Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/7ehwqs98

THE PREVALENCE OF DIFFICULT AIRWAY AND ITS ASSOCIATED FACTORS IN PEDIATRIC PATIENTS WHO UNDERWENT SURGERY UNDER GENERAL ANESTHESIA: AN OBSERVATIONAL STUDY.

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Abstract:

Background: There are numerous anatomical, physiological, and clinical differences between pediatric and adult airway management. Airway obstruction in children is unquestionably a stressful situation for the medical staff and the patient's family.

Aim: The prevalence of difficult airway and its associated factors in pediatric patients who underwent surgery under general anesthesia.

Methods: This prospective observational study was performed on 62 children under two years of age that were presenting to pediatric emergency for elective surgery under general anesthesia with endotracheal intubation in SMGS Hospital Jammu. The parameters measured, including age, weight, height, stern omental distance (SMD), mouth opening (MO), neck circumference (NC), acromio-axillo-suprasternal notch index (AASI), and intubation difficulty scale score (IDS). The bivariate and multivariate logistic regression was used to measure the association between the dependent variable (pediatrics difficult airway) and independent variables. *p*-value <0.05 was used to declare statistical significance.

Results: In this prospective observational study, prevalence of difficult intubation with IDS > 4 was 14% and with IDS > 5 was 2%. The variables, including age, weight, height, and SMD, significantly predicted difficult intubation and cut-off points for these variables were age < 5 months, weight < 5.8 kg, height < 59 cm, and SMD < 5.3 cm respectively. Other variables, such as MO, AASI, NC, and gender, were unreliable predictors for difficult intubation.

Conclusion: Being pediatric patients less than 2 years of age, underweight pediatrics patients, having anticipated difficult airway, were identified as the main factors associated with the greater occurrence of difficult airway in pediatric patients. We found that IDS > 4, age< 5-month, weight < 5.8 kg, and SMD < 5.3 cm are predictors for difficult intubation. It is helpful for the anesthesiologist to measure these predictors before anesthesia is administrated to predict difficult intubation.

Keywords: Pediatrics, difficult airway, pediatric intubation, airway management

Introduction:

The act of securing the airway in pediatric patients is a crucial element of care in the perioperative setting, pediatric intensive care unit, and pediatric emergency room. Due to anatomical and physiological differences, the technique of mask ventilation, direct laryngoscopy, and endotracheal intubation is relatively more difficult in children. In addition, the time available to accomplish these tasks is lesser in pediatric patients than in adults. Even among pediatric anesthesiologists and intensive care physicians, who are trained in pediatric airway management, failure to manage the airway is one of the primary events leading to morbidity and mortality. The closed claims database of the American Society of Anesthesiologists (ASA) and the Perioperative Cardiac Arrest Registry demonstrate that respiratory complications are one of the most common causes for perioperative morbidity and mortality in children. [1,2]

There has been a significant difference between the prevalence and severity of difficult airway complications in predictable and unpredictable cases in several studies. Paying attention to these predictive factors and performing safe intubation in children under two years of age reduces the complications of the difficult airway. [3-7] In previous studies on adults, some anatomical scales, such as acromio-axillo-suprasternal notch index (AASI), sternomental distance (SMD), mouth opening (MO), and neck circumference (NC) have been reported as reliable predictors of difficult airways and intubation. [8, 9] Hence, we planned to conduct a study to know the prevalence of difficult airway and associated risk factors in children undergoing surgery under general anesthesia.

Methods:

This observational sectional study was conducted in SMGS Hospital Jammu. The study participants were pediatric patients under two years of age that were presenting to pediatric emergency for elective surgery under general anesthesia. After getting approval from institute ethical committee, all parents signed the written informed consent. A total of 62 patients with the American Society of Anesthesiologists physical status I & II scheduled for surgery under general anesthesia with endotracheal intubation were included in this prospective observational study. Inclusion criteria were all children under two years of age and candidates for elective surgery under general anesthesia with endotracheal intubation. Exclusion criteria, previous neck surgery, previous head and neck radiotherapy, patients with a neck mass, and patients with contraindications of neck movement.

