

Overview of Bronchiolitis: Diagnosis and Management

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Abstract

Background: Inflammation of the lower respiratory tract, i.e., the bronchioles, is known as Bronchiolitis. Viruses are almost always responsible for this infection, and it usually affects very young children. Bronchiolitis also happens to be the commonest cause of the hospitalization of children in many countries. In this article, we summarise the epidemiology, pathophysiology, and diagnosis and emphasize guidelines for the treatment of Bronchiolitis.

Aim of the Work: An overview is aimed at describing bronchiolitis in terms of etiology, epidemiology, pathophysiology, clinical features, and various management modalities.

Methodology: The review is a comprehensive research of PUBMED from the year 2003 to 2021

Conclusion: Hospitalization due to Bronchiolitis is quite common among infants. The most common causative factor is the Respiratory Syncytial Virus (RSV), among other viruses. Infection typically starts with fever and rhinorrhea, followed by wheezing and hypoxia in severe cases—common management techniques minimal handling, maintenance of oxygen saturation, fluid balance, and nutrition. Inhalation with saline and epinephrine are also other modes of treatment, but their efficacy is yet to be proved. In cases of respiratory failure, invasive and non-invasive ventilation may also be required

Keywords: Bronchiolitis; RSV Infection; Bronchodilator

Introduction

Inflammation of the lower respiratory tract, i.e. the bronchioles, is known as Bronchiolitis. It usually occurs in early childhood caused by various viruses, and its key symptoms are coughing, wheezing, and poor nutrition. Hospitalization of children due to Bronchiolitis is frequent in numerous countries that negatively affects the economy and working of pediatric departments. The commonest virus involved in Bronchiolitis is the Respiratory Syncytial Virus (RSV) which is known to occur as epidemics in the winter season [1].

Etiology

The commonest virus involved in Bronchiolitis is the Respiratory Syncytial Virus (RSV) which accounts [2] for 60 - 80% of the bronchiolitis cases in infants below 1year of age. The next most common virus is the Rhinovirus (RV) (14 - 30%), subsequently human bocavirus (14 - 15%), human metapneumovirus (3 - 12%), entero-, adeno-, corona and influenza viruses (1 - 8%). Infections with more than one virus are reported in 20 - 30% of children but do not seem to be linked with increased severity [3].

Epidemiology

Several epidemiological studies have been done on the incidence of bronchiolitis in northern countries. Studies in the USA have revealed approximately 20% of children below 12 months of age develop bronchiolitis, whereas Norway and England report the incidence to be 21.7 and 24.2 per 1000 children respectively during the 1st year of their lives [4,5]. In northern countries, the epidemics of bronchiolitis caused by RSV arise during winter seasons, with maximum cases in January. Risk factors include preterm birth, underlying illnesses such as lung, congenital heart diseases, and immunodeficiency, and infants under three months of age [6].

Certain immunocompromised adults with chronic obstructive lung disease may have RSV infection all over the year, and they become a reservoir of the virus. On the brighter side, mortality rates from RSV infections are quite low and improving over the years. Studies have shown mortality rates to be 2.9 (UK) to 5.3 (USA) deaths per 100 000 children below 12 months. Studies have also demonstrated improvements in mortality rates from 21.5 to 1.8 per 100 000 children (age till one year) from 1979 to 2000 [7].

Pathophysiology

The infection begins in the upper airway, i.e. nose/throat, which soon spreads to the bronchioles within a small number of days. Leucocytes, mostly mononuclear cells, attend to the bronchioles, which leads its inflammation leading to edema of submucosa and adventitia. Direct viral injury or the reactive immune response damages the respiratory airway epithelium. Edema due to inflammation, secretion of mucus and epithelial necrosis lead to airway obstruction leading to wheezing and hypoxia [1].

