Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 8
Open Access

A study to predict difficult airway by Ultrasonography and conventional indices in Obese and Non-Obese population

Dr. Rajeev Puri[1], Dr. Vatsyayan Srivastava[2], Dr. Akanksha Verma[3], Dr. Varun Dwivedi[4], Dr. Santosh Kumar[5], Dr. Utkarsh Puri*[6]

[1.] Associate Professor, Department of Anaesthesia, SN Medical College, Agra
[2.] Senior Resident, Department of Anaesthesia, Autonomous State Medical College, Kanpur Dehat
[3.] Assistant Professor, Department of Obstetrics and Gynaecology, SN Medical College, Agra
[4.] JR-2 Department of Anaesthesia, SN Medical College, Agra
[5.] Professor, Department of Respiratory Medicine, S N Medical College, Agra
[6.] 2nd Year MBBS Student Rama Medical College, Kanpur

Cite this paper as: Dr. Rajeev Puri, Dr. Vatsyayan Srivastava, Dr. Akanksha Verma, Dr. Varun Dwivedi, Dr. Santosh Kumar, Dr. Utkarsh Puri (2024). A study to predict difficult airway by Ultrasonography and conventional indices in Obese and Non-Obese population. *Frontiers in Health Informatics*, *13 (8) 1185-1190*

ABSTRACT

Background: A "difficult airway" is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with mask ventilation, difficulty with tracheal intubation or both. The purpose of undertaking airway assessment is to diagnose the potential for difficult airway for optimal patient preparation, proper selection of equipment and technique and participation of personnel experienced in the difficult airway management. This study aims at proper airway assessment using conventional methods and ultrasound and then comparing it with the result obtained by laryngoscopy using proper statistical tests to prove the usefulness of USG for difficult airway prediction.

Material and Methods: This was a prospective comparative study done in the department of anesthesia and critical care in Sarojini Naidu Medical college, Agra. It involved a total of 120 patients divided into 2 groups of 60 patients each based on their BMI value who were found to be eligible for the study after meeting the inclusion criteria. Its objective was to compare the effectiveness of ultrasonography over conventional methods in prediction of difficult airway in obese and non-obese population. The study was conducted over a period of 18 months. The outcomes studied were Mallampati score, hyomental distance ratio obtained clinically, neck circumference, mouth opening, and neck mobility for conventional indices while hyomental distance ratio obtained using ultrasonography, hyoid bone visualization, distance from skin to epiglottis and anterior neck soft tissue at the level of vocal cord. The level of significance was set at <0.05.

Results: On the basis of all the conventional indices combined, 15 patients in non-obese group while 53 patients in obese group were found to be having difficult airway. On the basis of all the USG indices combined, 10 patients in non-obese group while 42 patients in obese group were found to be having difficult airway. Upon laryngoscopy, 10 patients in non-obese and 39 patients in obese group were found to be having difficult airway. All the groups were compared and the result was found to be statistically significant.

Conclusion: The above results clearly show the superiority of USG over conventional methods as a tool for prediction of difficult airway in both obese and non-obese population. Ultrasound of the upper airway shows promise in being an effective method for airway management.

Keywords- obese, non-obese, conventional indices, ultrasonographic indices, difficult airway.

INTRODUCTION

The term "airway" refers to the passage through which air/gas passes during respiration. It is divided into upper and lower airway. A "difficult airway" is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with mask ventilation, difficulty with tracheal intubation or both. The purpose of undertaking airway assessment is to diagnose the potential for difficult airway for optimal patient preparation, proper selection of equipment and technique and participation of personnel experienced in the difficult airway management. Routine preoperative airway examination usually includes an assessment of mouth opening and dentition, Mallampati classification, thyromental distance measurement, and evaluation of neck mobility.[1]

After direct laryngoscopic visualization by placing the intubating blade in the patient's airway, we can tell the Cormack-Lehane grading. If it becomes 3/4, this is a dreaded feature unless we are prepared for the difficult airway. Hence pre-operative prediction of these is a very useful tool for difficult airway assessment. Preoperative difficult airway prediction is one of the most important elements for the preanesthetic evaluation and comprises several clinical signs.[1] As none of the clinical signs has absolute diagnostic value and none can exclude difficult intubation, there is a continuous search for a predictive test with improved diagnostic accuracy that identifies patients at risk for airway problems, such as the inability to intubate and/or ventilate.

