IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 4 Ser.5 (April. 2021), PP 41-47
www.iosrjournals.org

"An assessment of anthropometric parameters to assess airway in Eastern Indian population: A prospective observational study"

Dr. Meera Pillai,[1] Dr Amit Kumar Sahu,[2] Dr. D.P. Samaddar,[3]
Dr. Abhishek Chatterjee[4]
1,2 DNB Anaesthetist, 3 Chief Anaesthesiologist, 4 Specialist 1,2,3,4 Deptt of Anaesthesia and Critical Care, Tata Main Hospital, Jamshedpur, India

Abstract:
Background: *Maintaining a patent airway is essential for adequate oxygenation and ventilation failure to do so, even for a brief period, can be life threatening. The anthropometric parameters are preferred over the observational parameters due to higher specificity, sensitivity and positive predictive value. This study was conducted to find out whether the western parameters can be applied to the Indian population which is ethnically different as well as to calculate the average values of different airway anthropometric parameters in the local population from Eastern India.*
Material and methods: *In this prospective observational study, 1000 patients of aged 20 - 60 years with BMI <30 kg/m2 were evaluated by single investigator for following anthropometric parameters: i) Inter-incisor gap ii) Thyromental distance iii) Sternomental distance iv) Horizontal length of Mandible v) Ratio of Height to Thyromental Distance and vi) Body Mass Index. All these parameters were analyzed for correlation as well as compared with western data.*
Results*; There was no significantly strong positive or negative co-relation between the anthropometric parameters. Present study on comparing with western data shows statistically significant difference, suggesting variation in ethinicity affecting anthropometry and demography.*
Conclusion: *Population of Eastern India is anthropometrically different not only from the rest of India but also from other countries. Age and sex related changes were also observed and hence age and sex is also an important factor to predict difficult airway.*
Keywords: *Inter-incisor gap (IIG), Thyromental distance (TMD), Sternomental distance (SMD), Horizontal length of Mandible (HLM), Ratio of Height to Thyromental Distance.*

Date of Submission: 29-03-2021 Date of Acceptance: 12-04-2021

I. Introduction

The term 'airway' refers to the upper airway which may be defined as the extra-pulmonary air passage, consisting of the nasal and oral cavities, pharynx, larynx, trachea and large bronchi.[1] Maintaining a patent airway is essential for adequate oxygenation and ventilation and failure to do so, even for a brief period, can be life threatening. The assessment of the patient's airway is therefore, an integral part of the preoperative workup.

'Difficult airway' is a situation in which there is a problem in establishing or maintaining gas exchange via a mask, an artificial airway or both.[2] Anticipation of difficult airway therefore is mandatory before planning anaesthesia. Airway can be assessed using both observational and anthropometric parameters. The anthropometric parameters are preferred over the observational parameters due to higher specificity (79 % - 91 %), higher sensitivity (77 % - 89 %), high reproducibility and a high positive predictive value (82 % - 94 %) in comparison to observational parameters.[3]

Anthropometric parameters routinely observed are hyomental distance, sternomental distance, inter-incisor distance, thyromental distance, neck circumference, neck movements, ratio of height to thyromental distance, horizontal length of mandible. Observational parameters commonly include nostril patency, length of the upper incisors, alignment of incisors on clenching of teeth, upper lip bite test, ability to protrude or advance the lower (mandibular) incisors in front of the upper (maxillary) incisors, tongue size, Mallampati grading, presence of heavy facial hair, compliance of the mandibular space. Srinivas et al in his study found that the specificity of the observational parameters ranged between 60 to 90% and for anthropometric parameters was 75 -93%.[4]

Since most studies for prediction of difficult airway have been done in caucasians , the cut off values set by them cannot be extrapolated to the Indian population. According to anthropometric studies, there are racial differences in body habitus and craniofacial features.

To address this issue, we undertook a prospective study to find out whether the western parameters can be applied to the Indian population which is ethnically different and to analyses average values of different airway anthropometric parameters.

II. Material And Methods

This Prospective Observational Study was conducted in the department of Anesthesia and Critical Care, Tata Main Hospital, Jamshedpur which is a 914 bedded multidisciplinary teaching hospital.

