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Original Research Article

Efficacy of 3% hypertonic saline nebulization in children hospitalized with moderate bronchiolitis

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ABSTRACT

Background: Bronchiolitis is one of the most common lower respiratory tract viral infections within the first 2 years of life; more than one third of children develop bronchiolitis. Of these, 1 out of 10 children will be hospitalized.
Methods: We did interventional, randomized control study of 3% hypertonic saline nebulization to 100 moderate bronchiolitis children admitted during our study period of 18 months. Primary outcome of duration of hospital stay and secondary outcome of Cough resolution time, wheeze resolution time are analyzed. No side effects or adverse drug reactions are observed.
Results: There was a 3.9 percentage reduction in length of stay in the hypertonic saline group compared to the control group which received supportive therapy alone. But these findings were not statistically significant. The cough resolution time and the wheeze resolution time were statistically significant shorter duration in the study group than the control group.
Conclusions: Nebulized hypertonic saline significantly reduced the cough and wheeze resolution time but not significantly reduced the hospital stay.

Keywords: Moderate bronchiolitis 3% saline, Nebulization cough and wheeze resolution time

INTRODUCTION

Bronchiolitis is one of the common causes of lower respiratory tract infections in infants and the leading cause of hospitalization of infants.[1] Bronchiolitis is a predominantly due to viruses like respiratory syncytial virus 50-80%, adenovirus 20%.[2] There exists the first necrosis of the respiratory epithelium in bronchiolitis. Following by the fact that, exaggerated mucus production occurs due to the proliferation of goblet cells. On the other hand, epithelial regeneration with nonciliated cells happens thus decreasing mucociliary clearance. Lymphocytic infiltration may result in submucosal edema.[2]

The diagnosis of bronchiolitis is mainly a clinical, diagnosed by a constellation of symptoms and signs of first episode of wheezing in a child younger than 12 to 24 months who has no other explanation for the wheezing, such as pneumonia or atopy.[2,3] None of the tried treatments have been proven to significantly alter the course of disease.[4] 3% hypertonic saline too has been tried in bronchiolitis and found to alter the duration of the disease and clinical severity in some studies.[5] Since the treatment of bronchiolitis is mainly supportive we decided to work on the morbidity part and also to find out if there is any significant difference in the length of stay, cough resolution time and wheeze resolution time.

Objective of present study was to establish the efficacy of nebulized hypertonic saline in reducing respiratory distress, cough resolution time, wheeze resolution time, duration of stay and severity in cases of moderate bronchiolitis.

Since the main management of bronchiolitis is largely supportive, we would like to work to reduce the respiratory distress and the clinical severity by means of hypertonic saline nebulization alone and this modality of treatment is affordable and practically feasible in a developing country like ours and also not many studies have been conducted in the Indian context which in many ways is quite different from the European or American context.

METHODS

Authors did interventional, randomized control study comparing 3% hypertonic saline nebulization to the study group of 50 moderate bronchiolitis children with normal saline nebulization to the control group with of 50 moderate bronchiolitis admitted during our study period of 18 months from March 2013-August 2014. Protocol preparation was done from December 2012 to February 2013, Data analysis and manuscript preparation- was done from September 2014 to November 2014.

Primary outcome of duration of hospital stay and secondary outcome of Cough resolution time, wheeze resolution time are analyzed. No side effects or adverse drug reactions are observed.

Bronchiolitis is defined as per American academy of pediatrics definition as a constellation of clinical symptoms and signs like rhinorrhea, cough, wheezing, tachypnea, and increased respiratory effort manifested as grunting, nasal flaring and intercostal and or subcostal retractions in children less than two years of age.

Moderate bronchiolitis is characterized by feeding difficulty, moderate respiratory distress with some chest wall retractions and nasal flaring and oxygen saturation less than 92% which is correctable with oxygen.[6]

Respiratory distress was defined by intercostal, subcostal or supra sternal retractions.

