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CME article

Acute viral bronchiolitis in children- a very common condition with few therapeutic options

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EDUCATIONAL AIMS IN READING THIS ARTICLE, THE READER WILL BE ABLE:

- To understand the diagnosis, pathophysiology and risk factors for acute viral bronchiolitis.
- To discuss the management of acute viral bronchiolitis.
- To review the current literature pertinent to acute viral bronchiolitis and highlight important gaps in management practice.

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SUMMARY

Acute viral bronchiolitis remains a cause of substantial morbidity and health care costs in young infants. It is the most common lower respiratory tract condition and most common reason for admission to hospital in infants. Many respiratory viruses have been associated with acute viral bronchiolitis although respiratory syncytial virus (RSV) remains the most frequently identified virus. Most infants have a mild self limiting illness while others have more severe illness and require hospital admission and some will need ventilatory support. Differences in innate immune function in response to the respiratory viral insult as well as differences in the geometry of the airways may explain some of the variability in clinical pattern. Young age and history of prematurity remain the most important risk factors although male gender, indigenous status, exposure to tobacco smoke, poor socioeconomic factors and associated comorbidities such as chronic lung disease and congenital heart disease increase the risks of more severe illness. Supportive therapy remains the major treatment option as no specific treatments to date have been shown to provide clinically important benefits except for inhaled hypertonic saline. Prophylaxis of high risk infants with palivizumab should be considered although the cost effectiveness is still unclear. Many questions remain regarding optimal management approaches for infants requiring hospitalisation with bronchiolitis including use of nasogastric feeding, the optimal role of supplemental oxygen, optimal use of hypertonic saline and the role of combinations of therapies, the use of heliox or modern physiotherapy approaches.

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INTRODUCTION

Acute viral bronchiolitis is a clinically diagnosed condition causing significant morbidity and mortality in infancy. Children typically have a prodrome of coryzal symptoms including rhinorrhea and fever and develop increased work of breathing with wheeze and cough. There may be difficulty feeding and very young infants may present with apnoea. It is the most common lower respiratory tract condition and most common cause of admission to hospital in the first 12 months of life.¹ Hospitalisation with bronchiolitis peaks between 3 and 6 months of life.² Most

children have a self limiting illness and are managed in the community although around 1–3% of all infants require admission to hospital. Over the last 20 years there has been an increase in the number of children admitted to hospital with bronchiolitis which is unexplained and the cause is likely to be multifactorial although it is possible that the use of pulse oximetry is related to the increased admission rates.³ Bronchiolitis is generally seasonal and associated with respiratory viral infections, most commonly respiratory syncytial virus (RSV).⁴ Death from bronchiolitis is thought to be rare although the risk of death increases substantially with pre-existing medical conditions.⁵ There are approximately 2.9 deaths per 100,000 population per year in infants infected with RSV and a respiratory cause of death under 12 months in the UK⁶ and around 5.3 deaths per 100,000 in the USA.⁷ Around 40–50% of infants requiring hospital admission with

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bronchiolitis will have recurrent episodes of wheeze^{4,8} and many infants have prolonged or relapsing symptoms of wheeze and cough lasting weeks or months following the acute episode.⁹

DIAGNOSIS

The diagnosis of bronchiolitis is clinical and based on a typical history of nasal discharge, fever, and wheezy cough and examination findings of inspiratory crackles and/or expiratory wheeze. While there is general agreement about the pattern of presentation there are differences internationally with regard to the importance of crackles and wheeze in making the diagnosis and in the age range recognised for diagnosis. In North America wheeze is regarded as a more important examination finding and the first 24 months of life are usually used for defining bronchiolitis.¹⁰ Early presentations of asthma or wheeze with viral infections are thus likely to overlap with the diagnosis of bronchiolitis. In the United Kingdom the presence of inspiratory crackles is regarded as a more important examination finding and the first 12 months of life are usually used for making the diagnosis (<http://www.sign.ac.uk>). The differences in diagnostic criteria used have complicated the interpretation of both clinical trials and epidemiological studies.

