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ARTIGO ORIGINAL / ORIGINAL ARTICLE

A Prospective Study to Compare Predictive Value of Five Parameters for Difficult Intubation

Estudo Prospectivo para Comparar o Valor Preditivo de Cinco Parâmetros na Intubação Difícil

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Airway Management; Intubation, Intratracheal; Laryngoscopy.

Palavras-chave
Intubação Intratraqueal; Laringoscopia; Manuseamento das Vias Aéreas.

ABSTRACT

Introduction: Patients undergoing surgery under general anesthesia must have their airways secured and proper breathing and oxygenation. Complications from poor airway control might include aspiration, hypoxemia, airway damage, and even mortality. Therefore, it is crucial to anticipate a challenging airway and intubation to prevent complications. The study aims to develop a simple, easy-to-use predictor with high specificity and sensitivity for predicting difficult intubation. The five parameters being looked at are thyromental height test (TMHT), thyromental distance (TMD), modified Mallampati classification (MPC), neck circumference (NC), and Wilson's score (WS).

Methods: Five parameters were used to evaluate patients preoperatively for difficult intubation, and an intubation difficulty score was calculated. We calculated and compared the specificity, sensitivity, positive predictive value, negative predictive value, and area under the curve for these five parameters.

Results: The PPV of TMHT was 80%, TMD was 40%, MPC was 34.37%, NC was 26.83%, and MPC was 26.09% respectively. The TMHT showed a specificity of 97.75%, sensitivity of 71.43%, NPV OF 96.44%, and accuracy of 94.80% with an area under the curve was 0.946.

Conclusion: The study found that thyromental height (TMHT) was the best predictor out of all the factors that were looked at. It had the highest sensitivity, PPV, NPV, accuracy, and AUC. Mallampati score (MPC), neck circumference (NC), and Wilson score (WS) demonstrated similar statistical values, but these were of limited diagnostic value. Thyromental distance (TMD) was the least reliable parameter for predicting difficult intubation due to its limited sensitivity.

RESUMO

Introdução: Os doentes submetidos a cirurgia sob anestesia geral devem ter as vias aéreas asseguradas, bem como uma ventilação e oxigenação adequadas. As complicações decorrentes de um controlo ineficaz da via aérea podem incluir aspiração, hipoxemia, lesão das vias aéreas e até mortalidade. Por isso, é crucial antecipar a existência de uma via aérea difícil e uma intubação desafiante, de forma a prevenir estas complicações. Este estudo tem como objetivo identificar um preditor simples, de fácil aplicação e com elevada especificidade e sensibilidade para prever a dificuldade na intubação. Os cinco parâmetros avaliados foram: o teste da altura tiromentoniana (TMHT), a distância tiromentoniana (TMD), a classificação modificada de Mallampati (MPC), a circunferência do pescoço (NC) e o índice de Wilson (WS).

Métodos: Os cinco parâmetros foram usados na avaliação pré-operatória dos doentes quanto à possibilidade de intubação difícil, tendo sido calculado um índice de dificuldade de intubação. Foram determinados e comparados a especificidade, sensibilidade, valor preditivo positivo (VPP), valor preditivo negativo (VPN) e a área sob a curva (AUC) para cada um dos cinco parâmetros.

Resultados: O VPP do TMHT foi de 80%, da TMD de 40%, do MPC de 34,37%, da NC de 26,83% e do WS de 26,09%, respetivamente. O TMHT demonstrou uma especificidade de 97,75%, sensibilidade de 71,43%, VPN de 96,44% e uma precisão de 94,80%, com uma área sob a curva de 0,946.

Conclusão: O estudo concluiu que a altura tiromentoniana (TMHT) foi o melhor preditor entre todos os parâmetros avaliados, apresentando os valores mais elevados de sensibilidade, VPP, VPN, precisão e AUC. A classificação de Mallampati (MPC), a circunferência do pescoço (NC) e o índice de Wilson (WS) apresentaram valores estatísticos semelhantes entre si, mas de utilidade diagnóstica limitada. A distância tiromentoniana (TMD) revelou ser o parâmetro menos fiável na previsão de intubação difícil, devido à sua reduzida sensibilidade.

