit from oxygen therapy.

The chest requires formal assessment in terms of inspection, palpation, percussion and auscultation.

INSPECTION: inspect for any of the following signs:

- asymmetry of chest wall movement; previous sternotomy / thoracotomy scars; obvious bruising or deformity;
- paradoxical chest wall movements;
- open wounds

PALPATE: formally assess for the following:

- tracheal deviation with apical shift;
- surgical emphysema or localised tenderness;
- AP and lateral palpation of the chest wall to elicit pain that could signal underlying bony thoracic injury.
- sternal injury

PERCUSS: percussion should be performed in all lung fields, paying close attention to the lung apices and bases (including the axillae). Any dullness to percussion should raise suspicion of an effusion and any hyper-resonance should raise the possibility of a pneumothorax (or emphysematous bulla).

Where the percussion note is not obvious to interpret, attention should be paid to any asymmetry between left and right lung fields. Any abnormality should warrant further investigation for the presence of injury.

AUSCULTATION: auscultation of all lung fields should be performed, comparing left to right. In the context of trauma, crackles may be interpreted as contusions; absent breath sounds as pneumothoraces and reduced breath sounds as effusions. Auscultation of heart sounds should be performed to assess for muffled heart sounds or bruits / murmurs.

With elderly patients, abnormal signs on respiratory examination may represent more than just findings secondary to acute traumatic injury. Fine crepitations from congestive cardiac failure could be misinterpreted as lung contusions; a silent chest in severe COPD could be misinterpreted as a pneumothorax; and a dull percussion note from malignant effusions could be misinterpreted as a haemothorax.

HECTOR advises that a cautionary approach is taken for elderly patients with chest injury, especially if such patients have pre-existing lung and/or cardiac disease. History-taking is key with history of injury and symptom-onset, and past medical history playing vital roles in the decision-making process.

If any life-threatening injuries are found during the primary survey (e.g. tension pneumothorax, open pneumothorax, massive haemothorax), these should be treated as soon as they are identified, usually with chest decompression and/or tube thoracostomy.

The examiner should also be vigilant to the possibility of concurrent illness that may have precipitated the trauma. Underlying sepsis and pneumonia should be managed according to local findings if identified on primary survey.

Similarly, any evidence of myocardial insult (e.g. ACS), should warrant formal medical review at an early stage to determine the appropriate next stages of care.

C – Circulation & Haemorrhage Control

Any physiological abnormality to blood pressure or heart rate should lead the examiner to consider the possibility of diminished venous return caused by tension pneumothorax, massive haemothorax or pericardial tamponade. Similarly, it may represent a peri-arrest state if caused by haemorrhagic shock.

Such states warrant immediate action and consideration should be given for the decompression of any tension or tamponade whilst also considering the role of massive transfusion and correction of coagulopathy.

Large haemothoraces may be unaccompanied by physiological derangement, in which case signs suggestive of occult hypoperfusion should be noted.

If there are no obvious sources for altered physiological states within the chest, attention should be paid to other others (e.g. abdomen, scalp, pelvis, long limbs, retroperitoneum), especially in the context of high mechanisms of injury.

D – Disability

GCS should be repeated following the initial recording at triage and any changes should lead the examiner to consider the possibility of intracranial injury, and in the context of chest injuries, the effects of diminished ventilation / oxygenation. A blood glucose should also be performed.

Any elderly patient with a significant chest wall / intra-thoracic injury and declining GCS should have a repeat arterial blood gas. Declining $Pa0_2$ or increasing $PaCO_2$ should lead the assessing clinician to reassess pain management, and consider whether early mechanical ventilation may be appropriate to prevent further deterioration. These decisions should not be made in isolation but should be made between senior team members and take into account the patient's underlying pre-morbid condition.

Imaging

Plain Film Radiography

The assessing clinician should employ a structured method for interpreting Chest X-Rays to ensure that key features are not missed.

A – Accuracy
A – Adequacy
A - Airway
B – Breathing
C – Cardiac & Costal cartilages
D – Diaphragm
S – Soft Tissues

A – Accuracy: Is this the right film for the right patient? Are there any old films for comparison?

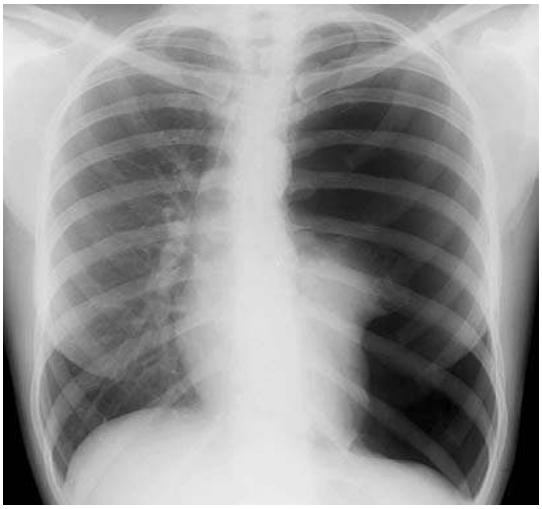
A – Adequacy: Are both lung apices and costo-phrenic angles clearly visible on the image? Is there any rotational element to the image? (observe any overlap or discontinuity of clavicular heads at sternoclavicular joint or alignment of spinous processes of thoracic spine) Is the image AP or PA, erect or supine?

A – Airway: Observe the trachea down to the left and right main bronchi – is there any obvious narrowing? Is there any deviation or flattening of the trachea / bronchi?

B – Breathing: View both lung fields and compare for any obvious symmetry. Look at the lung markings and ensure they meet the edge of the chest wall – if not consider the possibility of a pneumothorax. Look for radio-opacity and collapse for possibility of lung contusions / pneumonia.

Right sided pulmonary contusion

Right middle lobe pneumonia



Absence of left sided lung markings suggestive of pneumothorax

C – Cardiac & Costal Cartilages: observe the cardiac shadow and mediastinum – ts there any widening or unfolding of the mediastinum? Are the heart borders distinct? Trace each anterior / posterior rib in turn and note any obvious fractures / irregularities. Observe the clavicles, humeral heads and scapulae for obvious injury.

D – Diaphragm: view the costophrenic angles and note the presence of any obvious effusion. Note any elevation of either hemidiaphragm and herniation of abdominal contents into the thoracic cavity.

S – Soft Tissues: look at the soft tissues and surrounding structures for the presence of surgical emphysema. Note any medical equipment (e.g. endotracheal tube, oxygen tubing) appearing on the Xray.

If there is any suspicion of sternal fracture (anterior chest wall pain following RTC; focal tenderness over the sternum), dedicated sternal views should be requested.

Sternal Fracture on Sternal Xray

Ultrasonography

In experienced hands, chest ultrasonography may be used to assess for the presence of:

- occult pneumothoraces;
- pleural effusions;
- sternal fractures;
- pulmonary oedema.

Extended FAST views of the lienorenal angle and Morrison's pouch through superior migration of the probe, will elucidate the diaphragm and lung bases. Fluid is anechoic and will be demonstrated by a dark appearance:

Supine plain film radiography only has a 50%-76% sensitivity for small pneumothoraces. Sensitivity of ultrasound is between 86-100% and hence may be of more use in excluding pneumothoraces[6].

Ultrasound findings include:

i. Loss of pleural sliding ii. Loss of comet tail artefacts iii. Clearly defined lung point – point at which pleural sliding appears and disappears (anterior in small pneumothoraces; lateral in larger pneumothoraces)

CT Imaging

In most emergency departments, CT scanning will be the most appropriate method for identifying specific thoracic injuries. In the absence of multi-system trauma, focussed CT imaging of the thorax will be sufficient to detect significant abnormalities.

If there is no suspicion of great vessel injury and no history of penetrating trauma, a non-contrasted CT scan will be appropriate to detect pulmonary contusions, haemopneumothoraces and bony injuries and will avoid the nephrotoxic effect of intravenous contrast agents.

Contrast-enhanced CT and angiography should be considered in cases of penetrating trauma or where there is suspicion of great vessel injury.

Management of Different Types of Injury

Rib Fractures & Flail Chest

Simple rib fractures account for more than 50% of thoracic injuries due to blunt trauma. The most common mechanism of injury in elderly persons is a fall from height or standing. Close attention should be paid to the exact mechanics of the fall – if the patient has fallen with their chest

striking a blunt object, the risk for rib fractures is increased.

Pain from rib fractures can compromise ventilation by causing respiratory splinting, resulting in atelectasis and pneumonia. Multiple successive rib fractures, (>3 successive rib fractures) can increase the risk of a patient developing respiratory insufficiency and pneumonia if not managed appropriately.

Flail chest describes the paradoxical movement of a segment of chest wall that arises when two or more consecutive ribs are fractured in two or more places. For elderly patients with osteoporosis, the blunt force needed to create such an injury is lessened, thus rendering elderly patients more vulnerable to such injuries with lower mechanisms of trauma.

Respiratory insufficiency is likely to result if a flail chest or rib fractures are associated with underlying pulmonary contusion, especially in the presence of underlying lung disease. The management of these types of injury focuses on optimising pulmonary mechanics through adequate analgesia and chest physiotherapy.

Management of Pain

Intravenous opiates are commonly used for severe pain but have the adverse effects of causing:

- cough suppression;
- respiratory depression;
- hypoxia.

These side-effects may render opiates counter-intuitive to recovery in patients with significant chest wall injury.

Patients with four or more rib fractures or a flail segment are at significant risk of mortality and morbidity and should all be considered for epidural analgesia unless contra-indicated**.** A combination of a narcotic (e.g. fentanyl) and a local anaesthetic (bupivicaine) is considered to be the most effective form of epidural analgesia.

Epidural analgesia has been demonstrated to result in an increased functional residual capacity (FRC), lung compliance and vital capacity. Tidal volume increases and the paradoxical movements of flail segments are reduced.

In a hospital setting, epidural analgesia may result in hypotension, especially when associated with hypovolaemia and may be technically demanding in patients with confusion or dementia.

Surgical Fixation

The National Institute of Clinical Excellence (NICE) have published guidance for the surgical fixation of patients with flail segments[7]. Other evidence includes a randomised control trial of 40 patients with 3 or more rib fractures allocated to surgical stabilisation or conservative treatment. This discovered that patients in the surgical group had fewer days in hospital, fewer days on mechanical ventilation and fewer days in critical care. ($p<0.001$)[8]

At present, HECTOR neither supports nor dismisses such practice. Surgical management of rib fractures will vary according to specialist centres and patient selection for such a procedure has yet to be defined in a clear manner.

Ongoing Care

All elderly patients with rib fractures should be given optimum pain relief, oxygenation as needed and receive

elements of chest physiotherapy (either as an inpatient or as outpatient advice). Patients with severe pain should be admitted for close observation and any clinical deterioration should warrant further arterial blood gas analysis, repeat chest radiography and formal clinical assessment. Antibiotics should be given for suspected pneumonia and the development of any effusions should merit ultrasound guided or video-assisted thoracoscopic drainage.

Pulmonary Contusions

Pulmonary contusions occur when the lung parenchyma is damaged, resulting in blood and oedema collecting in alveolar spaces. This interrupts normal respiratory function and most progress over a 24 hour period.

Such injuries tend to follow blunt trauma and may be evidenced by crackles heard on auscultation or increased radio-opacity on a plain film Chest X-Ray.

The combination of pain from associated injuries (e.g. rib fractures) with parenchymal damage, limits ventilation, worsens alveolar gas exchange and can lead to progressive respiratory distress. These features are exaggerated if an individual suffers from underlying lung disease (e.g. COPD; UIP), in which case careful management of pain, oxygenation and ventilation is often required. Blood in the alveolar spaces is an excellent culture medium for bacteria with pneumonia being a common complication of such injuries.

The mainstay of treatment for patients with contusions rests with optimal analgesia, chest physiotherapy and vigilance for declining respiratory function. Pulmonary contusions may develop over a period of 24 hours so all elderly patients should be admitted for close observation.

Patients with exacerbations of COPD / asthma should be managed with controlled oxygen therapy and nebulised Beta – agonists. Baseline arterial blood gases taken at admission can be used as a guide to determine whether an individual's condition is improving or becoming gradually worse.

Traditional practice has been to place patients with pulmonary contusions under strict fluid restriction regimes. Contrary to this practice, patients should be resuscitated with crystalloid to maintain adequate tissue perfusion and thereafter, unnecessary fluid administration should be avoided.

The main complications of pulmonary contusions are ARDS and pneumonia. At molecular level, a mediator-driven inflammatory process (e.g. interleukin-6, tumour necrosis factor etc...), can cause further insult after the initial injury and lead to ARDS.

Pneumothorax – Simple, Open & Tension

Pneumothorax is the presence of air between the parietal and visceral pleura. Management will depend on the degree of symptoms, size of pneumothorax and level of cardiorespiratory impairment.

Elderly patients with COPD may have underlying lung disease that mimics the presence of pneumothoraces on clinical and radiological evaluation. These patients may have long-standing emphysematous bullae. Careful evaluation of past medical history, medical records and previous X-Rays may be required to ensure that chronic

problems are not associated with the acute consequences of trauma.

Open and tension pneumothoraces are medical emergencies and need treating as soon as they are identified. Such injuries can cause severe cardiorespiratory distress and should be prioritised as they are for younger patients.

Specific Management

Tension pneumothorax should be managed by immediate chest decompression and followed by formal tube thoracostomy. The decompression can occur via needle thoracocentesis or thoracostomy.

Standard peripheral venous cannulae may not be long enough to penetrate the chest wall tissue. Furthermore, the presence of soft tissue swelling and/or surgical emphysema would increase the distance between the skin and pneumothorax even more. Thoracostomy is a more effective means of decompression but may not be tolerated particularly well in confused, agitated patients.

HECTOR recommends that either technique can be used and will depend on the state of the individual patient and urgency of procedure.

With the open pneumothorax, clinical teams should apply a three-way dressing over the wound site and proceed to perform tube thoracostomy. Chest drains should not be inserted through the wound which is often caused by penetrating trauma and can be associated with underlying visceral injury.

Large, simple pneumothoraces (>2cm between pleural edge and lateral chest wall) are best managed with tube thoracostomy. Trauma drains are preferable to Seldinger drains as they are less likely to become blocked by blood clots.

An occult pneumothorax is one which is evident on computed tomography but not on plain film radiography. In the absence of respiratory distress, such injuries can be treated conservatively without tube thoracostomy. If mechanical ventilation is required, this is not an absolute indication for tube thoracostomy.

Ongoing Care

A persistent leak and failed resolution of pneumothorax at 3 days following injury may be an indication for VATS assessment. If a pneumothorax persists beyond 3 days, patients with this injury should be referred to the Thoracic specialists for ongoing management decisions.

Haemothorax

Traumatic haemothoraces may result from either blunt or penetrating trauma. Multiple rib fractures, lung lacerations or thoracic spinal fractures may be the underlying cause for accumulation of blood in the chest.

The absence of abnormal physiological signs that would otherwise correlate with hypovolaemic shock, bear less relevance in the elderly population. Closer attention should be paid to occult hypoperfusion (I.e. raised lactate, base deficit), in the presence of finding an effusion on examination or imaging.

Management

All patients with a haemothorax, irrespective of size, should be considered for drainage via tube thoracostomy. In circumstances where physiology is abnormal and suggestive of shock (i.e. low

blood pressure, raised heart rate), especially if accompanied by low O2 sats or rising ETCO2, attempts should be made to drain any effusion / haemothorax immediately.

Surgical exploration should be considered in the presence of:

- drainage exceeding 1500mL in any 24-hour period;
- patients with grossly abnormal physiology;
- evidence of uncontrolled intrathoracic haemorrhage demonstrated by the need for ongoing transfusion to maintain tissue perfusion.

Patients with a persistent retained haemothorax on plain film radiography should be managed with VATS within the first 3 to 7 days of hospitalisation to decrease the risk of infection and conversion to thoracotomy.

Haemothorax or Effusion?

Pleural effusions may be long-standing and can have multiple causes. Deciding on whether to treat an effusion with formal drainage will depend on the cardiorespiratory state of the patient and the likelihood that the effusion represents a collection of blood.

A clear history of trauma with associated rib fractures may point towards the latter but if there is any doubt a CT scan will define blood as having a density of +30 to +45 Hounsfield Units (HUs), and demonstrate any associated injury.

If there is still concern about whether an effusion represents blood, an experienced clinician could attempt an ultrasound-guided diagnostic pleural tap to sample the fluid. If at this point it is clearly blood that has been aspirated, tube thoracostomy is indicated. If the aspirated fluid is not blood, management will depend on the suspected underlying cause of the effusion.

Thoracic Great Vessel Injuries

The thoracic aorta may be injured by a sudden change in velocity, with the commonest mechanisms being road traffic collisions and falls from height. The aortic arch is fixed by great vessels with the ascending and descending thoracic aorta being more mobile and stopping at a later point of deceleration causing stress on the aortic root and isthmus.

Full thickness injury will result in catastrophic haemorrhage with most patients dying on scene. Other injuries include minimal intimal flaps through to extensive pseudoaneurysm formation.

Elderly patients may sustain such injuries with lower level impacts than in younger patients. This patient group therefore warrants a higher level of awareness in the event that they present following deceleration injuries. CT angiography will be the imaging modality of choice in most centres to identify such injuries.

Traumatic Aortic Dissection

Patients may present with an abrupt onset of chest pain that is felt worst at its onset and at the impact of trauma, and is tearing in nature. It can be associated with a combination of early neurological and cardiovascular complications that include:

- Cerebrovascular accident (CVA)
- Syncope
- Congestive cardiac failure
- Ischaemic limb
- Progressive paraplegia

Examination may reveal transient pulse deficits, signs suggestive of cardiac tamponade, raised JVP, and new onset aortic regurgitation.

Plain film radiography may reveal the following findings:

Widening of superior mediastinum
Dilatation of aortic arch
Obliteration of aortic knob
Double density of aorta
Trachea/NG tube deviated to right
Flattening if left mainstem bronchus
Left pleural effusion
Cardiomegaly

Strategies should be taken to control blood pressure, with the aim of a systolic blood pressure between 100-120mmHg.

Pericardial Tamponade & Myocardial Contusion

Sternal fractures occur in approximately 3% of blunt chest trauma and are usually a result of road traffic collisions caused by the seat belt or steering column. The prevalence is higher in patients over 50, with simple falls whereby the anterior aspect of the chest strikes a hard object being a likely mechanism. Approximately 6-12% of patients with sternal fractures will develop a myocardial contusion.

If any of the following are present, patients will require admission and further investigation:

- abnormal ECG;
- elevated cardiac enzymes (Troponin, CK); inadequate pain control;
- cardiorespiratory compromise.

Elderly patients with pre-existing cardiac co-morbidity (i.e. ischaemic heart disease; congestive cardiac failure; previous myocardial infarction), will require cardiac monitoring and/or serial ECGs in the presence of myocardial / pericardial injury.

Emergency Thoracotomy

The indications for Emergency thoracotomy continue to be discussed within the trauma fraternity. Most of these discussions do not take into account a patient's age and there are limited studies to pass comment on the survival of elderly patients undergoing this procedure.

Emergency thoracotomy is often done in the context of penetrating thoracic trauma where there has been a traumatic arrest with previously witnessed cardiac activity or with unresponsive hypotension (BP<70mmHg).

In blunt thoracic injury, indications may include unresponsive hypotension (BP<70mmHg) or rapid exsanguinations from a chest drain (>1500mL). It is contra-indicated in the context of: blunt traumatic injuries with no witnessed cardiac activity; multiple blunt trauma; and severe head injury.

The purpose of thoracotomy is to perform one or more of the following life-saving interventions:

a) Release of pericardial tamponade
b) Control of intrathoracic haemorrhage
c) Control of massive air embolism or bronchopleural fistula
d) Open cardiac massage
e) Cross-clamping the descending aorta.

Irrespective of the indication, emergency thoracotomy is a traumatic procedure in itself and any chance of survival will also depend on the patient's reserve for

ongoing recovery and ability to cope with the procedure. REBOA (retrograde balloon occlusion of the aorta) may be a more appropriate life-saving procedure in the elderly patient, but again there is insufficient evidence to pass further comment.

Summary

- Elderly patients with thoracic injuries may present following simple falls or following higher mechanism of injury. Following a fall, a history of blunt trauma to the chest against a hard object (e.g. furniture, concrete kerb), should raise concerns with the assessing team.

- Clinicians should have a basic understanding of the effects of ageing on the respiratory system which all contribute towards declining respiratory function and a reduced tolerance to any given injury.

- All patients should have a thorough examination of the chest performed on primary survey and have this augmented with arterial blood gas analysis. A knowledge of the baseline PaO2 and PaCO2 will help direct ongoing care and guide oxygen prescription.

- Life-threatening thoracic injuries should be treated as they are found and most involve thoracostomy.

- Ongoing care will be focussed on providing optimum analgesia, and epidural analgesia for patients with multiple rib fractures if appropriate, adequate oxygenation and chest physiotherapy.

- Clinicians should have a lower threshold for admitting elderly patients with thoracic injury due to the higher comparative rate of complications such as pneumonia, empyema and ARDS.

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Chapter 11 – Abdominal & Pelvic Injuries

Introduction

Abdominal Trauma

Patients with blunt abdominal trauma can present with: pain; tenderness on palpation; gastrointestinal haemorrhage; or evidence of peritoneal irritation, (e.g. rebound tenderness). Features to suggest significant trauma may include:

- lap belt marks;
- steering wheel shaped contusions; abdominal distension;
- instability of the lower thoracic cage;
- Grey Turner (ecchymosis in flanks)
- Cullen sign (ecchymosis around umbilicus).

Intra-abdominal injury following blunt trauma may occur for one of the following reasons:

a. Crushing of solid viscera between the anterior abdominal wall and vertebral column or posterior thoracic cage;

b. Rapid deceleration causing solid or hollow organs and vascular pedicles to tear at fixed points of their attachment;

c. External compression resulting in a rapid increase in intra-abdominal pressure causing the rupture of a hollow organ.

Elderly patients may be particular vulnerable to these types of force as they have: reduced muscle mass and therefore reduced protection of internal organs; bone fragility resulting in fractures that can damage solid organs; and age-related organ atrophy placing more tension on vascular pedicles.

Abdominal examination in elderly patients has a low sensitivity for diagnosing injury. Concomitant use of opiate analgesia and/or steroids can mask signs of peritoneal involvement and limit the effectiveness of clinical examination.

In this context, abdominal examination should not be considered as a reliable means of excluding serious injury in elderly age groups. Factors such as dangerous mechanisms of injury, associated chest wall/pelvic injury and evidence of occult hypoperfusion should be used in combination to raise the level of suspicion for abdominal injury.

Pelvic Trauma

Osteoporosis in the elderly age groups leaves individuals vulnerable to pelvic trauma with relatively low mechanisms of injury. The most common injuries include fractures of the femoral neck and/or pubic rami after same-level falls.

No injury to this area should be regarded as trivial and seemingly minor injuries like pubic rami fractures can cause catastrophic haemorrhage, especially in patients taking anticoagulant medication.

Patients sustaining significant pelvic disruption (e.g. open book or vertical shear injuries), often do so following high-energy trauma mechanisms. The risk of associated injury is great and formal trauma team review is merited if such injuries are discovered.

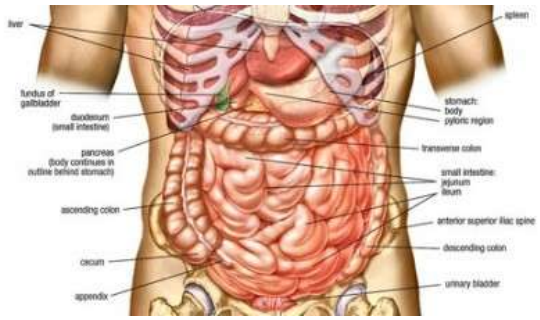
In order to gain a greater appreciation of the different types of injury to these body regions, it is important to understand the basic anatomy of each area.

The Abdomen

The abdomen is the space between the thorax and pelvis, formed by the diaphragm at its upper surface and pelvic brim at its lower surface. The anterior layers of the abdomen are the:

- External oblique;
- Internal oblique;
- Transverse abdominis which merge in the midline to form the rectus abdominis.

Solid organs such as the liver and spleen are contained within the upper aspect of the abdomen and are particularly vulnerable to injuries that involve the lower thoracic cage.



The Spleen

The spleen is the most commonly affected organ in blunt injury to the abdomen for all age groups. It weighs approximately 75-150g and filters 10-15% of the total blood volume every minute. Nearly 25% of the human body's circulating platelets are held in reserve in the spleen.

Direct blows to the spleen or rapid deceleration during road traffic collisions or falls from height can lead to injury. Most patients with minor injury will complain of left upper quadrant tenderness and possibly left shoulder-tip pain. Progressive haemorrhage leads to clinical signs of early shock and/or raised lactate.

Elderly patients with lower left-sided chest wall tenderness or left upper quadrant pain following trauma should be considered as being at risk of splenic injury and arrangements made for appropriate imaging to confirm / refute the diagnosis.

