

Article

Not peer-reviewed version

Risk Factors and Clinical Outcomes of Post-Extubation Stridor in Pediatric Intensive Care

[Jakeline G. Fonseca](#)*, Cristiane F. de Moura, Geovana S. Rézio, Laís A. da Silva, Mayara M. de Deus, Amanda E. Rodrigues, Juliana A. de S. Caixeta, Luiza Avelino Ferri, [Melissa A. G. Avelino](#)

Posted Date: 31 October 2025

doi: 10.20944/preprints202510.2472.v1

Keywords: respiratory sounds; airway extubation; pediatric intensive care unit; mechanical ventilation



Preprints.org is a free multidisciplinary platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This open access article is published under a Creative Commons CC BY 4.0 license, which permit the free download, distribution, and reuse, provided that the author and preprint are cited in any reuse.

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Article

Risk Factors and Clinical Outcomes of Post-Extubation Stridor in Pediatric Intensive Care

Jakeline G. Fonseca ^{1,2,*}, Cristiane F. de Moura ¹, Geovana S. Rézio ^{1,2}, Laís A. da Silva ², Mayara M. de Deus ^{1,3}, Amanda E. Rodrigues ^{1,3}, Juliana A. de S. Caixeta ¹, Luiza Avelino Ferri ⁴ and Melissa A. G. Avelino ¹

- ¹ Faculdade de Medicina, Universidade Federal de Goiás, Brazil
 - ² Hospital Estadual De Urgências Governador Otávio Lage De Siqueira (HUGOL), Goiânia, Goiás, Brazil
 - ³ Hospital Estadual da Criança e do Adolescente (HECAD), Goiânia, Goiás, Brazil
 - ⁴ Faculdade Ciências Médicas da Santa Casa de São Paulo, Brazil
- * Correspondence: jakelinegf40@gmail.com

Abstract

Objectives: To assess risk factors for post-extubation stridor in children and its impact on clinical outcomes. **Methods:** Prospective cohort study with children aged from 0 to 13 years who were intubated or underwent orotracheal intubation in the pediatric intensive care units (PICU) of two tertiary public hospitals. The outcome of interest was the occurrence of post-extubation stridor. The information collected included patient characteristics, comorbidities, history of airway manipulation, and factors related to orotracheal intubation. A logistic regression was used to identify potential risk factors for post-extubation stridor; data were analyzed until hospital discharge, death, or referral to another facility. **Results:** A total of 239 children were included, with a median age of 1.3 years and a duration of intubation of three days. Post-extubation stridor was observed in 57.3% of children. A multivariate analysis included prehospital or non-specialized hospital intubation, trauma or complications during intubation, and orotracheal intubation longer than seven days as risk factors for stridor. Children with stridor had a longer PICU length of stay, longer duration of invasive mechanical ventilation, and were often managed with non-invasive ventilation ($p < 0.05$). Most children with extubation failure ($p = 0.001$) and cardiorespiratory arrest ($p = 0.03$) presented stridor. **Conclusions:** Risk factors for post-extubation stridor included intubation performed in prehospital or non-specialized hospitals, orotracheal intubation longer than seven days, and trauma or complications during intubation. Children with stridor had a worse prognosis, with longer stays in the PICU and on mechanical ventilation and higher rates of extubation failure.

Keywords: respiratory sounds; airway extubation; pediatric intensive care unit; mechanical ventilation

1. Introduction

Orotracheal intubation poses a high risk in critically ill children with difficult airways, unstable hemodynamics, or respiratory failure [1]. Compared with adults, children have distinct airway anatomy, lower functional residual capacity, and higher oxygen demand [2]. Orotracheal intubation can lead to complications, including laryngeal edema and stenosis, granulation tissue, and vocal fold paralysis, which may result in upper airway obstruction after extubation [3].

Upper airway obstruction is the leading cause of extubation failure in children, and the post-extubation stridor is the main sign of this obstruction [3–5]. Extubation failure occurs in 3% to 30% of pediatric patients [4–10] and is associated with prolonged hospital and intensive care unit (ICU) length of stay, longer duration of mechanical ventilation, increased reintubation and airway injury, higher costs, tracheostomy, and greater morbidity and mortality [4,6,11].

