Incidence and predictive factors for pediatric post extubation stridor at Tikur Anbessa Specialized Hospital and Menelik II Hospital, Addis Ababa, Ethiopia, 2024

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ABSTRACT

Background

Airway obstruction manifested by the presence of stridor is a well-known complication following extubation after patients have been on mechanical ventilation using invasive airway device.

Objective

The objective of the study is to assess the incidence of post extubation stridor in pediatric patients admitted to the two selected intensive care units, at Tikur Anbessa Specialized Hospital and Menelik II Hospital, and the predictive factors associated with its occurrence.

Methodology

Prospective observational cross sectional study was conducted over an eight month span (from September 2023 to April 2024), focusing on Patients aged 0-16years who had received invasive mechanical ventilator support in the pediatric ICU and were later extubated. The study collected and analyzed relevant data from two selected referral hospitals based on a literature review.

Result

A total of fifty seven patients were included in the study with median age of 2.5 years and median duration of intubation was 3 days. The incidence of post extubation stridor in pediatric intensive care unit in our study area was found to be 10.5%. Prolonged duration of intubation (*p*-value=0.038) and multiple tube insertions (*p*-value= 0.047) were significantly associated with this complication.

Conclusion

The study showed moderate frequency of post extubation stridor compared to previous studies. Prolonged duration of intubation and presence of multiple tube insertions were found to be predictive factors in our study. Awareness of the incidence as well as the associated factors for pediatric stridor following extubation leads to timely identification and prompt management which can improve patient outcome.

Keywords: pediatric, complications, intensive care, endotracheal tubes, stridor, post extubation,

Table of Contents

2. Abbreviations

AAU: Addis Ababa University

EM: Emergency Medicine

ER: Emergency Room

ETT: Endotracheal Tube

ICU: Intensive Care Unit

KG: Kilogram

OR: Operating Room

PICU: Pediatric Intensive care unit

PES: Post Extubation stridor

SPSS: Statistical Package for Social Science

TASH: Tikur Anbessa Specialized Hospital

VAP: Ventilator Associated Pneumonia

Acknowledgement

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1. Introduction

1.1. Background

Pediatric post extubation stridor (PES) is a common complication observed in patients who have been on mechanical ventilation with invasive airway device.(1) Stridor refers to a harsh, high pitched sound produced during inspiration due to partial obstruction of the airway. PES can be a marker of airway trauma that may have occurred in the process of endotracheal tube placement, maintenance or removal. It is a common respiratory complication observed in children after extubation, especially in critically ill patients.

In a study examining laryngeal trauma following intubation in pediatric patients, over 90% of cases were identified within the initial 48-hour period through endoscopic examination.(2) The trauma can manifest in a range of symptoms, from mild swelling to severe airway obstruction posing a life-threatening risk.(3) The injury usually occurs at medial side of arytenoid cartilages, sub-glottis, cricoid cartilage and its lamina where the greatest pressure is applied by the endotracheal tube.(4-5) Most of these injuries resolve without manifestation or consequence, but occasionally it may lead to significant airway problems.(2)

Due to their unique airway anatomy, children are more susceptible to airway complications following extubation than adults.(6-8) Pediatric airways have a smaller caliber and are at risk of injury during intubation, particularly in the most tapered area of the airway, the subglottic area, which is slightly above the cricoid cartilage.(9-10) While the rima glottidis (glottis opening) is defined as the slenderest portion, it is distensible with manual manipulation and muscle relaxants. In contrast, the subglottic area is non-distensible, making it more vulnerable to injury.(11-12) The previously believed narrowest part of the airway, the cricoid cartilage, is now described as circular, unlike the infraglottic area, which is elliptical with a shorter transverse diameter and wider anteroposterior diameter. In addition, children have looser submucosal connective tissue in the subglottic region than adults, which can cause fluid buildup and lead to obstruction.(6,9)

Post extubation stridor is a particular concern in pediatric ICU patients as it can lead to respiratory distress, hypoxia, extubation failure with associated increased risk of VAP, longer ICU stay, and higher mortality rates.(13-14) There are several risk factors for post extubation stridor assessed in literature but with inconsistent results. These include age, gender, duration of intubation, personnel performing the intubation, improper use of cuffed tubes and tube sizes. Performance of air leak test through the endotracheal tube is not a reliable indicator of successful extubation in pediatric patients who are critically ill. (15-16)

The management of post extubation stridor in pediatric patients depends on severity of the symptoms. Mild cases may resolve with conservative measures, including close monitoring, humidified oxygen therapy and steroid administration. However, severe cases may require re-intubation and further interventions.(17)

1.1. Statement of the problem

The incidence and associated factors of pediatric post extubation stridor in pediatric ICU are critical issues that require urgent attention. Post extubation stridor is associated with increased morbidity and mortality rates, prolonged ICU stay, and higher healthcare costs.