Study population and period: All 1000 patients were aged between 20 - 60 years with a BMI <30 belonging to eastern India states admitted to the ward or attending OPD during the study period i.e. January 2016 to July 2017, were included in our study.

The sample size calculation: A total of 1000 patients were evaluated using formula

$$N= z^2 \times p\,(100-p)/e^2$$

Z=abscissa of the normal curve with confidence interval of 99%.

P= prevalence which is taken as 1.5 (The incidence of difficult airways is 1.1 – 3.8%)

e = precision (acceptable absolute error) which is taken as 1

Hence,

$N = 2.58^2 \times 1.5(100-1.5)/1^2$

N = 983.48 rounded off to a sample size of 1000 for convenience.

Inclusion criteria: All patients admitted to our institution and attending the OPD with BMI <30, Age group 20-60 years were included after obtaining informed and written consent.

Exclusion Criteria: Patients with BMI >30, with obvious craniofacial anatomical deformities, unstable cervical spine injury**,** unwilling to participate and past history of difficult intubation or ventilation.

III. Methodology

After taking the age, weight by a standard weighing scale and height, the following airway characteristics were assessed by single investigator to reduce inter-observer variability. Measurements were made with rigid rulers.

a) Inter-incisor gap (IIG): It is the distance between the upper and lower incisors after asking each patient to open the mouth as wide as possible. Normal value is 4.6 cm or more; while < 3.8 cm predicts difficult airway.[1] (Fig-1)

b) Thyromental Distance (TMD) (Patil's test): This measurement helps in determining how readily the laryngeal axis will fall in line with the pharyngeal axis when the atlanto-occipital joint is extended. Alignment of these two axes is difficult if the TMD is < 3 finger breadths or < 6 cm in adults; while a value of > 6.5 cm is considered normal for a given population. TMD was measured as the straight distance between the thyroid notch and the lower border of the mental prominence, with the head fully extended and the mouth closed, using a rigid ruler. [10] (Fig-2)

c) Sternomental distance: The distance from the suprasternal notch (upper border) to the bony point on the mentum. It is measured with the head fully extended on the neck with the mouth closed. A value of less than 12 cm is found to predict a difficult intubation.[7] (Fig-3)

d) Horizontal length of Mandible: The amount of mandibular space into which the tongue can be compressed to allow a line of sight to the glottis can be assessed by the horizontal length of the mandible. A mandibular length of greater than 9 cm predicts easy intubation .It is the distance between the bony alveolus immediately behind the third molar tooth and the lower border of the mandible[8] (Fig-4)

e) Ratio of Height to Thyromental Distance (RHTMD): Height of the patient will be measured in centimeters from vertex to heel with the patient standing and was rounded to the nearest one cm. Ratio of Height to Thyromental Distance (RHTMD) is calculated as Height (in cms)/TMD (in cms).[9,10]

f) Body Mass Index (BMI): Body mass index (BMI) will be calculated by the formula i.e. Weight(in Kg)/ square of height in meters (m^2).

Anthropometric Parameters

FIG-1

FIG-2

FIG-3

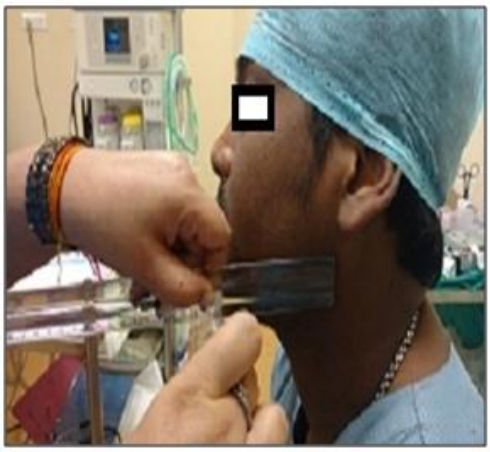

FIG-4

Statistical Methods: Results have been expressed as means (±SD) or numbers (percentage).
Spearman correlation analysis was used to examine the relationship of the five anthropometric measurements. Categorical variables have been compared by the chi-square test. Mean along with standard deviation of different studies were compared by independent t test. A p value <0.05 will be considered statistically significant.

