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Comparison of Hypertonic Saline with Normal Saline Nebulization in the Management of Bronchiolitis in Children

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ABSTRACT

Objective: "To compare the outcome of hypertonic saline with normal saline nebulization in management of bronchiolitis in children" **Study design:** Randomized controlled trial. **Study place and duration:** Department of Pediatrics, Hameed Latif Hospital, Lahore from 1st Oct 2024 to 15th April-2025. **Methodology:** Sixty infants fulfilling selection criteria were enrolled through emergency and were randomly divided in two groups. In group A, infants were given hypertonic (3%) saline nebulization. In group B, infants were given normal saline nebulization. Clinical severity score (CSS) was noted after 30, 60 and 120 minutes of nebulization and change in CSS was calculated. All the data was noted in proforma and analsyed in SPSS v.26. **Results:** At baseline, the median CSS score was 3.00 (IQR: 0.00) in bob groups, as all the infants has CSS score >2 at the time of presentation / enrolment. The median change after 30 minutes was observed as 1.00 (IQR: 1.00) with hypertonic saline and 1.00 (IQR: 0.25) with normal saline ($p<0.05$). The median change after 60 minutes was observed as 2.00 (IQR: 1.00) with hypertonic saline and 2.00 (IQR: 1.00) with normal saline ($p<0.05$). The median change after 120 minutes was observed as 3.00 (IQR: 1.00) with hypertonic saline and 2.00 (IQR: 0.25) with normal saline ($p<0.05$). **Conclusion:** The outcomes in terms of reduction in clinical severity score of bronchiolitis with hypertonic saline nebulization is better than normal saline nebulization.

INTRODUCTION

The most prevalent lower respiratory tract infection in children under two years old is acute bronchiolitis. When the bronchioles, which are tiny structures that lead to the lungs, get infected, bronchiolitis develops, resulting in swelling, inflammation, and the production of mucus. As a result, breathing becomes challenging, particularly for very young infants who experience wheezing and coughing.[1] The water molecules or medications can be inhaled through the mouth or nose and transported to the respiratory tract and lungs by the airflow when regular saline is used as the diluent in nebulizers and oxygen is used as a vaporizer.[2] The medications can dilute the respiratory tract's secretions once the molecules are absorbed by the alveolar capillaries, which will subsequently cause expectoration and alleviate bronchospasm symptoms.[3, 4] In acute bronchiolitis, the most common lower respiratory infection that causes dyspnea in babies under two years old, inhaled hypertonic saline has been proven to help reduce airway edema.[3]

Since normal saline is also utilized as the vehicle for nebulizing the active medication, it makes sense that nebulized normal saline would be employed as the placebo in the majority of randomized clinical studies.[5, 6] Nonetheless, bronchodilator trials have consistently shown above-expected improvement rates in individuals receiving placebo.[7] These results might be explained by the waxing and waning nature of bronchiolitis, but considering the significant improvement trend, it's also plausible that nebulized normal saline is working as a useful therapy.[8, 9] The purpose of this study is to evaluate the effectiveness of hypertonic saline with regular saline nebulization in treating pediatric bronchiolitis. According to published research, hypertonic saline is superior than regular saline in terms of lowering the clinical severity of illness. Thus ultimately help in early healing and discharge from hospital in infants of age <2 years. But limited work has been done before in this regard and no study conducted in local population that can help to impellent more effective saline solution for nebulization. Therefore,

we conducted this study to get evidence for local population.

MATERIAL AND METHODS

After approval from ethical review committee of the hospital. This randomized controlled trial was conducted at the Department of Pediatrics, Hameed Latif Hospital, Lahore from 1st Oct 2024 to 15th April-2025. By using openepi.com, sample size of 60 cases; 30 in each group was estimated by keeping 95% confidence level, 90% power of study and mean change in CSS i.e. 3.57±1.41 with hypertonic saline and 2.26±1.15 with normal saline nebulization.[10] All the infants who fulfilled the selection criteria were enrolled from emergency department by setting Non-probability, consecutive sampling technique in our set-up.

Inclusion

Infants aged <2 years, both genders, presented with bronchiolitis. Bronchiolitis was diagnosed with child present with first episode of acute wheezing, starting as a viral upper respiratory infection (coryza, cough or fever) with clinical severity score >2.

