International Journal of General Medicine

Dovepress

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ORIGINAL RESEARCH

Predisposing Factors of Difficult Tracheal Intubation Among Adult Patients in Aliabad Teaching Hospital in Kabul, Afghanistan – A Prospective Observational Study

Mohammad Sharif Oria[1], Sultan Ahmad Halimi[2], Fahima Negin[1], Abdullah Asady[3]

[1]Department of Anesthesiology, Aliabad Teaching Hospital, Kabul University of Medical Sciences, Kabul, 1001, Afghanistan; [2]Department of Pathology, Kabul University of Medical Sciences, Kabul, 1001, Afghanistan; [3]Department of Microbiology, Kabul University of Medical Sciences, Kabul, 1001, Afghanistan

Correspondence: Abdullah Asady, Department of Microbiology, Kabul University of Medical Sciences, 3rd district, Kabul, 1001, Afghanistan, Tel +93 731087928, Email asady_abdullah@yahoo.com

Background: Airway management may be a considerable challenge for anesthesiologists. Currently used preoperative screening tests are known to lack sufficient specificity and sensitivity. Nevertheless, preoperative screenings and the combination of various tests are highly recommended to reduce the risk of unexpected difficult or failed airway management.

Purpose: This study aims to determine if socio-demographic characteristics can predict difficult intubation among adult patients scheduled for elective surgeries under general anesthesia in Aliabad Teaching Hospital, Kabul, Afghanistan.

Methods: A total of 341 patients were selected based on consecutive sampling method. Informed consent forms were obtained before inclusion in the study. Data were collected using a data collection form. Age, gender, ASA physical status and ethnicity were recorded for each participant. Airway assessment tests such as mouth opening (MO), thyromental distance (TMD), and Mallampati classes, inability to prognath (AP) and neck mobility and size (NM) category were conducted by research team. Data were initially entered into an Excel data sheet and then exported to SPSS Statistics version 22 for analysis.

Results: From 28 October 2018 to 30 January 2019, a total of 341 patients included in the study. Of these, 193 (56.6%) were male and 148 (43.4%) were female. The mean age of the subjects was 36.98 ± 15.048 years. More than half (54.5%) of the study population were Tajiks. Patients from the Hazara ethnicity, female patients, older patients and those suffering from systemic diseases found to be more difficult to intubate. We recognized that, Mallampati classes ≥3, small MO, short TMD, AP, reduced NM were also associated with difficult intubation. Multiple logistic regression analysis of the associated factors determined that increased age more than 40 years, AP and small MO were independent predictors of difficult intubation.

Conclusion: The study findings show that Hazara ethnicity, female patients, increasing age and systemic disease have significant associations with difficult intubation. Mallampati classes III and IV, MO ≤4 cm, TMD ≤6 cm, and reduced NM had higher risks of difficult intubation. Multiple logistic regression analysis determined that increased age, AP and MO were independent predictors for difficult intubation.

Keywords: difficult intubation, intubation difficulty scale, anesthesiology, difficult airway, IDS

Introduction

Airway management is one of the key challenges for anesthesiologists. Tracheal intubation is one of the supports in airway management during general anesthesia.[1] Screening tests have different diagnostic values depending on the variety of incidence of intubation, insufficient statistical power, and different test applications.[2]

Received: 10 November 2021
Accepted: 14 January 2022
Published: 5 February 2022

Studies have included variables such as gender, age, ethnicity classification, ASA physical status classification, Mallampati score (MP), mouth opening (MO), thyromental distance (TMD), inability to prognath (AP) and neck mobility and size (NM) in the preoperative airway assessment.[2–4]

Risk factors reported to be associated with difficult intubation are MO less than 4 cm, TMD less than 6 cm, Mallampati Class III or higher, NM less than 35°and inability to advance the mandible. Almost all (98%) difficult intubations may be predicted by performing a thorough and careful assessment of the airways prior to surgery.[5,6]

To have a safe intubation, it is essential to perform a precise preoperative airway assessment, but still there is an argument which tests and anatomical landmarks would be the best predictors.[7]

Intubation Difficulty Scale (IDS) score is a function of seven parameters, which result in a progressive and quantitative determination of intubation complexity. This score is calculated by the operator immediately after intubation. An IDS score of = 0 represents easy intubation; IDS score of = 1–5 represents slight difficult intubation; IDS score of >5 represents moderate to major difficult intubation; and IDS score of = ∞ denotes impossible intubation.[3] Difficult intubation is defined as more than three attempts (IDS >5) or more than 10 mins using direct laryngoscopy to complete tracheal intubation.[2,8]

This study aims to determine if socio-demographic characteristics can predict difficult intubation among adult patients scheduled for elective surgeries under general anesthesia in Aliabad Teaching Hospital, Kabul, Afghanistan. This is the first study of its type in Aliabad Teaching Hospital (ATH), Kabul Afghanistan which attempts to provide baseline data for future researches.

