Journal of Shaheed Ziaur Rahman Medical College
https://www.szmcjournal.com/
ISSN: 1607-5854
Volume 45: Issue 2; July 2026.
*DOI: **10.5281/zenodo.22659186***

OPEN ACCESS

ORIGINAL ARTICLE

Effect of 3% Hypertonic Saline vs Nebulized Adrenaline on O_2 Requirement & Clinical Recovery in Infants with Acute Bronchiolitis

Hasan N[1*], Hossain S[2], Akter H[3], Kausar T[4], Afrosy S[5]

Received: 30/06/2026 **Revision: 12/08/2026** **Accepted: 20/08/2026**

ABSTRACT

Background: Acute bronchiolitis is a common viral respiratory infection in infants, causing wheezing, respiratory distress, and increased oxygen requirement. Management is mainly supportive, with limited effective pharmacological options. Nebulized 3% hypertonic saline may improve mucus clearance, while adrenaline may reduce airway edema. However, their comparative effectiveness remains uncertain, particularly in Bangladesh. This study aimed to compare their effects on oxygen requirement and clinical recovery in infants with acute bronchiolitis.

Methods: A randomized controlled study was conducted at Ashiyan Medical College Hospital, Dhaka, from February to July 2025, involving 114 Children aged 2–12 months with acute bronchiolitis. Infants were randomly assigned to nebulized 3% hypertonic saline (n=57) or adrenaline (n=57), alongside standard supportive care. Oxygen requirement, clinical recovery, SpO_2, respiratory rate, severity score, and hospital stay were assessed. Data were analyzed using SPSS 27.0, with $p<0.05$ considered significant. Ethical approval and parental consent were obtained.

Results: Among 114 infants, baseline characteristics were comparable. Compared with adrenaline, 3% hypertonic saline significantly reduced oxygen requirement (32.6 vs. 40.8 hours; p=0.009), clinical recovery time (3.2 vs. 3.8 days; p=0.012), and hospital stay (3.7 vs. 4.3 days; p=0.018). SpO_2 at 24 hours was higher with hypertonic saline (94.3% vs. 93.5%; p=0.010). Recovery within 72 hours was higher with hypertonic saline (78.9% vs. 63.2%), but not statistically significant. No serious adverse events occurred, while tachycardia was less frequent with hypertonic saline (0% vs. 8.8%; p=0.023).

Conclusion: 3% hypertonic saline reduced oxygen requirement, recovery time, and hospital stay compared with nebulized adrenaline and was well tolerated, suggesting a beneficial role in acute bronchiolitis.

Keywords: Acute Bronchiaolitis, Infants, 3% Hypertonic Saline, Nebulized Adrenaline, O_2 Requirement, Clinical Recovery

INTRODUCTION

Acute bronchiolitis is a common viral lower respiratory tract infection affecting predominantly children younger than 2 years. It is characterized by inflammation, edema, and obstruction of the small airways, typically beginning with rhinitis, nasal congestion, and cough, followed by tachypnea, wheezing, and increased work of breathing [1]. Respiratory syncytial virus (RSV) is the predominant causative pathogen, accounting for approximately 60–75% of cases, while other important viruses include rhinovirus, parainfluenza, influenza, and human metapneumovirus [2,3]. The risk of severe disease is increased by prematurity, younger age, male sex, chronic lung or congenital heart disease, neuromuscular disorders, tobacco smoke exposure, maternal asthma, and low socioeconomic status [4]

Management of acute bronchiolitis is primarily supportive, with oxygen supplementation, adequate hydration, and respiratory support when required. Routine use of antibiotics, bronchodilators, and corticosteroids is generally not recommended because of limited clinical benefit. Similarly, interventions such

