International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

Management of Pediatric Bronchiolitis

S.T. Tivyalakshmi[1]*, E. Ramnath[1], K. Senthilpandi[1,]
S.Swarnapriya[1], M. Fathima Basheera[2].
[1]*Doctor of Pharmacy, Arulmigu Kalasalingam College of Pharmacy, Krishnankoil,Srivilliputhur, TamilNadu, India*
[2]*Assistant Professor, Arulmigu Kalasalingam College of Pharmacy, Krishnankoil, Srivilliputhur, TamilNadu, India*

Submitted: 10-10-2022 Accepted: 21-10-2022

ABSTRACT
Paediatrics with Bronchiolitis usually present with upper respiratory symptoms such as cough and congestion and later develop lower respiratory signs and including dyspnoea, wheezing, crackles and hypoxia. One of the most frequent pediatric medical emergencies is acute viral Bronchiolitis, which is frequently seen by doctors treating seriously unwell kids. We provide an overview of the epidemiology, pathophysiology, and diagnosis in this article, with a particular emphasis on best, practices for treating new-born Bronchiolitis. The supply of oxygen and the use of the proper fluid treatment are the cornerstones of the care of viral Bronchiolitis, and a "minimum handling approach" is generally advised. Although there is little research, it is a widespread practice in several nations to inhale adrenaline. Hypertonic saline inhalation has recently been recommended as a potential therapy. Non-invasive and invasive ventilation may be required to stop and support respiratory failure in new-borns when medical treatment is unable to stabilize them. Reviewing current research on severe Bronchiolitis in infants with a focus on management is the purpose of this article.

KEYWORDS: BRONCHIOLITIS, MANAGEMENT, PREVENTION.

I. INTRODUCTION

Any inflammatory condition involving air-conducting passageways smaller than 2 mm in diameter is referred to as Bronchiolitis in pathology. There are numerous clinical and pathologic Bronchiolitis presentations. The underlying condition may be acute or chronic and show obstructive or restrictive physiology depending on its type. A constellation of histologic abnormalities related to illnesses of the more proximal airways, such as bronchiectasis or alveolates parenchyma, frequently includes Bronchiolitis as one of its components (e.g., pneumonia).

Coughing, wheezing, and poor nutrition are the main signs of Bronchiolitis, an acute lower respiratory tract infection that occurs in young children and is caused by several viruses [1-3]. As many as 2-3% of all infants will be hospitalized with Bronchiolitis within their first year of life, and a significant number of children will experience at least one episode of Bronchiolitis [1-4]. The most frequent cause of pediatric hospitalization in many nations is Bronchiolitis, which puts a strain on the pediatric departments' budget, space, and manpower. The most frequent virus that causes Bronchiolitis is the respiratory syncytial virus (RSV), which tends to spread in epidemics during the winter [1, 2].

Some babies, especially those at risk, will get a severe case of Bronchiolitis. The most frequent medical reason for a child's admission to an intensive care unit (ICU) is Bronchiolitis, which presents difficulties with breathing, fluid balance, and general support [5]. ICUs without a dedicated pediatric division would find this to be especially difficult.

DEFINITION

Due in part to the heterogeneous set of etiologically, clinically, and pathologically dissimilar lesions that makeup Bronchiolitis, the term "Bronchiolitis" is not regularly used as a descriptive or a formal diagnostic term. Furthermore, many of these disorders are made more difficult by pathologic alterations in the proximal bronchi and/or farther-reaching alveolar lung tissues. This diversity of lesions results in a wide morphologic range of inflammatory events concentrated on no cartilaginous airways that are typically less than 2 mm in diameter from a strictly histologic perspective.

The bronchioles, the proximal limit of the pulmonary acinus, are located in the centre of the

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

secondary pulmonary lobule. Since connective tissue septa are not present, initial lesions of the small airways have a centrilobular distribution. Bronchioles can occasionally be histologically undetectable and are easily hidden by inflammatory infiltrates that are airway-centred. It is possible to distinguish Bronchiolitis from other types of diffuse lung illness because to the patchy, centrilobular distribution of the condition in histologic sections. Simple columnar secretory cells (Clara cells), both ciliated and non-ciliated, line the bronchioles. Despite being scarce, the peribronchiolar interstitial has a layer of smooth muscle and no submucosal glands. The respiratory bronchioles that develop from more proximal terminal bronchioles are bordered by a continuous columnar epithelium and are partially alveolate.

EPIDEMIOLOGY

According to a study, children under the age of 12 months saw a mean yearly hospitalization incidence of 21.7 per 1000 [12]. Studies from the USA have shown a growing prevalence in this age range (from 188/1000 new-borns in 1996/97 to 265/1000 in 2002/03) [6, 11]. In the first year of life, 20% of children have Bronchiolitis. All infants with Bronchiolitis under the age of 12 months were admitted at a rate of 24.2 per 1000 in a major English study, and a Norwegian study.

In general, Bronchiolitis is seasonal, with winter being the time of year when outbreaks most usually occur [14]. The same seasonal trend is seen for RSV everywhere, with the majority of cases in the northern hemisphere occurring from October to May [14, 15]. Adults with chronic obstructive pulmonary disease and other immunocompromised patients are susceptible to RSV infection all year round and serve as the virus' reservoir [16, 17].

The disease Bronchiolitis has significant morbidity but a low fatality rate. For RSV Bronchiolitis, the fatality rate from respiratory failure ranges from 2.9 (UK) to 5.3 (USA) deaths per 100 000 infants less than 12 months [18, 19]. Diagnostic techniques and socioeconomic factors both have the potential to contribute to differences. According to a UK study, improvements in pediatric intensive care contributed to a low and declining fatality rate for Bronchiolitis in children under the age of 12 months, which decreased from 21.5 to 1.8 per 100 000 children (age 1 to 12 months) between 1979 and 2000 [20].

PATHOPHYSIOLOGY

Influenza viruses (1–8%), enteroviruses (1-4%), adenoviruses (1-4%), coronaviruses (1-4%), human metapneumoviruses (3–12%), etc. Dual infections are said to affect 20–30% of youngsters, but this RSV is the virus that commonly causes Bronchiolitis in children. In most studies [1, 10, 21–23], it is to blame for 60–80% of cases of Bronchiolitis in infants less than 12 months. Rhinovirus (RV) is the second-most common virus in children under the age of 12 months (14-30%), and it does not seem to be linked to more severe illness [6, 10, 21, 24].

Within a few days, the infection spreads from the upper respiratory tract to the lower airways. Edema of the submucosa and adventitia, as well as peribronchial infiltration of white blood cell types—mostly mononuclear cells—define the inflammation in the bronchioles [2, 6]. Direct viral damage to the pulmonary airway epithelium can cause harm, as can indirect immune response activation [6].