In literature the incidence of post extubation stridor varies from 2%to 42%. Various associated factors had been evaluated in various researches but with inconsistent result. In Ethiopian health care with resource limited setup, there is lack of data regarding this issue.

1.2. Significance of the study

We encounter pediatric patients developing stridor following removal of endotracheal tube in pediatric ICU. Even though this is a common problem observed in our setup; there is no adequate and comprehensive data regarding the incidence. Therefore, this study provides data on the identified problem so it can serve as a bench mark for further inquiries targeting this subject. Recognizing the occurrence of post-extubation and understanding its contributing factors helps in promptly identifying and managing its complications, which can enhance patient outcome

2. Literature review

There are numerous studies that described the incidence of post extubation stridor in different setups ranging from 2% to 41.2%. Generally, numbers reported from PICU are much higher than in the OR settings. Multiple risk factors presumed to cause post extubation stridor in pediatric population had been evaluated in various research but showing unclear results. Some of the variables assessed are age, sex, length of intubation, traumatic intubation, use of cuffed tubes, inappropriate tube size, location of intubation, inadequate analgesia and sedation, gastro-esophageal reflex disease, tracheobronchial infection, personnel performing the intubation and corticosteroid use before extubation. (2,17-20)

A prospective observational cohort study was done for 1year from June 2010, by Veder et al, on the incidence of post extubation stridor and its associated factors in PICU at a tertiary hospital. 150 children between the age of 0-16 who were intubated for more than 24 hrs participated in the study. Exclusion criteria used by the study comprised of children with congenital or acquired airway anomalies, stridor before intubation, prolonged intubation needing tracheostomy tube and death before extubation or within 24 hrs of extubation. 18.7% of the children developed stridor following extubation and intubation on the scene, use of cuffed tubes and lower age were found to have a significant predictive value in the occurrence of this complication. In 17.9% of the patients with stridor, it resolved without treatment other than oxygen supplementation. 67.9% of the patients were treated with steroid or adrenaline nebulization, or IV dexamethasone. Re-intubation was required in 10.7% and 3.6% of the patients needed endoscopic dilation for developing subglottic stenosis. (17)

Study conducted from January 2008 to April 2011 prospectively to determine risk factors associated with stridor included 136 pediatric patients. 41.2% had stridor after extubation and 19.6% of them needed re-intubation. Age, weight, diagnosis, tube type and size, as well as duration of mechanical ventilation were evaluated as a possible cause of stridor but only duration of mechanical ventilation, especially greater than 72hrs,(odds ratio of 8.6;95% confidence interval of 2.98-24.82; $p<0.001$) was shown to be significantly associated with the development of this complication.(30)

Previously, cuffed endotracheal tubes were not used in pediatric patients under the age of 8 due to concerns about an increased risk of causing laryngeal trauma. However, in recent decades, there has been a shift in practice since many studies have shown the safety of cuffed tubes in this group of patients. For instance, In 1997 Khine et al carried out a study which involved 488 patients from full term neonates to 8 years of age. The study

compared the incidence of postop croup after they were randomly assigned to receive appropriate size cuffed vs. uncuffed ETT for general anesthesia. 2.4% of cuffed and 2.9% of uncuffed group had sign and symptom of croup; 1.2% of cuffed and 1.3% of uncuffed groups needed treatment for croup. 2 patients needed admission to hospital (0.4% in each group) but none needed re-intubation (22).

Over 7 month study period; data were collected prospectively in PICU at children's hospital of Los Angeles comparing the incidence of post extubation stridor between patients using cuffed and uncuffed endotracheal tubes. The decision to use either type of ETT was not randomized rather it was based on the preference of the treating physician. Out of 188 patients included in the study, the overall incidence of stridor was 14.9% and there was no significant difference between the two groups. Younger age was identified as a risk factor for development of stridor but absence of air leak and accidental extubation had no significant association with acquiring stridor.(23)

