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Original Research Article

COMPARATIVE STUDY ON THE EFFICACY OF ADRENALINE NEBULISATION AND BUDESONIDE NEBULISATION IN POST-EXTUBATION STRIDOR

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ABSTRACT

Background: Post-extubation stridor (PES) is a common complication in paediatric patients after mechanical ventilation, often caused by laryngeal oedema. Timely intervention is essential to prevent respiratory distress and to avoid reintubation. This study compared the effectiveness of nebulised adrenaline and budesonide in reducing stridor symptoms.

Materials and Methods: A total of 92 children with stridor were randomly assigned to receive nebulised adrenaline (Group A) or budesonide (Group B) in a paediatric ICU setting. Stridor scores and physiologic parameters were monitored at baseline and at 20, 40, and 60 min, and 2, 4, 8, and 12-hours post-treatment.

Results: Baseline mean stridor scores were 6.80 ± 1.49 in Group A and 7.05 ± 1.27 in Group B (p = 0.391). Both groups showed consistent improvements over time. At 20 minutes, scores were 5.61 ± 2.24 in Group A and 5.49 ± 2.39 in Group B (p = 0.798); by 40 minutes, 5.92 ± 2.23 and 6.35 ± 2.35 (p = 0.369); and at 60 minutes, 5.82 ± 2.19 and 5.07 ± 2.38 (p = 0.121), respectively. At 2 h, Group A scored 5.00 ± 1.70 and Group B 4.60 ± 1.55 (p = 0.167). At 12 h, the scores were reduced to 2.08 ± 1.45 and 2.02 ± 1.37 (p = 0.892), with no significant differences observed between the groups in stridor scores. Physiologic parameters remained stable and comparable between the groups throughout the study period.

Conclusion: Epinephrine and budesonide showed similar effectiveness in treating post-extubation stridor in paediatric patients, with no significant outcome differences. Both therapies were well tolerated, and the baseline parameters remained comparable. Broader studies with extended follow-up and reintubation analyses are needed for stronger validation.

Keywords: Postextubation stridor, Adrenaline, Budesonide, Paediatric ICU, Nebulisation, Stridor.

INTRODUCTION

Postextubation stridor (PES) is a common and clinically relevant complication observed after removal of the endotracheal tube, especially in paediatric and neonatal populations. It typically arises due to laryngeal oedema caused by mechanical irritation or trauma during intubation.[1] Although oedema may be asymptomatic in some cases, it can progress to significant upper airway narrowing, manifesting as inspiratory stridor a high-pitched sound indicative of partial obstruction.[2] This condition may lead to acute respiratory compromise and requires prompt clinical intervention.

The occurrence of PES contributes to increased morbidity, extended duration of intensive care unit (ICU) admission, and elevates the likelihood of reintubation.[3] Reintubation, in turn, is associated with complications such as ventilator-associated pneumonia, mechanical trauma to the airway, and

elevated mortality.[4] The incidence of PES varies across populations and clinical environments ranging from 2% to 22% in adult ICUs (median 12%), 2% to 40% in paediatric ICUs (median 15%), and up to 50% in neonatal ICUs.[5] These discrepancies are influenced by differences in patient demographics, intubation methods, and diagnostic standards. Approximately 10% to 20% of PES cases may necessitate reintubation.[6] This likelihood is particularly pronounced in younger children due to their anatomically narrower upper airway, where even slight oedema can cause significant obstruction.[7] Timely identification and intervention are therefore critical to prevent deterioration and avoid severe airway compromise.

Structured assessment tools, such as the stridor score, are useful in quantifying the severity of PES by evaluating clinical features like noisy respiration, chest retractions, and supplemental oxygen requirement.[8] This facilitates early identification, monitoring of progression, and standardised evaluation of therapeutic response. Pharmacological treatment is directed at minimising airway oedema and inflammation.[9] Nebulised agents are preferred in this context for their rapid onset and ease of delivery. Among them, adrenaline acts through vasoconstriction to rapidly reduce mucosal swelling, whereas budesonide, a corticosteroid, exerts a slower but potentially sustained anti-inflammatory effect.[10] Despite their common use, comparative data evaluating their relative efficacy in PES remains limited.

Considering the clinical significance of post-extubation stridor and the necessity for optimal therapeutic approaches, the present study was undertaken to evaluate and compare the efficacy of nebulised adrenaline and budesonide. The objective of this study was to evaluate which of these therapies more effectively reduces stridor symptoms and prevents the need for reintubation, thereby improving patient outcomes and reducing the burden on intensive care resources.