Ultrasound has recently emerged as a simple, compact, portable, noninvasive and safe tool for rapid airway assessment and management in operating room, emergency department and intensive care units.[2] Ultrasound has the same efficacy as of CT scan in quantifying almost all dimensions of airway structure. More than fifteen ultrasonographic measured parameters have been used in prospective studies, among which the significant ones are the measurements of the hyomental distance (HMD) and hyomental distances ratio (HMDR), visualization of hyoid bone using sublingual ultrasound, distance measured from skin to epiglottis and quantification of anterior neck soft tissue at the level of vocal cord and tongue thickness measurement.[3] The diagnostic accuracy of these conventional parameters varied widely in subsequent studies, suggesting that evaluation of clinical parameters might be operator dependent. In the last years, ultrasound measurements were applied for the hyomental distance ratio (HMDRecho), also with variable sensitivity and specificity.[4][5] We hypothesized that ultrasound measurements might be more precise compared to the clinical measurements. This might be especially important for patients in whom the hyoid bone is not easy to palpate, like the morbidly obese patients. These are believed to have higher difficult intubation incidences.[6] The aims of our study is to assess and describe the correlation between HMDR(clin) and HMDR(echo) in patients with and without morbid obesity and to compare their diagnostic accuracy for the prediction of difficult airways. We have demonstrated that the inability to visualize the hyoid bone using sublingual ultrasound predicts difficult intubation with a high sensitivity and specificity.[7] One of the parameters which recently had good predictive results was the ultrasonographically measured distance from skin to epiglottis at the level of thyrohyoid membrane.[8][9]

After using both the conventional methods of airway assessment and ultrasound guided airway assessment indirect laryngoscopy was done in each patient and the laryngoscopic view was defined using the "Cormack-Lehane" grading with grade 3&4 described as difficult intubation. Final result obtained by using conventional indices and USG was then compared with the result obtained by laryngoscopy using proper statistical tests to prove the usefulness of USG for difficult airway prediction.

MATERIAL AND METHODS

This study was a prospective comparative study conducted in the department of anaesthesia, pain and critical care at Sarojini Naidu Medical College, Agra. A total of 120 patients were included in the study, who met the inclusion criteria after taking informed consent. Ethical clearance was taken from the institutional ethical committee of the college. Patients

with neck deformities, laryngeal neoplasm, or a history of radiotherapy, cervical spine surgery, or emergency surgery requiring rapid sequence inductions were excluded.

All patients were allotted in two groups, obese and non-obese of 60 patients each on the basis of their BMI value. During the standard preanesthetic evaluation, the patient's body mass index was calculated as weight in kg. divided by the height in m^2. Standard clinical signs of difficult intubation were recorded including the Mallampati score, upper lip bite tests, neck circumference, mouth opening, and head extension. Modified Mallampatti classification (MMC) was specified according to the visibility of pharyngeal structures with the patient in an upright sitting position, head in neutral position, mouth wide open and tongue protruding to its maximum without phonation. Neck circumference was measured by a measuring tape at the level of thyroid cartilage. Clinical measurements for HMD in neutral and maximal hyperextended positions were done. The measurements were performed from the hyoid bone as palpated and the tip of the mandible. HMDR(clin) was obtained from the ratio of the hyomental distance measured with the head placed in maximal extension and the hyomental distance with the head placed in neutral position. Thyromental distance was measured with the patient's neck fully extended with closed mouth. Distance was measured from thyroid notch to the tip of mentum.

Ultrasound measurements were performed with a standard curvilinear probe placed in the mid sagittal plane in the submandibular region. HMDR(echo) was obtained from the ratio of the hyomental distance with the head placed in maximal hyperextended position and the hyomental distance measured with the head in neutral position. The hyomental distance was measured between the anterior border of the hyoid bone and the posterior aspect of the symphysis menti. To obtain the ultrasonography measured distance from skin to epiglottis at the thyrohyoid membrane level in transverse plane, the participants were placed supine with head and neck in neutral position without a pillow. A linear transducer was used for this study. Ultrasound quantification of anterior neck soft tissue was performed using a high frequency linear probe (13-6 MHz). The distance from skin to anterior aspect of trachea was measured at three levels: vocal cords, thyroid isthmus and suprasternal notch. The amount of soft tissue at each zone was calculated by averaging the amount of soft tissue in millimeters obtained in the central axis of neck and 1.5 mm to the left and right of central axis. The hyoid bone appeard as a hypoechoic, inverted 'U' shaped linear structure with posterior acoustic shadow on a transverse view with a linear probe. Next the thickness of soft tissue at hyoid bone was calculated by taking the average of the thickness of the soft tissue in mm obtained in the central axis at the hyoid bone and 10 mm to the left and right of central axis. The final reading was the average of 3.

