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ORIGINAL STUDY

Anaesthesiologic and intensive care particularities in cervical surgery

Olimpia Iulia Zoican[1,2], Codrut Sarafoleanu[3]

[1]Anesthesiology and Intensive Care Department, University Emergency Hospital, Bucharest, Romania

[2]"Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

[3]ENT Department, Faculty of Dentistry, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

ABSTRACT

BACKGROUND. Endotracheal intubation is frequently used to maintain airways proper functioning during elective surgical operations, in intensive care and in emergency rooms. The pathology of the oropharyngeal and laryngeal area or that of the cervical area induces, in most cases, changes in the airways, especially in the sense of their narrowing or deviation. The presence of tumors on the oro-pharyngo-laryngeal axis, some bleeding easily spontaneously or upon touch, can make the anaesthetic procedure difficult.

MATERIAL AND METHODS. We conducted a prospective, observational study on 50 patients with cervical pathology who required general anaesthesia during 2019-2021. The criteria and parameters analysed for predicting difficult intubation were the duration of orotracheal or nasotracheal intubation, difficult face mask ventilation, Cormack-Lehane and Mallampati scores, anthropometric determinations of various cervical landmarks, including the thyromental distance, the distance between the arytenoid cartilages and the distance from the plane of the arytenoid cartilages to the skin, both of the latter determined ultrasonographically.

RESULTS. The following statistically significant differences emerge from the study: the duration of orotracheal intubation ($p<0.001$), the difficulty of face mask ventilation ($p<0.001$), the intercondylar distance ($p=0.042$), the intermastoid distance ($p=0.023$), the Cormack-Lehane score ($p=0.013$), the Mallampati score ($p=0.004$), the distance between the arytenoid cartilages ($p=0.007$), the distance between the plane of the arytenoid cartilages and the skin ($p<0.001$). All were increased in patients with tumoral pathology.

CONCLUSION. The study demonstrates the variation of new criteria and parameters that can be analysed for the prediction of a difficult airway, identifies the efficiency of using ultrasound whenever possible in the preanesthetic evaluation of the airway, and quantifies the risk of difficulty in airway management based on anthropometric data, particularly through the occurrence of asymmetry at the cervical or facial level.

KEYWORDS: anaesthesiology, intensive care, cervical asymmetry, difficult intubation prediction, cervical surgery, upper airway ultrasound.

INTRODUCTION

A problematic airway is a clinical scenario in which a healthcare professional with expertise in airway management, an anaesthesiologist, has trouble using one or more of the accepted airway management techniques1. There are some differences across national expert guidelines and there is no common definition in the literature regarding a "problematic airway"[1].

The degree of difficulty in managing an airway varies greatly and it is influenced by several variables, including the patient's characteristics, medical and surgical history, airway examination, the clinical situation (including the nature of any planned surgical procedure), and the patient's current medical condition and vital signs[2].

Any patient experiencing respiratory distress should have their airway evaluated as quickly as possible for any indications of potential trouble[2]. Congenital or acquired anatomical anomalies should be quickly evaluated at first[2]. Patients who have experienced face, head, or neck injuries, oral bleeding, regurgitated stomach contents, or mouth foaming should receive special treatment[2].

An assessment by Mallampati score should be carried out on patients who are cooperative[3]. Through bucopharyngoscopy we examine the tongue's size, the mouth's ability to open fully, the teeth's health and existence, the aspect of the soft palate and the uvula[3]. The intubation should be simpler

Corresponding author: Olimpia Iulia Zoican, MD, PhD candidate, Anesthesiology and Intensive Care Department, University Emergency Hospital, Bucharest, Romania
Address: 24 Octavian Goga Blvd., District 3, 030981, Bucharest, Romania
ORCID: https://orcid.org/0009-0002-0708-6030
e-mail: olimpia.iulia.zoican@gmail.com
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the more uvula is visible behind the tongue[3]. The thyromental distance should be checked externally[3]. The thyromental distance is measured as a straight line between the lower edge of the mental protuberance and the prominence of the thyroid cartilage, with the head in extension.