Hypoxemia and increased work of breathing can result from edema, mucus secretion, and injury to the airway epithelium with necrosis [1, 2]. These conditions can also result in partial or complete airflow blockage, distal air trapping, atelectasis, and a ventilation-perfusion mismatch. A little part in the pathologic development of Bronchiolitis appears to be played by smooth-muscle constriction [2].

CLINICAL CHARACTERISTICS

Symptoms typically peak in 3 -5 days after onset and then gradually improve 2 to 3 weeks and the onset of new symptoms or worsening of existing symptoms after 3 to 5 days should raise concern for complications of Bronchiolitis. The symptoms of a lower respiratory tract infection, such as tachypnoea, wheezing, and cough, gradually worsen as the Bronchiolitis progresses. Rhinorrhoea due to the initial upper respiratory tract infection causing increased secretion Rhinorrhoea and fever are frequently the first symptoms of Bronchiolitis. Feeding issues mostly due to dyspnoea

Apnoea – reduced stimulation of the respiratory centre by the lack of carbon dioxide caused by compensatory hyperventilation to overcome the hypoxia. Apnoea may be a very young child's primary symptom, especially in those with a history of prematurity [2, 6]. Feeding issues are frequent.

Fine inspiratory crackles on auscultation may be the primary finding on clinical examination in the youngest children, whereas high-pitched expiratory wheeze may be predominant in later children [2]. The infants may be observed to have cyanosis, increased respiratory rate, chest motions,

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

longer expiration, recessions, usage of accessory muscles, and a decline in general health.

In research including kids with Bronchiolitis from an outpatient clinic, 40% of the kids' symptoms resolved after more than 14 days, and After 4 weeks, 10% of people still reported symptoms [6]. One day (IQR 0-3) was the median period of hospitalization in a sizable study that included infants younger than 12 months [13], and 80 hours (SD 67) was the average length of hospitalization in a Norwegian study [22].

Male gender, history of prematurity, young age, birth during the RSV season, pre-existing conditions like bronchopulmonary dysplasia, underlying chronic lung disease, neuromuscular disease, congenital heart disease, exposure to environmental tobacco smoke, high parity, young maternal age, short duration/no breastfeeding, maternal asthma, and poor socioeconomic conditions are risk factors for Bronchiolitis. But the majority of kids who are hospitalized for Bronchiolitis don't have any other health issues [6, 11, 13]. The same circumstances could put someone at risk for a more serious course of action. Recent research has linked certain gene variants to an increased risk of developing more severe Bronchiolitis [25].

RISK FACTORS FOR SEVERE BRONCHIOLITIS

1. ≤12 WEEKS OF AGE
2. Low birth weight (≤2.5kg)
3. Immunodeficiency
4. Exposure to tobacco smoke
5. Congenital heart disease
6. Congenital lung disease
7. Cystic fibrosis and bronchopulmonary dysplasia
8. Preterm birth (L34 weeks gestational (age)

CLINICAL ASSESSMENT

As mentioned, [3], Bronchiolitis is diagnosed clinically. Young age, which is linked to an increased risk of apnoea, prolonged hospitalization, hypoxemia, admission to an ICU, and the requirement for mechanical ventilation are risk factors for a severe course that should be recognized [2, 3].

When possible, pulse oximetry should be used in the clinical evaluation of Bronchiolitis because it can identify hypoxemia that the clinical examination is unable to detect (Table 1) [2, 3].

Repeated evaluations are necessary due to the unpredictable nature of the course of Bronchiolitis, especially in infants who have risk factors.

LABORATORY ASSESSMENT

No routine diagnostic test, except for pulse oximetry, has been demonstrated to significantly affect the clinical course of Bronchiolitis, and recent recommendations and evidence-based reviews advise against using any diagnostic test on a routine basis [2, 3, 5, 6, 26]. The use of diagnostic and therapeutic options has decreased as a result of the implementation of guidelines for the assessment and treatment of babies with Bronchiolitis, along with a further decrease in expenses and duration of stay [2, 27–31].

The viral agent's identification has little impact on the clinical course or treatment of Bronchiolitis [2, 3]. However, it has been demonstrated that determining a viral aetiology reduces the need for antibiotics, the number of

The duration of the stay and the investigations [6, 28]. Depending on the environment, a viral diagnosis may be necessary for patient cohorts and may lessen nosocomial infections, which may affect the child's long-term prognosis [3]. Others have, however, disputed this [32].

In less than 1% of cases, a chest X-ray may reveal lobar consolidations that point to the need for antibiotics while also increasing the rate of antibiotic prescription [5, 33]. However, an X-ray may be more likely to be helpful in children who have a high and persistent fever, have a chronic cardiopulmonary disease, have an oxygen saturation below 90%, or who require ICU admission or mechanical breathing [5, 34].

Children with Bronchiolitis frequently have blood tests; however, these procedures typically have no therapeutic value and are not advised [2, 3, 35]. If a secondary bacterial infection is suspected, tests such as the total blood count, C-reactive protein, and electrolytes may be performed on infants who are having feeding difficulties and exhibiting signs of dehydration. Infants with severe respiratory distress and possibly respiratory failure should have blood gases taken [6].

GENERAL MANAGEMENT

Since no medical intervention has been demonstrated to improve critical clinical outcomes including length of hospital stay, utilization of supportive care, or transfer to an intensive care unit, management of acute Bronchiolitis is often supportive. Particularly for the youngest age group (less than three months), a conservative, "minimum

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

handling" strategy appears advantageous [1, 2, 22]. If new-borns are closely watched, the prone posture is advised since it may increase oxygenation [1, 36]. In new-borns who produce a lot of secretion, careful nasal suctioning may be helpful [1, 37].

OXYGEN

When a new-born has Bronchiolitis and is hypoxic, oxygen should be given via nasal cannula or a face mask [1]. No randomized controlled trials have contrasted different oxygen supplementation regimens, and there is disagreement about the amount of oxygen saturation (SpO2) oxygen assistance should strive for [1]. While the AAP advises a maximum SpO2 of 90% in otherwise healthy infants, oxygen is frequently administered in the UK to reach a SpO2 of 92-95% [1,37]. observer-based research, [3] however, suggests that a goal of 90%, as opposed to 94%, has the potential to considerably shorter hospital stays [38, 39], and the AAP recommendations suggest reducing surveillance as the infant progress.

FLUID AND NUTRITION

An essential component of caring for infants with Bronchiolitis is maintaining hydration. The respiratory discomfort brought on by the increased labour of breathing may result in insufficient food and, in the long run, poor hydration [1]. Additionally, tachypnoea and fever cause more fluid loss, which could make the dehydration worse [40, 41]. In milder situations, oral feeding may be maintained by frequent, small-volume feedings, and breastfeeding should be promoted. However, a sizable portion of babies who are sent to the hospital with Bronchiolitis requires fluid supplementation, either through intravenous (IV) fluid or enteral feeding through a gastric tube (GT) [1, 2, 41]. Many nations have historically administered IV fluids, and the current AAP recommendations support this practice [3]. The benefit of intravenous fluids could be a Low-calorie intake may result in a catabolic state and increase the risk of fluid overload and electrolyte imbalance, but there is a lower risk of aspiration and no interference with breathing [42, 43]. Infants may get a better nitrogen balance and nutritional condition by GT feeding, which may be helpful for recovery and maybe a way to administer expressed breast milk [41, 44]. In cases of severe respiratory distress, feeding via GT may be administered continuously or in boluses [1].

