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Original Research Article

A Study on Nebulized Hypertonic Saline in the Treatment of Acute Bronchiolitis in Infants and Children in a Teaching Hospital of Bihar

Naz Yasmeen[1], Amrit Raj[2], Prem Kumar[3], Mohammed Shamim[4], Nupur Kumari[3], Alka Singh[5]

[1]Senior Resident, Department of Paediatrics, Nalanda Medical College & Hospital, Patna, Bihar, India

[2]Senior Resident, Department of Paediatrics, Nalanda Medical College & Hospital, Patna, Bihar, India

[3]Senior Resident, Department of Paediatrics, Nalanda Medical College & Hospital, Patna, Bihar, India

[4]Senior Resident, Department of Paediatrics, Nalanda Medical College & Hospital, Patna, Bihar, India

[5]Professor & HOD, Department of Paediatrics, Nalanda Medical College & Hospital, Patna, Bihar, India

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Corresponding author: Dr. Mohammed Shamim

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Abstract

Background: Bronchiolitis is a common lower respiratory tract disease of infant and young children. Most episodes are caused by respiratory syncytial virus (RSV), although recently an increasing number of respiratory viruses have been incriminated in causing the same clinical syndrome. Bronchiolitis is the leading cause of hospitalization in infancy.

Aim: To study the efficacy of nebulized hypertonic saline in treatment of acute bronchiolitis

Materials and Methods: This prospective observational study was done on 110 babies between one month to 24 months of age who were admitted in a teaching hospital of Bihar over a period of one year from March 2022 to February 2023. All patients who fulfilled the inclusion criteria were give nebulized hypertonic saline (3% saline in our study). Hypertonic saline nebulizations were given every 6 hours to start with. Then after improvement in clinical severity score (CSS), frequency of nebulization was adjusted to every 8 hours. Clinical condition was analysed before and after nebulization.

Results: A total of 110 patients were included in the study of which majority (64, 58.18%) were males. Mean age was 5.75 ± 5.66 months. Mean respiratory rate at admission was 65.77±8.78 per minute, mean oxygen saturation was 89%, 63% of patients had chest retractions and 58% had wheezing. There was significant improvement in respiratory rate, oxygen saturation, chest retractions and wheezing after three consequent nebulizations.

Conclusion: 3% saline nebulization is an effective way to treat bronchiolitis. It significantly reduces CSS and length of hospital stay.

Keywords: Hypertonic Saline, Nebulization, Bronchiolitis, Respiratory Syncytial Virus.

Introduction

Bronchiolitis is a common viral disease that affects infants and young children, with respiratory syncytial virus being the primary causative agent[1]. Other etiological agents include parainfluenza, adenovirus, and mycoplasma. Human boca virus and human metapneumovirus are newly implicated agents[2,3]. RSV is a single-stranded RNA virus that belongs to the genus pneumovirus of the family paramyxoviridae. The virion of the RSV is enveloped with a lipid bi-layer and contains three surface glycoproteins: the attachment protein G, fusion protein F, and the small hydrophobic SH protein. These glycoproteins have different functions in pathogenesis[4].

The mean age at presentation of bronchiolitis is around 6 months, with a slight male preponderance, and most cases occur in the winter season. Infection is spread by direct contact with respiratory secretions, and epidemics last for 2-3 months, beginning in November and peaking in January or February. Although 93% of cases occur between November and early April, sporadic cases may occur throughout the year[6]. Only 1-2% of all children need hospitalization, and about 5-10% of hospitalized patients need mechanical ventilation[7]. However, it has been estimated that about 600,000 infants and young children die from RSV annually, which has a serious effect on healthcare expenditure. Nearly half of the patients develop recurrent episodes of wheezing up to the age of 11-12 years, which impacts considerably on their quality of life.

Bronchioles are small airways (<2mm in diameter) and lack cartilage and submucosal glands. The terminal bronchiole, a 16th generation airway, is the final conducting airway that terminates in the respiratory bronchioles[8]. The acinus (i.e., the gas exchange unit of the lung) consists of respiratory bronchioles, the alveolar duct, and alveoli. The bronchiolar lining consists of surface-secreting Clara cells and neuroendocrine cells, which are the source of bioactive products such as somatostatin and serotonin. Bronchiolitis causes thickening of bronchioles, leading to marked generalized emphysema, patchy consolidation, atelectasis, and abnormal linear shadows on chest X-ray[8,9]. Host factors such as male gender, formula feeding, overcrowding, maternal smoking during pregnancy, and younger maternal age increase the risk of bronchiolitis. Bronchiolitis is diagnosed clinically based on a constellation of symptoms and signs, with mild, moderate, and severe categories based on the severity of the symptoms[10,11]. Mild cases can be managed at home, and moderate cases may require hospital admission for oxygen therapy. Severe cases require intensive care. Bronchodilators are used on a trial basis, with intravenous fluids only used if the patient is unable to tolerate oral feeds[12].