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INTRODUCTION

Patients undergoing surgery under general anesthesia must have their airways secured and have proper breathing and oxygenation.[1] Complications from poor airway control might include aspiration, hypoxemia, airway damage, and even mortality.[2,3] Anesthesiologists are particularly concerned about difficult tracheal intubation because it increases perioperative morbidity and mortality.[4] Most common airway

emergencies happen when airway problems go unnoticed.[5] Tracheal intubation and laryngoscopy complications have been documented in 1.5% to 8% of patients who undergo general anesthesia.[6,7] The inability to manage a problematic airway accounts for 30%-40% of all anesthesia deaths.[8,9] Therefore, anesthesiologists must forecast difficult tracheal intubation and anticipate a problematic airway to avoid difficulties.

Several bedside screening tests, such as sternomental distance, hyomental distance, Patil's thyromental distance measurement, the modified Mallampati classification, the Wilson scoring system, and neck circumference, have been developed to address unanticipated difficult intubation.[10] However, these tests have limitations, and no single test is comprehensive. The perfect predictor should be simple to use, give a high positive predictive value with few false positives, and have high sensitivity and specificity.[11] Previous studies have shown that screening tests for difficult intubation are less helpful when they employ only one parameter.[12] Therefore, combining two or more individual parameters or using multivariate risk index systems may provide incremental diagnostic value compared to a single parameter.[13]

The thyromental height test is a novel bedside screening tool that outperforms the sternomental distance, thyromental distance and modified Mallampati score.[14]

This study aims to find a simple, easy-to-use predictor with high specificity and sensitivity for difficult intubation. The five parameters are thyromental height test (TMHT), thyromental distance (TMD), modified Mallampati classification (MPC), neck circumference (NC), and Wilson's score (WS). The intubation difficulty measure (IDS), a comprehensive measure for predicting difficult intubation, will be utilized to assess intubation difficulty.[16]

MATERIAL AND METHODS

The Department of Anaesthesia at a tertiary care hospital conducted a prospective observational and comparative study over two years on 250 patients in all operating rooms, with Institutional Ethics Committee permission. The study included all patients with ASA grades I and II, regardless of gender, aged 18 to 60, undergoing elective surgery under general anesthesia. The study excluded patients who denied consent, were unable to sit, had neuromuscular diseases, upper airway pathology, were pregnant, or had cervical spine fractures. Patients who met the inclusion criteria were added to the study after providing written informed consent. All data were recorded in the study proforma. Patients scheduled for elective surgery under general anesthesia had a preanesthetic examination. This included a thorough history, airway assessment, and general and systemic examination.

Airway Assessment

Thyromental Height Test (TMHT) **(Fig. 1)**: Measure the anterior borders of the thyroid cartilage and mandibular mental protuberance with a depth caliper to determine thyromental height. The patient was placed in a supine position with a pillow under their head and their head and neck in a neutral position. The height was measured with a depth gauge. It was determined that a height of less than 50 mm was suggestive of a challenging intubation.[17]

Figure 1. Thyromental height test

This is the thyromental distance (TMD) **(Fig. 2)**. To get an idea of it, a straight line was drawn from the top edge of the thyroid cartilage to the bony growth of the mentum. Less than 6.5 cm was a predictor of intubation difficulty.[18]

Figure 2. Thyromental distance

Modified Mallampati classification (MPC) **(Fig. 3)**: The MPC was assessed while the subject was seated, with the mouth open and the tongue protruding without phonation.[19]

