Bronchiolitis

This article discusses and evaluates the management options for children with bronchiolitis, and identifies children at high risk of a clinically severe illness.

Introduction

Bronchiolitis is a common viral respiratory tract infection mostly affecting children under the age of 2 years (75% under 1 year), with a peak incidence of around 2–8 months and a slight male predominance.

There are a number of causative viruses (*Table 1*). The most common is respiratory syncytial virus, from the paramyxoviridae family. By 3–4 years of age, most children will have been infected by it.

Bronchiolitis is more common during the winter months in the northern hemisphere. Infection does not convey lifelong immunity. Re-infection may occur as a result of different viruses, or different strains of the same virus.

Pathophysiology

Bronchiolitis is an infection of the lower respiratory tract. These small airways (bronchioles) lack cartilage and submucosal glands. Damage through infection causes oedema, cellular debris and mucus over-production, leading to airways plugging, air trapping and atelectasis. The relative reduction in size of the bronchioles of infants, compared to those of older children, makes infants most likely to be severely affected (*Figure 1*).

Table 1. Aetiology

Virus	Incidence
Respiratory syncytial virus	64%
Rhinovirus	16%
Parainfluenzavirus	10–30%
Influenza virus	10–20%
Adenovirus	5–10%
Human metapneumovirus	9%

From Mansbach et al (2008)

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Diagnosis

Diagnosis is clinical. Some characteristic signs, symptoms and examination findings associated with bronchiolitis (Scottish Intercollegiate Guidelines Network, 2006) include:

- Cough or coryza with nasal congestion and rhinorrhoea. This usually precedes wheeze, and the cough is persistent and wet sounding
- Low-grade pyrexia
- Reduced feeding and dehydration
- Auscultation (generalized crepitations and wheeze are heard on chest auscultation)
- Respiratory distress, e.g. tachypnoea, subcostal, intercostal and sternal recession, nasal flaring, head bobbing or tracheal tug, or grunting (to create positive end-expiratory pressure and prevent alveolar collapse)
- Apnoeas (pauses in breathing >15–20 seconds) – particularly in infants and pre-term babies
- Cyanosis (if hypoxic).

Dehydration, apnoeas and cyanosis warrant urgent medical intervention.

Clinical course

Respiratory syncytial virus is spread by droplet transmission. It has a 2–5-day incubation period and takes 3–7 days to resolve. Clinical severity peaks on days 4–5 of the illness, after which a gradual improvement is seen. The cough may last longer (Thompson et al, 2013).

Consideration of the day of illness may guide clinicians regarding the necessity for admission. Illness duration is affected by disease severity, age and pre-existent comorbidities. Generally, younger patients are more severely affected, with milder symptoms observed on re-infection.

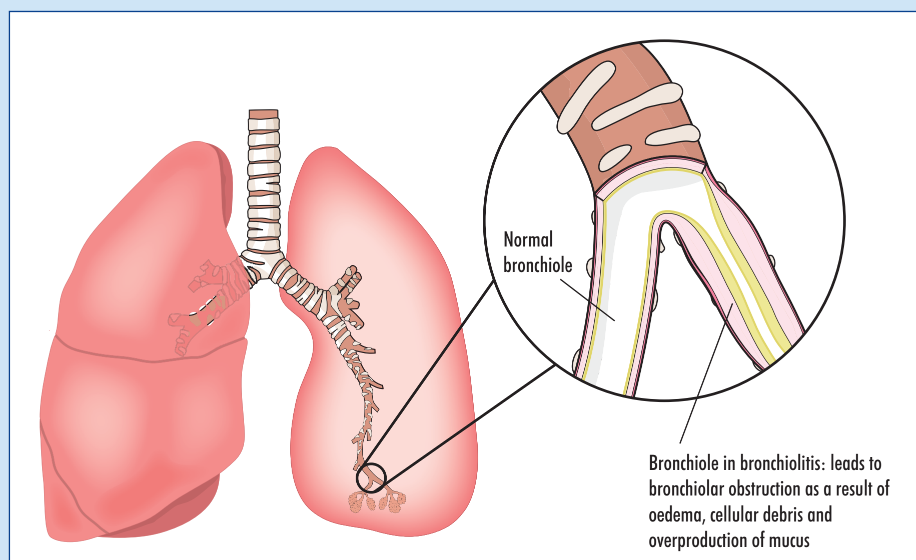
Bronchiolitis, viral-induced wheeze and asthma

Clinical distinction between bronchiolitis and viral-induced wheeze becomes increasingly difficult with age. In the USA, bronchiolitis refers to any child with a wheezy episode under the age of 2 years. In the UK, isolated wheezy episodes, particularly in children under 12–18 months of age, are usually classified as bronchiolitis. Children approaching 2 years of age with multiple wheezy episodes and a coryzal prodrome may be categorized as viral-induced wheeze.

In the context of a personal or family history of atopy, increasing age and frequent wheezy episodes, a diagnosis of asthma may be considered.