MATERIALS AND METHODS

This randomised controlled trial was conducted in the Pediatric Intensive Care Unit (PICU) of the Department of Paediatrics, Chengalpattu Medical College Hospital. The study included a total of 92 children and was conducted over a period of 17 months, from May 2023 to September 2024. Informed consent was obtained from the parents and the guardians, and ethical approval was obtained from the ethical committee.

Inclusion and exclusion criteria

Children who were mechanically ventilated and developed barking cough, hoarseness of voice, or inspiratory stridor with a stridor score > 4 were included in the study. Children with a history of allergy to the study drugs or existing chronic upper airway disorders were excluded.

Methods

Children were randomly assigned to two groups, Group A (n=49, adrenaline) and Group B (n=43, budesonide), using stratified randomisation to ensure equal distribution of primary upper airway conditions. After group assignment, each child received the assigned nebulisation treatment. Clinical details, such as respiratory rate, stridor score, blood pressure, and oxygen saturation, were recorded before nebulisation and then at 20, 40, and 60 min, followed by 2, 4, 12, and 18 h after treatment. The effectiveness of each treatment was evaluated by monitoring the changes in the stridor score over time.

Statistical Analysis

The collected data were analysed using IBM SPSS Statistics (v27). Numerical values are presented as means with standard deviation (SD), while categorical variables are shown as numbers and percentages. An unpaired Student's t-test was used to compare the mean values between the two groups. The Chi-square test or Fisher's exact test was used for the comparison of categorical data, and a p-value of <0.05 was considered statistically significant.

RESULTS

Males constituted 51.02% vs. 67.44%, and females 48.98% vs. 32.56% in Group A and Group B, respectively (p = 0.139). Respiratory failure was the most common indication (30.61% vs. 37.21%). Combined respiratory failure and shock occurred in 34.69% vs. 39.53%. Low Glasgow Coma Scale (GCS) was more frequent in Group A (28.57% vs. 16.28%). Shock alone was noted in 6.12% vs. 2.33%. Raised intracranial tension (ICT) and upper airway obstruction were reported only in Group B (0% vs. 2.33% each) (p = 0.403). [Table 1]

Table 1: Gender and indications for intubation between groups

Variable		Group A (N=49)	Group B (N=43)	P-value
Gender	Male	25 (51.02%)	29 (67.44%)	0.139
	Female	24 (48.98%)	14 (32.56%)	
Indication for Intubation	Respiratory failure	15 (30.61%)	16 (37.21%)	0.403
	Shock	3 (6.12%)	1 (2.33%)	
	Respiratory failure + Shock	17 (34.69%)	17 (39.53%)	
	Low GCS	14 (28.57%)	7 (16.28%)	
	Raised ICT	0 (0%)	1 (2.33%)	
	Upper airway obstruction	0 (0%)	1 (2.33%)	

Abnormal respiratory rate was noted in 73.47% (Group A) vs. 76.74% (Group B) (p = 0.811). Abnormal heart rate was observed in 69.39% (Group A) vs. 76.74% (Group B) (p = 0.487). Normal

systolic blood pressure was recorded in 95.92% (Group A) vs. 86.05% (Group B); abnormal in 4.08% vs. 13.95% (p = 0.140). Normal diastolic blood pressure was found in 79.59% (Group A) vs. 67.44% (Group B); abnormal in 20.41% vs. 32.56% (p = 0.236). Abnormal oxygen saturation was observed in 67.35% (Group A) vs. 67.44% (Group B) (p = 0.992). [Table 2]

Table 2: Physiological parameters between groups

Parameter		Group A (N=49)	Group B (N=43)	P-value
Respiratory rate	Normal	13 (26.53%)	10 (23.26%)	0.811
	Abnormal	36 (73.47%)	33 (76.74%)	
Heart rate	Normal	15 (30.61%)	10 (23.26%)	0.487
	Abnormal	34 (69.39%)	33 (76.74%)	
Systolic BP	Normal	47 (95.92%)	37 (86.05%)	0.14
	Abnormal	2 (4.08%)	6 (13.95%)	
Diastolic BP	Normal	39 (79.59%)	29 (67.44%)	0.236
	Abnormal	10 (20.41%)	14 (32.56%)	
Oxygen Saturation	Normal	16 (32.65%)	14 (32.56%)	0.992
	Abnormal	33 (67.35%)	29 (67.44%)	

Intubation duration of 0–5 days was recorded in 59.18% of Group A compared to 55.81% of Group B, while durations exceeding 5 days were noted in 40.82% and 44.19% of patients, respectively (p=0.833). A stridor score of less than 4 was observed in 91.84% and 93.02% of patients in Groups A and B, respectively, whereas scores ≥ 4 were reported in 8.16% and 6.98% of patients in Groups A and B, respectively (p=0.83). [Table 3]