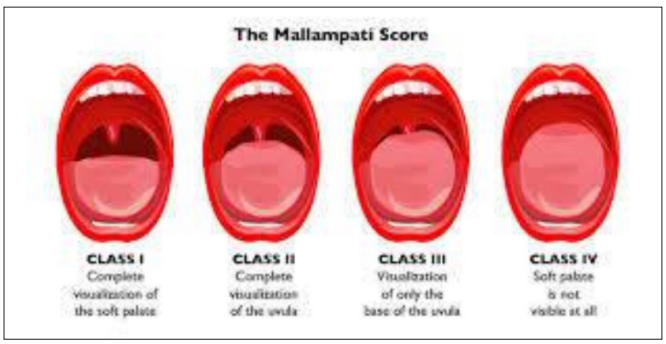

Figure 3. Modified Mallampati Score

Neck circumference (Nc) **(Fig. 4)**: It was measured using a tape at the level of the thyroid cartilage. A measurement greater than

Figure 4. Neck circumference

37.5 cm was deemed a predictor of problematic intubation.[20]
Wilson's score (Ws) **(Fig. 5)**: Five factors are considered in this scoring- weight, head, and neck movement, receding mandible, Buck test, and jaw movement.[21]
Prediction: 0-1= easy intubation
≥2-3= possibly difficult
≥4= often difficult

WILSON SCORE

Parameter	0	1	2
Weight (kg)	< 90	90 – 110	> 110
Head & neck movement	> 90	= 90	< 90
IID	> 5	= 5	< 5
Receding mandible	None	Moderate	severe
Buck teeth	None	Moderate	severe

Figure 5. Wilson's score

On the surgery day:
Before taking the patient to the theatre reevaluation done. Monitors were attached and basal parameters were noted, and a 20G peripheral intravenous catheter was secured.
The patient was pre-oxygenated and pre-medicated with inj. glycopyrrolate 0.004 mg/kg, inj. midazolam 0.03 mg/kg, inj. pentazocine 0.5 mg/kg IV. Patient induced with inj. propofol 2 mg/kg in graded doses till loss of consciousness. The patient was checked for ventilation and after confirming ventilation, a muscle relaxant inj. succinylcholine 1.5 mg/kg was given to facilitate endotracheal intubation. After 60 seconds, neuromuscular blockade was evaluated. Using a Macintosh blade number three or four, a team of anesthesiologists with at least three years of expertise performed laryngoscopy in the sniffing position. They were blinded to the five parameters assessment. After successful laryngoscopy and intubation, IDS was recorded and graded by the senior anaesthesiologist as follows
Intubation Difficulty score (IDS):
N1 (each attempt of additional intubation) =
N2 (number of additional operators) =
N3 (number of alternative intubation techniques) =
N4 (Cormack Lehane (CL) grading) =
N4=0 Grade I: entire glottis seen
N4=1 Grade II: only the posterior portion of the glottis seen
N4=2 Grade III: only epiglottis seen
N4=3 Grade IV: absence of glottis and epiglottis
N5 lifting force applied during laryngoscopy =
N5=0, if considerable force not applied
N5=1, if considerable force applied
N6 (external laryngeal pressure needed) =
N6=0, if no external pressure applied
N6=1, if external pressure applied
N7 vocal cord position =
N7=0, if not abducted
N7=1, if adducted
Rules for calculation of IDS
N1 Every additional attempt adds 1pt
N2 Each additional operator adds 1pt
N3 Each alternative technique adds 1 point: Repositioning of the patient, change of materials, change in approach (nasotracheal/orotracheal), or use of another method (fiberoptic, intubation through a laryngeal mask)
N4 Cormack grading for the initial oral attempt.
N4 = 0 for a successful blind intubation.
N7 If the vocal cords are not visualized, N7 = 0
Impossible intubation: IDS uses the value obtained before the discontinuation of intubation attempts.
Easy intubation- IDS<5
Difficult laryngoscopy- IDS>=5
Statistical analysis: A semi-structured, pretested questionnaire was used to gather data, which was then entered into Microsoft Excel. Frequencies, percentages, and tables were used to display the data. The mean and standard deviation of the quantitative variables were shown. SPSS software version 21 was used for analysis, and appropriate statistical tests (Chi-square test) were used. To determine the degree of agreement, kappa statistics were performed. ROC curve analysis was performed to determine the strongest predictor for challenging intubation. AUC was studied.