1. Nazmul Hasan, Associate Professor, Department of Pediatrics, Ashiyan Medical College, Dhaka, Bangladesh, Email: nazmul.mdmc@gmail.com, Phone: +8801723216875.
2. Salma Hossain, Associate Professor, Department of Pediatrics, Ashiyan Medical College, Dhaka, Bangladesh
3. Helena Akter, Assistant Professor, Department of Pediatrics, Ashiyan Medical College, Dhaka, Bangladesh
4. Tamanna Kausar, Assistant Professor, Department of Obstetrics and Gynecology, Ashiyan Medical College, Dhaka, Bangladesh
5. Sharmin Afrosy, Associate Professor, Department of Pediatrics, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh.
* Address for Correspondence.

as chest physiotherapy and magnesium sulfate have not demonstrated consistent efficacy [5–7]. Therefore, there remains considerable interest in safe therapies that may reduce respiratory distress, oxygen requirements, and duration of illness.

Nebulized 3% hypertonic saline (HS) has been proposed as a potential therapy because it may improve airway surface hydration, reduce mucus viscosity, enhance mucociliary clearance, and facilitate secretion removal. These effects may reduce airway obstruction and respiratory distress and promote clinical recovery [8]. However, randomized trials have reported inconsistent findings. One trial demonstrated reduced hospital admission compared with normal saline in infants treated in the emergency department, but no significant improvement in hospital stays or respiratory distress among hospitalized infants [9]. Conversely, the multicenter SABRE trial found no significant difference in readiness for discharge or actual discharge with HS compared with standard care [10]. Other studies have reported improvements in clinical severity scores and earlier discharge, particularly among infants with mild-to-moderate bronchiolitis [11]. Thus, the effectiveness of HS may depend on disease severity, treatment setting, and concomitant therapy.

Nebulized adrenaline (epinephrine) has also been investigated in acute bronchiolitis. Through α-adrenergic vasoconstriction, adrenaline may reduce airway mucosal edema, while β-adrenergic activity may provide transient bronchodilation [12]. Nevertheless, clinical benefits have been inconsistent. Evidence from a Cochrane review suggested a reduction in early hospital admission among outpatients, but this benefit was not sustained, and evidence was insufficient to support routine use in hospitalized infants [13]. More recent evidence has suggested modest improvements in some clinical outcomes, particularly when adrenaline is combined with hypertonic saline; however, substantial heterogeneity and low-to-moderate certainty of evidence limit definitive conclusions [14].

Comparing 3% HS with nebulized adrenaline is therefore clinically important because the two interventions target different components of bronchiolitis pathophysiology. HS primarily promotes mucus hydration and mucociliary clearance, whereas adrenaline mainly reduces mucosal edema and may provide transient bronchodilation. Despite their potential benefits, direct evidence comparing these two therapies, particularly regarding oxygen requirement and clinical recovery, remains limited [9-14]. This question is especially relevant in resource-limited settings, where bronchiolitis contributes substantially to pediatric admissions and oxygen utilization. Identifying an effective therapy that reduces oxygen requirement and accelerates clinical recovery could potentially shorten hospitalization, reduce healthcare costs, and lessen the burden on pediatric services.

Evidence from Bangladesh directly comparing 3% hypertonic saline with nebulized adrenaline in acute bronchiolitis is limited. This study aims to compare their effects on oxygen requirement and clinical recovery in affected infants.

MATERIAL AND METHODS

Study Design and Setting

A hospital-based, comparative randomized controlled study was conducted to compare the effect of 3% hypertonic saline and nebulized adrenaline on oxygen requirement and clinical recovery among infants with acute bronchiolitis. The study was conducted in the Department of Pediatrics of Ashiyan Medical College Hospital, Dhaka, Bangladesh, over a six-month period from February 2025 to July 2025.

Study Population

The study population consisted of infants diagnosed with acute bronchiolitis who were admitted to the hospital during the study period. A total of 114 infants were included in the study. Participants were randomly allocated into two equal groups: 57 Children received nebulized 3% hypertonic saline (hypertonic saline group) and 57 infants received nebulized adrenaline (adrenaline group).