Table 1

Clinical Severity Score

Variables	Score			
	0	1	2	3
RR	< 30	31–45	46–60	> 60
Wheezing	None	Terminal expiration/only with stethoscope	Entire expiration or audible on exp. without stethoscope	Inspiration and expiration without stethoscope
Retraction	None	Intercostals	Tracheo-sternal	Severe with nasal flaring
General condition	Normal			Irritable, lethargic, poor feeding

Exclusion

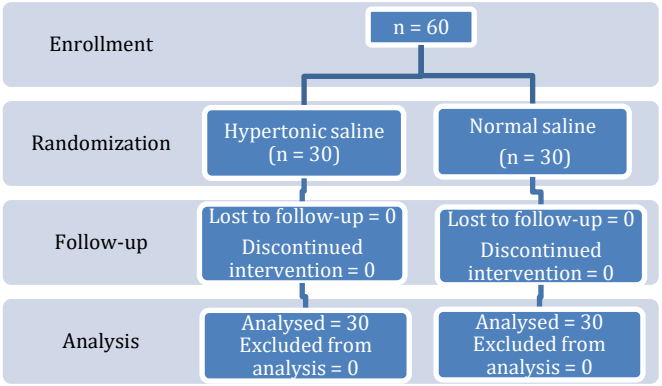
Infants with severe disease (clinical severity score >9), any underlying disease (e.g., cystic fibrosis, bronchopulmonary dysplasia and cardiac or renal disease), prior history of wheezing, asthma, Oxygen saturation (SpO2) <85%, need mechanical ventilation, previous treatment with bronchodilators within last 4 h, and any steroid therapy within 48 h.

Informed consent was taken from parents. Demographics details like name, age, gender, weight, duration of symptoms, respiratory rate, heart rate, SPO2, feeding pattern, residence, socioeconomic status, season, were noted. Then infants were admitted and were randomly divided in two groups by using lottery method. In group A, infants were given hypertonic (3%) saline nebulization. In group B, infants were given normal saline nebulization. Standard antibiotic treatment was also given to all the infants to prevent any bias in the study. CSS score was noted at the time of presentation. During follow-up, infants were examined for CSS after 30, 60 and 120 minutes of nebulization and change in CSS was calculated. All the nebulization and doses were set by researcher. All the data was noted in proforma that was designed for the study."

Data was entered in computer software SPSS version 26.0 and analyzed through it. Shapiro-Wilk test was applied to assess the normality of data. For CSS score (before and after treatment and change in CSS) were calculated as mean ± SD. For Both groups were compared for mean change in CSS by using independent samples t-test. Repeated measure ANOVA (generalized linear model) was also applied to assess the significant change in CSS score in both groups. P-value ≤ 0.05 was considered as significant.

Figure 1

Patient Flow Diagram (n= 60)



RESULTS

In this trial, we enrolled total 60 infants with bronchiolitis. The mean age of infants was 13.00 ± 6.37 months who were randomized in hypertonic saline group while 13.60 ± 6.01 months who were randomized in normal saline group. In hypertonic saline group, there were 17 (56.7%) male infants while 13 (43.3%) females infants. In normal saline group, there were 14 (46.7%) male infants and 16 (53.3%) female infants. In hypertonic saline group, the mean weight of infants was 7.40 ± 1.57 kg and in normal saline group was 7.40 ± 1.28 kg. In hypertonic saline group, 11 (36.7%) infants were on solid food, 10 (33.3%) were on semi-solid food and 9 (30.0%) were on liquid (milk). In normal saline group, 10 (33.3%) infants were on solid food, 12 (40.0%) were on semi-solid food and 8 (26.7%) were on liquid (milk). In hypertonic saline group, 29 (96.7%) were coming from urban areas while only 1 (3.3%) infant was coming from rural areas. In normal saline group, 25 (83.3%) were coming from urban areas while 5 (16.7%) infants were coming from rural areas. Distribution of socioeconomic status and season at the time of resignation is given in table 2. The mean duration of symptoms was 3.63 ± 1.47 bpm in hypertonic saline group and 3.73 ± 1.60 bpm in normal saline group. Statistics of heart rate and oxygen saturation in both groups is given in table below. Table 2

At baseline, the median CSS score was 3.00 (IQR: 0.00) in bob groups, as all the infants has CSS score >2 at the time of presentation / enrolment. After 30 minutes, the median CSS score was 2.00 (IQR: 1.00) with hypertonic saline while 2.00 (IQR: 0.25) with normal saline ($p<0.05$). The median change after 30 minutes was observed as 1.00 (IQR: 1.00) with hypertonic saline and 1.00 (IQR: 0.25) with normal saline ($p<0.05$), showing significant change / fall in CSS score better with hypertonic saline nebulization as compared to normal saline nebulization ($p<0.05$). After 60 minutes, the median CSS score was 1.00 (IQR: 1.00) with hypertonic saline while 1.00 (IQR: 1.00) with normal saline ($p>0.05$). The median change after 60 minutes was observed as 2.00 (IQR: 1.00) with hypertonic saline and 2.00 (IQR: 1.00) with normal saline ($p<0.05$). After 120 minutes, the median CSS score was 0.00 (IQR: 1.00) with

hypertonic saline while 1.00 (IQR: 0.25) with normal saline (p<0.05). The median change after 120 minutes was observed as 3.00 (IQR: 1.00) with hypertonic saline and 2.00 (IQR: 0.25) with normal saline (p<0.05). Table 3
Figure-II showing graph plotted for follow-up of infants during treatment. The graph depicted better performance of hypertonic saline nebulization than normal saline nebulization (P<0.0001).