Methods

A prospective observational study was carried out for a period of 12 months from March 2022 to February 2023. Ethical committee approval was obtained from the institution for this study.

One hundred and ten children between the age group of 1 month to 24 months with signs and symptoms of Acute Bronchiolitis admitted to Nalanda Medical College and Hospital, Patna formed the study group. Written consent was obtained from parents of every patient at the time of enrollment. Detailed history and clinical findings were recorded in a standardized proforma.

In this study, all the patients enrolled received inhalation of hypertonic saline solution. In our stud, 3% saline was considered as hypertonic saline. All patients received 6 nebulizations at 4 hourly intervals every day. On improvement, patients were given 4

nebulizations at 6 hourly intervals, until the patient was ready to for discharge. Nebulizations were given using a nebulization chamber, routinely available in our ward connected to a source of pressurized oxygen, from a central source, set to flow rate of 5-6 L/min. The nebulizers were administered until empty.

Relevant demographic, clinical data and laboratory investigations were obtained from each patient who included the following parameters:

- Relevant demographic profile of each patient, particularly: age sex address etc.
- Relevant history of previous wheezing episodes, cardiac disease, gestational age, and mode of delivery.
- Vital parameters (heart rate, respiratory rate, saturation), presence of cyanosis, pallor, and chest retraction.
- In systemic examination, emphasis will be laid on breath sounds and presence of wheezing or with crackles.
- Complete blood counts.
- Chest x-ray.

All children with mild and moderate bronchiolitis were started on standard treatment protocol with oxygen therapy, saturation monitoring, fluid and electrolyte management.

Inclusioncriteria

- All children aged between1month to24 months with first episode of acute mild and moderate bronchiolitis.

Exclusioncriteria

- Preexisting cardiac disease.
- Previous wheezing episode.
- Altered consciousness.
- Acute severe bronchiolitis with impending respiratory failure.

Statistical methods

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. Chi-square test and Mcnemar- Bowker test has been used to find the significance of study parameters on categorical scale among study group.

Results

During the study period, a total of 114 patients were admitted with a clinical diagnosis of bronchiolitis. 111 of them were eligible for the study, one of them was excluded in view of pervious wheezing episodes. 4 among 114 were excluded in view of prior treatment with steroids from the referring hospital, parents did not consent for treatment and left against the medical advice excluded .Finally, 110 patients were included for the analysis. The 110 patients were treated with hypertonic saline during the study. In our study, we found that most of our patients were admitted during the first year of life. The mean age of the participants was 5.75±5.66 months. The youngest being 1 months and the oldest patient was 24 months of age. In our study, males were more commonly affected than females, no of males affected was 64 (58.18%) and females 46 (41.82%). In the present study, almost all the children had cough and 65% of children had fever, and 90% of children had cold as the associated complaints at the time of admission. At the time of admission, 69 patients had intercostals retractions. After 3 consecutive nebulizations, 65 out of 69 patients became normal, after consecutive nebulizations and respiratory distress decreased significantly. At the time of admission, 64 children had wheezing audible with stethoscope. After 3 consecutive nebulisations, 62 normalised (no wheezing). At the time of admission 94 children were irritable. After 3 consecutive nebulisations, 67(71%) became normal, and 27(29%) continued to have symptoms. At the time of admission mean clinical severity score of 110 patients was 6.87, after consecutive nebulizations,

mean score significantly decreased to 1.78, p value is <0.001. Complete haemogram and chest X-ray was done for all patients. The mean haemoglobin concentration in the study population was 10.37g/dl, and total leukocyte count was 11,299.09cells/cmm. Chest x-ray findings were within normal limits in 19% of the cases while 80.9 % subjects showed features of hyperinflation and patchy opacities suggestive of bronchiolitis.The principle outcome measure studied in our study was the improvement in oxygen saturation, respiratory rate, wheezing, retractions, and general condition after nebulization. In our study, we evaluated the improvement in all parameters and calculated p value.

We calculated the p value of the oxygen saturation, respiratory rate after three consecutive nebulizations. The p value was less than 0.0001.

Table 1: Respiratory rate at admission and after nebulizations

RR	**N**	**Mean**	**Std. Dev**	**Median**	**IQR**	**Friedman Repeated Measures Analysis**	
RR ADM	110	65.77	8.78	66.00	14.00	**Chi-square**	**P value**
RR N1	110	59.03	8.69	60.00	14.00	321.72	<0.001
RR N2	110	53.75	8.86	54.00	15.00	Difference is	
RR N3	110	47.85	10.13	48.00	15.00	significant	
Multiple Comparisons versus Control Group (Dunn's Method) :							
Comparison	**P<0.05**	**Difference is**					
RR N3 vs RR ADM	Yes	Sig					
RR N2 vs RR ADM	Yes	Sig					
RR N1 vs RR ADM	Yes	Sig					

The mean respiratory rates were 66 cycles/ min. After consecutive nebulisations significant improvement had seen, p value < 0.001 significant.

