Acta Clin Croat (Suppl. 1) 2023; 62:9-20

doi: 10.20471/acc.2023.62.s1.01

Original Scientific Paper

PREOPERATIVE SINGLE ANTHROPOMETRIC SCREENING TESTS OF DIFFICULT FACE MASK VENTILATION AND DIFFICULT DIRECT LARYNGOSCOPY INTUBATION IN PATIENTS UNDERGOING OTORHINOLARYNGOLOGICAL SURGERY: A PROSPECTIVE, OBSERVATIONAL, SINGLE CENTER STUDY

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SUMMARY – The aim of this study was to assess preoperative airway history data and single anthropometric screening tests of difficult face mask ventilation (FMV) and difficult direct laryngoscopy intubation (DLI) in otorhinolaryngological surgery. Final analysis included 62 patients aged ≥14 years undergoing elective surgery with endotracheal intubation at a single center during a one-month period. Data on difficult intubation history, airway symptoms and pathology related to difficult airway were prospectively collected. Han scoring classification of FMV and Intubation Difficulty Score (IDS) were used. There were 14 (22.6%) patients with a history of current airway tumors or abscesses. Only two (3.2%) patients were preoperatively evaluated as anticipated difficult airway. Both were slightly difficult to ventilate and scored IDS 5 and IDS 8. FMV was graded as easy in 50 (80.5%), slightly difficult in 10 (16.1%) and difficult in 2 (3.2%) cases. There were 29 (46.78%) slightly difficult DLIs and one (1.6%) case of difficult DLI. The study confirmed clinically relevant incidence of difficulties with FMV and DLI in otorhinolaryngologic surgery patients. However, there should be stronger evidence to identify a single preoperative variable predicting difficult airway.

Keywords: *Difficult airway; Otorhinolaryngologic surgical procedure; Head and neck surgery; Predictors*

Introduction

Preoperative airway assessment is an important part of any preoperative anesthetic patient evaluation as it identifies high-risk patients for difficult face mask ventilation and difficult intubation. The proper airway

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risk stratification guides anesthesiologists in planning perioperative airway management and using alternative airway devices. Although there is an emerging trend of using various imaging techniques for preoperative airway assessment such as radiological[1], computed tomography[2,3], ultrasound[4], transnasal endoscopy[5] and three-dimensional printing[6], the standard preoperative airway assessment is still relied on simple and widely available bedside methods[7], i.e., proper airway history taking and single anthropometric screening airway tests.

As focused on upper airway pathology, otorhinolaryngological surgery is perceived to be a risky surgery for preoperative airway management including difficult face mask ventilation and difficult laryngoscopy[8,9]. The aim of this study was to assess preoperative airway history data and single anthropometric screening tests of difficult face mask ventilation and difficult intubation in patients undergoing otorhinolaryngological and head and neck surgery in our institution and to compare our results with literature data. We hypothesized that it is possible to identify single preoperative airway history data and an anthropometric parameter predictive of difficult face mask ventilation and difficult direct laryngoscopy intubation in patients undergoing otorhinolaryngological and head and neck surgery.

Material and Methods

This study was performed as part of a national multicenter research entitled Multicenter Study of Risk Factors for Difficult Mask Ventilation (DMV) and Difficult Endotracheal Intubation (DEI) and Incidence of DMV and DEI in the Republic of Croatia (universal trial number (UTN) U1111-1137-5237), endorsed by the Croatian Society of Difficult Airway Management of the Croatian Medical Association (CMA-CSDAM). After obtaining approval from the local Ethics Committee (a letter from the Sveti Duh Ethics Committee, reg. no. 01/2455, as of July 12, 2013), we recruited all patients aged ≥14 and scheduled for elective surgery in general anesthesia with endotracheal intubation at the Department of Ear, Nose and Throat and Head and Neck Surgery, Sveti Duh University Hospital, during the period from July17, 2013 until August 14, 2013.

