STUDY OF VARIOUS MEASUREMENTS OF INTUBATION IN INFANTS AND THEIR CORRELATION WITH PREDICTION OF DIFFICULT INTUBATION

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ABSTRACT

BACKGROUND & AIMS

Several pre-operative screening tools are used in adult. Wide range of pediatric anatomical & developmental differences (especially with infants) makes uses of adult clinical predictors in challenge. The aim of our study is to assess various measurements of intubation in infants and their correlation with difficult laryngoscopy.

MATERIAL AND METHODS

This prospective randomized study conducted in 100 infants. We assessed the usefulness of neck length (NL), neck circumference (NC), Head Circumference, (HC) ratio of NC/NL and introduced length of laryngoscope blade as predictors of difficult laryngoscopy and intubation.

RESULT

NC, NL, HC and ratio of NC/NL were significantly associated with incidence of difficult laryngoscopy and intubation. As this ratio increases difficulty at laryngoscopy increases ($p<.001$). Difficult laryngoscopy was assessed using Cormack Lehane grading. We found as age increases laryngoscopy becomes easier. ($p<0.05$)

CONCLUSION

There is no single anatomical measurement of intubation in infants in our study we measured NC, NL, NC/NL, HC and introduced length of laryngoscope blade which were found to be important predictors of difficult laryngoscopy and intubation. Statistical significant correlation was found between age and Cormack Lehane grades. In infants, various congenital malformations are highly associated with difficult laryngoscopy and intubation.

KEYWORDS

Infants, Difficult intubation, neck circumference, neck length, Cormack Lehane grade.

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INTRODUCTION

Practice of general anaesthesia is difficult to imagine without the security afforded by a nasotracheal or orotracheal tube for airway rnanagement. A difficult intubation is said to occur when experienced anaesthesiologist requires three or more attempts to place an endotracheal tube with or without rescue adjuncts, such as retrograde wires, light wands, video-laryngoscopes or gum elastic bougies.[1]

Paediatric anaesthesia demands an appreciation of differences between paediatric patients and adults. The paediatric patients have anatomical differences of the airway from the adults and physiological differences in the mechanism of respiratory control. Anatomical differences include differences in size, shape and position of the airway as well as airway epithelium and its supporting structures. Paediatric airway management remains the most daunting task before the anaesthesiologist.[2]

Predicting difficult airway is very important in infants, because unexpected difficulties in intubation may be diminished by proper preoperative evaluation. The lack of studies in infants and the possibility of difficult intubation in infants apparently without anatomical deformities indicate the need of research in this field. The aim of present study is to determine various anatomical measurements in infants and analyze their importance for predicting difficult laryngoscopy and intubation.

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MATERIAL AND METHODS

This prospective study was conducted at Geetanjali Medical College and Hospital, Udaipur on 100 infants posted for elective and emergency surgery, after approval from hospital ethical committee. All patients were subjected to a

thorough preanaesthetic evaluation and different measurements like weight, Length (child in supine position, from head board to heel), Neck circumference (NC), Neck length (NL-Mastoid process to medial end of clavicle with patient in intubating position), Ratio of neck circumference and neck length (NC/NL), Introduced length of laryngoscopic blade at the time of direct laryngoscopy and laryngoscopic view – Cormack Lehane grade I, II, III, IV were noted.

After taking written informed consent all patients were anaesthetized in the following way. Pre-anaesthetic medication was given half an hour before the surgery (oral syp. promethazine 5mg/kg). After placing routine monitoring all the infants were induced by sevoflurane and intravenous line was introduced. After preoxygenation injection glycopyrrolate 0.004 mg/kg body weight and injection

Pentothal sodium 2.5% solution 5mg/kg body weight followed by injection suxamethonium chloride 1.5 mg/kg body weight was given. Laryngoscopy was done by Macintosh curved blade or Miller straight blade (marked from tip of blade in 1 mm scale). Patients position was supine with head in neutral position. Distance from tip of blade to lower incisor/gum (Introduced length) was noted. At the time of laryngoscopy grading was done according to Cormack Lehane.