Child is considered to be tachypnoeic-Based on World health organization guidelines.[7]

- ≥60 per minute in age less than two months.
- ≥50 per minute in age two to twelve months.
- ≥40 per minute in age more than one year.

Inclusion criteria

Children during the study period of 18months in a tertiary care hospital in Chennai with a clinical diagnosis of moderate bronchiolitis are included in our study. 100 Children who met the inclusion criteria were recruited for the study according to the desired sample size.

Written consent was documented from all the parents before enrolling them in to study.

Exclusion criteria

Children with Bronchopulmonary dysplasia or chronic lung disease, Neuromuscular impairment, Congenital heart disease are excluded from the study.

Randomization

Patients were randomized in to two groups based on computer generated random numbers. The eligible children who were recruited were randomized in to two groups using random table in blocks of ten.

Study group received 3% hypertonic saline nebulization 3 ml 8th hourly in addition to supportive therapy. The nebulizations were continued till discharge. Children in control group received supportive therapy alone.

Nebulizations were administered along with humidified oxygen at a rate of six liters per minute using nebulization chamber.

Children were included in study at the time of admission. The history was obtained from the mother and the children were examined at the time of entering in to the study as well as every day. Vital signs were recorded in all the patients. Children were observed for cyanosis, retractions as well as anemia.

Detailed examination of the respiratory system was also done. A complete blood count and an x-ray chest were done for all the children. All the children were given oxygen and IV fluids were administered for children who did not tolerate oral feeds.

Length of stay in the hospital was taken as the primary outcome. Cough resolution time and wheeze resolution time were taken as secondary outcomes in the study. Adverse effects were recorded for the study group.

The length of stay was recorded using a previously validated method. Every day the patients were examined for four conditions for which they were retained in the study.

Child is on drugs for the disease. Child administered humidified O2 or IVF because of the disease. Children retained because of co- morbid conditions. Hospital days were recorded only when the reason was administration of drugs or humidified O2 administration.

Time of discharge will be decided by the treating consultant.

Criteria for discharge

Criteria for discharge are oral feeding should be possible without respiratory distress. Spo2 should be more than ninety six percent and the child should be comfortable in room air for 4 hours.[8]

Statistical analysis

All data entered in data collection form are entered in excel spread sheet. Descriptive statistical analysis was done in the study. Continuous measurement is represented by mean plus or minus S.D. Categorical measurements were represented by percentage. Significance was assessed by five percent level of significance. For statistical analysis SPSS version 16 was used.

RESULTS

During the study 116 patients were admitted in to the study with a diagnosis of bronchiolitis with moderate severity. Of those 108 children were included 8 were not included due to previous history of wheeze. Amongst the 108 patients eight were excluded due to the prior treatment with corticosteroids. At last 100 children were analyzed and randomization was done for them and they were randomized in to two groups of 50 each.

The study group were administered 3% hypertonic saline nebulization along with supportive care were 50 in number and the controls who received supportive care alone contained 50 children.

Table 1: Age distribution of the enrolled children.

Group		Age			Total
		0-6m	6-12m	13-24m	
Case	Count	2	27	21	50
	%within group	4.0	54.0	42.0	100.0
Control	Count	1	26	23	50
	%within group	2.0	52.0	46.0	100.0
Total	Count	3	53	44	100
	%within group	3.0	53.0	44.0	100.0

p value =0.801

Supportive therapy included the administration of humidified oxygen and intravenous fluids. In study done by us the age was comparable in the study and control groups. The majority were in the 6-12-month age group.

Gender distribution

In this study males were more commonly affected than females. The male to female ratio was 1.43:1, P value=0.542.