According to the original protocol, preoperative evaluation and testing was performed on the day before the planned surgery, and a signed patient consent was obtained. During preoperative evaluation, the following demographic data were collected: gender (F, female, M, male); body weight in kilograms (kg); body height in centimeters (cm); current pregnancy history (yes/no, if yes, which month); and American Society of Anesthesiologists (ASA) classification of physical status score. The ASA physical status score includes six categories: I otherwise healthy patient undergoing surgery; II patient with mild systemic disease; III patient with severe but compensated systemic disease; IV patient with decompensated systemic disease; V moribund patient; and VI donor)[10]. Body mass index (BMI) was calculated according to the standard equation: patient's weight in kilograms divided by the square of height in meters (kgm^{-2})[11].

The collected preoperative data relevant to patient airway management were difficult intubation history (yes/no), relevant airway symptoms (yes/no), pathology related to difficult airway (yes/no), modified Mallampati score, dental status, mandibular appearance, flexibility of head and neck, presence of beard and moustache (yes/no), mandibular protrusion test, interincisal gap (IIG), neck circumference (NC), thyrosternal distance (TSD), thyromental distance (TMD), sternomental distance (SMD), hyomental distance (HMD), and thyrohyoid distance (THS). A list of relevant airway symptoms was enclosed (yes/no), as follows: dyspnea because of airway compression, dysphonia, dysphagia, documented obstructive sleep apnea (OSA) syndrome, history of snoring, sudden waking up during the night because of dyspnea, tiredness after night sleep, and excessive daytime sleepiness. A list of pathology related to difficult airway (yes/no), facial malformation, acromegaly, cervical spondylosis with restricted mobility, occipito-atlanto-axial diseases, airway tumors and abscesses, long-time diabetes with stiffed ankles, different syndromes (Pierre Robin, Treacher-Collins, Goldenhar, Down, Klippel Feil, and other if present) was also enclosed. The modified Mallampati score describes three anatomic structures of the oropharynx (uvula, palate, and tonsils) when the patient opens the month in sitting position and extrudes the tongue. It includes four categories: 1) uvula, tonsils, and palate visible; 2) tonsils and palate visible, uvula not visible; 3) only palate visible; tonsils and uvula not visible; and 4) none of three structures (uvula, tonsils, palate) visible[12]. Dental status was described as follows: presence of all eight upper teeth (yes/no), buckteeth (no, yes, intermediate), and presence of lower teeth (yes/no). Mandibular appearance was classified as absent (mandible appears normal), intermediate (mandible appears smaller, bite gapes a little) or strong micrognathia (receding mandible) (mandible small, the bite gapes). The patient was tested for flexibility of the head and neck in sitting position by goniometer and categorized as follows: >100°, 80° -100°, <80°. Mandibular protrusion test was performed in sitting position with the head in neutral position when the patient tries to pull out the mandible towards front[13]. If lower incisors reached far away the upper incisors, it was scored 1; if lower incisors reached exactly the upper incisors, it was scored 2; and if lower incisors did not reach the upper incisors, it was scored 3[13]. IIG was measured in centimeters in the midline in sitting position with maximally opened mouth between incisors if having teeth, or between gingivae (if no teeth). NC was measured with tape measure in centimeters in sitting position with the head in neutral position looking straight at the level of the cricoid. TSD was measured by tape measure in centimeters with the head extended maximally from thyroid cartilage to sternum. TMD was measured by tape measure in centimeters with the head extended maximally from thyroid cartilage to the chin. SMD was measured by tape measure in centimeters with the head extended maximally from sternum to the chin. HMD was measured by tape measure in centimeters with the head extended maximally from hyoid bone to the chin. THD was measured by tape measure in centimeters with the head extended maximally from thyroid cartilage to the hyoid bone.