Grade 1: Most of glottis is visible
Grade 2: Only the posterior extremity of the glottis is visible
Grade 3: No part of glottis is seen. Only the epiglottis **is** seen
Grade 4: Only the soft palate is visualized, epiglottis is not seen.

Laryngoscopy grade I and II was considered easy while III & IV was considered difficult.

PVC uncuffed endotracheal tubes were used for intubation. The requirement of cricoid pressure and improvement in laryngoscopy grade was noted. After successful placement of endotracheal tube bilateral air entry, pulse and colour of skin checked. Routine intraoperative and postoperative monitoring was done.

Anaesthesia was maintained with oxygen and sevoflurane. All the patients were kept on controlled ventilation with the help of non-depolarising muscle relaxant (Inj. atracurium 0.5 mg/Kg) Reversal of curarization was done with injection neostigmine 0.08 mg/kg and glycopyrrolate 0.004 mg/kg intravenously. Any complication at the time of laryngoscopy, during intraoperative period and 24 hours after surgery was noted.

In Our study various measurement were correlated with the difficulty of laryngoscopy. As there was no case in Cormack Lehane grade-4 so it was not included in table. Chi-square test was applied. As number of cases in grade-III is less (4%) frequencies were pooled with nearby frequency and significance (P value) was calculated.

RESULTS

In this prospective cohort study in 100 infants we took various anatomical measurements for prediction of difficult laryngoscopy and intubation.

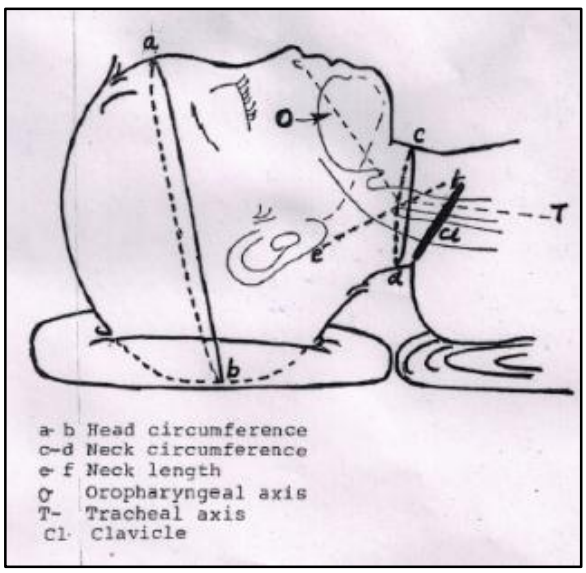

Figure 1

In our study we observed difficult laryngoscopy cases are more in age group >1 to 6 month.

Age (Months)	Laryngoscopy Grades			Total
	I	II	III	
0-1	22	3	0	25
>1 to 6	21	12	3	36
>6 to 12	23	15	1	39
Total	66	30	4	100

Table 1: RELATIONSHIP BETWEEN AGE AND LARYNGOSCOPIC GRADES

As age increases laryngoscopy becomes easier p<0.05. We also observed relationship between neck circumference neck length and head circumference. As the neck circumference and head circumference increases difficulty at laryngoscopy increases and as the neck length increases difficulty at laryngoscopy decreases. (Chi-square at 3 df = 29.686, P<0.001 (NC) & Chi-square at 6 df = 12.581; p<0.05(NL) chi-square at 8 df=21. 332.P <0.01 (HC) (Chi-square at 3 df + 33.243; P< 0.001)**.**

Neck Circumference (centimetres)	Laryngoscopic Grade			Total
	I	II	III	
18<19	32	4	0	36
>19-20	17	6	0	23
>20-21	13	7	0	20
>21-22	4	10	3	17
>22-23	0	3	1	4
Total	**66**	**30**	**4**	**100**
Neck length (cm)	I	II	III	Total
8-8.5	30	13	0	43
>8.5-9.0	30	11	2	43
>9-9.5	4	3	2	9
>9.5-10.0	2	3	0	5
Total	**66**	**30**	**4**	**100**

Head Circumference (cm.)	I	II	III	Total
30<35	17	3	-	20
>35-40	25	5	-	30
>40-45	22	17	3	42
>45-50	1	3	0	4
>50-55	1	2	1	4
Total	**66**	**30**	**4**	**100**

TABLE 2: RELATIONSHIP BETWEEN NECK CIRCUMFERENCE, NECK LENGTH AND HEAD CIRCUMFERNCE WITH LARYNGOSCOPIC GRADE

There was significant relationship between direct laryngoscopic grading and NC/NL. As this ratio increases (Means neck is fatty and short) the direct laryngoscopic grade increases, means difficulty at laryngoscopy increases.