Before we describe the study methods and results, it would be useful to briefly explain the practice and training of anesthesia in Afghanistan. In 2010 according to a need assessment and shortage of anesthesiologists, the government decided to train graduates of nursing faculty in anesthesia for two years to serve as anesthesiologists. Soon after, the two years anesthesia program was promoted to a 4-year undergraduate program, i.e., Bachelor of Science in anesthesia technology in 2012. The program is supervised by faculties and staff of Department of Anesthesiology, Kabul University of Medical Sciences. Students who graduate from this program, are allowed to offer direct clinical care under the supervision of an anesthesiologist in Afghanistan.

Materials and Methods

Study Design and Sampling

This was a cross-sectional study conducted in ATH, Kabul University of Medical Sciences, from October 2018 to January 2019. Patients who were scheduled for elective surgery under general anesthesia at Neurosurgery, Orthopedics, Urology and General surgery wards of ATH were chosen to participate in the study. A verbal briefing was provided to introduce the objectives and methodology of the study. Once the participants agreed to take part in the study, they were asked to sign the informed consent form. This was a blinded study. Intubation was performed after adequate muscle relaxation was achieved using Macintosh size 3 blade with the patients' head in sniffing position. The intubation was performed by anesthesiologists with more than three years' of experience.

The sample size estimation was based on the consecutive sampling where a common practice is to select all cases which are available in a given period of time or to select a sample size based on a previous study.[9]

Study Instrument, Tool Administration and Data Collection

MP (Table 1), MO, TMD, AP, and NM were the independent variables. In order to collect information on the socio-demographic characteristics of the participants, a data collection sheet was designed and developed in by the principal researchers with the intention to cover all possible factors associated with difficulty in intubation.[2–4]

On the day before surgery, all patients were assessed. The observer there after completed a data collection sheet explaining the procedure, number of attempts, Cormack Lehane grading, external laryngeal pressure, traction force, number of techniques, number of operators and movement of vocal cords.

All patients above 18 years old, ASA physical status I, II or III, both genders who required general anesthesia and orotracheal intubation were included in the study. However, patients with facial abnormalities, both congenital and

Table 1 Mallampati Classification

Class	Structures Visible
I	Soft palate, fauces, pillars and uvula
II	Soft palate, fauces and uvula
III	Soft palate, base of uvula
IV	Hard palate only

traumatic in whom airway assessment was not possible, patients undergoing emergency surgery, with a full stomach, tracheostomized, and those not receiving neuromuscular blocker were excluded from the study.

Ethical Considerations

This study did not include any experimental components nor did it use any human tissue samples. The study protocol was approved by Ethics committee of Department of Anesthesiology, ATH under protocol no. REC.18/103. All aspects of this study follow the ethical standards of the relevant national and institutional committees on studies involving human contacts and with the Declaration of Helsinki released in 1975 and subsequent revisions.

Data Analysis

Initial data was entered into an excel datasheet and then exported to IBM SPSS version 25.0 for analysis. Bi-variable (Chi-square) analysis was used to determine factors which are associated with difficult intubation. A p value of < 0.05 was considered significant at 95% confidence interval (CI). The results were presented as crude odds ratios (OR_C) with 95% CI. In order to find out indicators which made independent contribution to the preoperative predictors for IDS, factors which had a p-value of ≤ 0.25 were included in multivariate logistic regression analysis, as suggested by Bendel & Afifi. ORs were obtained using logistic regression analyses are presented as adjusted odds ratios (AOR).[10]

Results

The following diagram shows the flow of subject recruitment for the study (Figure 1).

