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Original Article

Correlation of Post-Intubation Croup with duration of General Anesthesia in Children undergoing Genitourinary Surgery

Abrar Ahmed, Syed Ali Mazhar Rizvi, Muhammad Saad Sikander, Khalid Buland, Muhammad Huzaifa Shareef, Muhammad Saad Farooq

Department of Anesthesia, Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To evaluate the effect of intubation time on frequency of post-extubation croup in children undergoing genitourinary surgery.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Department of Anesthesia, Combined Military Hospital, Rawalpindi Pakistan, from Mar to Sep 2022.

Methodology: Pediatric participants of either gender aged between 06 months to 12 years, American Society of Anesthesiologists (ASA) Grade I or II planned for elective genitourinary procedures under general anesthesia were included in the trial after obtaining a written informed consent. Stratification sampling technique was used to divide the patients into Group-A with intubation time <01hr and Group-B with intubation time >01hr. History of respiratory tract infections, characteristics of patients, intubation time, traumatic intubations were the recorded parameters.

Results: There were 245(58.1%) vs 177(80.5%) ASA-I patients in Group-A and Group-B respectively, and 35(12.5%) vs 43(19.5%) ASA-II. In Group-B a total of 11(5%) out of 220 patients developed croup after extubation while only 01(0.4%) out of 280 participants in Group-A experienced post extubation croup. Patients aged 1-4yrs had the highest frequency of croup 07(58.3%). Traumatic intubations and upper respiratory infections were significant factors leading to croup after extubation (*p*-value <0.01).

Conclusion: Intubation time greater than 01-hour in children undergoing genitourinary surgery increases the chances of post extubation croup. In age range of 1-4 years, traumatic intubations and history of upper respiratory tract infections are the identified risk factors for croup.

Keywords: Croup, Extubation, Intubation, Pediatrics.

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INTRODUCTION

Anesthesia administration in pediatric age group is very challenging due to a number of anatomical, physiological and pharmacological differences in children as compared to adults. In addition to the anatomical differences the higher sensitivity of the airway and variable responses to the drugs make them vulnerable to airway complications in the peri-operative period.[1]

Difference in the airway of pediatric population creates a greater impact on the technique of anesthesia. Nonetheless whatever the technique may be there are a number of risk factors which can result in respiratory complications like hoarseness, stridor, hypoxia, hypercarbia, laryngospasm, bronchospasm and cardiac complications.[2,3]

Correspondence: Dr Abrar Ahmed, Department of Anesthesia, Combined Military Hospital, Rawalpindi Pakistan
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Croup is one of the most common complications encountered in pediatric age group undergoing general anesthesia, due to the presence of an endotracheal tube in the airway, which act as a foreign body. High sensitivity of the pediatric airways can lead to an inflammatory reaction as a response of the foreign body placed in the trachea for ventilation during general anesthesia.[4,5] Resulting respiratory compromise has been identified as the most common precipitating factor which has a wide multisystemic effects ranging from neurological to cardiac complications in the pediatric age group. Diagnosis and treatment of children exhibiting such complications are the mainstay of uneventful recovery and failure to address the complications can increase the morbidity and mortality.[6-8]

The usual effective treatment of croup includes respiratory support if required, administration of glucocorticoids and nebulized epinephrine with keen

observation of the hemodynamic and respiratory parameters.[9]

Prevention of croup in the pediatric age group requires a detailed history and examination of the patients prior to induction of general anesthesia, identification of the risk factors and maintaining a balanced anesthesia approach to the children who are prone to develop croup after extubation.[10]

The aim of this study was to evaluate the effect of intubation time on the frequency of post extubation croup in children who are undergoing genitourinary procedures.

METHODOLOGY

This prospective longitudinal study was conducted at the Anesthesia Department of Combined Military Hospital, Rawalpindi Pakistan, from March to September 2022. Approval of the Ethical Review Committee was obtained as per the standard operating procedure under ERB no 278.

Inclusion Criteria: Pediatric participants of either gender with age ranging from 06 months to 12 years, American Society of Anesthesiologists (ASA) Grade I or Grade II planned for elective genitourinary procedures under general anesthesia were included.

Exclusion Criteria: Participants with congenital systemic anomalies, respiratory pathologies, history of respiratory infection in the previous 03 weeks, and known history of allergies to any medication were excluded.