IV. Observation and Results

Table 1: Shows the demographic parameters of our study. Of the 1000 patients' enrolled male to females were 467:533. The mean age was 41.425± 11.79 years in our patient population. Patients who were more than 40 years of age were 546 while patients whose age was less than 40 years were 454 in our study. The mean BMI and height observed were 25.72±3.08 kg/m^2 and 159.66±8.54 cm respectively.

Demographic Parameters	
n	1000
Sex	male - 467
	female -533
Age	41.425±11.79
age >40	546
age<40	454

BMI	25.56±2.77
Height	159.66±8.54

Chart 1 : Mean and standard deviation of all 5 anthropometric parameters and body mass index

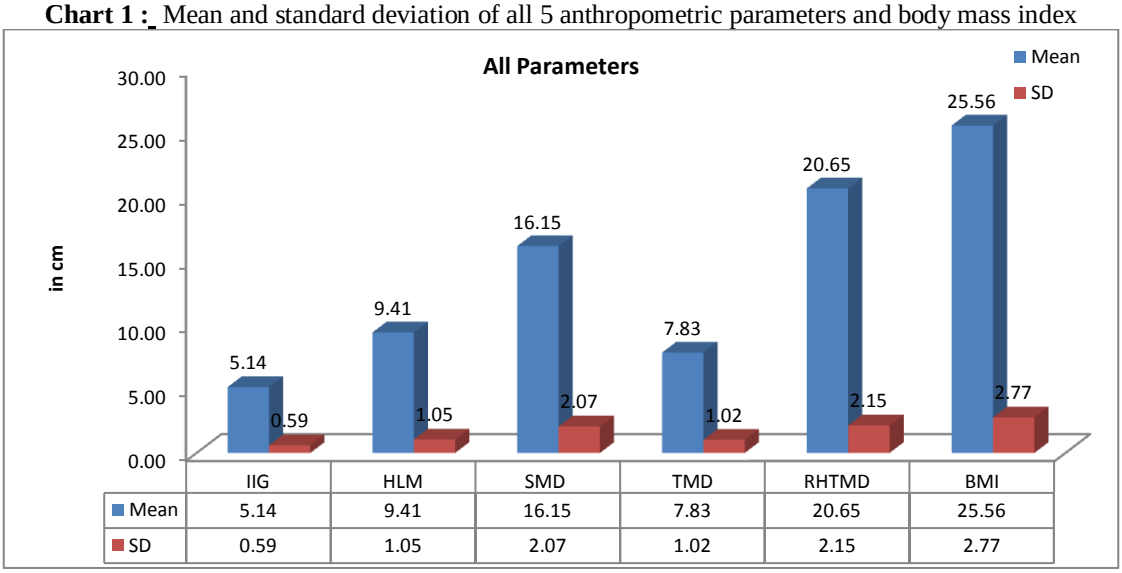

Table2 : Co-relation among the 5 anthropometric parameters :

There was no significantly strong positive or negative co-relation between the 5 anthropometric parameters

Co relation between the parameters	
IIG with HLM	0.59
HLM with SMD	0.53
SMD with TMD	0.68
IIG with SMD	0.56
TMD with IIG	0.33
HLM with TMD	0.45
TMD with RHTMD	-0.9054
RHTMD with IIG	-0.1691

Table 3: Mean and Standard deviation for 5 anthropometric parameters and body mass index for males and females.

It shows the mean and standard deviations and BMI among males and females. We observed statistically significant difference between the 2 sexes in all 5 parameters with p <0.001.

Male			**Female**		
Parameter	**Mean**	**SD**	**Mean**	**SD**	**p value**
Age	**40.73**	**12.43**	**41.62**	**11.02**	-
IIG	**5.46**	**0.59**	**4.86**	**0.43**	**<0.001**
HLM	**9.99**	**0.96**	**8.90**	**0.84**	
SMD	**17.74**	**1.50**	**14.75**	**1.37**	
TMD	**8.42**	**0.92**	**7.31**	**0.81**	
RHTMD	**20.00**	**2.03**	**21.22**	**2.09**	
BMI	**25.74**	**2.62**	**25.39**	**2.88**	-

Table 4: Comparison of present study with Balakrishnan et al by applying independent t test
We observed statistically significant difference in all anthropometric parameters (TMD, SMD and RHTMD). Demographic parameters except BMI also showed statistically significant difference.

