Acute Chest Infections in Children 3–12 Months

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Introduction

Respiratory health is an important consideration in Indigenous Australians, as the burden of respiratory disease remains high.[1,2] Australian Bureau of Statistics data based on Northern Territory (NT), Western and South Australia shows that respiratory illness was the second highest cause of death in adult Indigenous males and females.[1] Within the NT, in the 0–4 years age group, recently published data indicates that respiratory disease is still the leading cause of preventable mortality with rates of five times that of non-Aboriginal Territorians.[3] While mortality data is important, data on morbidity — and hence the burden of disease in the community — is crucial. However, it is difficult to obtain population information on morbidity which can be defined in many ways. Hospital morbidity data (with its limitations) is often used as a measure of the level of ill health in the population.[2] In the NT, respiratory diseases again top the list with rates of 399.1 admissions per 1000 population [Editor: 'average' of one infant in four admitted each year for resp infection!] in the 4–51 weeks age group and 84.8 in the 1–4 years age group (1993–97).[2] In Central Australia, the number of separations for pneumonia in 1997–2000 was 418–533 per year, giving a hospitalisation rate of 30–38 per 1000 children per year. This is significantly higher than that reported elsewhere (Pacific Islanders in Auckland 14 per 1000, Fiji 1.7 per 1000, USA 0.5–1 per 1000).[4] Based on these figures alone, the management of acute respiratory infections is important and highly relevant for remote and rural health practitioners.

Respiratory infections are manifested in different ways in infants and children, although there is a considerable amount of overlap. This chapter is restricted to those aged between 3–12 months and to the four most commonly seen infective respiratory illnesses in this age group. Previous editions of the CARPA STM have focused mainly on the detection and management of acute bacterial pneumonia. The 4th edition of the CARPA STM has added the dimension of detection of respiratory sounds. Should the practitioner be unsure of these sounds, bypassing of this section is recommended, and the user should proceed directly to assessing the respiratory rate. In addition, the previous edition recommends the use of physiotherapy and bronchodilators in infants with bronchiolitis. New evidence (levels 1 and 2) do not support this approach and has been removed from the 4th edition (see Bronchiolitis, below).

The management of croup, bronchitis and pertussis are not discussed in this section as they are far more common in the toddler age group. Brief

statements specifying the peculiarities in infants with these infections are made below.

Literature review and discussion

Why children are different from adults

The respiratory system like any other system undergoes a process of maturation in infancy and childhood. While external features such as walking and talking are obviously developing, the developmental process of internal features such as control of the respiratory system, respiratory muscles, thoracic cage and glandular development of the respiratory tree, are often forgotten by adult-focused practitioners. These various factors result in the young child's basal respiratory state lying closer to the fatigue threshold and, thus, predispose a child to develop respiratory failure earlier than adults.[5]

Another aspect of paediatric respiratory disease is the influence of prenatal factors and when insults to the system occur, growth potential can be lost.[6] In the respiratory system it has been well documented that lower respiratory infections (LRTI) in children can lead to later respiratory morbidity, chronic lung disease and lung function abnormalities.[7,8,9,10,11,12] In adenovirus and many viral ALRIs, the young child has an increased risk of developing lung function abnormality.[8,13] Management should arguably be intensive in children, as it is now increasingly appreciated that inflammatory disease processes may impair lung growth in addition to accelerated respiratory function decline in later years.[14,15,16]

Major risk factors for development of respiratory failure

Infants with decreased respiratory reserve are more likely to develop severe respiratory distress and respiratory failure. Clinically, these infants are identified by the presence of significant past history of prematurity associated with respiratory distress, previous mechanical ventilation, congenital cardiac defects, chronic neonatal lung disease, known respiratory disease or immunodeficiency.[17,18] Extra caution should be exercised when these infants develop any respiratory infections as the disease process is more likely to rapidly progress to a severe state.[17,18]

Classification of respiratory infections in young children

Upper respiratory tract infections (including 'cold', otitis media, pharyngitis etc.) will not be discussed in this section.

