ORIGINAL ARTICLE

Journal of Army Medical College Chattogram
Volume 3 Issue 2 December 2020; 6-10

Comparative Efficacy of Nebulised 3% Sodium Chloride Versus 0.9% Sodium Chloride Plus Salbutamol Solution in the Treatment of Acute Bronchiolitis

Mohammad Nazmul Islam Bhuiyan[1] Md Golam Mostafa Sarwar[2]*
Mahamuda Yasmin[3] Mohammd Ashfaque Ahemmed Khan[4] Rajmoni Umme Asha[5]

ABSTRACT

Background: Acute bronchiolitis is the most common respiratory tract infection between 2 months to 2 years baby, particularly in winter. Respiratory syncitial virus is the leading cause. No consensus exists on the management of bronchiolitis, other than oxygen therapy, hydration and nutrition. Hence, the present study was conducted to compare the efficacy of nebulized 3% Sodium chloride solution versus 0.9% Sodium chloride plus Salbutamol solution in the treatment of acute bronchiolitis.

Materials and methods: A prospective randomized controlled study of 100 children between 2 to 24 months with Acute Bronchiolitis. Patients were randomized into two group, A and B who received 3% Sodium chloride and 0.9% Sodium chloride plus Salbutamol nebulisation respecively. Nebulisation was given 6 hourly and outcome variables were assessed by clinical severity score, length of hospital stay and length of oxygen therapy.

Results: Baseline clinical severity score and O_2 saturation in group-A were (8.1±1.0 and 94.9±3.8) and in Group B were (8.3±1.7 and 94.6±3.6) respectively. At 72 hours, the mean severity score for the group-A and B were (1.3 ±0.99) and (4.24 ± 1.48) respectively. Group-A required a shorter oxygen therapy compared to group-B (15.0±6.0 hours versus 26.4±5.04 hours respectively). 46(92%) of group-A children recovered and discharged by 72 hours whereas 29 (58%) of group-B showed the same. Length of hospital stay was shorter in group-A compared to group-B (58.1±22.0 hours versus 74.7±27.2 hours). None of the cases encountered any side-effects.

Conclusions: 3% Sodium chloride nebulisation can be considered as an effective treatment for acute bronchiolitis. It significantly reduced the clinical severity score and length of hospital stay and oxygen therapy compared to 0.9% Sodium chloride plus Salbutamol.

Key words: Bronchiolitis; Nebulisation; Salbutamol; Sodium chloride.

Introduction

Acute bronchiolitis is the most common respiratory tract infection in children between 2 months to 2 years, particularly during winter[1]. Peak age is 2 to 6 months. Upto to 3% of all children are hospitalized for acute bronchiolitis in their first year of life[2]. Respiratory Syncytial Virus (RSV) is the leading cause and is responsible for >50% of cases[3]. Other agents include Influenza, Parainfluenza, Adeno virus, Rhino virus, Rheo virus, Mycoplasma, Human Metapneumovirus and Human Boca virus[4]. Risk factors include non-breastfeeding, parental smoking, overcrowding, prematurity, male sex[5]. Bronchiolitis is an infection of the bronchiolar epithelium, characterized by cough, wheeze, chest tightness and respiratory distress. Despite of high prevalence of acute bronchiolitis, no definite consensus exists in the management of the disease. Management is mainly supportive. Hydration, nutrition and oxygenation is the mainstay of treatment. Other than these, nebulisation with 3% Sodium chloride, Normal saline plus Salbutamol, only Normal saline, Adrenaline, Ipratropium bromide are used but they are still in controversy. Study suggest that 3% saline solution for infants with bronchiolitis, due to its ability to lower the viscosity of secretions, reduce airway oedema, and improve mucociliary function. This hypertonic saline solution favorably alters mucociliary clearance in both normal and diseased lungs. Though role of antiviral and antibiotic is also controversial, almost all the cases of acute bronchiolitis in Bangladesh are treated with antibiotics[6,7]. Hence, the current study was undertaken to compare the efficacy of nebulized 3% Sodium chloride solution with 0.9% Sodium chloride plus Salbutamol solution in the treatment of acute bronchiolitis with an objective of improvement in clinical severity score and duration of O_2 therapy and hospital stay.