There is no evidence to support an increased risk of asthma in children following respiratory syncytial virus infection. Since almost all children will encoun-

Figure 1. Cross section of bronchiole.



ter respiratory syncytial virus in the first 2 years of life, the association between the asthma and bronchiolitis is likely to be multifactorial (Piippo-Savolainen and Korppi, 2008).

Investigations

Chest X-rays and blood tests are unlikely to be helpful, although they may be considered in patients with risk factors for severe disease, or in whom the clinical course is unusual.

Some hospitals provide bedside respiratory syncytial virus testing. This rapid viral antigen test of nasopharyngeal secretions looks for respiratory syncytial virus. It is not necessary for diagnosis, but may help cohort patients for inpatient management, although evidence for this method of nursing is lacking (Scottish Intercollegiate Guidelines Network, 2006).

Blood may be sent for urea and electrolytes and full blood count if a cannula is inserted. In severe cases, clinical course may be assessed through capillary blood gas monitoring. Arterial blood gas monitoring is not practiced as a bedside test in children.

Blood gas analysis

Initially, an increase in respiratory rate causes a reduction in pCO_2 (partial pressure of carbon dioxide) and a slight alkalosis (respiratory alkalosis). As the child tires, breathing becomes less effective and pCO_2 levels rise. Initially, the pH may be maintained (compensated) but as the respiratory distress continues, pH may fall. Respiratory acidosis is a worrying sign and identifies those in need of further respiratory support.

Children under 3 months

Vigilance is needed in the management of pyrexial children <3 months of age in whom a diagnosis of bronchiolitis is uncertain. In accordance with the National Institute for Health and Care Excellence (2013) guidelines for pyrexia in children, a full septic screen, including chest X-ray, blood cultures, urinalysis and lumbar puncture may be indicated.

Decision for admission

Many children with bronchiolitis will not be brought to the attention of medical services. The capacity of paediatric units would be greatly exceeded in peak months if all 'borderline' children were admitted. No validated clinical scoring system exists to predict whether admission is necessary. However, well-hydrated children with no supplemental oxygen requirement and minimal respiratory distress can be managed at home (Scottish Intercollegiate Guidelines Network, 2006), with clear guidance to parents.

Approximately 3% of children with bronchiolitis require admission. Most are under 6 months of age, with an average stay of 3–4 days. Under 5% of hospital admissions for bronchiolitis occur in the first 30 days of life, possibly because there is some protection from transplacental antibody transfer.

Admission is more likely in children with risk factors for severe disease (Meissner, 2003), including:

- Children with underlying chronic lung disease or congenital cardiac disease (especially if on home oxygen)
- Those with a new oxygen requirement
- Children with difficulty feeding secondary to respiratory distress (tolerating <60% of normal feeds)
- Those with a markedly elevated respiratory rate (>70 breaths/min) or moderate–severe clinical signs of respiratory distress
- Children under 3 months of age with unclear diagnosis and fever
- 'Borderline' for admission in a child not yet thought to be at the peak of clinical severity. If the clinician thinks the child is borderline for meeting requirements for admission, and very likely to get significantly worse in the next day (i.e. not at the peak of clinical severity), he/she may wish to consider admission at this earlier stage. This is balanced against parents' confidence and previous experiences, and has be taken on a case by case basis
- Children who were premature or ex-premature (gestational age <37 weeks)
- Children with known airway abnormalities
- Patients where there is concern about how parents would cope with the condition at home.

Management

Management is mostly supportive, and includes the following.

Good nursing care

This includes isolation precautions, minimal handling and good hand hygiene.

Review fluid intake and feeding

As obligate nasal breathers, babies may struggle to coordinate breathing and feeding when nasal passages are blocked. Assess for signs of dehydration: tachycardia, dry mucous membranes, reduced urine output, sunken fontanelle. Generally, enteral feeds are preferred to parenteral. If the child cannot tolerate feeds despite increasing feed frequency and reducing feed volume, consider nasogastric feeding.

In patients with severe or deteriorating bronchiolitis, intravenous fluids may be needed.

Respiratory syncytial virus infection may result in syndrome of inappropriate antidiuretic hormone secretion. In severe bronchiolitis, overall fluid intake should be restricted to two thirds of standard maintenance fluid requirements, with blood electrolyte monitoring.

Pharmacological interventions

There is minimal evidence for the efficacy of pharmacological intervention.

Control fever

Temperature in children <3 months of age should be assessed thoroughly (National Institute for Health and Care Excellence, 2013). Antipyretics (paracetamol and ibuprofen) may be used. Aspirin is not licenced for use in children <16 years of age because of an association with Reye syndrome.

Reduce nasal congestion

Nasal saline drops (1–2 drops per nostril, 10–15 minutes before a feed) may help to clear blocked noses. Nasal suction may be used for inpatients.

Antibiotics and cough mixtures

There is no evidence supporting the use of antibiotics or cough mixtures (Spurling et al, 2011). Antibiotics may be considered in very sick children needing admission, but the risk of concurrent bacterial infection in bronchiolitis is low.

