PEDIATRICS AND NEONATAL NURSING

Review

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Nursing Care of Infants and Children With Bronchiolitis

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ABSTRACT

Bronchiolitis is the most common cause of lower respiratory infection in the first year of life. It is a leading cause of acute illness and hospitalization for infants and young children worldwide. Previous studies have demonstrated that at least 1% of children younger than 24 months of age are hospitalized for bronchiolitis. These hospitalizations have been found to consume a significant amount of health care resources. The primary treatment of bronchiolitis remains largely supportive with administration of fluids and supplementary oxygen, observation and mechanical ventilation if needed. Other types of treatment remain controversial. Successful treatment of this diagnosis requires coordination of care of a multidisciplinary team. Pediatric nurses and advanced practice pediatric nurses in both primary and acute care clinical settings can play a major role in educating other health care professionals on the use of Evidence-based practice and why it is important to decrease costs and improve patients' outcome by changing the traditional and habitual use of diagnostic and therapeutic options that are no longer recommended by the most recent guidelines. The purpose of this review was to identify the best evidence available for the updated management of infants and children with bronchiolitis. This updated simplified management of infants with bronchiolitis would result in not only decreasing the cost of care but also result in a better outcome as mentioned in guidelines according to the recent literature.

KEYWORDS: Bronchiolitis; Respiratory syncytial virus; Bronchiolitis management; Nursing care.

ABBREVIATIONS: RSV: Respiratory Syncytial Virus; LOS: Length of hospital stay; RR: Respiratory Rate; NG: Nasogastric; ADH: Antidiuretic Hormone; HS: Hypertonic Saline; CPT: Chest physiotherapy; ED: Emergency Department; HFNC: Humidified High-Flow Nasal Cannula; CPAP: Continuous Positive Airway Pressure; BPD: Broncho-pulmonary dysplasia; CF: Cystic Fibrosis.

EPIDEMIOLOGY

Respiratory Syncytial Virus (RSV) accounts for 60-85% of cases. Rhinovirus, human metapneumovirus,[1] adenovirus, parainfluenza, influenza, paramyxovirus (hMPV), Bocovirus or co-infection occur in 10-30% of cases.[2] Associated bacterial infection was observed in 10% of cases.[2-4] The incubation period is approximately 4 days, but the virus can be shed from nasal secretions for up to 3 weeks.

Bronchiolitis is highly contagious. The virus spread from person to person through direct contact with nasal or oral secretions, airborne droplets and fomites. RSV found in acute infection can survive on hard surface for approximately 6 hours and on soft surfaces for upto 30 minutes.[5]

CLINICAL PRESENTATION

Infants become fussy and have difficulty with feeding.[6] They are present with low grade fever, hypothermia in younger infants, running nose, and irritating cough.[7,8] Concomitant otitis media is common.[8] Apnea may occur particularly in low-birth weight and preterm babies.[8,9]

Severe cases may progress over 2 to 5 days to the following signs and symptoms due to spread of virus to lower respiratory tract:[10] Cough, dyspnea, nasal flaring, tachypnea, tachycardia, irritability, fever, retractions, prolonged expiration, fine crackles (47%), diffuse fine wheezing, hypoxia and over-expanded chest.[2,8,11]

RISK FACTORS FOR SEVERE DISEASE

Lower birth weight, younger gestational age,[3] age<12 weeks,[12] lower post-natal weight, caesarean section delivery,[2] underlying cardiopulmonary disease, immunodeficiency,[3,12] cystic fibrosis,[13] and multiple congenital anomalies.[14] The main risk factor for hospitalization is chronologic age, with 58-64% occurring in first 5 months after birth.[15] Other risk factors are positive RSV result, maternal age between 15-19 years, and maternal history of asthma and/or smoking.[3,16]

IMPORTANT NURSING ISSUES

Good bed-side nursing care involves the recognition of deterioration that will necessitate treatment.[8]

Repeated Clinical Assessment

Scheduled intermittent checks of pulse oximetry and heart rate should be done. The use of supplemental oxygen therapy is recommended when SpO_2 falls consistently below 90%. Factors to monitor include: cardiopulmonary monitoring, signs of increasing difficulty in feeding and associated risk of pulmonary aspiration, fatigue, work of breathing, and apneic episodes. Minimizing the impact of procedures (e.g. cannulation) as well as giving support and education to parents is also important.[8]

Nursing Management at Home

Home O_2 is increasingly being used in patients with uncomplicated bronchiolitis and on-going hypoxia to reduce hospital admission and LOS.[3] Health setting at home is focused on improving respiratory functions, preventing dehydration and promptly identifying worsening respiratory functions.[17] Patient positioning should promote comfort and breathing. Activity that induce agitation should be avoided.[3,17]

Patient Education

Education should be provided regarding the following:
• Natural history of bronchiolitis.

