ORIGINAL ARTICLE

Comparison Between 0.9% Normal Saline and 0.3% Hypertonic Saline Nebulization in Acute Bronchiolitis in Terms of Mean Length of Hospital Stay

ABIDA PARVEEN, SAIMA NAUREEN, RIZWAN WASEEM, TAYYABA NOOR, TOOBA MALIK, BUSHRA SHAHEEN

Pak Pediatr J 2025; **49(2):** 139-43

Correspondence to:

Dr. Saima Naureen,
Assistant Professor
Pharmacology, Lahore Medical & Dental College, Lahore

E-mail:
dr_saimanoreen@yahoo.com

Received 12th February 2025;
Accepted for publication
21th June 2025

ABSTRACT

Objective: To compare the outcome of nebulization with 3% hypertonic saline versus 0.9% normal saline in terms of mean length of hospital stay in children hospitalized with bronchiolitis.

Study Design: Randomized controlled trial.

Place and Duration of Study Settings: Department of Pediatric Medicine, Ghurki Trust Teaching Hospital, Lahore. 29th December 2023 to 28th June 2024.

Material and Methods: A total of 234 children (117 in each group), aged less than 24 months, of both genders, presenting with bronchiolitis were included. Group A received nebulization with 4 ml of 3% hypertonic saline every 6 hours, while Group B received 4 ml of normal saline every 6 hours. The length of hospital stay was recorded in hours upon discharge according to outcome criteria.

Results: The mean age of patients in Group A was 14.72 ± 4.33 months, and in Group B was 15.0 ± 4.59 months. The mean length of hospital stay in Group A (hypertonic saline) was 1.83 ± 1.13 days, while in Group B (normal saline) it was 3.37 ± 1.39 days (p-value = 0.0001).

Conclusion: This study concluded that the mean length of hospital stay was shorter in patients nebulized with 3% hypertonic saline compared to 0.9% normal saline in the treatment of bronchiolitis.

Key Words: *Bronchiolitis, Hypertonic saline, Normal saline*.

INTRODUCTION

Bronchiolitis is an infection of the smaller airways, commonly occurring in children under 2 years of age, mostly during the winter season, leading to a significant number of pediatric ward admissions.[1,2] Acute bronchiolitis is a viral infection affecting the lower respiratory tract and poses a substantial health burden worldwide for infants and young children.[3] The most common causative agent is respiratory syncytial virus (RSV), but other viruses such as metapneumovirus, rhinovirus, influenza, and parainfluenza viruses may also be involved.

Bronchiolitis causes edema, necrosis, and sloughing of the respiratory epithelium, leading to airflow resistance during both inspiration and expiration. Bronchiolar obstruction due to mucus plugs can result in air trapping and varying degrees of lobar collapse.[4] Although pediatricians have treated acute bronchiolitis for generations, and despite the disease's high burden and

severity, there remain limited evidence-based options for its specific treatment.[5] Since no definitive antiviral therapy exists for most cases, management primarily focuses on symptomatic relief, hydration, and oxygenation.

Acute bronchiolitis is generally a self-limiting illness with a favourable outcome; therefore, supportive care remains the standard treatment.[6] The age group mostly affected is children younger than 2 years of age. Symptoms of bronchiolitis mostly lasts for 2-3 weeks. A big number of patients with bronchiolitis do not require hospital admission, only 3% of children with bronchiolitis are hospitalized while total hospital admissions in infants is 18%.[7] Children with acute bronchiolitis are often treated with nebulization using either 0.9% normal saline or 3% hypertonic saline. Nebulization with 3% hypertonic saline has been associated with a reduced hospital stay and improved clinical severity scores in inpatients, as well as a reduced risk of hospitalization for outpatients and those seen in the emergency department. Hypertonic saline is considered safe, cost-effective, and efficacious in infants hospitalized with moderate to severe viral bronchiolitis. It works by drawing fluid from the epithelium, thereby reducing edema, preventing necrosis, and promoting epithelial healing. The increased fluid content in the airways thins mucus, facilitates its clearance, and may induce coughing, which further helps in airway clearance. Hypertonic saline may also suppress inflammatory markers released by neutrophils, contributing to symptom improvement.

Several studies have shown that hypertonic saline significantly reduces hospital stays; however, some trials report no significant reduction in length of stay. A few studies have also found no significant decrease in hospital admission rates when compared with normal saline in infants experiencing their first episode of moderate to severe acute bronchiolitis. Moreover, mild adverse events may occur more frequently with hypertonic saline.