RESULTS

Around 25 participants had a thyromental height of less than 50 mm out of whom 20 (80%) people had difficult intubation. Just 3.5 percent of research participants with a thyromental height greater than 50 mm received a difficult intubation score. This difference was statistically significant (**Table 1**).

Table 1. Relation between Thyromental Height and Intubation Difficulty Score.

Thyromental height	Intubation score		Total	
	Difficult	Easy		
<50 mm	20	5	25	*p* value <0.001
=/>50	8	217	225	
Total	28	222	250	

Approximately five participants in the study exhibited a thyromental distance of under 6.5 cm, with 40% of them experiencing difficult intubation. A percentage of 11.8% of the individuals with a thyromental distance greater than 6.5 cm faced challenges during intubation. The relationship between thyromental distance and intubation difficulty score was statistically significant (**Table 2**).

Table 2. Relationship between Thyromental Distance and Intubation Difficulty Score.

Thyromental height	Intubation score		Total	
	Difficult	Easy		
<6.5	2	3	5	*p* value 0.003
=/>6.5	26	219	245	
Total	28	222	250	

Around 32 study participants had Mallampati grades more than two (3.4) among whom 34.37% had difficult intubation. When compared to participants who had Mallampati grades 1 and 2, only 7.7% of them had difficult intubation. This difference was statistically significant (**Table 3**).

Table 3. Relationship between Mallampati Score and Intubation Difficulty Score.

Mallampati score	Intubation score		Total	
	Difficult	Easy		
>2	11	21	32	*p* value 0.002
=/<2	17	201	218	
Total	28	222	250	

Of the 41 trial participants with a neck circumference larger than 37.5 cm, 26% found intubation difficult. Of the 208 individuals in the research, 8% had difficult intubation. This difference was statistically significant (**Table 4**).

Table 4. Relationship between Neck Circumference and Intubation Score.

Neck circumference	Intubation score		Total	
	Difficult	Easy		
>37.5	11	30	41	*p* value 0.002
=/<37.5	17	192	209	
Total	28	222	250	

Of the 23 research participants with a Wilson score below 4.26% had difficulties in intubation, compared to 227 individuals with a score below four. There was a statistically significant difference (**Table 5**).

Table 5. Relationship between Wilson Score and Intubation Difficulty Score.

Wilson score	Intubation score		Total	
	Difficult	Easy		
>4	6	17	27	*p* value 0.03
<4	22	205	227	
Total	28	222	250	

When all these predictors of difficult intubation are compared in terms of sensitivity, specificity, PPV, NPV, area under the curve and, accuracy shows the following result (**Table 6**).

DISCUSSION

Difficult or failed intubation has caused significant perioperative morbidity and mortality, making it a major concern for anesthesiologists. Such complications include hypoxemia, aspiration, airway trauma, and even death. Most of these complications occur when difficult intubation is not recognized in advance. Therefore, anticipating difficult intubation has become important for anesthetists to prevent these complications.

Various bedside tests, such as thyromental distance, sternomental distance, neck circumference, Mallampati score, weight, height, BMI, and Wilson score, have been described to anticipate difficult intubation, but they often yield unsatisfactory results. As a result, there is a need for a single test with improved predictive value for difficult intubation. Etzadi *et al*[22] hypothesized that difficult laryngoscopy is closely associated with the thyromental height test. Using a 50 mm threshold, the study found that TMHT was more correct than other tests (all $p < 0.0001$). Rao KV *et al* (2018),[23] compared TMHT with other predictors of difficult intubation like TMD, MPC, NC, and neck extension. According to their research, TMHT, with difficulty measured by the Cormack-Lehane (CL) grading system, was the most promising anatomical metric for forecasting difficult laryngoscopy.