S. No.	Ratio NC NL	Laryngoscopic Grade			Total
		I	II	III	
1.	2-2.15	8	2	0	10
2.	2.16-2.30	33	8	0	41
3.	2.31-2.45	24	8	0	32
4.	2.46-2.60	1	9	2	12
5.	2.61-2.75	0	3	2	5
	Total	**66**	**30**	**4**	**100**

TABLE 3: RELATIONSHIP BETWEEN RATIO OF NECK CIRCUMFERENCE AND NECK LENGTH (NC/NL) WITH LARYNGOSCOPIC GRADE

We observed in grade I no patient required laryngeal pressure while in grade II 25 out of 30 patients required laryngeal pressure. In grade III almost all patients required laryngeal pressure. Patients who were difficult at direct laryngoscopy required 3 and more attempts for successful intubation**.**

Grade	LP ±	No. of attempts				Total
		1	2	3	4	
I	0/66	64	2	0	0	66
II	25/5	26	4	0	0	30
III	4/0	0	2	1	1	4
	Total	**90**	**8**	**1**	**1**	**100**

TABLE 4: RELATIONSHIP BETWEEN LARYNGOSCOPY GRADE AND LARYNGEAL PRESSURE REQUIRED

DISCUSSION

Difficulty in intubation continues to be major cause of anaesthesia related morbidity, mortality and litigation. It is a major cause of cardiac arrest, brain injury and death.[3, 4] Intubation may be difficult in paediatric patients because of normal variation in airway anatomy and may be exaggerated by congenital anomalies. The preoperative identification, of patients in whom intubation may be difficult, can avoid major catastrophes.

No single anatomical factor predicts difficult laryngoscopy. Different tests have been used for prediction of difficult intubation in adult patients[5, 6, 7] but there are controversies about usage of these test in paediatric patients. The lack of studies in children and the possibility of difficult intubation in paediatric patients, apparently without anatomical deformities indicate the need of studies in this field.[8]

Mallampati test is a simple airway assessment method and is widely used. The upper lip bite test found by Khan et al,[9] ratio of height to TMD (RHTMD),[10] measurement of thyromental distance and, distance from tragus to nares,[11] assessment of head, neck and jaw movements are various other useful methods. Since the incidence of difficult intubation and laryngoscopy as well as development of hypoxia during induction of anaesthesia is greater in infants than in older children[12, 13, 14] so it is imperative that we focus on this age group.

Our study in hundred patients was a prospective cohort study in which various measurements like age, length, weight, neck circumference, neck length, ratio of neck circumference and neck length, introduced length of laryngoscope blade were taken before and during induction period. The view on laryngoscopy (with or without cricoid pressure required) was graded according to CL grading. Laryngoscopy grade I and II were categorized as easy and III and IV as difficult laryngoscopies. On the other hand intubation when done in one or two attempts was graded as easy and in three or more attempts was graded as difficult intubation.

In our study laryngoscopy was easy (grade 1 and 2) in 96% and difficult (grade 3 and 4) in 4% cases. Incidence of difficult laryngoscopies was reduced from 4% to 2% from external laryngeal pressure. In a retrospective study done in 497 infants by Junko A et al[15] in 2015, Cormack Lehane grading I and II was noted in 96.9% and III & IV in 2.4% cases. In another study by Nosheela basit et al[11] in 2014 the frequency of difficult intubation among paediatric patient was found 2%. In another study[16] done in 1996 laryngoscopy was easy in 92.6% cases and difficult in 7.38% cases. Xue FS et al[17] in 2006 observed difficult laryngoscopy in 4.77% of cases and difficult intubation in 1.93% of cases. Above studies are in accordance with the our study though some differences in patient characteristic due to race and ethnicity may influence the incidence of difficult airway.[18]

