Original
Research

Citation: Nanayakkara S, Nanayakkara SDI & Wijekoon P, et al., 2021. Do conventional predictors of "Difficult airway" truly predict difficult airway? Experience with cleft surgeries. Sri Lanka Journal of Medicine, 30(1), pp 53-61
DOI: <http://doi.org/10.4038/sljm.v30i1.244>

Do conventional predictors of "Difficult airway" truly predict difficult airway? Experience with cleft surgeries

Nanayakkara S¹, Nanayakkara SDI², Wijekoon P³ & Sewwandi C⁴

¹Senior Lecturer, Department of Anaesthesiology and Critical Care Medicine

²Senior Lecturer, Department of Physiology, Faculty of Medicine

³Senior Lecturer, Department of OMF Surgery, Faculty of Dental Sciences, University of Peradeniya

⁴Nursing Student, Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya

Correspondence: Saman Nanayakkara
Senior Lecturer, Department of
Anaesthesiology and Critical Care Medicine
Email: nsaman@y7mail.com

<https://orcid.org/0000-0001-7832-9621>

Abstract

Background: We designed this prospective observational study in order to evaluate whether conventional predictors of "Difficult airway" truly predict difficult airway in patients who present for cleft surgeries at Cleft Centre Peradeniya.

Methods: One hundred and two babies between the ages of 2 months to 18 months who underwent cleft lip or palate repairs at Cleft centre, Peradeniya August 2015 to April 2016 were included in the study. For each of the patients, we gave a grade for the degree of mouth opening and the laryngoscopic view prior to surgery.

Results: Out of the 102 participants, 9.8% of patients had difficult laryngoscopy. At least one out of seventeen studied "predictors of difficult airway," was found in seven patients out of the 10 in whom laryngoscopy was difficult. There was a significant association of difficult laryngoscopy with reduced mouth opening. Furthermore, factors such as the presence of microstomia, micrognathia, retrognathia, and short neck were significantly associated with difficult laryngoscopy in Cleft Lip and Cleft palate patients who underwent surgical repair.

Keywords: *airway, laryngoscopy, cleft surgery, anaesthesia*

INTRODUCTION

Cleft deformities are considered the most common craniofacial abnormality, [1,2] with the incidence being 1 in 600 to 700 live births in the world [3,4] and cleft palate alone being 1 in 2000 live births. [4] In Sri Lanka, cleft abnormalities occur at a rate of

0.83 per 1000 live births. [5] Generally, cleft lip repair and cleft palate repair are carried out at 4-5 months and 9-12 months respectively. [6] Establishing airway is always a challenge in paediatric anaesthetic practice. Unique

differences in the anatomy of neonatal and paediatric airways make airway access more technically difficult than in an adult. [7] Difficult airway access leading to delays in establishing the airway together with a higher oxygen consumption rate and limited body oxygen reserves due to a lower functional residual capacity makes a paediatric patient vulnerable for hypoxia during induction of anaesthesia. The smaller the child the greater the differences in the airway compared to an adult. Small dimensions of the airway, anteriorly and higher placed larynx guarded by a long and intrinsically floppy epiglottis with a short neck, disproportionately large tongue with a small mandible and narrow cricoid makes pediatric airway management very difficult. Moreover, the presence of congenital airway abnormalities and craniofacial anomalies further complicate pediatric airway management. [7] Furthermore, multiple tracheal intubation attempts, with inadequate oxygenation in-between the attempts ending in a failed or delayed intubation have resulted in adverse consequences such as hypoxemic brain damage, cardiac arrests, and even deaths. [8,9,10,11]

The incidence of difficult laryngoscopy in cleft surgeries varies across different studies from 4.77% [12] to 7.38 %. [13] However, a clear comparison of figures and management among different centres cannot be done easily as the patient age, airway characteristics and intubation techniques differ widely. Previous researchers have revealed factors associated with an increase of airway complications and difficult intubation. These factors are mostly anatomical such as those deformities making it difficult to place the laryngoscope blade [14], the presence of associated facial deformities such as micrognathia [12,15] and retrognathia. [13] Literature is also available to indicate that there is a higher risk of difficult airway occurring in bilateral cleft lips. [12,13]

The occurrence of difficulty in intubation continues to pose a major problem for anaesthetists since it leads to considerable morbidity and mortality. [16] Therefore, it is essential to identify pre-operatively, patients in whom intubation may become difficult. There are bedside tests like Mallampati test modified by Samsoon & Young,