We examined the following factors as possible indicators of difficult intubation: Wilson score, neck circumference, Modified Mallampati score, thyromental height, and thyromental distance. Since these numbers indicate the likelihood of difficult intubation for patients who test positive and the likelihood of not experiencing difficult intubation for patients who test negative, the positive predictive value and negative

Table 6. Comparison of predictors of difficult intubation.

Predicting factors of difficult intubation	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy	Area under the curve
Thyromental height	71.43%	97.75%	80.00%	96.44%	94.80%	0.946
Thyromental distance	7.14%	98.65%	40.00%	89.39%	88.40%	0.642
Mallampati score	39.29%	90.54%	34.37%	92.20%	84.80%	0.752
Neck circumference	39.29%	86.49%	26.83%	91.87%	81.20%	0.650
Wilson score	21.43%	92.34%	26.09%	90.31%	84.40%	0.755

predictive value were utilized for comparison.

The Intubation Difficulty score (IDS), which not only helps evaluate characteristics associated with difficult intubations but also offers a standardized method for comparing studies on this topic, was used to measure the difficulty at the time of intubation.

We observed that 25 participants had a thyromental height of less than 50 mm, of whom 20 (80%) experienced difficult intubation. Among participants with a thyromental height greater than 50 mm, only eight (3.5%) had a difficult intubation score. Our findings revealed that the greatest sensitivity, accuracy, area under the curve (AUC), positive predictive value (PPV), and negative predictive value (NPV) were found in thyromental height, with values of 71.43%, 80%, 96.44%, 94.80%, and 0.946, respectively. It also had a good specificity of 97.75%. Etzadi *et al*,[22] compared TMHT with the MPC, TMD, and sternomental distance in 314 patients aged ≥16 years. They noted Cormack-Lehane grading during intubation to assess difficult intubation. It was shown that the thyromental height had an 83% sensitivity and a 99% specificity. After determining that the range of 47.46 to 51.02 mm had the optimum sensitivity and specificity, they decided to employ a cut-off value of 50 mm for clinical application. In comparison to current anatomical measurements, the thyromental height test was found to be more accurate than other tests (all $p < 0.0001$), indicating that it is a more reliable predictor of difficult laryngoscopy. Rao KV *et al*,[23] found sensitivity, specificity, PPV, NPV, accuracy, and AUC values of 84.2%, 98.97%, 88%, 98.3%, 97.7%, and 0.92, respectively, for TMHT. Two (40%) of the five study participants who had a thyromental distance of less than 6.5 cm experienced challenging intubation. Twenty six (11.8%) of the remaining 219 participants who had a thyromental gap larger than 6.5 cm experienced difficulties during intubation. The sensitivity, NPV, and AUC of thyromental distance were the lowest, at 7.14%, 89.39%, and 0.642, respectively. Its PPV was 40%, its accuracy was 88.40%, and its specificity was the best at 98.65%. The results were in line with several other research, showing that thyromental distance (TMD) had the best specificity but the lowest sensitivity as a predictor of difficult intubation.

Shiga *et al*[24] conducted a meta-analysis on 35 patients and found a sensitivity of 20%, a specificity of 94%, and an odds ratio of 3.4 for TMD. Nilesh Jain *et al*,[17] found a sensitivity of 22%, specificity of 98%, PPV of 58%, NPV of 92%, and accuracy of 91%, which were similar to our findings.

Thirty-two study participants had a Mallampati grade greater than two (3 or 4), among whom 11 (34.37%) had difficult intubation, compared to only 17 (7.7%) among those with Mallampati grade 1 or 2. The sensitivity, specificity, PPV, NPV, accuracy, and AUC were 39.2%, 90.54%, 34.37%, 92.20%, 84.80%, and 0.752, respectively. Shiga *et al*,[24] reported almost similar findings in their study. Rao KV *et al*[23] reported a sensitivity of 61%, moderate specificity of 71%, PPV of 25%, NPV of 97%, and accuracy of 80%, which were similar to our study.