Eligibility Criteria

Infants aged 2–12 months presenting with a first or acute episode of bronchiolitis were eligible for inclusion. Acute bronchiolitis was diagnosed clinically based on a history of upper respiratory tract symptoms followed by cough, wheezing and/or respiratory distress. Infants with moderate to severe disease requiring hospital admission were included.

Infants with congenital heart disease, chronic lung disease, neuromuscular disorders, significant congenital anomalies, previous recurrent wheezing, pneumonia, or those requiring immediate mechanical ventilation were excluded.

Sample Size

The sample size was calculated using the formula for comparison of two independent means, based on the findings reported by Verma et al. (2017). Considering a 95% confidence level ($Z\alpha = 1.96$), 80% statistical power ($Z\beta = 0.84$), a standard deviation of 0.94 in the control group and 0.85 in the experimental group, and expected mean values of 1.32 and 1.67, respectively, the calculated sample size was 102 participants. To ensure adequate statistical power, the sample size was increased to 114 participants. Accordingly, a total of 114 infants were enrolled in the study, with 57 participants allocated to the 3% hypertonic saline group and 57 to the nebulized adrenaline group. All enrolled participants completed the study.

Randomization and Intervention

Eligible infants were randomly assigned in a 1:1 ratio to either the 3% hypertonic saline group or the nebulized adrenaline group using a computer-generated randomization sequence. The hypertonic saline group received nebulized 3% hypertonic saline, while the adrenaline group received adrenaline nebulized according to the hospital's pediatric treatment protocol. Nebulization was administered using the same type of nebulizer device in both groups at predefined intervals. Both groups received standard supportive management for acute bronchiolitis, including nasal saline and suction when required, adequate hydration, feeding support, and supplemental oxygen when indicated. Other treatment was provided according to the clinical condition of the infant.

Data Collection

Baseline information was collected using a structured data collection form. Demographic variables included age, sex, and body weight. Clinical variables included respiratory rate, oxygen saturation (SpO_2), clinical severity score, and disease severity at admission.

Oxygen saturation was measured using a pulse oximeter. Respiratory rate was counted for one full minute. Clinical severity was assessed using a standardized clinical severity score incorporating relevant respiratory findings. The same assessment procedure was followed during subsequent clinical evaluations.

Outcome Measures

The primary outcomes were the duration of oxygen requirement and clinical recovery time. Duration of oxygen requirement was recorded in hours from initiation until the infant maintained satisfactory oxygen saturation without supplemental oxygen according to the predefined clinical criteria.Clinical recovery time was recorded in days from initiation of treatment until improvement in respiratory distress, respiratory rate, oxygen saturation, and overall clinical condition.

Secondary outcomes included changes in SpO_2, respiratory rate, clinical severity score, duration of hospital stay, proportion of infants recovering within 72 hours, treatment failure, need for escalation of respiratory support, and treatment-related adverse events. Treatment failure was defined as clinical deterioration requiring escalation of respiratory support or other higher-level respiratory intervention.

Follow-up and Assessment

Participants were clinically assessed at baseline and during hospitalization. SpO_2, respiratory rate, and clinical severity score were reassessed during follow-up, particularly at 24 and 48 hours after initiation of treatment. The duration of oxygen requirements, time to clinical recovery, and total hospital stay were recorded for each participant.

Adverse events such as cough, irritability, and tachycardia occurring during or after nebulization were documented. Any serious adverse event or requirement for escalation of respiratory support was also recorded.

Statistical Analysis

Data were entered, cleaned, and analyzed using SPSS version 27.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage. The independent samples t-test was used to compare continuous variables between the two treatment groups, and the Chi-square test or Fisher's exact test was used for categorical variables, as appropriate. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the appropriate institutional ethical review authority before commencement of the study. Written informed consent was obtained from the parents or legal guardians of all participating infants. Confidentiality of participant information was maintained throughout the study, and participation was voluntary.

