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Comparison of Mean Length of Hospital Stay Between Hypertonic (3% Saline) With Normal (0.9% Saline) Nebulization in the Management of Acute Bronchiolitis in Children 2 Months To 18 Months of Age

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ABSTRACT

Background: Bronchiolitis is a common lower respiratory tract ailment of infants. The mainstay of treatment for acute bronchiolitis remains supportive. **Objective:** To compare the mean length of hospital stay between hypertonic saline (HS) and normal saline (NS) nebulization in the management of acute bronchiolitis in children 2-18 months of age. **Study Design:** Randomized controlled trial. **Settings:** Department of Pediatrics, Faisalabad Medical University, Faisalabad Pakistan. **Duration:** Six months from January 01, 2021 to June 30, 2021. **Methods:** Total 70 children fulfilling the inclusion criteria were included and divided into two groups. In group A, patients were given 4 ml HS solution and in group B, patients were given 4 ml NS solution every 2 hourly for three doses, then every 4 hourly for five doses, followed by every 6 hourly until discharge by standard air compressed nebulizers. Patients were monitored every 6 hourly by on duty doctor and length of hospital stay was assessed. **Results:** In Group-A mean age of children was 6.71 ± 4.79 months and in Group-B 6.43 ± 3.69months. Mean clinical severity score at discharge in Group-A and in Group-B was 1.63 ± 1.66 and 3.46 ± 1.40 respectively. Mean length of hospital stay of children in Group-A was 2.83 ± 0.78 and in Group-B it was 3.80 ± 0.71 days (p-value: 0.000). **Conclusion:** HS is superior to NS nebulization in the management of bronchiolitis in children in terms of mean length of hospital stay.

Keywords: *Length of hospital stay, Hypertonic (3%) saline(HS), Normal (0.9%) saline(NS) nebulization, Bronchiolitis in children.*

INTRODUCTION

Bronchiolitis is an acute lower respiratory tract infection in early childhood caused by different viruses, with coughing, wheeze and poor feeding as the major symptoms. A substantial proportion of children will experience at least one episode of bronchiolitis, and as much as 2-3% of all children will be hospitalized with bronchiolitis during their first year of life.[1]

Populations at increased risk for severe bronchiolitis include racial and ethnic minorities and those who had preterm birth, bronchopulmonary dysplasia (BPD) or congenital heart disease.[2]

Bronchiolitis is infection of the bronchial and bronchiolar epithelium, which is mainly caused by respiratory syncytial virus (RSV). The primary treatment remains largely supportive, with mechanical ventilatory support as needed.[3]

The standard treatment for acute bronchiolitis remains supportive care and includes ensuring adequate oxygen exchange, fluid intake and feeding of the infant.[4] Since the introduction of oxygen therapy, antiviral agents, oral and inhaled steroids and a variety of bronchodilators have neither decreased lengths of hospital stay nor impacted on the course of the acute illness while an effective vaccine still appears some way off.[5]

Clinical practice in the acute management of bronchiolitis varies widely even between centers in one country, and there is much controversy, confusion, and lack of evidence over the best treatment for this common, life-threatening condition.[4, 5]

Some studies published over the past 8 years have suggested that nebulized hypertonic saline (HS) may influence the course of the illness and reduce the duration of hospitalization.[6] HS decreases airway edema, improves mucus rheologic properties and mucociliary clearance, and thus decreases airway obstruction.[5]

Inhaled NS can be administered to increase clearing of mucous, although it is not suggested in current guidelines and reviews.[7] However, some authors have suggested that normal saline can impact favorably on the clinical outcomes and, as such, is an active comparator.[5]

In one study the length of hospital stay in bronchiolitis children nebulized with HS was 4.8 ± 1.2 and with NS it was 6.4 ± 1.4 (p <0.01).[3]

While another study stated that there is no advantage of HS over NS nebulization in the management of bronchiolitis. According to this study length of hospital stay in bronchiolitis children with HS nebulization was 44.82 ± 23.15 and with NS it was 43.6 ± 28.25 (p = 0.86).[8]

There is controversy in literature regarding the efficacy of HS nebulization. So, the results of this study will be helpful in selecting the better treatment modality for the management of bronchiolitis in children in terms of shorter length of hospital stay.

Objective of the study was to compare the mean length of hospital stay between HS with NS nebulization in the management of bronchiolitis in children < 2 years of age.