Prospective randomized controlled trial done in 24 European pediatric anesthesia centers, comparing cuffed and uncuffed tubes in patients aged from birth to 5yrs for general anesthesia requiring placement of ETT, showed no significant difference in the rates of developing post extubation stridor. From 2246 children (1119 cuffed/1127 uncuffed), stridor was observed in 4.4% and 4.7% of patients respectively.(24)

Use of cuffed tubes has some advantages over uncuffed tubes, including better spirometry, reliable capnographic readings, lower re-intubation rates, reduced risk of aspiration, use of low fresh gas flow, and decreased OR pollution (11,22,24). Additionally, the use of cuffed tubes is being emphasized in pediatric airway management due to the COVID-19 pandemic. (4) This is because there is a greater effort to reduce aerosol spread during airway management procedures. Based on available evidence, it is currently advised to completely avoid using uncuffed tubes for pediatric patients. However, there may be exceptions when the outer or inner diameters of the tubes are crucial, such as during bronchoscopy or for neonates with low and extremely low birth weight.(4)

Currently, appropriately used cuffed endotracheal tubes are recommended in the ER, anesthesia and intensive care settings (25-27). Some of the measures suggested to decrease risk of airway damage are use of cuffed endotracheal tubes designed to have low pressure high volume cuffs, cuff pressure monitoring with pressure release valve for pressures >20ccH20, and use of proper sized outer tube (28). Without proper pressure monitoring using pressure monitoring device, high intra-cuff pressure cannot be avoided using subjective palpation method only. This was demonstrated in a study done by Robert J Hoffman et al in 2006 on how well emergency medicine physicians can estimate and

safely inflate ETT cuff. Forty one faculty EM physicians and 5 EM residents participated in the study, only 22% sensitivity in identifying overinflated cuffs were found and the average pressure inflated by the physicians was 93cmH2O which is way higher pressure than recommended (29).

A recent analysis has found that corticosteroid therapy can be helpful in preventing post extubation stridor and re-intubation in adults. (31) However, it may not be applicable to children and neonates due to differences in their anatomy. In 2020, a systematic review and meta-analysis consisting of ten randomized control trial and involving 591 pediatric patients found that despite a relatively small sample sizes and wide age ranges, using corticosteroids to prevent post extubation stridor and extubation failure may be considered acceptable in children.(32)

3. Objective

3.1. General objective:

The purpose of the study is to determine the incidence of the post extubation stridor among patients admitted to the pediatric intensive care unit in Tikur Anbessa Specialized Hospital and Menelik II Hospital and identifying the risk factors associated with its occurrence.

3.1. Specific objectives:

- To assess the incidence of post extubation stridor in PICU in our setup
- To recognize the associated risk factors for pediatric post extubation stridor
- To identify the outcome and interventions given to the patients who developed post extubation stridor

4. Methods

4.1. Study area and period

The study was conducted at Tikur Anbessa Specialized Hospital and Menelik II Referral Hospital intensive care units, located in Addis Ababa, Ethiopia from September 2023 to April 2024. Both are tertiary level centers that provide a range of services, including intensive care, emergency, and outpatient services.

At the time of writing, TASH's unit caters to critically ill pediatric patients and has a capacity of six beds and four mechanical ventilators. Meanwhile, Menelik II Referral Hospital's intensive care unit is mixed; serving both adults and pediatrics patients at the same area with overall capacity of seven beds and seven mechanical ventilators.

4.2. Study design

Multi-center, prospective observational cross-sectional study

4.3. Population

Source population: All pediatric patients admitted to the specified intensive care units with various diagnoses.

Study population: All pediatric patients who received invasive mechanical ventilation support and later been extubated.

- **Inclusion criteria**- All pediatric patients who present to the intensive care units and received invasive mechanical ventilation support using endotracheal tubes and subsequently been extubated.
- **Exclusion criteria**- patients with pre-existing stridor, anomaly or surgery of the upper respiratory tract prior to the intubation procedure, current or past tracheostomy, and patients who died before extubation.

4.4. Sample size and sampling technique

Using single proportion formula

$$\mathrm{ni} = \frac{z^2_{1-\frac{\alpha}{2}} \times \mathrm{p} \times (1-\mathrm{p})}{\mathrm{d}^2}$$

Where ni = Initial estimated sample size, Z = Confidence level (alpha, α), 1.96, P = prevalence from previous study, 0.18, d = marginal error, 0.05,

$$\frac{(1.96)^2 0.18(1-0.18)}{(0.05)^2} \approx 226.8$$

Since the population is <10,000, the correction formula was used to get the final sample size

$$nf = \frac{ni}{1+ni/N}$$

Where nf – final sample size, *ni*– initial sample size, N – Sampled population

- $nf = \frac{227}{1+\frac{227}{65}} = 50$

When we add, 10% non-respondent percentage, final sample size is 55. However, convenient consecutive sampling method was used to include all patients that fulfill the inclusion criteria.