The intubation may be more challenging the closer the chin is to the chest wall when the head is in the middle position[3]. Similar to this, a severe overbite might make it difficult to place the laryngoscope.

Injury to the neck may make it unsafe to move the head, and poor placement can pose challenges for intubation[3]. Every time an intubation attempt is made on a patient who has neck instability, in-line stabilization should be carried out[3].

Another factor leading to a difficult airway is obesity[3]. Visualizing the vocal cords might be challenging due to redundant mucosal folds in the buccal cavity and excessive adipose tissue near the posterior pharynx[1].

One of the biggest concerns for anaesthesiologists is airway control[4]. One of the supports in managing the airway when under general anaesthesia is tracheal intubation[4]. Due to the wide range of intubation rates, low statistical power, and various test applications, screening tests have varying diagnostic values[4].

In preoperative airway assessments, studies have taken into account different elements including gender, age, ethnicity classification, American Society of Anesthesiologists' (ASA) physical status classification system, Mallampati score (MP), mouth opening (MO), thyromental distance (TMD), inability to prognath (AP), and neck mobility and size (NM)[5]. MO less than 4 cm, TMD less than 6 cm, Mallampati Class III or above, NM less than 35°, and difficulty to extend the mandible are risk factors that have been linked to problematic intubation[4].

By carefully assessing the airways before surgery, nearly all (98%) problematic intubations may be anticipated[4].

Considering the difficulties and challenges which an anaesthesiologist can face when managing a patient with cervical surgery, we have designed a study in order to evaluate the anaesthesiologic and intensive care particularities in ENT patients diagnosed with different types of cervical tumoral pathology.

The aim of the present research was to thoroughly study, from an anaesthesiologic point of view, every pharyngo-laryngo-tracheal or cervical condition that can increase the difficulty of airway management, identify possible new criteria for predicting difficulty in approaching the airway in the specifics of cervical surgery, and obtain additional information to allow for a concrete and measurable definition and update of general formulations, sometimes subjective, of "thick neck" or "short neck" or "cervical stiffness" in the context of cervical pathology.

MATERIAL AND METHODS

A prospective, observational, transversal and analytical study was performed between November 2019 and January 2021 in "Prof. Dr. D. Hociota" Institute of Phono-Audiology and Functional ENT Surgery, Bucharest, Romania. The study included 50 patients diagnosed with tumoral or non-tumoral cervical pathology and admitted to the Institute for surgical intervention. They were analysed according to their clinical and epidemiological characteristics, including some scores and measurements used for predicting difficult intubation.

Patients' selection

The patients included in the present study fulfilled the following inclusion criteria: adult patients (>18 years) with tumor pathology in the cervical area that required surgical intervention; patients who required general anaesthesia with oro- or nasotracheal intubation and who consented by signing the informed consent proposing and explaining the anaesthetic procedure; patients who, following the preanesthetic consultation, gave their written consent to participate in the study.

The exclusion criteria were: dyspneic patients in ortho- or clinostatism, regardless of the cause/types of dyspnea; patients consuming psychotropic substances; patients who complained of spontaneous or palpable pain in the cervical area; patients who had skin lesions, bleeding or fistulized abscesses in the cervical area; patients admitted as a surgical emergency and who required immediate surgical procedures.

Study design

The 50 patients included in the study were divided into two distinct groups: Group A – 23 patients diagnosed with cervical tumors; Group B – 27 patients diagnosed with non-tumor pathology in the cervical area.

The preanesthetic consultation included the verification of the known difficulty criteria (Mallampati score, thyromental distance, ability to prognath) currently applied. Since it is known that even the summation of these known criteria cannot fully predict the difficulty of airway management in general, and specifically in cervical surgery, we extended the study by incorporating ultrasound examination of the airway in patients proposed for cervical surgery, as well as anthropometric measurements that this pathology could influence based on the tumor's location.