The parameters measured, including age, weight, height, sternomental distance (SMD), mouth opening (MO), neck circumference (NC), acromio-axillo-suprasternal notch index (AASI), and intubation difficulty scale score (IDS).

All the patients included in the study were pre-medicated with Injection glycopyrollate 6mcg/kg(im) and syrup Triclofos 20mg/kg (orally) one hour before surgery.

In operation theater, to set up an intravenous line, gaseous induction was done uniformly with oxygen and sevoflourane (4-8%) mask.

All the patients meeting the selection criteria underwent surgery with general anesthesia. The anesthesia protocol included propofol at dose of 2mg per kg, fentanyl at 2mcg per kg bolus and atracurium at 0.5 mg per kg body weight.

In all patients, surgery was carried out under general anesthesia with endotracheal intubation, vital parameters (pulse rate, blood pressure, spo2) were recorded during intraoperative period.

After controlling the vital signs and condition of the patient, the four predictive test measurements were accomplished by two trained anesthesiologists on all patients as follows:
1-AASI: a) A line was drawn vertically from the top of the acromion process to the superior border of the axilla at the pectoralis major muscle named as line A.
b) The second line was drawn perpendicular to line A from the suprasternal notch named line B.
c) Line C was defined as the portion of line A laid above where line B bisects line A. AASI was calculated as the ratio of c to A (C/A) .
2- SMD: SMD extension was measured as the straight distance from the upper border of the manubrium sterni to the mentum, with the head in full extension and the mouth closed.
3- MO: The distance between the upper and lower incisors at the midline when the mouth was opened.
4- NC: Neck circumference at the level of the cricoid cartilage was measured.

The laryngoscopic view was graded with Cormack-Lehane (CL) grading system, which contains four grades: I: vocal cords visible, II: only posterior commissure or arytenoids visible, III: only epiglottis visible, and IV: none of the preceding visible. Difficult visualization of the larynx (DVL) was defined as CL III or IV views on direct laryngoscopy, and easy visualization of the larynx (EVL) was defined as CL I or II views on direct laryngoscopy.

The IDS score was determined according to scientific criteria so that a value equal to zero indicated intubation in ideal conditions. Patients were divided into two groups based on IDS; patients with IDS≥ 4 were assigned to the difficult intubation group and patients with IDS < 4 were assigned to the easy intubation group.

Statistical analysis:
After collecting information, to analyze and compare the variables in the study groups, SPSS software version 25 was used using descriptive statistics, such as indicators of central tendency and also analytical statistics, including, Spearman's rank correlation coefficient, and Mann-Whitney U test were used. In all tests, a significant level of 0.05 was considered.

Results:
A total of 62 pediatrics patients were included in this study. The prevalence of difficult airway in pediatrics patients who underwent surgery was 16.12%. Children under two years of age were examined, of whom 41 cases (66.12%) were boys, and 21 cases (33.87%) were girls. The age range of children was from 2 days to 24 months, with an average of 9.4 months and a standard deviation of 6.6 months. 10 children (16.12%) had difficult intubation while as 52 cases (83.87%) had easy intubation [Table 1].

Table: Demographic profile among the study population

Variables	Mean ±SD (%)
Age	**9.3±6.5**
Sex M/F	**66.12/33.87**
Difficult intubation	**16.12**
Easy intubation	**83.87**

The age < 6month, weight < 5/9 kg, and height < 61 cm were predictors of difficult intubation in children. Based on the area under the curve, age, weight, height were significant predictors for easy and difficult intubation (P < 0.001) [Table 2]. Although the values of SMD and NC were statistically significant, they had a small area under the curve and were ignored (Figure 1).

