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To Determine Predictors of Difficult Airway in Paediatric Age Group upto 6 Months of Age

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Introduction

ASA defines difficult airway as the situations in which the conventionally trained anaesthesiologist experiences difficulty with mask ventilation, laryngoscopy and intubation. Techniques and practices in airway management have long been an important concern of ASA, as illustrated in difficult airway guidelines[1]. Management of airway is paramount to safe peri-operative care and the following steps become necessary to favourably affect outcome.

1. Through airway history and physical examination
2. Process of maintaining oxygenation and ventilation.
3. Consideration of the ease of rapid tracheal intubation
4. Formation of management plans for use of a supraglottic means of ventilation.
5. Weighing the risk to the patient of failed airway maneuvers.[2]

The anatomically complex airway undergoes growth and development and significant changes in its size, shape and relation to the cervical spine between infancy and childhood[3]. During pediatric anesthesia, airway assessment and management is paramount for the anesthetist. To understand the comprehensive method of assessment of pediatric airway, one has to know the anatomy pertaining to airway as it develops from birth, infancy and childhood.

Children have a proportionately large head and occiput relative to body size. This causes neck flexion, leading to difficulty in extension of neck which helps to bring oral axis to align with pharyngeal axis.

Relative large tongue decreases the size of the oral cavity in children and more easily obstructs the airway. In infants lying supine, the tongue tends to flatten out against the soft palate in inspiration and may remain in the same position for the passive expiration through the nose[4]

Anatomic differences between the paediatric and adult airway:[5]

1. Proportionately smaller infant or child larynx.
2. Narrowest portion: cricoid cartilage in infants/child; vocal folds in adult.
3. Relative vertical location C_3, C_4, C_5 in infant or child; C_4, C_5, C_6 in adults.
4. Epiglottis longer, narrower and stiffer in infant or child.

5. Aryepiglottic fold closer to midline in infant or child.
6. Vocal folds: anterior angle with respect to perpendicular axis of larynx in infant or child
7. Pliable laryngeal cartilage in infant and child
8. Mucosa more vulnerable to trauma in infant or child

There is no single factor that reliably predicts difficult airway in children as there can be many predictors of difficult airway in the same patient at the same time. We don't even know the normal values of many prediction criteria.[6]

Here in this study we plan to determine the predictors for difficult airway in children upto 6 months of age.

Aims and Objectives of Research

- To determine the correct predictors of difficult airway (Difficulty in mask ventilation, laryngoscopy and Intubation) in children upto 6 months of age.
- **Primary outcome:** predictors of difficult airway
- **Secondary outcome:** combination of values/ratios predicting difficulty airway

Materials and Methods

After due approval from the hospital ethical committee and informed written consent from parent or guardian, a observation study was conducted at Department of Anaesthesiology and Intensive care, VMMC & Safdarjang hospital, of both the sexes, upto 6 months of age, ASA grade I & II scheduled for elective surgery.

Pre-operative airway assessment was performed for all the patients by the same post graduate student of anaesthesia. Airway management was performed by an anaesthetist with a minimum of 3 years of experience.

Inclusion Criteria

- Children upto 6 months of age
- ASA grade I & II
- Children requiring general anesthesia.

Exclusion Criteria

- Children > 6 months of age
- ASA grade III and IV

The parameters that were assessed in history

1. Frequent cough and URI
2. Fever
3. Nasal bleeding
4. Choking
5. Feeding problems
6. Drooling
7. Noisy breathing
8. Snoring
9. Mouth breathing
10. Sleep abnormalities
11. Change in voice
12. Hearing abnormalities
13. Previous difficulty in maintain airway
14. Performance in school
15. Birth history

The parameters that were assessed in examination

1. Abnormal facies
    1. Pouting lips
    2. Microstomia
    3. Small nostrils
    4. Beaked nose
    5. Frontal bossing
    6. Down slanting palpebral fissure
2. Low posterior hair line
3. Macroglossia
4. Dental examination
    1. Malallignment
    2. Prominent incisors
    3. Loose teeth
    4. Natal teeth

5 .Skin lesions
    1. Pre auricular tags
    2. Skin bullae

6. Nose examination
    1. Patency of nasal airway
    2. Nasal mass/polyp

7. Maxilla and mandible
    1. Hypoplasia
    2. Temporomandibular joint instability

8. Neck examination
    1. Short neck
    2. Neck movement
    3. Neck swelling
9. Spine examination
    Kyphoscoliosis
10. Lymphadenopathy
11. Cyanosis
12. Microtia

Measurements that were taken

1. Length/height
    1. Weight
2. Head circumference
3. Neck circumference
4. Chest circumference
5. Interalveolar distance
6. Distance between tragus and angle of mandible
7. Distance between angle of mandible and mentum
8. Hyomental distance
9. Distance between mentum and first neck crease
10. Distance between occipital protruberence to cervical prominance(C_7)