Parameter	Present Study (n=1000)	Balakrishnan et al (n=2004)	Mean Difference (95% CI)	P Value
Age	41.21±11.7	50.22±12.04	-9.01(-9.915502 -8.104498)	<0.001
Height	159.66±8.54	154.96±8.42	4.7 (4.057755 5.342245)	<0.001
Weight	65.25±9.45	60.14±12.44	5.11 (4.238708 5.981292)	<0.001
BMI	25.56±2.77	25.13±5.26	.43 (.0820021 .7779979)	0.0155
IIG	5.14±0.59			
TMD	7.83±1.02	9.03±1.25	-1.2 (-1.289462 -1.110538)	<0.001
SMD	16.15±2.07	16.59±1.86	-.44 (-.5866985 -.2933015)	<0.001
HLM	9.41±1.05			
RHTMD	20.65±2.15	17.46±2.43	3.19 (3.012319 3.367681)	<0.001

Table 5: Shows the comparison of our study with Liaskou C et al (Greece) using independent t test.
There was statistically significant difference in the TMD, SMD and RHTMD among the 2 populations. All the demographic parameters also had a statistically significant difference

Parameter	Present Study (n=1000)	Liaskou C et al (n=341)	Mean Difference (95% CI)	P Value
Age	41.21±11.7	50±18	1.73 (.3054205 3.15458)	0.0173
Height	159.66±8.54	169±9	-9.34 (-10.40525 -8.27475)	<0.001
Weight	65.25±9.45	75±15	-9.75 (-11.10305 -8.396948)	<0.001
BMI	25.56±2.77	26±4	-.44 (-.8248664 -.0551336)	0.0251
IIG	5.14±0.59			
TMD	7.83±1.02	8.6±1.4	-.77 (-.9088502 -.6311498)	<0.001
SMD	16.15±2.07	17.2±2.3	-1.05 (-1.312127 -.7878732)	<0.001
HLM	9.41±1.05			
RHTMD	20.65±2.15	20.2±3.1	.45 (.1514643 .7485357)	0.0032

Table 6: Comparison of present study with Krobbuban et al :
We compared the observed values of our study with study in Thailand by Krobbuban et al. The IIG, TMD and RHTMD of the populations were statistically different. All the demographic parameters barring the height showed a statistically significant difference.

Parameter	Present Study (n=1000)	Krobbuban et al (n=550)	Mean Difference (95% CI)	P Value
Age	41.21±11.7	45±15	-3.79 (-5.140223 -2.439777)	<0.001
Height	159.66±8.54	160±8	-.34 (-1.209737 .5297371)	0.4433
Weight	65.25±9.45	58±10	7.25 (6.258404 8.241596)	<0.001
BMI	25.56±2.77			
IIG	5.14±0.59	4.0±0.6	1.14 (1.078193 1.201807)	<0.001
TMD	7.83±1.02	7.1±0.8	.73 (.6313024 .8286976)	<0.001
SMD	16.15±2.07			
HLM	9.41±1.05			
RHTMD	20.65±2.15	22.8 ±2.8	-2.15 (-2.399988 -1.900012)	<0.001

V. Results

Similar studies included Krobbuaban et al[6] in 550 Thai population, Vallem et al[13] in 200 South Indian population, Liaskou C et al[14] in 341 Greek population and Balakrishnan et al[12] in 2000 south Indian population. Balakrishnan et al[12] concluded that ratio of height to TMD (RHTMD) predicted difficult intubation with sensitivity of 64.60%.

Demographic Parameters:

Age: The mean age of our study population was 41.21±11.79 years. In contrast to our study, Balakrishnan et al[12] (50.22±12.04 years), Liaskou C et al[14] (50±18 years) and Krobbuban et al[6] (45±15 years) had included older patients, whereas, Vallem et al [13] had included younger population with a mean age of 39.48±11.22 years.