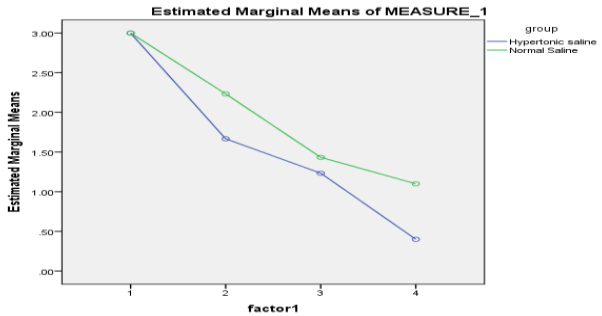
Table 2
Demographics Details of Infants Recruited in the Trial (n=60)

Variables	Group	
	Hypertonic saline	Normal saline
n	30	30
Age (in months)	13.00 ± 6.37	13.60 ± 6.01
Sex (M:F)	17 (56.7%) / 13 (43.3%)	14 (46.7%) / 16 (53.3%)
Weight (kg)	7.40 ± 1.57	7.40 ± 1.28
Feeding pattern		
Solid	11 (36.7%)	10 (33.3%)
Semi-solid	10 (33.3%)	12 (40.0%)
Liquid	9 (30.0%)	8 (26.7%)
Residence		
Rural / Urban	1 (3.3%) / 29 (96.7%)	5 (16.7%) / 25 (83.3%)
Socioeconomic status		
Low / Middle / High	5 (16.7%) / 4 (13.3%) / 21 (70.0%)	8 (26.7%) / 5 (16.7%) / 17 (56.7%)
Season		
Winter	22 (73.3%)	17 (56.7%)
Summer	1 (3.3%)	6 (20.0%)
Spring	3 (10.0%)	6 (20.0%)
Autumn	4 (13.3%)	1 (3.3%)
Duration of symptoms	3.63 ± 1.47	3.73 ± 1.60
Respiratory rate (bpm)	68.20 ± 3.60	67.50 ± 4.02
Heart rate (bpm)	96.30 ± 8.15	94.10 ± 9.57
Oxygen saturation (SPO2, %)	91.80 ± 2.01	92.10 ± 1.92

Table 3
Comparison of Outcome of Trial (Change in CSS Score from Baseline after 30, 60 and 120 Minutes of Nebulization), n=60

CSS at	Group		p-value
	Hypertonic saline	Normal saline	
Baseline	30 (IQR:00)	30 (IQR:00)	NA
After 30 minutes	2.00 (IQR: 1.00)	2.00 (IQR: 0.25)	0.016
Change after 30 minutes	1.00 (IQR: 1.00)	1.00 (IQR: 0.25)	0.002
After 60 minutes	1.00 (IQR: 1.00)	1.00 (IQR: 1.00)	0.794
Change after 60 minutes	2.00 (IQR: 1.00)	2.00 (IQR: 1.00)	0.031
After 120 minutes	0.00 (IQR: 1.00)	1.00 (IQR: 0.25)	0.016
Change after 120 minutes	3.00 (IQR: 1.00)	2.00 (IQR: 0.25)	0.000

Figure 2
Repeated Measures ANOVA Showing Fall in CSS Score at Baseline, after 30, 60 and 120 Minutes of Nebulization, p<0.0001.