RESULTS

A total of 114 infants with acute bronchiolitis were included in the study, with 57 infants allocated to the 3% hypertonic saline group and 57 to the nebulized adrenaline group. The baseline demographic and clinical characteristics of the two groups were broadly comparable.

Table 1 shows the mean age of the infants was 7.8 ± 3.1 months in the hypertonic saline group and 7.5 ± 3.0 months in the adrenaline group. Males constituted 59.6% and 61.4% of the respective groups. The mean baseline respiratory rate, oxygen saturation, and clinical severity scores were also comparable between the groups.

Table 1. Baseline demographic and clinical characteristics of the study participants (n=114)

Variable	3% Hypertonic saline(n=57)	Nebulized adrenaline (n=57)	p-value
Age, months, mean ± SD	7.8 ± 3.1	7.5 ± 3.0	0.612
Male, n (%)	34 (59.6)	35 (61.4)	0.850
Female, n (%)	23 (40.4)	22 (38.6)	
Weight, kg, mean ± SD	6.9 ± 1.4	6.8 ± 1.3	0.708
Respiratory rate/min, mean ± SD	56.4 ± 7.2	57.1 ± 7.5	0.604
SpO_2 at admission (%), mean ± SD	91.8 ± 1.9	91.6 ± 2.0	0.592
Clinical severity score, mean ± SD	6.8 ± 1.4	6.9 ± 1.5	0.718
Moderate severity, n (%)	43 (75.4)	42 (73.7)	0.832
Severe severity, n (%)	14 (24.6)	15 (26.3)	

Table 2 presents at baseline; the mean oxygen saturation was 91.8 ± 1.9% in the 3% hypertonic saline group and 91.6 ± 2.0% in the adrenaline group. Following

treatment, oxygen saturation improved significantly in both groups. However, the improvement was slightly greater in the hypertonic saline group. The mean duration of oxygen requirement was 32.6 ± 14.2 hours in the hypertonic saline group compared with 40.8 ± 17.5 hours in the adrenaline group (p=0.009).

Table 2. Comparison of oxygen requirement and oxygen saturation

Outcome	3% Hypertonic saline	Nebulized adrenaline	p-value
Duration of O_2 requirement, hours	32.6 ± 14.2	40.8 ± 17.5	**0.009**
SpO_2 after 24 h (%)	94.3 ± 1.5	93.5 ± 1.7	**0.010**
SpO_2 at 48 h (%)	95.1 ± 1.2	94.5 ± 1.4	0.016
Infants requiring O_2 >48 h, n (%)	11 (19.3)	20 (35.1)	**0.063**

Table 3 shows the mean clinical recovery time was also shorter among infants receiving 3% hypertonic saline (3.2 ± 1.1 days) compared with those receiving nebulized adrenaline (3.8 ± 1.3 days), with the difference being statistically significant (p=0.012). Similarly, the mean duration of hospital stay was lower in the hypertonic saline group (3.7 ± 1.2 days vs. 4.3 ± 1.4 days; p=0.018).

Table 3. Comparison of clinical recovery and hospital stay

Outcome	3% Hypertonic saline (n=57)	Nebulized adrenaline (n=57)	p-value
Clinical recovery time, days	3.2 ± 1.1	3.8 ± 1.3	**0.012**
Hospital stays, days	3.7 ± 1.2	4.3 ± 1.4	**0.018**
Respiratory rate at 48 h/min	43.8 ± 5.6	46.2 ± 6.1	0.028
Clinical severity score at 48 h	3.1 ± 1.0	3.7 ± 1.2	**0.006**

Table 4 shows regarding clinical outcome, 45 (78.9%) infants in the hypertonic saline group achieved clinical recovery within 72 hours compared with 36 (63.2%) in the adrenaline group (p=0.063). Treatment failure requiring escalation of respiratory support occurred in 4 (7.0%) infants in the hypertonic saline group and 8 (14.0%) in the adrenaline group.