Intubation was challenging for 11 (26%) of the 41 study participants whose neck circumference was larger than 37.5 cm, while it was easy for 17 (8%) of the 208 persons whose neck circumference was less than 37.5 cm. The diagnostic values for neck circumference were sensitivity 39.29%, specificity 86.49%, PPV 26.83%, NPV 91.87%, accuracy 81.20%, and AUC 0.65. Gonzalez H *et al*,[25] reported very good results for neck circumference with a sensitivity of 92%, specificity of 84%, PPV of 37%, and NPV of 99%, using a cut-off value of >43 cm. In our study, the results were moderate, as we used a cut-off of >37.5 cm. Rao KV *et al*,[23] found a sensitivity of 65%, specificity of 32%, PPV of 7%, NPV of 91%, accuracy of 35%, and AUC of 0.49.

Out of 23 participants with a Wilson score ≥4, six (26%) had difficult intubation, compared to 22 (9%) among 227 participants with a Wilson score <4. The diagnostic values for the Wilson score in our study were sensitivity 21.43%, specificity 92.34%, PPV 26.09%, NPV 90.31%, accuracy 84.40%, and AUC 0.755. Shiga *et al*,[24] found that the Wilson score had moderate diagnostic value, with sensitivity of 46%, specificity of 89%, and positive and negative likelihood ratios of 5.8 and 0.6. Gonzalez H *et al*[25] found good results for the Wilson score with sensitivity of 75%, specificity of 60%, PPV of 16%, and NPV of 96%.

In our study, 28 out of 250 patients had difficult intubation according to the IDS, resulting in an incidence of 11.2%. We compared five predictors of difficult intubation in this study. The sensitivities were as follows: TMHT (71.43%) > MPC (39.29%) = NC (39.29%) > WS (21.43%) > TMD (7.14%). TMHT was the most sensitive parameter, while TMD was the least sensitive. TMD (98.65%) had the highest specificity, followed by TMHT (97.75%), WS (92.34%), MPC (90.54%), and NC (86.49%). The PPVs were in the following order: TMHT (80%) > TMD (40%) > MPC (34.37%) > NC (26.83%) > WS (26.09%). The NPVs in decreasing order were: TMHT (96.44%) > MPC (92.20%) > NC (91.87%) > WS (90.31%) > TMD (89.39%). Accuracy was best for TMHT (94.80%) > TMD (88.40%) > MPC (84.80%) > WS (84.40%) > NC (81.20%). The best AUC was observed in TMHT (0.946), followed by WS (0.755), MPC (0.752), NC (0.650), and TMD (0.642).

Etzadi *et al*,[22] found the sensitivities as: TMHT (82%) > MPC (26%) > TMD (21%). In their study, the specificities were: TMHT (99%) > MPC (86%) > TMD (80%). The PPVs were in the following order: TMHT (90%) > MPC (13%) > TMD (8%). The NPV was highest for TMHT (98%) > MPC (93%) > TMD (92%). Accuracy in their study was as follows: TMHT (98%) > MPC (86%) > TMD (71%).

Rao *et al*,[23] also showed the best results for TMHT with sensitivity of 84% (MPC 73%, NC 65%, TMD 11%), specificity of 98% (TMD 83%, MPC 81%, NC 32%), PPV of 88% (MPC 25%, NC 7%, TMD 5%), NPV of 98% (MPC 97%, NC 91%, and TMD 91%), accuracy of 97% (MPC 80%, TMD 77%, NC 35%), and AUC of 0.92 (MPC 0.77, NC 0.49, TMD 0.10).

Limitations

We considered an IDS score of ≥5 as indicative of difficult intubation, excluding mild to moderate cases.

CONCLUSION

This study concluded that the thyromental height has proven

to be the best predictor among all the parameters we compared, with the highest sensitivity, PPV, NPV, accuracy, and AUC. Mallampati score (MPC), neck circumference (NC), and Wilson score (WS) demonstrated similar statistical values, but these were of limited diagnostic value. The measure with the lowest sensitivity and AUC for predicting difficult intubation was thyromental distance (TMD). Other metrics, such as Wilson score, MPC, and NC, produced comparable outcomes and were just as useful as those for challenging intubation. Therefore, we deduce that the Thyromental Height test (TMHT) is the most useful metric for forecasting challenging intubation.