Sex Distribution: Out of 1000 patients enrolled in our study, 46.7 % were male (n=467) and 53.3% were female (n=533). Studies done by Vallem et al[13] ,Chara et al[14], Balakrishnan et al[12] and Krobbubanetal[6] also showed female preponderance similar to present study, whereas, Oza et al[11]in their study did not reveal the sex distribution.

Height : The mean height of population of our study was 159.66±8.54cm which was comparable to mean height of Thai population (160±8 cm) as observed by Krobbuabanetal.[6] Studies done in South-Indian population showed statistical significant difference in height as observed by Vallem et al[13] (157.97±7.22cm) and Balakrishnan et al[12](154.96±8.42cm) (Table 4).

Body Mass Index : The mean weight of our study population was 65.25± 9.45 Kg which was significantly lower than Greek population (75±15 Kg) and significantly more than Thai (58±10Kg) as well as South Indian population (57.78±9.04Kg).

The body mass index (BMI) found in our study was 25.56±2.77. Similar to height and weight, the BMI also showed statistically significant difference when the same was compared to Greek population and south Indian population. Krobbuaban et al[6] in his study, involving Thai group included weight but failed to take BMI as an observed parameter.

Airway parameters:

Thyromental distance (TMD): The mean TMD in our patients was 7.83±1.02cm, which was significantly lower than observed mean TMD (8.6±1.4cm) in Greek population (Liaskou C et al)[14] and also mean TMD of 8.2 cm in Turkish population(Selvi O et al) [15] but TMD was 9.03±1.25cm in south India ,Balakrishnan et al[12]. On the other hand, Krobbuaban et al[6] in Thai population observed a TMD of 7.1±0.8cm which was significantly lower than our group of patients (Table 6).

Ratio of Height to Thyromental distance (**RHTMD)**: The mean value of RHTMD in our study population was 20.65±2.15. Patients in Greek study by Liaskou C et al[14] showed significantly lower RHTMD (20.2±3.1) than our population, whereas, patients of Thailand in study by Krobbuaban et al[6] showed significantly higher value of 22.8± 2.8.

Sternomental distance (SMD): Ramadhani et al[7] have shown that sternomental distance had an increased sensitivity and specificity for predicting difficult laryngoscopy.

The mean SMD in present study was16.15±2.07cm, which on comparison, was found to be significantly lower than Greek patients (17.2±2.3cm, $p<0.001$) as observed by Liaskou C et al[14] and significantly more than one South Indian population (15.84±1.19cm, $p=0.04$) by Vallem et al[13] while it is lower than the other study conducted by Balakrishnan et al[12] (16.59±1.86cm, $p<0.001$) in south Indian population.

Horizontal length of mandible (HLM): The mean HLM in our study was 9.41 ± 1.05 cm. However we failed to compare it with above mentioned studies as they did not quote the normal values of HLM in their study.

Inter incisor gap (IIG): The inter-incisor gap in our study was 5.14±0.59 cm which is significantly higher compared to Krobbuaban et al.[6] (4±0.6 cm) in Thai group of patients and Vallem et al[13] (4.53±0.59 cm) in south Indian population. Based on the normal values of this particular parameter it appears that intubation should be easy in our population but the cut off value for the same can only be decided later on.

Effect of gender on observed parameters: On statistical analysis in our study (Table 3) we observed a statistically significant ($p <0.001$) difference in all anthropometric parameters between the male and female gender, implying the need for gender based values for the anthropometric parameters.

- On comparison with two Indian studies conducted by Balakrishnan et al[12] and Vellam et al[13] our study showed statistically significant difference in both demographic and anthropometric parameters which showed variation in parameters within different regions of the same country.
- Present study on comparing with Krobbuban et al[6] in Thailand and Liaskou et al[14] in Greece again revealed statistically significant difference, suggesting variation in ethinicity affecting anthropometry and demography.

VI. Conclusion

Population of eastern India is anthropometrically different not only from the rest of India but also from other countries. Age and sex related changes were also observed in certain anthropometric parameters and hence age and sex is also an important factor to predict difficult airway. Ethnicity, age and sex, therefore, play an important role in predicting a difficult airway and hence we need different cut off values for all the parameters for patients belonging to different regions, age groups and genders. We have made an attempt to find out the normal values in the population relevant to us and plan to take this as the base line for identifying the cut off values in future study.