Lower respiratory tract infection, (LRTI), including:

- Pneumonia
- Bronchiolitis
- Croup
- Bronchitis
- Pertussis

Diagnosis of a lower respiratory tract infection

In infants, Campbell and colleagues reported that a high fever (>38.5°C), vomiting and refusal to breast-feed were the best predictors of acute pulmonary lobar consolidation.[19] Vomiting and refusal to feed will lead to a degree of dehydration; the severity will depend on the length of the acute illness and the intesity of the illness. Thus, any infant who is dehydrated should be urgently referred and discussed with a doctor.

Respiratory rate should be counted over 60 secs (not 30 secs as in third edition of CARPA STM) as it has been shown that counting respiratory rate over a shorter period leads to different results.[20,21] Periodic breathing is normal in infants and becomes less pronounced with increasing age.[22] In infants and children respiratory rate is physiologically dependent on the activity level (awake vs asleep, feeding etc.), sleep state, gender, age, arousal level among other factors.[22,23,24] Thus, measuring respiratory rate in a consistent manner (over 60 secs) and state (calm state) is important.[25] In pathological situations, respiratory rate has been shown in some studies to be a good discriminator of upper vs lower respiratory tract infection as assessed by trained field workers.[26] The use of respiratory rate for management purposes has largely been based on studies for detection of pneumonia and has not been validated for conditions such as bronchiolitis and croup.

Chest in-drawing as a sign of severe LRTI has been shown to be a reliably detected sign by health workers. However, it may not necessarily be a good discriminator for severe LRTI in all community settings.[19] Campbell and colleagues warn against the use of hospital-based data of chest in-drawing in the community.[19]

Oximetry is a valuable clinical tool and the presence of hypoxaemia (SpO2 <95) is highly clinically important in the context of a child with respiratory illness. However, the use of oximetry in children is not as straightforward as it is in adults and, like any other instrument, must be interpreted in the context of the clinical state of the child. For accurate measurement in children it is essential to obtain a good trace on the pulse-meter (should always be displayed and clinics should choose an oximeter that displays the pulse), use an appropriate probe that is not placed too tightly and placed on a well perfused limb. Movement artefacts must always be considered. Single instantaneous SpO2 may not reflect the true reading in children and the trend over several minutes is more reliable. In very darkly pigmented individuals, the readings may be erroneously high.[27]

Audible respiratory sounds

These can be divided into inspiratory or expiratory sounds. Typically inspiratory sounds are generated from extra-thoracic lesions and expiratory sounds from intra-thoracic lesions. When either is severe enough, a bi-phasic (both inspiratory and expiratory) sound may be audible.

Wheeze is a high-pitched musical sound that is characteristically in the expiratory phase. The commonest cause of wheeze in infancy is bronchiolitis (see below). Stridor is a high pitched monophonic musical sound, and the commonest cause in infants over nine months is viral laryngotracheobronchitis. Paroxysmal cough is classically due to pertussis.

Grunting is an expiratory sound and the noise is generated when expiration occurs against a partially closed glottis. The presence of grunting is always significant and almost always is a sign of involvement of the respiratory system (though not always necessary). Infants grunt to increase airway pressure and thus preserve or increase functional residual capacity.

Limitations of the STM protocol

The suggested CARPA STM protocol, in line with the WHO protocol, is heavily reliant on elevated respiratory rate as a criterion for the presence of chest infection in children. The use of respiratory rate thresholds is

however limited by how it is measured, e.g. state of child, length of observation, as outlined above. There is no correlation between respiratory rate and hypoxaemia[28], and the use of respiratory rate is more reliable in children over 12 months than in infants (<12 months).[19]

Management of chest infections in children

Pneumonia

The best predictor of the cause of paediatric pneumonia is age, and in the first two years of life viruses are most frequently implicated.[28] Guidelines for practical diagnosis and treatment of paediatric pneumonia are available.[28,29] The CARPA STM is based on WHO recommendations in which the aim is largely to prevent death from bacterial infections[30], as well as local historical influences. Penicillin is the antibiotic of choice for management of paediatric pneumonia and five days of treatment is the commonly used length of treatment. There is a dearth of randomised controlled trials to guide antibiotic choice, length of treatment, and administration method.

All children with pneumonia (irrespective of where they are treated) should be closely followed up for a clinical response. Cough should cease after 3–4 weeks and, if cough is persistent, the child should be managed aggressively until the cough totally clears. In a yet unpublished study in Central Australia, 19.7% of those who were followed up following lobar pneumonia had a new diagnosis on follow-up. The majority of these had chronic suppurative lung disease.