DECLARAÇÃO DE CONTRIBUIÇÃO / *CONTRIBUTORSHIP STATEMENT*

Todos os autores são responsáveis por contribuições substanciais para a concepção ou o desenho do trabalho. Todos os autores aprovaram a versão final a ser publicada.

All authors are responsible for substantial contributions to the conception or design of the work. All authors approved the final version to be published.

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Confidencialidade dos Dados: Os autores declaram ter seguido os protocolos da sua instituição acerca da publicação dos dados de doentes.
Proteção de Pessoas e Animais: Os autores declaram que os procedimentos seguidos estavam de acordo com os regulamentos estabelecidos pela Comissão de Ética responsável e de acordo com a Declaração de Helsínquia revista em 2024 e da Associação Médica Mundial.
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REFERENCES

1. Li LT, Chitilian HV, Alfille PH, Bao X. Airway management and anesthesia for airway surgery: a narrative review. Transl Lung Cancer Res. 2021;10:4631-42. doi: 10.21037/tlcr-21-917.
2. Khan RM, Sharma PK, Kaul N. Airway management in trauma. Indian J Anaesth. 2011;55:463-9. doi: 10.4103/0019-5049.89870.
3. Cook TM, MacDougall-Davis SR. Complications and failure of airway management. Br J Anaesth. 2012;109 Suppl 1:i68-i85. doi: 10.1093/bja/aes393.
4. Joffe AM, Aziz MF, Posner KL, Duggan LV, Mincer SL, Domino KB. Management of Difficult Tracheal Intubation: A Closed Claims Analysis. Anesthesiology. 2019;131:818-29. doi: 10.1097/ALN.0000000000002815.
5. Benumof JL. Management of the difficult adult airway. With special emphasis on awake tracheal intubation. Anesthesiology. 1991;75:1087-110. doi: 10.1097/00000542-199112000-00021. Erratum in: Anesthesiology 1993;78:224.
6. Kamal K, Rani D, Ahlawat G, Bansal T. Prediction of Difficult Endotracheal Intubation by Different Bedside Tests: An Observational Study. Bali J Anesthesiol. 2023;7:8-12. doi: 10.4103/bjoa.bjoa_228_22
7. Tamire T, Demelash H, Admasu W. Predictive Values of Preoperative Tests for Difficult Laryngoscopy and Intubation in Adult Patients at Tikur Anbessa Specialized Hospital. Anesthesiol Res Pract. 2019;2019:1790413. doi: 10.1155/2019/1790413.
8. Galway U, Wang M, Deeby M, Zura A, Riter Q, Abdelmalak B. Recognition and management of the difficult airway—a narrative review and update on the latest guidelines. J Oral Maxillofac Anesth 2023;2:29. doi: 10.21037/joma-23-3
9. Joffe AM, Aziz MF, Posner KL, Duggan LV, Mincer SL, Domino KB. Management of Difficult Tracheal Intubation: A Closed Claims Analysis. Anesthesiology. 2019;131:818-29. doi: 10.1097/ALN.0000000000002815.
10. Roth D, Pace NL, Lee A, Hovhannisyan K, Warenits AM, Arrich J, et al. Airway physical examination tests for detection of difficult airway management in apparently normal adult patients. Cochrane Database Syst Rev. 2018;5:CD008874. doi: 10.1002/14651858.CD008874.pub2.
11. Shailaja S, Nichelle SM, Shetty AK, Hegde BR. Comparing ease of intubation in obese and lean patients using intubation difficulty scale. Anesth Essays Res. 2014;8:168-74. doi: 10.4103/0259-1162.134493.
12. Tantri AR, Firdaus R, Salomo ST. Predictors of Difficult Intubation Among Malay Patients in Indonesia. Anesth Pain Med. 2016;6:e34848. doi: 10.5812/aapm.34848.