At the end, we can say from our study that "All are humans but all humans are not the same".

Limitation: For predictive difficult airway, we did not correlate the observations made by us with the laryngoscopic findings.

References

[1]. Gupta S, Sharma R, Jain D. Airway assessment: predictors of difficult airway.Indian J Anaesth. 2005 Jul 1;49(4):257-62.

[2]. Benumof JL. Definition and incidence of difficult airway. Airway management: principles and practice. 1996:121-5.

[3]. Shah PJ, Dubey KP, Yadav JP. Predictive value of upper lip bite test and ratio of height to thyromental distance compared to other multivariate airway assessment tests for difficult laryngoscopy in apparently normal patients. Journal of anaesthesiology, clinical pharmacology. 2013 Apr;29(2):191.

[4]. S S.OzaV.KumarV.ParmarV.Chhaya V. Assessment of difficult airwaypredictors for predicting difficult laryngoscopy and intubation.International Journal of Biomedical and Advance Research 2014;05(07):340-342.

[5]. Shiga T, Wajima ZI, Inoue T, Sakamoto A. Predicting Difficult Intubation in Apparently Normal PatientsA Meta-analysis of Bedside Screening Test Performance. Anesthesiology: The Journal of the American Society of Anesthesiologists. 2005 Aug 1;103(2):429-37.

[6]. Krobbuaban B, Diregpoke S, Kumkeaw S, Tanomsat M. The predictive value of the height ratio and thyromental distance: four predictive tests for difficult laryngoscopy. Anesthesia & Analgesia. 2005 Nov 1;101(5):1542-5.

[7]. Ramadhani SAL, Mohammed LA, Roche DA, and Gouws E: Sternomental distance as the sole predictor of difficult laryngoscopy in obstetric anesthesia. Br J Anaesth 1996; 77: 312-316.

[8]. Merah NA, Foulkes-Crabbe DJ, Kushimo OT, Ajayi PA. Prediction of difficult laryngoscopy in a population of Nigerian obstetric patients.West African journal of medicine. 2004;23(1):38-41.

[9]. Schmitt HJ, Kirmse M, Radespiel-Troger M. Ratio of patient's height to thyromental distance improves prediction of difficult laryngoscopy. Anaesthesia and intensive care. 2002 Dec 1;30(6):763.

[10]. Krishna HM. Prediction of difficult laryngoscopy in Indian population: role of ratio of patient's height to thyromental distance. Journal of Anaesthesiology Clinical Pharmacology. 2005;21(3):257-60.

[11]. OzaV,ChhayaV,ParmarV,BadhekaJ,GohilC,DuaD.Prediction of difficult laryngoscopy and endotracheal intubation in Rajkot city-Gujarat. Int J Res Med. 2013; 2(1);25-28.

[12]. Balakrishnan KP, Chockalingam PA. Ethnicity and upper airway measurements: A study in South Indian population. Indian journal of anaesthesia. 2017 Aug;61(8):622.

[13]. Vallem B, Thalisetty J, Challapalli SR, Israel N, Gudise S, Murthigari S. Comparison of upper lip bite test with other four predictors for predicting difficulty in intubation. JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS. 2015 May 14;4(39):6811-7.

[14]. Liaskou C, Vouzounerakis E, Moirasgenti M, Trikoupi A, Staikou C. Anatomic features of the neck as predictive markers of difficult direct laryngoscopy in men and women: A prospective study. Indian journal of anaesthesia. 2014 Mar;58(2):176-82.

[15]. Selvi O, Kahraman T, Senturk O, Tulgar S, Serifsoy E, Ozer Z. Evaluation of the reliability of preoperative descriptive airway assessment tests in prediction of the Cormack-Lehane score: A prospective randomized clinical study. Journal of Clinical Anesthesia. 2017 Feb 28;36:21-6.

Dr. Meera Pillai, et. al. "An assessment of anthropometric parameters to assess airway in Eastern Indian population: A prospective observational study."*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(04), 2021, pp. 41-47.