• Importance of RSV prophylaxis for high-risk patients.
• Importance of avoiding RSV exposure in the first 2-3 months of life and contact with ill people and day-care centers.[2]
• The importance of breast feeding, and avoidance of smoke.[12,18]
• The importance of vitamin D supplementation should be emphasized as a prospective birth cohort study demonstrated 6-folds risk of bronchiolitis if vitamin D is deficient.[19]
• Methods for limiting transmission (hand washing and avoiding childcare centers while ill).[12]
• Criteria for return to the ED.[2]

Prevention of nosocomial transmission of infection

The following actions are needed as: Isolation or cohort nursing away from high risk infants,[8] strict hands washing before and after direct contact with objects in the patients' vicinity and after glove removal.[20]

Alcohol-based rubs or antimicrobial soap should also be used[21] plus the use of gloves, gowns, and face masks.[3,18]

Nursing role in updating the management according to the most recent guidelines and in advising other health professionals to omit some unnecessary diagnostic and therapeutic options. The justified use of only 2 or 3 truly needed diagnostic tests and also the concentration on the supportive treatment with oxygen, gentle suction and hydration instead of using unnecessary therapeutic options as bronchodilators, antiviral drugs, corticosteroids and/or antibiotics as discussed in the following section.

DIAGNOSIS

The most common tests used in hospitalized cases with bronchiolitis, although most that are unnecessary, are:

1. Rapid viral antigen testing of nasopharyngeal secretions for RSV. Although this test has little significance on outcome it may influence treatment as physicians tend to stop antibiotics if it is positive. However AAP guidelines reported that it is unnecessary [12] as multiple viruses may cause bronchiolitis.[3,12]

2. Arterial blood gases: ABG analysis.[9]

3. WBCs and differential

4. C-reactive protein (CRP level)

5. ECG or Echocardiography is reserved to cases with arrhythmia or cardiomegaly.[2]

6. Chest radiography: It is not routinely necessary. Findings from chest radiography are variable. Hyperinflation is usually present and 20-30% show lobar infiltration, atelectasis or both. Other findings are bronchial wall thickening, flattened diaphragm, increased AP diameter, peri-bronchial cuffing, tiny nodules and linear opacities.[22]

7. Pulse oximetry is a good indicator of severity and if it is per-

sistently <92% indicates possible need for hospitalization.[2]

8. Electrolytes if the child needs IV fluids.[3]

9. Blood culture if temp > 38.5 ºC.[8]

10. Other investigations are done only when needed as: Urine analysis and culture, CSF analysis and culture or urine specific gravity.[2]

Cultures and chest radiography and even CBC are unnecessary in previously healthy children as the risk of secondary bacterial infection is low.[2,22] These tests are considered only in severe disease, or very ill appearance, infants<3 months,[9] pre-existing cardiac or pulmonary disease, a markedly elevated temperature or other risk factor of more severe disease or when alternative diagnosis is suspected.[3,8,9]

In conclusion, many diagnostic tests for bronchiolitis are not needed in most cases. Diagnosis is based on clinical presentation, patient age, seasonal occurrence and findings from the physical examination. Few laboratory tests are necessary as oximetry and serum electrolytes. Other tests are sometimes needed to exclude other diagnoses as pneumonia, heart failure or sepsis.

The pediatric nurse has an important role here, to advise other health care professionals to exclude unnecessary diagnostic tests as radiology and viral detection to help to decrease the cost of management

TREATMENT

DiNicola is an extensive review that states most therapies used to treat bronchiolitis are still controversial.[2] The authors addressed that issue extensively and reviewed previous literature and some of the guidelines till 2014.

Because no definitive treatment for the specific virus exists, therapy is directed toward symptomatic relief and maintenance of hydration and oxygenation.[2,23]

Supportive Care

Supplemental humidified Oxygen *via* nasal prongs, facemask or head box is the only intervention known to improve outcome as it decreases V/Q mismatch caused by air trapping[3,8] and is recommended for previously healthy infants with oxygen saturations <90%[21] or 92%.[2,8,9] It was reported that, 90-92% in the recovery phase of un-distressed child is accepted.[8] Pulse oximetry monitoring is reduced as the clinical condition improves.[25]

As mild hypoxia is a major reason for hospitalization, treatment at home with Home oxygen therapy for those with hypoxia without other indications for admission was found to decrease need for hospitalization by almost 2 days with no difference in outcome.[26]

Hydration

Mild cases should be fed more frequently in smaller amounts to be better tolerated and breast feeding shouldn't be suspended.[13] Moderate cases who cannot tolerate oral feeding and RR>50/minute should receive NG feeding.[2,18] Intravenous fluids are needed in breathless infants and those with risk of pulmonary aspiration.