4.5. Data collection procedures and quality management

Data collection procedure involved the use of a questionnaire, which was developed by the principal investigator based on literature review. Data was collected by trained pediatric and anesthesia residents who were working at the unit. To ensure the completeness of the data, the information collected was regularly checked and cross-checked with ICU logbook and patients' charts, so as not to miss any patient's record. In cases where information was missing, personnel involved in the management of the patient was approached to gather the required information.

4.6. Study variables

Dependent variable: post extubation stridor

Independent variables:-Age

- Sex
- Length of mechanical ventilation
- Size of ETT
- Number of tube insertion
- Personnel performing the intubation
- Use of corticosteroid before extubation

4.7. Operational definition

Pediatric: age < 16 years

Stridor: high pitched, wheezing sound caused by turbulent airflow through a narrowed or partially obstructed airway

Extubation: the procedure of removing an endotracheal tube from a patient's airway after they have been intubated. It can be either accidental or planned.

Post extubation period (for stridor observation): refers to the time up to and minimum 2 hours after the patients' endotracheal tube has been removed

Number of tube insertion: the total number of times the patient has been intubated with endotracheal tube till either the development of stridor or last extubation performed. It also includes tube changes due to accidental extubation or tube blockade.

When analyzing cases with multiple intubation procedures, we utilized the initial record but when stridor occurred, the data where the patient developed stridor was used.

If more than 2 hours lapsed between two intubation procedures in the same patient, these were considered as separate events.

Inappropriate sized ETT: size of ETT that is greater than 0.5mm in internal diameter than the predicted for age by the formula age/4 + 3.5

Steroid prior to extubation: if the patient received steroid within 24 hours before extubation procedure. If only a single dose was given pre-extubation, it has to be at least 4 hours prior to the extubation

4.8. Data analysis procedure

Data from the questionnaire was entered and analyzed using the Statistical Package for Social Science (SPSS) version 27. We used bivariate logistic regression selection method to find at least moderately associated variables with the occurrence of post extubation stridor. Those variables identified to be at least moderately associated with the outcome, were subsequently analyzed using multivariate analysis. 95% confidence interval was used and $p < 0.05$ was considered statistically significant.

4.9. Ethical consideration

Before conducting this study, ethical clearance was obtained from Department of Anesthesiology, critical care and pain medicine. The data for the study was collected

from patients charts, ICU logbooks, and clinical observations made by health professionals working in the unit. As no additional intervention or investigation was carried out, informed consent was not mandatory. The study ensured confidentiality of all the information collected and protected patients' identifying details.

5. RESULTS

During the study period from September 2023- April 2024, a total of 98 pediatric patients were admitted that received invasive mechanical ventilation support in both intensive care units. Of these 41 patients were excluded and there was no missing cases. Therefore, the study was done on 57 (44 from TASH and 13 from Menelik II Referral Hospital) patients aged from 0-11 years.

The incidence of post extubation stridor in these institutions was 10.5%. The presence of prolonged intubation period and multiple tube insertions were found to be significantly associated with the occurrence of stridor.

5.1. Baseline characteristics

Baseline characteristics of the study population are shown in table 1 and 2. Age of the patients ranged from 1-136 months (0-11years) with median of 30months (2.5years). Thirty two (56.1%) patients were males. Median weight was 13Kg (3.8-31Kg).

Tab le 1: Baseline characteristics

Variable	Category	Frequency	Percent (%)
Age (in years)	0-1	13	22.8
	1-8	32	56.1
	8-16	12	21.1
Sex	Male	32	56.1
	Female	25	43.9

