JOURNAL OF
CONTEMPORARY MEDICINE

DOI: 10.16899/jcm.745672
J Contemp Med 2020;10(2):243-247

Orjinal Araştırma / Original Article

Assessment of Difficult Intubation Predictors in Different Populations of Turkey

Türkiye'nin Farklı Bölgelerindeki Zor Entübasyon Tahminlerinin Değerlendirilmesi

Ali Bestemi Kepekçi[1], Elif Erdoğan[2], Hatice Pinar Yavaşca[3], Serkan Telli[4]

[1]Istanbul Yeni Yuzyil University, Vocational Health High School, Department of Anesthesia, Istanbul, TURKEY
[2]Sanko University Sani Konukoglu Practice and Research Hospital, Department of Anesthesiology and Reanimation, Gaziantep, Turkey
[3]Istanbul Istinye State Hospital, Department of Anesthesiology and Reanimation, İstanbul, Turkey
[4]Lefke European University Vocational School of Health Services, Department of Anesthesia, Lefke, Turkish Republic of Northern Cyprus

Abstract

Aim: Difficult tracheal intubation is defined when tracheal intubation requires multiple attempts, in the presence or absence of tracheal pathology. Most importantly, difficult intubation differs between countries and populations. Physicians should be aware of difficult intubation frequencies of their populations. Turkey is a transit country between East and West. Eastern Turkey reflects the Middle East and Asia, while western Turkey has European features. Our objectives were to investigate the frequency of difficult intubation in different regions' populations, and specificity and sensitivity of predictive values.

Method: According to the population in the regions, 24 experienced anesthesiologists from 13 hospitals in 7 regions, were included in the study.

Results: Of 1313 patients, 143 patients (10.89%) were detected as difficult intubation. Mallampati (MLP) III-IV were alone (p = 0.043), and the combination of thyromental distance <6 cm and MLP III-IV (p: 0.018) were statistically significant in difficult and easy intubation patient groups. The specificity was 97.46% in MLP + thyromental combination, and 98.05% in MLP + mouth opening combination. Western region had the shortest measurements in sternomental, thyromental and mouth opening (p <0.05), and had the most difficult intubation frequency compared to the other regions (p: 0.001).

Conclusion: The positive predictive values were increased with increasing combinations, but further research is needed on the predictors of difficult intubation.

Keywords: Anthropometric measurements, airway management, demography, difficult intubation, laryngoscope, predicting difficult intubation

Öz

Amaç: Zor trakeal entübasyon, entübasyon trakeal patolojinin varlığında veya yokluğunda çoklu girişimler gerektirdiğinde tanımlanır. En önemlisi, zor entübasyon ülkeler ve popülasyonlar arasında farklılık gösterir. Doktorlar, popülasyonlarının zor entübasyon sıklıklarının farkında olmalıdır. Türkiye, Doğu ile Batı arasında bir geçiş ülkesidir. Türkiye'nin doğusu Ortadoğu ve Asya'yı yansıtırken, Türkiye'nin batısında Avrupa özellikleri bulunmaktadır. Hedeflerimiz, farklı bölgelerdeki nüfuslarda zor entübasyon sıklığını ve öngörücü değerlerin özgüllüğünü ve duyarlılığını araştırmaktı.

Yöntem: Bölgelerdeki nüfusa göre, 7 bölgedeki 13 hastaneden 24 deneyimli anestezi uzmanı çalışmaya dahil edildi.

Bulgular: 1313 hastanın 143'ünde (%10,89) zor entübasyon saptandı. Mallampati (MLP) III-IV tek başına (p = 0.043) ve tiromental mesafe <6 cm ve MLP III-IV (p: 0.018) kombinasyonu, zor ve kolay entübasyon hasta gruplarında istatistiksel olarak anlamlıydı. Spesifite MLP + tiromental kombinasyonda %97,46 ve MLP + ağız açma kombinasyonunda %98,05 idi. Batı bölgesi sternomental, tiromental ve ağız açıklığında en kısa ölçümlere sahipti (p <0.05) ve diğer bölgelere kıyasla en fazla zor entübasyon sıklığına sahipti (p: 0.001).

Sonuç: Pozitif prediktif değerler artan kombinasyonlarla arttı, ancak zor entübasyonun prediktörleri üzerinde daha fazla araştırmaya ihtiyaç vardır.