After preoperative evaluation, patients were allocated to two groups: group 1 including patients without anticipated difficult airway and group 2 of patients with anticipated difficult airway. Group 1 was intubated regularly with direct laryngoscopy with Macintosh metal blade with a stylet in the tube, according to the predefined protocol for induction and intubation. Preoxygenation was performed by 100% oxygen via manual face mask 6 L/min for minimally 3 minutes or by reaching 80% expiratory oxygen concentration. Anesthesia induction was with propofol (2 mg/kg total body weight) and rocuronium (0.7 mg/kg predicted body weight). Opioids were added after intubation. After intubation, the practitioner filled out questionnaire A (Appendix 1) with relevant data on the performance of face mask ventilation and intubation. Face mask ventilation was scored according to the Han scoring scale[14] before and after applying neuromuscular blocker (0, there was no mask ventilation, 1, easy face mask ventilation; 2, slightly difficult, use of oropharyngeal or nasopharyngeal tube; 3, difficult ventilation (inadequate, instable or need for two persons); and 4, impossible ventilation). Intubation was scored according to the Intubation Difficulty Score[15] (IDS) that includes the number of intubation attempts, number of involved practitioners, number of used alternative methods (alternative blade (McCoy, Miller), bougie, supraglottic devices, laryngeal mask, video laryngoscope, rigid bronchoscope, fiberbronchoscope), the Cormack Lehane score at first attempt, applied forced elevation of laryngoscope, applied external laryngeal pressure, and adduction of vocal cords. The Cormack Lehane score describes visualization of the laryngeal inlet (glottis)[16]. It includes four categories: 1, the whole glottis visible; 2, the epiglottis partially obscures full visualization of the glottis; 3, only epiglottis visible, glottis not visible; and 4, neither epiglottis nor glottis visible. The practitioner filled out each component of IDS within the questionnaire immediately after intubation, but final scoring was performed afterwards by the programmed Excel table because it involves additional mathematical operations. Final categories of difficulty of intubation are as follows: 0, easy intubation, 1-5 slightly difficult intubation, and ≥6 difficult intubation[15]. If the intubation operator was a resident, one attempt of intubation was allowed. If the resident failed to perform intubation at the first attempt, the specialist could perform another two attempts. If the resident intubated at the first attempt, this was noted as successful intubation. If the resident failed, his/her attempt of intubation was not counted, but just those performed by the specialist.

The intubation operator was free to choose the method of intubation in group 2 patients. After intubation, the practitioner filled out questionnaire B (Appendix 2), which included data on the person who made decision on anticipated difficult airway (1 or 2 specialists, years of experience), the reason it was grounded upon (derived from preoperative history and evaluation data, or some other subjective reasons such as experience, own intuition, etc.), and detailed description of the method and performance of ventilation by Han's scale and intubation by IDS.

For this study, we derived the data collected on patients who matched all inclusion criteria. When emergency surgeries and patients aged <14 were excluded, there were eligible 69 patients aged ≥14 scheduled for elective otorhinolaryngology surgery in general anesthesia during the study period. However, there were three patients aged 14-18, whose parents did not consent, two adults who did not consent themselves, and two cases where tracheostomy was planned initially. Thus, final analysis included 62 patients.

In the literature, there are a variety of thresholds of single anthropometric variables for difficult airway. For our further analysis, we used the following thresholds: IIG threshold 3.5 cm[17], NC threshold 45 cm[11], TMD threshold 6.5 cm[18], SMD threshold 12.5 cm[19], and HMD threshold 3.5 cm[20]. We did not find reference threshold for TSD and THD.

Statistical methods

Data were processed by descriptive methods first and the results presented tabularly and graphically. The distribution of quantitative variables (age, body weight, body height, BMI, IIG, NC, TSD, TMD, SMD, HMD, THD, IDS) was determined by Kolmogorov-Smirnov test and Shapiro-Wilk test of normality. Only body weight and NC showed normal distribution and were expressed as mean ± standard deviation (SD). Other quantitative data (age, body height, BMI, IIG, TSD, TMD, SMD, HMD, THD, IDS) did not show normal distribution and were expressed as median ± interquartile range. Category data (gender, ASA, BMI, modified Mallampati score, anatomic area of surgery, history relevant for difficult airway, symptoms related to airway, mandibular protrusion test) were expressed in absolute numbers and corresponding percentages. The independent Kruskal Wallis test was used to compare quantitative variables between the groups with difficulties during face mask ventilation. The χ^2-tests (Pearson χ^2, Fisher exact test) were used to compare categorical variables between the groups with difficulties during face mask ventilation. Spearman's rank correlation was used to correlate quantitative variables with IDS and each other. The independent Kruskal Wallis test was used to correlate categorical variables with IDS. The results were interpreted at the 5% significance level. We used computer data statistical program IBM® SPSS software for Windows, version 19.0 (IBM SPSS Inc., Chicago, IL, USA).