OPERATIONAL DEFINITIONS

Bronchiolitis: Children presenting with wheezing, coughing and moist crackles were said to have bronchiolitis. The severity of bronchiolitis was assessed through clinical severity score as follows:[9]

	0 point	1 point	2 points	3 points
Respiratory rate (breaths/min)	0-6 months: < 50 6 mon-1 yr: < 40 1yr + : < 30	0-6 months: < 60 6 mon-1 yr: < 50 1yr + : < 45	0-6 months: < 70 6 mon-1 yr: < 60 1yr + : < 60	0-6 months: > 70 6 mon-1 yr: > 60 1yr + : > 60
SpO2	≥ 90%	≥ 88%	≥ 86%	≤ 85%
General appearance	Calm and no distress	Mildly irritable; easy to console	Moderately irritable; difficult to console	Extremely irritable; cannot be comforted
Retractions and nasal flaring	No retractions	Mild retractions (abdominal)	Moderate retractions (Intercostals, sub costal)	Severe retractions (obvious, intercostals, sub costal tracheal retractions and nasal flaring)
Auscultation	Clear	Scattered wheezes	Diffuse expiratory wheezing	Biphasic wheezing or very poor air movement

***Mild**: 1 – 5 points, **Moderate:** 6 – 9 points, **Severe:** 10 - 15*

Length of Hospital Stay: It was calculated in mean number of days from the time of admission till the discharge of the patient. Patient' discharge criteria was disappearance of cough, wheezing and pulmonary moist crackles and clinical severity score < 4.

METHODS

This randomized controlled trial was conducted at the Department of pediatrics, Faisalabad Medical University, Faisalabad Pakistan. The duration of the study was six months from January 01, 2021 to June 30, 2021.

By using WHO sample size calculator for 2 mean, total number of patients were 70 (35 in each group). Non probability consecutive sampling technique was used.

Children of age between 2 months to 18 months of both genders and children have moderate to severe bronchiolitis as per operational definition were included in the study.

Patients with chronic cardiac and pulmonary disease, premature infants (gestational age < 34 weeks), patients having immunodeficiency and patients with bronchiolitis requiring mechanical ventilator were excluded from the study.

After taking approval from hospital ethical review committee, patients coming through emergency of the department, who fulfilled the inclusion criteria were enrolled and informed consent was taken from them. Demographic details were noted. All the patients were randomly divided into two groups by using computer generated random number table. In group A, patients received 4 ml HS solution and in group B, patients received 4 ml NS solution. The solution was administered every 2 hourly for three doses, then every 4 hourly for five doses, followed by every 6 hourly until discharge. All inhaled treatments were delivered to infants from standard air-compressed nebulizers by on duty staff nurse. Patients were examined after every 6 hours of treatment by on duty doctor and length of hospital stay was assessed as per operational definition. All the information was collected on proforma.

All the data was entered and analyzed on SPSS Version 17.0. Mean ± Standard Deviation were calculated for age, duration of symptoms, clinical severity score and length of hospital stay. Frequency and percentages were calculated for gender and severity of bronchiolitis. Independent sample t-test was used to compare length of hospital stay between two groups. Effect modifiers like age, duration of symptoms, severity of bronchiolitis and gender were stratified and post-stratification independent sample t-test was applied. A p-value of less than 0.05 was considered significant.

RESULTS

The characteristics distribution in relation to age in months, gender, duration of symptoms and severity of symptoms is shown in table 1.

Table 1: Characteristic distribution (n=70)

Characteristics		Group-A	Group-B
Age (Months)	Mean	6.71 ± 4.79	6.43 ± 3.69
Gender	Male	19 (54.3%)	22 (62.9%)
	Female	16 (45.7%)	13 (37.1%)
Duration of symptoms (weeks)	Mean	1.80 ± 0.53	2.00 ± 0.64
Severity of symptoms	**Moderate**	18 (51.4%)	27 (77.1%)
	Severe	17 (48.6%)	8 (22.9%)

Group-A= *HS solution,* ***Group-B=*** *NS solution*

The clinical severity score at baseline and at discharge in both groups is shown in table 2.

Table 2: Clinical severity score at baseline & at discharge (n=70)

	Baseline		Discharge	
	Group-A	Group-B	Group-A	Group-B
Mean	9.86 ± 2.90	8.60 ± 2.48	1.63 ± 1.66	3.46 ± 1.40

Group-A= *HS solution,* ***Group-B=*** *NS solution*

The length of hospital stay in both groups in relation to duration, age, gender and severity of symptoms is shown in table 3.