For the clinician assessing the patient and making a diagnosis the potential overlap with early presentation of asthma often leads to a trial of asthma like therapies including bronchodilators or steroids. However, as neither bronchodilators nor steroids have been shown to provide clinically important benefit in this condition such trials increase the risk of adverse events and costs.^{11,12}

OTHER CONDITIONS THAT MAY PRESENT AS BRONCHIOLITIS

Other conditions may have a similar presentation to bronchiolitis including asthma, pneumonia, airway lesions, congenital lung disease or diaphragmatic hernia, cystic fibrosis, congenital heart disease, sepsis and severe metabolic acidosis. Atypical clinical findings, prolonged symptoms or severe disease should prompt further investigation.

PATHOPHYSIOLOGY AND PATHOGENESIS

The airway epithelium is the primary site of infection with respiratory viruses in bronchiolitis. The virus may directly damage the airway epithelium by infection with necrosis and cilia damage or indirectly by promoting inflammatory responses. This results in bronchiolar obstruction with oedema and accumulation of mucus and cellular debris in the airways which with increasing severity may go on to widespread airway occlusion which is the major finding in autopsy specimens.⁴ Cilia damage can persist for many weeks or months following acute bronchiolitis.⁴

There is a growing interest in the role of innate immune responses and risks of long term wheezing illness or more severe disease with bronchiolitis.¹³ Innate immune responses are important in limiting the spread of respiratory viral infections within the lung and defects in some of the components of the innate immune system are associated with more severe disease. Low levels of interferon gamma and substance P in the airways have been associated with more severe disease in one study although how these findings led to more severe disease was unclear as there was no direct relationship found with viral load and theoretically low substance P levels should have been associated with reduced IL-9 secretion of mucus.¹⁴ Infection of airway epithelial cells particularly with RSV or rhinovirus (RV) leads to activation of NF- κ B pathway with induction of a variety of cytokines, chemokines and adhesion molecules and recruitment of

particularly neutrophils but also dendritic cells, macrophages and lymphocytes into the airways.¹³ Respiratory viruses stimulate different components of the innate immune system and some like RSV have evolved processes such as impairing apoptosis of infected airway epithelial cells to enhance viral replication.¹⁵

INFECTION AND BRONCHIOLITIS

A growing number of viruses have been associated with bronchiolitis although RSV remains the most commonly isolated virus (up to 75% of cases) and cases of bronchiolitis increase in peak RSV season.⁴ Reinfection with RSV is also common even in the same RSV season, although the primary infection is usually the most severe. Rhinovirus (RV) is the next most commonly associated virus¹⁶ although other viruses including human metapneumovirus (hMPV),¹⁷ human bocavirus,¹⁸ enteroviruses, adenovirus, influenza, human coronavirus and parainfluenza infection have also been associated with bronchiolitis.¹⁶ More than one virus may be isolated from the same patient during an episode of bronchiolitis. Dual or even triple viral infections may be detected with RV and RSV being the most common dual infections.¹⁶ There are conflicting data regarding the association between type of virus and disease severity with some studies suggesting rhinovirus¹⁶ or RSV¹⁹ may be associated with more severe disease. The effect of dual infections also appears to be unclear and there are conflicting studies regarding the effects of dual viral infections on disease severity with some studies suggesting concomitant infection with RSV and hMPV leads to more severe disease²⁰ while others have not found any increase in severity for dual infection with these viruses²¹ or for concomitant RSV and RV.¹⁹ The debate is further complicated by conflicting studies examining the association between increased severity and RSV subtype.^{22,23} The effects of viral load are also unclear as although viral load reduces over the course of the disease²⁴ some studies have reported an association between viral load and increased clinical severity²³ while others have not found such an association.¹⁴