Results

Table 1 depicts basic demographic characteristics. Anatomic areas of surgery were as follows: nose 26 (41.9%), oropharynx 17 (27.4%), thyroid gland 9 (14.5%), larynx 4 (6.5%), external face 2 (3.2%), anterior neck 2 (3.2%) patients, and ear 1 (1.6%) and vocal cord 1 (1.6%) patient each. Most of the study population did not have history data relevant for difficult airway assessment preoperatively. There were no patients with facial malformation, acromegaly, occipito-atlanto axial diseases or diabetes with stiffed ankles in

Table 1. Patient characteristics (N=62)

Variable	n (%)
Male gender	34 (54.8)
Age[a] (years)	36.50 [26-54]
Body height[a] (cm)	178.00 [170-184]
Body weight[b] (kg)	80.03±17.78
BMI	24.87 [170-184]
BMI <18.5 kgm^{-2}	2 (3.2%)
BMI 18.5-24.9 kgm^{-2}	30 (48.4%)
BMI 25-29.9	18 (29.0%)
BMI ≥30 kgm^{-2}	12 (19.4%)
ASA I/II/III	30 (48.4%)/29 (46.8%)/3 (4.8%)

[a]Data not normally distributed presented as median [25th percentile to 75th percentile]; [b]data normally distributed presented as mean ± standard deviation; ASA = American Society of Anesthesiologists score; BMI = body mass index

this study group. There was only 1 (1.6%) patient with difficult intubation history and 2 (3.2%) patients with cervical spondylosis. There were 14 (22.6%) patients with a history of current airway tumors or abscesses. There were 5 (8.1%) patients with dyspnea because of airway compression, 5 (8.1%) dysphonic patients and 2 (3.2%) patients with dysphagia. Documented OSA syndrome was observed in 9 (14.5%) cases, although history of snoring was observed in 28 (45.2%) patients. Sudden waking up during the night because of dyspnea was observed in 6 (9.7%), tiredness after night sleep in 8 (12.9%) and excessive daytime sleepiness in 10 (16.1%) patients.

Preoperative anthropometric variables are shown in Table 2. Most of the patients had modified Mallampati score 1, normal dental status, normal flexibility of head and neck, and normal mandible. Almost all were without beard or moustache and with average anthropometric airway measurements. There was no patient evaluated as modified Mallamapti 4 or with head and neck flexibility less than 80°.

Face mask ventilation was graded by practitioners as easy in 50 (80.5%), slightly difficult in 10 (16.1%) and difficult in 2 (3.2%) cases. There was no case of impossible face mask ventilation. There were no differences in face mask ventilation before and after neuromuscular blockade.

Half of intubations were categorized as easy and scored IDS 0 (n=32, 51.6%). There were 29 (46.78%) slightly difficult intubations with the following distribution of IDS score 1-5: IDS 1 was observed in 13 (21%), IDS 2 in 7 (11.3%), IDS 3 in 5 (8.1%), IDS 4 in 3 (4.8%) patients and IDS 5 in 1 (1.6%) patient. There was only 1 (1.6%) case categorized as difficult intubation and scored IDS 8. There were no cases scored IDS 6 or IDS 7 or above 8.

Table 2. Preoperative anthropometric variables relevant for difficult airway assessment (N=62)

Variable	n (%)
Modified Mallampati score 1/2/3	41 (66.1%)/12 (19.4%)/9 (4.5%)
All eight upper teeth present	48 (77.4%)
Lower teeth present	56 (90.3%)
Micrognathia intermediate/strong	7 (11.4%)/1 (1.6%)
Flexibility of head and neck 80°-100°/>100°	12 (13.4%)/50 (80.6%)
Beard present	2 (3.2%)
Moustache present	2 (3.2%)
Mandibular protrusion test 1/2/3	53 (85.5%)/8 (12.9%)/1 (1.6%)
Interincisal gap[a] (cm)	5 [4.5-5.5]
Interincisal gap below 4.5 cm threshold	15 (24.2%)
Neck circumference[b] (cm)	39.30±4.63
Neck circumference above 46 cm threshold	17 (27.4%)
Thyrosternal distance[a] (cm)	9 [8-10]
Thyromental distance[a] (cm)	9 [8.5-11.0]
Thyromental distance below 6.5 cm threshold	5 (8.1%)
Sternomental distance[a] (cm)	18 [17-20]
Sternomental distance[a] below 12.5 cm threshold	0
Hyomental distance[a] (cm)	6 [5-7]
Hyomental distance below 3.5 cm threshold	1 (1.6%)
Thyrohyoidal distance[a] (cm)	3 [2-4.5]