Table 3: Duration of intubation and stridor scores between groups

Variable		Group A (N=49)	Group B (N=43)	P-value
Duration of Intubation (days)	0–5	29 (59.18%)	24 (55.81%)	0.833
	>5	20 (40.82%)	19 (44.19%)	
Stridor Score	<4	45 (91.84%)	40 (93.02%)	0.83
	≥4	4 (8.16%)	3 (6.98%)	

The comparison of pain scores between the two groups over time, at baseline (0 minutes), the mean score was 6.8 ± 1.49 in Group A and 7.05 ± 1.27 in Group B (p=0.391). At 20 and 40 minutes, the scores were 5.61 ± 2.24 vs 5.49 ± 2.39 (p=0.798) and 5.92 ± 2.23 vs 6.35 ± 2.35 (p=0.369), respectively. At 60 minutes, the scores were 5.82 ± 2.19 and 5.07 ± 2.38 (p=0.121), while at 2 hours they were 5.43 ± 2.32 and 5.02 ± 2.01 (p=0.376). Pain scores at 4, 8, and 12 hours were 4.82 ± 2.21 vs 4.88 ± 2.36 (p=0.888), 5.16 ± 2.13 vs 4.81 ± 2.18 (p=0.441), and 4.29 ± 2.14 vs 3.98 ± 1.98 (p=0.477), respectively. [Figure 4]

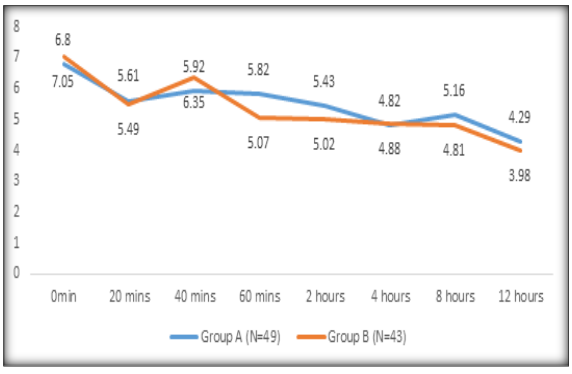

Figure 1: Mean stridor scores between groups at various intervals

DISCUSSION

This study aimed to evaluate and compare the clinical parameters, intubation profiles, and therapeutic responses to epinephrine and budesonide in paediatric patients with post-extubation stridor. The sex distribution and indication for intubation were similar between the groups, with respiratory failure being the most common indication for intubation. Raised intracranial pressure and airway obstruction occurred only in one group, without any significant overall differences. Similarly, Sinha et al. found that Group A included 26 men and Group B included 24 women (p = 0.58). Respiratory failure was the most common indication for intubation in both groups: 34.4% in Group A and 36.7% in Group B. Shock alone was observed in 18.8% of Group A and 6.7% of Group B, while the combination of respiratory failure and shock occurred in 9.4% and 10% of patients, respectively. Raised intracranial pressure was more frequent in Group B (30%) than in Group A (12.5%), and upper airway obstruction was seen in 12.5% of Group A and 6.7% of Group B (p = 0.57).[11] The groups showed comparable clinical profiles, with respiratory failure as the leading cause of intubation, and no significant differences were observed.

Our study showed that the baseline physiological parameters, including respiratory rate, heart rate, blood pressure, and oxygen saturation, were comparable between the two groups, without significant differences. Similarly, Farooq et al. reported in a comparative study between epinephrine and salbutamol that the baseline heart rates were similar (119.02 ± 4.48 bpm vs. 118.29 ± 4.63 bpm; p> 0.05), but after 48 h, the heart rate was significantly lower with epinephrine (122.58 ± 4.75 bpm vs. 127.87 ± 4.44 bpm; p < 0.05). Respiratory

rate also decreased more with epinephrine (35.16 ± 3.29 vs. 39.84 ± 3.32 breaths/min; $p < 0.05$), while oxygen saturation improved more markedly (85.24 ± 2.74% vs. 80.38 ± 3.26%; $p < 0.05$).[12]

Sah et al. reported in a study that both adrenaline and salbutamol significantly reduced the respiratory rate ($p < 0.00001$), except in the 19–24-month age group. Adrenaline was more effective in lowering the respiratory rate ($p < 0.0001$) and caused a greater increase in heart rate across all age groups than salbutamol.[13] Bertrand et al. reported that nebulised epinephrine significantly improved clinical scores on the first day ($p = 0.025$) and reduced scores more rapidly than salbutamol ($p = 0.02$), with more children remaining hospitalised in the salbutamol group on days four and five ($p = 0.03$, $p = 0.025$).[14] Physiological parameters were initially similar, and epinephrine showed superior improvements in heart rate, respiratory rate, oxygen saturation, and clinical outcomes.