Anahtar Kelimeler: Antropometrik ölçümler, demografi, hava yolu yönetimi, laringoskop, zor entübasyon, zor entübasyon prediktif değerleri

Corresponding *(İletişim)*: Ali Bestemi Kepekçi, Istanbul Yeni Yuzyil University, Vocational Health High School, Department of Anesthesia, Istanbul, TURKEY
E-mail *(E-posta)*: alibestemi.kepekci@yeniyuzyil.edu.tr
Received *(Geliş Tarihi)*: 31.05.2020 **Accepted *(Kabul Tarihi)*:** 22.06.2020

INTRODUCTION

Airway management is one of the vital resuscitative procedures of anesthesia, emergency, and critical care medicine. Difficult intubation occurred more frequently in these departments in proportion to the excess of intubation performed compared to the other departments. American Society of Anesthesiologists defines difficult airway in which a trained anesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation, or both. Difficult tracheal intubation is defined when tracheal intubation requires multiple attempts, in the presence or absence of tracheal pathology.[1] Unanticipated difficult intubation is one of the most important cause of anesthesia-related morbidity.[2,3] The experience of the anesthesiologist is very essential for the management of difficult intubation and unanticipated difficult intubation situations, and it is recommended to practice existing guidelines.[4,5]

Difficult airway can be predicted in some patient groups such as obese, pregnant, and pediatric patients. But in some patients, it is hard to predict. The frequency of difficult airway has a huge range between 0.05-18%, and 2-3% of them could be very difficult airway.[6,7] The difficult intubation also differs between countries and populations. Difficult intubation ratio was 8% in India[8] and 6% in Europe[9] Turkey is a transit country between East and West. Eastern Turkey reflects the Middle East and Asia, while western Turkey has European features.[10] In the mid-20th century, immigration from Europe had gone to the Western Turkey, while the other immigration from the Middle East and Asia had gone to the Eastern Turkey.[10]

We investigated the difficult intubation predictors indifferent regions of Turkey, which has a mixed demographic structure. Our study is the first multicenter study on the demographic intubation difficulty in Turkey. Our first objective was to investigate the frequency of difficult intubation in different regions' populations, and secondary objective was to assess specificity and sensitivity of predictive values in difficult intubation. Our other objectives were to investigate the regional difference and difficult intubation predictive values.

MATERIAL AND METHOD

This study was a prospective, multicenter study in Turkey between 15.07.2013-15.08.2013. After Haseki Education and Research Hospital Ethics Committee approval (decision No. 23 dated 07.08.2013), we selected the hospitals from Turkey's different regions and examined the distribution of the population by region. We divided the regions as North-West, West, South, South-East, East, and North. According to the population in the regions, 24 experienced anesthesiologists, who had similar experiences on airway management, from 13 hospitals were included in the study. We included at least one hospital from each region and sent the study form to the anesthesiologists who participated in the study. All patients over the age of 16, who had general anesthesia and orotracheal intubation, were included in the study. Patients who were taken to the emergency operation due to head and neck trauma were excluded from the study. The presence of the equipment which would be used in the study (machintosh laryngoscope, chuck to be placed in the tube, Fast Track LMA, Video Laryngoscope or Fiberoptic Bronchoscopy) was confirmed before the study in the selected centers. The patients were classified into the regions according to their place of birth, not their place of residence.

Before the intubation trials, all patients' age, gender, weight, height, body mass index, large tongue, presence of impaired anterior teeth, birthmarks, mallampati (MLP), thyromental (TM) distance, sternomental (SM) distance and mouth openings were measured at the operating table and Cormack Lehane Scores (CLS) during laryngoscopy were recorded on printed forms.

Intubations of all patients were attempted with machintosh laryngoscope. Patients who could not be intubated in the first 3 attempts were with a machintosh laryngoscope and after that trial, a mandrel was inserted into the tube and next intubations were attempted. Patients who could not be intubated with this step were intubated using Fast Track Laryngeal Mask Airway (LMA). After this step, the intubations of patients, who could not be intubated, were attempted with video laryngoscope or fiberoptic bronchoscopy. The patients, who were intubated after 3 trials or/and could be intubated with a mandrel, Fast Track LMA, video laryngoscope or fiberoptic bronchoscope were considered difficult intubation. At the end of the study, all forms were sent to a single-center by post. While patients are being evaluated; first they were divided into two groups as difficult and easy intubation. When evaluating regional differences; the patients were gathered in 6 subgroups according to their birthplace regions.