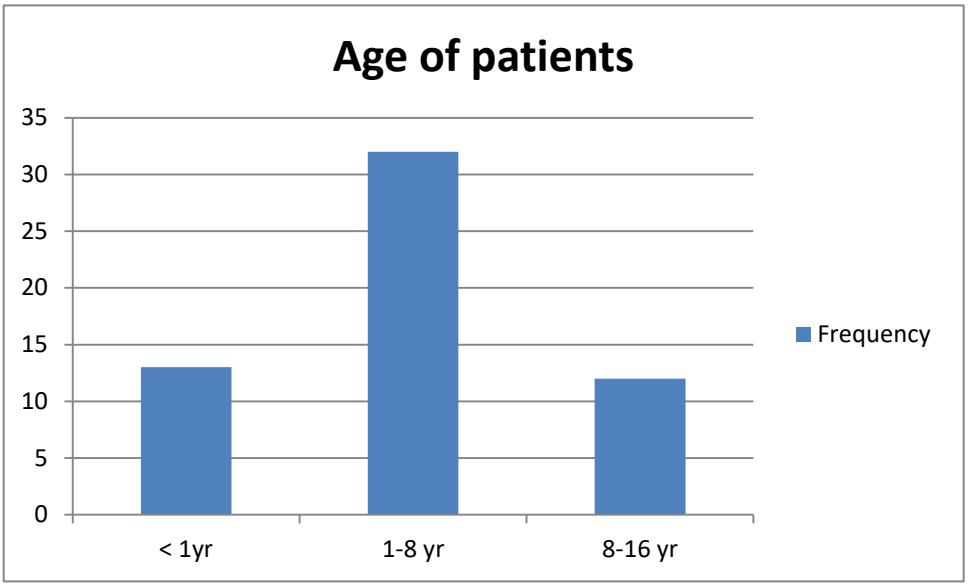


Table 2: Weight of the patients

Variable	Range	Median
Weight (in KG)	3.8-31	13

5.2. Medical information

The study involved 29 medical and 28 surgical patients. Thirty three patients (57.9%) were primarily intubated for the indication of respiratory failure. Only 2 children had congenital syndrome (one child had Down syndrome and the other had Pierre Robin sequence).

Table 3: Medical information of the patients

Variable	Category	Frequency	Present (%)
Main diagnosis	Medical	29	50.9
	Surgical	28	49.1
Reason for intubation	Respiratory failure	33	57.9
	Airway protection	24	42.1
Congenital syndrome	No	55	96.5
	Yes	2	3.5

5.3. Intubation procedure

Majority (n=50, 87.7%) were intubated by anesthesiology residents and (n=27, 47.4%) were initially intubated in the OR. All candidates received cuffed endotracheal tubes and, according to the age based formula, appropriate sized tracheal tubes were used.

Table 4: Data on intubation procedures

Variable	Category	Frequency	Percent (%)
Personnel performing the intubation	Anesthesiology resident	50	87.7
	Pediatric pulmonology fellow	4	7
	Other	3	5.3
Location of intubation	ICU	30	52.6
	OR	27	47.4
ETT type	Cuffed	57	100
Correct tube size	Yes	57	100

5.4. Course in ICU

In this study the duration of intubation ranged from 1-19days with a median of 3 days. Ten (17.5%) patients had multiple tube insertion procedures. There was a 64.9% (n=37) need for sedation. Most children received steroid prior to extubation (n=36, 63.2%)

Table 5: Course in ICU

Variable	Category	Frequency	Percent (%)
Duration of intubation	≤ 7 days	43	75.4
	> 7 days	14	24.6
Number of tube insertion	Single	47	82.5
	Multiple	10	17.5
Need for sedation	Yes	37	64.9
	No	20	35.1
Steroid prior to extubation	Yes	36	63.2
	No	21	36.8

5.5. Post extubation stridor and associated factors

Post extubation stridor occurred in 6 patients (10.5%). prolonged duration of intubation and multiple tube insertions were found to be significantly associated with the development of post extubation stridor in pediatrics.