There is currently insufficient research to support either using GT feeding or not in babies with Bronchiolitis [43], and a recent large Australian study found no significant differences in main outcomes between the two approaches [45]. However, certain nations [38, 46, 47], notably the most recent recommendations of the Norwegian Paediatric society, are adopting and using GT feeding more frequently. No children received intravenous fluids in a sizable Scottish study of Bronchiolitis, and problems with GT feeding were not noted [38]. In a recent small randomized pilot study, IV fluid and feeding of GT revealed no differences in the length of stay or the amount of time spent using each technique [40].

The ideal volume of fluid to be administered during replacement in Bronchiolitis has not been extensively studied. According to recommendations, new-borns should get no more than 100% of their daily fluid requirements, which are typically 100 ml/kg for infants under 10 kg [3], to replenish fluid loss and prevent dehydration. However, Bronchiolitis has been linked to fluid retention caused by improper antidiuretic hormone secretion, so doctors need to be aware of this potential [1, 48, 49]. Therefore, especially in those with severe disease, 70–80% of the daily requirements may be advised [1, 3, 41]. The treatment for these kids may be guided by careful monitoring of their weight, serum and urine osmolality, and serum electrolytes [1]. Overhydration is probably less of a concern during enteral eating enabling the body to absorb the required quantity of fluid and electrolytes.

INHALED SALINE

In several trials examining the effects of bronchodilators or hypertonic saline, inhaled normal saline (0.9%) is used as a placebo to increase mucus clearance in children with Bronchiolitis. Normal saline is not recommended in the most recent guidelines and reviews, and we are not aware of any randomized study that compares it to no treatment [1-3, 6, 37]. As a result, no suggestions can be made.

Patients with a variety of disorders have shown that inhaling hypertonic saline increases mucociliary clearance, potentially by causing an osmotic influx of water to the mucus layer and by rupturing ionic connections in the mucus gel [50]. Hypertonic saline (3-5%) may shorter hospital stays and lower hospitalization rates, according to recent meta-analyses involving more than 1000 infants with mild to moderate Bronchiolitis [51, 52]. However, all but a few individuals received a combination with a bronchodilator due to the potential side effect of bronchospasm. Uncertainty exists regarding the ideal delivery device,

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

concentration, and delivery interval. Four studies revealed no such impact, raising questions about the short-term effect [51]. The use of 7% hypertonic saline and epinephrine in a recent trial did not the clinical severity score [53] in any way.

Based on the available data, hypertonic saline inhalations must be recommended along with a bronchodilator. We do not currently support such a proposal because recent data firmly supports the "minimum handling" strategy for treating infants with Bronchiolitis [22]. There are now several trials using hypertonic saline without bronchodilators, and the outcomes may change the recommendations [1].

INHALATION WITH BRONCHODILATORS

Adrenaline inhalation, which has led to regular use in children with Bronchiolitis, may also reduce mucosal swelling in addition to bronchodilation. However, neither adrenaline nor beta-2 agonists have been shown to have a clinically significant effect. Studies on immediate impacts have shown contradictory findings. According to a recent Cochrane analysis, inhaled (racemic) adrenaline does not reduce the need for supportive treatment or length of hospital stay in patients with moderate to severe Bronchiolitis [58]. A recent sizable Norwegian randomized controlled experiment (RCT) with 404 infants lends support to this [22]. In this trial, patients who received care "as needed" as opposed to according to a set schedule experienced fewer inhalations (12 vs. 17 per day), a shorter hospital stay (47.6 vs. 61.3 hours), and less need for supplementary oxygen. and less ventilatory assistance (4.0 vs. 10.8%) (38.3 vs. 48.7%). Children under three months old mostly saw the benefit (a 25-hour shorter hospital stay), and as adrenaline tends to have a negative impact relative to saline in this age group, caution is advised. As a result, adrenaline is not advised as a standard treatment for infants with Bronchiolitis. However, in children older than 3 months, a trial may be conducted, with a critical evaluation of the outcome concerning the continuing administration [22]. For babies with Bronchiolitis, beta-2 agonists are not advised [55, 56].

STEROIDS

In children with Bronchiolitis, systemic corticosteroids have no positive impact on hospitalization rates for outpatients or length of stay for inpatients, according to a recent meta-analysis of 17 RCTs [57]. Dexamethasone has, however, been demonstrated to have a positive effect in one study.

(0.15 mg/kg every 6 hours for 48 hours) in children who were mechanically ventilated, indicating that this might be an alternative for critically ill patients [58]. Additionally, a small trial [59] found that the combination of high-dose oral dexamethasone (1 mg/kg at presentation and 0.6 mg/kg for an additional 5 days) with inhaled epinephrine tended to lower the rate of hospital admission. However, until this treatment has been examined in more comprehensive research, it cannot be advised

ADDITIONAL MEDICATION

Children with lower respiratory tract infections frequently receive antibiotic treatment, however, a Cochrane analysis that included 543 new-borns came to the opposite conclusion [60]. Antibiotics may, however, be needed more frequently because infants with severe illness—especially those who require mechanical ventilation—often have concomitant bacterial infections [61]. Antiviral medication has no place in the treatment of Bronchiolitis [62].

Patients on mechanical ventilation who are seriously ill have been recommended surfactant therapy. Only three small trials have examined this so far, and a recent Cochrane review found that there is not enough support for such a course of treatment [63]. Children with Bronchiolitis have not shown any improvement in any of the outcome factors when using recombinant human deoxyribonuclease [64].

NON-INVASIVE AND INVASIVE VENTILATION

In children with moderate to severe Bronchiolitis, continuous positive airway pressure (CPAP) with a nasal tube or a nasal mask has been utilized extensively. By enlisting collapsing airways and the associated alveoli, CPAP may reduce mean airway resistance. As a result, there is a further increase in lung emptying during expiration, which improves gas exchange and reduces the labor of breathing and hyperinflation [65, 66].

Contrary to its widespread use, there is little research on the utility of CPAP for Bronchiolitis. According to a recent systematic review, the data supporting the use of CPAP to lower PCO2 and respiratory distress is of low quality, and no indication doing so decreases the need for additional medical treatment.

venting that is intrusive [65] Only two minor RCTs [67, 68] have been conducted; all other studies [69–73] used a before-after design.