The main objective of the study was to investigate whether patients with oncological diseases present greater challenges in terms of orotracheal intubation (OTI) compared to non-oncological ones. It was also aimed at establishing the existence, between these two categories of patients of anatomical and anthropometric differences in the cervical area and determining some predictors of difficult intubation (quantified by the duration of OTI) in patients with ENT diseases that require surgical intervention. Face mask ventilation is considered difficult when an experienced anaesthesiologist fails to achieve effective ventilation. Thus, the criteria are: lack of end-tidal CO_2 detection on the monitor, peripheral O_2 saturation does not exceed 90%, or assistance is needed to ensure a proper seal of the face mask in order to reduce oxygen loss from the circuit.

The main endpoint of the study was the duration of the OTI procedure (measured in seconds). A comparison of the OTI duration was made between the two groups of patients, and various anatomical and anthropomorphic parameters

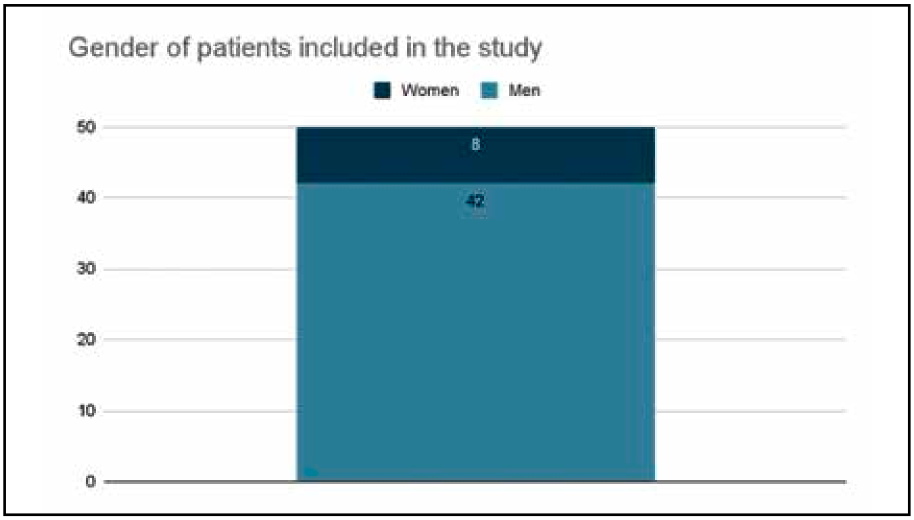

Figure 1. Gender of the patients included in the study.

were also compared. The duration of intubation was determined from the time the laryngoscope tip was inserted between the dental arches until the laryngoscope was removed from the dental arches at the end of intubation. This time is variable from one doctor to another.

The criteria and parameters analysed for predicting difficult intubation were: duration of orotracheal or nasotracheal intubation, difficult face mask ventilation, Cormack-Lehane and Mallampati scores, anthropometric determinations of various cervical landmarks, including the thyromental distance, the distance between the arytenoid cartilages and the distance from the plane of the arytenoid cartilages to the skin, both of the latter determined ultrasonographically.

The following measurements were taken:

- the intercondylar distance measured through the submandibular plane chosen to intercept tumors or asymmetries;
- the intermastoid distance measured through the submandibular plane;
- the mentocervical angle in order to identify whether an acute angle or an obtuse angle (obesity) can influence the degree of difficulty;
- the thickness of right and left sides of the neck comparatively and at different levels – chin, hyoid, thyroid, cricoid - to explore relationships between tumor positioning, the difference in thickness and the difficulty in airway management;
- the angle formed at the level of the sternal notch between the anterior borders of the sternocleidomastoid muscle (SCM) and the angle formed by the posterior borders of the SCM, in an attempt to quantify the relationship, if any, with the difficulty in mask ventilation or intubation, or with the body mass index (BMI).