Table 2: Evaluation of Quantitative Variables Based on Easy and Difficult Intubation

Variables	Easy intubation	Difficult intubation	P Value
Age	9.9±5.5	6.2±4.3	<0.001
weight	7.8±2.4	5.8±2.6	<0.001
Height	68.3±10.1	60.3±10.8	<0.001
SMD	5.8±1.2	5.2±1.2	<0.001
MO	2.4±1.3	2.2±0.7	0.758
AASI	35.8±18.1	39.7±14.6	0.09
Neck circumference	19.8±2.2	20.1±3.1	0.671

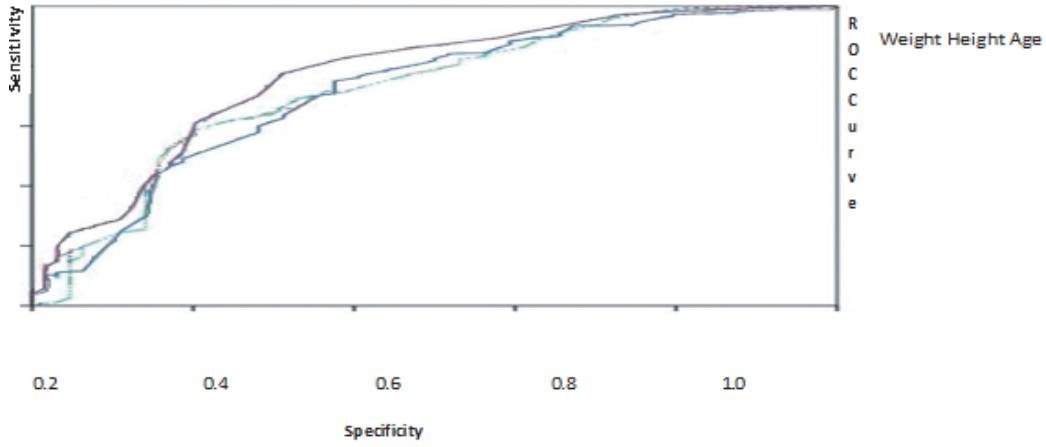

Fig 1.

Discussion:

Pediatrics patients have relatively more difficult MV, direct laryngoscopy, and endotracheal intubation as compared to adults. [10,11,12] The intubation difficult scale is a blend of subjective and objective criteria that permit a qualitative and quantitative approach to the progressive nature of the difficulty of intubation.[13]

Difficult airways can be anticipated and unanticipated. The latter situation is undoubtedly more stressful for medical professionals and prone to errors, as teams often need to be prepared and ready with equipment. Although unanticipated tracheal intubations have more severe complications and require more attempts, studies show that most difficult airways in children are, in fact, predictable. Anticipated situations may result from congenital syndromes and anatomical airway dysfunctions. [14, 15] In addition, children with pre-existing respiratory risk factors have an increased likelihood of critical respiratory events (regardless of the airway device used). Therefore, such factors require better preoperative assessment and planning. [16]

In our study the incidence of difficult intubation was about 16.12%, which is higher than previous studies. In a study on 1,018 children with difficult airways, the intubation failure rate was reported to be 2%. [15] In our referral hospital, children with cleft lip and palate were included in our study; thus, the frequency of difficult intubation was higher than in other studies. Also, the age < 6 month, weight < 5/9 kg, and height < 61cm were predictors of difficult intubation in children. Our results were similar to those found in anesthesia reference books . [17,18,19]

Baudouin et al. showed that the Mallampati test and mouth opening were not predictive tests for difficult intubation in children less than 18 months. [20] Aggarwal et al.found that the interincisor

gap (MO) seemed to be an inadequate predictor of difficult intubation in children. [21] These results are similar to our study and showed MO (P value = 0.01) with no significant predictive value for difficult intubation.

Kılıç et al. showed that interincisior distance is a predictor for difficult intubation in children. [22] The reason for the difference between the results of their study with ours is that the average age of their study population was more than our study (six years vs. nine months).

In this study, we found that in children less than two years, AASI was not a predictor for difficult intubation (P value = 0.09). This finding is contrary to what has been emphasized in adult studies. [23, 24] The reason for this difference could be due to the difference in the anatomy of the upper respiratory tract and the fitness of the body in children compared to adults.

