

Bronchiolitis in children

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Abstract

Bronchiolitis is the commonest lower respiratory tract infection in infants needing hospital admission. It is caused by the virus mainly the respiratory syncytial virus. The infants typically present with initial upper respiratory symptoms such as rhinitis, nasal congestion and low grade fever which is followed by tachypnea recessions grunting apnoea and cyanosis in severe cases. Young age group, prematurity congenital heart diseases are the major risk factors for the severe disease. Diagnosis of bronchiolitis is mainly depended on clinical features. Clinical assessment of a child suspected with bronchiolitis should include clinical features to diagnoses the bronchiolitis and to assess the severity of the bronchiolitis. There is no definitive management for bronchiolitis. None of the drugs tried in the management of bronhiolitis have shown their efficacy in reducing the length of hospital stay, severity of the illness or improvement in the outcome. The main stay of management is supportive like minimum handling, supplementary oxygen, and care on fluid and nutrition and ventilator support whenever needed.

Introduction

Lower respiratory tract infections are the common cause for hospital admission in children. They accounts for 20 -30% of inpatient hospital admission of children less than 5 year old. (1, 2) The leading cause of death among younger children is also the lower respiratory infection. (2) Acute bronchiolitis is the commonest lower respiratory tract infection in infants and it

represents the important causes of hospitalization in this age group. Hospital admission dueto bronchiolitis consumes significant burden on healthcare cost as the management needs oxygen and sometimes ventilator support in the intensive care unit.

Clinical definition of Bronchiolitis

There is no clear definition for bronchiolitis accepted worldwide. In June 2013, American Academy of Paediatrics revised the 2016 bronchiolitis guidelines and defined the bronchiolitis as a “constellation of clinical signs and symptoms occurring in children younger than 2 years, including a viral upper respiratory tract prodrome followed by increased respiratory effort and wheezing” .

Epidemiology and Global burden

Nearly 20% of infants need hospital visits due to bronchiolitis. (4) The prevalence of bronchiolitis is progressively increasing in the recent past. Annual rates of hospital visit due to bronchiolitis is increased by 41 % over the 5 years period from 1997 to 2003 and annual hospitalization due to bronchiolitis is also increased by nine fold over a period of 32 years from 1979 to 2011.(4,5)

The estimated PICU admission rate ranged between 1.3 to1.6 per 1000 infants aged < 1 year with most vulnerable age group is 0-2 months. (5) Among the children younger than one year who admitted with bronchiolitis 1% needed endotracheal intubation and ventilation support.

The mortality due to bronchiolitis is 2.2 per

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100,000 live births and it remains stable over the 19 years from 1979 to 1997. (6)

Pathophysiology

Respiratory Syncytial Virus (RSV) is the commonest cause for bronchiolitis. It accounts for 60 to 80% of children with bronchiolitis. (7,8,9) Other viruses which are responsible for bronchiolitis are Rhinovirus, Human Metapneumo Virus, Adenovirus Human bocavirus, influenza virus and Parainfluenza virus (8,9). More than one virus was detected in nearly 30% of the children with bronchiolitis (10).

The infection starts in the upper respiratory tract and spreads to the lower respiratory tract within a few days. Acute bronchiolitis is characterized by bronchiolar obstruction with oedema, mucus and cellular debris.

Both direct invasion of the organism and immune-mediated response of the respiratory cells cause damage in bronchiolitis. Necrosis of the respiratory epithelium, excessive mucus production, and peribronchiolar lymphocytic infiltration result in submucosal oedema. Cytokines and chemokines released by the infected respiratory epithelial cells amplify the immune response by increasing cellular infiltration. Interferon- γ , interleukin 4, interleukin 8 and interleukin 9 are found in high concentration in respiratory secretions of infants with bronchiolitis. Epithelial necrosis, oedema and mucus secretion cause airflow obstruction, distal air trapping and atelectasis. IgE-mediated reactions and release of inflammatory mediators result in exacerbation of acute obstruction and may contribute to chronic obstructive pulmonary dysfunction, a common sequela of bronchiolitis. (11, 12)

Risk factors for bronchiolitis.