Concurrent severe bacterial infection is not thought to be common in infants with RSV bronchiolitis²⁵ although bacterial infection in the lower respiratory tract has been reported in severe disease.²⁶ One study examined endotracheal aspirates in infants requiring assisted ventilation with RSV positive bronchiolitis over three winters and found 70 out of 165 infants (around 42%) had bacteria detected on admission to paediatric intensive care with high bacterial colony counts ($> 10^5$ CFU/mL) in 36 out of 165 (21.8%) infants.²⁶ The most common bacterial pathogens were *Staphylococcus aureus*, *Haemophilus influenzae*, *Moraxella catarrhalis* and *Streptococcus pneumoniae* although more unusual pathogens were also detected including *Pseudomonas aeruginosa*. Ventilation was longer for infants with bacterial co-infection (6 versus 4 days $P < 0.01$).²⁶ It is unclear however whether bacterial lower respiratory tract infection is causal or a marker for severe disease.

Some atypical infections such as *Bordetella pertussis*²⁷, *Mycoplasma pneumoniae*²⁸ and *Simkania negevensis*²⁹, a Chlamydia like intracellular organism found in water samples, have also been associated with bronchiolitis.

It is likely that disease severity is the result of complex interaction between infections including the type and characteristics of infection and possible infective load and host factors including airway size and immune responses.

CROSS-INFECTION

As infants with bronchiolitis have respiratory viral infection, care is required to avoid cross infection particularly in doctors

waiting rooms, emergency departments and in hospital wards. Collection of nasopharyngeal samples with rapid detection of viral infection using enzyme linked immunosorbent assay / polymerase chain reaction (ELISA/PCR) testing has been shown to be cost effective in reducing hospital length of stay³⁰ and should be combined with appropriate cohorting and isolation of patients and the use of protective gowns and gloves for health care workers in contact with infected infants. Viral transmission for RSV is thought to be by direct contact with large droplets or fomites³¹ and thus the mainstay of infection control is careful hand hygiene including hand washing and the use of alcohol rubs before and after contact with patients along with the use of aprons or gowns to avoid contamination of clothing and gloves for all those in contact with the infant or their surroundings. The number of viruses detected on nasopharyngeal testing varies depending on the local laboratory and many viral infections may be missed if the viruses are not looked for. Patients should be regarded as infectious for two weeks or until recognized viruses are negative on nasopharyngeal testing.³²

It is particularly important to avoid transmission of infection to high risk infants and children in hospital with other comorbidities who are at increased risk of severe disease and increased mortality from nosocomially acquired respiratory viral infection. In hospitals visitors with symptoms of viral infection should be restricted and health care workers with viral symptoms should avoid contact with high risk infants such as premature infants or infants with congenital heart disease or chronic lung disease.

RISK FACTORS

As most studies have examined infants admitted to hospital it is difficult to separate risk factors for having bronchiolitis and risk factors for severe disease. The decision to admit to hospital is influenced by many different medical and social factors. In addition, because of difficulties in diagnostic criteria for bronchiolitis, some studies have examined admission rates with RSV infection as opposed to diagnosis of bronchiolitis as such. There are few population based studies although one recent large retrospective population study from the US examined the epidemiological features of incident bronchiolitis among 93 058 singleton births.³³

Many risk factors cannot be modified and these include age, gender and underlying medical conditions. Infants with older siblings have an increased risk of acquiring viral infections and are more likely to be admitted to hospital with bronchiolitis.³³ Males have an increased risk of bronchiolitis and also more severe disease with hospital admission which may be related to airway mechanics and having relatively smaller airways compared with females.³³ There is an increased risk of wheezing illness following RSV bronchiolitis although there is no convincing evidence of association with personal or family history of atopy and bronchiolitis.³⁴ Epidemiological studies from New Zealand, Australia and also USA have shown an association between ethnic background and risk of both bronchiolitis and more severe disease with admission to hospital for indigenous infants of Aboriginal,³⁵ Maori³⁶ or First Nation background.³³ Younger infants are more likely to be admitted to hospital than older infants with bronchiolitis and thus timing of birth in relation to the RSV season will affect the risk of requiring admission to hospital with RSV. Infants born prematurely (≤ 36 weeks gestation) are at increased risk for more severe disease and hospital admission with bronchiolitis. The risks of hospital admission with RSV infection were associated with gestational age in a study from Finland which reported a higher relative risk (RR) for hospital admission for infants born under 32 weeks gestation (RR 3.6, 95% confidence

interval (CI), 2.7–4.8) although the relative risk was still increased for infants born between 32–35 weeks gestation (RR 1.9, 95%CI 1.4–2.6).³⁷