The incidence of post-extubation stridor in children ranges from 4.5% to 44.4% [12,13]. Potential risk factors for stridor and laryngeal injuries include previous orotracheal intubation, comorbidities (e.g., gastroesophageal reflux disease and prematurity), traumatic intubation, inappropriate tube size, use of cuffed tubes or high cuff pressures, prolonged intubation, multiple tube repositioning, reintubation, inadequate sedation, and infection [14–22].

In this context, identifying risk factors for post-extubation stridor is crucial for implementing best clinical practices in intubated children, reducing complications, optimizing interventions, and preventing severe laryngotracheal stenosis or tracheostomy. Therefore, this study aimed to investigate risk factors for post-extubation stridor in children and its impact on clinical outcomes.

2. Materials and Methods

This prospective cohort study was conducted between September 2022 and September 2023 within 60 beds of six pediatric intensive care units (PICU) in two public hospitals in central Brazil. The study was approved by the research ethics committee (CAAE 55640121.4.0000.5082), and written informed consent was obtained from the legal guardians of all children.

Children of both genders, aged from 0 to 13 years, who were either admitted while intubated or underwent orotracheal intubation during hospitalization were included. Exclusion criteria comprised children who had a tracheostomy without an extubation attempt, those who died before extubation, underwent extubation outside the study hospitals, followed a brain death protocol, or received palliative extubation.

Data were collected using a standardized questionnaire, based on previous studies [19,20,22], and refined following a pilot test with nine children. Researchers responsible for data collection were trained in advance. Information was obtained from electronic medical records at both hospitals and from legal guardians. A follow-up was ensured through daily visits to the PICU.

Information was collected on patient characteristics, comorbidities (e.g., syndromes, encephalopathies, neoplasms, congenital heart disease, lung disease, gastroesophageal reflux, prematurity), history of airway manipulation (diagnostic or therapeutic), and intubation-related factors. Researchers also monitored the clinical course, including the use of pre-extubation corticosteroids, post-extubation antibiotics, and inhaled epinephrine.

The outcome of interest was the occurrence of post-extubation stridor within 72 hours, assessed by the PICU physician, physiotherapist, or speech-language pathologist. Data were analyzed until hospital discharge, death, or transfer to another facility. Endotracheal tube size was considered suitable according to the American Heart Association guidelines (American Heart Association & American Academy of Pediatrics, 2006). Duration of intubation was defined as the interval between intubation and the first extubation. Extubation failure was defined as reinsertion of the endotracheal tube within 72 hours after extubation [7].

The sample size calculation assumed that approximately 768 children are intubated annually in the PICU of both hospitals. Based on the literature, the incidence of post-extubation stridor ranges from 4.5% to 44.4% [12,13], and an incidence of 20% was used for calculation. Considering a 95% confidence interval (95%CI) and a 5% margin of error, a target sample size of 187 children was determined.

Data were analyzed using SPSS version 21.0. Continuous variables were reported as medians with 95%CI, while categorical variables as frequencies and percentages. Associations were assessed using the chi-square test (categorical variables) or the Mann–Whitney test (continuous variables). Logistic regression was used to identify potential risk factors for stridor through univariate and multivariate analyses. Statistical significance was set at $p < 0.05$.

3. Results

A total of 239 children, with a median age of 1.3 years (0 to 13 years), were included. Stridor occurred in 137 children (57.3%). Table 1 describes the sample characteristics.

Table 1. Sample characteristics (n = 239).

Variable	With stridor n (%)	Without stridor n (%)	Total n (%)	P
Gender				
Male	78 (56.9%)	60 (58.8%)	138 (57.7%)	0.77
Female	59 (43.1%)	42 (41.2%)	101 (42.3%)	
Prematurity	27 (19.7%)	19 (18.6%)	46 (19.2%)	0.83
Comorbidities	52 (38.0%)	53 (52.0%)	105 (43.9%)	0.03*
Previous orotracheal intubation	28 (20.4%)	22 (22.0%)	50 (21.1%)	0.77
History of laryngitis	16 (12.0%)	16 (16.3%)	32 (13.9%)	0.35
Upper airway malformation	1 (0.7%)	0 (0.0%)	1 (0.4%)	0.38
Previous upper airway surgery	0 (0.0%)	1 (1.0%)	1 (0.4%)	0.24

Chi-square test; *p < 0.05.