There are few risk factors identified for RSV bronchiolitis. They are young age, male sex, born prematurely, preexisting disease such as bronchopulmonary dysplasia, chronic lung disease, congenital heart disease, neuromuscular

diseases, no/short duration of breast feeding, exposure to environmental tobacco smoke, young maternal age and high parity. But most infants who are hospitalized due to RSV bronchiolitis are born at term and have no identified risk factors. (13) The chronological age is the single most important predictor of severity of the disease. Nearly two thirds of hospitalization due to RSV bronchiolitis occurs within the age of 5 months and the highest percentage is between 1-3 months. (7, 13)

Clinical features

The clinical features of bronchiolitis typically begin with features of upper respiratory tract infection such as low grade fever, rhinitis with or without nasal congestion and irritating cough. After 1-3 days this will progress to tachypnoea, wheezing and increased respiratory effort manifested as grunting, nasal flaring, and intercostal and/or subcostal or supraclavicular retractions. (3)

The clinical examination will reveal tachypnoea, recession, use of accessory muscles and nasal flaring. Grunting, apnoea and cyanosis are seen in infants affected with severe bronchiolitis. On auscultation of chest reveals fine inspiratory crackles in young infants and high pitched expiratory wheeze and prolonged expiration in older children.

Assessment

Clinical assessment

Bronchiolitis is a clinical diagnosis. The assessment should include to diagnose the bronchiolitis and to assess the severity of the illness. Assessment of severity begins with adequate history to identify the risk factors such as prematurity, underlying cardiac disease, lung disease or neuromuscular disease and period of breastfeeding.

Several tools have been studied to assess the severity of bronchiolitis, but none have shown their effectiveness in predicting the severity. (14) The severity of bronchiolitis is classified into three groups as mild, moderate and severe based

on Australasian Bronchiolitis Guideline. (15) (Table 1)

Table 1: Classification of bronchiolitis

	Mild	Moderate	Severe
Behaviour	Normal	Some/in- termittent irritability	Increasing irritability and/or leth- argy Fatigue
Respiratory Rate	Normal to mild tachy- pnoea	Increased respiratory rate	Marked increase or decrease in respiratory rate
Use of muscles	Nil to mild chest wall retraction	Moderate chest wall retractions Tracheal tug Nasal flaring	Marked chest wall retractions Marked tra- cheal tug Marked na- sal flaring
Oxygen sat- uration / oxygen re- quirement	O2 sat- urations greater than 92% (in room air)	O2 satu- rations 90 - 92% (in room air)	O2 satura- tions less than 90% (in room air) Hypoxemia, may not be corrected by O2
Apnoeic episodes	None	May have brief ap- noea	May have increasingly frequent or prolonged apnoea
Feeding	Normal	May have difficulty with feeding or reduced feeding	Reluctant or unable to feed

Laboratory assessment

Bronchiolitis is a clinical diagnosis. Laboratory or

radiographic studies are not routinely needed to diagnose and manage bronchiolitis.(3,16) Routine radiographic studies (CXR) is not recommended as it does not improve the management of bronchiolitis and it is considered when another diagnosis is suspected or if there is no improvement at the expected rate. Routine virology testing has no role in the management. (16)

Management

General management

The management of bronchiolitis is mainly supportive and there is no definitive management for bronchiolitis. None of the drugs showed tried in the management of bronchiolitis have shown their efficacy in reducing the length of hospital stay, severity of the illness or improvement in the outcome.

Minimal handling is beneficial. Nasal suctioning is not recommended as a routine practice, and it may be beneficial in children with respiratory distress or feeding difficulties because of upper airway secretions. (16)

Oxygen

Oxygen should be administered for children with hypoxia due to bronchiolitis. It can be given via face mask or nasal cannulae if the oxygen saturation is less than 92% .