Sociodemographic Characteristics of the Participants

Table 2 shows the socio-demographic characteristics of study participants. From a total of 341 patients, 193 (56.60%) were males and 148 (43.40%) females. The age of the subjects ranged from 18 years to 65 years with a mean age of 36.98 ± 15.048 years.

Preoperative Airway Assessment

Table 3 provides the data on preoperative airway assessment and their distribution among study participants. Among the study population, 69.6% of them were from ASA Class I, 26.4% from ASA Class II, and remaining 3.8% were from ASA Class III. More than half 54.5% of the study population were from Tajik ethnicity, 22.3% were Pashtuns, 19.4% were Hazaras and 3.8% were Uzbeks.

Incidence of Difficult Intubation Among Study Participants

Figure 2 provides the data on incidence of difficult intubation among study participants. The overall incidence of difficult intubation was 26.7%, whereas, 83 (24.3%) had slightly difficult intubation (IDS = 5), seven (2.1%) had moderate to major difficult intubation (IDS >5), and only one patient (0.3%) detected as failed intubation (IDS >7).

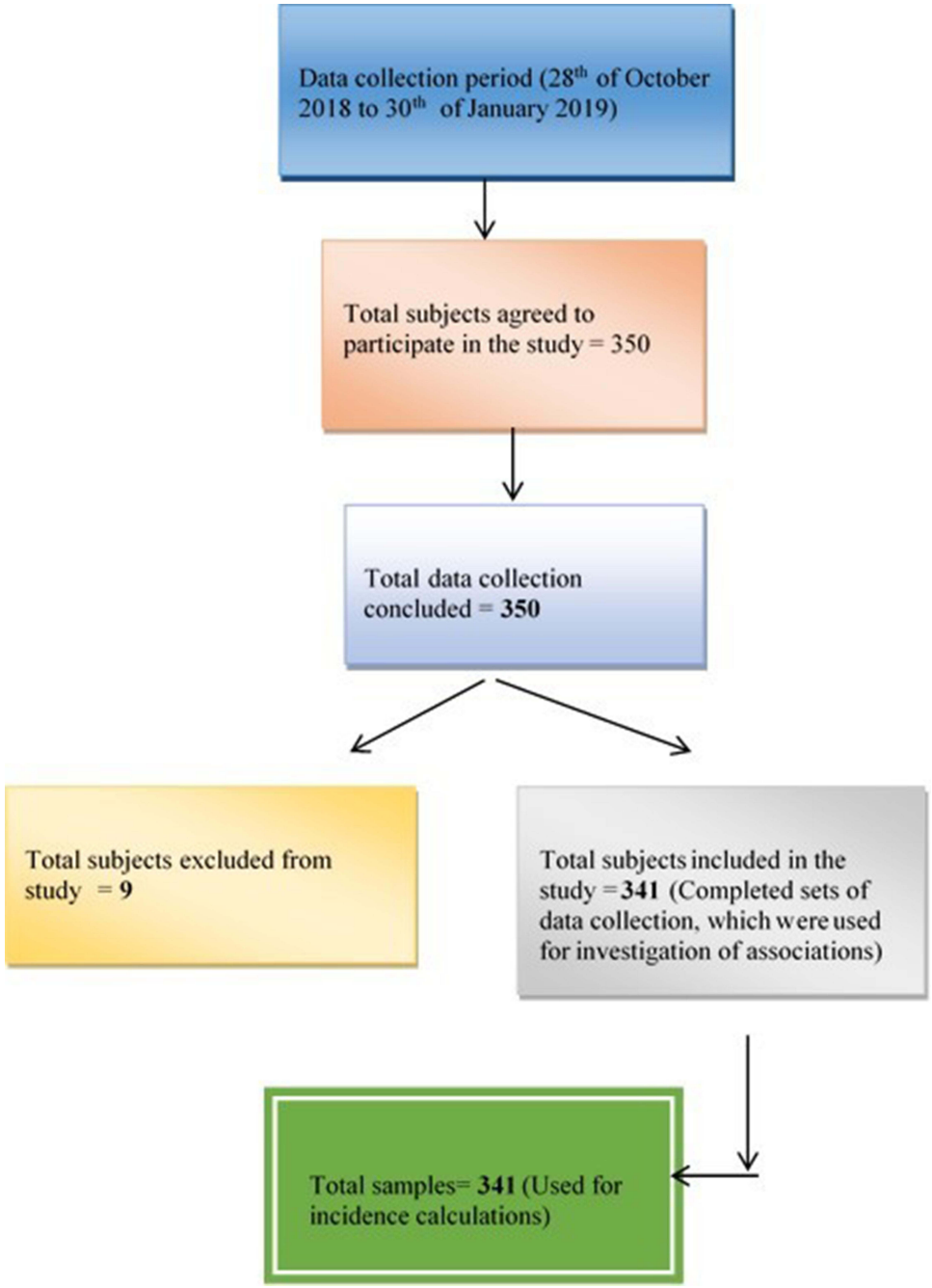

Figure 1 Flow diagram of subject recruitment for the study.