Statistically significant differences were observed between children with and without stridor regarding the reason and setting of intubation, the specialty of the professional performing it, intubation-related trauma, and intubation duration exceeding seven days. Table 2 summarizes these results.

Table 2. Description of orotracheal intubations (n = 239).

Variable	With stridor n (%)	Without stridor n (%)	Total n (%)	p
Reason for orotracheal intubation				
Surgery	32 (23.4%)	53 (52.0%)	85 (35.6%)	0.001*
Acute respiratory failure	53 (38.7%)	29 (28.4%)	82 (34.3%)	
Low level of consciousness	39 (28.5%)	16 (15.7%)	55 (23.0%)	
Other reasons	13 (9.5%)	4 (3.9%)	17 (7.1%)	
Setting of orotracheal intubation				
Prehospital	18 (13.1%)	12 (11.8%)	30 (12.6%)	0.029*
Emergency department	17 (12.4%)	13 (12.7%)	30 (12.6%)	
Pediatric intensive care unit	29 (21.2%)	17 (16.7%)	46 (19.2%)	
Surgical center	23 (16.8%)	35 (34.3%)	58 (24.3%)	
Other hospitals	50 (36.5%)	25 (24.5%)	75 (31.4%)	
Specialty of orotracheal intubation				
Anesthesiologist	31 (22.6%)	48 (47.1%)	79 (33.1%)	0.002*
Pediatrician	55 (40.1%)	34 (33.3%)	89 (37.2%)	
Other specialties	51 (37.2%)	20 (19.6%)	71 (29.7%)	

Inadequate orotracheal tube	69 (51.1%)	45 (44.6%)	114 (48.3%)	0.319
Tube with cuff	98 (72.6%)	68 (66.7%)	166 (70.0%)	0.324
Intubation-related injuries	21 (40.4%)	6 (12.2%)	27 (26.7%)	0.023*
Orotracheal intubation exceeding seven days	42 (30.9%)	13 (12.9%)	55 (23.2%)	0.001*

Chi-square test; *p < 0.05.

A univariate analysis was performed to assess risk factors associated with stridor. Variables with $p < 0.20$ were included in the multivariate models (Table 3). Prehospital and non-specialized hospital intubation, intubation-related injuries or complications, and orotracheal intubation exceeding seven days were identified as risk factors ($p < 0.05$).

Table 3. Univariate and multivariate analyses of risk factors for stridor (n = 239).

Variable	Stridor n (%)	Total n	Univariate		Multivariate	
			Odds Ratio (95%CI)	P	Odds Ratio (95%CI)	P
Prematurity						
Yes	27 (58.7%)	46				
No	110 (57.0%)	193	0.9 (0.5 - 1.8)	0.834	0.7 (0.3 - 1.61)	0.429
Comorbidities						
Yes	52 (49.5%)	105				
No	85 (63.4%)	134	1.8 (1.0 - 2.9)	0.032*	1.5 (0.7 - 3.1)	0.309
Previous orotracheal intubation						
Yes	28 (56.0%)	50				
No	109 (58.3%)	187	1.1 (0.6 - 2.1)	0.771	1.0 (0.5 - 2.3)	0.916
History of laryngitis						
Yes	16 (50.0%)	32				
No	117 (58.8%)	199	1.4 (0.7 - 3.0)	0.352	1.6 (0.7 - 3.5)	0.280
Setting of orotracheal intubation						
Outside study hospitals	68 (64.8%)	105	1.7 (1.0 - 2.9)	0.040*	2.2 (1.2 - 3.9)	0.007*