Table 4. Clinical outcome of the study participants

Clinical outcome	3% Hypertonic saline, n (%)	Nebulized adrenaline, n (%)	p-value
Recovery within 72 h	45 (78.9)	36 (63.2)	0.063
Recovery after 72 h	8 (14.0)	13 (22.8)	
Treatment failure	4 (7.0)	8 (14.0)	
Required escalation of respiratory support	4 (7.0)	8 (14.0)	0.222

Table 5 shows no serious adverse events were observed in either group. Transient cough or irritability during nebulization was reported in 5 (8.8%) infants receiving hypertonic saline and 9 (15.8%) receiving adrenaline. The difference was not statistically significant (p=0.248).

Table 5. Adverse events during treatment

Adverse event	3% Hypertonic saline, n (%)	Nebulized adrenaline, n (%)	p-value
Cough during nebulization	4 (7.0)	5 (8.8)	0.729
Irritability	1 (1.8)	4 (7.0)	0.168
Tachycardia	0 (0.0)	5 (8.8)	0.023
Serious adverse event	0 (0.0)	0 (0.0)	—
Any adverse event	5 (8.8)	9 (15.8)	0.248

DISCUSSION

In our study, baseline demographic and clinical characteristics were comparable between the 3% hypertonic saline and nebulized adrenaline groups, including age, sex, weight, respiratory rate, SpO_2, and clinical severity scores. This finding is consistent with previous comparative studies, which also reported similar baseline characteristics between treatment groups, supporting the comparability of the two groups [15].

In this study, 3% hypertonic saline significantly reduced oxygen requirement and improved SpO_2 at 24 and 48 hours compared with nebulized adrenaline. This finding is consistent with a previous comparative study that reported reduced oxygen requirement and improved clinical outcomes with hypertonic saline, supporting its potential benefit in improving oxygenation and reducing supplemental oxygen needs [16].

In our study, 3% hypertonic saline significantly shortened clinical recovery time and hospital stay and produced greater improvement in respiratory rate and clinical severity score at 48 hours. These findings are consistent with previous research showing better clinical improvement and shorter hospitalization with hypertonic saline than epinephrine in infants with bronchiolitis [17].

This study, recovery within 72 hours was higher with hypertonic saline than adrenaline, although the difference was not statistically significant. Treatment failure and the need for respiratory support escalation were also lower with hypertonic saline. These findings are consistent with a previous randomized controlled study reporting better clinical recovery with hypertonic saline [18].

In our study, both treatments were well tolerated, with no serious adverse events. Overall adverse events were less frequent with hypertonic saline, and tachycardia was significantly lower. This finding is consistent with previous studies reporting good tolerability of hypertonic saline and fewer cardiovascular adverse effects compared with adrenaline-containing regimens [13,18].

Overall, in our study, 3% hypertonic saline demonstrated greater clinical benefit and better tolerability than nebulized adrenaline, particularly in reducing oxygen requirement, shortening recovery time and hospital stay, and improving clinical status in infants with acute bronchiolitis.

CONCLUSION

3% hypertonic saline showed more clinical advantages than nebulized adrenaline in infants with acute bronchiolitis, notably lowering oxygen needs, recovery time, and duration of hospital stay while enhancing oxygen saturation. Recovery within 72 hours was greater with hypertonic saline, but the difference lacked statistical significance. Both therapies were typically well accepted, with a lower incidence of adverse events noted with hypertonic saline. In general, 3% hypertonic saline seems to be a safe and effective addition to supportive care for enhancing clinical recovery and decreasing oxygen reliance in infants experiencing acute bronchiolitis.

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How to Cite: *Hasan N, Hossain S, Akter H, et al. Effect of 3% Hypertonic Saline vs Nebulized Adrenaline on O_2 Requirement & Clinical Recovery in Infants with Acute Bronchiaolitis. SZMCJ 2026; 45(2): 108-113. DOI: 10.5281/zenodo.22659186.*