Ultrasound measurements were used to determine the distance between the arytenoid cartilages and the distance from the plane of the arytenoid cartilages to the skin, in order to identify a potential relationship with the difficulty in airway management. The ultrasound was performed with the Mindray DP-10

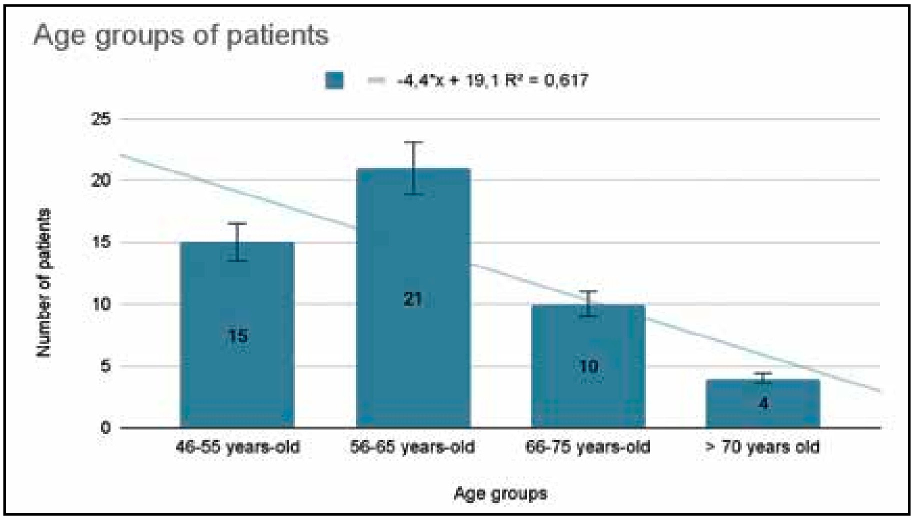

Figure 2. Age groups of the patients included in the study.

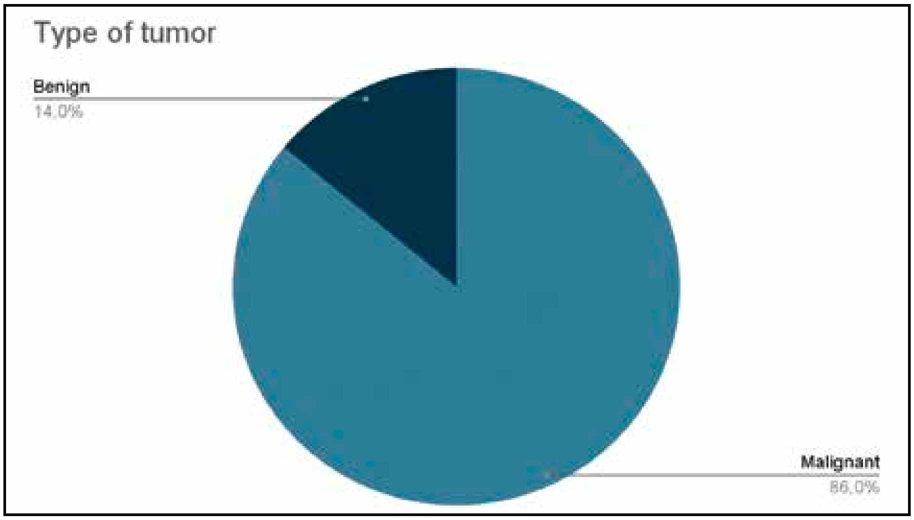

Figure 3. Histopathological diagnosis of the patients included in the study.

portable ultrasound machine with a linear and convex probe, for which we received the hospital's consent to use it in the study.

Statistical analysis

For statistical analysis, the R software, version 4.2.3 (Copyright (C) 2023, The R Project for Statistical Computing, R Core Team (2023), R Foundation for Statistical Computing, Vienna, Austria; https://www.R-project.org) was used, along with the standard packages; the gtsummary package was also utilized[5].

Welch's t-tests were used for continuous variables, and $\chi2$ (chi-square) tests or Fisher's exact tests were used for categorical variables.

The significance level α of the study was 0.05, so p-values < 0.05 were considered statistically significant.

RESULTS

We included 50 patients in the study, of which 42 were men (84%) (Figure 1). The median age of the patients was 61, with a minimum of 46 and a maximum of 81 years old (Figure 2).

Most of the patients were admitted for a malignant cervical pathology (43 patients, 86%) (Figure 3). The pathology, benign or malignant, was located both within and outside the airway lumen at different levels, causing asymmetries. As a result, some of the anatomical landmarks needed for the analysis were impalpable.

We evaluated the characteristics of patients with difficult intubation by analysing all the variables and parameters described in the study design (Table 1).