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

But according to these studies, using CPAP for Bronchiolitis is safe and generally reduces capillary PCO2 by 0.8 to 1.3 kPa from before to immediately after CPAP is started [65].

The typical CPAP breathing pressure ranges from 4 to 8 cm H2O, and research has shown that a pressure of 5 cm H2O is effective in lowering PCO2. The most effective nasal CPAP level for easing respiratory distress and enhancing breathing patterns, according to a recent prospective study, was 7 cm H2O [74].

Low-density gas helix is a combination of helium and oxygen. By changing turbulent gas flow into laminar gas flow and enhancing oxygenation and the washout of CO2, it may play a helpful function in Bronchiolitis [75]. Three studies have looked at CPAP-He, which combines helix and CPAP. There were only a few children in each study, one quasi-RCT, and two before-and-after investigations [65, 76–78]. In all three studies, transcutaneous or arterial PCO2 and respiratory distress were found to have dramatically decreased. But as no blinded RCT has been carried out, it must be inferred that more proof is required before CPAP-He may be recommended [65]. It has been demonstrated that helix therapy is useless when not used in conjunction with a nasal cannula or a tight CPAP.

Although there are no set standards, common indications that children should receive CPAP treatment include apnoea's, respiratory distress, and high oxygen demands or rising pCO2 [1]. The biggest indicators of needing CPAP therapy, according to a recent study, were oxygen need, low oxygen saturation, younger age, and greater respiratory rate [80].

As an alternative to nasal CPAP, heated humidified high-flow nasal cannulae (HFNC) are being used more frequently [81–87], including in general pediatric wards [88]. The technique is currently employed in new-born medicine [89], and it typically works by raising pharyngeal pressure, which reduces breathing efforts and lessens respiratory distress [90]. Recent research based on the literature reveals that HFNCmay is achievable and lessen the requirement for intubation in children with Bronchiolitis [83, 86]. Larger pediatric units have replaced CPAP with HFNC as the first-line non-ventilatory support in Bronchiolitis because HFNC may be more tolerable than nasal CPAP [82, 85, 91]. The most recent analysis finds that there is not enough data to decide if HFNC is useful in treating infants with Bronchiolitis, even though no randomized trial has yet assessed the effect in Bronchiolitis patients [92]. Children treated with HFNC have been shown to occasionally develop serious air leak syndrome [93].

When children have moderate Bronchiolitis, the safety of HFNC and CPAP may be reasons to start non-ventilatory assistance early [65]. However, in new-borns who do not receive enough assistance from nasal CPAP or HFNC, mechanical ventilation may still be required. In addition to apnoea, low oxygen saturation, poor oral intake, and severe retractions at admission, other risk factors include prematurity, low birth weight, and bronchopulmonary abnormality [94, 95]

There is disagreement over the ideal ventilation strategy for kids with Bronchiolitis [66, 96]. With a wide range of ventilator rates (10–60 beats per minute), maximum pressure (20–50 cm H2O), and tidal volume (6–20 ml/kg), both volume and pressure-cycled ventilation have been used [66]. PEEP usage ranges from 0 to 15 cm H2O as well. In some case reports, the use of high-frequency oscillation has been successful [97]. However, it has been hypothesized that slower rates and longer expiratory durations may be advantageous for infants with hyperinflation [66].

associated Extracorporeal membrane oxygenation has been demonstrated to offer some benefits for the extremely small subset of patients who are not under mechanical ventilator control (often with severe bronchopulmonary dysplasia) [66, 94].

PREVENTIVE MEASURE

It's crucial to prevent the nosocomial transmission of RSV and other respiratory viruses from Bronchiolitis-infected youngsters [98]. RSV is spread either directly or indirectly through touch and can survive on surfaces for up to seven hours [99].

Additionally, RSV RNA has been found in persons with RSV infection up to 700 cm from the patient's bed's head [100]. A key technique for primary prevention is hand decontamination using antimicrobial soap or alcohol-based hand rubs before and after contact with patients, as well as after removing gloves and contact with potentially contaminated objects [3]. Mask use, however, has not been demonstrated to provide extra benefits [3].

PREVENTION

1. Education caregivers on respiratory hygiene and hand hygiene
2. Stop exposure to second-hand smoke
3. Encourage breastfeeding
4. Advice to avoid being in a crowded place.

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

DIFFERENTIAL DIAGNOSTIC CONSIDERATIONS

In most cases, the diagnosis of Bronchiolitis is clinically evident and no further tests are indicated to rule out another diagnosis [2]. However, another diagnosis may be considered in a child with atypical presentations including severe respiratory distress, and recurrent symptoms, and in a child presenting with otherwise typical symptoms, but with no signs of viral infection [2]. Differential diagnoses may include gastroesophageal reflux, laryngotracheobroncholamacia, pertussis, foreign body aspiration, vascular ring, and other mediastinal obstructions or other congenital lung diseases [2,6]. Asthma may be considered in the oldest infants with recurrent episodes of wheezing, but the overlap with asthma is less likely when Bronchiolitis is only defined in infants younger than 12 months of age [6].

PALIVIZUMAB PROPHYLAXIS

1. It is a monoclonal antibody against the respiratory syncytial virus of protein which provides PASSIVE immunization to RSV infection.
2. American academy of paediatrics (AAP) criteria for neonatal chronic lung disease.
3. Requiring supplemental oxygen during the first 28days of life.

OUTCOME

The likelihood of developing asthma later in life, lung function, and bronchial hyperresponsiveness are all raised in infants hospitalized with Bronchiolitis [23, 101]. They don't appear to have an elevated risk of atopy [106] aside from in the Sigurset al. trials [7]. Children hospitalized with RSV negative Bronchiolitis or Bronchiolitis caused by a rhinovirus had a higher risk of developing asthma [23, 103], but the relationship between RSV Bronchiolitis in infancy and eventual respiratory morbidity weakens with age [104]. Bronchitis and subsequent asthma have a complicated relationship that is likely influenced by viral aetiology, and genetic, structural, immunological, inflammatory, and environmental processes [105].

II. CONCLUSION

The most frequent cause of inpatient hospitalization during infancy is Bronchiolitis, which places a strain on the kid and family and incurs high expenses for the healthcare system. The major therapy tenets are minimal intervention, preservation of oxygen saturation, fluid balance, and nourishment. Inhalations of epinephrine, normal saline, or hypertonic saline are other treatment possibilities, however, there is little research to support their usage. In patients with respiratory failure, CPAP and heated humidified high-flow nasal cannulas are frequently utilized, although additional high-quality studies are required to demonstrate their effectiveness. Very few kids might require mechanical ventilation.