DISCUSSION

In our trial, we observed that the median CSS score was reduced from 3.00 (IQR: 0.00) to 2.00 (IQR: 1.00) after 30 minutes, to 1.00 (IQR: 1.00) after 60 minutes and to 0.00 (IQR: 1.00) after 120 minutes of treatment with hypertonic saline nebulization. While with normal saline solution, the median CSS score was reduced from 3.00 (IQR: 0.00) to 2.00 (IQR: 0.25) after 30 minutes, to 1.00 (IQR: 1.00) after 60 minutes and to 1.00 (IQR: 0.25) after 120 minutes of treatment. The difference in both groups was significant and CSS score was reduced significantly more with hypertonic saline nebulization as compared to normal saline nebulization.
In our trial, we observed that the median change after 30 minutes was observed as 1.00 (IQR: 1.00) with hypertonic saline and 1.00 (IQR: 0.25) with normal saline (p<0.05). The median change after 60 minutes was 2.00 (IQR: 1.00) vs. 2.00 (IQR: 1.00) (p<0.05). The median change after 120 minutes was 3.00 (IQR: 1.00) vs. 2.00 (IQR: 0.25) (p<0.05), respectively.
The most prevalent lower respiratory tract infection in children under two years old is acute bronchiolitis. When the bronchioles, which are tiny structures that lead to the lungs, get infected, bronchiolitis develops, resulting in swelling, inflammation, and the production of mucus. As a result, breathing becomes challenging, particularly for very young infants who experience wheezing and coughing.[11, 12] Both in the outpatient and inpatient departments, pediatricians have significant challenges in managing bronchiolitis. Because supportive measures including chilled, humidified oxygen, fluids, bronchodilators, epinephrine, and corticosteroids are often the cornerstone of therapy choices. Although some substances have been suggested as supplemental treatments, there is debate over their efficacy. According to recent research, nebulized hypertonic saline (3%) may be somewhat beneficial.[13, 14]
Khanal et al., found that mean change in clinical severity score i.e. 3.57±1.41 with hypertonic saline and 2.26±1.15 with normal saline nebulization for bronchiolitis in <2 years old infants (p<0.05).[10] Shahid et al., conducted another trial on 220 children, and observed that the mean CSS score at baseline was 7.28 ± 1.47. The post-treatment mean CSS was 4.29±2.83 with hypertonic saline while 5.99±2.64 with normal saline (p=0.0001). They showed that nebulization with hypertonic saline solution was considerably more efficient than nebulization with normal saline in lowering CSS in infants with acute bronchiolitis up to the age of two.[15]
"Hossain et al., in a study carried out in Bangladesh, it was shown that while CSS improved by three days, children who got nebulized hypertonic saline showed a greater improvement (1.7±1.2) than those who received nebulized normal saline (3.5±1.8). When compared to babies treated with conventional saline nebulization, they found that 3% hypertonic saline nebulization dramatically lowers CSS in infants with acute bronchiolitis.[16] Yu et al., conducted a meta-analysis of 27 trials involving 3495 infants. They observed that as compared to normal saline, infants received 3% hypertonic saline showed better outcomes in terms of CSS improvement after 24 hours (MD = -0.79, 95% CI [-1.23, -0.34], I2 = 74%, P < .001), day 2 (MD = -1.26,

95% CI [-2.02, -0.49], I2 = 91%, P = .001). They concluded that 3% hypertonic saline nebulization was better than 0.9% normal saline in improving CSS, and in enhancing the severity of respiratory distress.[17]

Mazhar et al., conducted a trial in Multan and observed that the mean CSS with hypertonic saline was documented at 7.9 ± 0. Hypertonic saline group had a mean CSS of 68 at the beginning of the study while that of normal saline group was 8.2 ± 0.68 (p=0.017). At 12 hours, again there was an overall improvement in CSS and the mean CSS of hypertonic saline stood at 6.9 ± 0. On the average at 48 hours, the CSS with hypertonic saline was 2.6 ± 0.59 which is relatively less compared to total number of respondents belongs to the normal saline group, which was only 3.9 ± 0.66 (p<0. 001). Within 72 hours, the infants in hypertonic saline group had a mean CSS of 1.5 ± 0.[18]"

But Abid et al., investigated 65 instances of acute bronchiolitis in Rawalpindi and found that there was no significant difference in CSS between the two groups, with the saline group having a value of 5.42 ± 2.88 and the hypertonic saline group having a value of 4.50 ± 2.88 (p-value = 0.921).[19]

Salman et al., conducted another trial in Multan and compared hypertonic saline with normal saline nebulization and reduction in condition of infant was observed. But they used modified respiratory assessment (MRA) score for assessment of improvement in condition of infant. They observed that the MRA score after 48 hours of nebulization was 4.89 ± 1.22 in normal saline group versus 3.34 ± 1.05 in infants of hypertonic saline group (p value <0.001). Reduction in MRA score was more in hypertonic saline group as compared to normal saline group. [20]

CONCLUSION

The outcomes in terms of reduction in clinical severity score of bronchiolitis with hypertonic saline nebulization is better than normal saline nebulization. Thus the results of this study support the results of previous trial. Now, in future, we will impellent more effective saline solution for nebulization i.e. hypertonic saline nebulization for management of such high risk infants.

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