Table 3: Descriptive statistics for length of stay (days)

Characteristics		Group-A	Group-B	P-value
Duration (days)	**N**	**35**	**35**	
	Mean	2.83 ± 0.78	3.80 ± 0.71	
Age	2-6 months	2.83 ± 0.89	3.91 ± 0.68	**0.000**
	7-12 months	2.88 ± 0.64	3.73 ± 0.79	**0.022**
	13-18 months	2.75 ± 0.50	3.47 ± 0.05	**0.034**
Gender	Male	2.84 ± 0.83	3.91 ± 0.81	**0.000**
	Female	2.81 ± 0.75	3.62 ± 0.51	**0.003**
Severity of symptoms	Moderate	2.56 ± 0.70	3.56 ± 0.57	**0.000**
	Severe	3.12 ± 0.78	4.63 ± 0.51	**0.000**

Group-A= *HS solution,* ***Group-B=*** *NS solution,* ***p-value=*** *0.000*

DISCUSSION

Bronchiolitis is a common clinical problem in children below 2 years presenting with cough, wheeze, tachypnea, and increased respiratory effort.[10]

In this study HS was compared with NS nebulization in the management of bronchiolitis in children between 2 – 18 months of age. The main outcome variable in this study was hospital stay. Children who were given HS nebulization, their hospital stay was shorter as compared to the children who were nebulized with NS. As well children who were nebulized with HS their clinical severity score was also low on discharge as compared to that of NS.

Some studies published over the past 8 years have suggested that nebulised HS may influence the course of the illness and reduce the duration of hospitalization.

In 2015 a systematic review by Linjie Zhang *et al* was conducted to assess the effects of neubulized HS in infant with acute bronchiolitis. The review concluded that patients treated with nebulized HS had a significantly shorter length of stay and significantly lower post treatment clinical score in first 3 days of admission compared with those receiving 0.9% saline or standard care. [11]

Brain A. Kuzik *et al*[12] in his study found that the infants in HS group had statistically significant (26%) reduction in length of hospital stay as 2 ± 1.9days compared with 3.5 ± 2.9 days in NS group (P = 0.05). Results of our study are consistent with the results reported by them.[12]

Avigdor Mandelberg *et al* in their trial on 52 hospitalized infants showed significant improvement in clinical severity score on respective days of hospitalization and significantly reduced days of stay in hospital (P < 0.05).[13] Their results are also in line with the results of this study supporting the effectiveness of HS.

The studies conducted by Simran Grewal *et al*, Ayse Berna Anil *et al* and Ilke OzahiIpek *et al* showed no significant difference in the HS group versus other groups.[14,15,16] Their findings are not consistent with the results of this study. This might be due to the difference in defining the outcome measures and some other technical issues with outcome variables.

Sadbhavna Pandita in his study compared HS with NS. As per his findings the mean ± SD length of stay in hospital in HS and NS group was 3.92 ± 1.72 days and 4.08 ± 1.90 days respectively. There was no significant difference noted between two groups (P = 0.67).[17]

As per findings of Gaurav Malik mean Length of hospital stay in HS, NS and Salbutamol groups was 3.4 ± 1.7, 4.9 ±

1.4 and 3.7 ± 1.9 days respectively, which was found to be statistically significant (p= 0.001).[18]

Several studies have looked into the concentration and volume of saline used, *vis-a-vis* clinical outcomes. It has been shown that the change in airway surface liquid depth is a direct result of total mass of sodium chloride added to the airway surface and can be altered by both increasing the concentration and lowering the volume or *vice versa*.[19]

In another study conducted by Todd A. Florin *et al*, showed no difference in mean length of stay(LOS) (HS 2.3 days vs non-recipients 2.5 days; B-coefficient – 0.04; 95% CI – 0.15, 0.07; p=0.5).[20]

As per studies discussed above some studies advocate the use of HS to be effective in shorter hospital stay while some did not agree with this. However, this debate continues but this study finds HS nebulization to be effective in successfully reducing the hospital stay. To get the clear evidence for efficacy of HS, few variables were also stratified to avoid bias. Stratification of age, gender, severity duration and severity score showed that in HS group hospital stay was shorter as compared to the NS nebulization.

CONCLUSION

As per findings of this study HS is superior to NS nebulization in the management of bronchiolitis in children in terms of mean length of hospital stay.

LIMITATIONS

As this study is conducted on small local group, in future large clinical trials can be done to prove HS as a gold standard treatment for bronchiolitis in a more logical way.

SUGGESTIONS / RECOMMENDATIONS

HS may be recommended for use in the management of bronchiolitis in children 2 to 18 months of age.

CONFLICT OF INTEREST / DISCLOSURE

No conflict of interest is involved.

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