Pre-existing disease increases the risk of death in infants with RSV infection.⁵ Infants with chronic neonatal lung disease born under 32 weeks gestation have an increased risk of severe disease with RSV infection and admission to hospital with a hospital admission rate reported in one series of 19%,³⁸ and infants with underlying congenital anomalies³³ or chronic lung disease such as cystic fibrosis even born at term also have increased risk for more severe disease and admission to hospital. Infants with congenital heart disease have a higher risk of severe disease with RSV infection and account for around 6.4% of admissions in some cohort studies.³⁹

There are also risk factors that may be modified and these include exposure to environmental tobacco smoke, socioeconomic factors and protective factors such as breast feeding. Parental smoking is a recognized risk factor for hospital admission with bronchiolitis. There is some evidence to suggest both in utero exposure to tobacco from maternal smoking³³ and postnatal exposure are associated with an increased risk of hospital admission for bronchiolitis.⁴⁰ Poor socioeconomic factors, such as overcrowding and bedroom sharing may be associated with increased risk of transmission of respiratory viral infections are associated with an increased risk of admission with RSV infection.⁴¹ In one small case control study the risk of hospital admission with bronchiolitis increased with socioeconomic deprivation score.⁴² In a large epidemiological study, infants of mothers under 20 years of age had an increased risk of admission with bronchiolitis.³³

PROTECTIVE FACTORS

A protective effect of breast feeding on risk of hospitalization for RSV infection in young infants has been reported⁴⁰ and not initiating breast feeding prior to discharge from hospital after delivery has been associated with an increased risk of admission to hospital with bronchiolitis in Canada.³³

ASSESSMENT AND HOSPITAL ADMISSION

Clinical trials have used a variety of clinical scoring systems to assess severity although none have been shown to be useful in a clinical setting and generally the degree of disease severity is assessed from the history, clinical examination and investigation. Most infants have mild disease and can be safely managed at home. Families should be given adequate advice and information on how to recognise deterioration in their child's clinical status. Disease severity tends to worsen over the first 72 hours of the illness and the phase of illness should be considered in the decision for timing of review or admission to hospital. There should be a lower threshold for admission to hospital for infants with specific risk factors such as poor socio economic circumstances, a history of prematurity, congenital heart disease or chronic lung disease and geographical factors and transport difficulties also need to be carefully considered. Any of the following features should lead to further review and referral for hospital admission:⁴³

- a history of apnoea
- difficulty feeding may require supportive care and if infants have taken less than 50% of their usual fluid intake in the preceding 24 hours hospital admission is required
- severe respiratory distress with accessory muscle use or grunting
- Respiratory rate greater than 60

- diagnostic uncertainty
- cyanosis/ haemoglobin saturation \leq 92% in room air

Around 1–3% of infants may require admission to paediatric intensive care. Criteria for referral and admission to intensive care will vary between hospitals however infants with severe respiratory distress, exhaustion, failure to maintain haemoglobin saturation above 92–94% with supplemental oxygen or with recurrent apnoea should be considered for intensive care consultation.