REFERENCE

[1]. Nagakumar P, Doull I. Current therapy for Bronchiolitis. Archives of disease in childhood. 2012 Sep 1;97(9):827-30.
[2]. Zorc JJ, Hall CB. Bronchiolitis: recent evidence on diagnosis and management. Pediatrics. 2010 Feb;125(2):342-9.
[3]. American Academy of Pediatrics. Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of Bronchiolitis. Pediatrics. 2006;118:1774-93.
[4]. Stockman LJ, Curns AT, Anderson LJ, Fischer-Langley G. Respiratory syncytial virus-associated hospitalizations among infants and young children in the United States, 1997–2006. The Pediatric infectious disease journal. 2012 Jan 1;31(1):5-9.
[5]. Choi J, Lee GL. Common pediatric respiratory emergencies. Emergency Medicine Clinics. 2012 May 1;30(2):529-63.
[6]. Wainwright C. Acute viral Bronchiolitis in children-a very common condition with few therapeutic options. Paediatric respiratory reviews. 2010 Mar 1;11(1):39-45.
[7]. Sigurs N, Aljassim F, Kjellman B, Robinson PD, Sigurbergsson F, Bjarnason R, Gustafsson PM. Asthma and allergy patterns over 18 years after severe RSV Bronchiolitis in the first year of life. Thorax. 2010 Dec 1;65(12):1045-52.
[8]. Henderson J, Hilliard TN, Sherriff A, Stalker D, Shammari NA, Thomas HM, ALSPAC Study Team. Hospitalization for RSV Bronchiolitis before 12 months of age and subsequent asthma, atopy and wheeze: a longitudinal birth cohort study.

Pediatric allergy and immunology. 2005 Aug;16(5):386-92.
[9]. Mikalsen IB, Halvorsen T, Øymar K. Response to letter. Pediatric Pulmonology. 2013 Aug 13;9(48):936-.
[10]. Jartti T, Lehtinen P, Vuorinen T, Ruuskanen O. Bronchiolitis: age and previous wheezing episodes are linked to viral etiology and atopic characteristics. The Pediatric infectious disease journal. 2009 Apr 1;28(4):311-7.
[11]. Carroll KN, Gebretsadik T, Griffin MR, Wu P, Dupont WD, Mitchel EF, Enriquez R, Hartert TV. Increasing burden and risk factors for Bronchiolitis-related medical visits in infants enrolled in a state health care insurance plan. Pediatrics. 2008 Jul;122(1):58-64.
[12]. Fjaerli HO, Farstad T, Bratlid D. Hospitalisations for respiratory syncytial virus Bronchiolitis in Akershus, Norway, 1993–2000: a population-based retrospective study. BMC pediatrics. 2004 Dec;4(1):1-7.
[13]. Murray J, Bottle A, Sharland M, Modi N, Aylin P, Majeed A, Saxena S, Medicines for Neonates Investigator Group. Risk factors for hospital admission with RSV Bronchiolitis in England: a population-based birth cohort study. PloS one. 2014 Feb 26;9(2):e89186.
[14]. Birkhaug IM, Inchley CS, Aamodt G, Ånestad G, Nystad W, Nakstad B. Infectious burden of respiratory syncytial virus in relation to time of birth modifies the risk of lower respiratory tract infection in infancy: the Norwegian Mother and Child Cohort. The Pediatric Infectious Disease Journal. 2013 Jun 1;32(6):e235-41.
[15]. Midulla F, Scagnolari C, Bonci E, Pierangeli A, Antonelli G, De Angelis D, Berardi R, Moretti C. Respiratory syncytial virus, human bocavirus and rhinovirus Bronchiolitis in infants. Archives of disease in childhood. 2010 Jan 1;95(1):35-41.
[16]. Stensballe LG, Devasundaram JK, SIMOES EA. Respiratory syncytial virus epidemics: the ups and downs of a seasonal virus. The Pediatric infectious disease journal. 2003 Feb 1;22(2):S21-32.
[17]. Seemungal T, Harper-Owen R, Bhowmik A, Moric I, Sanderson G, Message S, MacCALLUM PE, Meade TW, Jeffries DJ, Johnston SL, Wedzicha JA. Respiratory viruses, symptoms, and inflammatory markers in acute exacerbations and stable chronic obstructive pulmonary disease. American journal of respiratory and critical care medicine. 2001 Nov 1;164(9):1618-23.
[18]. Fleming DM, Pannell RS, Cross KW. Mortality in children from influenza and respiratory syncytial virus. Journal of Epidemiology & Community Health. 2005 Jul 1;59(7):586-90.
[19]. Thompson WW, Shay DK, Weintraub E, Brammer L, Cox N, Anderson LJ, Fukuda K. Mortality associated with influenza and respiratory syncytial virus in the United States. Jama. 2003 Jan 8;289(2):179-86.
[20]. Panickar JR, Dodd SR, Smyth RL, Couriel JM. Trends in deaths from respiratory illness in children in England and Wales from 1968 to 2000. Thorax. 2005 Dec 1;60(12):1035-8.
[21]. Midulla F, Pierangeli A, Cangiano G, Bonci E, Salvadei S, Scagnolari C, Moretti C, Antonelli G, Ferro V, Papoff P. Rhinovirus Bronchiolitis and recurrent wheezing: 1-year follow-up. European Respiratory Journal. 2012 Feb 1;39(2):396-402.
[22]. Skjerven HO, Hunderi JO, Brügmann-Pieper SK, Brun AC, Engen H, Eskedal L, Haavaldsen M, Kvenshagen B, Lunde J, Rolfsjord LB, Siva C. Racemic adrenaline and inhalation strategies in acute Bronchiolitis. New England Journal of Medicine. 2013 Jun 13;368(24):2286-93.
[23]. Mikalsen IB, Halvorsen T, Øymar K. The outcome after severe Bronchiolitis is related to gender and virus. Pediatric allergy and immunology. 2012 Jun;23(4):391-8.
[24]. Brand HK, de Groot R, Galama JM, Brouwer ML, Teuwen K, Hermans PW, Melchers WJ, Warris A. Infection with multiple viruses is not associated with increased disease severity in children with Bronchiolitis. Pediatric pulmonology. 2012 Apr;47(4):393-400.
[25]. Siezen CL, Bont L, Hodemaekers HM, Ermers MJ, Doornbos G, Van't Slot R, Wijmenga C, van Houwelingen HC, Kimpen JL, Kimman TG, Hoebee B. Genetic susceptibility to respiratory syncytial virus Bronchiolitis in preterm children is associated with airway

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

remodeling genes and innate immune genes. The Pediatric infectious disease journal. 2009 Apr 1;28(4):333-5.

[26]. Bordley WC, Viswanathan M, King VJ, Sutton SF, Jackman AM, Sterling L, Lohr KN. Diagnosis and testing in Bronchiolitis: a systematic review. Archives of pediatrics & adolescent medicine. 2004 Feb 1;158(2):119-26.

[27]. Johnson LW, Robles J, Hudgins A, Osburn S, Martin D, Thompson A. Management of Bronchiolitis in the emergency department: impact of evidence-based guidelines?. Pediatrics. 2013 Mar;131(Supplement_1):S103-9.