A sample size of 500 was calculated using OpenEPi calculator., with the reported frequency of croup after extubation being 1%.[11] Using a stratified sampling technique, a total number of 500 patients undergoing genitourinary surgery participants were divided into two groups based on the duration of the surgical procedure. Children with surgery time less than 01 hour were enrolled to Group-A and participants with surgery time greater than 01 hour were enrolled in Group-B.

Patients who were admitted to pediatric urology unit of our hospital were interviewed by the attending classified anesthesiologist at the pre-anesthesia evaluation clinics before the elective procedures. A detailed history, clinical examination and laboratory investigations as per the requirement of each participant were assessed and fitness was obtained for the procedure after explaining the complete plan to the parents/guardians. A written informed consent was obtained, and patients were incorporated into the trial after obtaining fitness for general anesthesia procedures. Patients were kept in wards and prepared for the procedures as per usual protocol. A nil-per-oral strategy was followed for a period of 06-08 hours before the procedure. On the day of procedure patients were shifted to operation theatre, followed by a second assessment of all the systems before commencement of the procedure. Noninvasive monitoring including pulse oximeter, non-invasive blood pressure cuff, temperature probe and electrocardiographic electrodes were attached to each patient for continuous monitoring intraoperatively. An intravenous line was placed in the upper limb and intravenous infusion of pediatric solution was administered to each patient as per the pre-procedure protocol. This was followed by premedication with injection maxolon @ 0.15mg/kg, injection dexa-methasone @ 0.1mg/kg, injection glycopyrrolate @ 0.01mg/kg and injection nalbuphine @ 0.1mg/kg. Preoxygenation was done for a period of 03 minutes to ensure denitrogenation, which was followed by induction of anesthesia. The induction was done using injection propofol @ 2mg/kg and after confirmation of adequate bag mask ventilation, a dose of muscle relaxant injection atracurium @ 0.5 mg/kg was administered to the patient. Once adequate muscle relaxation was achieved after a 03 mins period of ventilation, the participants were intubated using an endotracheal tube of adequate size. The appropriate size of the endotracheal tube was calculated by using the formula age+4/4. Non-cuffed tubes were used for the participants with age less than 8 years while cuffed tubes of 0.5mm size smaller than the size calculated using the formula was used for participants with age over 8 years. Maintenance of anesthesia was done using injection atracurium @0.1 mg/kg and isoflurane @1.2-2 MAC. Hemodynamic monitoring was carried throughout the procedure while maintaining normoxia, normocarbia, normovolemia, normothermia analgesia and adequate anesthesia as per the institutional protocol. At the end of surgical procedure administration of injection neopyrolate (neostigmine+ glycopyrrolate) at a dose of 0.04 mg/kg and 0.01mg/kg was done. Extubation was done at the commencement of purposeful body movements or obeying verbal commands. After extubation participants were shifted to post anesthesia care units for observation. Symptoms of respiratory difficulty like hoarseness, stridor or retraction of respiratory muscles were recorded as diagnostic for post intubation croup. History of upper respiratory tract

infection, demographic characteristics, operative time, trauma to airway as denoted by multiple intubation attempts were recorded. Based on the duration of surgery stratification of the participants was done and enrolled in Group-A if intubation time is <1hr while enrolment in Group-B was done for participants with intubation time >1hr.

Data was analyzed by using Statistical Package for Social Sciences (SPSS) version 23. Categorical variables were presented by percentages and frequencies and Chi-square test was applied.A *p*-value of ≤0.05 was considered as significant.

RESULTS

Out of 500 children 220 patients were recruited into Group-A and 280 patients were placed in Group-B. Gender distribution revealed a total of 334(66.8%) males as compared to 166(33.2%) females in total. ASA distribution of the patients revealed ASA I patients were 245(58.1%) vs 177(80.5%) in Group-A and Group-B respectively, while ASA II patients were 35(12.5%) vs 43(19.5%). Characteristics of the patients in both groups are shown in Table-I.

Table–I: Characteristics of the Participants (n=500)

Variables		Group-A (n=220) n(%)	Group-B (n=280) n(%)	*p*-value
Age (Years)	<01	30(10.7%)	30(13.6%)	0.090
	1-4	112(40%)	103(46.8%)	
	>04	138(49.3%)	87(39.5%)	
Gender	Males	193(68.9%)	141 (64.1%)	0.254
	Females	87(31.1%)	79(35.9%)	
ASA	ASA I	245(58.1%)	177(80.5%)	0.030
	ASA II	35(12.5%)	43(19.5%)	

A total of 12 patients developed croup among both groups. Prolonged intubation time was a significant risk factor leading to croup. In Group-B a total of 11(5%) out of 220 patients developed croup after extubation while only 01(0.4%) out of 280 participants in Group-A experienced post-extubation croup. Seven (58.3%) patients who developed croup were from the age group of 1-4yrs followed by 03(25%) patients with age greater than 04 years and 02(16.7%) patients with age group <1 year.