INVESTIGATIONS

Most infants with bronchiolitis require no investigations. Infants presenting to or admitted to hospital should have haemoglobin saturation measured using pulse oximetry to help in determining their requirement for supplemental oxygen. Haemoglobin saturation in room air on presentation to the emergency department has in some studies been a predictor of severity however even small differences in values of 2% may have a considerable impact on the decision by physicians to admit infants to hospital.³

Infants with bronchiolitis seen in the emergency department should have rapid virological testing where possible. Rapid testing may be performed for RSV at the point of care and although it has been shown to have reduced sensitivity compared with laboratory testing it may facilitate appropriate cohorting strategies. Rapid virological testing has been shown to be cost effective and associated with reduced hospital stay, reduced use of antibiotic therapy, and reduced investigations³⁰ and may reduce antibiotic prescription in the community.⁴⁴

A chest X-Ray is not required in infants presenting with mild disease⁴⁵ and a typical clinical presentation although in infants with more severe illness or infants with atypical features where the diagnosis is unclear or in infants with particular risk factors a chest X-ray may be warranted.

Blood tests are generally not required. A systematic review found no advantage in measurement of full blood count either for diagnostic or decisions for therapeutic intervention⁴⁵ and although there are few data examining the advantages of urea and electrolytes it is thought that they are unlikely to be deranged unless there is severe disease. Similarly, blood gases may be useful in the assessment of infants with potential respiratory failure but are otherwise not warranted.

Routine bacteriological cultures including blood cultures and urine cultures are not generally required. However, infants under 60 days of age with fever should have urine culture and febrile infants who acquire RSV nosocomially or who have congenital cyanotic heart disease or who require intensive care should have both blood and urine cultures performed. Infants requiring assisted ventilation should have bacterial culture of lower respiratory tract secretions.²⁶

MANAGEMENT

General management and discharge

The management of acute viral bronchiolitis is good supportive care. Most infants require no specific measures and can be managed at home. For infants requiring admission to hospital, the use of clinical pathways particularly with specified discharge criteria can reduce readmission rates and reduce the use of inappropriate therapies.⁴⁶ Infants with haemoglobin saturation over 94% in room air are usually considered for discharge from the emergency department or hospital depending on the phase of illness and other clinical and social factors. A retrospective study of 129 infants admitted to hospital with bronchiolitis reported a lag

between resolution of feeding problems and need for oxygen supplementation of around 2 days and no infants required intensive care management once feeding was reestablished.⁴⁷

Oxygen supplementation

Oxygen supplementation appears to be the major determinant of length of hospital stay although there are no studies examining the effect of supplemental oxygen on recovery from bronchiolitis and no data on which to base safe haemoglobin saturation limits for admission and discharge from hospital or indeed during admission.

Nasal Suction

Nasal suction is very commonly used and in one US survey with responses obtained from 519 of 812 physicians contacted, 82% physicians recommended nasal suction although there are no trials to date assessing the benefits or disadvantages of nasal suction.³

Nasogastric (NG) Feeding/ Intravenous (IV) Fluids

Infants may have difficulty feeding with increased respiratory distress, exhaustion and copious nasal secretions. Frequent small feeds may be used however IV fluids or NG fluids may be required to maintain adequate input and hydration. There are currently no data on which to base the choice between IV fluids and NG feeding and the issue warrants investigation with a well designed clinical trial.⁴⁸

Bronchodilators, inhaled beta agonists, epinephrine

Bronchodilators are commonly used in the management of bronchiolitis in the USA although less frequently in the UK and in New Zealand. A systematic review including 22 clinical trials with 1428 children with bronchiolitis aged less than 24 months and administered salbutamol, ipratropium bromide or adrenergic agents reported evidence of small, short-term improvement in clinical scores of doubtful clinical importance.¹¹ Bronchodilators are not therefore currently recommended for infants with bronchiolitis.