Head extension at Atlanto-Occipital joint, Thyromental distance, Sterno-mental distance. Delilkan's sign that may provide clues about possible difficult intubation. [17,18]. However, these bedside tests cannot be properly performed in children and infants. Moreover, those tests are not sensitive or specific enough for routine use. [19]

We felt that there was a need to look for predictors of difficult laryngoscopy in paediatric patients presenting for cleft lip and palate repairs. "Predictors of difficult airway" are helpful to identify or anticipate a difficult airway prior to anaesthesia and to be prepared to tackle it. This would help to perform surgery with minimal anaesthetic complications. Previous research was done at our Cleft centre Peradeniya, Sri Lanka from 1985 – to 1994[13] where 800 cleft lip and palate repair surgeries were studied, reported that the incidence of difficult laryngoscopy (Cormack & Lehane Grades III and IV) was 2.95% in unilateral cleft lips, 45.76% in bilateral cleft lips and 34.61% in patients with retrognathia. They reported a significant positive association with the difficult laryngoscopic view when the age of the patient was less than 6 months. Tracheal intubation was reported as being successful in 99% of the sample and the difficulty with intubation was reported to have been overcome by the administration of muscle relaxant drugs. As this study was performed more than 25 years ago and the anaesthetic techniques, patient monitoring and drugs used have made a significant advancement since then, we felt that it was time to perform this study.

Therefore, we designed the present study in order to evaluate whether conventional predictors of "Difficult airway" truly predict difficult airway in patients who present for cleft surgeries at Cleft Centre Peradeniya.

METHODOLOGY

Babies between the age of 2 months to 18 months who underwent cleft lip or palate repairs at Cleft centre, Peradeniya August 2015 to April 2016 were included in the study. Patients who had asleep fiberoptic intubations, intubation with drugs other than Sevoflurane and Atracurium, and with non-

congenital cleft lips and palates (those due to trauma and infections), were excluded.

Ethical review committee approval was obtained from the Faculty of Dental Sciences, University of Peradeniya. Patients were assessed preoperatively for the presence of seventeen predictors of difficult airway - micrognathia, retrognathia, macroglossia, microstomia, facial asymmetry, obesity, short neck, difficult neck extension, shoulder hump, and neck fat pads were some of

them. Patients' mouth opening was assessed by a method similar to the Mallampati test. Since it was difficult to get the patient to open the mouth on request, mouth opening was assessed by opening the mouth with two fingers of the observer or in older children when they cried.

The degree of mouth opening was assessed on a scale mentioned below (similar to the Mallampati classification).

Class I: Uvula, faucial pillars and pharyngeal wall seen.

Class II: Soft palate and base of the uvula seen.

Class III: Only soft palate seen.

Class IV: Soft palate not seen.

Class I and Class II were considered as normal Airways and Class III and Class IV were considered as "Possible Difficult Airways".

Anaesthesia was induced and maintained with Sevoflurane and oxygen. Laryngoscopy was performed by an anaesthetist using a laryngoscope with a size 2 mackintosh-curved blade after achieving muscle paralysis with intravenous Atracurium 0.5mg/kg body weight.

The laryngeal view obtained was classified according to 'Cormack and Lehane' classification. Grade I is a full view of the glottis, grade II is a

partial view of the glottis and full view of the epiglottis, grade III is no part of the glottis visible and only the epiglottis is visible and grade IV is a visualization of only the soft palate with no view of the glottis or the epiglottis. Results of Laryngoscopic views were classified as "easy", for laryngoscopic views of grade I and grade II and as "difficult", for laryngoscopic views of grade III and IV.

Grade I - Full view of the glottis

Grade II - Full view of the epiglottis and only partial view of the glottis

Grade III - No part of the glottis is visible, only the epiglottis is visible

Grade IV- neither glottis nor epiglottis is seen, only the soft palate is seen

The laryngoscopic view was assessed just before intubation. An attempt was made, therefore, to assess the degree of correlation between the degree of mouth opening during the preoperative assessment and the laryngoscopic view grades observed during anaesthesia.

Using G-power statistical software, minimum total sample size of 60 was obtained (Effect size-0.2, α significance level- 0.05 and the power of the study - 80% were used). Assuming 15% of dropout rate for the study, the final sample size is adjusted to achieve the target statistical significance given by the hypothesis.

Data were analyzed using SPSS version 22 for windows. Numerical data were expressed as mean

$\pm$ SD while categorical data was expressed as frequencies. Tests of significance (*t*-tests, *chi-square* tests, and *Fisher's exact test*) were used as appropriate. A p-value of < 0.05 was considered statistically significant.