The Liver

The liver is divided into two lobes (right and left) and divided further according to its vascular and bile duct distribution. It may be injured during blunt abdominal trauma, especially when there is associated injury to the right lower thoracic cage.

Elderly patients with any of the following features should be considered at risk of injury and warrant further assessment:

- Injury to the right lower chest wall;
- Pain in the right upper quadrant after a traumatic injury;
- Significant ecchymoses over the right upper quadrant

The Retroperitoneal Space

The retroperitoneal space exists behind the peritoneum and contains organs that are covered by peritoneum on their anterior aspect only.

The following structures are retroperitoneal:

Urinary
• Adrenal glands • Kidney • Ureter

Circulatory
• Abdominal aorta • Inferior vena cava
Gastrointestinal / Abdominal
• Rectum • Head, neck and body of pancreas • Duodenum (except proximal segment) • Ascending and descending colon

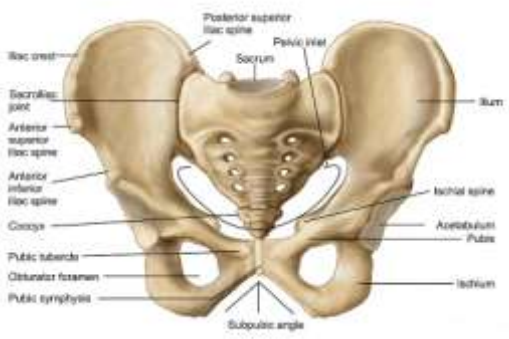
The retroperitoneum is an area that can conceal ongoing haemorrhage. A high index of suspicion is needed to consider a retroperitoneal bleed and may only arise when patients fail to respond to resuscitation and there being no overt signs of injury.

Early diagnosis and management of bleeding is crucial to prevent rapid deterioration. Contrast-enhanced imaging will be needed to confirm the diagnosis and patients may then be candidates for interventional radiology to arrest the haemorrhage.

The Pelvis

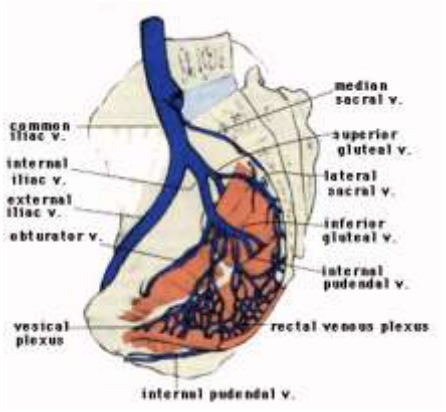
The bony pelvis consists of: two innominate bones; the sacrum and the coccyx.

The sacroiliac joints connect the ilium of the innominate bones to the sacrum. The sacrococcygeal symphysis connects the sacrum to the coccyx and the pubic symphysis connects the pubic bodies:



Injuries to the sacroiliac joints can cause injuries to the veins of the pelvic venous plexus and branches of the iliac arteries, leading to catastrophic haemorrhage.

Any suspicion of pelvic fracture in the elderly age group should lead to a high index of suspicion for vascular injury and ongoing haemorrhage until it can be excluded by appropriate contrast-enhanced imaging.



Pelvic veins

Initial Assessment & Triage

All patients should have routine observations at the point of initial assessment (HR, BP, O_2 sats, RR, Blood Glucose). High mechanisms of injury such as: pedestrian traffic collisions; high speed road traffic collisions; or falls from height / downstairs warrant formal trauma team activation.

Patients with lower mechanism of injury may be at risk of intra-abdominal trauma if they are suspected to have sustained injuries to the lower chest wall. Other features that should concern the triage team include the use of anticoagulant medication.

The initial triage of patients should include an assessment for signs that may suggest:

- Pelvic injury - shortening and rotational asymmetry of the lower limbs; lower abdominal bruising; blood around external genitalia

- Lower chest wall injury – crepitus, bruising, raised respiratory rate

- Abdominal injury – bruising over the flanks or over the anterior aspect of the abdomen.

Primary Survey

A – Airway & Cervical Spine Control

Careful attention should be paid to mechanisms of injury that could result in cervical injury, (e.g. fall with head trauma; high mechanisms of injury)

B – Breathing & Ventilation

If pain is elicited in the lower chest wall or the examining clinician feels any lower crepitus, surgical emphysema or witnesses paradoxical chest wall movement, this should raise suspicion of the possibility of hepatic and/or splenic injury.

If bowel sounds are heard on auscultation over the chest, the examining clinician should also consider the possibility of diaphragmatic rupture.

C- Circulation & Haemorrhage Control

Physical examination of the abdomen may yield little useful information in determining the presence or absence of intra-abdominal injury.

Any pain in the right or left upper quadrant or bruising over these areas or in the flanks should make the clinician concerned about the possibility of injury. All patients should have bloods sent for FBC, U&E, LFT, Amylase, Clotting, Group & Save and Fibrinogen. Venous lactate on blood gas analysis may raise concern of occult injury if >2.5.

Urine samples should be obtained to assess for the presence of haematuria. If a patient has frank, macroscopic haematuria, injury to the renal tract should be suspected and imaging performed (ultrasound or CT abdomen/pelvis).

Patients with any shortening or rotational deformity of the lower limbs should have a pelvis X-Ray for low mechanisms of injury. For high mechanism of injury, the team should consider the application of a pelvic splint and perform WBCT.

Features that may suggest pelvic fracture on primary survey examination include:

- Blood around the tip of the urethral meatus;
- Bruising above the inguinal ligament;
- Scrotal haematoma.

Patients with any of these findings should have a CT scan of the pelvis as a minimum.

Depending on expertise, FAST scan may be performed to assess for the possibility of intra-abdominal haemorrhage. Elderly patients with ascites or who have ambulatory peritoneal dialysis will give a false positive result on FAST scanning. In these circumstances, CT imaging is likely to be required to confirm the extent of injury before operative intervention is considered.

Abdominal ultrasound can also be performed to assess the calibre of the

abdominal aorta. The scan can be used to assess aortic calibre on two transverse views and one longitudinal view but it will not demonstrate small tears, haemorrhage or aneurysmal rupture.

D – Disability

All patients should have a temperature recorded in addition to blood glucose and a GCS.

Imaging

Ultrasound and CT scanning are ideal imaging modalities for intra-abdominal injuries. Contrast-enhanced scanning with arterial and porto-venous phase imaging will be needed to identify small areas of bleeding and contrast extravasation.

Pelvis X-Ray & Pelvic Injuries

Plain film radiography of the pelvis can be used to identify any obvious bony abnormality:

A – Accuracy
A – Adequacy
A – Alignment
B – Bones
C- Contours

A – Accuracy: is this the right film for the right patient?

A – Adequacy: if prostheses are present, have they been imaged in their entirety? Are both iliac crests visible?

A – Alignment: trace around the following and assess for any obvious steps: the inner pelvic rim; around the inferior aspect of the superior pubic ramus and superior aspect of the inferior pubic ramus; Shenton's line (a line drawn along the medial border of the femoral neck and head continued along the inferior aspect of the superior pubic ramus).

B – Bones: inspect the following: the femoral head and neck for any obvious deformity and breaks in trabeculae pattern; the iliac crests; and the pubic rami

C – Contours: review the sacroiliac joints for widening; review any widening of the pubic symphysis.

Common injury patterns will involve fractures of the pubic rami (superior, inferior or both), and the neck of the femur (intratrochanteric, subtrochanteric or subcapital).

Subtrochanteric Neck of Femur fracture

Widening of pubic symphysis

Fracture of right iliac crest

Management of Intra-Abdominal Injuries

Splenic Injury

Patients with splenic injury will vary in their states of presentation – some patients may be haemodynamically stable whereas others could be in a state of haemorrhagic shock in need for urgent definitive care.

Any patient with suspicion of splenic injury who is hypotensive has a surgical emergency and should be taken to the operating theatre or interventional radiology suite as soon as possible.

In simple terms, a patient who has sustained blunt trauma with haemodynamic instability which is unresponsive to fluid challenge / transfusion and no other signs of obvious haemorrhage should be considered as having a life-threatening injury until proven otherwise.

Patients who have a transient response to resuscitation or with a blood pressure >110mmHg, heart rate <90 bpm may be suitable for imaging in the first instance to assess whether interventional radiology is a more appropriate step than laparotomy.

Elderly patients may benefit from a less invasive approach as it will prevent them from having to recover from the secondary trauma caused by the laparotomy.

For stable patients with splenic injury, (i.e. those neither in need of immediate theatre nor radiological intervention), the need for operative intervention will depend on:

i. Presence of intraperitoneal blood
ii. Contrast blush on CT scan
iii. Calculated risk of rebleeding
iv. Presence and severity of associated injuries / illness
v. Grade of Injury
vi. Options regarding blood transfusion

Patients on anticoagulant medication may have a more pressing need for definitive intervention and the threshold for removal might be lowered. If observant management is planned, any signs of persistent bleeding or haemodynamic instability would be indications for surgery.

Grade of Splenic Injury[1]

Grade	Type	Description
I	Haematoma	Subcapsular <10% surface area
	Laceration	Capsular tear, <1cm parenchymal depth
II	Haematoma	Subcapsular, 10-50% surface area, <5cm diameter
	Laceration	1-3cm parenchymal depth, not involving a vessel
III	Haematoma	Subcapsular, >50% surface area or expanding, ruptured subcapsular or parenchymal haematoma >5cm
	Laceration	>3cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration of segmental or hilar vessels producing major devascularisation (>25% of spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury with devascularised spleen

Hepatic Injury

Patients who are haemodynamically unstable or who have diffuse abdominal peritonitis after blunt abdominal trauma should be considered for laparotomy.

Stable patients without peritonitis should have a contrast-enhanced abdominal CT scan to identify and assess the severity of any injury to the liver.

Patients with active contrast extravasation or who are transient responders to resuscitation should be referred to Interventional Radiologists for consideration of embolisation.

Non-operative management in stable patients should be safe provided that facilities are available to monitor such patients, perform serial clinical assessments and are available to take a patient to theatre in the event of deterioration.

The severity of hepatic injury, increasing age and the presence of associated injuries should not act as contra-indications to non-operative care.

Grade of Hepatic Injury[1]

Grade	Type	Description
I	Haematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear <1cm depth
II	Haematoma	Subcapsular, 10-50% surface area; intraparencyhmal < 10cm diameter
	Laceration	Capsular tear, 1-3cm depth, <10cm length
III	Haematoma	Subcapsular, >50% surface area pr ruptured with active bleeding; intraparenchymal > 10cm diameter
	Laceration	Capsular tear > 3cm depth
IV	Haematoma	Ruptured intraparenchymal with active bleed
	Laceration	Parenchymal disruption involving 25-75% hepatic lobe or 1-3 Couinaud segments (within one lobe)
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud segments (within one lobe)
	Vascular	Juxtahepatic venous injuries (IVC, major hepatic vein)
VI	Vascular	Hepatic avulsion

Renal Injury

Most renal trauma occurs as a result of blunt trauma and most injuries can be divided into the following groups: laceration; contusion and vascular injury. Any patient presenting with macroscopic haematuria following injury should have immediate imaging to assess the severity of injury.

Grade of Renal Injury[2]

Grade	Type	Description
I	Contusion	Simple contusion or non-enlarging subcapsular haematoma without laceration
II	Superficial Laceration	<1cm depth and not involving the collecting system
	Contusion	Non expanding perirenal haematoma
III	Laceration	>1cm, without extension into the renal pelvis or collecting system and no evidence of urine extravasation
IV	Laceration	Extends to renal pelvis or urinary extravasation
	Vascular Injury	Injury to main renal artery or vein with contained haemorrhage
V	Shattered Kidney	Avulsion of renal hilum with devascularisation of kidney

The kidney lends itself to non-operative management with the closed retroperitoneal space promoting the tamponade of any bleeding, and the availability of high levels of tissue factor which activates the coagulation cascade helps to prevent further bleeding.

Surgical management should be reviewed on an individual basis at senior consultant level. Patients with persistent renal bleeding as demonstrated by a pulsatile, expanding retroperitoneal haematoma or with avulsion of the main renal artery or vein should be considered for surgery.

Decisions about definitive care should take into account concurrent injuries and co-morbidities – if a patient is unlikely to survive, this should be discussed with the patient and their family in a collaborative manner and as soon as possible.

Traumatic Pancreatitis

Pancreatic injury is uncommon and more likely to be associated with penetrating trauma than high-mechanism blunt trauma. With the force needed to injure the pancreas being severe, such injuries rarely occur in isolation and other injuries should be sought.

Bruising to the flanks, seatbelt marks and penetrating injuries should raise the suspicion for pancreatic injury. Symptoms and signs are most likely to be related to other injuries and pancreatic trauma may not become evident until a few days into a person's care.

If CT findings are inconclusive, further investigation with MRCP may be useful, especially in patients who are not recovering as well as expected.

Management of Pelvic Injuries

Fractured Neck of Femur

Since the launch of the National Hip Fracture Database (NHFD) in 2007, over 250,000 cases have been recorded. The NHFD reviews standards of care for patients with these injuries which include:

- Surgery within 36 hours
- Shared care by surgeon and geriatrician
- Assessed by geriatrician within 72 hours
- Pre-and post-operative mental test score assessment
- Geriatrician-led multi-disciplinary rehabilitation

Patients presenting following a fall with groin/hip pain and leg shortening / rotation should be assessed for a fractured neck of femur. Hip fracture is the commonest reason for admission to an orthopaedic trauma ward.

All patients with moderate or severe pain should be offered analgesia within 15-30 minutes of arrival to an Emergency Department and have a Pelvis X-Ray within one hour.

All patients should have routine bloods and an assessment completed which includes the following (as covered in the HECTOR assessment):

- Pressure sore risk
- Hydration and nutrition
- Fluid balance
- Pain
- Continence
- Co-morbidities
- Cognitive state
- Previous mobility
- Functional ability

After admission, patients should be co-managed by orthopaedic and orthogeriatric teams and have their surgery within 36 hours.

Fascia Iliaca Compartment Block (FICB)

Adequate analgesia is a vital part of the fractured neck of femur pathway. Over-use of opiates can lead to respiratory depression and increase the risk of atelectasis and noscomial illness. An alternative to opiate analgesia is the fascia iliaca compartment block.

The FICB is an effective method of providing pre-operative analgesia for patients with injuries to the hip and thigh. It limits the need for opiate analgesia and thus reduces the side-effects associated with such medication.

Anatomy
The femoral nerve, obturator nerve and lateral femoral cutaneous nerve all arise from the lumbar plexus and provide part of the nerve supply to the legs.

Femoral Nerve – sensory supply to anteromedial surface of thigh

Obturator Nerve – sensory supply to medial aspect of the thigh

Lateral Femoral Cutaneous Nerve (LFCN) – sensory supply to lateral aspect of thigh to the knee.

The fascia iliaca compartment is a space between the fascia iliaca anteriorly and iliacus muscle posteriorly which contains the femoral, obturator and lateral femoral cutaneous nerves. It is an ideal space for allowing the instillation of local anaesthetic to block these nerves.

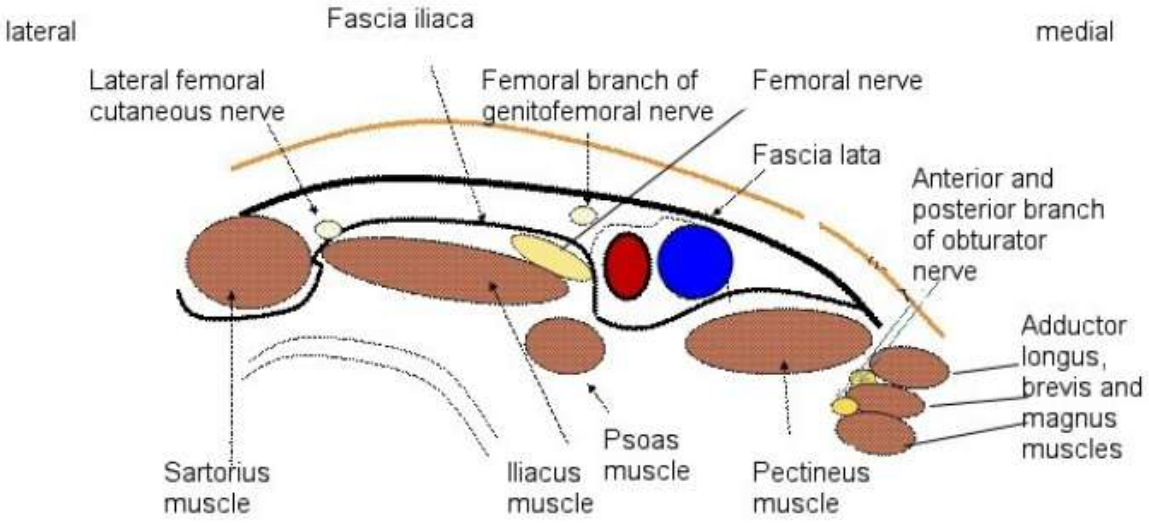
FICB can be used for patients with a fractured neck or shaft of femur except in the following circumstances:

a. Anticoagulation
b. Previous femoral bypass surgery
c. Inflammation or infection over injection site
d. Refusal by patient
e. Allergy to local anaesthetic agent.

Informed consent should be obtained which involves informing the patient of the following complications:

- Intravascular injection;
- Local anaesthetic toxicity;
- Temporary or permanent nerve damage;
- Infection;
- Block failure;
- Perioperative injury secondary to numbness or weakness

Close monitoring is essential within the first 15 minutes after injection.



The fascia iliaca compartment[3]

Equipment

- Blunted or short-bevelled needle
- Antiseptic skin solution
- 1-2mL 1% Lidocaine for skin infiltration in the awake patient
- Long-acting local anaesthetic: 2mg/kg 0.25% bupivacaine or 2.5-3mg/kg levobupivicaine
- Ultrasound machine and needle if being used

Landmark Technique

1. Draw an imaginary line between the anterior superior iliac spine and pubic tubercle

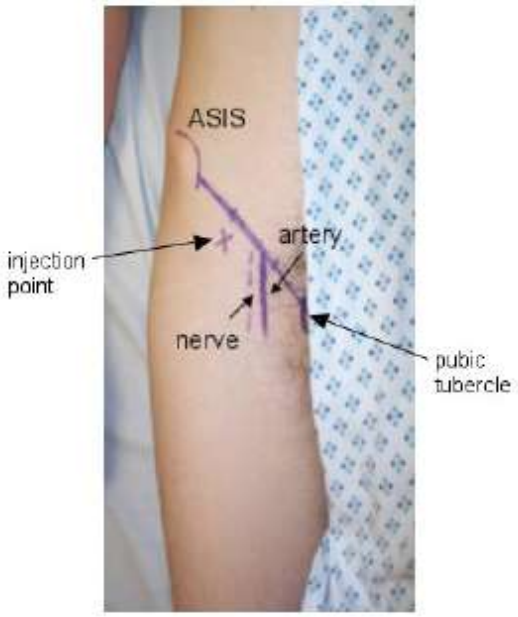
2. Divide this line into thirds and mark a point 1cm caudal from the junction of the lateral and middle third

3. Palpate the femoral pulse at the level of the planned injection site (should be 1.5-2 cm medial to site)

4. Prepare the skin and infiltrate skin and deep tissues with 1% lidocaine

5. Using a syringe of long-acting local anaesthetic with a short-bevelled needle attached, pierce the skin at right angles to its surface.

6. Once through the skin, adjust the angle to 60O and aim cranially



Anatomical Landmarks for Fascia Iliaca Compartment Block[3]

7. Advance the needle through two distinct "pops" which represent the fascia lata and fascia iliaca.

8. Aspirate before injection and after every 5mL injected – there should be no resistance to injection.

Large volumes of local anaesthetic (30mL) are required to achieve good spread of the agent and a better chance of providing block to the three nerves. If possible, reduce the concentration of the local anaesthetic agent to achieve higher instillation volumes.

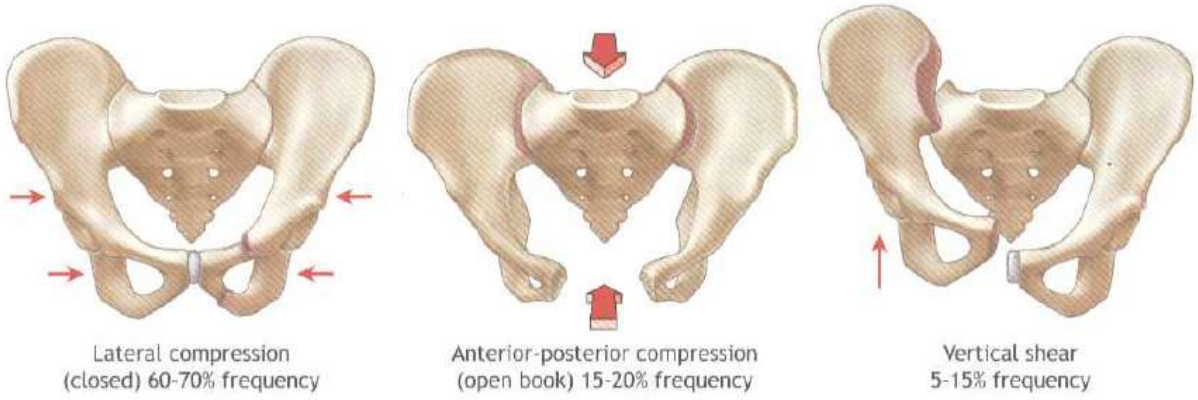
Unstable Pelvic Fractures

Patients with unstable pelvic fractures are most likely to sustain such trauma after high-energy mechanisms. As such, head, chest and abdominal injuries are likely to occur at the same time.

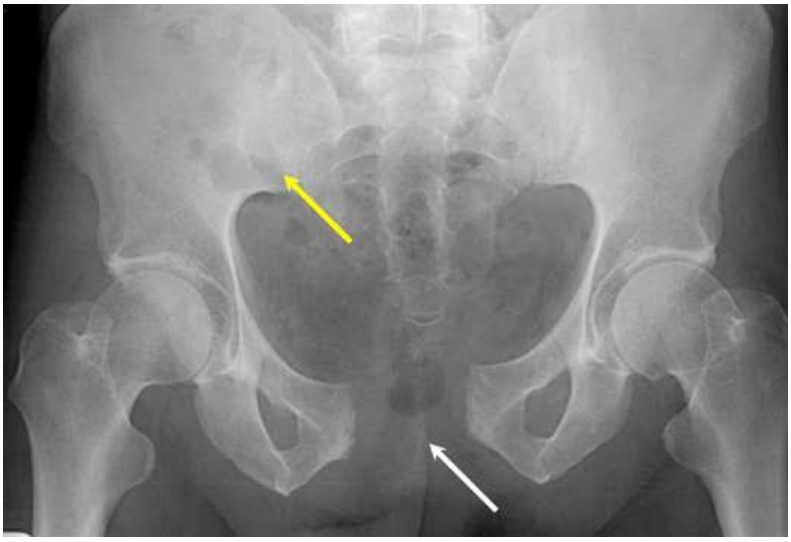
Most elderly patients present following low-energy mechanisms and are thus more likely to sustain injuries to the pubic rami or neck of femur than have significant disruption to the pelvic ring.

Patients with unstable and/or displaced pelvic ring disruptions on plain film radiography should undergo contrast-enhanced CT imaging to assess for active extravasation and haemorrhage. If required, the assistance of an interventional radiologist should be sought at the earliest opportunity.

When the pubic symphysis is disrupted, there is often injury to the posterior osseous ligamentous complex, represented by disruption to the sacroiliac joint or fracture.



Types of Pelvic Ring Injury



Widening of symphysis pubis with disruption of right sacroiliac joint following antero-posterior compression

Patients with unstable pelvic fractures can bleed from one of the following sources:

a. Fractured bone surface
b. Pelvic venous plexus
c. Pelvic arterial injury
d. Extra-pelvic sources

Massive transfusion protocol should be activated for patients with haemodynamic instability and unstable pelvic injuries.

CT and angiography may fulfil an essential role for unstable patients prior to theatre and external fixation. Such decisions should be made by the Consultant team responsible for damage control surgery.

Pubic Rami Fractures

Such injuries are common in the elderly population following simple falls. Patients may present with groin pain and an inability to weight bear. Adequate analgesia should be prescribed and if necessary, patients may require admission.

Patients taking anticoagulant medication should be considered for admission and observation. Any evidence of haemodynamic instability, occult hypoperfusion or pain not controlled despite adequate analgesia should warrant formal CT imaging to assess for the presence of haematoma or ongoing haemorrhage.

Summary

- Blunt abdominal trauma is often associated with high mechanism of injury but can also accompany injuries to the lower chest wall following same-level falls.

- Abdominal examination is an unreliable method for excluding intra-abdominal injury and cues taken from the primary survey (occult hypoperfusion, FAST findings, injury mechanism), should be used to determine the need for further imaging.

- Intra-abdominal injuries to solid viscera can often be managed in a conservative manner with close

observation. Vascular injuries and injuries to hollow viscera are more likely to need definitive damage-control management.