Similarly, a systematic review of use of epinephrine in infants with bronchiolitis found no clinically important benefit for infants admitted to hospital although an improvement in clinical scores 60 minutes after treatment was seen in children who were not admitted to hospital. The clinical significance of this is not clear.⁴⁹

Corticosteroids- oral/inhaled

Inhaled corticosteroids have been used to prevent post bronchiolitis wheezing. A systematic review of 5 studies involving 374 infants found no evidence of benefit although the authors were unable to provide strong recommendations as they felt the number of participants was small and they were unable to pool all the clinical outcomes.⁵⁰

The use of systemic glucocorticoids (given orally or by the intramuscular or intravenous route) in infants with bronchiolitis has also been examined in a systematic review. Thirteen trials involving a total 1,198 children managed as either outpatients or in hospital were included. There was no difference in length of stay, clinical score, readmission rates or hospital admission rates and use of systemic glucocorticoid therapy for bronchiolitis is not recommended.¹²

Combined Epinephrine and Dexamethasone

A recent large randomized controlled trial examined the effect of combining nebulised epinephrine with oral dexamethasone administered in the emergency department in preventing hospital

admission.⁵¹ The results suggested a possible synergistic effect of combining drugs although the effect size was small (11 infants would require treatment to prevent one admission). In addition, the potential long term consequences of even short term use of high dose corticosteroids in young infants on brain and lung development are unclear and this treatment cannot be recommended without further evidence.

Hypertonic saline

Hypertonic saline improves mucociliary clearance and several small trials have examined the use of 3% hypertonic saline given with or in one study without bronchodilators in infants with bronchiolitis. A recent systematic review which included four randomised clinical trials concluded that inhaled 3% hypertonic saline reduced length of hospital stay and improved clinical severity score in infants with bronchiolitis.⁵²

Antibiotics including macrolides

Bacteraemia is uncommon in infants with bronchiolitis (<1%) and antibiotics are not recommended for the management of infants with bronchiolitis unless assisted ventilation is required and/or bacterial infection is strongly suspected or detected. There are however few good quality trials on which to base recommendations. A very small randomized controlled trial of clarithromycin in 21 infants suggested possible benefit with reduced hospital length of stay and possible reduction in readmission to hospital.⁵³ A larger randomized placebo controlled trial of azithromycin in 71 infants hospitalized with RSV bronchiolitis showed no benefit in length of stay, or resolution of clinical symptoms.⁵⁴ Inappropriate antibiotic use exposes children to an unnecessary the risk of drug related adverse events and increases the risk of the development of antimicrobial resistance and should be avoided.

Montelukast

Cysteinyl leukotrienes are elevated in the respiratory secretions from infants with RSV positive bronchiolitis and are thought to play a role in the airway inflammatory response in bronchiolitis. One randomized controlled study reported no benefit in length of stay in hospital, clinical severity score or in cytokine levels in nasal lavage in young infants with bronchiolitis administered montelukast a leukotriene receptor antagonist.⁵⁵ In a large randomized controlled trial montelukast administered to infants aged 3–24 months over 24 weeks following either a first or second episode of RSV positive bronchiolitis did not improve post bronchiolitis respiratory symptoms.⁹

Antivirals

Ribavirin is not recommended for infants with bronchiolitis although may have a place in children post transplant. Studies have been of poor quality and small, the drug is potentially toxic and is difficult to use.

Physiotherapy

Chest physiotherapy is used in respiratory conditions with excessive respiratory secretions to improve airway clearance. A systematic review including three trials of variable quality in infants who were hospitalized with acute bronchiolitis but did not require paediatric intensive care concluded that chest physiotherapy using vibration and chest percussion did not improve clinical severity scores or reduce length of stay or requirement for oxygen supplementation.⁵⁶

Intensive care management with non-invasive ventilation and with heliox

There are few studies examining ventilation strategies for infants with severe bronchiolitis requiring assisted ventilation. A retrospective study suggested the use of non-invasive ventilation for infants with bronchiolitis decreased ventilator associated pneumonia and reduced time requiring supplemental oxygen.⁵⁷ Administration of heliox may improve density dependent airway obstruction and there has been a growing interest in examining the effects in different respiratory illness including bronchiolitis. A small prospective study reported improvement in clinical score and CO₂ levels in infants with severe bronchiolitis with enhanced improvements in infants managed using non-invasive ventilation and heliox.⁵⁸ Well designed clinical trials are required to further examine these interventions.

