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Original Article

NEBULIZED 3% HYPERTONIC SALINE REDUCES THE DURATION OF HOSPITAL STAY IN COMPARISON TO NEBULIZED ADRENALINE IN THE TREATMENT OF ACUTE BRONCHIOLITIS

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Abstract

Background: *In case of infants and young childraen acute bronchiolitis is the most common lower respiratory tract infection. It is the leading cause of hospitalization in case of infants below 2 years of age. The respiratory syncytial virus is the most common cause of acute bronchiolitis. Bronchiolitis being a viral disease, there is no effective management. The role of nebulized 3% saline has come into focus recently. As an another treatment option nebulized adrenaline has also been suggested, its primary role being the reduction of mucosal edema, which is an important part of the disease pathology in bronchiolitis.*

Objective: *To compare the effects of nebulized adrenaline with nebulized 3% hypertonic saline in the treatment of acute bronchiolitis.*

Methods: *This study was a randomized controlled trial, carried out in the Department of Pediatrics, East West Medical College and Hospital from October 2022 to September 2024. A total number of 70 children aged from 1 month to 2 years of either sex who were diagnosed and admitted with acute bronchiolitis were enrolled in the study. They were assigned to 3% nebulized hypertonic saline (group A=35) and nebulized adrenaline-1:1000 group (group B=35) randomly. Monitoring was done by respiratory distress assessment instrument (RDAI) score at 12 hourly for 1st 24 hours and then 24 hourly till the time of discharge. The effectiveness was determined by assessing clinical severity score/ RDAI score and duration of hospital stay. Data were analyzed using SPSS version-27.*

Results: *The mean age was found 6.67±5.10 months in group A and incase of group B 6.47±4.31 months. The majority of patients were males in both groups. All patients had a cough, difficulty in breathing, ronchi, and chest indrawing in both groups. Changes in heart rate were 7.87±1.58/min in group A and 4.99±3.02/min in group B, that was significantly decreasing in group A than in group B. Mean clinical severity scores at 24 hours and at 48 hours were statistically significant ($p<0.05$) between the groups. The mean duration of oxygen therapy was 17.00±4.78 hours in group A and 23.45±10.87 hours in group B. The mean duration of oxygen therapy was significantly higher in group B compared with group A. The length of hospital stay was found 38.51±21.12 hours in group A and 54.36±33.36 hours in group B. The mean duration of hospital stay was significantly higher in group B in compared with group A.*

Conclusion: *Nebulization with 3% hypertonic saline significantly reduced the duration of hospital stay and clinical severity score in comparison to nebulized adrenaline in the treatment of acute bronchiolitis.*

Key words:
Acute bronchiolitis, 3% hypertonic saline, Nebulized adrenaline

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Introduction

Bronchiolitis is the most common respiratory disease affecting infants and young children, characterized by inflammation and congestion of the bronchioles.[1] The American Academy of Pediatrics (APP), define bronchiolitis as a viral upper respiratory tract infection

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followed by respiratory effort with wheezing in children younger than 2 years of age.[2] According to the national guideline of Bangladesh, diagnosis of bronchiolitis is clinical characterized by cough and respiratory distress associated with wheeze, preceded by a runny nose with or without fever in children aged below 2 years of age, commonly between 2-6 months of age.[3] This viral disease is caused by Respiratory Syncytial Virus (RSV), Human Parainfluenza virus, Rhinovirus, Human metapneumovirus, Influenza virus, Coronavirus, Human bocavirus, Mycoplasma pneumonia and adenovirus.[4] Incidence is most commonly in the winter seasons, from December to March in northern India.[5] The work of breathing increases characterized by nasal flaring, subcostal and intercostal retractions, hyper expansion of the chest, restlessness, and peripheral cyanosis.[6] World Health Organization(WHO-2009) estimates that globally RSV causes 64 million infections and 160,000 deaths annually.[7] Near about 100,000 bronchiolitis hospital admissions occur annually in the United States, leading to an estimated cost of $1.73 billion.[8] The diagnosis is clinical and investigations are not generally needed to confirm the diagnosis. However, RSV infection can be made by Enzyme-linked Immunofluorescence Assay (ELISA) and fluorescent antibody techniques for detection of the viral antigen, and amplification of the virus using the shell vial method, and amplification of viral genome by Polymerase Chain Reaction (PCR) or viral culture. A Rapid Test using monoclonal antibodies against RSV on nasopharyngeal aspirates can identify RSV at the bedside.[9] There is no universally accepted treatment for bronchiolitis. Treatment of bronchiolitis is mainly supportive. Options of management include oxygen (O2) therapy; $beta_2$-adrenergic agonists, albuterol and levalbuterol; racemic epinephrine; corticosteroids; antibiotics; and, recently, hypertonic saline. Oxygen therapy acts as a direct bronchodilator provides oxygen to the lungs. Current AAP guidelines recommend the use of supplemental oxygen if saturations of oxygen are less than 90% in order to avoid hypoxemia.[10] Hypertonic saline shifts the water into the mucus layer by osmosis, resulting in reduction of submucosal edema, reducing the viscosity of mucus, improving mucus clearance, and rehydrating the air surface.[11-13] The updated AAP guidelines support the use of nebulized hypertonic saline for infants and children hospitalized for bronchiolitis. Racemic epinephrine should be a useful therapeutic option because of its agonistic effects on alpha and beta receptors, helping to reduce mucosal plugging and edema. As a result of possible improvement in patients with severe bronchiolitis, the 2014 AAP guidelines provided support for racemic epinephrine as a rescue agent in the hospital setting, conducted a study where they found that adrenaline nebulization in infants with moderate to severe bronchiolitis is superior than salbutamol nebulization.[14-16]