1. Lt Col & Classified Specialist in Paediatrics Cardiologist Combined Military Hospital (CMH) Dhaka.
2. Lt Col & Deputy Chief Medical Officer Dhaka North City Corporation, Dhaka.
3. Junior Consultant of Gynaecology & Obstratics (OSD DGHS, Attached- Departement of REI BSMMU) Dhaka.
4. Lt Col & Classified Child Specialist in Paediatrics Combined Military Hospital (CMH) Dhaka.
5. Major & Trainee in MS Cardiac Surgery Phase-A Combined Military Hospital (CMH) Dhaka.

*Correspondence: **Lt Col (Dr.) Mohammad Nazmul Islam Bhuiyan**
Cell: +88 01716 15 36 60
Email: n.nazmul101130@gmail.com

Submitted on : 10th August 2020
Accepted on : 12th September 2020

Journal of Army Medical College Chattogram
Volume 3 Issue 2 December 2020; 6-10

Materials and methods

A prospective randomized controlled study was carried out for a period of 12 months from January 2017 to December 2017 at Combined Military Hospital (CMH) Momenshahi, Mymensingh, Bangladesh. The study protocol was approved by the hospital ethical committee. Study population comprises of 100 admitted children between the age of 2 months to 24 months presenting with pre-existing runny nose, cough, wheeze, chest tightness and respiratory distress.

All the patients were divided into two groups by using computer generated random number table. Group-A received nebulisation with 2 ml of 3% Sodium chloride solution and group-B received 2.5 ml of 0.9% Sodium chloride plus 0.5 ml of Salbutamol solution at 6 hours interval until improved enough to be discharged. Each group received the same supportive treatment like head up position, suction, feeding, oxygen therapy (When oxygen saturation < 93%), fluid and electrolyte management, paracetamol for fever, and counseling. Following randomization and intervention, cases were monitored by Clinical Severity Score (CSS) at 12 hour intervals till discharge. Oxygen therapy was started or stopped when the patients $SP0_2$ was below and above 93% respectively. Length of hospital stay means from time of admission to time of discharge. Discharge was on clinical ground only. These children were subjected to the need based investigations including Complete Blood Count (CBC), Chest X Ray (CXR) and Arterial Blood Gas Analysis (ABG). Informed written consent was obtained from parents. Detailed clinical history and examination findings were recorded in a standard predesigned proforma. Assessment of patient's CSS and SpO_2 readings by pulse oximeter were done at admission. The outcome variables were i) Clinical severity score ii) Length of hospital stay iii) Oxygen saturation in room air iv) duration of oxygen supplementation v) Side effects of drugs. Collected data were processed and analyzed using computer software SPSS version 19.

Table I : Clinical Severity Score (CSS)

Variables	0	1	2	3	Total
Respiratry rate	<30 bpm	31 to 45 bpm	46 to 60 bpm	>60 bpm	3
Wheezing	None	Terminal Expiratory/ only with stethoscope	Entire expiration / Audible on Expiration without stethoscope	Inspiration and expiration without stethoscope	3
Retraction	None	Intercostals only	Tracheosternal	Severe with nasal flaring.	3
General condition	normal			Irritable, lethargic, or poor feeding	3

They were reassessed every 12 hours, clinical response was determined by improvement in CSS and O_2 saturation, and for those whose CSS was not improving or was worsening, antibiotic and other supportive measures were added.

Inclusion criteria

i) Age between 2 months to 24 months.
ii) Meet clinical definition of Bronchiolitis.
iii) Clinical severity score 1-10 (Table-1).

Bronchiolitis was clinically defined as the first episode of acute wheezing in children less than two years of age, starting as a viral upper respiratory infection (Coryza, cough or fever).

Exclusion criteria

i) Acute severe bronchiolitis with impending respiratory failure.
ii) Acute severe bronchiolitis with concomitant infection.
iii) Acute severe bronchiolitis with Congenital Heart Disease.
iv) Those who already received treatment outside for acute bronchiolitis.