In our study there was significant association between age and laryngoscopic view. ($p<0.01$). We observed out of 4% difficult intubation 3% were in age group 1-6 months and 1% in 6-12 months. 2% cases were observed difficult at laryngoscopy because of large head (hydrocephalus and huge occipital meningo-myelocele) and in one case it was laryngeal oedema which made intubation difficult. Aggarwal A et al[19] in 2012 concluded in their study that as age increases laryngoscopy and intubation becomes easier because after 2years of age airway is more or less similar to adults apart from small in size. This inference was further strengthened by study performed by Junko A et al in 2015 where he concluded that infants who received general

anaesthesia repeatedly at different age, CL grade was decreased from 4 to 3 in one and from 3 to 2 in two infants during anaesthesia performed later. In another study incidence of difficult intubation was more in children (34%) vs adult (23%), and among children 28% difficult intubation was noted in patients under the age of 1year.[4]

Obesity and short fat neck have been associated with difficult laryngoscopy because .posterior cervical neck fat may limit cervical flexion and head extension. Mean neck length in our study was 9.5+0.42cm in normal laryngoscopy and 8.45+0.12 cm in difficult laryngoscopy cases, which was found to be statistically significant. Gonzalez H found increasing neck circumference associated with problematic intubation in adults.[19] No absolute values are given in literature either for adults or paediatric age group. In our study mean neck circumference was 19.9cm+1.28 in normal laryngoscopy and 21.61cm+0.28 in difficult and was found to be statistically significant (p<.001). Derived ratio of neck circumference divided by neck length (NC/NL) was designed to try to quantify 'short fat neck' which was widely believed to be associated with difficult intubation. In this study this ratio in normal laryngoscopy was 2.28+0.47 as compared to difficult laryngoscopy 2.53+0.22.which was statistically significant (p<.001). Wilson et al found NC/NL was higher (2.80+0.40) in difficult laryngoscopy cases as compared to easy laryngoscopy where ratio was 2.5+0.4.[20]

In our study head circumference was found to be significant criterion for prediction of difficult airway in infants, where we had two cases of large head circumference with difficult intubation. In another case report by Malinzak et al in 2015, found that increased head circumference due to congenital hydrocephalus distort the normal anatomy of skull, making airway management difficult. The large occiput places the neck in extreme flexion and the large forehead may obscure the line of sight in laryngoscopy, so elevating the body with pillows or towels is necessary in order to facilitate laryngoscopy.[21, 22]

We found that as introduced length of laryngoscope blade increases difficulty at laryngoscopy increases. Introduced length of laryngoscope blade was measured in every case in our study which was found to be statistically significant (<0.01).

Cricoid pressure holds importance in better visualization of airway in anteriorly placed larynx. In our study 29% of infants required laryngeal pressure where none were of CL grade I. In another study[11] cricoid pressure was required in 19.2% of patients under the age of five years.

It was observed in our study that as the grade of difficult laryngoscopy and attempts of intubation increases, incidence of complications like bleeding from gums, bronchospasm, bradycardia and laryngeal oedema increases.

CONCLUSION

In present study conducted in 100 infants of either sex posted for elective as well as emergency surgeries were thoroughly evaluated preoperatively to assess the anatomical factors and some measurements at head and neck for prediction and to find our any relationship with difficult intubation. After statistical evaluation we concluded that age was found to be a significant factor for difficult laryngoscopy (p value <0.05) and intubation as age increases laryngoscopy becomes easier. There significant correlation between mean of neck circumference, neck length and ratio of NC/NL with difficult laryngoscopy and intubation. As neck circumference increases and neck length decreases difficulty in laryngoscopy and intubation increases. It was also observed that as the introduced length of laryngoscopy blade increases (>4.5cm), difficulty at direct laryngoscopy increases (p value <0.01).

There are no defined norms for these measurements in literature for infants thus further research with larger sample size is required to further explore the role of these measurements.

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