[28]. Ferronato ÂE, Gilio AE, Ferraro AA, Paulis MD, Vieira SE. Etiological diagnosis reduces the use of antibiotics in infants with Bronchiolitis. Clinics. 2012;67:1001-6.

[29]. Ralston S, Garber M, Narang S, Shen M, Pate B, Pope J, Lossius M, Croland T, Bennett J, Jewell J, Krugman S. Decreasing unnecessary utilization in acute Bronchiolitis care: results from the value in inpatient pediatrics network. Journal of hospital medicine. 2013 Jan;8(1):25-30.

[30]. Akenroye AT, Baskin MN, Samnaliev M, Stack AM. Impact of a Bronchiolitis guideline on ED resource use and cost: a segmented time-series analysis. Pediatrics. 2014 Jan;133(1):e227-34.

[31]. Parikh K, Hall M, Teach SJ. Bronchiolitis management before and after the AAP guidelines. Pediatrics. 2014 Jan;133(1):e1-7.

[32]. Mansbach JM, Piedra PA, Teach SJ, Sullivan AF, Forgey T, Clark S, Espinola JA, Camargo CA, MARC-30 Investigators. Prospective multicenter study of viral etiology and hospital length of stay in children with severe Bronchiolitis. Archives of pediatrics & adolescent medicine. 2012 Aug 1;166(8):700-6.

[33]. Schuh S, Lalani A, Allen U, Manson D, Babyn P, Stephens D, MacPhee S, Mokanski M, Khaikin S, Dick P. Evaluation of the utility of radiography in acute Bronchiolitis. The Journal of pediatrics. 2007 Apr 1;150(4):429-33.

[34]. Mahabee-Gittens EM, Bachman DT, Shapiro ED, Dowd MD. Chest radiographs in the pediatric emergency department for children≤ 18 months of age with wheezing. Clinical pediatrics. 1999 Jul;38(7):395-9.

[35]. Viswanathan M, King VJ, Bordley C, Honeycutt AA, Wittenborn J, Jackman AM, Sutton SF, Lohr KN. Management of Bronchiolitis in infants and children. Evidence report/technology assessment (Summary). 2003 Jan 1(69):1-5.

[36]. Gillies D, Wells D. Positioning for acute respiratory distress in hospitalised infants and children. Cochrane Database of Systematic Reviews. 2005(2).

[37]. Miller ST. How I treat acute chest syndrome in children with sickle cell disease. Blood, The Journal of the American Society of Hematology. 2011 May 19;117(20):5297-305.

[38]. Unger S, Cunningham S. Effect of oxygen supplementation on length of stay for infants hospitalized with acute viral Bronchiolitis. Pediatrics. 2008 Mar;121(3):470-5.

[39]. Schroeder AR, Marmor AK, Pantell RH, Newman TB. Impact of pulse oximetry and oxygen therapy on length of stay in Bronchiolitis hospitalizations. Archives of pediatrics & adolescent medicine. 2004 Jun 1;158(6):527-30.

[40]. Kugelman A, Raibin K, Dabbah H, Chistyakov I, Srugo I, Even L, Bzezinsky N, Riskin A. Intravenous fluids versus gastric-tube feeding in hospitalized infants with viral Bronchiolitis: a randomized, prospective pilot study. The Journal of pediatrics. 2013 Mar 1;162(3):640-2.

[41]. Oakley E, Babl FE, Acworth J, Borland M, Kreiser D, Neutze J, Theophilos T, Donath S, South M, Davidson A. A prospective randomised trial comparing nasogastric with intravenous hydration in children with Bronchiolitis (protocol) The comparative rehydration in Bronchiolitis study (CRIB). BMC pediatrics. 2010 Dec;10(1):1-8.

[42]. Hernandez E, Khoshoo V, Thoppil D, Edell D, Ross G. Aspiration: a factor in rapidly deteriorating Bronchiolitis in previously healthy infants?. Pediatric pulmonology. 2002 Jan;33(1):30-1.

[43]. Kennedy N, Flanagan N. Is nasogastric fluid therapy a safe alternative to the intravenous route in infants with Bronchiolitis?. Archives of Disease in Childhood. 2005 Mar 1;90(3):320-1.

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

[44]. Atzei A, Atzori L, Moretti C, Barberini L, Noto A, Ottonello G, Pusceddu E, Fanos V. Metabolomics in paediatric respiratory diseases and Bronchiolitis. The Journal of Maternal-Fetal & Neonatal Medicine. 2011 Oct 1;24(sup2):59-62.

[45]. Oakley E, Borland M, Neutze J, Acworth J, Krieser D, Dalziel S, Davidson A, Donath S, Jachno K, South M, Theophilos T. Nasogastric hydration versus intravenous hydration for infants with Bronchiolitis: a randomised trial. The Lancet Respiratory Medicine. 2013 Apr 1;1(2):113-20.

[46]. Brand PL, Vaessen-Verberne AA. Differences in management of Bronchiolitis between hospitals in The Netherlands. European journal of pediatrics. 2000 Apr;159(5):343-7.

[47]. Babl FE, Sheriff N, Neutze J, Borland M, Oakley E. Bronchiolitis management in pediatric emergency departments in Australia and New Zealand: a PREDICT study. Pediatric emergency care. 2008 Oct 1;24(10):656-8.

[48]. van Steensel-Moll HA, Hazelzet JA, van der Voort E, Neijens HJ, Hackeng WH. Excessive secretion of antidiuretic hormone in infections with respiratory syncytial virus. Archives of disease in childhood. 1990 Nov 1;65(11):1237-9.

[49]. Gozal D, Colin AA, Jaffe M, Hochberg Z. Water, electrolyte, and endocrine homeostasis in infants with Bronchiolitis. Pediatric research. 1990 Feb;27(2):204-9.

[50]. Mandelberg A, Amirav I. Hypertonic saline or high volume normal saline for viral Bronchiolitis: mechanisms and rationale. Pediatric pulmonology. 2010 Jan;45(1):36-40.

[51]. Zhang L, Mendoza-Sassi RA, Wainwright C, Klassen TP. Nebulised hypertonic saline solution for acute Bronchiolitis in infants. Cochrane database of systematic reviews. 2017(12).

[52]. Chen YJ, Lee WL, Wang CM, Chou HH. Nebulized hypertonic saline treatment reduces both rate and duration of hospitalization for acute Bronchiolitis in infants: an updated meta-analysis. Pediatrics & Neonatology. 2014 Dec 1;55(6):431-8.

[53]. Jacobs JD, Foster M, Wan J, Pershad J. 7% Hypertonic saline in acute Bronchiolitis: a randomized controlled trial. Pediatrics. 2014 Jan;133(1):e8-13.