Results

100 children with Acute Bronchiolitis met the inclusion criteria included in the study. About 33 (66%) of the children in Group-A were 2-6 months old as opposed to 29 (58%) in Group-B. Very few children were above the age 12 months, 2(4%) in group-A and 4(8%) in group- B. The mean age of the children were 9.2 ± 3.2 and 9.1 ± 3.1 months in group A and B respectively with a male predominance in the both groups, 28(56%) in group-A and 29(58%) in group-B (Table II).

Table II : Demographic characteristics between groups

Age in months	Group-A(HS) (n = 50)	Group B(NSS) (n = 50)	p- value
2-06	33(66%)	29(58%)	
06-12	15(30%)	17(34%)	
12-24	2(4%)	4(8%)	
Mean ± SD#	9.2 ± 3.2	9.1 ± 3.1	0.82
Male	28(56%)	29(58%)	0.5
Female	22(44%)	21(42%)	

All the cases in both the groups presented with runny nose, cough, breathing difficulty, chest indrawing and rhonchi but feeding difficulty was presenting feature in 25 (50%) cases in group-A and 28 (56%) cases in group–B. Wheezing was presenting feature in 47(94%) cases in group-A and 48(96%) cases in group-B. Only 7(14%) cases in group-A and 8(16%) cases in group-B presented with nasal flaring. In group-A, 13(26%) cases and in group-B,12(24%) cases presented with fever (Table III).

Journal of Army Medical College Chattogram
Volume 3 Issue 2 December 2020; 6-10

Table III : Clinical presentation of the cases on admission

Clinical presentation	Group-A(HS)	Group- B(NSS)
Runny nose	50(100%)	50(100%)
Cough	50(100%)	50(100%)
Breathing difficulty	50(100%)	50(100%)
Feeding difficulty	25(50%)	28(56%)
Wheeze	47(94%)	48(96%)
Chest in-drawing	50(100%)	50(100%)
Nasal flaring	07(14%)	08(16%)
Tachypnoea	45(90%)	43(86%)
Tachycardia	46(92%)	44(88%)
Rhonchi	50(100%)	50(100%)
Fever	13(26%)	12(24%)
Oxygen saturation (Mean± SD)	94.9 ±3.8	94.6 ±3.6

Baseline clinical characteristics as per clinical severity score were almost similar in both the groups ($p > 0.05$ in each case) (Table IV).

Table IV : Comparison of baseline Respiratory Distress Assessment Instrument (RDAI) score and Clinical severity

Baseline clinical characteristics	Group-A (HS) (n = 50)	Group B (NSS) (n = 50)	p value
Respiratory rate	2.4±0.5	2.6±0.4	0.142
Wheezing	2.1±0.5	2.0±0.3	0.193
Retraction	2.0±0.5	2.0±0.6	0.859
General condition	2.3±1.3	2.7±0.9	0.083
Clinical severity score	8.1±1.	8.3 ±1.87	0.943

Mean clinical severity score at base line, at 12 hours, at 24 hours, at 36 hours, at 48 hours, at 60 hours, and at 72 hours in Group-A (HS) were 9.1, 7.2, 6.4, 4.1, 3.6, 2.2, 1.3 while in Group-B (NSS) score were 9.3, 8.5, 7.6, 6.2, 5.1, 4.8, 4.4 respectively. Clinical severity score of both the treatment groups were reduced by three days but reduction was more significant in children who received nebulised 3% Sodium chloride (Figure- 1).