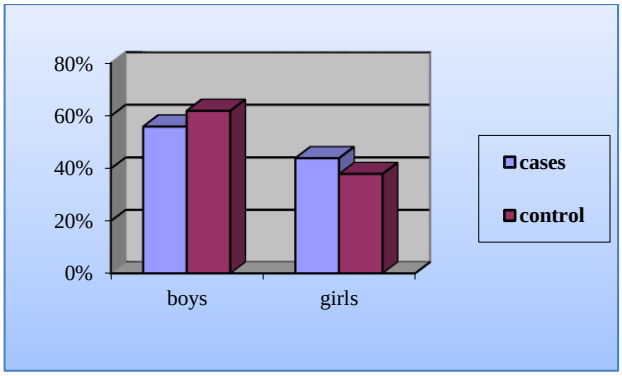

Figure 1: Gender distribution of the enrolled children.

Amongst cases 56% were males and remaining 44% were females. Amongst controls 62% were males and remaining 38% were females.

Table 2: Chest x-ray of both groups.

Group		X_ray		Total
		Normal	BHI	
Case	Count	26	24	50
	% within group	52.0	48.0	100.0
Control	Count	41	9	50
	% within group	82.0	18.0	100.0
Total	Count	67	33	100
	% within group	67.0	33.0	100.0

p value = 0.003

Amongst all cases clinically diagnosed as moderate bronchiolitis 67% had normal X-rays, only 33% had the classical feature of bilateral hyperinflation. Amongst the study group there were a higher proportion of children with bilateral hyperinflation. Hence the study group and the control group were not comparable with respect to bilateral hyperinflation in chest X-ray.

Blood count

Amongst cases getting 3% hypertonic saline nebulization 4 percent had abnormal blood counts.

Similarly, amongst controls receiving supportive therapy 4 percent had abnormal blood counts. The two groups were comparable with regard to abnormal blood counts.

Humidified oxygen was administered to all the cases in the study as well as in the control group as part of the supportive therapy. Hence, the two groups were comparable with regard to oxygen administration

Cough resolution time

Amongst cases receiving 3% hypertonic saline along with supportive therapy in 48% of cases the cough got resolved in 3-4 days. In 52% of the cases the cough got resolved in 1-2 days. Amongst children receiving supportive therapy alone in 74% of the cases the cough

resolved in 3-4 days. In remaining 26% the cough got resolved in 1-2 days. Overall in both the groups, in 61% of the cases the cough got resolved in 3-4 days. In 39% of the cases the cough got resolved in 1-2 days. P value=0.014 statistically significant.

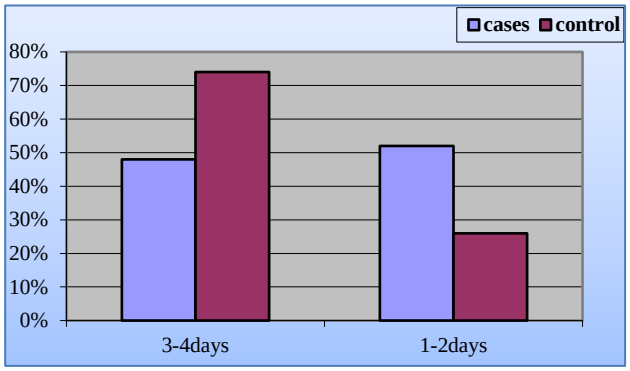

Figure 2: Cough resolution time in 2 groups.

Wheeze resolution time

Amongst children receiving hypertonic saline along with supportive therapy in 60% of cases the wheeze got resolved in 1-2 days. In 36% of children the wheeze got resolved in 3-4 days. In remaining 4% the wheeze got resolved in 5-6 days.

Table 3: Wheeze resolution time in the enrolled children.

Group		WR time			
		1-2 days	3-4 days	5-6 days	Total
Case	Count	30	18	2	50
	% within group	60.0%	36.0%	4.0%	100.0%
Control	Count	11	39	0	50
	% within group	22.0%	78.0%	0.0%	100.0%
Total	Count	41	57	2	100
	% within group	41.0%	57.0%	2.0%	100.0%

P value = 0.001

Amongst children receiving supportive therapy alone in 22% of the cases the wheeze got resolved in 1-2 days. In 78% of the cases the wheeze got resolved in 3-4 days.