At study hospitals	69 (51.5%)	134				
Specialty of orotracheal intubation						
Others	82 (54.7%)	150	1.3 (0.8 - 2.3)	0.282	1.3 (0.6 - 2.7)	0.498
Pediatrician	55 (61.8%)	89				
Tube with cuff						
Yes	98 (59.0%)	166	1.3 (0.8 - 2.3)	0.325	1.3 (0.7 - 2.6)	0.371
No	37(52.1%)	71				
Intubation-related injuries or complications						
Yes	21 (77.8%)	27	2.9 (1.1 - 7.5)	0.028*	4.5 (1.5 - 13.3)	0.007*
No	116 (54.7%)	212				
Adequate orotracheal tube						
Yes	66 (54.1%)	122				
No	69 (60.5%)	114	0.8 (0.5 - 1.29)	0.319	0.8 (0.5 - 1.5)	0.548
Duration of orotracheal intubation						
≤ seven days	94 (51.6%)	182				
> seven days	42 (76.4%)	55	3.0 (1.5 - 6.0)	0.002*	3.5 (1.7 - 7.3)	0.001*

95%CI: 95% confidence interval; * p < 0.05.

Children with stridor received pre-extubation intravenous corticosteroids more often than those without stridor (81% vs. 59.8%; p = 0.001). The same pattern was observed for post-extubation epinephrine nebulization (96.3% vs. 82.4%; p = 0.001). No significant differences were found for antibiotic use.

In addition, children with stridor had longer PICU length of stay (median 15.0 vs. 10.5 days; p = 0.004) and mechanical ventilation (5.0 vs. 2.0 days; p = 0.001) than those without stridor. Extubation failure occurred predominantly in children with stridor (p = 0.001), who also often required post-extubation non-invasive ventilation (p = 0.001). Most cases of cardiorespiratory arrest (p = 0.039) and airway endoscopy (p = 0.045) also involved children with stridor. Table 4 summarizes these results.

Table 4. Clinical outcomes according to the presence of stridor (n = 239).

Variable n (%)	With stridor	Without stridor	Total	p
Extubation failure				

Yes	32 (23.5%)	8 (7.8%)	40 (16.8%)	0.001*
No	104 (76.5%)	94 (92.2%)	198 (83.2%)	
Time to extubation failure				
≤ 6 hours	12 (37.5%)	0 (0.0%)	12 (30.8%)	0.154
6 to 24 hours	5 (15.6%)	2 (28.6%)	7 (17.9%)	
24 to 48 hours	5 (15.6%)	3 (42.9%)	8 (20.5%)	
48 to 72 hours	10 (31.3%)	2 (28.6%)	12 (30.8%)	
Reason for extubation failure				
Airway obstruction	20 (62.5%)	2 (25.0%)	22 (55.0%)	0.057
Other	12 (37.5%)	6 (75.0%)	18 (45.0%)	
Post-extubation non-invasive ventilation				
Yes	74 (54.4%)	33 (32.7%)	107 (45.1%)	0.001*
No	62 (45.6%)	68 (67.3%)	130 (54.9%)	
Cardiorespiratory arrest				
Yes	25 (18.2%)	9 (8.8%)	34 (14.2%)	0.039*
No	112 (81.8%)	93 (91.2%)	205 (85.8%)	
Tracheostomy				
Yes	10 (7.3%)	2 (2.0%)	12 (5.0%)	0.062
No	127 (92.7%)	100 (98.0%)	227 (95.0%)	
Airway endoscopy				
Yes	17 (12.5%)	5 (4.9%)	22 (9.2%)	0.045*
No	119 (87.5%)	97 (95.1%)	216 (90.8%)	
Airway surgery				
Yes	0 (0.0%)	2 (2.0%)	2 (0.8%)	0.100
No	137 (100%)	100 (98.0%)	237 (99.2%)	
Outcome				
Death	6 (4.4%)	4 (3.9%)	10 (4.2%)	0.977
PICU discharge	128 (93.4%)	96 (94.1%)	224 (93.7%)	
Transfer	3 (2.2%)	2 (2.0%)	5 (2.1%)	

PICU: pediatric intensive care unit; # median (95% confidence interval); * p < 0.05.