IBM SPSS Statistics 23 package program was used to evaluate the data. Number, percentage, mean and standard deviation values were given as descriptive statistics. Statistical evaluations were made using chi-square and independent T-test. $p<0.05$ value was considered statistically significant. Specificity and selectivity of predictive values in groups were cawlculated by considering the intersection clusters of patients who were foreseen that intubation would be difficult and patients who had difficult intubation according to a definition.

RESULTS

In 1 month period 1313 patients were included in the study. There was no statistically significant difference between difficult and easy intubation groups in gender (female n:779, 59%), age (mean:43.85±16.5), weight (mean:74.87±15.81), height (mean:165.42±8.49), and body mass index (BMI) (mean: 27.42±5.87). Of all patients 143 (10.89%) were detected as difficult intubation. There was no patient who could not to be intubated (**Table 1**).

Table 1. Characteristics of patients

	Easy intubation (n: 1170)	Difficult intubation (n:143)	Total (n: 1313)
Gender			
Male(n)	468	66	534
Female(n)	702	77	779
Age (year) mean±sd	43.73±16.38	44.76±17.53	43.85±16.5
Height (cm) mean±sd	165.41±8.45	165.48±8.88	165.42±8.49
BMI (kg/m^2) mean±sd	27.42±5.86	27.36±5.95	27.42±5.87
Weight (kg) mean±sd	74.88±15.79	74.73±16.03	74.87±15.81
Pregnancy (n)	70	4	74
Diabetic (n)	98	10	108
Large tongue (n)	96	17	113
Extension limitation of the head (n)	48	10	58
Presence of impaired anterior teeth (n)	82	9	91
TM<6 cm (n)	168	22	190
SM< 12,5 cm (n)	275	34	309
Mouth opening <3cm (n)	8	2	10
CLS iii-iv (n)	104	18	122
MLP iii - iv (n)	105	20	125

BMI: Body Mass Index, TM: Thyromental, SM: Sternomental, CLS: Cormack Lehan Score, MLP: Mallampati

In our study, there was no significant difference between diabetic and non-diabetic patients (p=0.12), and in the evaluation of women, there was no significant difference between pregnant and non-pregnant patients in easy and difficult intubation groups (p=0.09).

Only MLP III-IV were alone statistically significant in difficult and easy intubation patient groups (p=0.043). Anthropometric measurements, such as TM distance (p=0.411), SM distance (p= 0.507), and mouth opening (p=0.299), mouth opening (p=0.299), and Cormack Lehan Score (p= 0.102) evaluated separately, and there was no significant difference between difficult and easy intubation groups. When we evaluated the combination of TM <6 cm and MLP III-IV, a significant difference was found in the patient groups (p=0.018). The specificity was 97.46% in the MLP+TM combination, and it was 98.05% in the MLP+mouth opening combination (**Table 2**).

There was no significant difference in terms of gender, age, height and weight in the distribution of patients divided into regions according to their birth of region. The average values of the anthropometric measurements by region are as given in **Table 3**. There was a significant difference between regions in SM, TM and mouth opening measurements (p<0.05). Western region had the shortest measurements in SM, TM and mouth opening measurements.

There was a significant difference between the regions in difficult intubation (p:0.001). In relation to the shortness of TM, SM and mouth opening measurements which were measured before surgery, the western region had the most difficult intubation frequency compared to other regions.

Table 2. Sensitivity, specificity, positive and negative predictive values of variables

	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
MLP III-IV	14.08	91.03	16.00	89.73
CLS III-IV	12.58	91.11	14.75	89.5
Mouth Opening <3cm	10.5	93.00	15.46	89.47
SM< 12,5 cm	23.77	76.5	11.00	89.14
TM< 6 cm	15.4	85.64	11.60	89.22
MLP+ TM	6.9	97.46	25.00	89.47
MLP+Mouth Opening	2.63	98.05	13.04	90.04

MLP: Mallampati, CLS: Cormack Lehane Score, SM: Sternomental Distance, TM: Thyromental Distance

Table 3. Anthropometric measurements and difficult intubation frequencies in regions