In our study, the duration of intubation and post-extubation stridor severity were comparable between the groups, with no significant differences observed. Similarly, Nascimento et al., in a cohort study of 136 children, found post-extubation stridor in 41.2% of cases, with a significant association with ventilation >72 hours (OR = 8.6; $p < 0.001$).[15] Abbasi et al. showed lower stridor incidence with budesonide (3.3%) versus placebo (23.3%) in adult ICU patients intubated >36 hours ($p = 0.049$).[16] Markovitz and Randolph concluded in a meta-analysis that prophylactic steroids reduced post-extubation stridor (RR 0.53; 95% CI 0.28–0.97) and reintubation in children.[17] Veder et al. found in a study of 150 PICU patients that the median intubation duration was longer in those with stridor (5.6 days vs. 3.3 days; $p = 0.001$). Stridor occurred in 15.3% of cases; although 47.8% of the stridor group received dexamethasone versus 18.6% of the non-stridor group, this was not significant ($p = 0.06$).[18] Longer intubation increased stridor risk, and steroid use reduced stridor and reintubation rates, though not always significantly.

In our study, both groups showed a gradual reduction in stridor scores over time, with no significant intergroup differences at any interval. Similarly, in a study done by da Silva et al. found in a trial with 72 children that nebulised L-epinephrine in three doses also led to progressive improvement in stridor, with no significant difference across groups at all intervals ($p > 0.05$).[19] Sinha et al. observed stridor scores declined in both groups over 24 hours. At 2 hours, Group II had a higher median score [3 (0–5)] compared to Group I [0 (0–4)] ($p = 0.01$), but this difference resolved by 24 hours, with both groups showing a median of 0 ($p = 0.35$) and low frequency of stridor ≥4 ($p = 0.33$).[11]

Singh et al. reported that although no large RCTs directly compared epinephrine and budesonide in 2023–2024, both therapies had similar effectiveness in recent clinical observations and hospital protocols.[20] Both epinephrine and budesonide effectively reduced stridor, with similar outcomes at all time points and comparable results at 24 h. This comparative analysis shows that both epinephrine and budesonide are effective and safe for managing post-extubation stridor in children. Neither therapy was superior, and both led to significant clinical improvement based on clinical judgement.

Limitations

The single-centre setting and follow-up of this study limited the generalisability of the findings. The lack of a blinded assessment may have affected the reliability of the outcomes. Additionally, the exclusion of reintubation rates reduced the completeness of clinical evaluation.

CONCLUSION

Both adrenaline and budesonide nebulisation effectively reduced stridor scores in children with post-extubation stridor, with no significant differences observed at any time interval. Physiological parameters remained comparable, and both treatments were well tolerated without adverse effects. The reduction in stridor was consistent and progressive in both groups, with similar clinical outcomes at 24 h. Although adrenaline showed a slightly faster initial response, it was not sustained over time. The duration of intubation and severity of stridor did not differ significantly between the groups. These results support the use of either adrenaline or budesonide as effective options for managing post-extubation stridor in paediatric intensive care settings.

REFERENCES

1. Nileshwar A. Postextubation stridor in the ICU. Ind J Resp Care 2017;6(1):777–80. https://www.ijrc.in/abstractArticleContentBrowse/IJRC/31085/JPJ/fullText.
2. Ajith Kumar AK, Cascella M. Post-intubation laryngeal edema. StatPearls, Treasure Island (FL): StatPearls Publishing; 2025. https://www.ncbi.nlm.nih.gov/books/NBK560809/.
3. Masterson C, O'Toole D, Leo A, McHale P, Horie S, Devaney J, et al. Effects and mechanisms by which hypercapnic acidosis inhibits sepsis-induced canonical nuclear factor-κB signalling in the lung. Crit Care Med 2016;44: e207-17. https://doi.org/10.1097/CCM.0000000000001376.
4. Gao F, Yang L-H, He H-R, Ma X-C, Lu J, Zhai Y-J, et al. The effect of reintubation on ventilator-associated pneumonia and mortality among mechanically ventilated patients: A systematic review and meta-analysis. Heart Lung 2016; 45:363–71. https://doi.org/10.1016/j.hrtlng.2016.04.006.
5. Lewis D, Khalsa DD, Cummings A, Schneider J, Shah S. Factors associated with post-extubation stridor in infants intubated in the pediatric ICU. J Intensive Care Med 2024; 39:336–40. https://doi.org/10.1177/08850666231204208.
6. Tanaka A, Uchiyama A, Horiguchi Y, Higeno R, Sakaguchi R, Koyama Y, et al. Predictors of post-extubation stridor in patients on mechanical ventilation: a prospective observational study. Sci Rep 2021; 11:19993. https://doi.org/10.1038/s41598-021-99501-8.
7. Cathain E, Gaffey MM. Upper airway obstruction. StatPearls, Treasure Island (FL): StatPearls Publishing; 2025. https://www.ncbi.nlm.nih.gov/books/NBK564399/.
8. Schweiger C, Eneas LV, Manica D, Netto C de SS, Carvalho PRA, Piva JP, et al. Accuracy of stridor-based diagnosis of