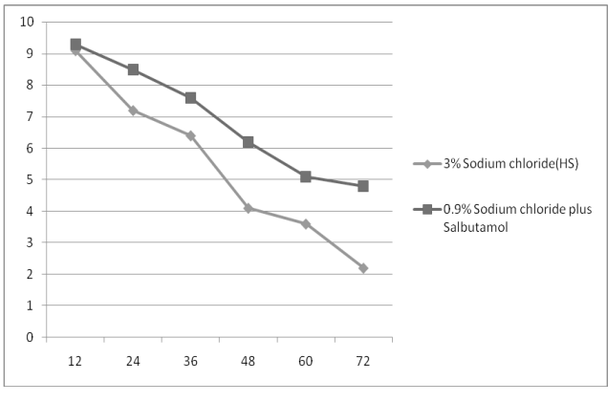

Figure 1 : Comparison of mean clinical severity score of two groups at 12 hourly intervals

In Group-A (HS) 4(8%) and in Group-B (NSS) 5(10%) patients required oxygen supplementation. The patients of Group-A on an average required 15 hours of oxygen therapy, while the patients of Group-B required 26.4 hours of oxygen therapy. Duration of oxygen therapy significantly reduced in Group- A compared to Group-B (Table-V).

Table V : Comparison of duration of oxygen therapy (In hours) between groups

Duration of oxygen therapy	Group- A (HS) (n = 4)	Group -B (NS) (n = 5)	p value
Mean ± SD	15.0±6.0	26.4±5.4	0.02

46 (92%) of the children in Group-A were recovered by 72 hours and discharged from the hospital, whereas 29(58%) of the children in Group-B were recovered and discharged during the same period ($p < 0.05$) (Table VI).

Table VI : Comparison of recovery and discharge from hospital between groups

Length of hospital stay was significantly less in Group-A in comparison to group-B ($p<0.05$).

Recovery and discharge	Group-A (n=50)	Group-B (n=50)	p value
Rapid (Within 72 hours)	46(92%)	29(58%)	< 0.001
Gradual (After 72 hours)	4(8%)	21(42%)	

3% Sodium chloride nebulisation significantly reduced clinical severity, length of hospital stay and duration of oxygen therapy in case of acute bronchiolitis in comparison to 0.9% Sodium chloride plus Salbutamol. Both modalities of treatment were found to have no adverse effect.

Discussion

Bronchiolitis is a common problem in children between two months to two years and is the most common cause of hospitalization[1]. The present study was carried out to see whether 3% Sodium chloride (Hypertonic saline) nebulisation reduces clinical severity and length of hospital stay in children with bronchiolitis than does nebulisation with 0.9% Sodium chloride plus Salbutamol. The two study groups in the present study were almost similar with respect to their demographic characteristics like age and sex, baseline clinical characteristics and clinical severity score. The study demonstrated that clinical severity score of both the treatment groups were reduced and oxygen saturation in room air are improved within three days but the reduction was much earlier in children who received nebulisation with 3% Sodium chloride than those who received 0.9% Sodium chloride plus Salbutamol. The mean duration of oxygen supplementation was shorter in the Group-A (15.0±6.0) hours