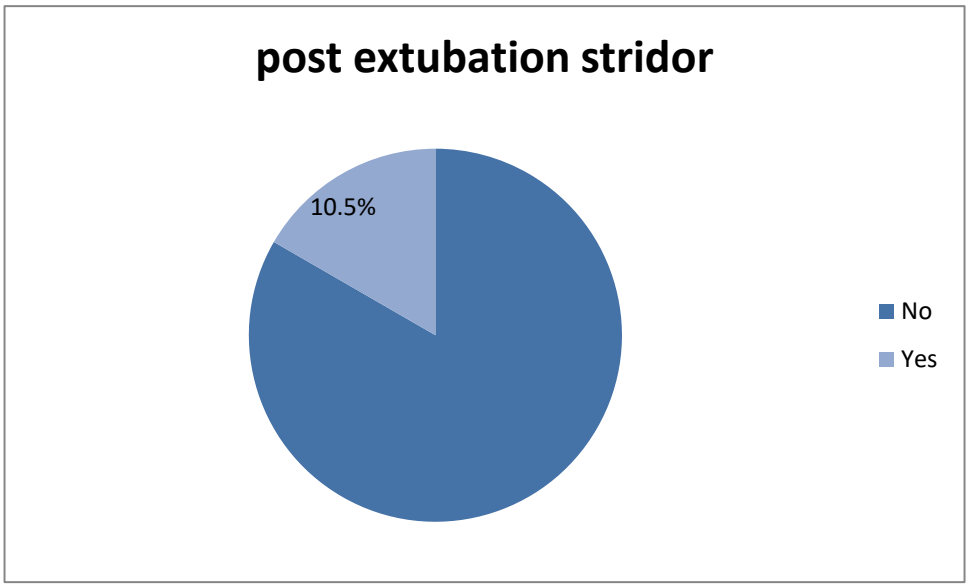
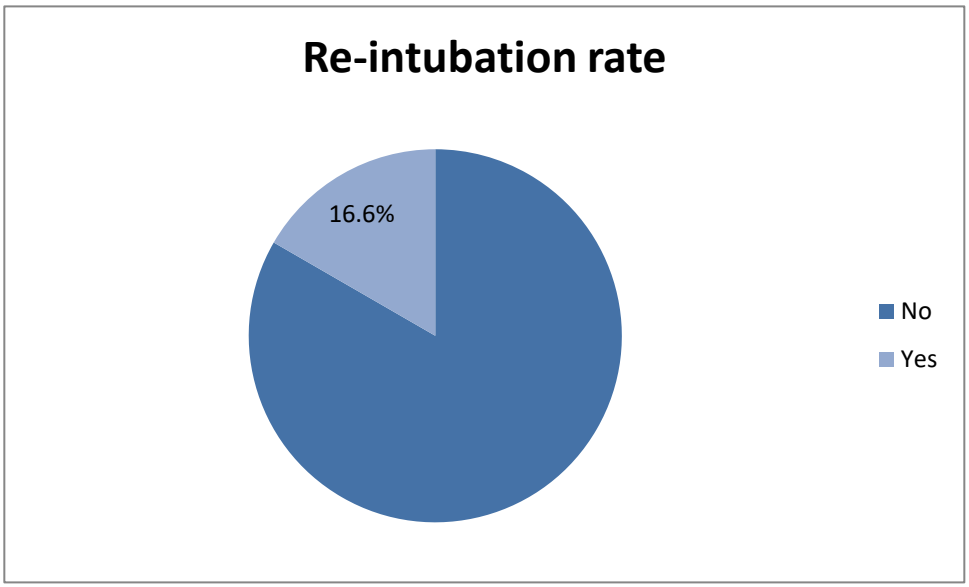


Table 6: Bivariate and Multivariate analysis

Variable	Category	Post extubation stridor		*p*-value	Bivariate	*p*-value	Multivariable
		Yes	No		COR (95%)		AOR (95%)
Sex	Male	1	20	0.249	2.857 (0.479,17.055)	0.073	0.079(0.005, 1.269)
	Female	4	19				1
Main Diagnosis	Medical	1	16				
	Surgical	4	23	0.373	2.250(0.378,13.399)		
Reason for intubation	Respiratory failure	4	19				
	Airway protection	1	20	0.647	0.659 (0.111,3.930)		
Number of tube insertion	Single	3	35				1
	Multiple	2	4	0.005	15 (2.245,100.201)	0.047 *	14.353(1.035 ,199.115)*
Duration of intubation	$\leq 7days$	2	34				1
	$> 7days$	3	5	0.024	1.351 (1.04,1.755)	0.038 *	20.176 (1.172,347.208)*
Location of intubation	PICU	2	18	0.891	1.125 (0.207,6.11)		
	OR	3	21				
Need for sedation	Yes	4	24	0.337	0.337(0.037,3.104)		
	No	1	15				
Age (in month)	Mean $\pm SD$	16.3 $\pm$ 15.3	51.41 $\pm$43.6	0.113	0.961 (0.916,1.009)	0.968	0.968(0.908, 1.031)

5.6. Post stridor outcome

Re-intubation was required in 16.6% (n=1) of children who developed stridor. Tube 0.5mm smaller than the one originally used was instituted. The other patients' stridor resolved using only supplemental oxygen, nebulization with epinephrine and intravenous steroid.