The rationale for our study is to compare the length of hospital stay in patients nebulized with hypertonic saline versus normal saline. It is important to evaluate the efficacy of hypertonic saline in our setting, as it is simple, safe, economical, and may reduce hospitalization duration.

MATERIAL AND METHODS

After the approval, as per IRB no: 2023/10/R-29, this study was designed as a randomized controlled trial. The sample size was 234 patients, with 117 in each group. The sample size was calculated based on a 95% confidence level, 80% power, and expected hospital stays of 2.6 ± 1.9 days for the hypertonic saline group and 3.5 ± 2.9 days for the normal saline group.

Inclusion Criteria:

- Children under 24 months of both genders with a primary diagnosis of bronchiolitis.
- Oxygen dependent due to bronchiolitis without any other complication.

Exclusion Criteria: Children with a history of recurrent wheezing or bronchodilator use, immunodeficiency, prematurity (<34 weeks gestation), congenital heart disease, or chronic lung diseases (pulmonary TB, bronchial asthma, cystic fibrosis, tracheoesophageal fistula, gastroesophageal reflux disease).

After diagnosis, written informed consent was obtained from the parents following counselling. All patients received hydration, oxygen therapy (if required), and monitoring of vital signs, including oxygen saturation. Relevant investigations such as CBC, chest X-ray, blood cultures, and ABGs were performed where indicated. Antibiotics were administered to both groups to prevent secondary infections. Patients were randomly allocated into two groups using the lottery method: Group A received 4 ml of 3% hypertonic saline every 6 hours; Group B received 4 ml of normal saline every 6 hours. Data were recorded.

Data were entered and analysed using SPSS version 20. Means and standard deviations were calculated for quantitative variables (e.g., age, weight, hospital stay), while frequencies and percentages were calculated for qualitative variables (e.g., gender). Comparison between groups were made using the t-test, with $p \leq 0.05$ considered statistically significant.

Data were stratified according to age, gender, weight, and duration of symptoms. Post-

stratification, comparisons of hospital stay were made using independent samples t-tests for each subgroup. A p-value < 0.05 was considered significant.

RESULTS

In this study, the patient age range was under 24 months, with a mean age of 14.89 ± 4.67 months. The mean age was 14.72 ± 4.33 months in Group A and 15.0 ± 4.59 months in Group B. The majority of patients (167; 71.37%) were between 13 and 23 months of age (table 1). Gender distribution is presented in table 2. The mean duration of symptoms was 8.31 ± 2.35 days (table 3) and the mean weight was 5.11 ± 1.32 kg (table 4).

The mean hospital stay in Group A (hypertonic saline) was 1.83 ± 1.13 days, while in Group B (normal saline) it was 3.37 ± 1.39 days (p = 0.0001) table 5.

Stratification of hospital stay length according to age, gender, weight, and duration of symptoms is provided in table 6.

TABLE-I: Age distribution for both groups (n=234).

Age (months)	Group A (n=117)		Group B (n=117)		Total (n=234)	
	No. of patients	Percentage	No. of patients	Percentage	No. of patients	Percentage
≤12	33	28.21	34	29.06	67	28.63
13-23	84	71.79	83	70.94	167	71.37
Mean ± SD	14.72 ± 4.33		15.0 ± 4.59		14.89 ± 4.67	

TABLE-2: Gender distribution for both groups (n=234).

Gender	Group A (n=117)		Group B (n=117)		Total (n=234)	
	No. of patients	Percentage	No. of patients	Percentage	No. of patients	Percentage
Male	68	58.12	65	55.56	133	56.84
Female	49	41.88	52	44.44	101	43.16

TABLE-3: Distribution of patients according to total duration of symptoms.

Total Duration ofsymptoms (days)	Group A (n=117)		Group B (n=117)		Total (n=234)	
	No. of patients	Percentage	No. of patients	Percentage	No. of patients	Percentage
≤7	49	41.88	28	23.93	77	32.91
>7	68	58.12	89	76.07	157	67.09
Mean ± SD	7.85 ± 1.84		8.83 ± 2.35		8.31 ± 2.35	

TABLE 4 : Distribution of patients according to weigh

Weight (kg)	Group A (n=117)		Group B (n=117)		Total (n=234)	
	No. of patients	Percentage	No. of patients	Percentage	No. of patients	Percentage
≤5	57	48.72	56	47.86	113	48.29
>5	60	51.28	61	52.14	121	51.71
Mean ± SD	5.20 ± 1.25		5.16 ± 1.22		5.11 ± 1.32	

TABLE 5: Comparison of outcome when nebulized with 3% hypertonic salineas compared to 0.9% normal saline in the terms of mean length of stay in hospitalized children suffering from bronchiolitis.