Overall fluid intake should be restricted to two thirds of standard maintenance fluid requirement, with blood electrolytes monitoring because of the possibility of inappropriate ADH secretion.[3,9,20,25]

Nasal Suctioning and Saline Nasal Drops

Nasal congestion can be reduced by saline nasal drops (1-2 drops per nostril, 10-15 minutes before a feed 2-3 times/day for 3 days in hospitalized infant).[2,9,26] Nasal Suctioning may be used for inpatients. Superficial nasopharyngeal suctioning before inhalation and feeding and when needed may improve the work of breathing and feeding but excessive suctioning may increase nasal edema.[3,18,26]

Deep pharyngeal suctioning is not supported and is even associated with longer LOS.[20,27-29] The use of antihistamines, immunoglobulins, oral decongestants or nasal vasoconstrictors are not recommended.[12,21]

Hypertonic Saline (HS)

It enhances mucociliary clearance by decreasing mucus viscosity. Evidence showed that it may decrease LOS by 25% and decrease admission.[9,29] In addition, Zhang, et al.[30] found that nebulized hypertonic saline in conjunction with bronchodilator may be effective in treatment and is better than 0.9% saline.

However, other studies show no short-term improvement in respiratory distress in ED.[12,21] HS is mostly safe without bronchodilators, inexpensive and apparently effective as an adjunct treatment in inpatient setting but not in ED.[30,32-34]

As regard mist-steam inhalation, there is insufficient evidence to show any benefit.[13]

Bronchodilators: Short-Acting Beta2-Agonists

Beta-agonist effects reverse bronchoconstriction but evidence showed no difference in: hospital admission, LOS, oxygen saturation, or length of illness.[9,18] Some clinicians favour a trial of inhaled $beta_2$ agonists in a subset of patients (particularly>12 months age). Positive effects (25%) in clinical score after treatment may be observed but it is short-lived and should be weighed against potential adverse effects.[9]

Therefore it is not recommended for routine use and

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experience suggests only a trial especially in older patients>24 months, family history of asthma,[12] or past history of wheezing and/or asthma.[35,36] Bronchodilators should not be continued unless an objective evidence of improvement is observed.[2,21] Recent evidence recommends against even a trial of bronchodilators (AAP Guidelines published online 2014)[2,12] as its possible effect of small short improvement has to be balanced against the risks of side-effects and costs, and the fact that it may contribute to agitation and V/Q ratio mismatching.[20,36] Ipratropium bromide has not been shown to be useful in bronchiolitis. [8,37]

Bronchodilators: Racemic Epinephrine

Beta-agonist properties reverse bronchoconstriction, while alpha-agonist properties cause vasoconstriction and reduce oedema. Evidence support that it is superior to placebo for short-term outcomes hospitalization within 24 hours but has no effects on: inpatient clinical course, vital signs, LOS and readmissions.[2] It is not currently recommended as it is not superior to saline, therefore, should not be given.[2,9,12,20,38,39]

Chest Physiotherapy (CPT)

CPT does not improve disease severity, respiratory parameters, LOS, or oxygen requirements.[3] Therefore, it is not recommended and is even discouraged as it may increase distress and irritability or cause rib fracture.[12,20,25,39]

Corticosteroids

Although it has anti-inflammatory effect, there is no evidence to support its routine use as studies showed no difference compared to placebo as regards: Admissions at day 1 and 7 , LOS, and clinical score, therefore they are not effective and should not be used.[20,21,41,42]

Methyl-xanthine

As for RSV-bronchiolitis – associated apnoea, only cases series have shown a benefit of methyl-xanthine such as caffeine and theophylline as a consequence of their central respiratory stimulant effect while most severe cases may need ventilator support.[13]

Antibiotics

Concerns for bacterial infection: fever, young age, secondary infections, and severe cases. But evidence showed low rates of serious bacterial infection (1-12%). Urinary tract infection and acute otitis media are most common.[9] The use antibiotics should be restricted to those with specific indications for bacterial infection given that overuse increases overall antibiotic resistance.[13,20]

Azithromycin was tried because of its anti-inflammatory, immune-modulatory and antibacterial action but it didn't alter clinical outcome, so it is not recommended.[38]

Humidified High-Flow Nasal Cannula (HFNC)

It may washout nasopharyngeal dead space and overcome nasopharyngeal resistance with flow, causing positive distending pressure and improved conductance and compliance. Retrospective reviews showed decreased need for intubation, decreased RR and decreased LOS in PICU with no adverse effects.