4. Discussion

The main risk factors for post-extubation stridor included intubation performed in prehospital or non-specialized hospitals, orotracheal intubation longer than seven days, and trauma or complications during intubation. Surgery was the primary reason for orotracheal intubation in the total sample, whereas acute respiratory failure was the main reason for children with stridor. This finding corroborates Lambercy et al. [20], who assessed 39 children and reported that most laryngeal injuries occurred after emergency intubations (84.6%), mainly due to clinical reasons (77.0%). Studies report that emergency intubations increase the risk of hypoxia, hypotension, airway injury, and multiple intubation attempts, often due to lack of equipment, incomplete medical history, or the urgent nature of the procedure [16,23–25]. Furthermore, trauma or difficulty during intubation is often underreported in medical records. The setting in which the orotracheal intubation procedure is performed may influence the occurrence of stridor. Veder et al. [22] reported that children intubated by prehospital services were five times more likely to develop stridor than those intubated in the

hospital, due to emergency and traumatic procedures, often performed by inexperienced professionals. In addition, the duration of orotracheal intubation may be associated with post-extubation stridor. Nascimento et al. [19] reported an association between intubation lasting more than three days and the development of stridor. Intubation exceeding seven days has been linked to more severe airway injuries, assessed by endoscopy, in a sample of 39 children with a mean age of 3.35 years [20], and to subglottic stenosis, with the risk increasing by 50.3% for every additional five days [17,21]. However, a recent systematic review found no association between duration and intubation-related injuries [12].

Our study highlights that over 70% of children were intubated with cuffed endotracheal tubes, which was not a risk factor for stridor. Evidence on the use of cuffed endotracheal tubes is conflicting. Nascimento et al. [19] assessed 136 young children and found no association between cuffed tubes and stridor, whereas Veder et al. [22] reported a higher risk in those younger than one year in a similar sample size. Furthermore, a systematic review found no significant difference in the incidence of stridor between cuffed and uncuffed orotracheal tubes, with a low quality of evidence [26]. Similarly, Chen et al. [27] reported that the presence of a cuff was not associated with stridor; however, uncuffed tubes were associated with a higher need for tube replacement, which has been linked to moderate to severe airway injury in children [28].

Moreover, 57.3% of children had post-extubation stridor, which is higher than previously reported incidences of 4.5% to 44.4% [12,13,19,22]. This findings may be attributed to the complexity and heterogeneity of the sample, differing from other studies, as our PICUs are divided into trauma, cardiology, neurology, respiratory, and general.

Furthermore, children with stridor had a longer ICU length of stay than those without stridor, corroborating Algebaly et al. [14]. In a large retrospective study with 14,045,425 patients under 20 years old in the United States, the hospital length of stay was longer for patients with subglottic stenosis (13.11 vs. 3.76 days), a clinical condition typically associated with stridor (13.11 vs. 3.76 days) [29].

Additionally, children with stridor required longer mechanical ventilation. This finding is consistent with Lamercy et al. [20], who found that moderate to severe laryngeal injuries were associated with prolonged intubation, with most of these patients presenting stridor. Likewise, children with stridor were more likely to require noninvasive ventilation after extubation. In a multicenter study involving 2,794 children (mean age 15.5 months), extubation failure was associated with airway rescue interventions, including steroids, epinephrine, heliox, or non-invasive ventilation, within 24 hours after extubation [4].

The extubation failure rate in our study is consistent with previous evidence (16.8%) [4,8–10]. Stridor was associated with extubation failure, agreeing with Simonassi and Sanso [10], who reported a 5.84-fold increased risk of extubation failure among children with post-extubation stridor. These findings highlight stridor as a clinical marker of laryngeal injury and a warning sign of potential adverse outcomes.

This study had some limitations. First, the lack of specialized staff and equipment for endoscopic assessment. Laryngotracheoscopy is the gold standard for diagnosing acute post-intubation injuries and is recommended in cases of persistent stridor or repeated extubation failures [3,11,13,30]. Early diagnosis of laryngeal injuries is essential for effective treatment, helping to avoid tracheostomies and complex open surgeries [3,15]. However, this assessment is not available in many PICUs, particularly in developing countries. Second, potential selection bias may have occurred, as data were collected in medical records. Nonetheless, strengths include a large sample size, inclusion of children with diverse profiles and reasons for hospitalization and intubation, and data collection conducted exclusively by three previously trained researchers who carried out a pilot study.