[54]. Hartling L, Bialy LM, Vandermeer B, Tjosvold L, Johnson DW, Plint AC, Klassen TP, Patel H, Fernandes RM. Epinephrine for Bronchiolitis. Cochrane Database of Systematic Reviews. 2011(6).

[55]. Gadomski AM, Scribani MB. Bronchodilators for Bronchiolitis. Cochrane database of systematic reviews. 2014(6).

[56]. Hartling L, Fernandes RM, Bialy L, Milne A, Johnson D, Plint A, Klassen TP, Vandermeer B. Steroids and bronchodilators for acute Bronchiolitis in the first two years of life: systematic review and meta-analysis. Bmj. 2011 Apr 6;342.

[57]. Fernandes RM, Bialy LM, Vandermeer B, Tjosvold L, Plint AC, Patel H, Johnson DW, Klassen TP, Hartling L. Glucocorticoids for acute viral Bronchiolitis in infants and young children. Cochrane Database of Systematic Reviews. 2010(10).

[58]. Van Woensel JB, Van Aalderen WM, De Weerd W, Jansen NJ, Van Gestel JP, Markhorst DG, Van Vught AJ, Bos AP, Kimpen JL. Dexamethasone for treatment of patients mechanically ventilated for lower respiratory tract infection caused by respiratory syncytial virus. Thorax. 2003 May 1;58(5):383-7.

[59]. Plint AC, Johnson DW, Patel H, Wiebe N, Correll R, Brant R, Mitton C, Gouin S, Bhatt M, Joubert G, Black KJ. Epinephrine and dexamethasone in children with Bronchiolitis. New England Journal of Medicine. 2009 May 14;360(20):2079-89.

[60]. Spurling GK, Doust J, Del Mar CB, Eriksson L. Antibiotics for Bronchiolitis in children. Cochrane Database of systematic reviews. 2011(6).

[61]. Thorburn K, Harigopal S, Reddy V, Taylor N, Van Saene HK. High incidence of pulmonary bacterial co-infection in children with severe respiratory syncytial virus (RSV) Bronchiolitis. Thorax. 2006 Jul 1;61(7):611-5.

[62]. Ventre K, Randolph A. Ribavirin for respiratory syncytial virus infection of the lower respiratory tract in infants and young children. Cochrane Database of Systematic Reviews. 2007(1).

[63]. Jat KR, Chawla D. Surfactant therapy for Bronchiolitis in critically ill infants. Cochrane database of systematic reviews. 2015(8).
[64]. Boogaard R, Hulsmann AR, van Veen L, Vaessen-Verberne AA, Yap YN, Sprij AJ, Brinkhorst G, Sibbles B, Hendriks T, Feith SW, Lincke CR. Recombinant human deoxyribonuclease in infants with respiratory syncytial virus Bronchiolitis. Chest. 2007 Mar 1;131(3):788-95.
[65]. Donlan M, Fontela PS, Puligandla PS. Use of continuous positive airway pressure (CPAP) in acute viral Bronchiolitis: a systematic review. Pediatric pulmonology. 2011 Aug;46(8):736-46.
[66]. Greenough A. Role of ventilation in RSV disease: CPAP, ventilation, HFO, ECMO. Paediatric respiratory reviews. 2009 Jun 1;10:26-8.
[67]. Thia LP, McKenzie SA, Blyth TP, Minasian CC, Kozlowska WJ, Carr SB. Randomised controlled trial of nasal continuous positive airways pressure (CPAP) in Bronchiolitis. Archives of disease in childhood. 2008 Jan 1;93(1):45-7.
[68]. Milési C, Matecki S, Jaber S, Mura T, Jacquot A, Pidoux O, Chautemps N, Novais AR, Combes C, Picaud JC, Cambonie G. 6 cmH2O continuous positive airway pressure versus conventional oxygen therapy in severe viral Bronchiolitis: a randomized trial. Pediatric Pulmonology. 2013 Jan;48(1):45-51.
[69]. Cambonie G, Milési C, Jaber S, Amsallem F, Barbotte E, Picaud JC, Matecki S. Nasal continuous positive airway pressure decreases respiratory muscles overload in young infants with severe acute viral Bronchiolitis. Intensive care medicine. 2008 Oct;34(10):1865-72.
[70]. Lazner MR, Basu AP, Klonin H. Non-invasive ventilation for severe Bronchiolitis: Analysis and evidence. Pediatric pulmonology. 2012 Sep;47(9):909-16.
[71]. Campion A, Huvenne H, Leteurtre S, Noizet O, Binoche A, Diependaele JF, Cremer R, Fourier C, Sadik A, Leclerc F. Non-invasive ventilation in infants with severe infection presumably due to respiratory syncytial virus: feasibility and failure criteria. Archives de Pediatrie: OrganeOfficiel de La SocieteFrancaise de Pediatrie. 2006 Sep 15;13(11):1404-9.
[72]. Larrar S, Essouri S, Durand P, Chevret L, Haas V, Chabernaud JL, Leyronnas D, Devictor D. Effects of nasal continuous positive airway pressure ventilation in infants with severe acute Bronchiolitis. Archives de Pediatrie: OrganeOfficiel de la SocieteFrancaise de Pediatrie. 2006 Sep 7;13(11):1397-403.
[73]. Beasley JM, Jones SE. Continuous positive airway pressure in Bronchiolitis. Br Med J (Clin Res Ed). 1981 Dec 5;283(6305):1506-8.
[74]. Essouri S, Durand P, Chevret L, Balu L, Devictor D, Fauroux B, Tissières P. Optimal level of nasal continuous positive airway pressure in severe viral Bronchiolitis. Intensive care medicine. 2011 Dec;37(12):2002-7.
[75]. Gluck EH, Onorato DJ, Castriotta R. Helium-oxygen mixtures in intubated patients with status asthmaticus and respiratory acidosis. Chest. 1990 Sep 1;98(3):693-8.
[76]. Martinón-Torres F, Rodríguez-Núñez A, Martinón-Sánchez JM. Nasal continuous positive airway pressure with heliox in infants with acute Bronchiolitis. Respiratory medicine. 2006 Aug 1;100(8):1458-62.
[77]. Mayordomo-Colunga J, Medina A, Rey C, Concha A, Los Arcos M, Menéndez S. Helmet-delivered continuous positive airway pressure with heliox in respiratory syncytial virus Bronchiolitis. Acta Paediatrica. 2010 Feb;99(2):308-10.
[78]. Martinon-Torres F , Rodriguez-Nunez A , Martinón-Sánchez JM . Nasal continuous positive airway pressure with heliox versus air oxygen in infants with acute Bronchiolitis: a crossover study. Pediatrics. 2008 May;121(5):e1190-5.
[79]. Chowdhury MM, McKenzie SA, Pearson CC, Carr S, Pao C, Shah AR, Reus E, Eliahoo J, Gordon F, Bland H, Habibi P. Heliox therapy in Bronchiolitis: phase III multicenter double-blind randomized controlled trial. Pediatrics. 2013 Apr;131(4):661-9.
[80]. Evans J, Marlais M, Abrahamson E. Clinical predictors of nasal continuous positive airway pressure requirement in acute Bronchiolitis. Pediatric pulmonology. 2012 Apr;47(4):381-5.