Analysing the results for the OTI duration, one can observe that it was approximately 6 seconds longer in the case of patients in Group A with cervical tumor pathology. The difference between the two groups was statistically significant (average OTI duration for Group A = 20.35±6.57 versus average OTI duration for Group B = 14.41±2.29, p<0.001) (as seen in Table 1). The same statistically significant difference can be observed in the case of mask ventilation difficulty (p<0.001). 69.37% of the patients included in Group A experienced difficult mask ventilation compared to only 7.4% in Group B (Table 1).

According to the Mallampati score, most of the patients (19 patients, representing 38%) included in study were defined as class 2 (Figure 4). High Mallampati scores (3 and 4) were more frequent in patients with tumor pathology – 73.92% vs 29.62% (Table 1). Interestingly, the Mallampati score was negatively correlated with the prediction of an easy or difficult intubation (Pearson -0.59) and with the necessity of using another device for intubation (Pearson -0.57). This means that a higher Mallampati score can be associated with an anticipated difficult intubation and a necessity to use another device.

High Cormack-Lehane scores (3 and 4) were more frequent in patients with tumor pathology included in Group A compared to Group B – 39.13% vs 11.11% (Table 1). The difference between the two groups was statistically significant (p=0.013).

Both the intercondylar distance and the intermastoid distance were greater in Group A of patients with cervical tumor pathology (Table 1). Compared to patients in Group B, the intercondylar distance was 2.66 cm higher in patients in Group A (28.69±5.66 versus 26.03±2.08) with p=0.042, while the intermastoid distance was 3.43 cm higher (31.07± 6.13 versus 27.64±3.51) with p=0.023. Among those who presented a small intercondylar distance (96% of patients, 22-32 cm), one third experienced difficult face mask ventilation, while those with medium (2% of patients, 32-35 cm) or large intercondylar distances (2%, >35 cm) had 100% incidence of difficult mask ventilation. Analysing the association between the two parameters, no statistically significant association was found (p=0.157).

The mentocervical angle did not represent a statistically significant parameter in determining a difficult intubation (p=0.47) (Table 1).

Analysing the results obtained for the distance between the arytenoid cartilages, it can be observed that it was 0.16 cm higher in patients included in Group A. The difference between the two groups was statistically significant (p=0.007). The same observation from a statistical point of view can be made

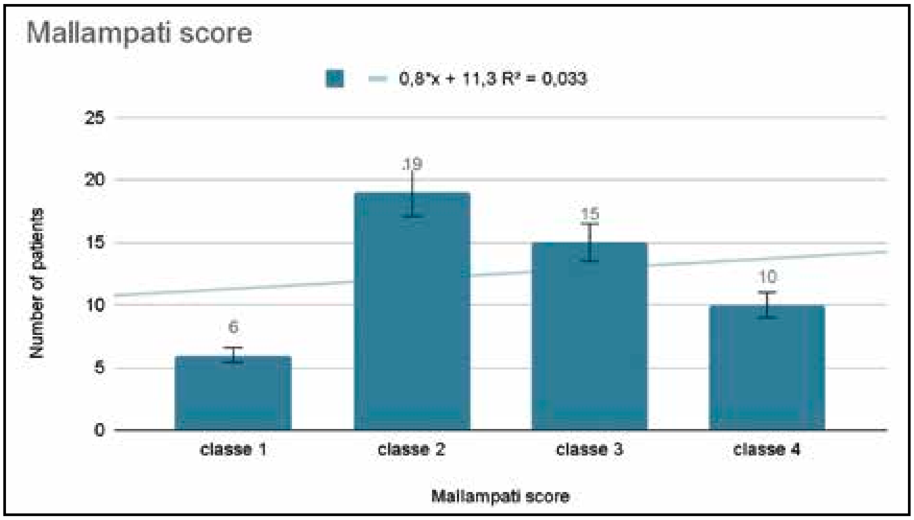

Figure 4. Mallampati score of patients included in the study.

for the distance between the plane of the arytenoid cartilages and the skin (measured via the anterior commissure), with a p-value <0.001. This distance was larger in patients with cervical tumor pathology by 1.54 cm compared to patients with non-tumor cervical pathology (Table 1).