Journal of Army Medical College Chattogram
Volume 3 Issue 2 December 2020; 6-10

than that in the Group-B (26.4±5) hours. Majority 46(92%) of the 3% Sodium chloride group children recovered within 72 hours, whereas 29(58%) of the children of 0.9% Sodium chloride plus Salbutamol group recovered from the disease during the same period. None of the patients encountered any side-effects. In the present study 3% Sodium chloride nebulisation significantly reduced the length of hospital stay. Most patients 46(92%) in 3% Sodium chloride group discharged within 3 days of treatment. Similar observation was seen in another study, mean length of hospital stay was shorter in hypertonic saline group[8]. In the present study the mean duration of oxygen supplementation was significantly shorter in 3% Sodium chloride group than that in the 0.9% Sodium chloride plus Salbutamol group. Almost similar observation was seen by Martin et al[9]. Consistent with the findings of the present study several investigators have reported the use of hypertonic saline solution for infants in bronchiolitis with substantial benefits of therapy reported by many of them[10,11]. The investigators showed that nebulized 3% Sodium chloride (HS) decreases the Length of Stay (LOS) in the hospital as compared with normal saline plus Salbutamol (NSS) among infants hospitalized with the disease[12]. Many of them used bronchiolitis severity score to evaluate patients over time and they found that inhaled 3% Sodium chloride with epinephrine administered by nebulisation every 6-8 hours improved the bronchiolitis severity score and reduced the length of hospital stay in hospitalized patients when compared with 0.9% saline with epinephrine[13]. None of the studies reported any side effects. These findings go in favor of many studies[14-16]. The mean length of hospital stay was much shorter (On an average 58 hours) in the 3% Sodium chloride group than that in the 0.9% Sodium chloride plus Salbutamol group (74 hours). A systematic review of four RCTs involving 254 infants with acute viral bronchiolitis (189 in-patients and 65 out-patients) concluded that nebulised 3% Sodium chloride may significantly reduce the length of hospital stay and improve the clinical severity score. However, an orthodox finding was reported by another small RCT which investigated the use of hypertonic saline in the emergency department setting, and the authors suggested that immediate clinical benefits may not be seen with nebulised hypertonic saline[17]. Airway oedema and mucus plugging are the predominant pathological features in acute viral bronchiolitis[18]. 3% Sodium chloride solution decreases airway oedema, improves mucus rheologic properties and mucociliary clearance, and thus decreases airway obstruction[19]. It is thought that 3% Sodium chloride facilitates removal of inspissated mucus through osmotic hydration, disruption of mucus strand cross-linking and reduction of mucosal oedema[20]. In summary, in this study both treatment groups demonstrated clear evidence of clinical improvement and oxygen saturation, but 3% Sodium chloride group in comparison with 0.9% normal saline plus Salbutamol group showed more efficacy in relieving symptom, improving oxygenation and reducing length of hospital stay in children with acute bronchiolitis. It seems that the use of nebulised 3% Sodium chloride in children admitted with moderate to severe viral bronchiolitis is a safe and effective therapy.

Limitation

Small number of study population and shorter duration of study period.

Conclusion

The study concluded that 3% Sodium chloride nebulisation significantly reduced clinical severity, length of hospital stay and duration of oxygen therapy in case of acute bronchiolitis in comparison to 0.9% Sodium chloride plus Salbutamol. Both the modalities of treatment were found to have no adverse effect.

Acknowledgement

All the patient and their parents participated in the study group.

Recommendation

Hypertonic solution nebulisation should be preferred instead of nebulisation with normal saline and salbutamol combination in acute bronchiolitis cases.

Disclosure

All the authors declared no competing interest.

References

1. Kusel MM, Klerk ND, Holt PG, Kebadze T, Johnston SL, Sly PD. Role of respiratory viruses in acute upper and lower respiratory tract illness in the first year of life: A birth cohort study. The Pediatric Infectious Disease Journal. 2006; 25(8):680-686.

2. Murray J, Bottle A, Sharland M et al. Risk factors for hospital admission with RSV bronchiolitis in England: a population-based birth cohort study. PloS one. 2014; 9(2):e89186.

3. Caballero MT, Polack FP. Respiratory syncytial virus is an “opportunistic” killer. Pediatric Pulmonology. 2018; 53(5):664-667.

4. Murphy FA, Gibbs EP, Horzinek MC, Studdert MJ. Veterinary virology. Elsevier;.1999 Oct 27.

5. Simoes EA. Environmental and demographic risk factors for respiratory syncytial virus lower respiratory tract disease. The Journal of pediatrics. 2003; 143(5):118-126.

6. Florin TA, Plint AC, Zorc JJ. Viral bronchiolitis. The Lancet. 2017; 389(10065):211-224.

7. Kabir AR, Mollah AH, Anwar KS, Rahman AK, Amin R, Rahman ME. Management of bronchiolitis without antibiotics: A multicentre randomized control trial in Bangladesh. Actapaediatrica. 2009; 98(10):1593-1599.

8. Sharma BS, Gupta MK, Rafik SP. Hypertonic (3%) saline vs 0.9% saline nebulization for acute viral bronchiolitis: A randomized controlled trial. Indian pediatrics. 2013;50(8):743-747.

9. Martín Martín R, Yep Chullen G, Sánchez Bayle M, Villalobos Pinto E, Flores Pérez P. Estudio sobre la eficacia y utilidad de la solución salina hipertónica al 3% en la bronquiolitis aguda del lactante hospitalizado. Pediatría Atención Primaria. 2013; 15(58):109-115.