- Consideration should be given for the role of interventional radiology in the elderly patient with intra-abdominal injury. The invasiveness of laparotomy may not be appropriate for all patients, especially those with high levels of frailty and co-morbidity.

- Pain management plays a large role in the management of patients with fractured neck of femur. Fascia iliaca compartment block can be used as an alternative to opiate analgesia and can prevent the side effect profile of the latter.

- The identification of severe pelvic injury warrants high levels of vigilance towards haemorrhage control and the existence of other injuries. Patients should have a WBCT as soon as such injuries have been identified.

References

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Chapter 12: Extremity Trauma and Burns

Introduction

The secondary survey is performed to identify any significant injuries that may have been missed during the primary survey. Elderly patients who present following simple falls may be at risk of extremity trauma (i.e. injuries distal to the elbow and knee).

These injuries can affect the skin, muscle and tendon structures, bony skeleton, neurovascular structures or all of the above. What is important to consider is how such injuries are likely to impact on an individual's recovery. A patient who is reliant on a zimmer-frame for mobility will be unable to use such a device if their arm is in plaster.

Seemingly minor injuries can impair recovery, and with that can lead to prolonged hospital stays, increased risk of noscomial illness and a high rate of complications.

Patients of increasing age are more likely to suffer from delayed wound healing, especially if initial management is suboptimal. Skin morphology changes with age and is due to the following:

- Reduction in dermal thickness;
- Reduced number of cells;
- Disrupted microcirculation;
- Altered collagen/elastin content;
- Changes to physical properties of collagen

When combined with conditions such as diabetes or medications that impair healing (immunosupressants, corticosteroids), these changes can lead to poor wound healing and skin breakdown. Compound fractures especially may not heal well and need high levels of input from tissue viability teams, with longer hospital stays.

In addition to blunt trauma, burn injuries are particularly troublesome in the elderly population with the vast majority occurring in a domestic setting. Flame and scald injuries are the most common cause of major burns, although patients may present following a fall and direct contact with a hot surface (e.g. a radiator), especially if they are unable to move due to associated injuries.

Different injury types and patterns are too numerous to include in their entirety. HECTOR will review the commonest types of injuries that present to Emergency Departments and offer advice on appropriate management.

Upper Limb Injuries

Colles' Fracture

This injury was first described by Abraham Colles in 1814 and was originally described as a "low energy extra-articular fracture of the distal radius occurring in elderly individuals". It is more common in elderly women and often associated with an underlying history of osteoporosis.

Patients may present following a simple fall onto a hand that they have stretched out to protect themselves and may have a "dinner-fork deformity" of the distal forearm.

With these injuries the dorsal surface undergoes compression whilst the volar surface undergoes tension.

Dinner-Fork Deformity in Colles' Fracture

X-Ray Findings

a. Dorsally angulated fracture of distal radius metaphysis
b. Fracture is 2.5cm proximal to the radiocarpal joint
c. Radial displacement of distal fragment
d. Loss of normal 5^{O} forward tilt of the joint surface
e. Impaction

Management of Patient with Colles' Fracture

In addition to providing adequate analgesia and excluding other serious injuries, patients should have an X-Ray wrist AP/Lateral to determine whether or not manipulation is required.

The following list summarises the situations in which manipulation may be required:

A. Gross displacement
B. Appreciable deformity to the naked eye
C. Displacement of the ulnar styloid or ulnar angulation of the distal fragment, (indicates serious disruption of the inferior radioulnar joint)

The decision to perform a manipulation should be reviewed on a case-by-case basis. The discomfort caused by such a procedure may be unnecessary for patients who have limited functional ability.

Attempts at reduction of such injuries should only be done with the provision of adequate analgesia, sedation or methods such as the Bier's Block. Irrespective of whether a patient undergoes manipulation, a below elbow backslab should be applied as soon as possible to splint the injury and alleviate pain.

Complications

Aside from complications such as non-union and arthritis, patients may develop the following complications after sustaining a Colles' fracture:

- Rupture of extensor pollicis longus tendon
- Median nerve compression
- Distal radioulnar joint injury leading to weak grip, localised pain and loss of supination
- Sudek's atrophy – swollen fingers and restriction of finger flexion

Smith's Fracture

This injury occurs around the distal radius and involves volar angulation in contrast to the dorsal angulation of a Colles' fracture. Individuals tend to fall onto the palm behind them.

Type I and II injuries are extra-articular whilst Type III injuries (Barton's fracture), enter the radiocarpal joint and involve

volar dislocation of carpus with the distal radius fragment.

Such injuries are commonly unstable and it may be difficult to obtain adequate reduction in an Emergency Department setting. If a patient is likely to be delayed getting to theatre for reduction, a single attempt to correct obvious deformity could be attempted within the ED, followed by application of a volar slab with the wrist in extension.

Radial Head Fracture

Fractures of the radial head normally occur following a fall onto the outstretched hand, with the impact of the fall driving the head of the radius onto the capitulum of the humerus.

Patients may complain of pain and swelling around the elbow and the assessing clinician will find pain on direct pressure over the radial head. Elbow X-Rays may be inconclusive for minimally displaced injuries, but more obvious for displaced or intra-articular fractures.

Management

Type I fractures may be difficult to identify on elbow X-ray but anterior fat pads may be visible anterior to the coronoid fossa. Patients can be treated in a broad-arm sling and be encouraged to mobilise the elbow early to avoid stiffness. Non-union will occur in 5% of these types of injury and in the event that it becomes symptomatic, may warrant resection.

Type II injuries involve fractures with less than 30% articular involvement and more than 2mm of displacement. Conservative treatment can be used in the acute setting with follow-up review determining the need for operative intervention.

Type III fractures occur when there is complete comminution of the radial head and significant displacement. Patients with these injuries should be referred immediately for Orthopaedic review and consideration of ORIF or radial head excision / implant.

Shaft of Humerus Fracture

Patients with fractures to the midshaft of the humerus will sustain the injury by either:

- Torsion force (spiral fracture);
- Bending force (transverse fracture);
- Combination of torsion and bending (oblique fracture with/out butterfly fragment)

Up to 18% of patients with fractures of the humeral shaft will have an associated radial nerve palsy. Most of the time these injuries are due to neuropraxia, and patients will recover within 3-4months.

Wrist extension, dorsal hand sesnation and assessment of extensor carpi radialis longus/brevis and extensor pollicis longus should be used to identify this complication.

Management

Patients with these type of injuries will need good levels of analgesia and application of a hanging cast which extends from at least 1cm proximal to the fracture site to the wrist.

The assessing clinician should assess for the presence of additional injuries and be

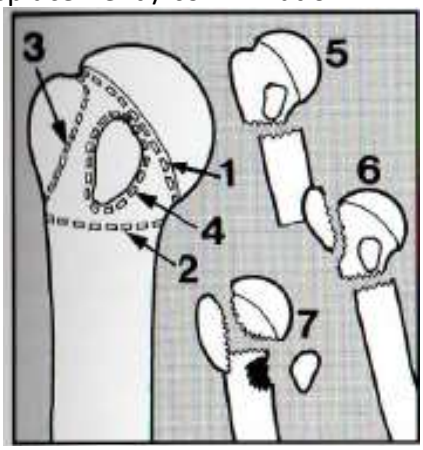
aware of the indications for operative intervention:

1. Unacceptable fracture position after closed reduction
2. New onset radial nerve palsy after closed reduction
3. Multi-trauma patients
4. Open fractures
5. Segmental humerus fractures
6. Floating elbow or ipselateral arm injuries
7. Suspicion of pathological fracture

Fractures of the Proximal Humerus

Fractures to the neck of the humerus are a common injury in elderly patients and are often sustained following a fall onto the affected side.

Injuries can be classified using Neer's classification which is based on the anatomical position of injury and degree of displacement / comminution:



1 = anatomical neck; 2 = surgical neck; 3 = greater tuberosity; 4=lesser tuberosity.

Type	Description
I	All fractures where there is minimal displacement or angulation (1-part)
II	All fractures of the anatomical neck displaced by more than 1cm
III	All fractures of the surgical neck with severe displacement or angulation
IV	All displaced fractures of the greater tuberosity (2 part or more)
V	Fractures of the lesser tuberosity (2 part or more)
Via	Dislocation of shoulder with greater tuberosity fracture
VIb	Dislocation with two-part fracture through the surgical neck
Vic	Three and four-part injuries where the humeral head is completely detached and displaced, or split

Most injuries can be treated with simple analgesia and a collar and cuff sling in the first instance. Patients with Type III injuries or greater should be discussed with the Orthopaedic team to plan future management. This will depend on a variety of factors and should remain patient-focussed.

Lower Limb Injuries

Shaft of Femur Fractures

Patients with fractures to the shaft of femur can lose between 0.5 – 1.0L blood into the surrounding tissues. This volume may increase in the presence of anticoagulant therapy. With this in mind, if such injuries are suspected in elderly patients, a formal ABCDE approach should be used for the initial assessment followed by appropriate resuscitation.

Underlying bone disease such as osteoporosis or metastatic deposits should be considered and looked for if patients present with relatively low mechanisms of injury.

Patients may present with a leg which is externally rotated, shortened and abducted. The gluteus medius and minimus abduct the proximal fragment through their attachments to the greater trochanter and the iliopsoas causes flexion as it inserts onto the lesser trochanter.

Management

AP and lateral X-rays of the femur will confirm the anatomy of injury and skin traction with the use of a Thomas Splint will provide comfort and restore elements of anatomical alignment prior to any further intervention. This can be applied following femoral nerve blockade, fascia iliaca compartment block, or with the use of strong opiate analgesia and/or sedation.

Complications

Patients with these injuries are at risk of ongoing haemorrhage if not treated properly. Other significant complications include fat embolism which may present 1-3 days after injury with shortness of breath, hypoxia and a degree of agitation or delirium. Patients may develop a petechial rash and develop thrombocytopaenia.

The most effective measure to prevent fat embolism is to reduce fractures as soon as possible after injury. Patients should not be left waiting in Emergency Departments for porters to take them to X-ray. Imaging should be performed as soon as the diagnosis is suspected in order to facilitate rapid reduction.

Fracture of the Patella

Fractures of the patella may occur following a direct fall onto the knee, or from direct trauma (e.g. from the dashboard in road traffic collisions). Patients will be unable to extend the knee and will be unable to perform adequate straight leg raise. Additional signs will include point tenderness and crepitus over the patella.

Patients with undisplaced fractures or fractures in a vertical orientation may be treated conservatively in a cylinder cast. Patients with X-Rays which demonstrate a displaced horizontal fracture will need intervention such as tension-band wiring.

Tibial Plateau Fracture

Fractures to the tibial plateau are often sustained following severe valgus stress, (lateral to medial compression). This is often due to the weight of the lateral femoral condyle sliding downwards and laterally from the tibial spine.

The Schatzker classification system can be used to classify these types of injury and reflects increasing energy imparted to the bone and an increasingly worse diagnosis.

I	Wedge-shaped fracture of the lateral tibial plateau with less than 4mm depression / displacement
II	Split and depression of lateral tibial plateau
IIIa	Lateral depression of the lateral tibial plateau
IIIb	Central depression of the lateral tibial plateau
IV	Depression of the medial tibial plateau, without a fracture fragment
V	Fractures of lateral and medial tibial plateau
VI	Fracture through the metadiaphysis of the tibia

Schatzker Classification of Tibial Plateau Fractures

Patients with these types of injury are likely to need formal CT imaging to assess the depth of depression of the fracture fragment. If the articular surface is depressed by more than 10mm, the success of conservative management is unlikely. For this reason, patients should be discussed with the Orthopaedic team to determine the appropriateness of further imaging and intervention.

Compound Fractures of the Tibia / Fibula

Open lower limb fractures are often associated with high-energy trauma in

younger patients, but may follow simple falls in elderly age-groups. If a patient presents to an emergency department with such an injury, the following steps should be taken:

a. Formal primary survey (vertical if lone clinician or horizontal if team-based approach)

b. Stop external haemorrhage by direct pressure or application of a CAT tourniquet (last resort)

c. Provide appropriate analgesia and perform neurovascular examination of the limb

d. Straighten and align the limb (ensuring that adequate analgesia and/or sedation is used)

e. Repeat neurovascular examination

f. Remove gross contaminants, photograph wound if possible and if the patient provides consent, and cover the wound with saline-soaked gauze.

g. Splint the fracture, repeat neurovascular examination

h. Give 1.2 g intravenous co-amoxiclav or clindamycin 600mg if the patient is allergic to penicllin

i. Check tetanus status and administer prophylaxis if required.

j. Obtain full length AP and lateral X-Rays.

The characteristics of injuries that should prompt referral to a specialist centre are based on the following domains:

FRACTURE PATTERNS
• Transverse or short oblique tibial fractures with fibular fractures at a similar level • Tibial fractures with comminution/butterfly fragments with fibular fractures at a similar level • Segmental tibial fractures • Fractures with bone loss, either from extrusion at the time of injury or after debridement
SOFT TISSUE INJURY PATTERNS
• Skin loss such that direct tension-free closure is not possible following wound excision • Degloving • Injury to the muscles which requires excision of devitalised muscle via wound extensions • Injury to one or more of the major arteries of the leg

The Trauma & Orthopaedic team may decide that certain groups of elderly patients warrant referral to specialist centres with Ortho-Plastic cover irrespective of whether they meet any of the above criteria. Specialist teams should review such decisions on an individual basis.

Burns

Elderly patients constitute between 13 and 20% of admissions to burns units but have the highest death rate of the overall burn population[1].

Sensory and cognitive impairment may prevent patients from recognising imminent dangers. For example, patients with peripheral neuropathy secondary to diabetes may not feel the burning process if their feet are being kept close to a heater.

Risk Factors

Mortality associated with all burns is linked to total body surface area (TBSA) affected, percentage of full thickness burns, and smoke inhalation injury[2].

Feature	Odd ratio (95% confidence interval)
Inhalation Injury	2.58 (2.03-3.29)
Full thickness burn size	1.10 (1.09-1.11)
Partial-thickness burn size	1.06 (1.06-1.07)
Age	1.05 (1.05-1.06)

Independent predictors of mortality

For older patients, other predictors of mortality include: the severity and number of comorbid illnesses; pre-existing malnutrition; post-burn complications; and increasing age.

Initial Assessment

Patients with burns injuries should be assessed using a structured ABCDE approach with modifications to conduct a thorough assessment for the possibility of inhalational injury, and immediate efforts to stop the burning process.

Airway Assessment

The supraglottic airway is vulnerable to oedema and progressive obstruction caused by heat exposure. Features of inhalational injury may not be immediately apparent, but patients can deteriorate rapidly so features that may herald such progression should be sought:

- Burns to the face / neck
- Singeing of the eyebrows and nasal hair
- Carbon deposits and inflammatory changes in the oropharynx
- Carbonaceous sputum
- Hoarse voice (new onset)
- HbCO >10% with history of being involved in a fire.

The presence of these features should warrant formal anaesthetic assessment with a low threshold for endotracheal intubation and transfer to a burns unit. New onset stridor in a patient with burns should be considered as an immediate indication for intubation.

Stop the Burning Process

All affected clothing should be removed, and if possible, extremities ran under tap water to promote cooling. Such techniques should be used cautiously and temperature checked regularly to prevent the onset of hypothermia. Warm, clean and dry blankets should be used to prevent hypothermia.

History

All patients presenting with burns injuries should have a thorough history taken, especially in the context of flame or inhalational injuries.

Relevant information includes:

- Exposure to a closed space fire;
- Duration of the exposure;

- Mode of extrication from smoke-filled spaces;
- History of loss of consciousness;
- Cause for fire (cigarette; chip-pan); Burning materials (e.g. sofas, electrical components).

Patients with direct contact or splash injuries should be asked about: duration of exposure; temperature of appliance; whether splashed fluids had been boiled and if so how recently; history of falls and associated injuries and symptoms.

All patients should be asked about past medical history, paying close attention to diabetes and peripheral vascular disease. An enquiry should be made into tetanus status and dates of last immunisation.

Breathing & Ventilation

Having assessed airway, patients should be examined for circumferential chest wall injuries and given high flow oxygen, (initially 100% but lowered in accordance with ABG and risk of type II respiratory failure).

Blood pressure and heart rate should be assessed and intravenous access obtained for burns more than 10% of total body surface area. Arterial or venous blood gas analysis should be performed to monitor HbCO.

Evaluating Burns – Depth & Body Surface Area

Burns should be classified in terms of depth and body surface area affected. The depth of burns can be graded as follows:

Superficial Erythema – erythema, pain and the absence of blisters. Should not be included in measurements for body surface area

Superficial Partial Thickness – involves upper layer of dermis and the skin is pink and blistered

Superficial Partial Thickness Burn

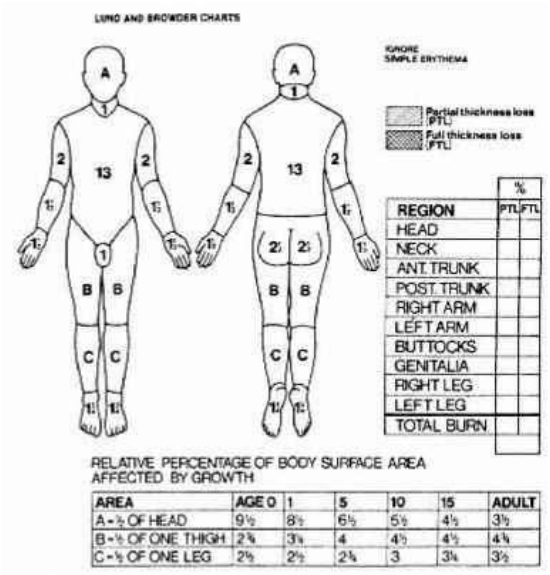
Deep Dermal – deeper dermal burn with fixed staining of the skin and a dry-looking wound

Deep Dermal Burn

Full Thickness – destruction of the epidermis and dermis manifested as a dense white, waxy or charred appearance, without sensation. Eschars appear as coagulated dead skin which is leathery in appearance

The percentage of total body surface area (TBSA) involvement can be calculated using Wallace's Rule of Nines or Lund and Browder Charts.

Wallace's Rule of Nines	
Body Region	**% BSA**
Head and Neck	9%
Upper Limbs (each)	9%
Torso anterior and posterior (each)	18%
Lower Limbs (each)	18%
Perineum	1%



AREA	AGE 0	1	5	10	15	ADULT
A - ½ OF HEAD	9½	8½	6½	5½	4½	3½
B - ½ OF ONE THIGH	2¾	3¼	4	4½	4½	4¾
C - ½ OF ONE LEG	2½	2½	2¾	3	3¼	3½

Fluid Resuscitation

Patients with burns > 10% TBSA will require fluid resuscitation. The Parkland Formula is commonly used to calculate fluid requirements in a 24 hour period and is given below:

PARKLAND:

4mL/kg X TBSA %

½ total volume should be given in the first 8hrs from time of burn
Remaining volume to be given in the next 16 hrs

Adequacy of fluid resuscitation can be measured by maintaining a mean arterial pressure above 60mmHg and ensuring an hourly urine output of 0.5-1.0mL/kg. Under-resuscitation can lead to hypovolaemic shock, renal impairment and organ dysfunction but over-resuscitation can lead to pulmonary oedema, especially in patients with impaired cardiac function.

Elderly patients needing fluid resuscitation are likely to have burns of more than 10% total body surface area, and should therefore be managed in specialised burns units. Early discussion should occur with the regional Burns team for such patients as aggressive, early excision (24-72 hours) of deeply burned tissues and early skin grafting will limit subsequent infections and provide a greater chance of a quicker return to function.

Other criteria for referral to specialist Burns Units include:

a. All full thickness burns
b. All circumferential burns
c. Any burns to hands, feet, face, genitalia and perineum.
d. Cold Injury (e.g. frostbite)
e. Chemical, electrical or friction burns.

One study has shown that early excision 24-72 hours after injury and early skin grafting provides a greater chance of a return to function, fewer complications and a shorter hospital stay[3]. However, survival has not been shown to improve with patients managed in this way[4].

Prognosis

The Baux score[5] (age + %TBSA = %mortality) is often cited in trauma training as a tool for prognostication but fails to address associated medical factors and does not correlate well with very old patients.

A score developed by Ryan et al[6] used three objective clinical criteria to predict different rates of mortality (see below):

Clinical Criteria
Age > 60 years More than 40% TBSA Inhalation Injury
No Risk Factors = 0.3% mortality 1 Risk Factor = 3% mortality 2 Risk Factors = 33% mortality 3 Risk Factors = 90% mortality

Ryan et al Criteria for predicting survival after burns injury

The problem with the above scoring tool is that a patient could have 100% TBSA burns as the only risk factor and only have a 3% risk of death.

The Abbreviated Burn Severity Index[7] was first published in 1982 and uses five variables and an adjusted scoring system to predict mortality. This has been shown to be more accurate and specific in determining outcomes after burn injury.

Abbreviated Burn Severity Index			
Parameter	**Score**	**TBSA**	**Score**
Male	0	1-10%	1
Female	1	11-20%	2
Age 0-20	1	21-30%	3
Age 21-40	2	31-40%	4
Age 41-60	3	41-50%	5
Age 61-80	4	51-60%	6
Age >80 years	5	61-70%	7
Inhalation Injury	1	71-80%	8
Full thickness burn	1	81-90%	9
		91-100%	10
Predicted mortality with ABSI			
ABSI Score		**Mortality**	
2-3		<1%	
4-5		2%	
6-7		10-20%	
8-9		30-50%	
10-11		60-80%	

Abbreviated Burn Severity Index

Summary

- Elderly patients with extremity trauma need to have prompt diagnosis and management to prevent injury-specific complications.

- Patients who have sustained a shaft of femur fracture should not have the reduction of their injury delayed. Plain film radiography should be prioritised as urgent to ensure rapid management to lessen the likelihood of fat embolism.

- Older patients with burn injuries should be managed as a priority, with clinical teams looking for any evidence of inhalational injury or other features that predict early mortality (e.g. full-thickness and partial-thickness burn size). Clinicians should have a low threshold for early referral to specialist burns units in an attempt to minimise complications.

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PART III: MEDICAL ILLNESS AND CO-MORBIDITIES IN THE INJURED ELDERLY PATIENT.

Chapter 13: Falls

Falls represent the commonest cause of injury-related mortality in the elderly population. In the space of 12 months, 30% of people over 65 years and 50% of people over 80 years would have had at least one fall.[1]

Falls place a dangerous burden on the individual. In addition to possible injury, patients may suffer from psychological distress, loss of independence, loss of mobility and loss of confidence.

There are many reasons why an individual may fall and accurate history taking is essential in determining why the fall occurred. **HECTOR rejects the term "mechanical fall" that is often quoted in patient records yet does not provide any useful information about why a patient fell.**

The term "mechanical fall" is often documented in clinical records but means nothing. It may refer to the fact that a patient has fallen without a precipitating medical cause (e.g. stroke, postural hypotension). However, it fails to state certain causes for a fall, (e.g. patient tripped over a rug etc..).

In terms of individual patient assessment, one of two scenarios may occur when trying to take a history:

1. Patient is able to provide a history and can be assessed in a routine manner.

2. Patient is unable to provide a history so corroborative history and screening investigations are essential.

Patients with dementia or acute delirium may not remember the exact cause, time or location of their fall. More details have to be gathered from pre-hospital teams, families, neighbours etc.. in order to paint a clearer picture of events.

The injuries sustained following a fall may be significant, but they may take second place to underlying medical conditions that precipitated the fall. The assessing clinician must bear this fact in mind and aim to address both sets of problems at the same time, and manage medical illness as well as acute injury.

Falls History

The First Question

The very first and most important question to ask any patient who has had a fall is:

"Do you remember hitting the ground?"

This will give a clearer indication if there are likely to be any neurological or cardiovascular events that caused a collapse. Patients who trip or slip are more likely to remember hitting the floor (depending on underlying cognitive state / memory).

History of Presenting Complaint

It is important for the assessing clinician to ascertain the following:

- Why did the patient fall?
- When did the patient fall?
- Where did the patient fall?
- How did the patient fall?

Knowing **why a patient fell** will involve asking about any underlying illness, mobility issues and environmental / behavioural factors that could have led to the fall. It will involve a formal systemic

enquiry to gather information about chest pain, dizziness, neurological symptoms (e.g. slurring of speech, limb weakness), before the fall. Delving into social history will allow the clinician to formulate a picture of the patient's home environment and use of mobility aids etc.. Drug history is also important at this stage to look for medications that could affect blood pressure (e.g. anti-hypertensives, beta-blockers etc..)

Knowing **when a patient fell** will allow the clinician to gather information such as: what was the patient doing at the time; how long could they have been lying on the floor for; and the length of time between presentation to hospital and any acute medical event (e.g. stroke)

Knowing **where a patient fell** will give some indication as to what time they fell and what they might have been doing. Patients falling in bedrooms could have been getting ready for bed, or getting up to get dressed / go to the toilet etc..

Finally, knowing how a patient fell will allow the clinician to assess the likely injuries that they could have sustained. For example, if a patient fell whilst twisting their leg, this could lead to a femoral shaft fracture. Likewise, if a patient fell and banged the back of their head, they could have sustained intracranial and / or cervical spine injuries.