Objectives

General objective:

To compare the effects of nebulized adrenaline with nebulized 3% hypertonic saline in the treatment of acute bronchiolitis.

Specific Objectives:

- To see the clinical recovery and length of hospital stay in the nebulized adrenaline group.
- To see the clinical recovery and length of hospital stay in the nebulized 3% hypertonic saline group.
- To compare the two groups

Methodology & Materials

This study was a randomized controlled trail, conducted at East West Medical College and Hospital, Dhaka, Bangladesh, from October 2022 to September 2024. Children aged between one month to two years presenting with previous or existing runny nose, cough, chest indrawing, difficult breathing and ronchi on auscultation admitted during this study period and fulfilled the enrollment criteria was enrolled as study population. A total number of 70 children with acute bronchiolitis were included in this study. They were randomly assigned to nebulized 3% hypertonic saline (n=35) group A and nebulized 1:1000 adrenaline (n=35) group B by lottery method.

Inclusion criteria:

Age group between 1 month to 2 years

Wheezing for the first time

History of viral prodrome present

No history of treatment with either nebulized 3% hypertonic saline or nebulized adrenaline during the disease course

Exclusion criteria:

Age group <1 month or >2 years.

Wheezing for more than one episode

Family history of Asthma.

Congenital heart disease

After admission, detail clinical history was taken from the patient's attendant and a through physical examination was done. Oxygen saturation in room air and RDAI score were recorded on admission as a baseline characteristics. Saturation of Oxygen was measured by using noninvasive pulse oximeter. The following investigations were performed for all patients:

- CBC
- X-ray chest at the time of admission

History of cough, breathing difficulty, chest in drawing, fever, and wheezing following a viral upper respiratory tract infection were taken. Respiratory rate, auscultator findings (ronchi), retraction, and general condition were assessed by using Respiratory Distress Assessment Instrument (RDAI) described by.[17]Informed written consent was taken. Group-A received nebulization with 4 ml of 3% hypertonic saline and the other site Group B received nebulization with 1 ml of adrenaline (1:1000) mixed with 3 ml normal saline four times every day until they were improved enough for discharge. The Two groups received the same supportive measures like propped-up positioning, suction, fluid, feeding, and oxygen therapy(when oxygen saturation <90%). Oxygen saturation in room air and the time required from the initiation of the oxygen support to the withdrawal of oxygen therapy were recorded. Oxygen therapy was stopped when $SP0_2$ >95% on room air. The total length of hospital stay was measured. Statistical analysis was carried out using the SPSS version 27.0. The Chi-square test was used for categorical variables. Unpaired t-test and paired t-test were used for continuous variables. P values <0.05 were considered statistically significant. Ethical clearance was taken from the ethical review committee of East West Medical College and Hospital.

Results

Table I showed the majority of patients belonged to age 1-6 months in both groups, which was 23(65.7%) in group A and 21(60%) in group B. The mean age was found 6.67±5.10 months in group A and 6.47±4.31 months in group B. The mean difference was not statistically significant (p>0.05). Males were predominant in both groups, which were 28(80%) in group A and 26(74.3%) in group B. Whereas females were 7(20%) and 9(25.7%) in group A and group B respectively. The differences were not statistically significant (p>0.05) between the groups.

Table II showed the distribution of the study patients according to clinical features. There was no statistically significant differences between the groups(p>0.05)

Table III showed the initial and 24 hours after nebulization means heart rate, which was not statistically significant when compared between the two groups. Changes in heart rate were 7.87±1.58/ min in group A and 4.99±3.02/min in group B, which was significantly decreasing in group A than in group B. Initial SPO_2 was not statistically significant when compared between the two groups but 24 hours after nebulization mean SPO_2 was statistically significant (p<0.05) when compared between the two groups. Changes in SPO_2 were slightly more in group A than in group B but were not statistically significant (p>0.05) between groups.