Our findings showed that SMD (mean ± SD = 5.2± 1.2, P value < 0.001) and NC (mean ± SD = 20.1 ± 3.1, P value <0.001) were not strong predictors. This finding is similar to previous studies reporting that SMD may be a predictor for difficult intubation in children under two years . [22, 25]

Also, Figueroa-Uribe et al. studied the existing difficult airway predictive scales and their possible applicability in pediatric patients in the emergency department and showed that SMD was not helpful. [26]

Our study showed that small age (0–2 years), underweight children, anticipated difficult airway from history and physical examination, children who had difficult airway history, and anesthesiologists who do not perform enough pediatric cases also will have difficulties in managing difficult airway (less than 4 years of experience) had a significant association with a difficult airway. In line with our finding, a study done in the pediatric intensive care unit showed that a history of difficult airways and less experienced providers were associated with difficult airways. [27]

Conclusion:

Being pediatric patients less than 2 years of age, underweight pediatrics patients, having anticipated difficult airway, were identified as the main factors associated with the greater occurrence of difficult airway in pediatric patients. We found that IDS > 4, age< 5-month, weight < 5/8 kg, and SMD < 5/3 cm are predictors for difficult intubation. It is helpful for the anesthesiologist to measure these predictions before anesthesia is started to find who has difficult intubation.

Conflict of interest: Nil

Funding: Nil

References:

1. Jimenez N, Posner KL, Cheney FW, Caplan RA, Lee LA, Domino KB. An update on pediatric anesthesia liability: a closed claims analysis. Anesth Analg 2007;104(01):147–153.
2. Ramamoorthy C, Haberkern CM, Bhananker SM, et al. Anesthesia related cardiac arrest in children with heart disease: data from the Pediatric Perioperative Cardiac Arrest (POCA) registry. Anesth Analg 2010;110(05):1376–1382.
3. Onal O, Gumus I, Sari M, Zora ME, Acar MA. The Obv-Eas Method: An Easy Way to Facilitate Fiberoptic Intubation in Pediatric Patients: Case of an Infant with Freeman-Sheldon Syndrome. *Anesth Pain Med*. 2018;**8**(5).
4. Coté CJ, Hartnick CJ. Pediatric transtracheal and cricothyrotomy airway devices for emergency use: which are appropriate for infants and children? *Paediatr Anaesth*. 2009;**19 Suppl 1**:66–76.
5. Thomas R, Rao S, Minutillo C. Cuffed endotracheal tubes for neonates and young infants: a comprehensive review.*Arch Dis Child Fetal Neonatal Ed*. 2016;**101**(2):F168–74.