RESULTS

Table No. 1: Comparison of obese and non-obese patients based on conventional indices

%	Easy		Difficult		Total	
	No.	%	No.	%	No.	%
Non–Obese	45	75.00	15	25.00	60	50.00
Obese	7	11.67	53	88.33	60	50.00
Total	52	43.33	68	56.67	120	100.00

$x^2 = 49.005$, $df = 1$, $p < 0.05$

Table 1 represents distribution of patients in obese and non- obese groups on the basis of all the conventional indices combined. 15 patients in non-obese group while 53 patients in obese group werefound to be having difficult airway. Both the groups were compared and the result was found to be statistically significant.

Table No. 2: Comparison of obese and non-obese patients based on USG indices.

	Easy		**Difficult**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Non–Obese	50	83.33	10	16.67	60	50.00

Obese	18	30.00	42	70.00	60	50.00
Total	68	56.66	52	43.33	120	100.00

$x^2 = 34.751$, $df = 1$, $p < 0.05$

Table 2 represents distribution of patients in obese and non-obese groups on the basis of all the USG indices combined. 10 patients in non-obese group while 42 patients in obese group were found to be having difficult airway. Both the groups were comparedand the result was found to be statistically significant.

Table No. 3: For Non-Obese patients

	Easy		**Difficult**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Conventional	45	75.00	15	25.00	60	50.00
USG	50	83.33	10	16.67	60	50.00
Laryngoscopy	50	83.33	10	16.67	60	50.00

$x^2 = 1.773$, $p > 0.05$

Table 3 represents distribution of patients in non-obese group on the basis of all the data obtained by conventional indices, USG indices and Laryngoscopy. Data obtained from all three methods was compared and the result was found to be statistically insignificant.

1. Senstivity for conventional indices = 10/15 x 100 = 66.67%
2. Specificity for conventional indices = 50/55 x 100 = 90.90%
3. Senstivity for USG indices = 10/10 x 100 = 100%
4. Specificity for USG indices = 50/50 x 100 = 100%

Table No. 4: For Obese patients

	Easy		**Difficult**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Conventional	07	11.67	53	88.33	60	50.00
USG	18	30.00	42	70.00	60	50.00
Laryngoscopy	21	35.00	39	65.00	60	50.00

$x^2 = 9.520$, $p < 0.05$

Table 4 represents distribution of patients in obese group on thebasis of all the data obtained by conventional indices, USG indices andLaryngoscopy. Data obtained from all three methods was compared and the result was found to be statistically significant.

1. Senstivity for conventional indices = 39/53 x 100 = 73.58%
2. Specificity for conventional indices = 21/35 x 100 = 66.67%
3. Senstivity for USG indices = 39/42 x 100 = 92.86%
4. Specificity for USG indices = 21/24 x 100 = 87.5%

DISCUSSION

The purpose of undertaking airway assessment is to diagnose the potential for difficult airway for optimal patient preparation, proper selection of equipment and technique and participation of personnel experienced in the difficult airway management.

Ultrasound has recently emerged as a simple, compact, portable, noninvasive and safe tool for rapid airway assessment and management in operating room, emergency department and intensive care units.[2] Ultrasound has the same efficacy as of CT scan in quantifying almost all dimensions of airway structure. In our study, 120 patients of either sex were enrolled and divided into 2 groups of obese and non-obese of 60 patients each based on their BMI value. A cutoff of 25 for BMI was kept for demarcation between obese and non-obese group. Demographic variables like age and gender were comparable in both the groups without any statistically significant difference (p value < 0.05). Mean value of age being 28 ± 11 in non-obese group and 30 ± 9 in obese group. The patients were assessed for their airway first by conventional methods viz. Mallampati Grading, Mouth opening, Neck mobility, Thyromental distance, Neck Circumference and Hyomental Distance ratio measured clinically and then by using USG indices viz. Distance from skin to epiglottis, Anterior Neck soft tissue measured at the level of vocal cord, Visualisation of hyoid bone using sublingual ultrasound Discussion [47] and Hyo-mental distance ratio measured and then compared the final result with the values we obtained by doing direct laryngoscopy based on CL (Cormack Lehane) grading.