Table 2: Oxygen saturation at admission and after nebulizations

Oxygen Saturation	**N**	**Mean**	**Std. Dev**	**Median**	**IQR**	**Friedman Repeated Measures Analysis**	
Oxygen Saturation ADM	110	89.12	2.87	89.00	6.00	**Chi-square**	**P value**
Oxygen Saturation N1	110	92.65	1.41	92.00	2.00	325.75	<0.001
Oxygen Saturation N2	110	95.02	1.45	95.00	2.00	Difference is significant	
Oxygen Saturation N3	110	96.42	1.10	97.00	1.00		
Multiple Comparisons versus Control Group (Dunn's Method) :							
Comparison	**P<0.05**	**Difference is**					
O2 N3 vs O2 ADM	Yes	Sig					
O2 N2 vs. O2 ADM	Yes	Sig					
O2 N1 vs. O2 ADM	Yes	Sig					

The mean oxygen saturations recorded by pulse oximetry was 89.12%. After consecutive nebulisations significant improvement had seen, p value < 0.001 significant.

Table 3: Comparison of Clinical Severity Score before and after nebulization

CSC	N	Mean	Std. Dev	Median	IQR	Oneway Repeated Measures Analysis
CSC ADM	110	6.87	2.72	7.00	2.00	Chi-square value 412.014 (P value<0.001)
CSC N1	109	5.34	3.20	5.00	4.00	
CSC N2	110	3.24	2.96	3.00	4.25	Difference is significant
CSC N3	110	1.78	2.51	0.00	3.00	
Multiple Comparisons versus Control Group (Dunnett's Method) :						
Comparison				P<0.050	Difference is	
CSC ADM vs. CSC N3				Yes	Sig.	
CSC ADM vs. CSC N2				Yes	Sig.	
CSC ADM vs. CSC N1				Yes	Sig.	

Discussion

Acute viral bronchiolitis is one of the commonest lower respiratory tract infections causing hospitalisation in children less than 2 years of age. Viruses account for about 49% (range 22-51.9%) of lower respiratory infection cases. It is generally a self-limiting condition and is commonly associated with respiratory Syncytial virus infection [13].The present study was carried out to see whether 3% nebulized hypertonic saline reduced clinical severity and length of hospital stay in children with bronchiolitis. Although the infection occurs all around the year, the incidence is higher during the winter season. In our study the highest number of admissions was recorded during the winter months between November-February, but cases were found sporadically in June and July months also. This was in concordance with the studies by John TJ et al[13] and Yeolekar et al[14] which showed the seasonal pattern of RSV. In our study, we found that most of our patients were admitted during the first year of life. The mean age of the participants was 5.7 months. The youngest being 1 months and the oldest patient was 24 months of age. This was in comparison with the population based retrospective study done by Fjaerli et al,[15] to find out the incidence and risk factors for RSV disease. The median age of presentation in their study was 6 months as compared to 5.7 months in our study. Wheezing is the predominant finding in bronchiolitis. In our study, cough was present all most all patients, wheezing or noisy breathing in 80%, cold and upper respiratory symptoms in 90% and fever in 65% of children. This was in comparison with studies done by Kabra SK et al and Kumar N et al.[16] In their studies, cough (98% and 100%), fever (75% and 67.7%) and fast breathing [90% and 100%] were the predominant symptoms. Tachypnoea, signs of viral illness like nasal catarrh and on auscultation, rhonchi and scattered rales are the predominant findings. The mean respiratory rate in this study population was 63.71cycles/min. Acute bronchiolitis is a clinical diagnosis based on history and physical findings. Investigations are necessary only to rule out coexistent bacterial infection. Haemoglobin concentration total leukocyte count and differential count are usually normal in acute bronchiolitis. In our study we did complete blood count and chest X- ray for all the patients. We found that the mean haemoglobin concentration of our study population was 10.37g/dl, which was low when compared to normal values for the age and sex. In acute bronchiolitis, chest radiography revels hyper inflated lungs

with patchy atelectasis. In our study we found that most of the radiological features were consistent with bronchiolitis (89%) and in 21% the radiographs were normal. Our observations were consistent with the findings of Schuh et al.[17] who, in a prospective cohort study, evaluated the utility of radiography in acute bronchiolitis and found that chest X ray was routinely done for most of the babies (72%0 and the findings were consistent with bronchiolitis in most of the cases (>90%).

Conclusion

Bronchiolitis commonly occurs in winter seasons and males are more commonly affected than females. 3% saline nebulisation was found to be a safe treatment method. Findings of our study strongly suggest that nebulised hypertonic saline is an effective treatment for bronchiolitis, in terms of improvement in oxygen saturation,clinical severity score in hospitalized children with moderate severiaty of acute bronchiolitis.

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