13. Kim WH, Ahn HJ, Lee CJ, Shin BS, Ko JS, Choi SJ, et alNeck circumference to thyromental distance ratio: a new predictor of difficult intubation in obese patients. Br J Anaesth. 2011;106:743-8. doi: 10.1093/bja/aer024.
14. Bhiwal AK, Sharma C, Tripathi A. Evaluation of thyromental height test as a single anatomical measure for prediction of difficult laryngoscopy: a prospective observational study. Ain-Shams J Anesthesiol. 2023;15:75. doi:10.1186/s42077-023-00372-0
15. Panjiar P, Kochhar A, Bhat KM, Bhat MA. Comparison of thyromental height test with ratio of height to thyromental distance, thyromental distance, and modified Mallampati test in predicting difficult laryngoscopy: A prospective study. J Anaesthesiol Clin Pharmacol. 2019;35:390-5. doi: 10.4103/joacp.JOACP_276_18.
16. Kang TW, Wang JD, Tsai YS, Lin CR, Tseng CA. Intubation difficulty scale contributors and time delay in clinical practice. Medicine. 2022;101:e28724. doi: 10.1097/MD.0000000000028724.
17. Jain N, Das S, Kanchi M. Thyromental height test for prediction of difficult laryngoscopy in patients undergoing coronary artery bypass graft surgical procedure. Ann Card Anaesth. 2017;20:207-11. doi: 10.4103/aca.ACA_229_16.
18. Cm A, Rao SS, Rooparani K, Vinay R, Vikas Kn, Deepak TS. The Ratio of Height to Thyromental Distance (RHTMD) and Height to Sternomental Distance (RHSMD) as the Predictive Tests for Difficult Tracheal Intubation. Cureus. 2022;14:e28734. doi: 10.7759/cureus.28734.
19. Singh M, Anand L, Singh J, Kapoor D. "PUSH" as a mnemonic for Modified Mallampati classification. J Anaesthesiol Clin Pharmacol. 2020;36:568-69. doi: 10.4103/joacp.JOACP_437_19.
20. Riad W, Vaez MN, Raveendran R, Tam AD, Quereshy FA, Chung F, et al. Neck circumference as a predictor of difficult intubation and difficult mask ventilation in morbidly obese patients: A prospective observational study. Eur J Anaesthesiol. 2016;33:244-9. doi: 10.1097/EJA.0000000000000324.
21. Siddiqui KM, Hameed F, Ali MA. Diagnostic Accuracy of Combined Mallampati and Wilson Score to Predict Difficult Intubation in Obese Patients: A Descriptive Cross-sectional Study. Anesth Pain Med. 2022;11:e118626. doi: 10.5812/aapm.118626.
22. Etezadi F, Ahangari A, Shokri H, Najafi A, Khajavi MR, Daghigh M, et al. Thyromental height: a new clinical test for prediction of difficult laryngoscopy. Anesth Analg. 2013;117:1347-51. doi: 10.1213/ANE.0b013e3182a8c734.
23. Rao KV, Dhatchinamoorthi D, Nandhakumar A, Selvarajan N, Akula HR, Thiruvenkatarajan V. Validity of thyromental height test as a predictor of difficult laryngoscopy: A prospective evaluation comparing modified Mallampati score, interincisor gap, thyromental distance, neck circumference, and neck extension. Indian J Anaesth. 2018;62:603-8. doi: 10.4103/ija.IJA_162_18.
24. Shiga T, Wajima Z, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. Anesthesiology. 2005;103:429-37. doi: 10.1097/00000542-200508000-00027.
25. Gonzalez H, Minville V, Delanoue K, Mazerolles M, Concina D, Fourcade O. The importance of increased neck circumference to intubation difficulties in obese patients. Anesth Analg. 2008;106:1132-6. doi: 10.1213/ane.0b013e3181679659.