In the case of the other evaluated parameters (thickness of the right and left hemineck at the level of the chin (M), hyoid (H), thyroid (T), cricoid (C); angle between the sternocleidomastoid muscle (SCM) and the anterior and posterior sternum, it can be observed that the difference between the two patient groups is not statistically significant for any of these parameters (Table 1), which proves that they do not have a major influence on the orotracheal intubation manoeuvre. The body mass index (BMI) also did not influence the degree of difficulty of the intubation manoeuvre (p=0.066).

Analysing the data from Table 1, we can say that the important parameters in predicting difficult intubation in this study were OTI duration, difficulty of mask ventilation, Mallampati and Cormack-Lehane scores, intercondylar distance, intermastoid distance, distance between the arytenoid cartilages, and distance between the arytenoid cartilages plane and the skin.

DISCUSSIONS

When a patient is given sedative drugs that reduce respiratory drive, induction of anaesthesia is a vital moment[6]. To sustain oxygenation and ventilation in the patient after induction of anaesthesia, the proceduralist must be able to ventilate the patient using a mask or by inserting an advanced airway[6]. While the majority of patients are simple to mask, ventilate and intubate, 5% of them are challenging to do so[7].

If a patient needs any kind of anaesthetic or needs to be intubated, the Mallampati score should be applied[8]. This will allow the proceduralist to anticipate difficulties with the airway's anatomy before establishing the airway[8]. The Mallampati classification, a bedside test that would later become one of the most used methods for predicting problematic airways, was initially reported by Mallampati et al. in 1985[9]. Numerous research has been carried out since then to more assess the prediction capabilities of both Mallampati and modified Mallampati[9].

Tracheal intubation may be challenging for physiologic or anatomical reasons[10]. It can be challenging to observe the vocal cords (difficult laryngoscopy) or insert an endotracheal tube into the trachea (anatomically challenging intubation; frequently referred to as a "difficult airway")[10]. An intubation that is physiologically challenging entails cardiopulmonary impairment, which frequently shows up as hypoxemia or hypotension[10]. Pre-intubation assessments are frequently inadequate to predict anatomical and physiological challenges[10].

Prior to the procedure, each patient is regularly checked for the risk factors listed below for an anatomically difficult intubation: documentation of a previous difficult intubation, jaw immobility, neck immobility (when a cervical collar is not necessary), deformity of the face or neck, blood or vomit in the mouth, inability to visualize the uvula with the mouth open, and airway sounds suggestive of an upper airway obstruction[11]. Many severely sick patients are unable to complete standard airway examinations, such as Mallampati scoring, due to altered mental state and cervical immobilization with a hard collar[11].

Hypoxemia during intubation is more likely to occur in patients with severe chronic lung disease, abrupt hypoxemic respiratory failure, or a SpO2 below 100% following pre-oxygenation[12]. Positive pressure breathing can assist stop hypoxemia in these high-risk patients during pre-oxygenation and in the interim between induction and laryngoscopy[12]. Aspiration is the main issue with positive pressure ventilation in this situation[12]. When possible, pre-oxygenate using non-invasive bilevel positive airway pressure (BiPAP) breathing with 100% FiO2 for 5 minutes in patients who are at high risk for hypoxemia and low risk for aspiration (e.g., those without vomiting, hematemesis, or hemoptysis)[13]. Pre-oxygenate patients who are at high risk for both hypoxemia and aspiration with 60 l per minute of 100% FiO2 with a high-flow nasal cannula or with supplementary oxygen using a regular

Table 1. The parameters evaluated to determine the degree of OTI difficulty in the two patient groups included in the study.

