

Original Article

# Comparison of 3% Normal Saline Nebulization versus Steroid Nebulization in the Treatment of Bronchiolitis

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## ABSTRACT

**Background:** Bronchiolitis is a leading cause of hospitalization in infants. This study aimed to compare the efficacy of 3% normal saline nebulization with steroid nebulization in the treatment of bronchiolitis.

**Methods:** Conducted at the Department of Pediatrics, Mardan Medical Complex, Mardan from November 15, 2022, to March 15, 2023, this randomized controlled trial involved 60 infants aged 3 to 12 months diagnosed with bronchiolitis. They were equally randomized into two groups: Group-A received 3% normal saline nebulization, while Group-B was treated with steroid and salbutamol nebulization, administered three times daily. Efficacy assessments were made at 0, 12, 24, 48, and 72 hours using the respiratory distress assessment instrument. The primary outcome was defined as the number of patients discharged from the hospital within  $\leq 72$  hours after starting treatment. The chi-square test was used for statistical comparison, with  $p \leq 0.05$  considered significant.

**Results:** The mean $\pm$ SD age in the study was  $6.91 \pm 2.41$  months, with a gender distribution of 55% male and 45% female. The study revealed that a significantly higher number of infants in Group-A were discharged from the hospital within  $\leq 3$  days compared to Group-B (90% vs 63.33%,  $p=0.01$ ). Additionally, Group-A had a significantly shorter mean length of hospital stay ( $2.76 \pm 0.51$  days) compared to Group-B ( $3.58 \pm 0.82$  days,  $p=0.00$ ).

**Conclusion:** Nebulization with 3% normal saline was found to be significantly more effective than steroid nebulization in reducing the severity of bronchiolitis and the duration of hospitalization in infants aged between 3-12 months.

**Keywords:** 3% Normal Saline, Bronchiolitis, Nebulization, Pediatric Intensive Care Unit, Steroids.

## INTRODUCTION

Bronchiolitis is a common acute infection encountered in pediatric units, primarily related to lower respiratory tract infections (RTI). This condition often affects infants, presenting with symptoms such as wheezing, crackles, and mild to moderate breathing difficulties (1). The etiology of bronchiolitis can include pathogens like influenza (A & B), parainfluenza (A & B), adenovirus, human metapneumovirus, rhinovirus, and coronavirus. However, the most prevalent cause is the respiratory syncytial virus (RSV). While bronchiolitis is typically a mild, self-limited infection in most children, it can progress to respiratory failure in infants (2,3).

The global prevalence of bronchiolitis is significant. In 2019, lower RTI caused by RSV was reported to affect as many as 33 million individuals worldwide (4). A study from the pediatric intensive care registry in New Zealand and Australia indicated an increase in bronchiolitis admissions from 62.5 to 208 per 100,000 infants over a 12-year period (5). In certain regions, RSV peaks during the winter and rainy seasons, accounting for approximately 30 to 70% of cases (6). The annual increase in these numbers is noteworthy, as is the economic impact: hospitalizations were estimated at 3.6 million, with approximately 26,300 cases resulting in mortality. The cost of treating children with bronchiolitis is estimated to be in the millions of dollars annually (7).

Diagnosis of bronchiolitis is primarily based on clinical history, and a rapid assay can confirm RSV involvement. Symptoms typically start with coughing and acute viral rhinitis, followed by fever lasting 1 to 3 days, potentially leading to respiratory distress. Peak symptoms, correlating with the maximum viral load, usually appear by day four, although this can vary (8). In severe cases, physical signs such as inadequate nutrition, tachypnea, chest hyperinflation, chest retractions, use of accessory muscles, and decreased SaO<sub>2</sub>

levels are observed. An elevated respiratory rate is a key indicator of severity, and apnea is a warning sign of impending respiratory failure (9).

The management of bronchiolitis includes supportive interventions like oxygen and hydration, which generally improve the disease course. No specific treatment for the infection is recommended (10). Infants with mild to moderate symptoms are often treated with nasal saline, cool mist humidifiers, and paracetamol for fever control (11). Those with severe symptoms, such as signs of dehydration and hypoxia or at risk of respiratory distress, are recommended for immediate hospitalization. Interventions like aggressive hydration are crucial, as feeding is often compromised, and maintaining oxygen saturation above 90% is essential. Treatments including beta-adrenergic agonists and steroids have been used, but their efficacy remains inconclusive.

Ahmad S. conducted a study to evaluate the efficacy of corticosteroids combined with  $\beta_2$  agonists in infants with acute bronchiolitis. This research, carried out in a Pakistani population with infants averaging  $11.4 \pm 1.5$  months of age, demonstrated significant improvement in respiratory rate ( $p=0.02$ ), SpO<sub>2</sub> ( $p=0.001$ ), wheezing ( $p<0.001$ ), and reduced length of hospital stay (LHS) ( $p<0.001$ ) after three days of treatment compared to a placebo (12).