Table IV showed mean clinical severity score/RDAI score at 24 hours and at 48 hours were statistically significant (p<0.05) when compared between group A and group B. However, mean clinical severity scores at baseline, at 12 hours, at 72 hours, and at 96 hours were not statistically significant between groups.

Table-I

Distribution of the study patients by demographic variables (N=70)

Demographic variables	Group A (n=35)		Group B (n=35)		P-value
	n	%	n	%	
Age group (months)					
1-6 months	23	65.7	21	60	0.477^{ns} 0.754^{ns}
6-12 months	7	20	11	31.4	
12-24 months	5	14.3	3	8.6	
Mean ±SD	6.67±5.10	6.47±4.31			
Gender					
Male Child	28	80	26	74.3	0.776^{ns}
Female Child	7	20	9	25.7	

Table-II

Distribution of the study patients by clinical features (N=70)

Clinical features	Group A (n=35)		Group B (n=35)		P-value
	n	%	n	%	
Cough	35	100.0	35	100.0	-
Fever	28	80	24	71.4	0.274^{ns}
Runny nose	30	85.7	31	88.5	1.000^{ns}
Difficulty in breathing	35	100.0	35	100.0	-
Feeding difficulty	25	71.4	21	60	0.314^{ns}
Irritability	10	28.5	10	28.5	1.000^{ns}
Lethargic	10	28.5	10	28.5	1.000ns
Wheeze	28	80	26	74.2	0.569^{ns}
Ronchi	35	100.0	35	100.0	-
Chest indrawing	35	100.0	35	100.0	-
Nasal flaring	20	57.1	15	42.8	0.232^{ns}
Tachypnea	4	11.4	6	17.1	0.495^{ns}
Tachycardia	12	34.2	9	25.7	0.434^{ns}

Table-III

Improvement of HR and SPO_2 after 24 hours of nebulization (N=70)

Physical examination	Group A(n=35) Mean ±SD	Group B(n=35) Mean ±SD	P-value
Heart rate (/min)			
Initial	130.12±7.45	126.54±8.27	0.061ns
24 hours after nebulization	122.25±5.87	121.55±5.25	0.601ns
Changes HR	7.87±1.58	4.99±3.02	<0.001s
SPO2 (%)			
Initial	91.15±4.98	89.21±4.87	0.104ns
24 hours after nebulization	96.12±3.01	94.12±3.02	0.007s
Changes SPO2	4.97±1.97	4.91±1.85	0.896ns

Table-IV

Mean respiratory distress assessment instrument (RDAI) score Among Two Group (N=70)

Mean RDAI score	Group A(n=35) Mean ±SD	Group B(n=35) Mean ±SD	P-value
At baseline	7.84±1.38	7.54±1.21	0.337^{ns}
At 12 hours	5.64±1.26	5.37±1.13	0.349^{ns}
At 24 hours	3.73±1.41	4.94±1.18	0.00023^{s}
At 48 hours	3.21±1.81	4.33±1.28	0.0040^{s}
At 72 hours	2.79±1.34	3.10±1.12	0.297^{ns}
At 96 hours	1.67±0.61	1.80±0.66	0.395^{ns}