6. DISCUSSION

This study showed that the incidence of pediatric post extubation stridor in our institutions was 11.4 %. The frequency is lower compared to the study done in Netherlands which was 18.7%. Study in Portugal, reported rate of 41. 2% and number from Children Hospital of Los Angeles (CHLA) in USA was 15%. Generally different literatures described the occurrence to be from 2 to 42%. This wide gap between results may be due to the lack of objective definition for stridor (17). Additionally, differences in airway anatomy even among pediatric population, absence of universal practice in managing patients on mechanical ventilator and dissimilar setups may contribute for the varying reports.

Numerous contributing factors have been evaluated in existing literature, yet findings have been inconsistent. Baseline characteristics such as age, sex and weight are usually evaluated variables in different studies. Young age, and weight < 5kg are shown to be risk factors in some studies and not in others. Female gender in adults is described to be associated with stridor, possibly due to smaller airway.(17). Conversely, in some studies male children seem to be more affected. In this research, none of these baseline variables were associated with stridor.

Study done in trauma intensive care unit found that compared to critically ill medical patients, trauma ICU patients were re-intubated for stridor more frequently. In other studies medical patients were more prone to stridor than surgical patients.(17) These was not the case in our setup where patients that were extubated following invasive mechanical ventilation support were comparable in terms of number, medical (n=29, 50.9%) and surgical (n=28, 49.1%), as well as in incidence of post extubation stridor.

On similar note, the primary reason for intubation, whether it is due to respiratory distress or airway protection, did not result in significant difference. In this study, the rate of congenital syndrome among the study population was very low (n=2, 3.5%) and did not reach statistical significance. This is comparable to the study done by Veder et al.

Predictive factors identified in this study were longer duration of intubation and multiple tube insertions (p=0.038 and p=0.047 respectively). Patients' data on the duration of intubation were stratified into two subgroups, those with ≤7 and >7 intubation days. This was based on a study done by Veder et al. Those who were intubated for longer than seven days (n=14, 24.6%) were identified to be more at risk of developing stridor than their counter parts. This finding is in line with the other research outputs. For instance, Nascimento et al defined longer duration of intubation, especially >72hrs significantly

association with post extubation stridor in PICU ($p<0.001$, AOR= 8.60 with 95% CI: 2.98-24.82).

The other variable that was found to be risk factor for the development of stridor in our study was the presence of multiple tube insertions. In this category two or more airway instrumentations were included regardless of the reason. These could be due to multiple intubation attempts or tube changes either for accidental extubation or tube blockade. We chose to assess these factors together under the term 'number of tube insertions' to look at the overall effect as oppose to assessing only the effect of accidental extubation. This is because in those children who have had multiple extubations, if they develop stridor, it would be difficult to differentiate whether the multiple intubations or the fact that it's accidental that caused the stridor.

In recent times, there were numerous studies that looked at cuffed versus uncuffed tracheal tubes as a cause for stridor in pediatric population. While most demonstrated the lack of difference and potential advantages of cuffed tubes, the practice in some institutions is still varied. In our research, the entire study population was intubated using cuffed endotracheal tubes. These shows that there is high acceptance rate for the use of cuffed tubes in children in our institutions. Likewise, based on the age-based formula for correct endotracheal tube sizing, all patients in our study received appropriate sized tubes.

Veder et al identified the location of intubation, outside of the hospital, to be associated with PES. In our context, there was no difference in outcome depending on the location of intubation. These is because our patients were intubated either in the operating room or ICU which have relatively similar setups in terms of intubating condition unlike the difficulty faced in the streets.

Most children (63.2%) were given corticosteroid prior to extubation. On further analysis of the data, the reason behind was that most patients were already taking steroid because of their underlying diagnosis. Systemic review and meta-analysis done on corticosteroids effect on prevention of post extubation stridor, showed that even though the evidences are not as strong as in adult studies; steroids significantly reduced the incidence. These may also be a contributing factor the lower incidence of stridor in our study.

Among the six patients that developed post extubation stridor, only one (16%) needed re-intubation. This is consistent with the findings in other studies.

6.1. Strength and Limitation of the study

- The study had a well-documented data demonstrated by lack of missing variables. Regular provision of completeness of the data played a crucial role in achieving this landmark.
- As it is first of its kind in a resource limited setup, it will serve as a starting point for further studies on the subject.
- The study involved two centers

- The study was held in a low resource setup with limited ICU capacity and mechanical ventilators. In addition, there was low rate of extubation in pediatric patients (58%). As a result it was difficult to get representative data within the stated timeframe.
- Cross sectional study
- Observation of post extubation stridor is subjective so it's liable for error and attributing the stridor solely for the effect of endotracheal tube was challenging as other confounding factors such as secretion, position and pain can contribute for production of similar sound. To minimize this error the data collectors received training to rule out these factors.
- The data was collected by members of the managing team, can introduce bias
- When using cuffed tubes, cuff pressure should be monitored regularly to ensure appropriate pressure is being used which would have been one of the variables on the study. However, as we do not have access to this monitoring device the effect of cuff pressure on the development of post extubation stridor was not assessed.