Fluid and nutrition

Bronchiolitis causes significant respiratory distress which may limit the feeding in infants. Maintaining the hydration is vital in the management of bronchiolitis. Mild to moderate bronchiolitis may be managed with small frequent breast feeding but infants with severe bronchiolitis may warrant either nasogastric feeds or Intra venous fluids for the maintenance of hydration.

Inhaled saline

Inhaled normal (0.9%) saline is commonly used in the management of bronchiolitis to clear the secretions. But none of the management guidelines on bronchiolitis routinely recommends its usage. Only a few evidence suggest that the

3% saline is safe and effective at improving symptoms of mild to moderate bronchiolitis after its usage for 24 hours, and reduced the length of hospital stay when the hospital stay is more than 3 days. But there is no evidence to support its use in emergency department where the use is short duration and there is no reduction in hospital admission due to use of 3% saline. (3)

Inhaled bronchodilator

The national guideline on the management of bronchiolitis does not recommend using inhaled beta 2 agonists in infants with bronchiolitis. Results of the Cochrane review indicate that there is no benefit in using inhaled bronchodilators in the clinical course of infants with bronchiolitis. The potential adverse effects (tachycardia and tremors) of these agents outweigh any potential benefits.

The studies have proven that the use of nebulized epinephrine did not significantly reduce the length of the hospital stay in infants admitted to the hospital with bronchiolitis. (15, 17, 18)

Systemic steroids

There is no proven benefit in the use of local or systemic steroids in the management of bronchiolitis thus the routine use of steroids in the management of bronchiolitis is not recommended. (3,15)

Antibiotics and anti-viral agents

Routine use of antibiotic is not recommended in children with bronchiolitis. The studies have shown that the use of antibiotic does not reduce the length of hospital stay or improvement in clinical course. However antibiotics may be considered when there is concomitant bacterial infection. (3, 15)

There is no place for routine antiviral treatment in the management of bronchiolitis. The studies have shown that the Ribavirin (antiviral) use does not significantly affect the mortality or shorten the hospital stay in routine use and need further evaluation to prove its beneficial effect. (19, 20)

Noninvasive and invasive ventilator support in bronchiolitis

Continuous positive airway pressure (CPAP) with nasal cannula or facemask is used in children with severe bronchiolitis and hypoxia. The studies have shown that the CPAP reduced the work of breathing in children with bronchiolitis but there is no clear evidence to support the improvement in the outcome of children who treated with CPAP. (21)

Heated humidified high flow nasal cannula (HHHFNC) oxygen is the relatively new mode of noninvasive ventilator support to deliver the oxygen to children with bronchiolitis and hypoxia. It is relatively safe to use in the wards and it improves the work of breathing in children with severe bronchiolitis. The studies have shown the early use of HHHFNC reduced the need for invasive ventilation and need for ICU care treatment. (22) Now the HHHFNC is used as the first line of noninvasive ventilator mode in children with bronchiolitis in many countries.

Even though noninvasive ventilator support reduces the need for invasive ventilator support in children with bronchiolitis the last resort for those infants not improving with noninvasive ventilation is the invasive ventilator support in the ICU.

There are several interventions used in critically ill infants with bronchiolitis such as surfactant, ribavirin, immune globulin, systemic corticosteroids, vitamin A, interferon, erythropoietin, and heliox. But currently there are no clear effective interventions available to improve the outcome of critically ill infants with bronchiolitis. (23)

In summary bronchiolitis is the commonest cause of lower respiratory tract infection in infants. As its high prevalence in this age group and the severity of illness needing ICU care contributes to the burden of bronchiolitis on healthcare cost. Respiratory syncytial virus is the commonest aetiological agent but there can be more than one viruses. Several identified risk factors contribute to the severity of the illness but there is no tools shown their efficacy in predicting the severity.

Diagnosis is clinical and the clinician should focus on identifying the risk factor and the severity of

the illness. Management is mainly supportive to correct the hypoxia and feeding. Even though several drugs have been tried in the management of bronchiolitis a few drugs showed their efficacy in the improvement of work of breathing but none of the drugs have shown the efficacy in the improvement of the outcome of bronchiolitis.

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