Outcome	Group A (n=117)	Group B (n=117)	p-value
	Mean ± SD	Mean ± SD	
Length of hospital stay (days)	1.83 ± 1.13	3.37 ± 1.39	**0.0001**

TABLE 6: Stratification of length of hospital stay with respect to age, gender,weight and duration of symptoms

		Group A (n=117) Length of hospital stay (days)		Group B (n=117) Length of hospital stay (days)		p-value
		Mean	SD	Mean	SD	
Age (months)	≤12	0.97	0.68	3.03	1.43	0.0001
	13-23	2.17	1.10	3.50	1.36	0.0001
Gender	Male	1.85	1.15	3.51	1.36	0.0001
	Female	1.80	1.12	3.19	1.42	0.0001
Duration (days)	≤7	2.02	1.28	2.50	0.84	0.0001
	>7	1.69	0.99	3.64	1.42	0.0001
Weight (kg)	≤5	1.79	1.10	3.82	1.55	0.0001
	>5	1.87	1.17	2.95	1.07	0.0001

DISCUSSION

This study was conducted to compare the outcome when patients were nebulized with 3% hypertonic saline in comparison to 0.9% normal saline in terms of mean length of stay in hospitalized children suffering from bronchiolitis. In my study, the mean age was 14.89 ± 4.67 months, which is higher in comparison to a previously conducted study. This was documented in a locally conducted study.[8]

This outcome was also confirmed in another study, which was a double-blind controlled trial with the same sample size and age group.[9] This male predominance may be due to an immune response to respiratory syncytial virus infection, which is gender-specific. The basic characteristics of both groups were almost the same in our study.

In this study, the mean duration of hospital stay in the hypertonic saline-treated Group A was 1.83 ± 1.13 days, and in Group B (normal saline) was 3.37 ± 1.39 days (p-value = 0.0001). Another randomized clinical trial showed a 26% reduction in hospital stay, i.e., 2.6 ± 1.9 days in Group A compared with 3.5 ± 2.9 days in Group B, and demonstrated a marked reduction in length of hospital stay.[10] Trials conducted in our region also showed a significant reduction (p = 0.0011) of 13 hours (12.2%), from 4 days 23 hours in Group B (nebulized with normal saline) to 4 days 10 hours for Group A (nebulized with hypertonic saline) in the mean length of stay.[11]

Patients who were nebulized with 3% hypertonic saline showed earlier resolution of symptoms compared to those nebulized with normal saline. The efficacy of hypertonic saline nebulization was also studied in another study. Ejaz et al.[12] documented that 3% hypertonic saline nebulization led to a faster decline in clinical severity scores compared to normal saline nebulization. This finding also supports our results. Due to the efficacy of hypertonic saline nebulization, clinicians have treated emergency patients with it, resulting in a reduction in hospital admissions, earlier discharges from outpatient departments, and a decreased hospital burden.[13,14]

On the other hand, Florin et al.[15] did not find improved outcomes with hypertonic saline nebulization when used in emergency patients in their study. In our study, we did not assess such outcomes, but we should consider this in future trials. In recent research published in 2023 by Zhang L, et al., they also observed the efficacy of hypertonic saline in patients with acute bronchiolitis. Their observations and results are quite similar to ours, showing that hypertonic saline moderately decreased the length of infants' hospital stays along with mild improvement in clinical severity scores.[16] The impact of hypertonic saline nebulization on hospital stay duration remains a focus of research for various investigators. In this study, the hospital stay of patients treated with hypertonic saline nebulization was markedly decreased compared to those who received normal saline nebulization; this was also demonstrated by a Cochrane review.[17]

CONCLUSION

By this study, we reached the conclusion that mean length of hospital stay is less in infants nebulized with 3% hypertonic saline in treatment of bronchiolitis in comparison to 0.9% normal saline. So, we recommend that hypertonic

saline should be used for nebulization as a treatment for bronchiolitis in children in order to reduce their morbidity and mortality.