6. Dennington D, Vali P, Finer NN, Kim JH. Ultrasound confirmation of endotracheal tube position in neonates.*Neonatology*. 2012;**102**(3):185– 9.
7. Honarmand A, Kheirabadi D, Safavi MR, Taghaei M, Golshani Nasab M. Comparison of the acromio-axillosuprasternal notch index with five anatomical indices for the prediction of difficult laryngoscopy and intubation. *Eur J Anaesthesiol*. 2019;**36**(7):542–4.
8. Honarmand A, Safavi M, Yaraghi A, Attari M, Khazaei M, Zamani M. Comparison of five methods in predicting difficult laryngoscopy: Neck circumference, neck circumference to thyromental distance ratio, the ratio of height to thyromental distance, upper lip bite test and Mallampati test. *Adv Biomed Res*. 2015;**4**:122.
9. Krishna SG, Bryant JF and Tobias JD. Management of the difficult airway in the pediatric patient. *J Pediatr Intensive Care* 2018; 7(3): 115–125.
10. Huang AS, Rutland L, Hajduk J, et al. Difficult airway management of children in ambulatory anesthesia: challenges and solutions. *Ambul Anesth* 2016; 3: 37–45.
11. Chambers N, Ramgolam A, Sommerfield D, et al. Cuffed vs. uncuffed tracheal tubes in children: a randomised controlled trial comparing leak, tidal volume and complications. *Anaesthesia* 2018; 73(2): 160–168.
12. Seo S-H, Lee J-G, Yu S-B, et al. Predictors of difficult intubation defined by the intubation difficulty scale (IDS): predictive value of 7 airway assessment factors. *Korean J Anesthesiol* 2012; 63(6): 491–497.
13. Aggarwal A, verma uc. Evaluation of difficult airway predictors in pediatric population as a clinical investigation. Journal of Anesthesia & Clinical Research. 2012; 03(11).
14. Sohn L, Peyton J, von Ungern-Sternberg BS, et al. Error traps in pediatric difficult airway management. Paediatr Anaesth. 2021; 31(12): 1271–1275.
15. Engelhardt T, Virag K, Veyckemans F, et al. APRICOT Group of the European Society of Anaesthesiology Clinical Trial Network. Airway management in paediatric anaesthesia in Europe-insights from APRICOT (Anaesthesia Practice In Children Observational Trial): a prospective multicentre observational study in 261 hospitals in Europe. Br J Anaesth. 2018; 121(1): 66–75.
16. Fiadjoe JE, Nishisaki A, Jagannathan N, Hunyady AI, Greenberg RS, Reynolds PI, et al. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis. *Lancet Respir Med*. 2016;**4**(1):37–48.
17. Coté CJ, Hartnick CJ. Pediatric transtracheal and cricothyrotomy airway devices for emergency use: which are appropriate for infants and children? *Paediatr Anaesth*. 2009;**19 Suppl 1**:66–76.
18. Gropper MA, Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, et al. *Miller's Anesthesia, 2-Volume Set E-Book*. Elsevier Health Sciences; 2019.
19. Davis PJ, Cladis FP. *Smith's anesthesia for infants and children e-book*. Elsevier Health Sciences; 2016.
20. Baudouin L, Bordes M, Merson L, Naud J, Semjen F, Cros AM. Do adult predictive tests predict difficult intubation in children?: A-627. *Eur J Anaesthesiol*. 2006; **23:163**.
21. Aggarwal A, Sharma KR, Verma UC. Evaluation of difficult Airway predictors in pediatric population as a clinical investigation. *J Anesth Clin Res.* 2012;**3**(11):1–5.
22. Kılıç Y, Onay M, Çetinkaya D, Bilir A, Yelken BB. Comparison of different predictive tests for difficult airways in pediatrics. *ENT Update*. 2020;**10**(3).
23. Sumer D, Cham D, Raipure D, et al. Evaluation of difficult airway in paediatric population ranging from 5-12 years age group. International Journal of Medical Research and Review. 2019; 7(5): 411–421.
24. Yemam D, Melese E, Ashebir Z. Comparison of modified mallam pati classification with Cormack and Lehane grading in predicting difficult laryngoscopy among elective surgical

patients who took general anesthesia in Werabie comprehensive specialized hospital - Cross sectional study. Ethiopia, 2021. Ann Med Surg (Lond). 2022; 79: 103912.

25. Ray S, Rao S, Kaur J, Gaude YK. Ratio of height-to-thyromental distance and ratio of height-to-sternomental distance as predictors of laryngoscopic grade in children. *J Anaesthesiol Clin Pharmacol*. 2018;**34**(1):68–72.
26. Figueroa-Uribe F, Flores-del Razo JO, Vega-Rangel V, Méndez-Trejo V, Ferrer-LópezM, González-Chávez NA. Predictive scales to identify difficult airway in the pediatric population: usefulness in the Emergency Department. *Revista Mexicana de Pediatría*. 2020;**86**(4):162–4.
27. Graciano AL, Tamburro R, Thompson AE, et al. Incidence and associated factors of difficult tracheal intubations in pediatric ICUs: a report from National Emergency Airway Registry for Children: NEAR4KIDS. *Intensive Care Med* 2014; 40(11): 1659–1669.