Bi-Variable and Multivariable Logistics Regression Analyses

Table 4 shows the results of bi-variable and logistics regression analyses of socio-demographic characteristics associated with difficult intubation. Female participants had more risk of difficult intubation compared to male participants, with odds ratio (OR) of 1.7 and its corresponding 95% CI (1.0–2.7). Patients with more than 40 years of age had increased risk of difficult intubation, as compare to those lower than 40 years old, with an OR of 11.1 and its correspondent 95% CI (1.0–2.7). Hazara ethnicity had more risk of difficult intubation as compared to other ethnicities, with an OR of 1.9 and its corresponding 95% CI (1.1–3.4). Furthermore, patients with systemic diseases (ASA II and ASA III) had increased risk for difficult intubation, as compared to those not suffering from systemic diseases with an OR of 4.0 and its

Table 2 Socio-Demographic Characteristics of the Subjects (n=341)

Characteristics	Classification	n (%)
Gender	Female	148(43.40)
	Male	193(56.59)
Age group	<40	192(56.30)
	≤40	149(43.69)
Ethnicity	Tajiks	186(54.5)
	Pashtuns	76(22.3)
	Hazaras	66(19.4)
	Uzbeks	13(3.8)
ASA physical status	ASA Class III patients	13(3.7)
	ASA Class II patients	90(24.6)
	ASA Class I patients	238(69.79)

Table 3 Preoperative Airway Assessments and Their Distribution Among Surgical Patients in Aliabad Teaching Hospital

Preoperative Assessments	Classification	Frequency	Percent
Mallampati classes	Class IV	2	0.6
	Class III	24	7
	Class II	101	29.6
	Class I	214	62.8
Mouth opening	=<4 cm	24	7
	>4 cm	317	93
Thyromental distance	=<6 cm	25	7.3
	>6 cm	316	92.7
Inability to prognath	Overbite, Poor extension	34	10
	Normal bite, Easy to reverse	23	6.7
	No overbite, Good extension	284	83.3
Neck mobility and size category	<30° short neck	15	4.4
	≥30° short neck	9	2.6
	≥30° normal neck	317	93

corresponding 95% CI (2.4 −6.6). In the binary logistic regression analysis, age group of patients equal or more than 40 years category in socio-demographic retained its protective effect against difficult intubation.

Table 5 shows significant predictive factors associated with difficult intubation. Patients included in Mallampati classes III and IV had higher risk of difficult intubation compared to those were in Mallampati classes I and II, with an OR of 9.2 and its correspondent 95% CI (3.7–22.7). Patients whose MO was less or equal to 4 cm had higher risk of difficult intubation as compared to those with MOof more than 4 cm, with an OR of 10.0 and its correspondent 95% CI (3.8–26.1).

Patients who had TMD less or equal to 6 cm had more difficult intubation than those who had a TMD of more than 6 cm, with an OR of 4.0 and its correspondent 95% CI (1.7–9.1). Patients who had limited NM were predisposed to difficult intubation than those who did not have any reduction in NM, with an OR of 8.0 and its correspondent 95% CI (3.2–20.0).

A multiple logistic regression analysis of predictive factors determined AP and MO as independent predictors for difficult intubation with p-value =0.004 and 0.036 respectively at 76.5% Hosmer and Lemeshow test with an AOR of 5.38 and 5.43, respectively at 95% CI.