Conflict of interest: None

Authors' affiliation

Dr. Abida Parveen, Post-graduate resident,
Department of Pediatrics, Ghurki Teaching Hospital, Lahore

Dr. Saima Naureen, Assistant Professor**,**
Department of Pharmacology, Lahore Medical & Dental College, Lahore

Prof. Rizwan Waseem,
Department of Pediatrics, Lahore Medical & Dental College, Lahore

Dr. Tayyaba Noor, Consultant Pediatrician**,**
Saleem Memorial Hospital

Dr. Tooba Malik, Department of Pharmacology, University of Health Sciences, Lahore

Dr. Bushra Shaheen, Assistant Professor,
Department of Pharmacology, Nishtar Medical University

REFERENCES

1. Mittal K, Bansal T, Mittal A. Acute bronchiolitis in children. J Pediatr Crit Care. 2020;7:293-6. doi:10.4103/JPCC.JPCC_131_20.
2. Chen S, Wang Y, Li A, Jiang W, Xu Q, Wu M, et al. Etiologies of hospitalized acute bronchiolitis in children 2 years of age and younger: a 3 years' study during a pertussis epidemic. Front Pediatr. 2021;9:621381. doi:10.3389/fped.2021.621381.
3. Li Y, Nair H. Trends in the global burden of lower respiratory infections: the knowns and the unknown. Lancet Infect Dis. 2022;22(11):1523-5. doi:10.1016/S1473-3099(22)00445.
4. Paluch L. Identifying and managing bronchiolitis. JAAPA. 2020;33(9):12-5. doi:10.1097/01.JAA.0000694944.22382.39.
5. Kooiman L, Blankespoor F, Hofman R, et al. High-flow oxygen therapy in moderate to severe bronchiolitis: a randomised controlled trial. Arch Dis Child. 2023;108:455-60.
6. Pittet LF, Glangetas A, Barazzone-Argiroffo C, Gervaix A, Posfay-Barbe KM, Galetto-Lacour A, et al. Factors associated with nonadherence to the American Academy of Pediatrics 2014 bronchiolitis guidelines: a retrospective study. PLoS One. 2023;18(5):e0285626. doi:10.1371/journal.pone.0285626.
7. Guitart C, Bobillo-Perez S, Alejandre C, Armero G, Launes C, Cambra FJ, et al; Hospital Network for RSV Surveillance in Catalonia. Bronchiolitis, epidemiological changes during the SARS-CoV-2 pandemic. BMC Infect Dis. 2022;22(1):84. doi:10.1186/s12879-022-07041-x.
8. Ahmad S, Aamir S, Ahmad S. Acute bronchiolitis in children; epidemiologic and clinical features. Prof Med J. 2013;20(5):707-12.
9. Ojha AR, Mathema S, Sah S, Aryal UR. A comparative study on use of 3% saline versus 0.9% saline nebulization in children with bronchiolitis. J Nepal Health Res Counc. 2014;12(26):39-43.
10. Wu S, Baker C, Lang ME, Schrager SM, Liley FF, Papa C, et al. Nebulized hypertonic saline for bronchiolitis: a randomized clinical trial. JAMA Pediatr. 2014;168(7):657-63.
11. Singh S, Masand R, Sharma GL, Mehta SJ. Comparative efficacy of nebulization with 3% hypertonic saline and 0.9% normal saline in the management of acute bronchiolitis. Indian J Child Health. 2020;7(3):144-7.
12. Ejaz I, Siddique A, Rathore AW, Khan HI. Hypertonic saline (3%) vs normal saline (0.9%) nebulization for acute viral bronchiolitis: a randomized control trial. Pak Pediatr J. 2015;39(4):248-51.
13. Zhang L, Mendoza-Sassi RA, Wainwright C, Klassen TP. Nebulised hypertonic saline solution for acute bronchiolitis in infants. Cochrane Database Syst Rev. 2017;12:CD006458.
14. Wu S, Baker C, Lang ME, Schrager SM, Liley FF, Papa C, et al. Nebulized hypertonic saline for bronchiolitis: a randomized clinical trial. JAMA Pediatr. 2014;168(7):657-63.
15. Florin TA, Shaw KN, Kittick M, Yaskscoe S, Zorc JJ. Nebulized hypertonic saline for bronchiolitis in the emergency department: a randomized clinical trial. JAMA Pediatr. 2014;168(7):664-70.
16. Zhang L, Mendoza-Sassi RA, Wainwright CE, Aregbesola A, Klassen TP. Nebulized hypertonic saline solution for acute bronchiolitis in infants. Cochrane Database Syst Rev. 2023;4(4):CD006458. doi:10.1002/14651858.CD006458.pub5.
17. Zhang L, Mendoza-Sassi RA, Wainwright C, Klassen TP. Nebulised hypertonic saline solution for acute bronchiolitis in infants. Cochrane Database Syst Rev. 2013;7:CD006458.