Important Questions to Ask

If a patient is able to provide a clear and accurate depiction of events, other useful information will help determine the exact nature of the patient's fall. By gaining as much detail as possible, one can try and ascertain what type of intervention may be needed to prevent further falls from happening.

Some of these questions include the following:

- What was the patient doing?
- Was the patient carrying anything that could have affected their balance?
- What was the patient wearing for footwear?
- Were any walking aids being used? If so, what type?
- What was the ambient lighting like at the time of the fall?
- What kind of flooring was the patient standing on?

Risk Assessment for Falls

The National Institute for Health and Care Excellence (NICE) recommends that a multi-factorial risk assessment is carried out for any patient presenting to emergency services following a fall.[1]

An example of such a risk assessment would include the following topics:

- Falls History
- Gait, balance, mobility, muscle weakness
- Osteoporosis risk
- Perceived functional ability and fear of falling
- Visual impairment
- Cognitive impairment
- Urinary incontinence
- Cardiovascular examination
- Medication review

The falls history should also encompass the frequency, context and characteristics of falls. It is important to know if there are any recurring themes that occur.

Whilst considering individual risk factors for falls, it is important to note that they may not occur in isolation and an individual may have a number of modifiable risk factors for falls. The only

way of managing these preventable causes is by identifying them in the first instance, (see below)[2].

Risk Factor	Adjusted OR
Sedative use	28.3
Cognitive impairment	5.0
Disability of lower extremities	3.8
Palmomental reflex	3.0
Abnormalities of balance and gait	1.9
Foot problems	1.8

Transient Loss of Consciousness & Syncope

Syncope may be defined as:
"..a transient loss of consciousness and loss of postural tone which is of rapid onset and spontaneous with a quick recovery"

Syncope is different from comatose states which lead to a more persistent altered loss of consciousness.

In general terms, causes for syncope can be divided under the following headings:

Reflex Syncope
- Vasovagal – fear; distress; pain - Situational – cough, sneeze, micturition - Carotid sinus syncope - Atypical
Orthostatic Syncope
- Primary autonomic failure – Parkinson's disease; Lewy body dementia - Secondary autonomic failure – diabetes; uraemia; spinal cord injury - Volume depletion – haemorrhage; dehydration; diuretics
Cardiac Syncope
- Arrhythmias - Heart block – Mobitz II; complete heart block - Altered QT interval

Like falls, syncope warrants a specific form of history taking to clarify the possible diagnoses. This history should be divided into descriptions about what happened before, during and after the attack:

Before Attack
Position of the patient Activity of patient Predisposing features – cold, warm, stressors, coughing etc.. Presence of aura / sweating Palpitations or chest pain Headache
During Attack
Nature of fall Skin colour Length of unconsciousness Snoring Abnormal movements Tongue biting Incontinence of urine / faeces
After Attack
Time to full recovery Residual weakness Speech disturbance Headache Pain / Injuries sustained

Taking vasovagal or situational syncope as an example, the individual will normally experience an abrupt sense of light-headedness or flushing in response to a particular stimulus. This will be followed by a fall and transient loss of consciousness with rapid recovery to normal when in a horizontal position.

Cardiac syncope may be preceded by sudden palpitations, chest pain or be evidenced by a sudden drop attack with no preceding symptoms.

Epileptiform seizures may be heralded by an aura and result in collapse with seizure activity, tongue biting and/or incontinence with a protracted recovery period.

Clinical Scoring Tools for Collapse

From a medical perspective, clinicians will often use scoring systems to determine the risk of an adverse event from occurring. For patients suffering from a collapse and transient loss of consciousness, the following scoring systems may be of use:

San Francisco Score[3]
Increased risk of adverse outcomes if 1 or more of the following are present:
Abnormal ECG
Congestive heart failure
Shortness of breath
Systolic blood pressure < 90mmHg
Haematocrit < 30%
OESIL Score[4]
Increased risk if two or more of the following are present:
Abnormal ECG
Age > 65 years
Lack of prodrome
History of cardiovascular disease
EGSYS Score[5]
Increased risk with any of the following:
Palpitations pre-syncopal episode
Abnormal ECG
Syncope during effort
Syncope whilst supine

NICE guidance also provides the main risk factors for transient loss of consciousness which help identify the subsequent need for formal medical / cardiology review[6].

1. ECG abnormality
2. Heart failure
3. Collapse during exertion
4. New or unexplained breathlessness
5. Heart murmur
6. Lack of prodromal symptoms

In the context of trauma, it is just as important to develop a list of differential diagnoses for the cause of the fall as it is diagnosing injuries. This should not be overlooked as some medical problems need immediate attention.

Alcohol History

It is wrong to assume that consumption of alcohol is confined to younger age groups. Alcohol use disorders in elderly people are often described as being "hidden" and may not be detected by clinicians. This may be a result of people being: ashamed of their drinking habits; under-reporting or under-estimating their consumption; and/or professionals being reluctant to ask an older person about drinking.

Alcohol can affect balance, decision-making processes and reflexes. This can precipitate falls and subsequent injury. It is important in any assessment to ask about alcohol consumption, and habitual drinking.

Alcohol problems may arise in the elderly population for various reasons (see below), and it is important to consider why someone might be drinking alcohol in a non-judgemental manner.

Emotional	Medical	Practical
-Bereavement -Loss of Friends -Loss of social status -Loss of occupation -Family conflict -Reduced self esteem	-Disability -Chronic pain -Insomnia -Sensory deficit -Reduced mobility -Cognitive impairment -Depression	-Reduced coping skills -Altered finances -Impaired self-care

Alcohol screening has proven to be effective through the use of the Michigan Alcohol Screening Tool – Geriatric Version (MAST-G). This consists of 24 questions about alcohol with 5 "Yes" responses to questions such as "Does having a drink

help you sleep", being indicative of an alcohol problem.

Such tools may not be practical to use in the acute setting but may have a role on the wards. For the purposes of acute assessment, all elderly patients who present following a fall should be asked about recent alcohol consumption and to quantify the amount of alcohol drank in a seven day period.

Approach to the Patient who is Unable to Provide a History

For patients with dementia, delirium, or those with head injury and altered loss of consciousness, it may not be possible to ascertain an accurate falls history. In these circumstances, the clinician should use whatever corroborative information is available.

Pre-Hospital information in terms of how and where the patient was found, what they were wearing and what injuries they are suspected to have sustained can give vital clues to the puzzle. This can be combined with history from neighbours or the next of kin about when they last saw the patient and if they had noticed anything different.

Each patient should have a formal primary and secondary survey followed by a formal searching of available resources to clarify their past medical history, drugs history and social history.

The "Long Lie"

Following a fall, an elderly patient may have lost the ability to move due to injury and hence remain in the same position until help arrives. In such circumstances, skeletal muscle necrosis can occur, leading to an increased risk of rhabodmyolysis. This may be manifested by a raised creatine kinase on blood tests.

It is important to ascertain the length of time an individual has been lying on the floor, or could potentially have been lying on the floor. If a "long lie" is associated with a raised creatine kinase, intravenous fluid rehydration should commence and adjusted according to urine output, (aim minimum of 0.5mls/kg/hr).

Summary

- Same level falls represent the commonest mechanism of injury for elderly patient with injuries
- All clinicians should be mindful of the need to address acute medical problems as well as manage any injuries that have been sustained.
- Accurate history taking is vital to ascertain medical conditions, injuries and also to clarify an individual's modifiable risk factors for future falls. Only when all of these features have been considered will interventions designed to promote recovery and prevent further falls be effective.
- Transient loss of consciousness should prompt the clinician to perform specific investigations and ask specific questions to clarify the cause for collapse.

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Chapter 14: ECG Interpretation and Management

All elderly patients presenting with traumatic injuries should have a 12-Lead ECG performed. All clinicians managing patients with traumatic injuries must possess the relevant skills needed to interpret these ECGs. This competency forms part of basic clinical training for independent practitioners and is a skill that can be lost due to non-use.

HECTOR appreciates that whilst acquisition of such skills occurs in medical school and foundation training, maintenance of skills may vary between specialities. This chapter aims to reintroduce the key concepts of ECG interpretation and provide an over-arching structure for recurrent practice.

Systematic Approach to the ECG

Accurate interpretation of ECGs is reliant on a structured method of assessment. Without such a structure, subtle changes and abnormal findings may be missed. HECTOR recommends the following structure for ECG interpretation:

- Patient Identifiers
- Rate
- Rhythm
- Axis
- PR Interval
- QRS Complexes
- ST Segments and T waves
- QT interval

By reviewing each feature in order, the clinician is less likely to miss specific features.

Patient Identifiers

- Is this the right ECG for the patient? Ensure that the patient's name and hospital number have been clearly documented on the ECG

- Is this the relevant ECG for the patient? Check the date and time when the ECG was recorded to ensure it is the most relevant one to current practice.

Rate

The ECG has thick lines which are 5mm apart. This equates to 0.20 seconds. The thin lines are closer together, measure 1mm, and correspond to 0.04 seconds of time.

To calculate rate, the following calculations can be done:

a. Count the number of large squares between successive R-waves and divide into 300.

b. Count the number of small squares between successive R-waves and divide into 1500 - useful if the heart rate is very fast.

c. Count the number of cardiac cycles in 6 seconds (30 large squares) and multiply by ten – useful if the rate is irregular.

Rhythm

The cardiac rhythm can be classified into the following broad categories:

Regular
Consistent interval between R-R waves
Regularly Irregular
Generally consistent interval between R-R waves May be interrupted by ectopic beats or change during the respiratory cycle

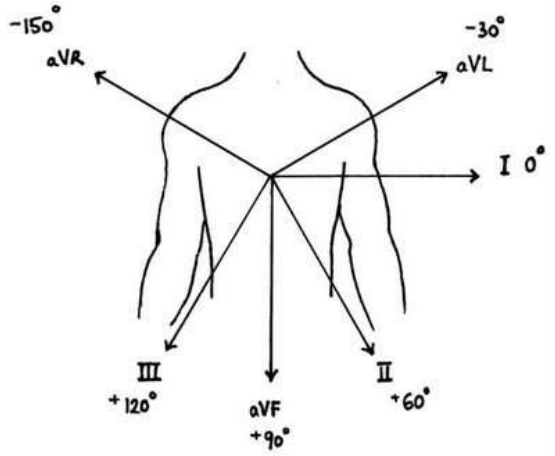
Irregularly Irregular
Inconsistent interval between R-R waves Absent p-waves denote atrial fibrillation

If it is unclear as to whether a rhythm is regular or irregular, the position of two or more adjacent R-waves can be marked on a separate piece of paper. This paper and these markings are then moved along the ECG to judge whether the R-R interval is consistent, (i.e. the spaces between R-waves should match the markings on the paper throughout the whole ECG).

Cardiac Axis

The cardiac axis is often poorly understood and missed during ECG interpretation. It represents the direction of the overall electrical activity of the heart and can be used to identify underlying disease.

The axis can be determined by reviewing the limb leads (I, II, III, aVL, aVF, aVR) and NOT the praecordial leads (V1-V6). In order to understand this process, one must be fully aware of the placement of ECG leads:



The Normal Axis

The normal cardiac axis lies between -30 and +90 degrees. This corresponds to an electrical axis that lies somewhere between lead aVL and aVF. In such circumstances, one is likely to see positive deflection of the QRS complex in leads I and aVF.

Left Axis Deviation

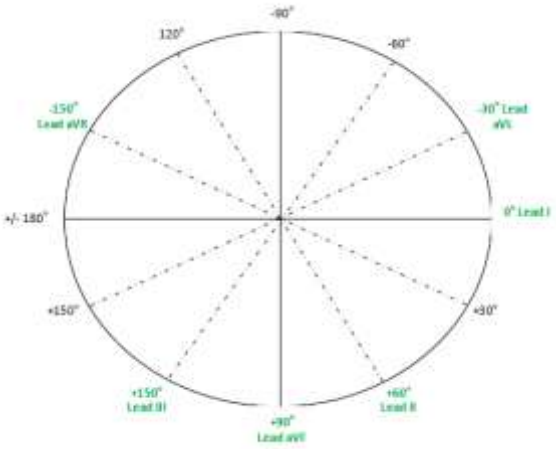
Left axis deviation occurs when the QRS vector falls between -30 and -90 degrees. This will be represented by a positive deflection in leads I and negative deflections in leads III and aVF.

Right Axis Deviation

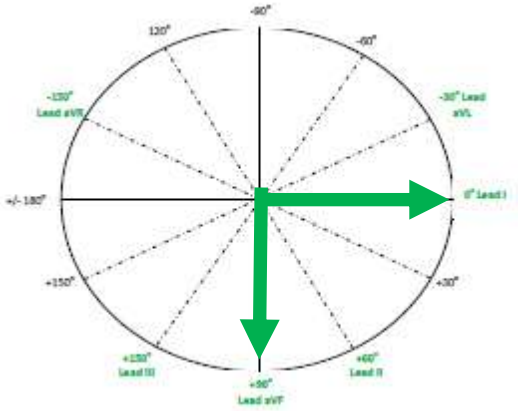
For right axis deviation, the QRS vector lies between +90 and +180 degrees. The ECG will demonstrate a positive QRS deflection in leads III and aVF but a negative deflection in lead I.

The Importance of Determining Cardiac Axis

When a patient presents following a collapse, it is essential to determine whether a patient has any underlying condition that could have precipitated the fall. Conditions such as pulmonary embolism, bifascicular and trifascicular heart block may be suspected in the presence of an abnormal axis.

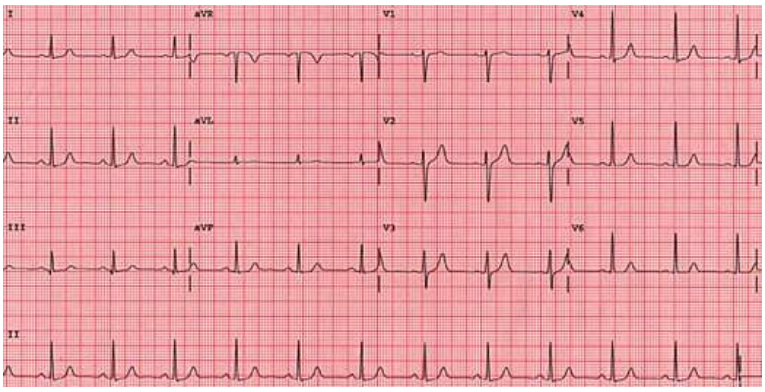


Normal Cardiac Axis

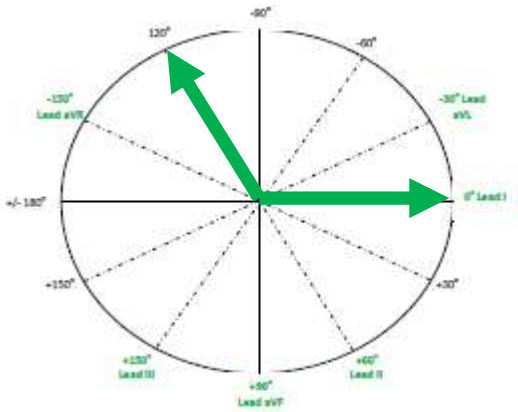


Leads I and aVF are both positive, inferring that the QRS vector lies between them.

This represents a normal cardiac axis

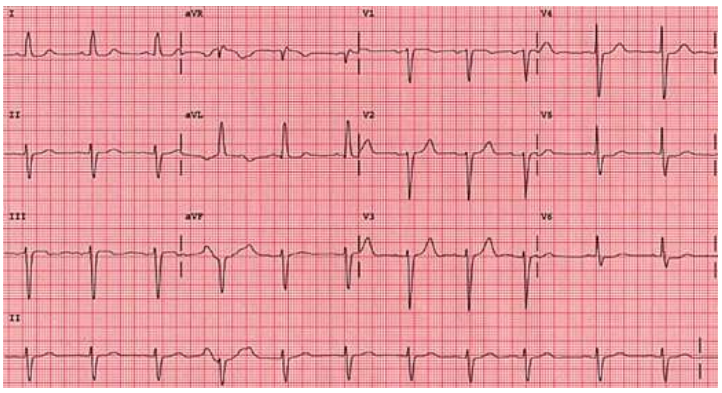


Left Axis Deviation

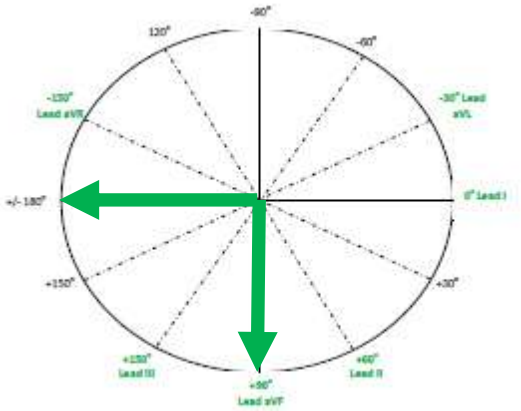


Lead I is positive whilst leads aVF and III are negative

This represents left axis deviation

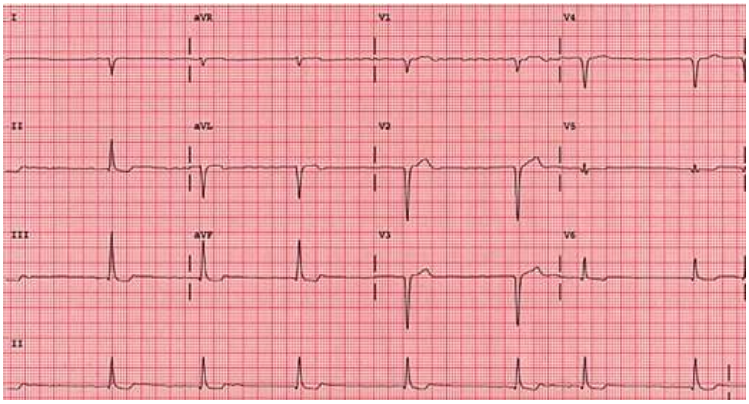


Right Axis Deviation



Lead I is negative whilst leads III and aVF are positive

This represents right axis deviation



The PR Interval

The PR interval should be between 0.12 – 0.20 seconds and represents the time between the onset of the p-wave and the start of the QRS complex.

First degree heart block is common and represents a delay in conduction through the atrioventricular junction. It is noted when the PR interval is longer than 0.20 seconds, (equivalent to five small squares).

Second degree heart block occurs when some but not all of the p-waves are conducted to the ventricles. This can lead to the absence of QRS complexes after some p-waves. There are two types of second degree heart block:

Mobitz Type I (Wenkebach)

- PR interval gets bigger and bigger after each p-wave, eventually leading to a dropped QRS complex:

Mobitz Type II

- Constant PR interval between conducted beats but some of the p-waves are not followed by a QRS complex
- Patients with this pattern of block are at risk of developing complete heart block or asystole.

Third degree or, complete heart block, exists where there is no relationship between p-waves and QRS complexes. This means that there is no

synchronisation between atrial and ventricular activity.

The QRS Complex

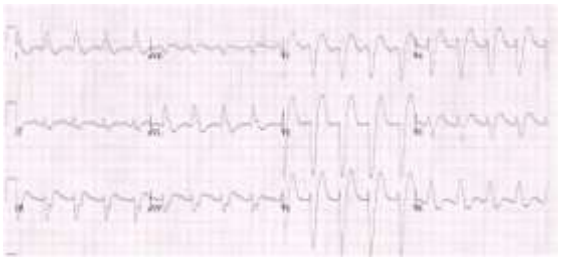
The QRS complex should be less than 0.12 seconds (= three small squares). If it is wider than this, it should be described as being broad complex. Broad complexes can occur in relation to ventricular ectopics, ventricular tachycardia and/or in bundle branch block.

Bundle Branch Block

In the cardiac cycle, electrical activity is transmitted to the right ventricle via the right bundle branch and to the left ventricle by the left anterior and posterior fascicles. Altered conduction down these branches will change the morphology of the QRS complex and could point to the underlying disease process.

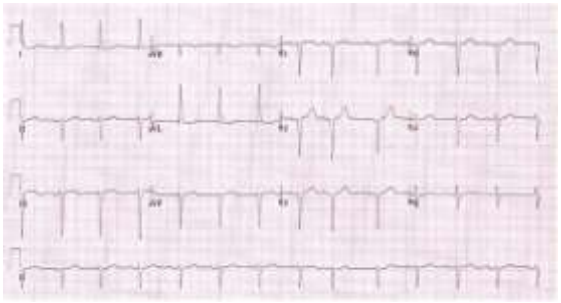
Right bundle branch block may be demonstrated by an additional R-wave in the anterior chest leads (V1-V3), due to slow conduction down the right ventricle. There will also be a slurred s-wave in the lateral leads (see below):

Left bundle branch block will be demonstrated by an additional R-wave in the lateral chest leads and a dominant s-wave in V1. There will also be an absence of Q-waves in leads V5 and V6 (see below):

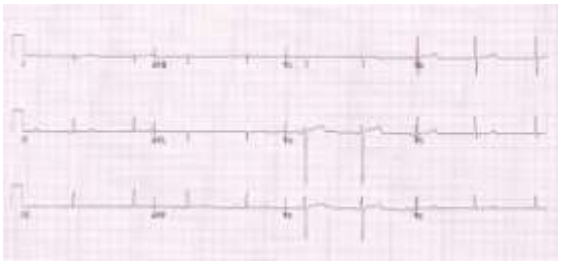


Fascicular Block

In left anterior fascicular block, the electrical impulse will be conducted by the left posterior fascicle, resulting in a predominant leftward axis with small R-waves and deep S-waves in the inferior leads:



In left posterior fascicular block, the impulse is carried by the left anterior fascicle and results in a rightward axis with small Q-waves and tall R-Waves in the inferior leads



The T-Wave and ST-Segments

The T wave follows the S-wave and may be normal or be peaked, flattened or inverted during different disease states. Peaked T-waves may be indicative of hyperkalaemia or hyperacute ischaemia in the presence of acute chest pain.

Flattened T-waves may be present with hypokalaemia and can be inverted with established myocardial infarction.

The ST-segment is usually isoelectric but can be elevated or depressed in acute myocardial infarction. Drugs such as digoxin can also cause ST depression to be evident on an ECG. Biphasic ST segments may be indicative of Wellen's syndrome whereby a critical stenosis has formed in the left main coronary artery.

The QT Interval

The QT interval is measured from the start of the QRS complex to the end of the T-wave. In normal circumstances, the QT interval shortens as the heart rate increases, so corrections need to be made for this.

The QTc (corrected QT interval) can be calculated using the following equation, but is also calculated electronically on most modern ECG machines:

$$QTc = QT / \sqrt{R\text{-}R}$$

Range 0.39 +/- 0.04 seconds

A prolonged QTc has many causes and can predispose an individual to torsades de pointes and collapse. A shorted QTc can be seen in digoxin treatment and with hypercalcaemia.

Management and Diagnosis of Patients with Specific ECG Abnormalities & Cardiac Conditions

Acute Coronary Syndrome (ACS)

In the context of trauma and falls / collapse, sudden onset severe chest pain preceding a fall should lead the examiner to enquire further about these symptoms and risk factors for coronary artery disease.

If ACS is a possible diagnosis, the TIMI scoring system[1] can be used to identify patients in low and high-risk groups. If present, the following features are awarded 1 point each:

TIMI Score

Age 65 years or older?
Three or more risk factors for coronary artery disease?
Prior coronary stenosis 50% or more?
ST segment deviation >0.5mm?
Use of aspirin in last 7 days?
Two angina events in last 24 hours?
Elevated serum cardiac markers?

Having calculated the TIMI score, the risk of all-cause mortality, new or recurrent MI or ischaemia is given below:

Risk Score	TIMI Risk
0-1	4.7%
2	8.3%
3	13.2%
4	19.9%
5	26.2%
6-7	40.9%

In addition to the above, the following ECG findings may be indicative of an acute coronary syndrome:

1. ST depression or elevation

2. T-wave inversion in chest leads or II, III, aVF

3. New onset left bundle branch block

If a patient with injuries has ongoing chest pain and any of the above ECG changes, urgent cardiology review is indicated.

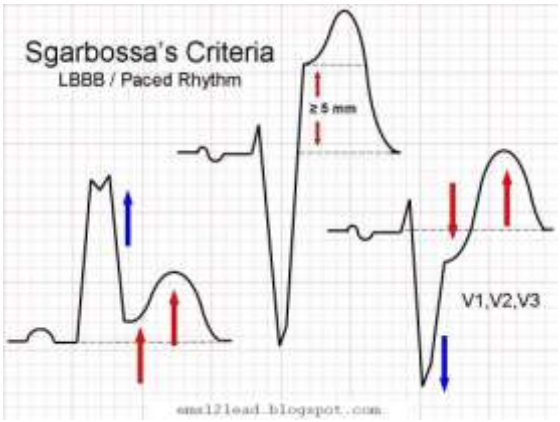
Such patients may need immediate primary coronary intervention.