	SM (cm)	TM (cm)	Mouth opening (cm)	Difficult intubation frequency (%)
Total	13.89±2.06	7.22±1.15	4.43±0.88	10.89
North-West	13.99±2.16	7.08±1.32	4.73±0.87	15.44
West	13.16±1.43	6.94±0.82	4.04±0.73	25.33
South	13.31±1.57	7.04±1.13	4.21±1.01	22.58
South-East	13.9±2.11	7.01±1.13	4.16±0.85	7.65
East	14.49±2.24	7.39±1.34	4.65±0.81	10.00
North	13.47±2.04	7.23±1.09	4.46±0.77	7.34
p values	0.002	0.000	0.000	0.001

SM: Sternomental Distance, TM: Thyromental Distance

DISCUSSION

Difficult intubation is an important clinical problem with high mortality. It can be seen in pathological situations or structural disorders. In pathological situations, difficult intubation could be foreseen. But in structural problems, difficult intubation could be hard to notice and have more serious consequences. Predictive parameters should be considered, and anthropometric measurements should be done properly in preoperative evaluations. Evaluation of predictive parameters together gives more significant results than evaluating them individually. Like Rao et al. stated neither the specificity or sensitivity of the TM distance alone was not sufficient[11] and our data were consistent with that. We found the specificity of MLP+TM combination was 97.46%, and the specificity of MLP+mouth opening combination was 98.05%.

It was reported that the evaluation of TM and SM distance measurement with the MLP test, the specificity decreased by 25%. But the selectivity and positive predictive value reached 100% with the evaluation of these parameters together.[12] In addition, Kandemir et al. reported that difficult intubation selectivity increased when MLP test and TM distance were evaluated together.[13]

Shah and Sunderam assessed difficult intubation with the half number of patients in our study. They used the predictors of difficult intubation, which we used in our study, too. They showed a difficult intubation frequency of 8%, and our data were consistent with it.[8] There was another study in France thatshowed a difficult intubation frequency as 9%.[14]

The most specific parameter in our study the combination of MLP+mouth opening. Studies have shown that the MLP score is directly related to difficult intubation.[15] Shah and Sundaram found difficult intubation was 40% in MLP III patients, while it was found 100% in MLP IV patients, and the mouth opening less than 3 cm was found to be significant in difficult intubation.[8]

In the literature, there were some cases, which were evaluated as MLP I in the preoperative assessment, developed inadequate mouth opening secondary to temporomandibular joint disorder after anesthesia induction.[16,17] In our study, we did not see any similar cases.

The frequency of difficult intubation was higher in the Western and Southern regions, which could be considered similar to the Greek population. Because it was shown that Western Turkey has European features.[9] However, our data differ from Zacharopoulos et al.[18] who found that the Greeks had a larger mandible compared to North American Whites. This result was the opposite of our study since easy intubation is directly proportional to the large mandible. Large meta-analyses and demographic studies in which difficult intubation criteria are evaluated in the world have been studied in recent years. England,[19] Thailand,[20] China,[21] Zimbabwe[22] and Saudi Arabia[23] investigated demographic structures. Moreover, a meta-analysis of 50760 cases in the European population was presented in 2005.[24]

Our study had some limitations. Although the number of hospitals was determined by the population distribution before our study, the number of patients was not reached as planned to be included in the study per hospital. Other limitation was about the anesthesiologists' airway management experience. This was a multi-center study, and it was difficult to assess the skill of anesthesiologists on difficult airway management individually. But the participated doctors had similar experience on anesthesiology. Additionally; migration in the mid-20th century event is not the single determinant, for the structure of population living in the area. Over the years, internal migrations (especially from eastern provinces to western) also effect. Due to interregional migration, evaluation of only birthplaces may not involve precise and complete information for the original anatomic/physiological structure of individuals of that region.

CONCLUSION

Although Turkey has a similar difficult intubation frequency with the world average, people from the Western and Southern had a higher risk of difficult intubation. This difference is also seen in anthropometric values. The positive predictive values will increase with increasing combinations. The most specific variables were MLP III-IV and mouth opening <3 cm when evaluated individually. We showed that difficult intubation should be expected in people with a short TM distance and high MLP score, but further research is needed on predictors of difficult intubation.