RESULTS

A total of 102 patients participated in this study and 55 were males. Their ages ranged from 3 months to 18 months. In the study sample of 102 patients, 47 underwent cleft lip repair and 55 underwent cleft palate repair surgery. The basic characteristics of the patients who underwent cleft palate and cleft lip repair surgeries are summarized in table 1.

Table 1: The basic features of the two groups of patients who underwent cleft lip repairs and cleft palate repairs

Type of surgery	n	Age (months)	Weight (kg)
Cleft lip repair	47	4.3 $\pm$ 0.2	4.25 $\pm$ 0.9
Cleft palate repair	55	9.5 $\pm$ 0.6	7.89 $\pm$ 1.1
Whether significantly different (p value)		< 0.001	< 0.001

The degree of mouth opening and the laryngoscopic view of all 102 patients were as shown in table 2. It was noted that all of the patients who had mouth opening class I, had laryngoscopic view of grade I. All of the patients who had mouth opening class I or II had laryngoscopic view of grade I or grade II. All of the

patients, who had mouth opening class III, had laryngoscopic view of grade III. Out of the three patients who had mouth opening class IV, two had laryngoscopic view of grade IV. The Fishers exact test ($p = 0.0048$) proved that there was a significant association between the mouth opening class and the laryngoscopic view grade.

Table 2: Mouth opening Classes and the Laryngoscopic view -Grades of the 102 patients

Grade/Class	Mouth opening Class	Laryngoscopic view Grade
I	36	55
II	57	37
III	7	8
IV	3	2

We studied 17 conventional predictors of difficult laryngoscopy in the sample of 102 patients who presented for surgery. Figure 2 indicates the factors which were tested and found to be present

in patients with difficult laryngoscopy and intubation. They included microstomia, facial asymmetry, short neck, micrognathia, and retrognathia.

Figure 1: Percentage of occurrence of each of the predictors of difficult airway in the 102 patients studied

When we separated the patients who had difficult laryngoscopy and looked at the presence or

absence of the above predictors of laryngoscopy there were some interesting observations. At least

one out of the five features mentioned above was found in 7 out of 10 patients in whom laryngoscopy was difficult (grades III or IV). It was also found that difficult laryngoscopy was significantly associated with poor mouth opening (Figure 3).

Figure 2: The presence or absence of the predictors of difficult airway in the patients who had difficult laryngoscopy

Figure 3: The presence of difficult or easy laryngoscopy in the two groups who had good mouth opening and poor mouth opening

When each of the difficult airway predictors were studied separately in the total sample of 102 patients, it was possible to do a Fishers exact test to see whether each of these predictors had a significant association with difficult laryngoscopy.

Figure 6 shows that four out of the five predictors which were present in our sample had a significant association with difficult laryngoscopy. They were namely microstomia, micrognathia, retrognathia, and the presence of a short neck.

Figure 4: The presence or absence of each predictor of difficult airway compared to easy or difficult laryngoscopy in the 102 patients studied (p value indicates the result of the Fishers exact test for each feature

DISCUSSION

We attempted to find out whether the conventional predictors of difficult airway truly predicted the difficulty in intubation in patients who presented for cleft repair surgeries. We studied 102 patients with 47 of them presenting for cleft lip repair surgeries while the rest were for cleft palate repairs. We found that at least one predictor of difficult airway occurred in seven patients out of 10 in whom laryngoscopic view was grade III or IV hence referred to as “Difficult Laryngoscopy”.

Among the 102 participants, 10 had “Difficult Laryngoscopy” (Laryngoscopic view grades 3 and 4), hence 9.80% of patients - had difficult laryngoscopy. This is a fairly high percentage compared to what was observed in the previous studies like 4.7-7.38%. [13].

Difficult airway is defined as “a clinical situation in which a conventionally trained anaesthesiologist experiences difficulty with facemask ventilation of the upper airway and/or difficulty with tracheal intubation or both.” Difficult airway represents a complex interaction between patient factors, clinical setting and skills of the anaesthetist. Patient Factors include the degree of Mouth opening, ability to view pharyngeal structures, condition of teeth (in adult patients), the anatomy of chin and neck, degree of head extension, degree of neck flexion, Thyro-mental distance, Mento-hyoid distance, obesity, and short neck.

A practice adopted in earlier anaesthetics in cleft lip and palate surgeries was to induce anaesthesia with Halothane and then to intubate 30 seconds after intravenous Suxamethonium 1mg/kg (a depolarizing muscle relaxant) to achieve muscle relaxation. Gunawardena’s [13] practice was to induce anaesthesia with Halothane and to intubate

after deepening anaesthesia with Halothane. With the current practice we followed, patients were intubated 3 min after administering intravenous Atracurium 0.5mg/kg a non-depolarizing muscle relaxant. The induction agent used was Sevoflurane, which gives a more rapid and smoother induction of anaesthesia.