Discussion

Unpredicted difficult intubation means patients are at an increased risk of complications.[11] As a result, soft tissue injury, trauma and subsequent airway edema, unnecessary surgical airway, inability to maintain tissue oxygenation, brain injury,

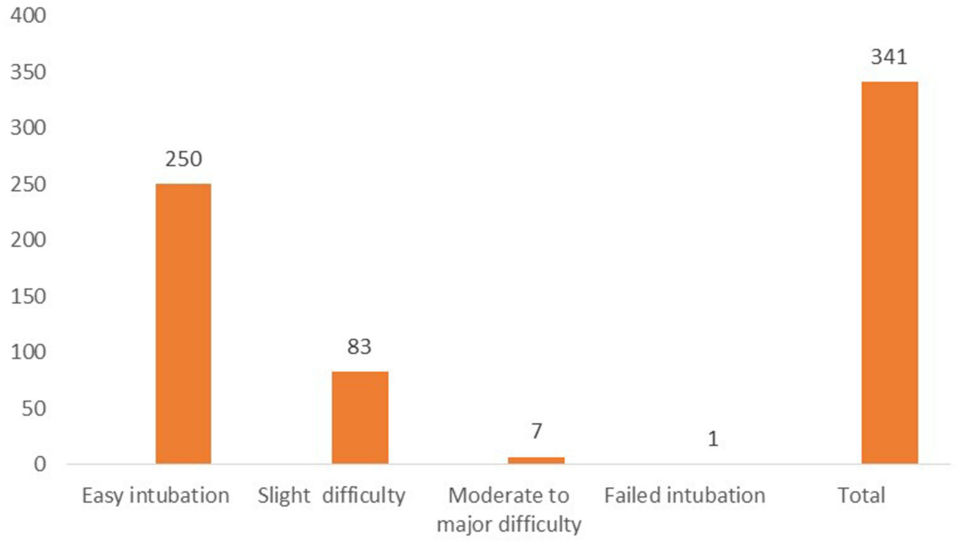

Figure 2 Incidence of difficult intubation among study participants (Frequency).

cardiorespiratory arrest, and even death could occur.[1] More emphasis is needed on the assessment, preparation, positioning, pre-oxygenation, maintenance of oxygen and decreasing trauma from airway interventions.[12] The purpose of this study was to investigate predisposing factors of difficult tracheal intubation among patients planned for elective surgery in Kabul, Afghanistan.

The overall incidence of difficult tracheal intubation was 26.7%, while 24.3% had slight difficulty (IDS = 5), 2.3% moderate to major difficulty (IDS >5). This is in line with the study conducted by Garg & Dua[3] in Karnataka, India and lower than what were reported by Prakash et al[2] and Schmitt et al.[13]

Chi-square analysis found that increasing age, i.e., more than 40 years, was associated with difficult intubation in our study. Prakash et al also reported that increasing age has a significant association with difficult intubation.[2] A study from Iran also reported a similar finding.[14] However, another study in Iran did not report any significant relationship between demographic findings (age and BMI) and difficult intubation.[15]

Table 4 Results of Chi-Square and Logistic Regression Analyses for Socio-Demographic Characteristics Associated with Difficult Intubation

Characteristics		Difficult Intubation		OR_C* (95% CI)	P	AOR**	P
		Present n (%)	Absent n (%)				
Gender	Female	48 (32.4)	100 (67.6)	1.7 (1.0–2.7)	0.036		
	Male	43 (22.3)	150 (77.7)	1		–	0.189
Age group	<40	16 (8.3)	176 (91.7)	11.1 (6.1–20.4)	0.001	15.775 (7.04–35.34)	
	≤40	75 (50.3)	74 (49.7)	1		1	0.000
Ethnicity	Hazara ethnicity	25 (37.9)	41 (62.1)	1.9 (1.1–3.4)	0.022		
	Other ethnicities	66 (24.0)	209 (76.0)	1		–	0.104
ASA physical status	Systemic disease patients	48 (46.6)	55 (53.4)	4.0 (2.4–6.6)	0.001	–	0.862
	ASA Class I	43 (18.1)	195 (81.9)				

Notes: *Crude odds ratio. **Adjusted odds ratio. 1= Reference category.