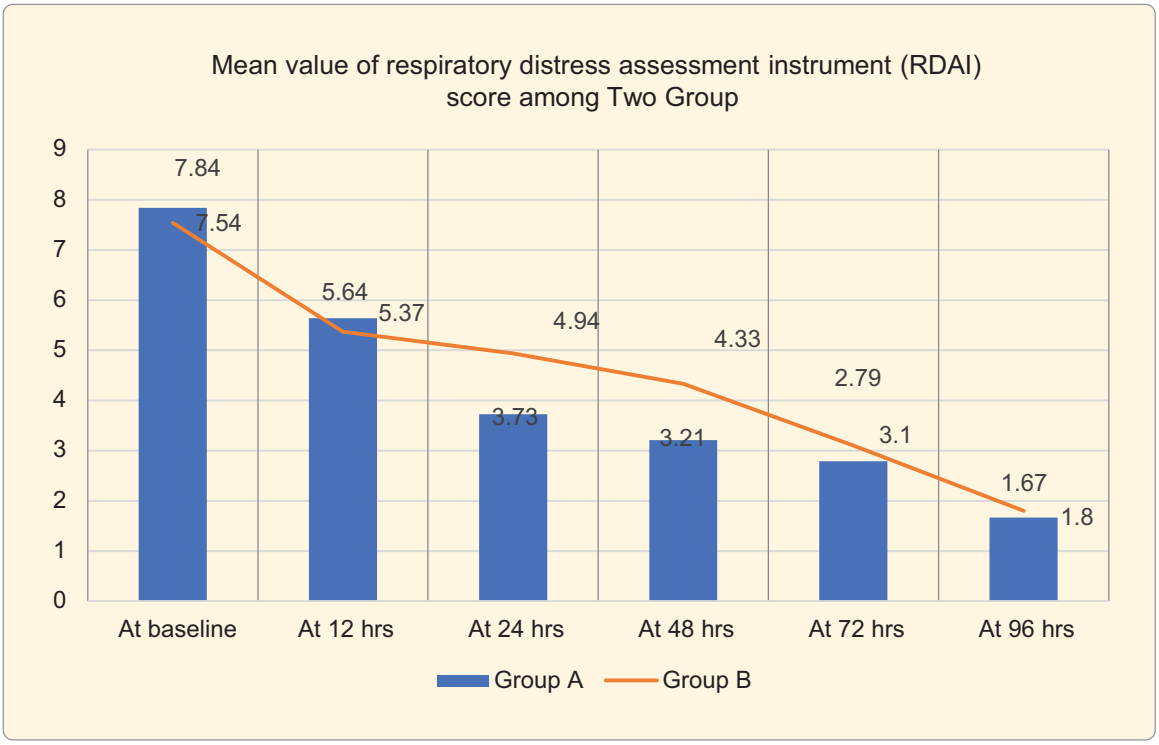

Figure 1: *Mean value of respiratory distress assessment instrument (RDAI) score Among Two Group (N=70)*

Table-V

Comparison of duration of oxygen therapy between groups (n=33)

	Group A(n=15) Mean ±SD	Group B(n=18) Mean ±SD	P-value
Duration of oxygen therapy (hours)	17.00±4.78	23.45±10.87	0.0024[s]

Table-VI

Comparison of length of hospital stays between groups (N=70)

	Group A(n=35) Mean±SD	Group B(n=35) Mean±SD	P-value
Length of hospital stay (hours)	38.51±21.12	54.36±33.36	0.021[s]

Table V showed that in group A 15 and in group B 18 patients required oxygen supplementation. The mean duration of oxygen therapy was found 17.00±4.78 hours in group A and 23.45±10.87 hours in group B. This indicates that the duration of oxygen therapy was significantly higher in group B than in group A ($p<0.05$).

Table VII showed that the mean length of hospital stay was 38.51±21.12 hours in group A and 54.36±33.36 hours in group B which indicate that the length of hospital stay was significantly higher in group B than in group A.

Discussion

This study was carried out in the Department of Pediatrics East West Medical college and Hospital, Dhaka. A total number of 70 patients of 1-24 months of age with acute bronchiolitis were included in this study. In this study, the majority of patients belonged to age 1-6 months in both groups. The mean age was found 6.67±5.10 months in group A and 6.47±4.31 months in group B. The mean difference was not statistically significant ($p>0.05$) between the two groups. The result was similar to the previous study

conducted by Hervas et al.[18] we observed that the males were predominant in both groups, which were 28(80%) in group A and 26(74.3%) in group B, whereas females were 7(20%) and 9(25.7%) in group A and group B respectively. The findings were similar to the previous studies conducted by Nagayama et al. and Boezen et al.[19-20] This study showed that initial and 24 hours after nebulization mean heart rate difference was not statistically significant when compared between two groups. Changes in heart rate were 7.87±1.58/min in group A and 4.99±3.02/min in group B, which was significantly decreasing in group A than in group B. According to a previous study, the changes of heart rate before and after treatment with 3% hypertonic saline alone or 3% hypertonic saline plus 1:1000 adrenaline was not significant statistically.[21] Initial SPO_2 was not statistically significant when compared between the two groups but 24 hours after nebulization mean SPO_2 was statistically significant when compared between the two groups($p<0.05$). Changes in SPO_2 were slightly more in group A than in roup B, but not statistically significant ($p>0.05$). Hasan N et al. also found similar results in their studies.[22] Mean clinical severity scores at 24 and at 48 hours were statistically significant between the two groups. It was similar to the study results conducted by Luo et al., Mandelberg and Tal.[23,24,25] In the present study, it was observed that the mean duration of oxygen therapy was 17.00±4.78 hours in group A and 23.45±10.87 hours in group B ($p<0.05$), which is similar to the study of Hasan N et al.[22] In this current study, the mean duration of hospital stay was significantly lower in group A in comparison to group B ($p<0.05$). Luo et al., Mandelberg and Tal also found similar correlation in their studies.[23,24,25]

Limitation of the study

Sample size was small. Bronchiolitis was diagnosed clinically. No confirmatory investigation was done. Therefore, in the future, further studies may be undertaken with a large sample size

Conclusion

Nebulized 3% hypertonic saline showed better clinical improvement and less hospital stay in comparison to nebulized adrenaline in the treatment of acute bronchiolitis.

Recommendations

Nebulized 3% hypertonic saline is effective in bronchiolitis without any side effects. Larger, multicenter, double-blind, randomized controlled trials are needed to obtain more reliable results.

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