[a]Data not normally distributed presented as median [25th percentile to 75th percentile];
[b]data normally distributed presented as mean ± standard deviation

There were 2 (3.2%) cases preoperatively evaluated as anticipated difficult airway. In both cases, face mask ventilation was slightly difficult but intubation was scored IDS 5 and IDS 8 in one case each.

There was a statistically significant association between slightly difficult and difficult face mask ventilation and some quantitative data: higher age (p=0.001), higher weight (p=0.005), higher BMI as quantitative data (p=0.004), and larger neck circumference (p=0.006). In addition, there was a significant association between slightly difficult and difficult face mask ventilation and some categories: higher BMI category (p=0.035), higher ASA (p=0.023), tiredness after night sleep (p=0.039), lack of upper teeth (p=0.003), less flexibility of head and neck (p=0.044) and neck circumference above threshold (p=0.002).

There was borderline association between slightly difficult and difficult face ventilation and some categorical data: documented OSA (p=0.062), higher modified Mallampati score (p=0.051) and mandibular protrusion test (p=0.062).

Table 3 shows correlations between IDS and quantitative variables (age, height, weight, BMI, IIG, NC, TSD, TMD, SMD, HMD, THD). There was a statistically significant association between IDS and age (rho=0.325, p=0.01), IDS and BMI (rho=0.268, p=0.035), and IDS and IIG (rho=-0.253, p=0.047). In addition, there was positive correlation of age and BMI (rho=0.525, p=0.000), age and NC (rho=0.255, p=0.046), and age and THD (rho=0.265, p=0.038). On the contrary, there was negative correlation of age and height (rho=-0.310, p=0.014), and age and HMD (rho=-0.287, p=0.024). There was positive correlation of height and weight (rho=0.565, p=0.000), IIG (rho=0.370, p=0.003), NC (rho=0.601, p=0.000), TSD (rho=0.329, p=0.009), SMD (rho=0.340, p=0.007) and HMD (rho=0.340, p=0.007). There was positive correlation of weight and BMI (rho=0.804, p=0.000), IIG (rho=0.353, p=0.005) and NC (rho=0.871, p=0.000). There was positive correlation of BMI and NC (rho=0.652, p=0.000). There was positive correlation of IIG and NC (rho=0.361, p=0.004), TSD (rho=0.377, p=0.003), SMD (rho=0.366, p=0.003) and HMD (rho=0.406, p=0.001). There was positive correlation of TMD and SMD (rho=0.734, p=0.000), TSD and HMD (rho=0.380, p=0.002) but negative correlation of TSD and THD (rho=-0.413, p=0.001). THD was related positively to SMD (rho=0.579, p=0.000), HMD (rho=0.498, p=0.000) and THD (rho=0.652, p=0.000). SMD was associated with HMD (rho=0.592, p=0.000).

Kruskal Wallis test was run to determine the relationship between IDS and categorical variables. There was a statically significant association between IDS

Table 3. Correlations between Intubation Difficulty Score (IDS) and patient characteristics

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1 IDS	-											
2 Age	0.325**	-										
3 Height	-0.064	-0.310*	-									
4 Weight	0.205	0.236	0.565**	-								
5 BMI	0.268*	0.525**	0.012	0.804**	-							
6 IIG	-0.253*	-0.193	0.370**	0.353**	0.156	-						
7 NC	0.145	0.255*	0.601**	0.871	0.652**	0.861**	-					
8 TSD	-0.228	-0.203	0.329**	0.133	-0.020	0.377**	0.168	-				
9 TMD	0.55	0.041	0.224	0.175	0.012	0.190	0.123	-0.034	-			
10 SMD	-0.122	-0.193	0.340**	0.099	-0.106	0.366**	0.078	0.734**	0.579**	-		
11 HMD	-0.060	-0.287*	0.340**	0.078	-0.155	0.406**	0.033	0.390**	0.498**	0.592**	-	
12 THM	0.164	0.265*	-0.043	0.072	0.079	-0.157	0.050	-0.413**	0.652**	0.094	-0.245	-