5. Conclusions

Risk factors for post-extubation stridor included intubations in prehospital settings or non-specialized hospitals, injuries or complications during orotracheal intubation, and orotracheal

intubation longer than seven days. Children with stridor had worse clinical outcomes compared with those without stridor, including longer invasive mechanical ventilation and PICU length of stay and greater use of non-invasive ventilation after extubation. Most children with extubation failure, and most of those who experienced cardiorespiratory arrest or underwent airway endoscopy, presented with stridor.

Author Contributions: Conceptualization, JGF, CFM, GSR, and MAGA; methodology, JGF, CFM, GSR, and MAGA; software, JGF, CFM, GSR, and MAGA; validation, JGF, CFM, GSR, AER, JASC, and MAGA; formal analysis, JGF, AER, JASC, and MAGA; investigation, JGF, CFM, and LAS; resources, JGF, CFM, GSR, LAS, MMD, and AER; data curation, JGF, and CFM; writing—original draft preparation, JGF, CFM, GSR, AER, JASC, LAF, and MAGA; writing—review and editing, JGF, AER, JASC, LAF, and MAGA; visualization, JGF, CFM, GSR, AER, JASC, and MAGA; supervision, JASC, and MAGA; project administration, JGF, CFM, GSR, and MAGA; funding acquisition, JGF, and MAGA. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee Leide das Neves Ferreira (CAAE: 55640121.4.0000.5082 on 03/17/2022).

Informed Consent Statement: Not applicable.

Acknowledgments: We thank the PICU staff of the participating hospitals and the collaboration of Nayara Rodrigues Gomes de Oliveira and Aika Ribeiro Kubo de Oliveira.

Conflicts of Interest: The authors declare that there are no conflicts of interest.

References

1. Nishisaki, A.; Turner, D.A.; Brown III, C.A.; Walls, R.M.; Nadkarni, V.M. A National Emergency Airway Registry for Children. *Crit. Care Med.* **2013**, *41*(3), 874-885. DOI: 10.1097/CCM.0b013e3182746736
2. Huang, A.S.; Hajduk, J.; Rim, C.; Coffield, S.; Jagannathan, N. Focused review on management of the difficult paediatric airway. *Indian J. Anaesth.* **2019**, *63*(6), 428. DOI: 10.4103/ija.IJA_250_19
3. Schweiger C.; Manica D. Acute laryngeal lesions following endotracheal intubation: risk factors, classification and treatment. *Semin. Pediatr. Surg.* **2021**, *30*(3). DOI: 10.1016/j.sempedsurg.2021.151052
4. Kurachek, S.C.; Newth, C.J.; Quasney, M.W.; Rice, T.; Sachdeva, R.C.; Patel, N.R.; Takano, J.; Easterling, L.; Scanlon, M.; Musa, N.; et al. Extubation failure in pediatric intensive care: A multiple-center study of risk factors and outcomes. *Crit. Care Med.* **2003**, *31*(11), 2657-2664. DOI: 10.1097/01.CCM.0000094228.90557.85
5. Newth, C.J.; Hotz, J.C.; Khemani, R.G. Ventilator liberation in the pediatric ICU. *Respir. Care.* **2020**, *65*(10), 1601-1610. DOI: 10.4187/respcare.07810
6. Egbuta, C.; Evans, F. Extubation of children in the operating theatre. *BJA Education.* **2022**, *22*(2), 75-81. DOI: 10.1016/j.bjae.2021.10.003
7. Ng, P.; Tan, H.L.; Ma, Y.J.; Sultana, R.; Long, V.; Wong, J.J.M.; Lee, J.H. Tests and Indices Predicting Extubation Failure in Children: a systematic review and meta-analysis. *Pulm Ther.* **2023**, *9*(1), 25-47. DOI: 10.1007/s41030-022-00204-wV
8. Khemani, R.G.; Hotz, J.; Morzov, R.; Flink, R.; Kamerkar, A.; Ross, P.A.; Newth, C.J. Evaluating risk factors for pediatric post-extubation upper airway obstruction using a physiology-based tool. *Am. J. Respir. Crit. Care Med.* **2016**, *193*(2), 198-209. DOI: 10.1164/rccm.201506-1064OC
9. Loberger, J.M.; Manchikalapati, A.; Borasino, S.; Prabhakaran, P. Prevalence, Risk Factors, and Outcomes of Airway Versus Non-Airway Pediatric Extubation Failure. *Respir. Care.* **2023**, *68*(3), 374-383. DOI: 10.4187/respcare.10341
10. Simonassi, J.; Sanso, J.P.B. Prevalence of extubation and associated risk factors at a tertiary care pediatric intensive care unit. *Arch. Argent. Pediatr.* **2019**, *117*(2), 87-92. DOI: 10.5546/aap.2019.eng.87
11. Lourenção, M.L.; Carvalho, W.B.D. Pediatric ventilation weaning. *Rev. Bras. Ter. Intensiva.* **2020**, *32*(3), 333-336. DOI: 10.5935/0103-507X.20200061