Clinical features

As the infection begins in the upper airway, Bronchiolitis often begins with rhinorrhoea and fever, subsequently gradually increasing with clinical features of a lower respiratory tract infection involving coughing, wheezing, and increased rate of breathing. Apnea is present in very young infants with preterm birth, and feeding problems are also common. On examination of very young infants, inspiratory crackles on auscultation is a major finding. On the other hand, a high-pitched expiratory wheeze may be important in older children. The infants may also present with tachypnea, increased chest movements, prolonged expiration, recessions, use of accessory muscles, cyanosis, and generalized poorer condition [8].

Assessment of the severity of bronchiolitis in infants < 12 months [9]

	Mild bronchiolitis	Moderate bronchiolitis	Severe bronchiolitis
Feeding	Normal	Less than usual > Half the normal	Not interested < Half the normal
Respiratory rate	< 2 months > 60/min > 2 months > 50/min	> 60/min	>70/min
Chest wall recessions	Mild	Moderate	Severe
Nasal flare or grunting	Absent	Absent	Present
SpO ₂	> 92%	88 - 92%	< 88%
General behavior	Normal	Irritable	Lethargic

Laboratory assessment

Apart from pulse oximetry, routine diagnostics in Lab or imaging have not been shown to improve clinical outcomes in bronchiolitis. It's not necessary to identify the involved viral agent, but identifying helps avoid the use of unnecessary antibiotics. Chest X-rays are also of not much help in general unless, in severe cases, prolonged fever, reduced O₂ saturation (< 90%), or patients requiring ICU admissions. If a secondary bacterial infection is alleged, total blood count and C-reactive protein tests might be useful blood tests as well as electrolytes in children suspected of dehydration. Blood gases are required in cases of respiratory failure [10].

Management

General

Supportive care is generally considered enough as clinical outcomes such as duration of hospitalization or the need of Intensive care unit don't seem to improve after any treatment. Infants can have improved oxygenation in a prone position if needed. Copious irrigation and gentle nasal suction also may help with symptoms [1].

Oxygen

Infants that display signs and symptoms of hypoxia, such as pale/bluish skin, lethargy, and poor reflexes, should be administered oxygen using a face mask or nasal cannulae. AAP recommends a level of oxygen saturation (SpO₂) of 90%. Monitoring can be reduced once symptoms have improved [10].

Fluid and nutrition

It is of utmost importance to maintain the fluid and nutrition of infants during bronchiolitis. The hydration of infants may be compromised due to increased effort in breathing and poor feeding. Increased rate of breathing and fever also add to water loss from the body. Frequent breastfeeding should be encouraged in all milder cases; however, infants in a hospital setup may require additional fluid supplementation via intravenous tube or feeding via gastric tube. Fluids given via Intravenous line have the advantages of no interference to breathing and minimizing the risk of aspiration. However, they also carry the risk of fluid overload, electrolyte imbalance, and inadequate nutrition. A gastric tube, although it may cause mild discomfort in breathing, is more beneficial when it comes to maintaining adequate nutrition [1,8].

Inhaled saline

Inhalation of normal saline (0.9%) is popularly used to improve the clearing of mucous secretions. Some studies have shown that the Inhalation of hypertonic saline (3 - 5%) improves mucociliary clearance, probably by breaking ionic bonds within the mucous gel and causing the osmotic flow of water. However, due to the probable adverse effect of bronchospasm, it isn't very commonly used, nor are there any guidelines for it [11].

Bronchodilators

Adrenaline and beta two agonist inhalations may reduce mucosal thickening, due to which it has been commonly used. Despite the supposed benefit, studies, in this case, have shown no significant improvement in length of hospitalization. Adrenaline is consequently not advised as a standard treatment in infants with bronchiolitis [12].

Steroids

Just like hypertonic saline and adrenaline, studies on steroids have shown no significant improvements in length or rate of hospitalization of infants. One study, however, has demonstrated a positive impact of dexamethasone in infants who were mechanically ventilated. This suggested that steroids can be administered in critically ill children. In short, steroids can't be made a recommended therapy until further research has been done [13].