Possible reasons for the observed increase in the occurrence of difficult airway in this study compared to Gunawardena's and other studies could be one of two. Firstly, more and more patients with difficult airways are being referred from other hospitals to Cleft centre at Teaching Dental Hospital Peradeniya now, hence a higher incidence of difficult airways is being encountered. Secondly, the use of Suxamethonium in the previous groups would have given a better degree of muscle relaxation, and therefore, a better laryngoscopic view. It is a known fact that Suxamethonium gives the optimum conditions for endotracheal intubation than any of the other muscle relaxants.

Evaluating some of the predictors of difficult airways in paediatric patients was extremely difficult, as the patients cannot follow instructions given by an investigator. eg Mallampati test or Delilkan's sign. Moreover, even simple mouth opening and tongue protrusion were very difficult with patients of this age group. In some patients, an observer had to wait for a long time till a child opened the mouth, or had to observe it when a child cried. However, these signs/parameters have not been validated properly for paediatric patients in previous studies.

The Mallampati test gives an idea about the degree of mouth opening and the ability to view the back of the pharynx. The mouth opening test we did, was also to get an idea about how easy or difficult it would be to perform laryngoscopy and intubation. The degree of mouth opening was put on a scale of grades 1- 4, similar to that of Mallampati.

One drawback of the present study is that our sample is considerably smaller than the sample used by Gunawardane [13]. Therefore, we should be cautious in drawing definite conclusions regarding the importance of other predictive factors and difficulty in performing

laryngoscopy/intubation in cleft lip and palate surgeries.

CONCLUSION

Among the 102 participants, 10 patients had 'Difficult Laryngoscopy (Laryngoscopic view grades 3 and 4), hence 9.8% of patients have had difficult laryngoscopy. At least one out of seventeen studied "predictors of difficult airway," was found in seven patients out of 10 in whom laryngoscopic view was grade 3 or 4 hence in expected Difficult Laryngoscopy. There was a significant association of the presence of microstomia, micrognathia, retrognathia, and short neck with difficult laryngoscopy in our sample. We also found that there was a significant association between the degree of mouth opening and the occurrence of difficult airway in Cleft Lip and Cleft palate patients.

Author declaration

Acknowledgements

We thank all the participants and their parents, the medical officers and the nursing staff for the cooperation extended to us during the study.

Author Contributions

All authors contributed for conception and design of the work, and the analysis, and interpretation of data for the study. Data collection was carried out by Saman Nanayakkara (SN) and Chandima Sewwandi (CS). All authors provided final approval of the version to be published.

Funding sources

None

Availability of data and materials

All data is available with the authors for submission upon request.

Ethics approval and consent to participate

Ethical clearance was obtained from the Faculty of Allied Health Sciences, University of Peradeniya. Informed written consent was obtained from the parents of the babies.