10 patients in non-obese group while 39 patients in obese group were found to be having difficult airway. (Cl grade III & IV) according to direct laryngoscopic view of glottic opening. These were taken as gold standard for further comparison of results we get from all conventional and USG parameters. By conventional method we got 15/60 in non-obese group while 53/60 in obese group as having difficult airway. After applying proper statistical tests the sensitivity of conventional indices for prediction of airway came out to be 66.67% for non-obese population and 73.58% for obese population. Specificity was 90.90% for non-obese and 66.67% for obese population. By ultrasonographic evaluation we got 10/60 in non-obese and 42/60 in obese group as having difficult airway. After applying proper statistical tests the sensitivity of USG for prediction of airway came out to be 100% for non-obese population and 92.86% for obese population. Specificity was 100% for non-obese and 87.50% for obese population. The above results clearly show the better results obtained by using USG and it's superiority for prediction of difficult airway.

CONCLUSION

The above results clearly show the superiority of USG over conventional methods as a tool for prediction of difficult airway in both obese and non-obese population. Ultrasound of the upper airway shows promise in being an effective method for airway management. The role of USG in airway management is commonly underappreciated. Its practicality and efficacy in evaluation of complex anatomy like in obese patients can lead to increased usage in clinical scenarios. Ultrasound is safe, portable, non-invasive, painless, and widely available. Ultrasound can be a useful adjunct in difficult airway situations. However, further studies are needed to validate the use of ultrasonography in facilitating clinical decisions in the prediction and management of difficult airways.

REFERENCES

1. Det, M.E.; Jivraj, N.; Adhikari, N.K.; Friedrich, J.O.; Pinto, R.; Simel, D.L.;Wijeysundera, D.N.; Scales, D.C. Will this patient be difficult to intubate? the rational clinical examination systematic review. JAMA 2019, 321, 493–503.
2. Koundal, V.; Rana, S.; Thakur, R.; Chauhan, V.; Ekke, S.; Kumar, M. The usefulness of point of care ultrasound (POCUS) in preanaesthetic airway assessment. Indian J. Anaesth. 2019, 63, 1022. [PubMed]
3. Sara H. Gomes, Ana M. Simões, Andreia M. Nunes, Marta V. Pereira, Wendy H. Teoh, Patrício S. Costa, Michael S. Kristensen, Pedro M. Teixeira and José Miguel Pêgo. Useful ultrasonographic parameters to predict difficult laryngoscopy and difficult tracheal intubation-A systematic review and meta analysis doi: 10.3389/fmed 2021.671658

4. Petrisor, C.; Szabo, R.; Constantinescu, C.; Prie, A.; Tranca, S.; Hagau, N. The performance of ultrasound-based quantification of the hyomental distance ratio in predicting difficult airway in anaesthesia: A STARD-compliant prospective diagnostic study. Eur. J. Anaesthesiol. 2018, 35, 627–628. [CrossRef]
5. Petrisor, C.; Szabo, R.; Constantinescu, C.; Prie, A.; Hagau, N. Ultrasound-based assessment of hyomental distances in neutral, ramped, and maximum hyperextended positions, and derived ratios, for the prediction of difficult airway in the obese population: A pilot diagnostic accuracy study. Anaesthesiol. Intensive Ther. 2018, 50, 110–116. [CrossRef] [PubMed]
6. Juvin, P.; Lavaut, E.; Dupont, H.; Lefevre, P.; Demetriou, M.; Dumoulin, J.L. Difficult tracheal intubation is more common in obese than in lean patients. Anesth. Analg. 2003, 97, 595–600. [CrossRef]
7. Petrisor, C.; Dîrzu, D.; Tranca, S.; Hagau, N.; Bodolea, C. Preoperative difficult airway prediction using suprahyoid and infrahyoid ultrasonography derived measurements in anesthesiology. Med. U-ltrasonography 2019, 21, 83–88. [CrossRef]
8. Pinto J, Cordeiro L, Pereira C, Gama R, Fernandes HL, Assunção J. Predicting difcult laryngoscopy using ultrasound measurement of distance from skin to epiglottis. J Crit Care. 2016;33:26–31.
9. Shi D, Ni H, He G, et al. Value of ultrasonic measurement of distance from skin to epiglottis for predicting the difficult airway. J Shanghai Jiaotong Univ (Med Sci). 2017;37(3):373–376.
10. Krage R, Van Rijn C, Van Groeningen D, Loer SA, Schwarte LA, Schober P. Cormack-Lehane classification revisited. Br J Anaesth. (2010) 105:220– 7. doi: 10.1093/bja/aeq136.