IDS = Intubation Difficulty Score; BMI = body mass index; IIG = interincisal gap; NC = neck circumference; TSD = thyrosternal distance; TMD = thyromental distance; SMD = sternomental distance; HMD = hyomental distance; THM = thyrohyoid distance; **p<0.01; *p<0.05

and modified Mallampati score (p=0.001), micrognathia (p=0.004), documented OSA (p=0.026) and tiredness after night sleep (p=0.024).

Discussion

In this prospective study, we analyzed upper airway characteristics of patients undergoing otorhinolaryngological and head and neck surgery with the aim to identify a single preoperative airway history datum and/or an anthropometric parameter predictive of difficult face mask ventilation and difficult direct laryngoscopy intubation. The results of our study showed that, indeed, we had difficulties with face mask ventilation and intubation. We had more problems with face mask ventilation than with difficult intubation in our study.

In the literature, it is rather difficult to find the exact prevalence of difficult face mask ventilation in otorhinolaryngological and head and neck surgery adult surgery. Some studies report on difficult airway in head and neck surgery, but also report on the use of fiberbronchoscopy intubation[21], which practically skips the use of face mask ventilation. For this reason, there may be wrong impression that there is no difficulty problems with face mask ventilation in otorhinolaryngological and head and neck surgery adult surgery. On the contrary, there are plenty of data on difficult face mask ventilation in general surgery, with great variability. The still most cited prevalence of difficult face mask ventilation is one of Kheterpal et al., reported to be 2.2% (1141/53,401)[22]. The study was performed on a large scale, in over 50,000 anesthetized patients for different types of surgery, having reported the prevalence of impossible ventilation of 0.15% (77/53,041)[22]. A more recent study by Khan et al. report the incidence of difficult face mask ventilation graded by Han's classification as high as 31.6% (93/294) in elective general surgery patients[23]. In a cohort Danish study of 46,804 general surgery patients, the prevalence of difficult face mask ventilation was 1.06% (95% CI 0.97-1.16)[24]. In our study, difficult face mask ventilation was graded by Han's classification as slightly difficult in 16.1% and difficult in 3.2% of cases, yielding a clinically significant incidence of face mask ventilation problems. Although our study was much smaller than the one by Kheterpal et al.[22], we think that our higher figure can be explained by the fact that our study population was already selected by surgical type as riskier for airway management. Indeed, in the study by Kheterpal et al.[22], a feature of neck radiation changes represented the most significant clinical predictor of impossible face mask ventilation, which is an often seen feature of head and neck surgery patients too. On the other hand, patients in the study by Khan et al.[23] were over selected as specifically high risk for face mask ventilation by three or more predictors for difficult face mask ventilation (age >47 years, male gender, BMI >35 kg/m^2, history of OSA, history of snoring, Mallampati III or IV, beard and limited jaw protrusion)[23]. Recently, Seet et al. published a study in which 869 patients without prior diagnosis of OSA were screened for OSA risk with the STOP-Bang tool, underwent preoperative sleep study, and had routine perioperative care, including general anesthesia with tracheal intubation for general surgery[25]. The rate of difficult face mask ventilation was 3.7% (32 of 869)[25]. However, in their study OSA was not associated with difficult face mask ventilation, and only increasing NC was found to be associated (adjusted p=0.002)[25]. This is in contrast to the findings of a consensus-based guideline that OSA is a relative risk factor for difficult face mask ventilation and intubation, and plans for difficult airway management should be considered and implemented[26]. In addition, Nagappa et al. report that difficult face mask ventilation was 3.39-fold higher in the sleep apnea versus non-sleep apnea patients scheduled for non-specific surgery (OSA vs. non-OSA: 4.4% vs. 1.1%; OR 3.39; 95% CI: 2.74-4.18, p<0.00001)[27].