Competing interests

None

REFERENCES

1. Augsornwan D, Pattangtanang P, Pikhunthod K, Surakunprapha P. Post-operative pain in patients with Cleft Lip and Palate in Srinagarind Hospital. *J Med Assoc Thai*. 2011 Dec;94 Suppl 6:S124-8. PubMed PMID: 22423427.
2. Hujoel PP, Bollen AM, Mueller BA. First-year mortality among infants with facial clefts. *Cleft Palate Craniofac J*. 1992 Sep;29(5):451-5. DOI:10.1597/1545-1569_1992_029_0451_fymaiw_2.3.co_2. PubMed PMID: 1472525
3. Mossey PA, Catilla EE. Global registry and database on craniofacial anomalies: Report of a WHO Registry Meeting on Craniofacial Anomalies. World Health Organization. Geneva, Switzerland. 2003. DOI: <https://apps.who.int/iris/handle/10665/42840>
4. Law RC, de Klerk C. Anesthesia for cleft lip and palate surgery. Update in Anaesthesia. 2002;14: 27–30.
5. Amaratunga AN, Chandrasekara A. Incidence of cleft lip and palate in Sri Lanka. *J Oral Maxillofac Surg*. 1989 Jun;47(6):559-61. DOI: 10.1016/s0278-2391(89)80066-7. PubMed PMID: 2723852
6. Chen PKT. Chang Gung Technique of Unilateral Cleft Lip Repair. In *Cleft Lip and Palate Primary Repair*. 2013; 105-158. Springer, Berlin, Heidelberg. DOI: 10.1007/978-3-642-38382-3_7
7. Ahmad, I.N. and Liming, B.J., 2020. Direct laryngoscopy assisted fiberoptic intubation: A novel technique for the pediatric airway. *Int J Pediatr Otorhinolaryngol*. 2020. DOI: 10.1016/j.ijporl.2020.110232. PMID: 32896347
8. Morray, J.P., Geiduschek, J.M., Caplan, R.A., Posner, K.L., Gild, W.M. and Cheney, F.W., 1993. A comparison of pediatric and adult anesthesia closed malpractice claims. *Anesthesiology*. 1993 Mar;78(3):461-7. DOI: 10.1097/0000542-199303000-00009. PubMed PMID: 8384428
9. Graciano, A.L., Tamburro, R., Thompson, A.E., Fiadjoe, J., Nadkarni, V.M. and Nishisaki, A., 2014. Incidence and associated factors of difficult tracheal intubations in pediatric ICUs: a report from National Emergency Airway Registry for Children: NEAR4KIDS. *Intensive care medicine*, 40(11), pp.1659-1669. DOI: 10.1007/s00134-014-3407-4. PubMed PMID: 25160031
10. Fiadjoe, J.E., Nishisaki, A., Jagannathan, N., Hunyady, A.I., Greenberg, R.S., Reynolds, P.I., Matuszczak, M.E., Rehman, M.A., Polaner, D.M., Szmuk, P. and Nadkarni, V.M., 2016. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis. *The Lancet Respiratory Medicine*, 4(1), pp.37-48. Epub 2015 Dec 17. DOI: 10.1016/S2213-2600(15)00508-1. PMID: 26705976
11. Mamie, C., Habre, W., Delhumeau, C., Barazzone Argiroffo, C. and Morabia, A., 2004. Incidence and risk factors of perioperative respiratory adverse events in children undergoing elective surgery. *Pediatric Anesthesia*, 14(3), pp.218-224. DOI:10.1111/j.1460-9592.2004.01169.x
12. Xue, F. S., Zhang, G. H., Li, P., Sun, H. T., Li, C. W., Liu, K. P., Tong, S. y., Liao, X. & Zhang, Y. M. (2006). The clinical observation of difficult laryngoscopy and difficult intubation in infants with cleft lip and palate. *paediatric anaesthesia*. 16: 283-289. DOI:10.1111/j.1460-9592.2005.01762.x
13. Gunawardana (1996). Difficult laryngoscopy in cleft lip and palate surgery. *British Journal of Anaesthesia*. 76: 757-759. Volume 76, Issue 6, June 1996. DOI: 10.1093/bja/76.6.757
14. Nargozian, C. (2004). The airway in patients with craniofacial abnormalities paediatric anaesthesia. 14: 53-59. DOI:10.1046/j.1460-9592.2003.01200.x
15. Frilles, T., Homann, C., Meyer, U., Reich, A., Joos, U. & Werkmeister, R. (2007). Perioperative complications in infant cleft repair *Head & Face Medicine*. 3: 9. DOI: 10.1186%2F1746-160X-3-9
16. King, T. A. & Adams, A. P. (1990). Failed tracheal intubation. *British Journal of Anaesthesia*. 65: 400-414. DOI: 10.1093/bja/65.3.400
17. Mallampati, S. R., Gatt, S. P., Gugino, L. D., Desai, S. P., Waraksa, B., Frieberger, D. & Liu, P. L. (1985). A clinical sign to predict difficult tracheal intubation: A prospective study. *Can Anaesth Soc J*. 1985 Jul;32(4):429-34. DOI: 10.1007/BF03011357. PMID: 4027773
18. Wilson, M. E., Spiegelhalter, D. & Robertson, J. A. (1988). Predicting difficult intubation. *British Journal of Anaesthesia*. 61: 211-216. DOI: 10.1093/bja/61.2.211
19. Charters, P., Perera, S. & Horton, W. A. (1987). Visibility of pharyngeal structures as a predictor of difficult intubation. *Anaesthesia*. 42: 1115. DOI: 10.1111/j.1365-2044.1987.tb05182.x. PMID: 3688398
20. J. A. Stirt, R. L. Katz, D. L. Schehl, C. Lee. Atracurium for intubation in man: A clinical and electromyographic study *Anaesthesia*, 1984, Volume 39, pages 1214-1221
21. Franz Faul, Edgar Erdfelder, Albert-Georg Lang, Axel Buchner *G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences*. Behavior Research Methods 2007, 39 (2), 175-191