In the absence of such findings but a degree of suspicion of ACS, serial high sensitivity troponin I levels taken at 0 and 3 hours can be used to identify this diagnosis. Any elevations above the upper limit of normal or increases or decreases from the initial baseline level should warrant cardiology review.

Some patients may have had previous cardiac disease and if any abnormalities are identified on ECG, it would be useful to review previous records and compare findings. If it is unclear whether a patient with chest pain has new or old left bundle branch block, the Sgarbossa criteria[2] have a specificity of 90% for detecting new acute coronary events:

Sgarbossa Criteria (>/= 3 points = 90% specificity):

a. Concordant ST elevation >1mm in leads with positive QRS complex (score 5)
b. Concordant ST depression >1mm in V1-V3 (score 3)
c. Excessively disconcordant ST elevation >5mm in leads with a negative QRS complex (score 2)



If ACS is a possible diagnosis standard treatment should be given (aspirin 300mg, analgesia – GTN and/or opiates, high-flow oxygen).

Atrial Fibrillation (AF)

AF is a common arrhythmia occurring in 5-10% of patients aged 65 years and over. Most patients with AF tolerate their rhythm and are controlled with beta blockers or digoxin and either antiplatelet or anticoagulants to reduced thrombotic risk of stroke, PE etc..

Atrial fibrillation in trauma may be due to the following:

- blunt thoracic injury;
- be pre-existing;
- be a precedent or consequence of the traumatic event.

Some of the causes of AF are listed below:

Cardiac Disease
Ischaemic heart disease
Mitral valve disease
Hypertension
Heart Failure / Cardiomyopathy
Post cardiac surgery / CABG
Intrathoracic Pathology
Pneumonia
Malignancy
Pulmonary embolus
Trauma
Metabolic Disturbance
Renal impairment
Acidosis / dehydration
Thyrotoxicosis
Drugs (alcohol, sympathomimetics)

Key principles of care rest on how well the atrial fibrillation is tolerated by the patient, and its duration since onset.

If a patient has fast atrial fibrillation, (defined as a heart rate over 150 beats per minute), and either shock, syncope,

myocardial ischaemia or heart failure, the UK Resuscitation Council advocates synchronised dc cardioversion if treatment has been given for underlying reversible causes.

In the context of trauma, if an individual has extensive traumatic injuries and / or massive blood loss, these factors should be controlled in the first instance before resorting to synchronised dc shock.

On a similar level, if a patient has sustained injuries following a collapse brought on by an underlying septic condition, fluid resuscitation and management of sepsis may be sufficient to control an unstable tachyarrhythmia.

In the event where reversible factors have been controlled, management of atrial fibrillation is conducted through either rate or rhythm control, depending on its duration since onset. If a patient is known to have atrial fibrillation and is not anti-coagulated, cardioversion may result in thrombo-embolic events such as stroke or PE.

Rate control with either beta-blockers such as bisoprolol (2.5-5mg) or digoxin (500mcg loading iv or oral), would be the recommended approach.

For patients where the atrial fibrillation has a duration of less than 48 hours the quicker they are cardioverted back to sinus rhythm the more likely they are to remain in this state.

Atrio-ventricular Block

First degree heart block is often well tolerated and does not need immediate intervention. Second degree and third degree atrioventricular blocks necessitate formal medical review.

Patients with collapse and Type II Mobitz block are at risk of asystole and progression to complete heart block. Similarly patients with collapse and bifascicular or trifascicular heart block require monitoring. All such patients should have cardiology review to determine whether pacemaker insertion is appropriate.

Bifascicular Block on ECG:

- Right bundle branch block
- Right or left axis deviation

Incomplete Trifascicular Block on ECG:

- Bifascicular block
- 1st or 2nd degree AV block

Complete Trifascicular Block on ECG:

- Bifascicular Block
- 3rd degree AV block (complete dissociation)

Patients with bradycardia (resting heart rate < 60bpm) should have any reversible features treated (e.g. digoxin or beta blocker toxicity). After treating such causes, atropine may be given 500mcg iv up to a maximum of 3mg or external pacing delivered.

Compromised patients with bradycardia and any of the following on ECG are at risk of asystole and need immediate management of the bradycardia:

a. Recent asystole
b. Mobitz II AV block
c. Complete heart block and broad QRS
d. Ventricular pause 3 seconds.

Causes of Prolonged QT Interval and Management

A Prolonged QT interval can predispose an individual to torsades de pointes and lead

to syncope. If identified on an ECG, (QTc > 450ms), consideration should be given to treating any electrolyte abnormalities, and reviewing a patient's drug history.

It may be sufficient to stop drugs that cause a prolonged QT interval but other causes (e.g. hypokalaemia, hypomagnesaemia) need more specific therapy. A single dose of magnesium sulphate (8mmol) may be appropriate first line treatment for patients with a prolonged QT interval (>500ms) and a history of syncope.

Anti-arrhythmics
Amiodarone, sotalol
Anti-psychotics / Anti-depressants
Chlopromazine, amitryptiline
Anti-histamines
Terfenadine
Antibiotics
Erythromycin and macrolides
Electrolyte abnormalities
Hypokalaemia Hypocalcaemia Hypomagnesaemia
Congenital / Other
Romano-Ward syndrome Myocardial infarction Mitral valve prolapsed

Causes of QT prolongation

Summary

- Skills in ECG interpretation and assessment of basic concepts of rate, rhythm, axis are essential for the assessment of the elderly trauma patient

- ECG abnormalities may represent long-standing conditions or be acute, as a preceding issue or as a consequence of the traumatic event.

- Attention to ECG details to diagnose acute illness should warrant the same amount of vigilance as the attention given to imaging to diagnose traumatic injuries

- Underlying causes for arrhythmias and ECG abnormalities need to be understood in order to provide the best possible treatment

- Management of reversible causes and the patient should take precedence before offering specific treatment for cardiac arrhythmias.

References

1.Elliott M, Antman MD, Cohen M et al. The TIMI Risk Score for unstable angina/non ST-elevation MI. *JAMA* 2000;284(7): 835-842.

2. Sgarbossa EB, Pinski SL, Barbagelata A et al. Electrocardiographic diagnosis of evolving acute myocardial infarction in the presence of left bundle branch block. *N Engl J Med* 1996; 334(8): 481-487

Chapter 15 – Management of Illness

This Chapter will aim to look at common conditions that may affect individuals as they get older and assess how such illnesses may influence management in trauma care. It is important for the assessing clinician to have a broad understanding of such illnesses and know the common treatment regimes.

Cardiovascular Disease

Hypertension

Hypertension is defined as:

"...a systolic blood pressure of >140mmHg and diastolic pressure of 90mmHg or more"

Alternatively, it can relate to people taking anti-hypertensive medication but with normal blood pressure due to their treatment.

Hypertension is a major risk factor for stroke, myocardial infarction, vascular disease and chronic kidney disease. In most developed countries, over 50% of people aged 60 years and over will have hypertension.

In the context of trauma, hypertension may predispose an individual to a higher blood pressure reading than expected in comparison to a younger individual with features of Class III/IV shock.

Knowledge of a patient's baseline blood pressure is crucial – if an individual has a resting systolic blood pressure of 170mmHg but attends after high energy trauma with a blood pressure of 120mmHg, this could represent a significant drop. The untrained individual may be falsely reassured by such readings. This stresses the importance of looking for other signs of shock such as cold clammy skin, reduced urine output and raised lactate.

Hypertension is treated in individuals with high or very high cardiovascular disease risk. In elderly patients, the thresholds for therapy are lowered so that a systolic blood pressure of >160mmHg in those over 80 years and systolic of >140mmHg between 60 and 79 years may warrant treatment. Such standards mean that elderly patients are more likely to take antihypertensive medication.

Common drugs that are used to manage hypertension include:

- Diuretics (bendroflumethiazide, furosemide);
- Beta-blockers (bisoprolol, atenolol);
- Calcium antagonists (amlodipine, nifedipine);
- ACE-inhibitors (ramipril, enalapril);
- Angiotensin receptor blockers (candesartan, losartan).

They can all be used in isolation or in combination.

Diuretics

Diuretics promote dieresis and micturition which may predispose an individual to volume depletion, hypokalaemia and an increased risk of falls from postural hypotension.

Beta-Blockers

Beta-blockers may inhibit the tachycardic response to volume loss and reduced preload, thus masking such signs in the face of major haemorrhage.

Calcium Channel Blockers

Elderly patients taking diltiazem or verapamil may have a greater level of heart rate suppression than younger individuals on the same medicines.

ACE-Inhibitors

ACE-Inhibitors are used in individuals for control of hypertension following myocardial infarction. They have fewer renal and cardiovascular complications than other antihypertensive agents.

In general, the assessing clinician needs to be mindful of the effects of antihypertensive medications on an individual's response to trauma (e.g volume depletion, blunting of sympathetic response), but they should also be mindful of not relying on "seemingly normal" physiological parameters to exclude major haemorrhage.

Ischaemic Heart Disease & Myocardial Infarction

Coronary heart disease is the leading cause of death in the UK and results from a build up of fatty atheroma in the coronary vessels, leading to gradual stenosis and predisposing an individual to thrombo-embolic events (myocardial infarction). Acute events could lead to an individual collapsing or falling over, whereby any resulting injury may shift a clinician's focus away from the actual cause for the fall/collapse.

All patients with a fall or collapse should have a 12-lead ECG recorded to assess for the presence of ischaemic changes. Patients may have an associated history of central chest pain, nausea or sudden onset breathlessness, or they may have no history of chest pain, especially if they are diabetic or have had previous bypass surgery.

HECTOR advocates that any patient over the age of 65 years with a history of fall / collapse leading to traumatic injury, and **who presented with chest pain prior to the fall** or who has **ECG changes suggestive of ischaemia**, should have blood tests taken for high sensitivity troponin.

The initial blood test should be repeated after 3 or 6 hours depending on the local troponin assay, and cardiology review be sought immediately if a patient has a raised level or who has features of ST-elevation MI (see below):

i. ST elevation of >2mm in two consecutive chest leads
ii. ST elevation of >1mm in two consecutive limb leads
iii. New onset Left bundle branch block
iv. Posterior MI – ST depression V1-V3
v. ST elevation >1mm in avR with depression in eight or more surface leads may hint at multivessel disease or left mainstem lesions

Patients with features suggestive of an acute STEMI should have primary coronary intervention within 90 minutes. There is no place for chemical fibrinolysis in trauma due to the risk of bleeding from associated injuries.

The lead clinician should be able to make a judgement about whether the treatment of a patient's injuries or the STEMI should take priority, and discuss this accordingly with a cardiology specialist.

Arrhythmias

Patients presenting following a fall or collapse should always have an ECG performed. If an arrhythmia is identified, it is important for the clinician to establish two things:

a. Is this arrhythmia new or old?
b. Is the patient stable or not?

If the arrhythmia is old and the patient was known to suffer from this before the traumatic event, the examiner should enquire about drug history and any medications that may have been used to control the arrhythmia.

If the arrhythmia is new-onset, the examiner should ask whether or not it may have led to a collapse that caused the injury, or whether it may have been a consequence of the injury itself.

In order to answer these questions, the examiner should review the patient's past medical history and perform a full examination to look for any potential causes of sepsis that may lead to arrhythmias such as AF. A baseline venous blood gas should be performed to look for any hypo or hyperkalaemia that can be treated urgently.

Respiratory Disease

Chronic Obstructive Pulmonary Disease / Asthma

A diagnosis of COPD is considered when a patient over 35 years of age with a risk factor (e.g. smoking) develops:

- exertional breathlessness,
- chronic cough,
- regular sputum production
- frequent wheeze.

Airflow obstruction is then confirmed by performing post bronchodilator spirometry.

Most patients with COPD will be using short acting bronchodilators (e.g. salbutamol known as Ventolin; terbutaline known as Bricanyl), and a combination of maintenance therapy depending on their FEV1:

If FEV1 >/= 50% Predicted:
Long acting beta agonist (salmeterol, known as Serevent) or long acting muscarinic antagonist (ipratropium bromide known as Atrovent, tiotropium known as Spiriva)

If FEV1 <50% Predicted:
Long acting beta agonist combined with an inhaled corticosteroid or a long acting muscarinic antagonist

Patients may also be using inhaled corticosteroid therapy (e.g. fluticasone known as Flixotide, beclomethasone known as Clenil, or budesonide known as Pulmicort).

The table below outlines the inhalers that are in common use in the UK and how they can be identified.

Short acting beta agonist		
Salbutamol Terbutaline	Ventolin Bricanyl	Blue colour White & Blue
Long acting beta agonist		
Salmeterol	Serevent	Green colour
Muscarinic antagonist		
Ipratropium Tiotropium	Atrovent Spiriva	
Inhaled corticosteroid		
Beclomethasone Fluticasone Budesonide	Clenil Flixotide Pulmicort	Brown / red Yellow/orange
Combination steroid & beta agonist		
Salmeterol & Fluticasone Formoterol & Budesonide	Seretide Symbicort	Purple

If a patient with COPD presents to the Emergency Department following a traumatic injury, the assessing clinician

should try and establish whether or not they need immediate therapy for their respiratory condition.

Acute breathlessness and wheeze on clinical examination should lead the clinician to prescribe inhaled or nebulised salbutamol in conjunction with oral or parenteral corticosteroids.

All patients should have an arterial blood gas, ECG and Chest X-ray performed and oxygen therapy should be administered and prescribed to target specific oxygen saturations.

If a patient is known to be vulnerable to CO2 retention, saturations should be targeted at 88-92%, otherwise, they can be targeted above 94%.

Patients with a hypercapnic respiratory failure (high PaCO2 >6kPa), in the presence of acidosis pH <7.35 should be considered for NIV therapy if this picture persists after one hour of standard medical therapy.

Some patients use NIV at home or only require its use during extreme acute exacerbations. The following table lists contra-indications to its use:

Contra-Indications to NIV
• Facial burns / trauma / recent facial or upper airway surgery • Vomiting • Fixed upper airway obstruction • Undrained pneumothorax • Upper gastrointestinal surgery • Inability to protect the airway • Copious respiratory secretions • Haemodynamically unstable patient • Confusion / agitation • Bowel obstruction • Patient declines therapy

In the context of trauma, if a patient with COPD develops Type 2 respiratory failure and has an indication for NIV therapy, injuries such as the following will limit its use:

- Intracranial bleeds;
- Significant facial trauma;
- Untreated pneumothoraces

Discussion should be had with critical care teams as early as possible about the need for intubation and mechanical ventilation and whether or not this is a pragmatic approach. Studies have shown that patients with COPD who require mechanical ventilation have a mortality rate above 50%.

HECTOR believes that rush decisions to intubate patients with significant injuries may not be in the patient's best interests if they have significant co-morbidity and a reduced quality of life. All attempts should be made to see if a patient's normal respiratory physician or GP has had a discussion with the patient about the use of mechanical ventilation for their COPD. Patients may have advanced directives or do not resuscitate orders contained within their records.

Diffuse parenchymal lung disease

Elderly patients may suffer from lung disease other than COPD as a result of wider systemic illness. The term "diffuse parenchymal lung disease" incorporates granulomatous disease (e.g. sarcoidosis), disease of known cause (e.g. drug-related, collagen vascular disease-associated), and idiopathic interstitial pneumonias (IIPs).

Idiopathic pulmonary fibrosis is a form of IIP that has an unknown cause or association and is characterised by slowly progressive breathlessness, crackles on chest auscultation in individuals aged >50 years. The long term survival is poor with 20-30% of patients surviving 5 years after

the time of diagnosis.

Other forms of IIP have different prognoses, but most are characterised by progressive scarring of lung tissue. Most patients will develop progressive respiratory failure and the presence of these diseases should also prompt a discussion about pragmatic limits of therapy for patients with significant traumatic injuries.

Idiopathic pulmonary fibrosis has a 5-year prognosis which is slightly better than gastric carcinoma but worse than leukaemia or ovarian carcinoma. It is important for the assessing clinician to be mindful of such conditions when it comes to decision making in the same way that underlying malignancy may affect treatment decisions.

Lower Respiratory Tract Infection / Pneumonia

Elderly patients are vulnerable to community acquired pneumonia and underlying infections may affect balance, mobility and predispose an individual to falls and subsequent trauma.

The presence of consolidation on an X-Ray or fever with associated breathlessness and/or a productive cough should warrant a course of antibiotics in accordance with local policy. The CURB-65 rule[1] is of use in determining an individual's risk:

CURB-65
Confusion of new onset
Urea > 7mmol/L
Respiratory Rate >30 breaths/min
Blood Pressure (systolic <90mmHg; diastolic <60mmHg)
Age 65 or older
Score 1 for each point (maximum 5)

The risk of death at 30 days increases as the score increases. Patients with a score of 4 or more have a 30-day mortality rate of 27.8% and should be considered for high dependency care.

Diabetes

Hypoglycaemia

All elderly patients with a history of diabetes should have a blood glucose evaluated as soon as possible after arrival. Symptoms of hypoglycaemia such as drowsiness, agitation, seizures and reduced GCS can mimic the symptoms of significant head injury. A blood glucose level should be checked in all patients as soon as possible after arrival to hospital.

Elderly patients are more vulnerable to hypoglycaemic attacks, and when these occur, are at increased risk of falls leading to traumatic injuries. Patients with diabetes who have suffered a long lie may be particularly vulnerable to hypoglycaemia and extreme vigilance should be taken with this patient group.

Diabetes UK recommends a practical policy of "make four the floor", whereby any blood glucose level less than 4.0mmol/L warrants treatment.

If possible, a patient should be given 15-20g quick acting carbohydrate (e.g. 90-120ml lucozade, or 3-4 heaped teaspoons of sugar in water), to treat hypoglycaemia. Capillary blood glucose can then be repeated 10-15 minutes later and further carbohydrate given if the glucose level remains below 4mmol/L.

Patients with traumatic injuries may be immobilised, unable to swallow or are being treated under a "nil by mouth" policy. A quick acting carbohydrate might be impractical to administer to treat hypoglycaemia. In such circumstances, 1mg glucagon im or 10% Dextrose iv

(100ml/hr) may be given.

Patients may also present with hypoglycaemia following Addisonian crises. If this is suspected, intravenous hydrocortisone should be administered in addition to controlling the blood glucose.

Hyperosmolar Hyperglycaemia State (HHS)

A precise definition of HHS does not exist but its characteristic features are:

a. Hypovolaemia

b. Hyperglycaemia (>30mmol/L) without significant ketonaemia (<3mmol/L) or acidosis (pH >7.3, HCO_3^- >15mmol/L).

c. Osmolality 320 mosmol/kg or more

HHS may affect elderly patients with type 2 diabetes and develops over many days. The principles of treatment are to:

- Normalise serum osmolality;
- Replace fluid and electrolyte losses;
- Normalise blood glucose.

A diagnosis should be suspected for any elderly patient with diabetes who presents with evidence of hypovolaemia and hyperglycaemia without acidosis or significantly raised ketones.

Once diagnosed, the principles of therapy are to take the following actions:

1. Measure or calculate osmolality to measure the response to treatment:
   ($2Na^+$ + Glucose + Urea)
2. Use intravenous 0.9% sodium chloride solution to reverse dehydration
3. Ensure that the rate of fall of plasma sodium does not exceed 10mmol/L in 24 hours (due to risk of central pontine myolysis)
4. Low dose intravenous insulin (0.05 units/kg/hr) should only be commenced once the blood glucose fails to fall with iv fluids alone, or if there is significant ketonaemia.

The clinical team should aim to consult a specialist with expertise in diabetes for ongoing management. If a patient has significant haemorrhage from underlying injury, the large volumes of fluid needed to correct HHS may interfere with coagulation. In these instances, definitive control of bleeding should take precedence over additional disease states.

Diabetic Ketoacidosis

Diabetic ketoacidosis is a complex disordered metabolic state characterised by hyperglycaemia, acidosis and ketonaemia. It is more likely to affect patients with Type 1 diabetes mellitus, but increasingly there are cases of ketone-prone type 2 diabetes being recognised.

A diagnosis of DKA is made when the following occurs:

Diabetic Ketoacidosis

1. Ketonaemia >3mmol/L or ketonuria (>2+ on standard urine sticks)

2. Blood glucose > 11.0mmol/L or known diabetes mellitus

3. Bicarbonate <15.0mmol/L and/or venous pH <7.3

In the first instance, patients require IV 0.9% sodium chloride solution to be

started followed by fixed rate insulin infusion therapy adjusted for weight (0.1unit/kg/hr). Once this has been started, hourly blood glucose and hourly ketone measurement should suffice but this should be adjusted according to the individual.

In the context of trauma, the management of DKA can occur alongside the management of traumatic injuries. Expert advice should be sought for any elderly patient with features of DKA and significant traumatic injuries.

Renal disease and Haemodialysis

Patients with end-stage renal disease have a complication and mortality rate approximately three times greater than those in the general trauma population. Patients on dialysis who suffer significant traumatic injuries should be cared for in centres with dialysis capability.

Outcomes are generally worse in elderly patients with traumatic injuries who have end-stage renal disease and a patient-centred, pragmatic approach should be taken for any definitive care being considered for this patient group.

Elderly patients with pre-existing renal disease are particularly vulnerable to the nephrotoxic contrast agents used in CT scanning. If a contrast-enhanced CT scan is deemed necessary for such patients, the clinician responsible for overall patient care should make an assessment on the risk-benefits of the scan.

A discussion should be had with the radiologist to determine if the relevant answers to clinical questions can be obtained without the use of contrast, and if not, then steps should be taken after CT-image acquisition to ensure that the patient remains adequately hydrated.

Neurological Disease

Cerebro-vascular Accident (CVA)

More often than not, patients who have suffered a stroke may be alerted to hospitals with the prime emphasis being placed on their neurological state. In such circumstances, pre-hospital teams may not consider additional injuries that a patient may have sustained if the event had caused them to collapse.

Pre-Hospital teams in the United Kingdom will use the “FAST” mnemonic to assess for the risk of stroke (see below):

F Face – face dropped to one side
A Arms – unable to lift arms
S Speech – slurring of speech
T Time – time to access help

Such a mnemonic is useful if a patient has suffered a stroke and might be a candidate for thrombolysis.

The following list contains examples of when thrombolysis might be considered for individuals following ischaemic stroke:

1. No upper age limit if presenting within 3 hours of symptom onset

2. Patients aged 18-80 years can be treated up to 4.5 hours after symptom onset

3. Patients on warfarin can be lysed if INR is 1.7 or less

Patients who have been alerted by pre-hospital teams as being “FAST Positive” should be assessed for the possibility of associated fall and/or collapse. If this is

not present, then the patient can be treated as per standard practice.

If a patient is found to have an acute thrombo-embolic stroke on CT scan but they have additional injuries (e.g. a femoral shaft fracture), thrombolysis should not be given and specialist advice sought about most appropriate therapy.

Transient Ischaemic Attacks (TIA)

Patients with injuries may present following a fall associated with a TIA. These episodes occur when a person suffers a transient episode of neurologic dysfunction caused by ischaemia but without associated infarction.

Patients suffering from these events may still be at risk of stroke after admission and the admitting team may focus on an injury as opposed to the TIA itself. As a simple rule, any patient suspected of having had a TIA should be risk-assessed using the ABCD2 algorithm (see below)[2].

Patients with a score of 4 or more have a 4-8% risk of stroke within 2 days. These patients should all be seen by a specialist team as soon as possible after admission.

ABCD2 Algorithm	
Feature	**Score**
Age (>60 years)	1
Blood Pressure >140/90mmHg	1
Clinical Features	
Unilateral weakness	2
Speech disturbance (no weakness)	1
Duration	
>60 mins	2
10-59 mins	1
Diabetes	1

Infection & Sepsis

General Principles

Any patient of any age can present with sepsis. Elderly patients are particularly vulnerable to infection and the physiological response to trauma can be similar to that seen with infection.

The two can co-exist and any elderly patient with traumatic injuries and underlying fever or hypothermia should be considered as being at risk.

If infection is suspected, a screening tool should be used to clarify the need for antimicrobial therapy. The "Survive Sepsis" campaign has generated a screening tool that ensures early recognition of sepsis and appropriate therapy.

Any two of the following present?
Temperature < 36 or >38oC Heart rate > 90 bpm WCC >12 or <4 x 109/L Respiratory rate > 20/min Acutely altered mental state Hyperglycaemia without diabetes
If yes, patient has SSI
Does patient have history or signs suggestive of infection?
Cough / sputum / chest pain Abdo pain / distension / diarrhoea Line infection Endocarditis Dysuria Headache and neck stiffness Cellulitis / septic arthritis
If yes, patient has Sepsis
Any signs of organ dysfunction
SBP < 90mmHg pr MAP < 65mmHg Urine output < 0.5ml/kg/hr for 2 hrs INR > 1.5 Lactate > 2 New need for oxygen to keep SpO2 >90% Platelets < 100 Creatinine > 177 mmol/L
If yes, patient has Severe Sepsis

On diagnosis of sepsis, the patient should receive the following:

- High-flow oxygen;
- Intravenous antibiotic therapy in accordance with local policy;
- Fluid therapy (0.9% sodium chloride or Hartmann's solution 20ml/kg-60ml/kg).