Bronchiolitis

There are many causes of wheeze in infancy, of which the most common in those with a first episode of wheeze is bronchiolitis. Infants with recurrent wheeze should always be referred for further assessment. This section does not cover those with recurrent wheeze. Any infant with wheeze and other concurrent risk factors (outlined above) requires extra precautions and should be discussed with the doctor. Evidenced based reviews for the management of bronchiolitis are available.[31,32] The previous CARPA STM protocol for wheeze in infants suggests the use of bronchodilators. However, new level 1 evidence does not recommended routine use of bronchodilators for first-time wheezer.[31,32] The use of bronchodilators has been associated with deterioration, including oxygen desaturation (level 2 evidence).[31] Chest physiotherapy is also not recommended (level 2 evidence), as it is associated with clinical deterioration.[31]

The management of bronchiolitis is largely supportive with oxygen therapy (when SpO_2 is <93% and fluid/nutritional support. Thus, transfer to hospital is necessary when: (a) these are required (b) the infant should be observed if he/she has major risk factors or (c) the infant is likely to deteriorate.

Croup

Anecdotally croup is uncommon in remote Indigenous communities. Stridor in any infant, especially in those under six months of age, requires careful evaluation: croup is uncommon in this age group and the stridor is more likely because of a congenital airway lesion in association with a upper RTI.

Bronchitis

Bronchitis is manifested by the presence of a cough and the child is otherwise usually well. Viral infections are the commonest cause of this infection, but secondary infection may occur. As early and heavy nasopharyngeal colonisation has been shown in some remote Indigenous communities[33], secondary infection may be more common in this setting. When the cough persists for longer than 2–3 weeks, a chronic condition should be suspected and bacterial infection considered.[34]

Pertussis

Infants with pertussis do not usually have a whoop and the infection is usually manifested by presence of paroxysmal cough. In between these episodes of cough the infant looks well. The young infant may present with apnoea without cough paroxysms. Any infant under six months with pertussis should be closely observed and closely monitored, as there is an increased risk of apnoea and death in this age group. It would therefore be necessary to transfer any infant under six months to the closest hospital for monitoring. Indications for admitting those over six months include cyanosis during paroxysms and excessive vomiting.[35] Management for those not requiring admission into hospital is otherwise supportive. There is no role for cough suppressants or bronchodilator therapy.[35]

Stabilisation of an infant with respiratory distress

Infants' respiratory basal states physiologically lie closer to the respiratory muscle fatigue threshold and therefore develop respiratory failure earlier than older children and adults.[5] Stabilisation of an infant prior to transfer to minimise the risk of respiratory failure is important in the remote setting. Recommendations for stabilisation are:

- Oxygen use. Hypoxaemia and hypercapnia leads to increased muscle fatigue and, if these abnormalities exist because of pulmonary disease, a vicious cycle of deterioration occur.[36] Oxygen should be commenced using nasal prongs of an appropriate size at 0.5–1.5 L/min. Alternatively, face masks at a minimum of 4 L/min could be used.
- Minimal handling. Handling an infant may upset the infant leading to increased cardiorespiratory demands that are already compromised, causing further hypoxaemia. Mechanisms for minimal handling include sitting the infant on the carer's lap and avoiding unnecessary manipulations such as venesection and suctioning.
- Erect or semi-erect position. The supine position decreases airway patency and functional residual capacity.[37] To optimise lung volumes, airway patency and respiratory muscles, the erect or semi-erect position is recommended. Effectively this means sitting the infant on the carer's lap with the infant resting against the carer's chest or carrying the infant against the carer's chest.

- Avoid feeds. When an infant has severe respiratory distress, aspiration of feeds can occur and lead to further deterioration. In the young infant, the balance of precipitating aspiration and hypoglycaemia and further dehydration must be considered. Ultimately it depends on severity of distress and length of time to transfer/admission of the infant.
- Hydration. Interventions for optimising this must be balanced with expertise of IV insertion, degree of dehydration, severity of

respiratory distress, avoidance of handling the infant, and length of time to transfer/admission of the infant.

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