7. CONCLUSION

The study showed moderate rate of incidence of stridor following removal of endotracheal tube in two selected pediatric intensive care units. Longer duration of intubation and multiple tube insertions were found to be significantly associated with the post extubation stridor. Awareness of its incidence and associated factors leads to timely identification and prompt management of this complication which can improve patient outcome.

8. RECOMMENDATION

According to the findings of this study, it is recommended that further research be conducted to better understand and prevent stridor in pediatric patients following extubation of endotracheal tubes. This complication can have serious consequences and understanding its frequency and predictive factors is crucial in reducing its incidence. Larger studies with longer follow-up periods are needed to fully understand the impact of stridor in pediatric patients.

Furthermore, this study indirectly suggests that pediatric patients receiving invasive mechanical ventilation support may have poor outcome in our setting. This underscores the importance of further exploration through future research project.

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ANNEXES

DECLARATION OF THE PRINCIPAL INVESTIGATOR

I hereby declare and affirm that this thesis is my own original work as a partial fulfillment of the requirement for the specialty certificate training in Anesthesiology, Critical care and Pain medicine. I have followed all the ethical considerations in the preparation, data collection, data analysis and completion of this research. I affirm that I have cited and referenced all the sources used in this document.

Name of the resident: _____

Date. _____ Signature_____

APPROVAL OF THE FIRST ADVISOR

Name of the first advisor:_____

Date. _____ Signature_____

APPROVAL OF THE SECOND ADVISOR

Name of the second advisor:_____

Date._____ Signature_____

Questionnaire

1. **Socio-demographic data**
   - **1.1. MRN_____**
   - **1.2. Age_____**
   - **1.3. Sex-M____ /F_____**
   - **1.4. Weight_____**
2. **Medical information**
   - **2.1. Diagnosis_____**
     _____
     _____
     _____
   - **2.2. Reason for intubation A. Respiratory failure**
     B. Airway Protection
     C. other_____
   - **2.3. Presence of pre-existing stridor: Yes_____/ No_____**
   - **2.4. Previous upper airway surgery (including tracheostomy):**

     Yes_____ /No_____
3. **Intubation procedure**
   - **3.1. ETT size_____**
   - **3.2. ETT type A. cuffed_____ B. uncuffed_____**
   - **3.3. Number of attempt_____**
   - **3.4. Drugs used_____**
   - **3.5. Who performed the procedure**
     - **A. Anesthesiology resident_____**
     - **B. Anesthesiology consultant_____**
     - **C. Pediatric pulmonology fellow_____**
     - **D. Pediatric Pulmonology consultant _____**
     - **E. Other _____**
     - **F. If more than one personnel, please specifiy_____**
   - **3.6. Location of intubation procedure**
     - **A. Pediatric ICU_____**
     - **B. Pediatric emergency_____**
     - **C. Ward_____**
     - **D. Other_____**

4. **Course in ICU**
    - **4.1. Length of intubation (in days)_____**
    - **4.2. Is sedation used YES_____/ NO_____**
5. **Extubation**
    - **5.1. Was it planned? YES_____/ NO_____**
    - **5.2. Presence of stridor? YES_____/NO_____**
    - **5.3. Was corticosteroid administered before extubation procedure YES_____/ NO_____**
    - **5.4. If "YES" to number 5.3., what dose and frequency _____**
    - **5.5. If "YES" to number 5.3., how many doses of corticosteroid? Pre extubation_____/ post extubation_____**
    - **5.6. If pre- extubation corticosteroid was given, how many hours prior to extubation was the last dose administered_____**

6. **Outcome**
    - **6.1. If "YES" to stridor, what intervention was given?**
        - **A. Oxygen supplementation _____**
        - **B. Nebulization_____**
        - **C. Re-intubation_____**
        - **D. Other_____**
    - **6.2. Re-intubation performed? YES_____/NO_____**
    - **6.3. Tracheostomy done? YES_____/ NO_____**
    - **6.4. If "YES" to number 6.3., how many times_____**