Summary

- Elderly patients may suffer from multiple complex co-morbidities that can affect either be affected or contribute to the acute traumatic event

- All clinicians responsible for the management of these patients should have a general understanding of common acute conditions and how these should be treated.

- Optimising an individual's illnesses, and/or exacerbation of them, may be required to optimise their overall condition following acute traumatic insults.

- Multidisciplinary input may be required for patients with specialised conditions such as COPD or those with end-stage renal failure on dialysis

- A pragmatic approach should be taken for each individual patient in light of their underlying co-morbidities, quality of life, and expected outcome from their injuries. Definitive care may not be in the patient's best interests for some injuries and in such circumstances, early discussion should be had with the family and their relatives about agreeing the ceilings of care.

References

1. Lim WS, van der Eerden MM et al. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. *Thorax* 2003; 58: 377-382.

2. Galvin R, Geraghty C, Motterlini N et al. Prognostic balue of the ABCD2 clinical prediction rule: a systematic review and meta-analysis. *Fam Pract* 2011; 28(4): 366-76.

Chapter 16: Pharmacological Considerations

Poly-pharmacy is common in the elderly population. With advancing age comes a higher risk of illness and a higher need for medicines to prevent worsening of established conditions. The more medicines a patient takes, the greater the chance of drugs interacting with each other and the greater the effect on an individual's physiology.

Drugs can affect the elderly patient but the elderly patient can also affect how the drugs work. Drug metabolism and renal function are less efficient with advancing age, thus resulting in drugs having a greater and more prolonged effect in the elderly age group.

This Chapter aims to cover the concepts of pharmacokinetics in an attempt to provide a greater appreciation of how drugs that may be given in the acute trauma setting can affect patients.

Pharmacokinetics

Pharmacokinetics relates to what the human body does to a drug, whereas pharmacodynamics is concerned with what the drug does to the body.

The stages of pharmacokinetics are as follows:

A. Absorption from the site of administration
B. Distribution within the body
C. Metabolic alteration
D. Excretion

Absorption

Absorption is the passage of a drug from its site of administration into the plasma. The commonest route of administration in trauma is through intravenous or intraosseous access. Both routes can deliver a very high concentration of drug that travels to the right heart, lungs and systemic circulation.

Distribution

The major compartments in which drugs are distributed are:

- Plasma (5% body weight)
- Interstitial fluid (16% body weight)
- Intracellular fluid (35% body weight)
- Transcellular fluid (2% body weight)
- Fat (20% body weight but varies)

Within each compartment, drug molecules exist in both free solution and bound form and rest in equilibrium across compartments depending on:

i. Permeability across tissue barriers
ii. Binding within compartments
iii. pH partition
iv. Fat:Water partition

Drugs that are protein-bound stay mainly in the plasma, as do lipid-insoluble drugs (which can also enter interstitial fluid). Lipid soluble drugs can reach all compartments and can accumulate in fat, (e.g. thiopentone, phenytoin, ethanol, diazepam)

Accumulation of drugs in fatty tissue can prolong drug action as the tissues release the drug as the plasma concentration decreases. Body composition changes with age with fat contributing a greater proportion to body mass in the elderly. Such groups may therefore experience prolonged effects with drugs such as benzodiazepines or alcohol.

Metabolism

Modification of drug molecules usually diminishes their pharmacological activity and typically occurs via a two stage process. Phase I reactions consist of oxidation, hydrolysis or reduction with the resulting product sometimes being more toxic or reactive than the parent drug.

Phase II reactions involve conjugation and often result in a compound that is inactive and has less lipid solubility so is more likely to remain in the plasma and be cleared by the kidneys.

These Phase I and Phase II reactions mainly take place in the liver by microsomal enzymes. The activity of these enzymes declines slowly with age, thus slowing the metabolism of many drugs. In addition to reduced enzymatic activity, blood flow to the liver and the number of hepatic cells is in decline, thus making the liver less efficient at metabolising medications.

Excretion

The main routes from which drugs are removed from the body are the kidneys, the hepato-biliary system and the lungs.

Most drugs can cross the renal glomerulus freely, although large molecules such as heparin, or those highly bound to plasma protein (e.g. warfarin), can not pass. Many drugs are actively secreted into the renal tubule and are thus excreted rapidly.

Several important drugs are removed predominantly by renal excretion and elderly patients with reduced renal function may be particularly vulnerable to their side effects. Furosemide, atenolol and digoxin are cleared in this way and if not used carefully, can have a profound effect on the individual in higher doses.

Frailty and Drug Metabolism

A wide variation of health / illness exists in the elderly population with different levels of disease and function affecting older people. There is a large difference between a "fit" elderly patient and a "frail" elderly patient.

Many studies refer to frailty in terms of function rather than disease:

"*Persons over 65 years who are not independently mobile and are dependent on others for activities of daily living*"

Studies have demonstrated a decline in the metabolic activity of plasma aspirin esterase with frailty. Esterases are Phase I enzymes which are located in the liver, plasma and brain. Other studies have shown that plasma aspirin esterase levels are reduced in patients with neck of femur fractures.

Trauma in itself, combined with frailty may thus impair the metabolism of drugs like aspirin, thus potentiating its effects and leading to a greater antiplatelet effect. In the context of trauma and traumatic coagulopathy, this may increase an individual's risk of bleeding.

Specific Pharmacological Considerations in Acute Trauma Management

Morphine & Opioids

The pure opioid agonists (morphine, codeine, pethidine etc..) act on different receptors, (μ-, δ-, κ-, σ-), with most having high affinity for μ-receptors. They provide analgesia, euphoria – although the latter

is less pronounced in patients with chronic pain.

Unwanted effects of morphine include:

- Respiratory depression;
- Depression of the cough reflex;
- Nausea and vomiting;
- Reduced gastrointestinal motility & constipation;
- Urinary retention.

Extreme care should be exercised when administering opioids to elderly patients who are opioid-naive or who have reduced renal function. HECTOR recommends slow injection of morphine (1mg/min) and monitoring the response to avoid high plasma concentrations that can lead to greater risk of side effects.

Any development of reduced respiratory rate, low blood pressure, reduced GCS or development of pinpoint pupils following opioid administration should warrant consideration of reversal. This can be achieved by giving intravenous doses of naloxone (400mcg), until a response is seen.

Elderly patients with a reduced cough reflex who have pre-existing lung disease, who are bed bound, or who are lying supine due to spinal trauma, may be more prone to developing basal atelectasis and subsequent lower respiratory tract infection. Opioids should be avoided where possible in these patients and replaced with alternative analgesics.

Patients given high doses of opioids or regular prescriptions of drugs like codeine, may become constipated and be at greater risk of delirium. If opioids are prescribed, patients should be asked on a daily basis about bowel opening and laxatives prescribed if bowel habit becomes sluggish.

Non-Steroidal Anti-Inflammatory Drugs

NSAIDs include a variety of different agents from different chemical groups. Most have three specific types of effect:

- Analgesia
- Anti-inflammatory
- Antipyretic

Most NSAIDs act by inhibiting arachidonic acid cyclo-oxygenase and reduced prostanoid synthesis. Nearly 25% of all reported adverse drug reactions in the UK are due to NSAIDs, with agents causing side effects in the gastro-intestinal tract, liver, kidney and spleen.

If used for elderly patients with acute traumatic injuries, NSAIDs can cause dyspepsia, and lead to an increased risk of GI bleeding. NSAIDs inhibit the synthesis of prostaglandins that normally reduce gastric acid secretion, and modulate gastric mucosa blood flow. Proton pump inhibitors (omeprazole, lansoprazole), are good agents to limit these unwanted effects by reducing gastric acid secretion.

NSAIDs reduce prostacyclin production thereby depressing renal and aldosterone secretion, which may cause the following to occur:

a. Acute ischaemic renal failure
b. Sodium retention
c. Water retention
d. Hyperkalaemia

Patients on long-term NSAIDs who are admitted to hospital following an acute traumatic event should have their renal function monitored on a regular basis to detect any acute deterioration in function.

Benzodiazepines

Benzodiazepines may be used for procedural sedation (midazolam), or taken by patients with acute anxiety or agitation (oral lorazepam, diazepam). They are lipophillic compounds and are distributed throughout all body components. Benzodiazepines cause reduced anxiety and aggression; sedation; muscle relaxation; and suppression of convulsions.

With advancing age and a higher proportion of body fat to muscle mass, benzodiazepines may be stored in fatty tissue and slowly released as plasma levels fall. This may prolong the effects of these agents and lead to increased levels of sedation.

Benzodiazepines should be used with extreme caution in the elderly population and if given intravenously, should be given very slowly, administering subsequent boluses to reach the desired effect. It may be advisable to wait a few minutes between successive 1mg boluses of midazolam for fear of causing unwanted toxic effects.

Flumazenil is a reversal agent which is available but HECTOR recommends that this should not be given unless in a life-saving situation. Flumazenil lowers the seizure threshold and may predispose an individual to convulsions – furthermore, its action only lasts two hours so drowsiness can return in acute benzodiazepine overdose.

In excessive benzodiazepine-induced sedation, supportive cardio-respiratory measures should be initiated prior to the administration of flumazenil. It may be preferable to manage patients conservatively or with ventilator support than reverse the benzodiazepine. These patients may be at an increased risk of delirium once the drug effects have worn off so should be monitored closely in high visibility areas.

β-Blockers

These drugs are commonly used in elderly patients and their main unwanted effects are a consequence of their action on β_1 and β_2 receptors. They can cause effects such as:

- Unwanted bronchoconstriction;
- Physical fatigue leaving an individual prone to falls;
- Concealing the sympathetic warning signs of hypoglycaemia.

Careful attention should be paid to the elderly patient who presents following a fall and has a history of diabetes and is taking medications such as atenolol or bisoprolol. All these patients need close monitoring of blood glucose to detect falling levels.

By blocking the β_1 receptor, these drugs lead to a reduced resting heart rate. In the context of trauma and major haemorrhage, elderly patients on β-blockers may not exhibit the associated tachycardia that accompanies fluid loss, thus rendering vital signs on unreliable indicator of shock.

Elderly patients who take beta-blocker medication warrant close observation and careful assessment for the possibility of occult injury. In such patients, a raised lactate (>2.5) or base deficit may be one of the only indicators of haemorrhage in trauma so close attention should be paid to these patients with high mechanisms of injury and a low threshold be taken for Whole Body CT.

Warfarin and Novel Anticoagulants

Warfarin and other anticoagulants have been covered in Chapter 3. Any patient with a history of trauma on these medications is at high risk of bleeding, especially if clotting profiles are deranged. Low-energy mechanisms such as fall from standing can have a profound effect on internal organs and a low threshold should be taken for CT-image acquisition.

Patients are particularly at risk of intracranial haemorrhage, splenic injury, retroperitoneal bleeding and haemorrhage from fracture sites. Any patient with a raised INR / clotting and any of these injuries should have their clotting reversed as soon as possible whilst definitive treatment is being coordinated.

Steroids

Elderly patients may be taking mineralo- or gluco-corticoids (fludrocortisone, prednisolone) as part of their regular medications. These drugs are commonly prescribed for anti-inflammatory or immunosuppressive purposes (see below), and may suppress the body's response to illness or injury.

Anti-Inflammatory / Immunosuppression
Asthma or COPD Hypersensitivity states Autoimmune and inflammatory diseases (e.g. rheumatoid arthritis; inflammatory bowel disease etc..) Post organ transplantation
Replacement Therapy
For patients with adrenal insufficiency or failure
Neoplastic Disease
To reduce cerebral oedema in patients with metastatic or primary brain tumours In combination with cytotoxic agents for ALL / Hodgkin's disease

Unwanted effects of steroids include thinning of the skin, leaving it vulnerable to injury and poor healing. If a patient has been taking steroids and has them suddenly withdrawn, this can result in adrenal insufficiency. Patients on long-term steroids should continue these where possible following acute traumatic injury.

Long-term steroid use can also predispose an individual to osteoporosis and muscle weakness/wasting, rendering them at increased risk of fragility fractures following simple falls.

Specific Illnesses and Important Drug Considerations

Parkinson's Disease

Missing doses of Parkinson's medication can cause serious complications, such as the neuroleptic-like malignant syndrome. Any patient who presents with an acute traumatic injury and takes regular Parkinson's medications should have these delivered at the same dose and at the same time where possible.

Neuroleptic malignant syndrome is characterised by altered consciousness, fever, autonomic instability, elevated creatine kinase and extrapyramidal signs. Withdrawal of levodopa therapy can precipitate this syndrome. It is thought to occur by central D2 receptor blockade or dopamine depletion. In addition to withdrawal of levodopa, the administration of drugs like: haloperidol; prochlorperazine; and metoclopramide can precipitate this syndrome by blockade of dopamine / serotonin pathways.

If patients are unable to take their anti-Parkinsonian medication orally, levodopa

can be administered via NG feeding as it is absorbed by the jejunum. Co-beneldopa (madopar) is available in dispersible form and can be used as an alternative to co-careldopa +/- entacapone where oral feeding is not possible. For patients taking oral dopamine agonists (e.g. ropinirole, pramipexole), rotigotine patches are available and if needed, advice should be sought from a specialist before administration.

Addison's Disease

Trauma may precipitate an Addisonian crisis in patients with an underlying adrenocortical insufficiency. The trauma itself can lead to adrenal failure and/or adrenal haemorrhage. Patients may present with any of the following features below as a cause of the trauma or a consequence of it, (e.g. a patient collapses with postural hypotension and sustains a cervical spine injury).

1. Hypotension and CVS collapse
2. Postural Hypotension
3. Nausea and vomiting
4. Hyponatraemia
5. Diarrhoea
6. Confusion
7. Hyperkalaemia
8. Hypoglycaemia
9. Metabolic acidosis

Treatment is often required before the diagnosis is confirmed and involves the administration of iv dextrose for hypoglycaemia, iv fluid resuscitation for shock and either iv dexamethasone or hydrocortisone for the adrenal insufficiency.

Polypharmacy and Review of Medications

Polypharmacy is the use of multiple medications by a patient, and normally consists of a patient taking four or more different medicines. Polypharmacy can be appropriate for some patients and inappropriate for others, leaving them at risk of falls and subsequent injury.

It may be a result of ill-considered prescribing or multiple prescribers for the same patient working independently of each other. The more drugs a person takes, the greater the risk of interactions and unwanted side effects.

The agents most commonly associated with adverse reactions include cardiovascular agents, antibiotics, diuretics, anticoagulants and hypoglycaemics amongst others.

Elderly patients should ideally have their medications reviewed by a pharmacist or elderly care physician soon after hospital admission. Different strategies exist for managing polypharmacy such as the Beer's Criteria and STOPP/START criteria[1].

Beer's Criteria for Potentially Inappropriate Medication Use in Older Adults

The Beers Criteria from the American Geriatrics Society lists the types of drugs to avoid or use in specific circumstances against the class of drug and underlying disease or syndrome.

It is of use as a reference guide for teams to decide if certain medications can be stopped in light of the clinical presentation and underlying state of the patient. Table 1 lists some of the recommendations given for specific disease states / syndromes

Disease or Syndrome	Drug(s)	Recommendation
Syncope	ACEIs Alpha blockers (doxazosin) Chlorpromazine, olanzapine	Avoid Increases risk of orthostatic hypotension
Delirium	All TCAs Anticholinergics Benzodiazepines Corticosteroids H2-receptor antagonist	Avoid Avoid in older adults with or at risk of delirium; if discontinuing drugs used chronically, taper to avoid withdrawal symptoms
Dementia	Anticholinergics Benzodiazepines Antipsychotics	Avoid Avoid antipsychotics for behavioural problems of dementia unless non-pharmacological options have failed. Antipsychotics are associated with increased risk of stroke and mortality
History of falls or fractures	Anticonvulsants Antipsychotics Benzodiazepines TCAs/SSRIs	Avoid unless safer alternatives are not available; avoid anticonvulsants except for seizures Ability to produce ataxiq, impaired psychomotor function, syncope
Parkinson's disease	All antipsychotics Metoclopramide Prochlorperazine	Avoid Dopamine receptor antagonists with potential to worsen parkinsonian symptoms
Chronic kidney disease stage IV	NSAIDS	Avoid

Drug	Recommendation
Aspirin	Use with caution in adults >80 years old Lack of evidence of benefit vs risk in patients > 80
Dabigatran	Use with caution in adults > 75 years old or with GFR < 30 mL/min Increased risk of bleeding when compared to warfarin
Prasugel	Use with caution in adults > 75 years old
Antipsychotics Carbamazepine SSRIs TCAs	Use with caution Can precipitate SIADH or hyponatraemia

The STOPP / START Toolkit

This toolkit serves as a guide to ensure appropriate medications are prescribed and inappropriate ones are stopped for elderly patients. It reviews specific systems and the medications acting on those systems, and makes recommendations on adjustments.

STOPP (Screening Tool of Older People's Potentially Inappropriate Prescriptions) and START (Screening Tool to Alert Doctors to Right Treatments) can be performed by clinicians or pharmacists.

STOPP (Potentially Inappropriate)	START (For Consideration)
Gastrointestinal System	
Loperamide, codeine phosphate -For diarrhoea of unknown cause -For treatment of severe infective gastroenteritis **Prochlorperazine or Metoclopramide** -With Parkinsonism **Proton pump inhibitor at treatment dose** -For peptic ulcer disease for > 8 weeks **Anticholinergic antispasmodic drugs** -With chronic constipation	**Proton Pump Inhibitor** With severe GORD or peptic stricture needing dilatation **Fibre supplement** For chronic, symptomatic diverticular disease with constipation
Cardiovascular System	
Digoxin -At long term dose of >125mcg/day with GFR < 50ml/min **Loop diuretic** -For dependent ankle oedema only and no other signs of heart failure -As first line therapy for hypertension **Thiazide diuretic** -With a history of gout **Beta-blocker** -In combination with verapamil -With COPD **Calcium channel blocker** -With chronic constipation -Use of diltiazem or verapamil with NYHA Class III or IV failure -Fall in last three months **Aspirin** -history of peptic ulcer disease without PPI or H2 receptor antagonist -at dose > 150mg/day -no history of coronary, cerebral or arterial symptoms -with concurrent bleeding disorder **Warfarin** -for first uncomplicated DVT of longer than 6 months duration -for first uncomplicated PE > 12months duration -with concurrent bleeding disorder -use of aspirin and warfarin without gastroprotection **Clopidogrel** -with concurrent bleeding disorder **Dipyridamole** -as monotherapy for secondary cardiovascular prevention -with concurrent bleeding disorder	**Warfarin** -in the presence of chronic atrial fibrillation **Aspirin** -in presence of chronic atrial fibrillation where warfarin is contra-indicated -atherosclerotic coronary disease in patients with sinus rhythm **Clopidogrel** -documented history of ischaemic stroke or peripheral vascular disease **Antihypertensives** -where systolic blood pressure is > 160mmHg **Statins** -History of coronary, cerebral or peripheral vascular disease where functional status is independent for activities of daily living and life expectancy is > 5 years **ACE-Inhibitors** -following acute myocardial infarction **Beta-Blockers** -with chronic stable angina

Summary

- Elderly patients with acute traumatic injuries may be taking a large variety of medications for underlying illness
- It is important to understand the general principles behind drug distribution, metabolism and clearance that may affect how drugs prescribed in the acute setting impact on an elderly patient
- Drugs such as morphine and benzodiazepines should be used with caution, especially in patients with

reduced renal function and those who are naive to these groups of medication

- Beta-blockade may inhibit the cardiovascular response to haemorrhagic shock so additional signs of occult hypoperfusion should be sought in high-energy mechanisms

- Patients with Parkinson's disease should continue their dopaminergic medications as soon as possible after injury to prevent neuroleptic malignant syndrome

- After admission, all elderly patients should have their medicines reviewed to manage unnecessary polypharmacy and associated unwanted effects that could precipitate delirium

References

1. Hamilton H, Gallagher P, Ryan C et al. Potentially inappropriate medications defined by STOPP criteria and the risk of adverse drug events in older hospitalised patients. *Arch Int Med* 2011; 171(11): 1013-1019.

With special thanks to a main contributor of this chapter, Dr Niall Fergusson Elderly Care Consultant Heart of England NHS Foundation Trust.

PART IV – ONGOING CARE AND RECOVERY

Chapter 17: The HECTOR Daily Assessment

Introduction

A patient's journey to recovery does not finish when they leave the Emergency Department, Theatre or Critical Care Unit. The provision of ongoing, quality care is essential to prevent the complications associated with injury and hospital admission itself.

If patients' are labelled as suffering from specific injuries such as, "*Mrs Smith has a peg fracture and is on bed rest*", this neglects the basic elements of care upon which the foundations of recovery need to be built.

The Constitution of the World Health Organisation (WHO) states that good health is:

"...a state of complete physical, social and mental well-being and not merely the absence of disease or infirmity."[1]

Elderly patients may suffer from co-morbidities and the acquisition of injuries places a greater burden on health. These patients will need basic, fundamental aspects of health care provision to prevent a worsening state of health.

These basic fundamentals of care include:

- Adequate hydration and access to water / fluids;
- Proper nutrition;
- Comfortable mattresses and clean, dry blankets and bed-sheets;
- Pain relief and regular assessment of the causes of discomfort;
- Appropriate facilities or support for toileting;
- Regular clinical assessment to review progress or deterioration.

It is important that all members of staff have an appreciation in managing common frailty syndromes such as confusion, falls and polypharmacy as well as issues like safeguarding in older patients.

The "Silver Book" or "Quality Care for Older People with Urgent & Emergency Care Needs" document[2] defines the underpinning principles for acute care in elderly patients. Part of these principles involves the routine assessment of the following:

Issue to Address
• Pain
• Depression
• Skin Integrity
• Falls and mobility
• Continence
• Safeguarding issues
• Delirium and dementia
• Nutrition and hydration
• Sensory loss
• Activities of daily living
• Vital signs
• End of life care issues

These issues are covered in the primary, secondary and silver surveys conducted in the acute stages of care, and are assessed on a daily basis via the HECTOR Daily Assessment Tool.

HECTOR Daily Assessment Tool

Concept & Design

The HECTOR Daily Assessment tool is designed to be included in the patient's records with the sheet being completed every day by the Clinical and Nursing teams. It requires multidisciplinary collaboration to ensure that all fields of concern are addressed. The tool ensures that areas which would be considered as being "Nursing" in the traditional sense

are held in equal importance to areas considered "Medical".

Insert Patient Sticker

DAILY ASSESSMENT

Date:

Assessing Clinician:

Consultant:

H	HYDRATION	Est/Actual Input: Est/Actual Output: Est Fluid Balance:	Date of Last U&E: Na+ Urea K+ Creatinine GFR
E	EATING & TOILETING	Diet (circle): NBM pre-op Soft Solid Fluid Only If NBM, date when this was instituted: Nursing Concerns about Intake: Last Bowel Opening:	
C	COMFORT & CONFUSION	Pain: Y / N Site of Pain: Severity of Pain: Mild Mod Severe Analgesia Prescribed: Y / N	AMT (1 point each) Year Place Age Birthday If AMT <4 is this: old new
T	THROMBO-EMBOLISM	VTE Prophylaxis (circle): TEDS Anticoagulant None Calf Assessment (circle): soft/normal swollen red	
O	OCCULT INJURY & ILLNESS	BP: RR: HR: O2 sats: Temp: MEWS:	RS: CVS: GIT: NEURO: SKIN (pressure areas):
R	RECOVERY	Has Anything Worsened since yesterday? If so, document: Targeted Discharge Destination: Home Residential Nursing Other	

The HECTOR Daily Assessment Tool

Structure

The tool ensures that the fields of care that could lead to the development of complications are addressed on a daily basis. It requires collaboration between Medical and Nursing staff to identify issues and act upon them as they are found.

Some centres may have access to Ortho-geriatricians who could be used to "troubleshoot" issues and advise on management strategies. Alternatively, the tool can be used as a guide and a way of developing teams' experience in the provision of elderly care.

H – HYDRATION

Monitoring of Input / Output

This section ensures that teams keep a note of a patient's urine output, fluid intake and renal function. Measurement of urea and electrolytes need not be taken each day, but the team need to be aware of when the last measurements were taken to assess for change.

If patients have injuries that require operative fixation, they may be kept on strict nil by mouth regimes. Cancellations to theatre or excessive delays could lead to prolonged periods without hydration and subsequent renal impairment. This can be pre-empted by reviewing daily input.

Fluid input may follow the enteral or intravenous route and be determined by the underlying state of the individual. Patients who have suffered from stroke may have failed a SALT assessment and be in need of NG or intravenous fluid input.

Urine output is an indicator of perfusion of the vital organs. Reduced urine output could be a feature of pre-renal, renal or obstructive "post-renal" disease. Patients on bed-rest who have been given opioid analgesia and develop constipation could be at risk of acute retention of urine and be in need of urethral catheterisation.