12. Veder, L.L.; Joosten, K.F.M.; Timmerman, M.K.; Pullens, B. Factors associated with laryngeal injury after intubation in children: a systematic review. *Eur. Arch. Otorhinolaryngol.* **2024**, *281*(6), 2833–2847. DOI: 10.1007/s00405-024-08458-7
13. Schweiger, C.; Eneas, L.V.; Manica, D.; Saleh, C.D.S.; Carvalho, P.R.A.; Piva, J.P.; Kuhl, G.; Marostica, P.J.C. Accuracy of stridor-based diagnosis of post-intubation subglottic stenosis in pediatric patients. *J. Pediatr. (Rio J.)*. **2020**, *96*(1), 39–45. DOI: 10.1016/j.jped.2018.08.004
14. Algebaly, H. F.; Mohsen, M.; Naguib, M. L.; Bazaraa, H.; Hazem, N.; Aziz, M. M. Risk factors of laryngeal injuries in extubated critical pediatric patients. *Gaz. Egypt Paediatr. Assoc.* **2021**, *69*(1), 18. DOI: 10.1186/s43054-021-00064-0
15. Pazinato, D.B.; Maunsell, R.; Avelino, M.A.G.; Lubianca, J.F.; Schweiger, C.; Caldas, J.P.D.S.; Brandão, M.B.; Souza, P.P.D.; Peixoto, F.A.D.O.; Ricachinevsky, C.P.; et al. Position paper of diagnosis and treatment of post-extubation laryngitis in a multidisciplinary expert-based opinion. *Braz. J. Otorhinolaryngol.* **2024**, *90*(3). DOI: 10.1016/j.bjorl.2024.101401
16. Martins, R.H.; Dias, N.H.; Braz, J.R.; Castilho, E.C. Airway complications associated with endotracheal intubation. *Braz. J. Otorrinolaringol.* **2004**, *70*(5), 671–677. DOI: 10.1590/S0034-72992004000500015
17. Manica, D.; Schweiger, C.; Maróstica, P. J.; Kuhl, G.; Carvalho, P. R. Association Between Length of Intubation and Subglottic Stenosis in Children. *The Laryngoscope.* **2013**, *123*(4), 1049–1054. DOI: 10.1002/lary.23771
18. Schweiger, C.; Manica, D.; Pereira, D.R.R.; Carvalho, P.R.A.; Piva, J.P.; Kuhl, G.; Sekine, L.; Marostica, P.J.C. Undersedation is a risk factor for the development of subglottic stenosis in intubated children. *J. Pediatr. (Rio J.)*. **2017**, *93*(4), 351–355. DOI: 10.1016/j.jped.2016.10.006
19. Nascimento, M.S.; Prado, C.; Troster, E.J.; Valério, N.; Alith, M.B.; Almeida, J.F.L.D. Risk factors for post-extubation stridor in children: the role of orotracheal cannula. *Einstein (São Paulo)*. **2015**, *13*(2), 226–231. DOI: 10.1590/S1679-45082015AO3255
20. Lambercy, K.; Pincet, L.; Sandu, K. Intubation Related Laryngeal Injuries in Pediatric Population. *Front. Pediatr.* **2021**, *9*, 1–7. DOI: 10.3389/fped.2021.594832
21. Cakir, E.; Atabek, A. A.; Calim, O. F.; Uzuner, S.; AlShadfan, L.; Yazan, H.; Ozturan, O.; Cakir, F. B. Post-intubation subglottic stenosis in children: Analysis of clinical features and risk factors. *Pediatr. Int.* **2020**, *62*(3), 386–389. DOI: 10.1111/ped.14122