Table 5 Results of Chi-Square and Logistic Regression Analyses for Significant Predictive Factors Associated with Difficult Intubation

Predictive Factors		Difficult Intubation		OR_C* (95% CI)	AOR**	P
		Present n (%)	Absent n (%)			
Mallampati classes	Difficult	19 (73.1)	7 (26.9)	9.2 (3.7–22.7)	–	0.097
	Easy	72 (22.9)	243 (77.1)			
Mouth opening	=<4 cm	18 (75.0)	6 (25.0)	10.0 (3.8–26.1)	5.436 (1.119–26.417)	0.036
	>4 cm	73 (23.0)	244 (77.0)		1	
Thyromental distance	=<6 cm	14 (56.0)	11 (44.0)	4.0 (1.7–9.1)	–	0.277
	>6 cm	77 (24.4)	239 (75.5)			
Inability to prognath	Difficult	26 (76.5)	8 (23.5)	12.1 (5.2–28.0)	5.382 (1.725–16.792)	0.004
	Easy	65 (21.2)	242 (78.8)		1	
Neck mobility and size	Difficult	17 (70.8)	7(29.2)	8.0 (3.2–20.0)	–	0.438
	Easy	74 (23.3)	243 (76.7)			

Notes: *Crude odds ratio. **Adjusted odds ratio. 1= Reference category.

Difficult tracheal intubation was also found to be more common in female gender. Studies have pointed out that fat deposition in the back of neck among women could be one reason for difficult intubation.[16] A study by Prakash et al reported that males were more likely to have difficult intubation compared to females.[2] Since this is the first study in the context of Afghanistan, this point needs to be further explored.

We found a notable association between ethnicity and difficult tracheal intubation among the study population. Subjects from Hazara ethnicity were found to have more difficult tracheal intubation than other ethnicities. This could be due to certain anatomical structures prominent in one ethnicity over another. Moreover, Studies have also discussed about various anatomical variations in Asians which may cause difficulty in tracheal intubation.[17]

Patients with systemic diseases (ASA II and ASA III) had increased risk for difficult intubation, as compared to those not suffering from any systemic disease. It is estimated that difficult tracheal intubation is ten times higher in patients suffering from long-term diabetes mellitus as compared to those not suffering from diabetes.[18] A study among Indians also indicated that people with diabetes mellitus had more difficult tracheal intubation.[2]

With regard to predictors of difficult intubations among the study population, Chi-square analysis revealed that Mallampati classes III and IV, MO ≤4 cm, TMD ≤6 cm, and reduced NM had higher risks of difficult intubation. Garg & Dua (2015) reported similarly.[3] Besides, Brodsky et al assessed a number of airway assessment methods including Mallampati classes, neck circumference, MO and TMD.[19] Class III upper lip bite test (similar to AP in our cases), IID <4.5 cm (similar to MO in our cases), TMD <6.5 cm, and SMD <13 cm were defined as predictors of difficult intubation in the study conducted by Khan et al.[20] Furthermore, Workeneh et al indicated that MO and Mallampati classes III and IV are the most sensitive assessments for predicting difficult intubation.[8]

A multiple logistic regression analysis determined that increasing age, AP and MO were independent predictors for difficult intubation. In contrast, Garg & Dua (2015) concluded that Mallampati classes III and IV and AP were significant of the variables studied.[3] Karkouti et al reported that, MO, chin protrusion (similar to AP in our study), and atlanto-occipital extension (similar to NM in our case) were highly significant for predicting difficult intubation.[21] Prakash et al reported that Mallampati classes III and IV, range of neck movement <80°, IID ≤ 3.5 cm and snoring were independently related to difficult intubation.[2]

Conclusion

The study findings show that Hazara ethnicity, female patients, increasing age and systemic disease have significant associations with difficult intubation. Mallampati classes III and IV, MO ≤4 cm, TMD ≤6 cm, and reduced NM had higher risks of difficult intubation. Multiple logistic regression analysis determined that increased age, AP, and MO were independent predictors for difficult intubation.

Strength and Weakness of the Study

This is the first study of its type in Kabul, Afghanistan which attempts to provide a baseline data for future researches. However, the findings of this study do not reflect the prevalence of difficult intubation in the Afghan population.

Recommendations

The authors would like to suggest the following:

1. In spite of various airway assessment tests no single test is 100% accurate. Therefore, it is advisable to use a combination of different tests. We would like to recommend anesthesia professionals to use the combination of routine preoperative tests to predict difficult intubation.
2. Anesthesia professionals should develop guideline for preoperative airway assessment to decrease incidence of difficult intubation.
3. Further multicenter study should be conducted in this particular topic to develop a national guideline for preoperative airway assessments.

Disclosure

The authors declare that they have no conflicts of interest.

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