If urine output is less than 0.5mls/kg/hr, the team should ask the following questions:

1. Is the patient having enough fluid?

2. Are there any sources of fluid loss / hypovolaemia (e.g. ongoing bleeding, sepsis)?

3. Are there any signs or symptoms suggestive of acute retention of urine?

Patients with acute retention of urine and delirium / dementia may not be able to communicate about levels of discomfort. Clinical examination of the abdomen may reveal a tense mass in the suprapubic area which is dull to percussion.

The presence of a large, distended bladder may be confirmed by ultrasound or the use of a bladder scanner, but if not available, urinary catheterisation should be performed to decompress the bladder.

In such circumstances, urine should be tested for evidence of infection (dipstick and/or MC&S), residual volume of urine drainage should be documented and the cause for retention should be sought (e.g. rectal examination for faecal loading, review of drug chart for opioid analgesia etc..)

Urea & Electrolytes

It is not necessary to check the urea and electrolyte levels each day, but the following situations may prompt testing:

i. Oliguria (urine output less than 0.5ml/kg/hour)

ii. Hypovolaemia

iii. Symptoms or history of urological obstruction

iv. Sepsis

v. Severe diarrhoea

vi. Deteriorating early warning score

vii. Hypotension

viii. Recent Use of iodinated contrast agents

ix. Use of drugs with nephrotoxic potential (e.g. NSAIDs, aminoglycosides, ACE-I, diuretics)

Results should be compared to baseline levels for urea and creatinine, (as taken on admission), and also compared to any historical results that may suggest the presence of chronic renal impairment.

Acute Kidney Injury

Acute kidney injury can be defined by using any of the following criteria:

- **A rise in serum creatinine of 26micromol/litre or greater within 48 hours**
- **A 50% or greater rise in serum creatinine within the past seven days**
- **A fall in urine output <0.5ml/kg/hour for more than 6 hours**

Elderly patients with traumatic injuries may be at risk of developing acute renal impairment, especially if they have any of the following risk factors:

- History of diabetes
- History of heart failure
- Liver disease
- Use of drugs with nephrotoxic potential in the per-operative period (e.g. NSAIDs after surgery)
- Use of iodinated contrast with pre-existing chronic kidney disease (eGFR < 40) or in patients aged over 75 years, or those with a renal transplant

Patients with risk factors for acute kidney injury and who have been given iodinated contrast agents (see above), should be given intravenous crystalloid volume expansion and the clinician should consider stopping any nephrotoxic agents on a temporary basis.

Symptoms / Signs that May Suggest Acute Kidney Injury
• Malaise • Confusion • Seizures • Coma • Nausea • Vomiting • Anorexia

Management of Patients with Acute Kidney Injury

Identify and Manage the Cause:

There are multiple reasons why patients develop acute kidney injury after hospital admission. Pre-renal causes such as hypotension and shock should be managed in accordance with the exact cause (e.g. antibiotics and iv fluids for sepsis; transfusion for ongoing haemorrhage).

Post-renal or obstructive causes should be managed by relieving the obstruction. Renal causes may be harder to diagnose and may require early input from a nephrologist (e.g. acute tubular necrosis secondary to: ischaemia from hypotension; sepsis; myoglobin excess / rhabdomyolysis; nephrotoxic agents).

Relieving Urological Obstruction:

If patients develop fever, loin pain and rigors, pyonephrosis should be suspected. In such circumstances, CT or ultrasound imaging should be performed as soon as possible to identify any source of obstruction.

Patients with acute kidney injury secondary to urine retention or nephrolithiasis should be referred to Urology teams for urgent review.

Pharmacological Management:

Loop diuretics (e.g. furosemide) should be considered for treating fluid overload or oedema. Patients with pulmonary oedema may need additional oxygen therapy and if either medication is needed, urgent review by the Nephrology team should be arranged.

Referral for Renal Replacement Therapy:

Patients should be referred to the nephrology and critical care specialists if any of the following complications are not responding to medical management:

a. Hyperkalaemia
b. Metabolic acidosis
c. Complications of uraemia (e.g encephalopathy)
d. Fluid overload / pulmonary oedema

Any decision to initiate renal replacement therapy should be taken in conjunction with the patient and their family and may not be appropriate for some patients.

Hyperkalaemia

Extracellular potassium is regulated between 3.5 – 5.0 mmol/L. As potassium concentration increases, the risk of serious consequences increases and urgent treatment is needed. Levels above >5.5mmol/L should be treated.

Other than blood tests, hyperkalaemia may be recognised on an ECG with the following changes:

ECG Changes with Hyperkalaemia
• First degree heart block • Flattening of p-waves • Tall, tented T-waves • ST-segment depression • Widened QRS (>0.12s) • Bradycardia • Ventricular tachycardia • S and T wave merging

Management of hyperkalaemia should focus on reverting potassium concentration back to acceptable levels and treating the underlying cause. The following table provides treatment recommendations for different levels of severity:

Mild Elevation (5.5 – 5.9 mmol/L)
• Potassium exchange resins (calcium resonium 15-30g) • Diuretics (slow IV furosemide 1mg/kg)
Moderate Elevation (6 - 6.4 mmol/L)
• Use strategies for mild elevation • 10 - 15 units insulin actrapid in 50mls 50% dextrose over 15 – 30 mins
Severe Elevation (>6.5 mmol/L)
• Use strategies for moderate elevation • Salbutamol 5mg nebulised • 50mL 8.4% sodium bicarbonate if metabolic acidosis is present (contact critical care / nephrology teams)
Severe Elevation with Toxic ECG Changes
• Use strategies for severe elevation

- 10mL 10% calcium chloride over 2-5 mins
- Critical Care & Nephrology Review Immediately

Hyponatraemia

Hyponatraemia can be common in the elderly population, especially in those patients taking diuretic medication. It is usually asymptomatic but in the context of trauma, may signify underlying occult injury. Changes in sodium concentration are likely to be detected after measuring urea and electrolytes and it is important for the relevant clinician to know how to manage any change.

Patients with a serum Na^+ </= 120mmol/L may be asymptomatic or could develop restlessness, confusion and irritability. All these features could potentially hinder an individual's recovery and cooperation with their targeted physiotherapy programme. When Na^+ approaches 110mmol/L, seizures and coma can develop, with an associated increase in mortality.

Assessment

Patients should be assessed with close attention paid to extracellular volume:

- Is the JVP elevated or low?
- Check supine and sitting or standing blood pressure to look for orthostatic hypotension
- Look for signs of excessive extracellular fluid (ascites, pulmonary oedema; sacral / lower limb oedema)
- Increased skin turgor with tenting for >1sec after pinching is indicative of low extra-cellular volume.

Patients with volume depletion will benefit from intravenous fluids, but those with SIADH (syndrome of inappropriate ADH secretion), are likely to need fluid restriction 800-1000mL/24hrs

Causes of Hyponatraemia

Hyponatraemia may be caused by reduced extracellular volume, or may occur with normal to increased extracellular volume in certain circumstances. In the context of trauma and head injury, a low Na+ may be a consequence of SIADH secondary to an expanding intracranial haematoma that was not identified on admission. In these situations, investigations such as CT Head would be appropriate to identify the underlying root cause.

Decreased Extracellular Volume
Diuretics
Addison's disease
Non-renal / GI losses
Burns
Normal – Mildly Increased Extracellular Volume
SIADH
CNS – Trauma; SAH; Malignancy; Infection
Malignancy – Lung; Pancreas; Prostate; Leukaemia / Lymphoma
Pulmonary
Drugs
Opiates; haloperidol; amitryptiline; carbamazepine
Increased Extracellular Volume
Congestive Cardiac Failure
Severe renal impairment
Cirrhosis and ascites
Nephrotic syndrome

Correction of hyponatraemia should be gradual and avoid volume overload as rapid correction could cause central pontine myelinolysis.

Patients with increased extracellular volume caused by cirrhosis and ascites

should be treated with water-restriction before considering diuretic medication.

If there is any doubt about the underlying cause for hyponatraemia, help should be sought by an endocrinology specialist or orthogeriatrician to guide future management.

E – EATING & TOILETING

With the assessment of a patient's hydration status, clinicians aim to identify that input is good enough to maintain an adequate urine output. In a similar sense, nutritional input can be considered at the same time as faecal output.

Elderly patients have similar nutritional requirements to younger patients, although their energy expenditure is less. The basal metabolic rate (BMR) in older patients is generally reduced owing to a fall in the fat-free mass, although the reverse may also be true for the BMR in patients with underlying malignancy.

On arrival to hospital, some patients may have problems with nutrition due to many factors such as:

- Dental problems;
- Lack of cooking skills (particularly in widowers);
- Depression;
- Financial restraints;
- Lack of motivation.

Malnutrition may be worsened by prolonged periods of being "nil by mouth" caused by delayed or cancelled operations.

It is important for clinical teams to ensure that patients are not only having regular meals on the wards (which includes assistance to eat meals if required), but also to monitor for signs of malnutrition in order to identify underlying illness or the need for expert advice from a nutritionist.

Conditions Associated with Energy Malnutrition

In circumstances of low dietary intake, the body is dependent on the breakdown of hepatic glycogen to glucose for energy. Once these stores are depleted, gluconeogenesis occurs from lactate, pyruvate, glycerol and amino acids.

Patients with underlying disease may be vulnerable to malnutrition from:

- Increased catabolism (e.g. sepsis);
- Tumour necrosis factor (e.g malignancy);
- Anorexia associated with disease states;
- Malabsorption.

Patients with traumatic injuries have a rise in glucocorticoid and catecholamine levels and an increased release of cytokines.

All of these contribute towards stimulating the ubiquitin - proteasome pathway which leads to enhanced proteolysis in skeletal muscle. This increases the rate of muscle breakdown and can lead to reduced strength and the need for longer periods of rehabilitation.

Disease States / Causes of Malnutrition	
Sepsis;	Trauma;
GI Tract Surgery;	GI disease;
Malignancy;	Dementia;
Depression;	Anorexia

Vitamin Deficiency

Elderly patients may suffer from deficiency of important vitamins. Patients

with alcohol dependency will be prone to thiamine deficiency, institutionalised patients (e.g. from Nursing Homes), or those with a poor diet may suffer from vitamin D deficiency.

Thiamine – an essential co-factor in carbohydrate metabolism. Patients with deficiency can present with polyneuropathy or Wernicke-Korsakoff syndrome. Either state can be a precipitant for a fall and subsequent traumatic injury. Patients should receive supplementation with iv Pabrinex or an equivalent.

Vitamin D - this is produced in the skin by sunlight photoactivation of 7-dehysrocholesterol. Deficiency usually results from lack of sunlight as opposed to dietary insufficiency. Vitamin D is needed to increase calcium absorption from the gastrointestinal tract.

Assessment of Dietary Intake

During the daily assessment, clinical teams should work alongside Nursing staff to document an individual's daily dietary intake. In addition to asking the patients about their intake, the team should aim to look for features that may hinder input. Poor dentition, oral candidiasis, increasing levels of confusion or evolving illness should be considered.

If there are any concerns that a patient is losing weight, Nursing teams should endeavour to record the patient's weight on a regular basis. Ongoing weight loss should trigger the need for clinical assessment and review by a nutritionist. Patients may be in need of dietary supplementation (e.g. Fortijuice, Fortisips etc..)

Toileting

The daily assessment should address the patient's bowel habits in order to identify any significant changes. Clinical teams should aim to assess what is normal for the patient at the point of admission, and observe for any change.

Nursing staff should keep stool charts that document stool frequency and the nature of stool production, such as described by the Bristol Stool Chart[3].

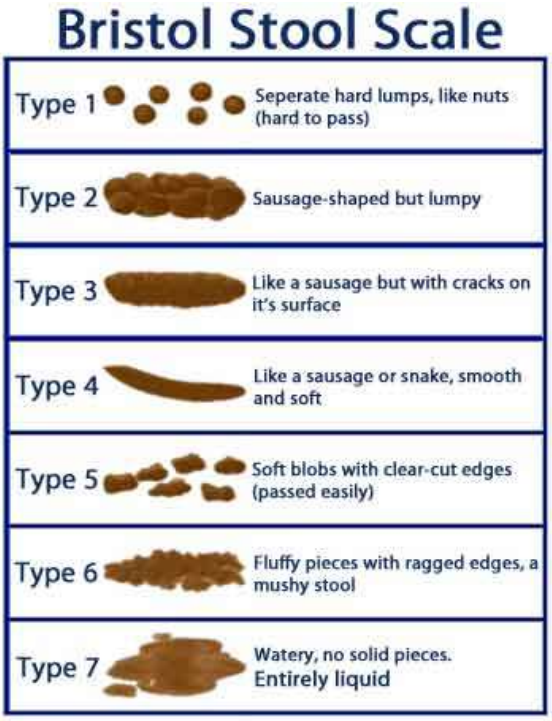
Constipation

Constipation will take different forms for different people. Some consider the passage of hard, painful pellets as being indicative of constipation others will perceive constipation as being unable to open the bowels for a few days.

Elderly patients are particularly vulnerable, especially in the presence of reduced mobility, altered diet, depression, and opiate use. It can lead to delirium in this age group, thus leading to increased mortality and morbidity.

If a patient has failed to open their bowels for a few days, or they pass hard, pellet-like stool, they should be examined for abdominal discomfort and a rectal examination should be performed.

Absolute constipation, defined as an inability to pass faeces or flatus, may be an early feature of large bowel obstruction or a late feature of small bowel obstruction. Patients with such a history in the presence of abdominal distension and / or vomiting should have an abdominal X-Ray to assess for acute obstruction.



Drug charts should be reviewed to assess for any medications that may contribute towards constipation and which may be stopped. Opiate and opioid analgesia (including codeine phosphate and its preparation with paracetamol), should be avoided where possible, or if needed, used at its lowest dose and titrated to pain.

Medications Associated with Constipation
• Anticholinergics • Antidepressants • Antihistamines • Calcium channel blockers • Diuretics • Iron / Ferrous sulphate • Opioids • Sympathomimetics • Levodopa (should not be stopped)

Osmotic laxatives (polyethylene glycol, lactulose), have the strongest supporting data for managing constipation in elderly populations, although sodium docusate is commonly used as a stool softener.

Hard faeces or a full rectum on digital rectal examination may respond to treatment such as glycerine suppositories or enemas, (e.g. Microlax – sodium citrate and sodium lauryl sulphoacetate).

Diarrhoea

Diarrhoea occurs when there is an increase in stool weight to greater than 300g per day, although it commonly is referred to as representing increased bowel opening and/or the passage of loose, watery stool.

Patients developing diarrhoea should have urea and electrolyte levels checked to monitor its impact on renal function and electrolytes such as potassium. Stool cultures should be sent for MC+S and patients should be isolated in side rooms with full reverse barrier nursing.

Recent use of antibiotics can lead to diarrhoea and abdominal cramps caused by pseudomembranous colitis. In the hospital setting, screening is needed for *Clostridium difficile* and its associated toxins. All antibiotics should be stopped and if *C. difficile* is confirmed, advice should be sought from the duty microbiologist about the need to prescribe metronidazole or intravenous vancomycin.

C – COMFORT & CONFUSION

All patients should be asked about levels of comfort or discomfort on a regular basis. Patients being admitted for management of traumatic injuries are likely to suffer from pain and therefore be at risk of delirium.

Patients with pre-existing dementia or confusional states may not be able to communicate their experience of pain with teams. In these circumstances, the

Abbey Pain Scale may be used and should be accessible to all ward staff[4].

Management of Pain

Chronic pain affects between 20-50% of elderly people and some patients will be on long-term analgesic regimes before they arrive at hospital (e.g. MST, fentanyl patch).

Additional injuries may require greater levels of analgesia and upset this regime. In these circumstances, the clinician needs to be aware of the practicalities of making changes to long-term pain management strategies.

In general terms, management of pain starts with an appropriate assessment of new injuries, (including the diagnosis of all injuries on secondary survey) and an assessment of long-standing conditions (e.g. back pain). Clinicians should aim to identify previous / current analgesic use and any adverse effects from medications.

Patients should be prescribed regular analgesia, rather than waiting for pain to break through. Paracetamol is an effective analgesic agent in most cases and is used as a starting point for the "analgesic stepladder".

Care should be taken for elderly patients with low body mass index and paracetamol dosing may need to be reduced to prevent toxic hepatic injury.

Opioids are effective agents for nociceptive pain, with low-dose codeine being an acceptable starting point. Consideration should be given to prescribing concomitant laxatives to prevent constipation.

The use of intravenous opioids should be restricted and controlled by slowly titrating as low a dose as possible to achieve the desired response. Pre-existing renal impairment may lead to a toxic accumulation and subsequent respiratory and depression.

Patients needing repeated doses of morphine may benefit from the prescription of fentanyl patches as an alternative agent. In these situations, the following patches can be used against daily morphine requirements:

Morphine Salt / 24hr	Fentanyl Patch
45mg	12
90mg	25
180mg	50
270mg	75
360mg	100

Elderly patients should avoid being given NSAIDs where possible. Patients being admitted with traumatic injuries may be at risk of contrast-induced nephropathy; hypovolaemic states etc.. all of which may contribute to worsening renal function in the presence of NSAIDs.

Confusion

On admission to hospital, patients may or may not have pre-existing levels of confusion or dementia. The Silver Survey uses a shortened version of the Abbreviated Mental Test (AMT4) as a means of establishing a baseline level of confusion / orientation.

This has been suggested as a means of providing an easy-to-use and pragmatic method of measuring cognition at the time of initial attendance.

AMT4	
1.	Age
2.	Date of Birth
3.	Place
4.	Year

This is easy to use but is a non-validated way of assessing for delirium after admission. The daily HECTOR assessment also uses this tool and if there is any deviation away from baseline, should lead the team to consider the possibility of occult injury or illness. If AMT4 score has changed from the one recorded on arrival, the clinical team should use the CAM-ICU screening tool to detect delirium.

The CAM-ICU tool incorporates the Richmond Agitated Sedation Scale (RASS) and is divided into four parts[5]:

1. acute onset or fluctuating course;
2. inattention;
3. altered level of consciousness;
4. disorganised thinking.

Patients are deemed CAM-ICU positive, meaning that delirium is present, if features 1. *and* 2. *and* either 3. *or* 4. are present. The onset of delirium should trigger a formal head-to-toe assessment looking at all systems, observations and investigations to determine any underlying organic cause. If delirium persists despite managing supposed causes, the opinion of an elderly care specialist should be sought to determine the presence of dementia or unrecognised illness.

Other screening tools for dementia exist such as the 6 Item Cognitive Impairment Test (6CIT) and Mini-Mental State Examination (MMSE), although the former is validated for a primary care setting.

T – THROMBO-EMBOLISM

Part of the daily assessment should include a check for mechanical and chemical thromboprophylaxis and a review for the presence of venous thromboembolism. In 2005 the House of Commons Health Committee reported that an estimated 25,000 people in the UK die every year from hospital-acquired venous thromboembolism (VTE).

A UK survey suggested that 71% of patients assessed as being at medium-high risk of developing VTE did not receive any form of prophylaxis. All patients should be assessed on admission for their risk of VTE and those at highest risk will meet one of the following criteria[6]:

- Surgical procedure with a total anaesthetic and surgical time of more than 90 minutes, or 60 minutes if the surgery involves the pelvis or lower limb
- Acute surgical admission with an intra-abdominal condition
- Expected significant reduction in mobility
- One or more of the following risk factors:

Risk Factors for VTE
Active cancer or cancer treatment
Critical care admission
Dehydration
Thrombophilias
BMI > 30
Personal history or 1st degree relative with VTE
Use of HRT
Varicose veins with phlebitis
>/=1 Medical comorbidities (heart disease; metabolic; endocrine; respiratory)
Age > 60 years

All elderly patients with traumatic injuries needing admission will therefore be at risk and need thromboprophylaxis.

CAM-ICU Worksheet

Feature 1: Acute Onset or Fluctuating Course	Score	Check here if Present
Is the patient different than his/her baseline mental status? OR Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e., RASS/SAS), GCS, or previous delirium assessment?	Either question Yes →	☐
Feature 2: Inattention		
Letters Attention Test (See training manual for alternate Pictures) Directions: Say to the patient, *"I am going to read you a series of 10 letters. Whenever you hear the letter 'A,' indicate by squeezing my hand."* Read letters from the following letter list in a normal tone 3 seconds apart. S A V E A H A A R T or C A S A B L A N C A or A B A D B A D A A Y **Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A."**	Number of Errors >2 →	☐
Feature 3: Altered Level of Consciousness		
Present if the Actual RASS score is anything other than alert and calm (zero)	RASS anything other than zero →	☐
Feature 4:Disorganized Thinking		
Yes/No Questions (See training manual for alternate set of questions) 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail? **Errors are counted when the patient incorrectly answers a question.** Command Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers) *If the patient is unable to move both arms, for 2nd part of command ask patient to "Add one more finger" **An error is counted if patient is unable to complete the entire command.**	Combined number of errors >1→	☐

Overall CAM-ICU Feature 1 plus 2 and either 3 or 4 present = CAM-ICU positive	Criteria Met →	☐ CAM-ICU Positive (Delirium Present)
	Criteria Not Met →	☐ CAM-ICU Negative (No Delirium)

Mechanical Thromboprophylaxis

Mechanical prophylaxis takes the forms of: TEDs or other anti-embolism stockings; foot impulse devices; and intermittent pneumatic compression devices. They should not be offered to patients who have:

a. Suspected or proven peripheral arterial disease

b. Peripheral arterial bypass grafting

c. Peripheral neuropathy or other causes of sensory impairment

d. Fragile "tissue paper" skin, dermatitis or recent skin graft

e. Allergy to material

f. Cardiac failure - severe leg oedema or pulmonary oedema

g. Unusual leg size or shape

h. Major limb deformity

Anti-embolism stockings provide graduated compression and a calf pressure of 14-15mmHg. Patients should be encouraged to wear them day and night until they are able to mobilise.

The HECTOR daily assessment provides the opportune moment to assess compliance with anti-embolism stockings and also to examine the underlying skin condition.

Chemical Thromboprophylaxis

Chemical prophylaxis (e.g. enoxaparin), should not be prescribed until an assessment has been undertaken for risk factors for bleeding. Patients with acute traumatic intracerebral haemorrhage should not receive chemical thromboprophylaxis until the lesion had either been secured surgically or the patient's condition is deemed stable. This may require further discussion with Neurosurgery specialists.

Different forms of prophylaxis exist, with fondaparinux sodium being used 6 hours after surgical closure of patients undergoing hip fracture surgery.

Alternatively, enoxaparin may be used on admission and stopped 12 hours before surgery, and restarted 6-12 hours post-operatively.

Risk Factors For Bleeding
• Active bleeding • Acquired bleeding disorders • Concurrent use of anticoagulants (INR > 2) • Lumbar puncture or epidural expected within the next 12 hours • Acute stroke • Thrombocytopaenia (platelets < $75x10^9$/L) • Uncontrolled hypertension (>230/120mmHg) • Untreated inherited bleeding disorders

Assessment for Deep Venous Thrombosis

Following admission for acute traumatic injuries, elderly patients who develop any signs or symptoms suggestive of a DVT should have Doppler Ultrasound Imaging to confirm or refute this diagnosis. The modified Wells score or d-dimer test would not be relevant as most patients with unilateral leg swelling and calf pain are likely to fall under the high-risk group.

O – OCCULT INJURY & ILLNESS

Having assessed Hydration, Eating & Toileting, Comfort and Confusion, and Thrombo-embolism, the clinical team should aim to complete a quick systems-based review of the patient as well as

taking recent observations into consideration.

Most issues with the genito-urinary or gastro-intestinal systems would have been identified at earlier stages of the assessment tool. Therefore, focus should be centred on looking for any features to suggest cardiovascular, respiratory or neurological compromise, whilst examining any post-operative or traumatic wounds and injuries.

Abnormalities in the early warning score (parameters dependent on the local hospital), should lead to a triggered assessment of a specific system.

For example, any symptoms of chest pain or changes in heart rate should warrant 12-lead ECG to detect any abnormalities. Low oxygen saturations or a raised respiratory rate should lead the team to examine the chest and consider plain film radiography for underlying infection.

Respiratory Illness

In the context of chest trauma, deteriorating respiratory function could be a marker of conditions such as:

- Worsening contusion;
- Lower respiratory tract infection; Empyema;
- Pneumo-haemothorax.

Neurological Considerations

If a patient has suffered from an intracerebral bleed, a falling GCS or episodic confusion should make the team consider whether a repeat CT Head is appropriate to detect expansion of the lesion.

Failure to identify the reasons behind abnormal observations or examination findings warrants escalation to senior personnel and other specialist teams, (e.g. general medicine, nephrology, respiratory etc.).

This stage of the daily assessment uses basic medical history and examination techniques that all doctors registered with the GMC should possess. Some clinicians may have more acute skills than others and in such situations, a team-based approach helps – those with technical surgical skills may rely on those with more acute skills to determine the most appropriate management strategy.

R – RECOVERY

The final part of the daily assessment centres on a formal multi-disciplinary approach. It should start with a general question:

"How are things since yesterday?"

If the answer is that the situation has worsened, then the reason for this should be identified, acted upon and documented in the medical records. If the situation remains the same, the team should also consider why care isn't progressing.