22. Veder, L. L.; Joosten, K. F. M.; Schlink, K.; Timmerman, M. K.; Hoeve, L. J.; van der Schroeff, M. P.; Pullens, B. Post-extubation stridor after prolonged intubation in the pediatric intensive care unit (PICU): a prospective observational cohort study. *Eur. Arch. Otorrinolaringol.* 1º de junho de **2020**, *277*(6), 1725–1731. DOI: 10.1007/s00405-020-05877-0
23. Mota, L. A. A.; Cavalho, G. B. D.; Brito, V. A. Laryngeal complications by orotracheal intubation: Literature review. *Int. Arch. Otorrinolaringol.* **2012**, *16*, 236–245. DOI: 10.7162/S1809-97772012000200014
24. Long, E.; Barrett, M. J.; Peters, C.; Sabato, S.; Lockie, F. Emergency intubation of children outside of the operating room. *Pediatr. Anesthesia.* **2020**, *30*(3), 319–330. DOI: 10.1111/pan.13784
25. Abid, E. S.; Miller, K. A.; Monuteaux, M. C.; Nagler, J. Association between the number of endotracheal intubation attempts and rates of adverse events in a paediatric emergency department. *Emerg. Med. J.* **2022**, *39*(8), 601–607. DOI: 10.1136/emered-2021-211570
26. De Orange, F.A.; Andrade, R.G.A.C.; Lemos, A.; Borges, P.S.G.N.; Figueiroa, J.N.; Kovatsis, P.G. Cuffed versus uncuffed endotracheal tubes for general anaesthesia in children aged eight years and under. *Cochrane Database Syst. Rev.* **2017**, (Issue 11), CD011954. DOI: 10.1002/14651858.CD011954.pub2.
27. Chen, L.; Zhang, J.; Pan, G.; Li, X.; Shi, T.; He, W. Cuffed versus uncuffed endotracheal tubes in pediatrics: a meta-analysis. *Open Med (Wars)*. **2018**, *13*(1), 366–373. DOI: 10.1515/med-2018-0055
28. Cordeiro, A. M. G.; Fernandes, J. C.; Troster, E. J. Possible risk factors associated with moderate or severe airway injuries in children who underwent endotracheal intubation. *Pediatr. Crit. Care Med.* **2004**, *5*(4), 364–368. DOI: 10.1097/01.PCC.0000128894.59583.66
29. Arianpour, K.; Forman, S. N.; Karabon, P.; Thottam, P. J. Pediatric acquired subglottic stenosis: Associated costs and comorbidities of 7,981 hospitalizations. *Int. J. Pediatr. Otorhinolaryngol.* **2019**, *117*, 51–56. DOI: 10.1016/j.ijporl.2018.11.016

30. Avelino, M.A.; Maunsell, R.; Valera, F.C.P.; Lubianca, J.F.; Schweiger, C.; Miura, C.S.; Chen, V.G.; Manrique, D.; Oliveira, R.; Gavazzoni, F.; et al. First Clinical Consensus and National Recommendations on Tracheostomized Children of the Brazilian Academy of Pediatric Otorhinolaryngology (ABOPe) and Brazilian Society of Pediatrics (SBP). *Braz. J. Otorhinolaryngol.* **2017**, *83*(5), 498-506. DOI: 10.1016/j.bjorl.2017.06.002

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.