Effect of multiple intubation attempts recorded as traumatic intubation and history of upper respiratory infections were significant factors leading to croup after extubation, with a *p*-value of <0.01, which can be seen in Table-II.

Table–II: Effects of Variables on Post-Extubation Croup (n=500)

Variables		Post Extubation Croup Present n(%)	Post Extubation Croup Absent n(%)	*p*-value
Age (Years)	<01	02(16.7%)	58(11.9%)	0.043
	01-04	07(58.3%)	208(42.6%)	
	>04	03(25%)	222(45.5%)	
Gender	Males	07(58.3%)	327(67.0%)	0.005
	Females	05(41.7%)	161(33.0%)	
History of Upper Respiratory Tract Infection	Yes	06(50.0%)	19(3.9%)	< 0.001
	No	06(50.0%)	469(96.1%)	
Intubation time in hours	≤01	01(8.3%)	279(57.2%)	0.001
	>01	11(91.7%)	209(42.8%)	
Traumatic intubations	Yes	04(33.3%)	15(3.1%)	< 0.001
	No	08(66.7%)	473(96.9%)	

DISCUSSION

This prospective cohort trial was conducted in children who were undergoing elective genitourinary procedures under general anesthesia with a focus on intubation time causing post-extubation croup. The frequency of croup among participants was 12(2.4%) out of 500 participants. Out of the total 12 participants who developed croup 11(91.7%) had intubation time greater than 01 hour as compared to 01(8.3%) with intubation time less than 01 hour. Croup was mostly seen in 07(58.3%) participants with age ranging from 01 to 04 years. History of upper respiratory infection was a precipitant leading to croup in 06(50%) of the children. Out of 12 children who developed croup, 04(33%) participants had traumatic intubation signified by more than 01 x intubation attempts. Similar to the results produced by our study, Egbuta *et al.*, reveals that history of upper respiratory infections, traumatic intubations, inappropriate size endotracheal tubes, inadequate cuff leak test are the risk factors leading to post extubation croup in children undergoing intubations for procedures under general anesthesia.[12] In another retrospective trial when children with history of intubation were evaluated it was found that the time of intubation is a significant factor leading to croup. Out of 112 patients 50 patients developed croup with a median intubation time of 20.5 days as compared to 62 patients with a median intubation time of 06 days.[13]

When children remain intubated for a longer period of time there are greater chances of inflammation of the upper airway leading to higher risk of post-extubation airway edema. Another trial

revealed that most of the pediatric patients with post-extubation airway edema had a history of longer intubation times and traumatic intubations which led to croup.[14] Similar to our trial, the risk factors identified by Rutter *et al.*, revealed that upper respiratory infections, traumatic intubations, inadequate cuff leak test and younger age predisposes to the development of croup after extubation.[15]

Several trials with similar results reveal that when intubation was done for longer duration, there should be a higher index of suspicion. When intubated patients were evaluated the most common lesion was subglottic stenosis seen in 31% of the children with a higher duration of intubation (median duration of intubation >1 week).[16] One study revealed that in pediatric participants who underwent tracheostomy, 67% developed croup in the post-operative period and the identified risk factor was the prolonged duration (>21 days) of intubation in these patients.[17]

For safe approach to pediatric surgeries a balanced anesthetic technique and adequate knowledge of the risk factors predisposing to post-extubation croup is required. A number of trials have been conducted to identify the predisposing factors of croup and the results were similar to the those achieved by our study.[18] Hence our study reveals the importance of intubation time which can increase the frequency of post-extubation croup in pediatric age group undergoing genitourinary procedures.

LIMITATIONS OF STUDY

Being a single-centre study, our generalizability is limited. Regression analysis to identify predictors of croup should also be performed.

CONCLUSION

Intubation time greater than 01 hour in children undergoing genitourinary surgery increases the chances of post-extubation croup with a frequency of 5%. Younger age (1-4 years), traumatic intubations and history of upper respiratory tract infections are the identified risk factors of croup.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AA & SAMR: Data acquisition, data analysis, critical review, approval of the final version to be published.

MSS & KB: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MHS & MSF: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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