Other studies have indicated that nebulization with hypertonic 3% normal saline is an effective treatment for bronchiolitis, reporting a high cure rate in infants. The efficacy of 3% normal saline is attributed to its ability to reduce the viscosity of secretions, decrease airway edema, and enhance mucociliary functions (13).

A recent review on this topic highlighted that there is no clear evidence supporting the efficacy of any treatment option, including epinephrine, bronchodilators, corticosteroids, or hypertonic saline (HS). The review noted that while some studies have shown the benefits of HS, more evidence is required before recommending it for all patient types (14).

The standard treatment protocol for infants with acute bronchiolitis typically involves inhalation of salbutamol diluted in normal saline solution and steroids. Based on recent data, this study was designed to determine the efficacy (in terms of reducing LHS) of nebulization with 3% normal saline HS solution in infants hospitalized due to bronchiolitis, compared to the common strategy of nebulization with salbutamol diluted in 0.9% normal saline solution and steroids. The findings of this study aim to assess the effectiveness of this approach in the local population, thereby informing treatment guidelines in our pediatric units.

## MATERIAL AND METHODS

This randomized controlled trial was conducted at the Department of Pediatrics, Mardan Medical Complex, Mardan, over a period of four months from November 15, 2022, to March 15, 2023. The sample size was calculated using the OpenEpi calculator, with a 95% confidence level and 80% power. The expected efficacy in bronchiolitis treatment for P1 (3% normal saline nebulization) was 94%, and for P2 (commonly used strategy), it was 58% (15). The estimated sample size was 60, with 30 patients in Group-A and 30 in Group-B. A total of 60 infants of both genders, aged 3 to 12 months and admitted to the pediatric unit with bronchiolitis, were included in the study through non-probability consecutive sampling. They were equally randomized into two groups.

The exclusion criteria included infants with underlying diseases such as cystic fibrosis, bronchopulmonary dysplasia, cardiac or renal diseases, a prior history of wheezing, a family history of asthma, pneumonia, tuberculosis, an allergic history, and progressive respiratory distress requiring mechanical ventilation. Patients in Group-A were nebulized with 3% normal saline, while those in Group-B received beclomethasone dipropionate (400  $\mu\text{g}/\text{day}$  in three divided doses) and salbutamol with 0.9% normal saline, administered three times a day at 8-hour intervals until discharge readiness. Supportive treatments provided to both groups included nasal suction, propped-up positioning, organizing pneumonia (OP) treatment, intravenous (IV) fluids, oxygen therapy (when oxygen saturation was below 90%), paracetamol for fever, antibiotics, feeding, and counseling.

Bronchiolitis was defined as an infant presenting with a rasping and persistent dry cough, noisy breathing (wheezing), and crackling or rattling sounds in the lungs, as heard through a stethoscope, and a respiratory distress assessment index (RDAI) score of 4 to 15. Patient monitoring utilized the RDAI score initially at 0, 12, 24, 48, and 72 hours. Efficacy for both groups was noted using a pre-determined format. The primary outcome was the efficacy of the treatment, defined as the number of patients discharged from the hospital in  $\leq 72$  hours after the start of treatment.

Written consent was obtained from the parents or guardians of the infants for participation in the study. Permission for conducting the study was granted by the ethical committee of the hospital. The trial's protocol was registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) under the identifier NCT06139029. Data analysis was performed using the statistical analysis program SPSS 26. Mean  $\pm$  SD was calculated for quantitative variables such as age, severity of bronchiolitis, and duration of hospital stay. Frequencies and percentages were calculated for qualitative variables like gender and efficacy. The efficacy between the two groups was compared using the chi-square test, with a p-value of  $\leq 0.05$  considered statistically significant.

## RESULTS

The Mean± SD of age in this study was 6.91±2.41 months with age range of 3-12 months. The male gender was 55% of total population while females were 45%. The group wise demographic details and status of bronchiolitis assessed by using RDAI score are given in Table-I.

Table-I: Demographics and clinical assessment

Demographics		Group-A n=30	Group-B n=30
Age (Mean± SD) Months		7.23±2.45	6.6±2.37
Gender	Male n (%)	16 (53.33)	14 (46.66)
	Female n (%)	17 (56.66)	13 (43.33)
Status of Bronchiolitis at time of admission	Severe n (%)	24 (80)	22 (73.33)
	Moderate n (%)	6 (20)	8 (26.66)
	Mild n (%)	0 (0)	0 (0)

Severity score of bronchiolitis recorded on 0, 12, 24, 48 and 72 hours as assessed by RDAI score showed significant improvement in Group-A compared to Group-B as given in table-II.

Table-II: Severity of bronchiolitis recorded at pre decided follow-up times.