Assessment

MASK VENTILATION	1	2	3
LARYNGOSCOPY	1	2	3
INTUBATION	1	2	3

1- No difficulty
2- Difficulty could be overcome
3- Difficulty could not be overcome

Observations and Results

Demographic Data

Age (<6mnths)	LENGTH(in cm)	WEIGHT(in kg)
Minimum	58	4
Maximum	93	10
Mean	70.91	6.43
Std deviation	9.66	1.23

After assessing 59 patients of less than 6months of age, mean weight of 4.15 ± 1.60 kg, mean height of 60.8 ± 12.33 cm, was observed

Mask Ventilation Difficulty

Age	Frequency	Percentage
<6 mnths	11	18.64

Mask ventilation was possible for all the patients. Some difficulty was encountered in 11 patients (18.64%) which could be managed.

Laryngoscopy Difficulty

Age	Frequency	Percentage
<6 mnths	8	13.56

Laryngoscopy was possible for all patients. Some difficulty was encountered in 8 patients (13.56%) which was managed.

Intubation Difficulty

Age	Frequency	Percentage
<6 mnths	8	13.56

Difficulty in intubation was encountered in 8 patients (13.56%) which could be managed.

Mean values of predictors used for airway assessment in upto 6 months of age:

Length - 60.8cm
Weight -4.15kg
Head circumference- 37.83cm
Neck circumference -21.94cm
Chest circumference- 37.37cm
Interalveolar distance- 2.91cm
Distance between tragus to angle of mandible- 3cm
Distance between angle of mandible to mentum- 5.76cm
Hyomental distance-2.89cm
Distance between mentum to first neck crease- 3.48cm
Neck length- 9.90cm

Age(< 6 months)	Interalveolar distance(in cm)	Dis b/w mentum and first neck crease(in cm)	Ratio of height/dis btw mentum and first neck crease	Neck circumference(in cm)
Minimum	2	1.5	28	18
Maximum	4	4.5	19.77	42
Mean	2.91	3.48	17.10	21.94
Std deviation	0.37	0.62	21.25	3.71

Correlation of parameters of airway assessment of <6month of age

		p-value	Correlation value	Power
Neck circumference	Weight	0.0001	0.4855	98
Hyomental distance	Weight	0.0018	0.3977	88
Dis b/w angle of mandible to mentum	Weight	0.0032	0.378	85
Dis b/w mentum to first neck crease	Weight	0.0005	0.441	94
Neck length	Weight	0.0060	0.3534	79
Mask ventilation	Weight	0.0059	-0.3546	79

Discussion

We assessed 59 patients up to 6 months of age preoperatively on the basis of history, physical examination and measurements (weight, length, head circumference, neck circumference, chest circumference, interalveolar distance, distance between tragus and angle of mandible, distance between angle of mandible to mentum, hyomental distance, distance between mentum to first neck crease, neck length and Mallampati class). The glottic view was then classified according to Cormack – Lehane classification during direct laryngoscopy and the difficulty with mask ventilation, laryngoscopy, and intubation was assessed.

In our study the mean weight and length in the age group less than 6 month was 4.15 kg and 60.8 cm respectively.

The average birth weight of neonates is about 3 kg. During the first few days after birth, the newborn loses extracellular fluid equivalent to about 10% of the body weight. Most infants regain their birth weight by the age of 10 days. Subsequently they gain weight at the rate of approximately 25 to 30g per day for the first 3 months of life. Thereafter they gain about 400g weight every month, for the remaining part of the first year. An infant usually doubles (6kg) his birth weight by the age 5 months. The birth weight triples (9kg) at 1 year and is four times (12kg) at 2 years of age. The weight of child at the age of three years is five times (15kg) that of the birth weight. At 5 years, the expected weight is calculated by multiplying the birth weight by 6 (18kg), at 7 years by 7 (21kg).[7]

The infant measures 50cm at birth, 60cm at 3 months, 70cm at 9 months, 75cm at 1 year and 90cm at 2 years. A normal Indian child is 100cm tall at the age of 4.5years. Thereafter, the child gains 6 cm in height every year, until the age of 12 years that is 106cm at the age of 5.5years and 112cm at the age of 6.5years.[7]

In a study by Olubukola O. Nafiu, Constance C. Burke, in 2011, positively correlated neck circumference and other indices of obesity in children, with some adverse respiratory events in children aged 6 to 18 years undergoing noncardiac surgery. The mean value of neck circumference in this study was 31.9cm for males and 29.8cm for females.[8]

In our study the mean value of neck circumference in the age group less than 6 month was 21.94 cm.