On the other hand, it was concluded that there is insufficient evidence to determine the effectiveness of HFNC (no clear evidence of decreased duration of O_2 therapy or LOS).[43] It may be useful in severe illness, but is not recommended for routine use.[9,44,45]

Continuous Positive Airway Pressure (CPAP)

There is no conclusive evidence to recommend CPAP but it may be useful in severely distressed patients to avoid intubation, increasing O_2 requirements, apnoea or rising pCO_2.[3,9,45]

Intubation and mechanical ventilation

This is indicated for increasing hypoxia and respiratory failure despite the above measures. Exogenous surfactant administration and extracorporeal membrane oxygenation may also be considered in this subset of patients.[3,9]

Helium-Oxygen (Heliox)

Several studies have shown improved respiratory distress scores in patients breathing Heliox and have suggested that combined Heliox with nasal CPAP may render intubation unnecessary.[47] Helium has lower density than air so improve gas flow through high-resistance airways. It lower respiratory score and pCO_2 immediately but causes no reduction in rate of intubation, need for mechanical ventilation, or LOS in PICU. There is insufficient evidence for its recommendation as there is a need for larger trials with homogenous administration.[3,48]

Ribavirin

It is a broad-spectrum antiviral that inhibits RNA and DNA virus replication. Although it may reduce duration of mechanical ventilation and LOS; with possible decrease in subsequent wheezing episodes but the evidence showed that it has a controversial efficacy, it is expensive, cumbersome, has possible teratogenic and other health effects on caregivers. Therefore, it is not routinely recommended except in severe disease, or those at high risk for severe disease as immune-compromised, congenital heart disease, BPD, CF and other chronic lung diseases.[12] In addition, it may be recommended in hospitalized cases under 6 weeks or those having underlying multiple congenital anomalies or neurologic metabolic diseases.[20,49]

Palivizumab

A humanized monoclonal antibody directed against F (fusion) protein of RSV. Evidence showed a reduction in RSV-associated hospitalization in high-risk groups: chronic lung disease, congenital heart disease, and premature (<35 weeks gestation). However, there is no decrease in mortality or rate of recurrent wheeze; therefore, it is not cost-effective or beneficial for routine use in all infants. Owing to the expenses, its use is limited to patients at high risk of severe disease as healthy infants with gestational age <29 weeks or those with significant risk factors: Infants younger than 24 months who have hemodynamically significant congenital heart disease or who have chronic lung disease and are off oxygen or pulmonary medications for less than 6 months at the start of the RSV season.[9,12,20,50]

Leukotriene Receptor Antagonists

It is not currently recommended as it has no benefit compared with placebo in randomized trials as it did not shorten duration of illness.[51,52]

FUTURE PREVENTIVE, DIAGNOSTIC AND THERAPEUTIC PERSPECTIVES

Efforts to develop an RSV vaccine are ongoing.[53] Lambert, et al.[54] used BALB/c mice and cotton rats, two well-characterized rodent models of RSV infection, to evaluate the immunogenicity of intramuscularly administered RSV vaccine. These studies indicated that a protein subunit vaccine consisting of RSV sF + GLA-SE can induce robust neutralizing antibody and T cell responses to RSV, enhancing viral clearance.

Sun, et al.[55] found that maleic anhydride (ML)-modified human serum albumin (HSA), designated ML-HSA, administered intra-nasally before RSV infection had led to a significant reduction of viral titers in the lungs of mice. These results suggest that MLHSA is a promising therapeutic candidate for further development into an effective, safe, and affordable intranasal regimen for pre-exposure prophylaxis of RSV infection in high-risk populations. Intranasal administration of small interfering RNA targeting specific RSV gene expression may change the approach to the treatment of bronchiolitis in the future.[56]

Future research is needed regarding controversial issues as diagnostic and therapeutic options for cases with bronchiolitis like the need for laboratory testing or radiology and also the value of using combinations of HS, bronchodilator and/or Heliox in therapy.

To summarize, the updated management of bronchiolitis, the most common cause of hospitalization of infants less than 1 year, has excluded many diagnostic and therapeutic options. Updating the management by discarding unnecessary options to make the management cost-effective and to improve outcome.

Only 2 or 3 diagnostic tests are needed instead of 10 tests. The only therapy that is truly needed is the supportive treatment with oxygen, gentle suction and hydration. Pediatricians and pediatric nurses should discard un-necessary therapeutic options as bronchodilators, antiviral drugs, corticosteroids and/or antibiotics which are still used in many hospitals..

The efficient updated nursing role in the care of infants with bronchiolitis should include the prevention care, observation at hospital and at home, and health education to parents. Furthermore, it should include the task of changing physicians' habitual use of un-necessary diagnostic and therapeutic options according to the more recent guidelines.

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