In some circumstances, progression will not be expected on a day-to-day basis (e.g. a patient with a thoracic vertebral body fracture on a regime of bed rest is likely to remain in a state of stasis for prolonged periods). However, other situations may arise whereby an issue such as constipation has been identified, treatment has been given, and yet the patient remains constipated. In these

situations, alternative laxatives may be required.

Progression of the care pathway is reliant on addressing social and psychological factors as well as the management of physical injury and illness.

Physiotherapy and Occupational Therapy teams have the ability to mobilise patients and address any concerns about falling or returning home. Once these concerns are raised, teams can develop targeted strategies to improve confidence and reduce the risk of further falls etc..

Ward-based teams should involve a patient's family in decisions about discharge as early as possible. A patient attending following a fall may lead their family to believe that they are no longer safe to look after themselves at home.

Communication with family members should be open, honest and occur as early as possible. If it is clear that a patient is unlikely to return to their own home after injury, a referral to social services should be made as soon as possible.

This early communication is likely to prevent any later conflict that may arise when a patient is deemed medically fit for discharge. It allows families to express their concerns whilst also allowing the clinical teams to outline the practicalities of ongoing care and recovery outside the hospital.

Summary

- All patients require basic levels of care and attention to be provided following admission. Failure to deliver such standards may result from low staffing levels, poor training and / or failure to acknowledge the complexity in dealing with frail elderly patients.

- The HECTOR Daily assessment tool provides the means of ensuring that basic care standards are being delivered on a consistent basis, and that any complications are identified early and can be acted on in a prompt manner.

- During the daily assessment, the following areas of patient care are addressed: Hydration (including review of input/output and urea and electrolytes); Eating and Toileting; Comfort and Confusion; Thromboembolism (detection and prevention); Occult injury and Illness; and Recovery.

- It requires high levels of collaboration and communication between the multidisciplinary team to ensure that any shortcomings or issues are addressed and acted on by the most appropriate people.

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Chapter 18: Elder Abuse

A vulnerable person is anyone aged 18 years and over who:

- Needs community care services because of mental or other disability, age, or illness;
- Is unable to take care of themselves;
- Is unable to protect themselves against significant harm or exploitation.

Many elderly adults who have been abused have suffered in their own homes, their relatives' homes, or in institutions such as hospitals and Nursing Homes. With increasing frailty comes an increasing inability to stand up for oneself leaving people vulnerable and open for unscrupulous individuals to take advantage.

Cognitive impairment and changes to behaviour may make people difficult to live with and may push others to forms of abuse. Similarly, those caring for such individuals could be at risk of abuse and caring professionals should remain open to the possibility that the vulnerable adult may not be the person they are treating.

Abuse

Elder abuse may be defined as:

"A single or repeated act or lack of appropriate action, occurring within any relationship where there is an expectation of trust, which causes harm or distress to an older person"

Abuse may be a single or recurrent act or failure to act, which results in harm or distress to an individual. The most widely publicised form of abuse is physical but there are other forms which elderly people may suffer from:

Physical	• Hitting; • Slapping; • Pushing; • Misuse of medication; Restraint
Financial	Using a person's money bank account, pension book, property or any other belongings without their consent
Neglect	Depriving a person of help leading to harm or suffering
Sexual	• Rape; • Unwanted touching; • Kissing or sexual activity without a person's consent
Emotional	• Shouting; • Swearing; • Threats of harm; Intimidation; • Humiliation; • Controlling behaviour; • Deprivation of contacts
Discriminatory	Abuse based on race, gender, disability, age, religion
Institutional	Mistreatment by a group of staff or individual within an institution

UK Study of Abuse and Neglect of Older People

A 2007 Joint Study between King's College London and the National Centre for Social Research[1] was commissioned to provide nationally representative prevalence estimates of elder abuse and neglect in the community.

The study was conducted by interviewing 2111 individuals over 65 years of age who lived in the community, (excluding institutions).

The study identified that 2.6% of people living in private households had experienced mistreatment involving a family member, friend or care worker in the last year. This equates to one in forty people or 227,000 people aged 66 and over experiencing mistreatment.

The predominant form of mistreatment was reported as neglect (1.1%) followed by financial abuse (0.7%). Mistreatment was influenced by some of the following factors:

a. Sex - women more likely to experience mistreatment than men

b. Marital status - 9.4% of those who were separated or divorced to 1.4% of those who were widowed

c. Socio-economic position

d. Tenure - those in rented housing had higher prevalence rates than owner-occupiers

e. Health - increased likelihood of mistreatment with declining health

f. Loneliness, depression and quality of life – all of these features increased prevalence rates

Partners and other family members were most commonly reported as being the perpetrators of mistreatment. The age pattern for neglect rose sharply for those aged 85 and over. The study proposed a hypothesis of the "Partner Effect".

This proposed that the effect of having a supportive partner is protective up until the moment when disability in the partner sets in – either physical, mental or both – and neglect increases.

The study suggested that reports of neglect may not necessarily be intentional, but may be a consequence of two people with increasing disabilities trying to help and support each other.

Barriers to Identifying Abuse

Most perpetrators of mistreatment are in close relationships with the victim. Such closeness may have an impact on the victim's willingness to come forwards for fear of getting a loved-one into trouble or through fear of further mistreatment. What remains troubling about this information is the likelihood that the victim is commonly discharged back to the care of the perpetrator and continues to "suffer in silence".

Cognitive impairment and physical illness such as vascular dementia and Alzheimer's disease may impair memory and may prevent the victim or perpetrator from volunteering the underlying cause of injury. Similarly, speech and language impairment caused by CVA may limit an individual's ability to provide an accurate history.

Deficiencies in the training of healthcare staff may limit the ability to identify mistreatment. Elder abuse does not have the same profile in the media or training programmes that are seen with safeguarding of children and adolescents so is commonly overlooked. Furthermore, a lack of understanding of the correct reporting procedures may hinder its identification.

Practitioners may fear the response of family members or carers if concerns are raised about abuse. This may be heightened further by having a suspicion with a victim who is unable or unwilling to

clarify the details about their mistreatment.

Risk Factors for Elder Abuse

Among carers and relatives, risk factors for abuse include:

A. Inability to cope with stress

B. Depression

C. Lack of support

D. Substance abuse (alcohol / drugs)

E. Inadequate training

F. Intensity and demands of an elderly person's illness or dementia

G. Social isolation

H. Elder's role as an abusive parent or spouse at an earlier time of life

I. History of domestic violence in the household

J. Elder's tendency towards verbal or physical aggression

In addition to the above risk factors, older women are at risk of mistreatment if they are the carer of an abusive partner. Such individuals are also more likely to experience abuse from a son and they more be reluctant to report abuse.

Signs and Symptoms of Elder Abuse

Many of the signs and symptoms of elder abuse overlap with symptoms of mental deterioration, as explained by a patient's carers or relatives. It is easy to dismiss certain features if a patient suffers from cognitive impairment and their carer provides the majority of the history. Clinical acumen and a heightened index of suspicion to specific signs and symptoms may prevent abuse from being dismissed.

Features of Physical Abuse

- Broken bones without reasonable explanation or where injuries occur which don't match a mechanism of injury and the patient's physical state
- Signs of being restrained, such as ligature marks on the wrists
- Carer's refusal to allow the patient to be left alone
- Unexplained, symmetrical injuries – bruises, welts or scars

Features of Emotional Abuse

- Behaviour that mimics dementia – rocking, sucking or mumbling to oneself
- Witnessed threatening or controlling behaviour by the carer
- Destructive criticism and verbal abuse – shouting, mocking, accusing, name-calling
- New-onset depression, anxiety, panic attacks

Features of Sexual Abuse

- Bruises around the breasts or genitals
- Unexplained vaginal or anal bleeding with associated traumatic laceration / injury
- Torn, stained or bloody underclothing

Neglect or Self-Neglect

- Malnutrition, dehydration
- Untreated physical problems or failure to seek medical advice for bedsores
- Unsanitary living conditions
- Dirty / unbathed appearance
- Unsuitable clothing and covering for the weather
- Desertion at a public place

Features of Financial Abuse

- Spending of an older person's money on oneself when shopping for the older person, without their expressed consent.
- Refusal to allow an older person to decide on how to spend their money
- Moving into an older person's home uninvited
- Pressure to change a will
- Pressure to sign property over
- Disconnecting the phone

Aiding Disclosure

If any form of mistreatment is suspected, subsequent interviews with relatives or carers should be undertaken in a supportive environment away from the alleged perpetrator. The victim may not be the patient in hospital and teams need to be aware of the risk to vulnerable carers.

It is important to ask direct questions rather than let improbable explanations occur without challenge. Some carers / patients will be reluctant to disclose information that could get their partner into trouble so everything should be asked in a sensitive and non-judgemental manner.

When taking a disclosure, individuals should be empowered to give an accurate account of what has happened or what may happen in the future. In such a circumstance, the individual should be given reassurance that their concerns are being taken seriously and action will be taken if needed to minimise future risk and increase safety.

When speaking to an individual, it is important to be honest and remember the following facts:

- Absolute confidentiality can not be promised – the individual should be informed that information about the mistreatment will need to be shared
- If risk is great, the individual should be aware that information may have to be shared to protect them
- Try and establish what the individual feels they need to ensure their safety
- Make an accurate, factual and contemporaneous record of the disclosure

Responding to Concerns of Mistreatment

Clinicians should be aware of the reporting process for adult safeguarding at their own place of work. These guidelines should be made available to all staff for quick reference and training programmes should be delivered around the reporting process.

Concerns about mistreatment may be made by the assessing clinician, members of the multi-disciplinary team in the Emergency Department or on the wards, or by the patient and/or their carers themselves.

When a concern is raised, the responsible clinician should aim to establish the level of harm caused by the mistreatment. The following questions could be asked to ascertain whether a safeguarding referral is required:

1. How serious was the harm or abuse or what was the potential consequence?

2. How often has the actual / risk of abuse occurred

3. What is the likelihood of abuse or harm recurring?

How serious was the harm or abuse or what was the potential consequence?

If no harm has befallen an individual and no criminal act has been committed, then a safeguarding referral may not be indicated. Further discussions and history should be sought to ascertain any level of intended harm and the actions adjusted accordingly.

If some harm has come to an individual (e.g. fractured ribs from assault), or if a criminal act has been committed, this should trigger a safeguarding referral to the local social services adult team.

How often has the actual or risk of abuse or harm occurred?

If an incident has occurred once, led to no harm and re-occurrence is considered as being minimal, then safeguarding is not required. However, a pattern of repetitive mistreatment or risk of mistreatment should warrant formal referral.

What is the likelihood of the abuse or harm recurring?

If there is a high likelihood that mistreatment will continue, then a safeguarding referral should be made. Evidence of this can be sought by looking at past attendances to the Emergency Department to identify recurring themes to suggest mistreatment.

Making a Safeguarding Referral

Local policies will dictate the exact conduct of such referrals. In the majority of cases, this will involve a telephone call to the local Adult Safeguarding team in addition to providing written documentation using local proformas which are sent via fax or email.

As a collaborative and multi-agency action is the normal response to safeguarding concerns, the adult at risk should be made aware of the need to share information. They should be asked if they are willing to give consent for this sharing of information.

If it is not possible for a person to consent to sharing information through illness and / or cognitive impairment, the clinician should act within the best interests of the alleged victim.

Family members should be consulted in this instance, unless they are the perpetrators of the alleged mistreatment. In such cases, appropriate action should be taken in the interests of protecting the patient from further mistreatment.

If an individual refuses to provide consent for their information to be shared, disclosure can be made if there is a legitimate purpose to do so, which includes:

- Preventing serious harm to an adult at risk
- Providing urgent medical treatment
- Implementing the Department of Health's "No Secrets" agenda of protecting adults.

After a safeguarding referral is made, it is vital that this is documented in the medical records and handover is given to the appropriate teams to ensure referral is met with necessary action.

Capacity

The 2005 Mental Capacity Act[2] was established to protect those individuals who lack the mental capacity to make decisions about their own care. The Act ensures that everyone has the right to make their own decisions, irrespective of whether such decisions are deemed "unwise".

The essence of the Mental Capacity Act identifies the need to perform a capacity assessment if "unwise" decisions about care are made. If a person lacks capacity, then decisions can be made for individuals in their best interests.

The Mental Capacity Act has designed a two-stage test of capacity:

1. Does the individual have an impairment of, or a disturbance in the functioning of, their mind or brain, whether as a result of a condition, illness, or other external factors such as alcohol or drug use?

2. Does the impairment or disturbance mean the individual is unable to make a specific decision when they need to?

An individual is unable to make a decision if they cannot:

a. Understand the information
b. Retain that information
c. Weigh up that information to make a decision
d. Communicate their decision back

If an individual lacks the capacity to make a decision, any further decisions about treatment must be made in their best interests. In such instances, the following checklist may be used to guide what is in an individual's best interests:

- Identify all the relevant circumstances – try and identify the things that the individual would take into account if they had capacity
- Find out the individual's past views and feelings from appropriate family members
- Assess whether capacity might be regained (e.g. low GCS due to subdural haemorrhage)
- Consult with those closest to the individual and enquire about any appointees of a Lasting Power of Attorney.

Deprivation of Liberty

In certain circumstances, a "deprivation of liberty" may be required to ensure that an individual receives care in their best interests. Where individuals lack the capacity to make decisions, but the provision of treatment is challenging (e.g. an agitated or non-cooperative patient), legal authorisation may have to be sought from the local authority to provide care.

Applications for this legal authorisation will follow local policy but can be provided on an "urgent" or "standard" basis.

Application for urgent authorisation is done when it is necessary to prevent a level of harm that is proportionate to the deprivation of their liberty. It is unlikely to be granted if it conflicts with a valid decision made by a person named under the Lasting Power of Attorney.

Self-Neglect

Self-neglect may be defined as:

"The inability (intentional or non-intentional) to maintain a socially and culturally accepted standard of self-care with the potential for serious consequences to the health and well-being of the individual and sometimes to their community"

The lifestyle choices that an individual makes may conflict with what is perceived to be common sense. These choices may also have a negative impact on an individual's health, wellbeing or safety.

However, any challenge to an individual about perceived risk of self-neglect must be balanced against their rights of self-determination – everyone has a fundamental right to live the way they choose.

Clinicians should be aware of the possible indicators for self-neglect:

- Living in unclean circumstances
- Poor self-care and personal hygiene
- Poor nutrition
- Pressure sores
- Poorly maintained clothing
- Long toenails
- Social isolation
- Non-compliance with medication
- Hoarding large numbers of pets
- Neglecting household maintenance
- Unpaid bills / no electricity or gas

When self-neglect is suspected, the clinical team should aim to establish whether or not an individual has capacity to make decisions about their safety and well-being.

It is essential to ensure that the clinical teams document: all factual observations which describe risk factors of self-neglect; all mental capacity assessments to include the date and time; any identified risks; communication with other agencies and proposed actions to minimise risk.

Engaging with Patients and Families

When self-neglect is suspected, families / friends / carers should be consulted to understand if the behaviour is new or a long-standing way of living and what may have initiated the behaviour, (e.g. depression, isolation, pain).

Some families / individuals may refuse help and if this occurs, it may be due to:

- cognitive processing (weighing up risks/costs);
- established habits or beliefs about having external help;
- experience of receiving help in the past;
- self-esteem and a fear of intrusion into one's environment.

Refusal of help may also be indicative of underlying abuse / mistreatment by others and alarm should be raised if a family refuse help against an individual's expressed consent to receive this help.

Managing Self-Neglect

i. Individual with capacity to make their own decisions

If concerns about self-neglect have been raised, the first step should be to assess an individual's capacity to make decisions.

If an individual has capacity this should be recorded in the notes. A Carers Assessment could still be offered to the individual but if this is refused, an adult

safeguarding referral could be made if there is evidence that the neglect is causing significant harm to the individual. This must be made in the patient's best interests with the intent of activating a multi-agency assessment.

ii. Individual has fluctuating capacity to make decisions

In these circumstances, an adult safeguarding referral should be made. The individual should be informed of this necessity and steps taken to look at renegotiating options for delivery of care / ongoing treatment.

iii. Individual lacks capacity to make decisions

When an individual lacks capacity and evidence of self-neglect has been demonstrated, the clinical team should complete an adult safeguarding referral and may even need to apply for Deprivation of Liberty Safeguard authority if a person is non-compliant with treatment plans.

Once an adult safeguarding referral has been made, the following agencies may also be important to engage:

- Mental Health services
- Domiciliary care providers
- CPN Counselling or therapy services
- Advocacy Voluntary organisations
- Environmental health
- Age UK
- Debt advice

A multi-agency assessment of risk should be performed and if a patient is deemed to have capacity, a multi-agency meeting should be held to create, monitor and review a support plan for the individual. If a patient lacks capacity, intervention may be provided in the best interests of the patient.

Summary

- Many elderly adults who have been abused have suffered in their own homes and often have close relationships with the perpetrator of the abuse.

- All clinicians managing older patients with injuries should be aware of the different forms of abuse and risk factors that will predispose individuals to certain types of abuse.

- Barriers to detecting abuse are mainly due to it not being considered through poor training, or a failure of the individual to disclose, or be able to disclose the abuse.

- Clinicians should follow their own local safeguarding policies if they are considering whether or not a person's injuries are a direct result of abuse.

- Open and honest communication with the patient and different family members is an essential part of the safeguarding process. Clinicians may discover that the patient they are treating is not actually the person being abused.

References

1. National Centre for Social Research & King's College London. UK Study of Abuse and Neglect of Older People. London 2007

2. Department of Health. Mental Capacity Act 2005, UK.

Chapter 19: End of Life Care and Do Not Resuscitate Decisions

In the context of trauma care, older patients may be at risk of death from:

- The direct effect of their injuries;
- As a consequence of their injuries (e.g. noscomial infections), and/or;
- From pre-existing co-morbidities.

Treatment options will vary for older patients as the risks of definitive interventions are balanced against the risk of death from anaesthesia etc..

Whereas a younger patient with a subdural haemorrhage may be taken to theatre for clot evacuation, an older patient from a Nursing Home is less likely to benefit from such invasive surgery.

A simple truth exists – age is related to mortality and older patients are at an increased risk of death from traumatic injuries.

The GMC states that:

"Good end of life care helps patients with life-limiting conditions to live as well as possible until they die, and to die with dignity".

This is based on doctors' obligations to show respect for human life and to make the care of their patients their first concern.

The term "life-limiting conditions" includes:

a. Organ or systems failure, where patients are likely to die as a result of an acute crisis

b. Life threatening acute conditions caused by catastrophic events (e.g. severe head injury)

c. Progressive conditions such as cancer or dementia

d. Permanent vegetative state

Making a Clinical Judgement

The starting point for decision-making lies in the consideration of an individual's clinical situation. This should be done on a case-by-case basis. In multi-system trauma, a high Injury Severity Score or low GCS without recovery may be indicative of poor prognosis.

Help should be sought from specialists with the expertise to prognosticate the likelihood of survival against the entire clinical picture (e.g. age, co-morbidities, prognosis of an isolated injury in the context of multi-system injuries).

Such a task is rendered near-impossible without good collection of data and information from patients and their families. The wishes of the patient should be considered whether it be a contemporaneous or historical expression of these wishes.

For example, a patient with widespread malignancy may not wish to have definitive treatment of traumatic injuries if they are on a palliative treatment course. However, one should not assume that patients on end-of-life pathways would refuse operative intervention.
For example, the same patient with widespread malignancy may benefit from

fracture fixation to manage pain and should not be denied access to such intervention because of their underlying disease.

Explaining the Clinical Issues

All treatment options should be explored with patients and their families. This should focus on goals of therapy and with the added explanation of the likely benefits, burdens and risks.

Elderly patients in a Trauma Unit with a severe head injury should still be informed of all the forms of intervention and be offered an explanation as to why the risks of surgery outweigh the possible benefits.

Such discussion is necessary for patients and their families to understand the decision making process. Open and honest communication about clinical issues will help to build trust and reduce the potential for conflict.

If an individual is inexperienced or does not have the clinical expertise to lead such discussions, this should be handed over to an appropriately-trained senior clinician. If patients are likely to die as a result of their injuries, early involvement of a senior clinician or team with experience of end-of-life care is recommended to support the patient and their families.

End of Life Care

End of life care refers to the support given to patients who are approaching death to enable them to live as well as possible until they die. It includes palliative care which aims to make people as comfortable as possible by controlling symptoms (e.g. pain, breathlessness, nausea) whilst providing other support (e.g. psychological, social).

End-of-life care should be delivered with certain standards which are described below:

1. People approaching the end of life are identified in a timely way
2. People and their families and carers are communicated with and offered information, in an accessible and sensitive way in response to their needs and preferences
3. People are offered comprehensive holistic assessments in response to changing needs
4. People have their physical and psychological needs met at any time of day or night
5. People are offered timely personalised support (including religious and spiritual support)

Dying individuals with catastrophic injuries should not be left without the levels of support as described above. Involvement of palliative care specialists may help to control symptoms such as pain or anxiety and make an individual's final days more comfortable.

DNAR (Do Not Attempt Resuscitation) Decisions

A DNAR order consists of formal, written documentation that an individual is not for cardio-respiratory resuscitation (CPR) in the event of a cardiac or respiratory arrest. It is good quality practice to discuss such orders with patients who are at risk of cardiac or respiratory arrest.

The following steps will aid in the decision-making process:

Is there a realistic chance that CPR could be successful?

If a DNAR decision is made on clinical grounds that CPR would not be successful, the patient should be informed of the decision and be offered an explanation of these reasons. If a patient lacks capacity, a welfare attorney, court-appointed deputy or family member should be informed of this decision.

If the decision is not accepted by the patient or those closest to them, a second opinion should be offered and explanation given for these reasons.

Does the patient lack capacity AND have an advance decision specifically refusing CPR OR an appointed attorney, deputy or guardian?

If an individual has made an advance decision refusing CPR, this should be respected provided that the criteria for applicability and validity are met.

Some advanced decisions are made in relation to underlying physical illness and may not be specific enough to reference an individual's wishes in response to acute traumatic injuries. In such situations, attempts should be made to discuss DNAR with the patient and their family.

Does the patient lack capacity?

If a patient is unable to demonstrate capacity to make their own decisions, discussion with those closest to the patient must be used as a guide to the patient's best interests.

Is the patient willing to discuss their wishes regarding CPR?

A patient's wishes must be respected. If they do not wish to be resuscitated and they do not want their family to know, these wishes must be respected under the duty of confidentiality.

All DNAR forms should be counter-signed by the Consultant responsible for the individual's ongoing care. Such orders must not be made without discussion with the patient, or if they lack capacity, with their family / closest relative.

Organ Donation

Although organ donation occurs after death, clinicians should be aware of local policy for identifying suitable donors before death. Organ donation should be considered as a usual part in end-of-life planning and clinicians should attempt to have discussions with patients and their families to ascertain an individual's wishes to be a donor.

Patients with a catastrophic brain injury and the absence of one or more cranial nerve reflexes and a GCS of 4 or less (which is not explained by sedation), should be considered as potential donors.

The following are currently listed as absolute contra-indications to deceased donation:

- Age 85 years or above
- Primary intra-cerebral lymphoma
- All secondary intracerebral tumours
- Any active cancer with evidence of spread outside affected organ within 3 years of donation
- Melanoma
- Active haematological malignancy
- Definite, probable or possible cases of human transmissible spongiform encephalopathy
- TB – active and untreated
- West Nile Virus

- HIV disease (but not with HIV infection)

In addition to the above, the following contraindications exist for organ-specific donation:

Liver
Acute hepatitis / Cirrhosis Portal vein thrombosis
Kidney
Chronic kidney disease / Long-term dialysis Renal malignancy Previous kidney transplant
Pancreas
Insulin-dependent diabetes Non-Insulin dependent diabetes Pancreatic malignancy BMI >40
Heart
Age > 65 years Documented coronary artery disease / LVEF < 30% Median sternotomy for cardiac surgery
Lungs
Intra-thoracic malignancy Chronic destructive or suppurative lung disease Major pulmonary consolidation on Chest Xray

The Final Word

Care of dying older people is not always done well. Age is a "protected characteristic" under the Equality Act 2010 and older people should not be discriminated against just because of their age. A 2015 review of the Liverpool Care Pathway recommended that:

"The starting assumption must always be that a person has the capacity to make a decision, unless it can be established that they don't have capacity".

It also stated that a person's capacity must not be judged on the basis of:

"..age, appearance, condition or an aspect of their behaviour"

Elderly patients with cognitive problems including dementia may at times have decisions made about their treatment based upon preconceived ideas of age or negative stereotyping. This should be avoided at all costs.

If an individual is unable to express their preferences for care as they approach the end of their life, the views on their care should be represented by an independent advocate.

Hospital chaplains or an appropriate person through a voluntary organisation will be suitable candidates to ensure that a patient's holistic needs as they approach death are delivered in a compassionate and caring manner.

References

1. Department of Health. Independent Review of the Liverpool Care Pathway. More Care, Less Pathway: A Review of the Liverpool Care Pathway. UK 2015