Clinical severity of bronchiolitis score	Group-A n=30	Group-B n=30	p-value
Start of treatment (Mean± SD)	9.61±1.41	9.52±1.16	0.818
At 12 h follow up (Mean± SD)	8.38±0.85	9.02±1.05	0.012
At 24 h follow up (Mean± SD)	6.42±0.92	7.97±0.71	0.000
At 48 h follow up (Mean± SD)	4.5±0.70	6.2±1.09	0.000
At 72 h follow up (Mean± SD)	1.80±0.36	3.20±1.40	0.000

The primary outcome of the study shows significantly higher number of infants recovered and discharged from hospital in ≤ 3 Days in Group-A compared to Group-B. Similarly total LHS was significantly less in Group-A compared to Group-B as shown in Table-III.

Table-III: Details regarding length of hospital stay among two groups.

Primary outcomes		Group-A n=30	Group-A n=30	p-value
LHS (Mean± SD) Days		2.76±0.51	3.58±0.82	0.000
Hospital Stay ≤ 3 Days	Yes n (%)	27 (90)	19 (63.33)	0.014
	No n (%)	3 (10)	11 (36.66)	

## DISCUSSION

Bronchiolitis, being one of the most common respiratory conditions in children and the leading cause of hospitalization in infants under two years, has been the subject of various therapeutic studies. Recent research has frequently examined the efficacy of 3% normal saline compared to other commonly used treatments for bronchiolitis. Gupta V. conducted a study comparing the efficacy of nebulization with 3% hypertonic saline (HS) to 0.9% normal saline with salbutamol in infants with acute bronchiolitis. The study

found that the clinical severity score for the 3% HS group on the third day of treatment was significantly lower ( $1.0 \pm 1.1$ ) compared to the 0.9% normal saline with salbutamol group ( $3.3 \pm 0.5$ ,  $p=0.000$ ). Additionally, the length of hospital stay (LHS) was significantly shorter in the 3% HS group ( $3.4 \pm 1.7$  vs  $4.9 \pm 1.4$  days,  $p=0.001$ ), leading researchers to conclude that 3% HS nebulization is not only effective but also cost-efficient (16).

Stobbelaar K. aimed to study the effects of 3% HS nebulization in infants with an average age of 3.4 months admitted to intensive care units for severe bronchiolitis. The results indicated that HS nebulization significantly reduced the need for respiratory support ( $p=0.01$ ) and LHS ( $p=0.04$ ) compared to patients who did not receive this treatment (17). Majagaiya B.S. compared the efficacy of 3% HS nebulization versus 0.9% saline given every 8 hours, with added salbutamol and corticosteroids, in infants suffering from moderate bronchiolitis. This study demonstrated significant improvements in clinical severity (CS) scores and a decrease in LHS in the group receiving 3% HS, concluding that it is an effective and safe choice for treating moderate bronchiolitis in infants (18).

In a recent study conducted in Pakistan, the efficacy of commonly recommended nebulization with salbutamol and other medications was compared to HS nebulization in treating bronchiolitis. The group receiving 3% HS nebulization showed significantly improved CS scores after 24 hours and a shorter LHS ( $p=0.003$ ) compared to the group receiving routine nebulization (19). In our study, the mean $\pm$ SD age was  $6.91\pm 2.41$  months, with an age range of 3-12 months. The study population consisted of 55% male and 45% female infants. In Group-A, 80% of patients were suffering from severe bronchiolitis, compared to 73.33% in Group-B, with the remainder having moderate bronchiolitis. The severity score of bronchiolitis, assessed by the Respiratory Distress Assessment Index (RDAI) at 12, 24, and 48 hours, showed a significant reduction in Group-A compared to Group-B from the start of treatment. At 72 hours, the clinical severity score was  $1.80\pm 0.36$  in Group-A and  $3.20\pm 1.40$  in Group-B ( $p=0.000$ ) (20). The primary outcome indicated a significantly higher number of infants cured and discharged from the hospital in  $\leq 3$  days in Group-A compared to Group-B (90% vs 63.33%,  $p=0.01$ ). The mean LHS was also significantly lower in Group-A ( $2.76\pm 0.51$  days vs  $3.58\pm 0.82$  days,  $p=0.00$ ).

Our study confirms that nebulization with 3% normal saline is significantly more effective than steroid nebulization in treating bronchiolitis in infants aged 3 to 12 months. However, the major limitation of our study is the small sample size and the specific age range of the infants included. Future studies involving a larger number of patients across different age groups would be valuable in providing more comprehensive treatment recommendations for bronchiolitis in infants and young children.

## CONCLUSION

Nebulization with 3% normal saline was significantly more effective than steroid nebulization in alleviating symptoms and reducing the severity of bronchiolitis. Consequently, it substantially decreased the duration of hospitalization in infants aged 3 to 12 months.

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