Other medications

In lower respiratory tract infections, antibiotics have been frequently prescribed in children, but studies have failed to provide any evidence in support of such a practice. However, antibiotics may more often be necessary due to concomitant bacterial infections in infants with severe disease, particularly those requiring mechanical ventilation. Antivirals, on the other hand, have no role in bronchiolitis. Surfactant therapy and recombinant human deoxyribonuclease have also been recommended, but they have not been efficacious in studies [14].

Ventilation

Non-invasive ventilation like Continuous positive airway pressure (CPAP) and humidified high-flow nasal cannulae (HFNC) have been commonly used in children with moderate or severe bronchiolitis. CPAP works by rescuing collapsed airways and the subsequent alveoli, thereby reducing the mean airway resistance. Therefore, the lung empties further during expiration, causing a reduction in hyperinflation and effort in breathing, and better gas exchange. Heliox is a combination of helium and oxygen and a low-density gas. This mixture of heliox and CPAP (CPAP-He) possibly benefit bronchiolitis by converting turbulent gas flow into laminar gas flow and thus enhancing oxygenation and the removal of CO₂ [15].

The use of heated humidified high-flow nasal cannulae (HFNC) is another option introduced in place nasal CPAP. It possibly acts by raising the pharyngeal pressure, which reduces respiratory efforts and heals respiratory distress [16].

However, mechanical ventilation still remains essential in infants with inadequate support by nasal CPAP or HFNC. Risk factors include premature birth with low weight and bronchopulmonary dysplasia, and further those with apnea, low oxygen saturation, inadequate oral intake, and severe retractions on admission [17].

Prevention

Despite several managements available, it's always best to prevent such an infection. It is essential for medical staff to prevent the nosocomial spread of RSV and other respiratory viruses from children with bronchiolitis to other non-infected children. RSV can persist for several hours on surfaces and is spread directly or indirectly by touch. The use of antimicrobial hand wash and alcohol hand rubs are very important before and after the patient examination. Use of gloves and avoiding the touch of decontaminated objects is very vital in prevention. The use of an oro-nasal mask in prevention hasn't demonstrated any additional benefits [10].

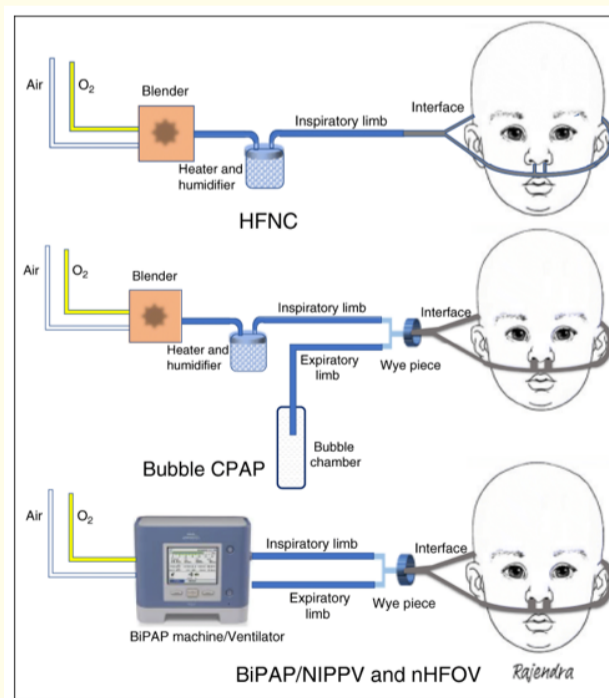


Figure 1: Increasing complexity in modes of non-invasive respiratory support. BiPAP: Bilevel Positive Airway Pressure; CPAP: Continuous Positive Airway Pressure; HFNC: High-Flow Nasal Cannula; nHFOV: Nasal High-Frequency Oscillatory Ventilation; NIPPV: Non-Invasive Positive Pressure Ventilation; O₂: Oxygen [18].