PROPHYLAXIS WITH PALIVIZUMAB

Palivizumab is a humanized murine monoclonal IgG antibody against the F protein of RSV. Clinical trials have demonstrated reduced risk of hospitalization with RSV in infants born prematurely⁵⁹ or in children aged less than 2 years with haemodynamically significant congenital heart disease.⁶⁰ However, the cost effectiveness of prophylaxis is less clear. The drug is expensive and studies have not demonstrated reduced mortality. In addition the drug appears to be less effective in children with the greatest risk of morbidity and mortality including very premature infants with chronic lung disease.⁵⁹

DURATION OF SYMPTOMS

The duration of symptoms is variable and the use of health care resources may be reduced by appropriate education of families. The median duration of symptoms reported in one study was 12 days (95% CI 11–14 days). Prolonged symptoms were experienced by 39% who were not back to baseline after two weeks, 18% were not back to baseline at three weeks and 9% at four weeks.⁶¹ It may be helpful to inform families that around half of all infants who are otherwise well will be back to baseline by two weeks however a small proportion of infants will still have symptoms up to one month after acute bronchiolitis.

There is a recognized increased risk of recurrent childhood wheezing illness following early RSV infection although the risk of development of atopic disease is not established following bronchiolitis.⁶²

CONCLUSION

Acute viral bronchiolitis remains a common problem for young infants particularly those with co-morbidities and there are few effective therapeutic options. Supportive care remains the cornerstone of management, the use of hypertonic saline seems to be beneficial and the use of heliox and non invasive ventilation for infants with severe disease appears promising.

PRACTICE POINTS

- Most children with bronchiolitis have a self limiting illness and are managed in the community although around 1–3% of all infants require admission to hospital.
- Bronchiolitis is generally seasonal and associated with respiratory viral infections, most commonly respiratory syncytial virus in up to 75% cases.

- Pre-existing disease increases the risk of severe illness and death in infants with RSV infection.
- It is particularly important to avoid transmission of infection to high risk infants and children in hospital with other comorbidities who are at increased risk of severe disease and increased mortality from nosocomially acquired respiratory viral infection.
- Supportive care remains the cornerstone of management in bronchiolitis although many questions remain regarding optimal supportive care including use of nasal suction, and optimal fluid management with nasogastric or intravenous fluids.
- The use of inhaled hypertonic saline seems to be beneficial in reducing clinical severity and hospital stay.

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Educational questions

Answer true or false to the following questions:

1. Diagnosis of acute viral bronchiolitis can be made from:
 - a. A history of apnoea.
 - b. A chest X-ray.
 - c. A history of rhinorrhoea.
 - d. A positive isolate of respiratory syncytial virus from a nasopharyngeal aspirate.
 - e. Consistent history and physical examination.
2. The most common infection associated with acute viral bronchiolitis is:
 - a. Rhinovirus.
 - b. Human metapneumovirus.
 - c. Mycoplasma pneumoniae.
 - d. Respiratory syncytial virus.
 - e. Adenovirus.
3. Infants are more likely to be admitted to hospital with acute viral bronchiolitis:
 - a. If they were born prematurely.
 - b. If they are male.
 - c. If they have pre-existing disease.
 - d. If they are of indigenous background.
 - e. All of the above.
4. Infants admitted to hospital with acute viral bronchiolitis should:
 - a. Have a full blood count performed.
 - b. Have a bronchoscopy to collect a sample from the lower respiratory tract.
 - c. Have a chest X-ray.
 - d. Have electrolytes measured.
 - e. Have assessment of pulse oximetry.
5. All infants presenting with acute viral bronchiolitis should receive:
 - a. A trial of inhaled bronchodilators.
 - b. Supportive care as required including supplemental fluids and oxygen therapy.
 - c. Oral corticosteroids.
 - d. Inhaled corticosteroids.
 - e. Ribavirin.