post-intubation subglottic stenosis in paediatric patients. J Pediatr (Rio J) 2020; 96:39–45. https://doi.org/10.1016/j.jped.2018.08.004
9. Sharma S, Hashmi MF, Chakraborty RK. Asthma medications. StatPearls, Treasure Island (FL): StatPearls Publishing; 2025. https://www.ncbi.nlm.nih.gov/books/NBK531455/.
10. Kalola UK, Ambati S. Budesonide. StatPearls, Treasure Island (FL): StatPearls Publishing; 2025. https://www.ncbi.nlm.nih.gov/books/NBK563201/.
11. Sinha A, Jayashree M, Singhi S. Aerosolized L-epinephrine vs budesonide for post extubation stridor: a randomized controlled trial. Indian Pediatr 2010; 47:317–22. https://doi.org/10.1007/s13312-010-0060-z.
12. Farooq A, Maqbool T, Aslam S, Tariq M, Khan MA, Ali MA, et al. Nebulized epinephrine versus salbutamol for the management of children presenting with bronchiolitis: Single Center Study. Prof Med J 2020; 27:2719–28. https://doi.org/10.29309/tpmj/2020.27.12.4726.
13. Sah VK, Giri A, Sah S, Niraula N. Comparison of efficacy of nebulisation with salbutamol versus adrenaline in acute bronchiolitis in children aged two months to two years. J Nobel Med Coll 2019; 8:27–32. https://doi.org/10.3126/jonmc.v8i1.24473.
14. Bertrand P, Araníbar H, Castro E, Sánchez I. Efficacy of nebulized epinephrine versus salbutamol in hospitalized infants with bronchiolitis. Pediatr Pulmonol 2001; 31:284–8. https://doi.org/10.1002/ppul.1040.
15. Nascimento MS, Prado C, Troster EJ, Valério N, Alith MB, Almeida JFL de. Risk factors for post-extubation stridor in children: the role of orotracheal cannula. Einstein (Sao Paulo) 2015; 13:226–31. https://doi.org/10.1590/S1679-45082015AO3255.
16. Abbasi S, Moradi S, Talakoub R, Kashefi P, Koushki AM. Effect of nebulized budesonide in preventing postextubation complications in critically patients: A prospective, randomized, double-blind, placebo-controlled study. Adv Biomed Res 2014; 3:182. https://doi.org/10.4103/2277-9175.139543.
17. Markovitz BP, Randolph AG. Corticosteroids for the prevention and treatment of post-extubation stridor in neonates, children and adults. Cochrane Database Syst Rev 2000:CD001000. https://doi.org/10.1002/14651858.CD001000.
18. Veder LL, Joosten KFM, Schlink K, Timmerman MK, Hoeve LJ, van der Schroeff MP, et al. post-extubation stridor after prolonged intubation in the pediatric intensive care unit (PICU): a prospective observational cohort study. Eur Arch Otorhinolaryngol 2020; 277:1725–31. https://doi.org/10.1007/s00405-020-05877-0.
19. da Silva PSL, Fonseca MCM, Iglesias SBO, Junior EL, de Aguiar VE, de Carvalho WB. Nebulized 0.5, 2.5- and 5-ml L-epinephrine for post-extubation stridor in children: a prospective, randomized, double-blind clinical trial. Intensive Care Med 2012; 38:286–93. https://doi.org/10.1007/s00134-011-2408-9.
20. Singh S, Hassan M, Gupta N, Mahajan C. Persistent post-extubation stridor in an intensive care unit: A decision dilemma. J Neuroanaesth Crit Care 2023; 10:140–1. https://doi.org/10.1055/s-0043-1763266.