Treatment algorithm for infants with bronchiolitis [19]

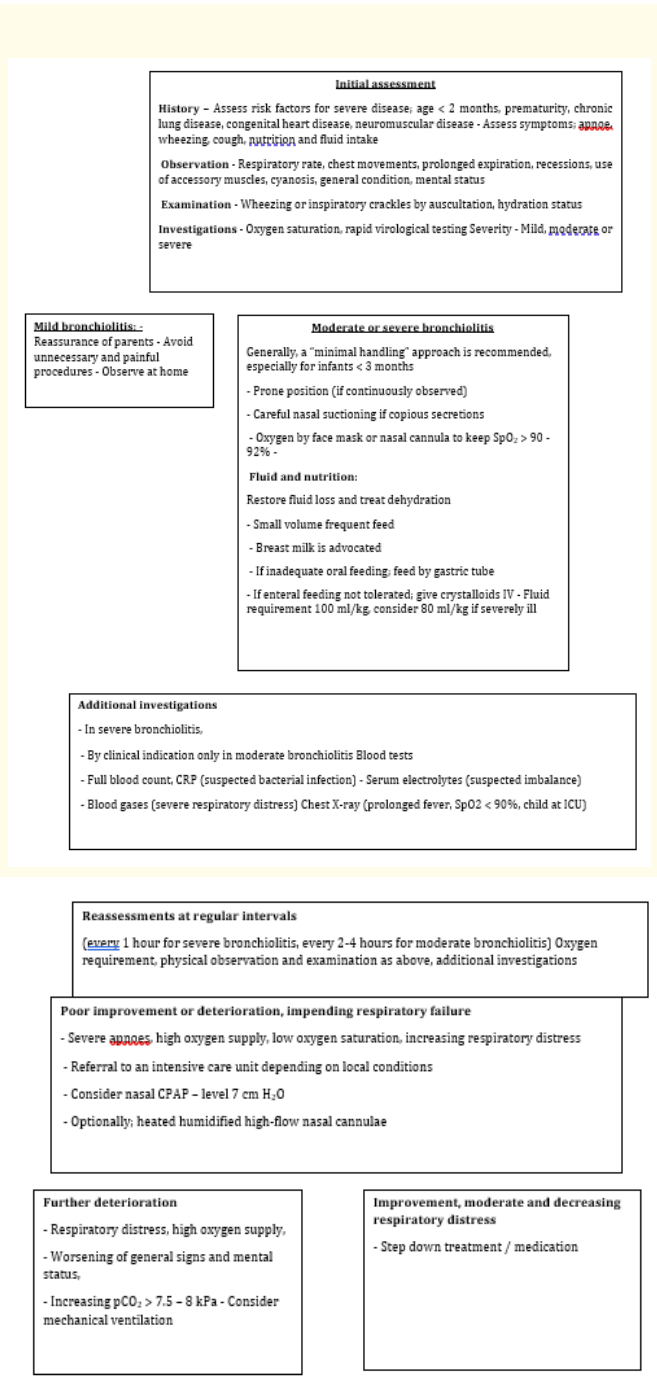


Figure 2

Outcome

There is an increased risk of consequent asthma, decreased lung function, and raised bronchial hyperresponsiveness in children that have a history of hospitalization with bronchiolitis. Children hospitalized with RSV negative bronchiolitis or bronchiolitis due to Rhinovirus are, particularly at a higher risk. Overall, the relationship between RSV bronchiolitis in infancy and consequent respiratory morbidity declines with age [20].

Conclusion

Hospitalization due to Bronchiolitis is quite common among infants. The most common causative factor is the Respiratory Syncytial Virus (RSV), among other viruses. Infection typically starts with fever and rhinorrhea, followed by wheezing and hypoxia in severe cases—common management techniques minimal handling, maintenance of oxygen saturation, fluid balance, and nutrition. Inhalation with saline and epinephrine are also other modes of treatment, but their efficacy is yet to be proved. In cases of respiratory failure, invasive and non-invasive ventilation may also be required.

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