In another study by Aggarwal et al the mean value of neck circumference reported was 24.29 cm. and were comparable with our study[9]

In the study by Aggarwal et al statistically significant correlation was found between neck circumference and mask ventilation (preparalysis p value=.02, r=-0.23, power 63%; post paralysis p value=.002, r=-0.31, power 88%). However in our study neck circumference had significant correlation with Mallampati class and Cormack

Lehane grade but not with difficulty in mask ventilation.[9]

Neck circumference didn't show any significant change with age.

Neck length significantly changed with age.

Hyomental distance and distance between tragus and angle of mandible changed proportionally with age.

In our study, it was observed that in infants less than 6months of age the parameters of airway assessment correlated better with the weight than the age of the infant. Neck circumference (p-0.0001), hyomental distance (p-0.0018), distance between angle of mandible to mentum (p-0.0032), distance between mentum to first neck crease (p-0.0005) and neck length (p-0.006) correlated with weight than the age of the infant. The weight also correlated with the difficulty in mask ventilation (p-0.0059).

In infants less than 6 months of age difficult mask ventilation was associated with high Cormack Lehane grade (p-0.0084). Difficulty in mask ventilation was associated with difficult laryngoscopy (p-0.00) and difficulty in laryngoscopy was associated with difficult intubation (p-0.033).

We could not find any literature to collaborate some of our findings as there are limited numbers of studies done this age group.

Difficulty in mask ventilation, laryngoscopy and intubation that was encountered could be managed due to the presence of experienced anesthetist while anesthetizing children of less than six months.

Conclusion

After analyzing the results of our study and thorough review of the available literature regarding difficult laryngoscopy and intubation, we reached to the conclusion that preoperative evaluation is important in the detection of difficult airway in children of less than six months.

In infants less than 6 months of age the parameters of airway assessment correlated better with the weight than the age of the infant. The weight also correlated with the difficulty in mask ventilation (p-0.0059). Difficult mask ventilation was associated with high Cormack Lehane grade (p-0.0084) in this age group. Difficulty in mask ventilation was also associated with difficult laryngoscopy (p-0.00) and difficulty in laryngoscopy was associated with difficult intubation (p-0.033).

We could not find any literature to collaborate some of our findings as there are limited numbers of studies done in this age group.

Difficulty in mask ventilation, laryngoscopy and intubation was encountered and could be managed due to the presence of experienced anesthetist while anesthetizing children of less than six months.

We recommend that airway assessment, an experienced anesthestist and anticipation of difficult airway is of paramount importance in the age group less than 6 months and further studies are required to be done in this age group to predict difficult airway.

Summary

Anatomically airway undergoes growth and development and significant changes in its size, shape between infancy and childhood. During paediatric anaesthesia, airway assessment and management is paramount for the anaesthetist. To understand the comprehensive method of assessment of paediatric airway, one has to know the anatomy pertaining to airway as it develops from birth, infancy and childhood.

We assessed 59 paediatric patients up to 6 months preoperatively on the basis of history, examination and measurements of certain parameters to identify difficult airway.

We aimed at determining the predictors of difficult airway or combination of values/ratios for predicting difficult airway.

The study was conducted on ASA grade I and II patients, scheduled for paediatric surgery under general anaesthesia. Preoperative measurements [Length/height, Weight, Head circumference, Neck circumference, Chest circumference,

Interalveolar distance, Distance between tragus and angle of mandible, Distance between angle of mandible and mentum, Hyomental distance, Distance between mentum and first neck crease and Distance between occipital protuberance to cervical prominence(C_7)] were taken by the same under graduate and airway management was performed by an anaesthetist with a minimum of 3 years of experience.

Difficulty in mask ventilation, laryngoscopy and intubation was graded as 1(no difficulty), 2(difficulty that could be overcome) and 3(difficulty couldn't be overcome).

Grade 2 difficulty in mask ventilation was encountered in age group less than 6months (18.64%). Grade 3 difficulty was not encountered in our study population.

Grade 2 difficulty in laryngoscopy was encountered in age group less than 6months (13.56%). No grade 3 difficulty in laryngoscopy was seen.

In our study, it was observed that in infants less than 6months of age the parameters of airway assessment correlated better with the weight than the age of the infant. The weight correlated with the difficulty in mask ventilation (p-0.0059). Difficult mask ventilation was associated with high Cormack Lehane grade (p-0.0084) in this age group. Difficulty in mask ventilation was associated with difficult laryngoscopy (p-0.00) and difficulty in laryngoscopy was associated with difficult intubation (p-0.033).

We could not find any literature to collaborate some of our findings as there are limited numbers of studies done in this age group.

Difficulty in mask ventilation, laryngoscopy and intubation was encountered but could be managed due to the presence of experienced anesthetist while anesthetizing children of less than six months.

We recommend that airway assessment, an experienced anesthestist and anticipation of difficult airway is of paramount importance in the age group less than 6 months and further studies are required to be done in this age group to predict difficult airway.

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