Evaluated parameters	Cervical tumoral pathology patients (Group A)	Cervical non-tumoral pathology patients (Group B)	p- value
OTI duration, Average (SD)	20.35 (6.57)	14.41 (2.29)	<0.001
Difficult Mask Ventilation, n (%)			<0.001
No	7 (30.43)	25 (92.6)	
Yes	16 (69.57)	2 (7.4)	
Intercondylar distance, Average (SD)	28.69 (5.66)	26.03 (2.08)	0.042
Intermastoid distance, Average (SD)	31.07 (6.13)	27.64 (3.51)	0.023
Mentocervical angle, Average (SD)	93.39 (12.86)	90.56 (14.73)	0.47
Cormack-Lehane, n (%)			0.013
1	0 (0)	5 (18.52)	
2	14 (60.87)	19 (70.37)	
3	5 (21.74)	3 (11.11)	
4	4 (17.39)	0 (0)	
Mallampati, n (%)			0.004
1	0 (0)	6 (22.22)	
2	6 (26.08)	13 (48.15)	
3	9 (39.13)	6 (22.22)	
4	8 (34.79)	2 (7.4)	
Right Hemineck thickness M, Average (SD)	25.55 (5.28)	24.98 (3.25)	0.66
Right Hemineck thickness H, Average (SD)	22.85 (6.28)	21.27 (3.49)	0.30
N/A	1	0	
Right Hemineck thickness T, Average (SD)	21.84 (7.32)	19.19 (3.89)	0.14
N/A	2	0	
Right Hemineck thickness C, Average (SD)	21.14 (8.12)	18.09 (4.63)	0.13
N/A	1	0	
Left Hemineck thickness M, Average (SD)	25.57 (5.03)	24.78 (3.68)	0.54
Left Hemineck thickness H, Average (SD)	23.03 (6.37)	21.05 (3.96)	0.20
Left Hemineck thickness T, Average (SD)	21.91 (7.74)	18.83 (4.06)	0.10
N/A	1	0	
Left Hemineck thickness C, Average (SD)	21.31 (8.27)	18.10 (4.88)	0.12
N/A	1	0	
Distance between arytenoid cartilages, Average (SD)	1.41 (0.20)	1.25 (0.21)	0.007
Distance arytenoid cartilages - skin, Average (SD)	4.23 (1.13)	2.69 (0.68)	<0.001
Anterior Sternal Angle SCM, Average (SD)	61.71 (19.32)	60.44 (18.95)	0.82
N/A	2	0	
Posterior Sternal Angle SCM, Average (SD)	74.76 (19.36)	70.63 (18.75)	0.46
N/A	2	0	
BMI, Average (SD)	27.37 (5.54)	24.96 (2.65)	0.066

face mask and nasal cannula[14]. According to the recent PreVent experiment, acute hypoxemia during tracheal intubation in the ICU was reduced by positive pressure bag-mask ventilation between induction and laryngoscopy[14].

Different airway management strategies and equipment have been developed as a result of the advancement of medical knowledge and technical progress. These seem to be important for maximizing the number of tries and overall success, which, in turn, lessens the unfavourable effects of airway manipulation.

Every patient should have a unique, organized airway management strategy before being intubated. Both tracheal intubation and airway assessment can benefit from technology[15]. To anticipate problematic airways, point-of-care cervical ultrasonography and artificial intelligence algorithms with automated face analysis have been applied[15]. It is possible to control airways using a variety of devices[15], such as: Vivasight, a system that uses cervical transillumination for glottis identification in difficult airways, a robotic video endoscope that guides intubation based on real image recognition, a laryngeal mask with a non-inflatable cuff that attempts to reduce local complications, video laryngeal masks that can confirm the correct position and facilitate intubation; Viescope™, a videolaryngoscope designed for combat medicine with a distinctive circular blade, cervical transillumination system for difficult airway glottis identification; and Vivasight SL™ tracheal tube with high-resolution camera at tip that ensures visual confirmation of tube location and directs placement of bronchial blockers[15].

CONCLUSIONS

The study demonstrates the multitude of new criteria and parameters that can be analysed for predicting a difficult airway, identifies the effectiveness of using ultrasonography whenever possible in preanesthetic airway assessment, and quantifies the risk of difficult airway approach based on anthropometric data, particularly through the presence of cervical or facial asymmetry.

Population, environment and locally accessible resources should all be taken into account before any novel equipment, procedures or technology are used for airway control. A well-structured airway management strategy is essential regardless of the advances in science and technology. Supporting the use of these novel technologies in the operating room, critical care unit and emergency department requires further study in the clinical context.