Although the literature does not specifically report the prevalence of ventilation problems in head and neck surgery patients, some authors try to overcome the ventilation problem besides already mentioned skipping the anticipated difficult ventilation by performing fiberbronchoscopy. In a small study, Tsukamoto et al. compared the efficacy of the alternative face mask types such as the QuadraLite without air cushion to a traditional face mask with an air cushion[28]. Although higher expiratory tidal volumes were observed with the QuadraLite face mask than with the air cushion face mask, differences did not reach statistical significance[28].

Contrary to data on the prevalence of difficult face mask ventilation, data on the incidence and prevalence of difficult intubation in head and neck surgery are better documented but show its complexity. In most cases, there are reports from high specialized centers only on one type of surgery in patients at a high risk of difficult airway. Zheng et al. report a single center experience of 12.7% of difficult intubations in 472 patients scheduled for oral cavity and oropharyngeal cancer surgery[29]. In a prospective observational study on 500 consecutive thyroid patients, it was observed in 9.6% of thyroid surgery patients[30]. The incidence of difficult intubation in thyroid surgery patients may be lower in patients with the Trachway procedure (2.7%) than in direct laryngoscopy (6.5%, p=0.01)[31]. Still these results are much higher than the prevalence of difficult direct laryngoscopy tracheal intubation of 5.2% (4704/91,297) as reported by Lundstrøm et al. in a cohort of over 90,000 patients having anesthesia for different types of surgery[32]. In the previously mentioned study by Khan et al., the prevalence of difficult intubation was as low as 3%[23]. One Canadian center has reported high performance as having only 111 (0.26%) cases of difficult intubation and 14 (0.03%) cases of failed intubation in 42,805 general surgical cases requiring endotracheal intubation over the seven-year period[33]. Interestingly, in OSA patients, the rate of difficult intubation was 6.7% (58 of 869), as reported by Seet et al.[25]. The rather small incidence of difficult intubation in our study based on one case is not representative enough for comparison with literature data.

In our study, we performed the most frequently used screening airway tests, i.e., Mallampati score, measurement of TMD, upper lip bite test, IIG, TMD, TSD, SMD, HMD, THD, NC and neck mobility. When used as a single parameter of predicting difficult direct laryngoscopy, the reliability of these anthropometric parameters is rather variable[7]. Derived scoring systems that integrate different anthropometric airway parameters and/or airway history data may provide greater reliability in predicting difficult direct laryngoscopy[7]. The Cochrane meta-analysis evaluated seven different prespecified index tests (Mallampati test, Wilson risk score, thyromental distance, sternomental distance, mouth opening test, upper lip bite test; or any combination of these tests) in 133 studies, as well as 69 other nonprespecified tests and 32 combinations (844,206 apparently normal participants), and confirmed that all index tests investigated had relatively low sensitivities with high variability[34]. For difficult face mask ventilation, they could only estimate summary sensitivity (0.17, 95% CI 0.06-0.39) and specificity (0.90, 95% CI 0.81-0.95) for the modified Mallampati test[34]. The upper lip bite test for diagnosing difficult laryngoscopy provided highest sensitivity compared to other tests (p<0.001)[34]. The modified Mallampati test had the highest sensitivity for diagnosing difficult tracheal intubation compared to other tests (p<0.001)[34].

Our results showed a statistically significant association between slightly difficult and difficult face mask ventilation and higher age, higher weight, higher BMI, larger NC, higher ASA, tiredness after night sleep, lack of upper teeth, less flexibility of head and neck, and NC above the threshold. In addition, there was a statistically significant association between the IDS and age, BMI, and IIG. Although we can find similar results in the literature[35], we were limited to make stronger conclusions because of the small number of patients in our study.

Conclusion

The study confirmed the clinically relevant incidence of difficulties with face mask ventilation and direct laryngoscopy intubation in otorhinolaryngologic and head and neck surgery patients. However, there is the need for stronger evidence based on a large scale study to identify a single preoperative variable predictive of difficult airway in general and specific otorhinolaryngologic and head and neck surgery patients.