ETHICAL DECLARATIONS

Ethics Comittee Approval: The study was carried out with the permission of Haseki Education and Research Hospital Ethics Committee (Permission granted 07.08.2013, Decision No. 23).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Status of Peer-review: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Apfelbaum JL, Hagberg CA, Caplan RA, et al. Practice guidelines for management of the difficult airwayan updated report by the American Society of Anesthesiologists task force on management of the difficult airway. Anesthesiology 2013;118(2):251-70.
2. Edelman D, Perkins E, Brewster D. Difficult airway management algorithms: a directed review. Anaesthesia. 2019;74(9):1175-85.
3. Langeron O, Bourgain J-L, Francon D, et al. Difficult intubation and extubation in adult anaesthesia. Anaesth Crit Care Pain Med 2018;37(6):639-51.
4. Law JA, Broemling N, Cooper RM, et al. The difficult airway with recommendations for management–part 2–the anticipated difficult airway. Can J Anesth 2013;60(11):1119-38.
5. Frerk C, Mitchell VS, McNarry AF, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. Br J Anaesth 2015;115(6):827-48.
6. Janssens M, Hartstein G. Management of difficult intubation. Eur J Anaesthesiol 2001;18(1):3-12.
7. Lakhe G, Poudel H, Adhikari KM. Assessment of airway parameters for predicting difficult laryngoscopy and ıntubation in a tertiary center in Western Nepal. J Nepal Health Res Counc 2019;17(4):516-20.
8. Shah PN, Sundaram V. Incidence and predictors of difficult mask ventilation and intubation. J Anaesthesiol Clin Pharmacol 2012;28(4):451.
9. Baillard C, Boubaya M, Statescu E, et al. Incidence and risk factors of hypoxaemia after preoxygenation at induction of anaesthesia. Br J Anaesth 2019;122(3):388-94.
10. Deniz O. Van City in terms of refuge mobilities and the demographic profile of refugees. Doğu Coğrafya Derg 2009;14(22):187-204.
11. Rao KVN, 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(8):603.
12. Iohom G, Ronayne M, Cunningham A. Prediction of difficult tracheal intubation. Eur J Anaesthesiol 2003;20(1):31-6.

13. Kandemir T, Şavlı S, Ünver S, Kandemir E. Sensitivity of the combination of mallampati scores with anthropometric measurements and the presence of malignancy to predict difficult ıntubation. Turk J Anaesthesiol Reanim 2015;43(1):7.
14. Adnet F, Racine S, Borron S, et al. A survey of tracheal intubation difficulty in the operating room: a prospective observational study. Acta Anaesthesiol Scand 2001;45(3):327-32.
15. Motamedi M, Soltani M, Amiri M, Memary E. The relationship between orotracheal ıntubation difficulty scoring systems and anthropometric factors. Adv J Emerg Med 2019;3(1):e5.
16. Kayashima K, Matsushita H, Murashima K. Difficult tracheal intubation using the Airway Scope in a patient with unexpected mouth-opening difficulty. J Anesth 2012;26(2):308-9.
17. Akasapu KR, Wuduru S, Padhy N, Durga P. Unanticipated cannot intubate situation due to difficult mouth opening. J Anaesthesiol Clin Pharmacol 2015;31(1):123.
18. Zacharopoulos GV, Manios A, Kau CH, Velagrakis G, Tzanakakis GN, de Bree E. Anthropometric analysis of the face. J Craniofac Surg 2016;27(1):e71-e5.
19. Frerk C. Predicting difficult intubation. Anaesthesia 1991;46(12):1005-8.
20. Chanchayanon T, Suraseranivongse S, Chau-in W. The Thai Anesthesia Incidents Study (THAI Study) of difficult intubation: a qualitative analysis. J Med Assoc Thai 2005;88(Suppl 7):S62-8.
21. Xue F, Zhang G, Li P, et al. The clinical observation of difficult laryngoscopy and difficult intubation in infants with cleft lip and palate. Pediatr anesth 2006;16(3):283-9.
22. Mbajiorgu F, Zivanovic S, Asala S, Mawera G. A pilot study of the mandibular angle in black Zimbabweans. Cent Afr J Med 1996;42(10):285-7.
23. Naguib M, Malabarey T, AlSatli RA, Al Damegh S, Samarkandi AH. Predictive models for difficult laryngoscopy and intubation. A clinical, radiologic and three-dimensional computer imaging study. Can J Anesth 1999;46(8):748.
24. Shiga T. Predicting difficult intubation in apparently normal patients. A meta analysis of bedside screening test performance. Anesthesiology 2006;105:885-91.