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Authors' information:

Olimpia Iulia Zoican, MD, PhD candidate, Anesthesiology and Intensive Care Department, University Emergency Hospital, “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania. E-mail: olimpia.iulia.zoican@gmail.com. ORCID: https://orcid.org/0009-0002-0708-6030.

Codrut Sarafoleanu, MD, PhD, Professor of otorhinolaryngology, ENT Department, Faculty of Dentistry, “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania. E-mail: csarafoleanu@gmail.com. ORCID: https://orcid.org/0000-0002-9436-7772.

REFERENCES

1. Kollmeier BR, Boyette LC, Beecham GB, Desai NM, Khetarpal S. Difficult airway. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023.
2. Huitink JM, Bouwman RA. The myth of the difficult airway: airway management revisited. Anaesthesia. 2015;70(3):244-9. DOI: 10.1111/anae.12989.
3. Hayashida K, Matsumoto S, Kitano M, Sasaki J. Predictive value of quick surgical airway assessment for trauma (qSAT) score for identifying trauma patients requiring surgical airway in emergency room. BMC Emerg Med. 2018;18:48. DOI: 10.1186/s12873-018-0203-4.
4. Oria MS, Halimi SA, Negin F, Asady A. Predisposing factors of difficult tracheal intubation among adult patients in Aliabad Teaching Hospital in Kabul, Afghanistan - A prospective observational study. Int J Gen Med. 2022;15:1161-9. DOI: 10.2147/IJGM.S348813.
5. Sjoberg DD, Whiting K, Curry M, Lavery JA, Larmarange J. Reproducible summary tables with the gtsummary package. The R Journal. 2021;13(1):570-80. DOI: 10.32614/RJ-2021-053.
6. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P, et al. Prediction of difficult mask ventilation. Anesthesiology. 2000;92(5):1229-36. DOI: 10.1097/00000542-200005000-00009.
7. 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(2):429-37. DOI: 10.1097/00000542-200508000-00027.
8. Stutz EW, Rondeau B. Mallampati score. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023.
9. de Carvalho CIC, da Silva DM, Leite MS, de Orange FVA. Is Mallampati classification a good screening test? A prospective cohort evaluating the predictive values of Mallampati test at different thresholds. Braz J Anesthesiol. 2022;72(6):736-41. DOI: 10.1016/j.bjane.2021.09.008.
10. Casey JD, Semler MW, High K, Self WH. How i manage a difficult intubation. Critical Care. 2019;23:177. DOI: 10.1186/s13054-019-2451-4.
11. Levitan RM, Everett WW, Ochroch EA. Limitations of difficult airway prediction in patients intubated in the emergency department. Ann Emerg Med. 2004;44(4):307-13. DOI: 10.1016/j.annemergmed.2004.05.006.
12. Casey JD, Janz DR, Russell DW, Vonderhaar DJ, Joffe AM, Dischert KM, et al. Bag-mask ventilation during tracheal intubation of critically ill adults. N Engl J Med. 2019;380(9):811-21. DOI: 10.1056/NEJMoa1812405.
13. Baillard C, Fosse JP, Sebbane M, Chanques G, Vincent F, Courouble P, et al. Noninvasive ventilation improves preoxygenation before intubation of hypoxic patients. Am J Respir Crit Care Med. 2006;174(2):171-7. DOI: 10.1164/rccm.200509-1507OC.
14. Frat JP, Ricard JD, Quenot JP, Pichon N, Demoule A, Forel JM, et al. Non-invasive ventilation versus high-flow nasal cannula oxygen therapy with apnoeic oxygenation for preoxygenation before intubation of patients with acute hypoxaemic respiratory failure: a randomised, multicentre, open-label trial. Lancet Respir Med. 2019;7(4):303-12. DOI: 10.1016/S2213-2600(19)30048-7.
15. Pereira AV, Simões AV, Rego L, Pereira JG. New technologies in airway management: A review. Medicine (Baltimore). 2022;101(48):e32084. DOI: 10.1097/MD.0000000000032084.