Overall in 41% of the cases the wheeze got resolved in 1-2 days. In 57% of the cases the wheeze resolved in 3-4 days. In the remaining 2% of the cases the wheeze got resolved in 5-6 days.

Length of stay

The mean duration in the group receiving 3% hypertonic saline along with supportive therapy was found to be 4.76±0.567 days.

The mean duration in the group receiving supportive therapy alone was found to be 4.90±0.505 days. However, this was not found to be statistically significant (P value = 0.235).

Table 4: Duration of stay in cases and controls.

	Cases	Controls
Duration of stay	4.76 days	4.90 days

DISCUSSION

Bronchiolitis is more common in males compared to females. In present study too a male predominance was observed accounting for 59% of all admissions. The male: female ratio in present study was found to be 1.43:1. This observation is consistent with the work done by John TJ et al in south india.[9] They studied the etiological factors, incidence, risk factor and clinical presentation of respiratory tract infection in children and came to the conclusion that males were more commonly affected than females. In their study the male is to female ratio was found to be 1.6:1.

Bronchiolitis is mainly a clinical diagnosis and investigations are not necessary to diagnose the disease. And blood counts are usually not done. They are done if there is atypical presentation and also to rule out other causes.

In this study 4% in the study group and 4% in the control group had abnormal blood counts of increased total leucocyte count when compared to age appropriate values. The groups were comparable in this respect.

In Bronchiolitis there will usually be hyperinflation of lungs and atelectasis. In present study authors found that majority of the x-rays were normal 67% and in the remaining 33% there was bilateral hyperinflation.

In current study the primary outcome measured was the length of stay.

The length of stay was arrived at by measuring the duration required to attain discharge criteria. The mean duration of length of stay in our hospital amongst the group receiving 3% hypertonic saline and supportive therapy was 4.76±0.657.

This was in contrast to the study done by Mandelbeg et al, Tal et al and Kuzik et al.[10-12] In the study done by Mandelber et al the mean duration of hospital stay was found to be 3.5. In the study done by Tal et al the mean duration of hospital stay was found to be 3.1.

Similarly in a study done by kuzik et al the mean duration of hospital stay was found to be 3.1. This difference in lengthof stay could be explained by the fact that in different centres the severity could have been different as well as the role of inter observer variation in grading of

severity cannot be underplayed.

In the 3% hypertonic saline group the duration of stay was slightly lesser compared to the group which received supportive therapy alone. But this difference did not attain statistical significance.

Tal et al arrived at a mean reduction of 0.9 days (26%) His findings were statistically significant.[11] Kuzik et al observed a 26% reduction in length of stay with the use of 3% hypertonic saline nebulisations.[12]

Maandelberg et al in his study using 3% hypertonic saline nebulisations in cases of mild and moderate bronchiolitis arrived at a finding of (25%) 1 day reduction in length of stay.[10]

Secondary outcomes of our study, the cough resolution time and wheeze resolution time in the study group were lesser than the control group. In general the use of 3% hypertonic saline is considered to be fairly safe. Some studies conducted in patients suffering from cystic fibrosis have reported bronchospasm as an adverse effect. But lesser concentrations of hypertonic saline have been studied in bronchiolitis and found to be safe.

In this study no, adverse effects were noted due to 3% hyper tonic saline administration. The same was observed in studies done by Mandelberg et al, and Tal et al, Kuzik et al.[10-12] They did not observe any adverse effects in their use of 3% hypertonic saline nebulization.

As authors included only moderate cases of bronchiolitis, the role of hypertonic saline in mild and severe bronchiolitis is unclear. Since bronchiolitis is mainly a clinical diagnosis, the role of Intra-observer variation is possible.

CONCLUSION

In conclusion, present study suggests that 3% hypertonic saline helps to reduce the cough resolution and wheeze resolution time thereby decreasing the clinical severity in hospitalized patients admitted with a diagnosis of moderately severe bronchiolitis. 3% hypertonic saline was found to be safe in treating bronchiolitis in children.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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