Corticosteroids (systemic or inhaled)

No studies have found a beneficial role of glucocorticoids in bronchiolitis (Fernandes et al, 2013).

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Antiviral agents: ribavirin
Current recommendations do not support the use of ribavirin (Ventre and Randolph, 2007).

Immunoglobulin
Respiratory syncytial virus immunoglobulin is not licensed for use in the UK.

Inhaled or nebulized therapies

β2-agonists and anticholinergics
The routine use of β2-agonists (e.g. salbutamol) and anticholinergics (e.g. ipratropium bromide) in the management of bronchiolitis is not recommended (Scottish Intercollegiate Guidelines Network, 2006). These do not reduce the length of illness or need for hospitalization (Gadomski and Brower, 2010).

Some clinicians trial inhaled β2 agonists in a subset of patients (particularly >12 months age). Positive effects may be short-lived and should be evaluated against side effects, with their use continued only if there is a beneficial response.

Hypertonic saline
Hypertonic saline (3%) is inexpensive, safe and effective for use in hospitalized children (Kuzik et al, 2007). When given 8-hourly, it may reduce the duration of hospitalization by 25% compared with children treated with 0.9% saline (Zhang et al, 2013). It lowers the viscosity of mucus to improve secretion clearance.

Adrenaline
Adrenaline may decrease admissions within 24 hours of administration, but has no effect on length of stay or admissions within 1 week (Hartling et al, 2011). Its use is not currently recommended.

Airway support

Oxygen
Oxygen administration is the only intervention known to improve outcome (Unger and Cunningham, 2008), by decreasing the ventilation/perfusion mismatch caused by air trapping. It should be titrated to maintain oxygen saturations >92%.

Heliox (mixture of inhaled helium and oxygen)
Use of heliox may improve pCO_2 and respiratory rate (Nagakumar and Doull, 2012). However, its use may not reduce the need for subsequent continuous positive airways pressure or intubation and ventilation (Liet et al, 2010).

Humidified high flow nasal cannula oxygen
This may reduce the need for intubation and mechanical ventilation (Furness et al, 2013), although evidence is insufficient for accurate conclusions to be drawn (Beggs et al, 2014).

Continuous positive airways pressure
The use of continuous positive airways pressure should be considered in patients with severe respiratory distress, increasing oxygen requirement, apnoea or rising pCO_2. Its use aims to improve work of breathing by maintaining positive end-expiratory pressure during respiration (Nagakumar and Doull, 2012).

Continuous positive airways pressure may reduce the need for further escalation to mechanical ventilation (Furness et al, 2013).

Intubation and mechanical ventilation
This is indicated for increasing hypoxia and respiratory failure despite the above measures.

Escalation of therapy
Escalation of therapy (e.g. to paediatric intensive care) should be considered in the case of:

- Worsening blood gases – hypoxia, hypercapnia or acidosis despite continuous positive airways pressure use
- Apnoea
- Altered mental status
- Severe work of breathing requiring ventilatory support.

Advice

Parental education should be individualized and in context of the stage of illness at the time of review. It should include indicators on when to seek help again (e.g. worsening work of breathing or reduced feeding). Advise that cough is likely to continue for some weeks, and that smoking in the home or around the child should be avoided.

Prevention and children at risk

A sub-group of patients may be offered palivizumab, a monoclonal antibody. It is an intramuscular injection given monthly for 5 months, starting before respiratory syncytial virus season. Owing to the expense, its use is limited to patients at 'high risk' of severe disease (*Table 2*).

Prognosis

Bronchiolitis is usually self-limiting. The vast majority of patients recover fully. Mortality in hospitalized children ranges from 0.2–7%, with higher levels mostly in patients predisposed to severe disease (Holman et al, 2003).

Severely affected patients may develop complications (Piastra et al, 2006), including:

- Bronchiolitis obliterans
- Bronchiectasis (possible association with adenovirus infection)
- Acute respiratory distress syndrome
- Type two respiratory failure
- Secondary infection
- Congestive cardiac failure +/- myocarditis and arrhythmias.

Conclusions

Bronchiolitis is a common cause of morbidity in children in their first year of life. It is important that doctors have confidence in the assessment and management of these patients. This encompasses the need for a sound knowledge of the natural history of bronchiolitis and early identification of patients at high risk of severe disease, or deteriorating clinical condition. BJHM

Table 2. Children eligible for palivizumab

Infants <24 months age with significant congenital heart disease or with chronic lung disease and on home oxygen or off oxygen for <6 months at the start of respiratory syncytial virus season	
On a case by case basis for infants <12 months with	Extreme prematurity
	Acyanotic congenital heart disease
	Pulmonary hypertension
	Severe congenital immune-deficiency

From Scottish Intercollegiate Guidelines Network (2006)

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Conflict of interest: none.

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KEY POINTS

- Bronchiolitis is a very common respiratory infection in children, particularly those under 1–2 years of age.
- During the winter, it forms a significant burden of health care.
- When assessing a child with suspected bronchiolitis, pay specific attention to oxygen saturations, work of breathing and feeding.
- Treatment is mainly supportive.

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