International Journal of Pharmaceutical Research and Applications
Volume 7, Issue 5 Sep-Oct 2022, pp: 1176-1188 www.ijprajournal.com ISSN: 2456-4494

[81]. McKiernan C, Chua LC, Visintainer PF, Allen H. High flow nasal cannulae therapy in infants with Bronchiolitis. The Journal of pediatrics. 2010 Apr 1;156(4):634-8.
[82]. Thorburn K, Ritson P. Heated, humidified high-flow nasal cannula therapy in viral Bronchiolitis—Panacea, passing phase, or progress?. Pediatric Critical Care Medicine. 2012 Nov 1;13(6):700-1.
[83]. Lee JH, Rehder KJ, Williford L, Cheifetz IM, Turner DA. Use of high flow nasal cannula in critically ill infants, children, and adults: a critical review of the literature. Intensive care medicine. 2013 Feb;39(2):247-57.
[84]. Arora B, Mahajan P, Zidan MA, Sethuraman U. Nasopharyngeal airway pressures in Bronchiolitis patients treated with high-flow nasal cannula oxygen therapy. Pediatric emergency care. 2012 Nov 1;28(11):1179-84.
[85]. Abboud PA, Roth PJ, Skiles CL, Stolfi A, Rowin ME. Predictors of failure in infants with viral Bronchiolitis treated with high-flow, high-humidity nasal cannula therapy. Pediatric Critical Care Medicine. 2012 Nov 1;13(6):e343-9.
[86]. Schibler A, Pham TM, Dunster KR, Foster K, Barlow A, Gibbons K, Hough JL. Reduced intubation rates for infants after introduction of high-flow nasal prong oxygen delivery. Intensive care medicine. 2011 May;37(5):847-52.
[87]. Haq I, Gopalakaje S, Fenton AC, McKean MC, O'Brien CJ, Brodlie M. The evidence for high flow nasal cannula devices in infants. Paediatric respiratory reviews. 2014 Jun 1;15(2):124-34.
[88]. Bressan S, Balzani M, Krauss B, Pettenazzo A, Zanconato S, Baraldi E. High-flow nasal cannula oxygen for Bronchiolitis in a pediatric ward: a pilot study. European journal of pediatrics. 2013 Dec;172(12):1649-56.
[89]. Manley BJ, Dold SK, Davis PG, Roehr CC. High-flow nasal cannulae for respiratory support of preterm infants: a review of the evidence. Neonatology. 2012;102(4):300-8.
[90]. Milési C, Baleine J, Matecki S, Durand S, Combes C, Novais AR, Combonie G. Is treatment with a high flow nasal cannula effective in acute viral Bronchiolitis? A physiologic study. Intensive care medicine. 2013 Jun;39(6):1088-94.
[91]. Klingenberg C, Pettersen M, Hansen EA, Gustavsen LJ, Dahl IA, Leknessund A, Kaaresen PI, Nordhov M. Patient comfort during treatment with heated humidified high flow nasal cannulae versus nasal continuous positive airway pressure: a randomised cross-over trial. Archives of Disease in Childhood-Fetal and Neonatal Edition. 2014 Mar 1;99(2):F134-7.
[92]. Beggs S, Wong ZH, Kaul S, Ogden KJ, Walters JA. High-flow nasal cannula therapy for infants with Bronchiolitis. Cochrane Database of Systematic Reviews. 2014(1).
[93]. Hegde S, Prodhan P. Serious air leak syndrome complicating high-flow nasal cannula therapy: a report of 3 cases. Pediatrics. 2013 Mar;131(3):e939-44.
[94]. Flamant C, Hallalel F, Nolent P, Chevalier JY, Renolleau S. Severe respiratory syncytial virus Bronchiolitis in children: from short mechanical ventilation to extracorporeal membrane oxygenation. E
[95]. Mansbach JM, Piedra PA, Stevenson MD, Sullivan AF, Forgey TF, Clark S, Espinola JA, Camargo Jr CA. Prospective multicenter study of children with Bronchiolitis requiring mechanical ventilation. Pediatrics. 2012 Sep;130(3):e492-500.
[96]. Leclerc F, Scalfaro P, Noizet O, Thumerelle C, Dorkenoo A, Fourier C. Mechanical ventilatory support in infants with respiratory syncytial virus infection. Pediatric Critical Care Medicine. 2001 Jul 1;2(3):197-204.
[97]. Berner ME, Hanquinet S, Rimensberger PC. High frequency oscillatory ventilation for respiratory failure due to RSV Bronchiolitis. Intensive care medicine. 2008 Sep;34(9):1698-702.
[98]. Harris JA, Huskins WC, Langley JM, Siegel JD, Pediatric Special Interest Group of the Society for Healthcare Epidemiology of America. Health care epidemiology perspective on the October 2006 recommendations of the Subcommittee on Diagnosis and Management of Bronchiolitis. Pediatrics. 2007 Oct;120(4):890-2.
[99]. Hall CB, Douglas Jr RG, Geiman JM. Possible transmission by fomites of respiratory syncytial virus. Journal of Infectious Diseases. 1980 Jan 1;141(1):98-102.

[100]. Aintablian N, Walpita P, Sawyer MH. Detection of Bordetella pertussis and respiratory syncytial virus in air samples from hospital rooms. Infection Control & Hospital Epidemiology. 1998 Dec;19(12):918-23.

[101]. Szabo SM, Levy AR, Gooch KL, Bradt P, Wijaya H, Mitchell I. Elevated risk of asthma after hospitalization for respiratory syncytial virus infection in infancy. Paediatric respiratory reviews. 2013 Jan 1;13:S9-15.

[102]. Stein RT. Long-term airway morbidity following viral LRTI in early infancy: recurrent wheezing or asthma?. Paediatric Respiratory Reviews. 2009 Jun 1;10:29-31.

[103]. Hyvärinen M, Piippo-Savolainen E, Korhonen K, Korppi M. Teenage asthma after severe infantile Bronchiolitis or pneumonia. Acta Paediatrica. 2005 Oct;94(10):1378-83.

[104]. Régnier SA, Huels J. Association between respiratory syncytial virus hospitalizations in infants and respiratory sequelae: systematic review and meta-analysis. The Pediatric infectious disease journal. 2013 Aug 1;32(8):820-6.

[105]. Beigelman A, Bacharier LB. The role of early life viral Bronchiolitis in the inception of asthma. Current opinion in allergy and clinical immunology. 2013 Apr;13(2):211.