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Appendix 1. Questionnaire A: Unanticipated difficult airway

General data
Name:
Date of birth:
ID:
Operator(s):
Ventilation performance

Han's scoring	Please circle one	
Description	Before neuromuscular blocker	After neuromuscular blocker
There was no mask ventilation	0	0
Easy face mask ventilation	1	1
Slightly difficult, use of oropharyngeal or nasopharyngeal tube	2	2
Difficult ventilation (inadequate, instable or need for two persons)	3	3
Impossible ventilation	4	4

Intubation Difficulty Score (IDS)

	Number (fill immediately)		Score (fill after)
Number of intubation attempts		N1 (>1)	
Number of anesthesiologists		N2 (>2)	
Number of alternative intubation techniques used		N3	
Cormack Lehane (first attempt)		N4 (-1) = (0-3)	
Need for forced lifting of laryngoscope		N5 (0-1)	
External laryngeal manipulation applied		N6 (0-1)	
Vocal cord adduction		N7 (0-1)	
Total score			

Comments:

Appendix 2. Questionnaire B: Anticipated difficult airway

<u>General data</u>
Name:
Date of birth:
ID:
Operator (s):
Decision on anticipated difficult airway is made by (name of the specialist):
Name 1; years of experience in anesthesia
Name 2; years of experience in anesthesia
Decision on anticipated difficult airway is grounded on (circle and add data):

a) preoperative history and evaluation data:
b) some other subjective reasons such as experience, own intuition, etc.:

<u>Ventilation performance</u>

Han's scoring	Please circle one	
Description	Before neuromuscular blocker	After neuromuscular blocker
There was no mask ventilation	0	0
Easy face mask ventilation	1	1
Slightly difficult, use of oropharyngeal or nasopharyngeal tube	2	2
Difficult ventilation (inadequate, instable or need for two persons)	3	3
Impossible ventilation	4	4

<u>Description of intubation performance (3 questions plus free text):</u>

1 which method was used:
2 who was the anesthesiologist:
3 how many attempts:
4 additional comments:

Sažetak

PRIJEOPERACIJSKI POJEDINAČNI ANTROPOMETRIJSKI TESTOVI PROBIRA OTEŽANE VENTILACIJE LIČNOM MASKOM I OTEŽANE INTUBACIJE DIREKTNOM LARINGOSKOPIJOM U OTORINOLARINGOLOŠKIH KIRURŠKIH BOLESNIKA: PROSPEKTIVNO OPSERVACIJSKO ISTRAŽIVANJE U JEDNOM CENTRU

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Cilj ovoga istraživanja bila je procjena prijeoperacijskih anamnestičkih podataka o dišnom putu i pojedinačnih testova probira za otežanu ventilaciju ličnom maskom (VLM) i otežane intubacije direktnom laringoskopijom (DLI) u otorinolaringološkoj kirurgiji. Završna analiza je uključivala 62 bolesnika u dobi od ≥14 godina podvrgnutih elektivnoj kirurgiji s endotrahealnom intubacijom u jednom centru unutar mjesec dana. Prospektivno su prikupljani podaci o povijesti otežane intubacije, simptomima dišnog puta i patologiji povezanoj s otežanim dišnim putom. Koristila se bodovna ljestvica po Hanu za VLM i Intubation Difficulty Score (IDS). Bilo je 14 (22,6%) bolesnika s anamnezom aktualnih tumora ili apscesa. Samo dva (3,2%) bolesnika su prijeoperacijski procijenjeni kao mogući otežani dišni put. Oboje su bili lagano otežane ventilacije i ocijenjeni IDS 5 i IDS 8. VLM je ocijenjena kao lagana u 50 (80,5%), lagano otežana u 10 (16,1%) slučajeva i otežana u dva (3,2%) slučaja. Bilo je 29 (46,78%) slučajeva lagano otežene DLI i jedan (1,6%) slučaj otežane DLI. Istraživanje je potvrdilo klinički značajnu incidenciju otežene VLM i DLI u otorinolaringološih kirurških bolesnika. Međutim, potrebni su jači dokazi za identifikaciju pojedinačne prijeoperacijske varijable koja bi bila prediktivna za otežani dišni put.

Ključne riječi: *Otežani dišni put; Otorinolaringološki kirurški postupci; Kirurgija glave i vrata; Prediktori*