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Research Article

Determination of Anthropometric Measurements that may be Associated with Difficult Intubation in Children

Çocuklarda Zor Entübasyon ile İlişkili Olabilecek Antropometrik Ölçümlerin Belirlenmesi

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Abstract

Aim: Difficult tracheal intubation is a fundamental cause of perioperative morbidity and mortality. The frequency of difficult intubation is thought to be higher in the pediatric age group due to the different anatomical and physiological structures, and it may not be easy to detect this beforehand. Anthropometric measurements were evaluated before the elective operation and the relationship of some parameters with difficult intubation.

Material and Method: This prospective cross-sectional study was conducted on 90 pediatric patients aged 2-14 who underwent elective surgery under general anesthesia. All patients' age, gender, height, weight, body surface area (BSA), and body mass index (BMI) records were recorded before the operation. Mallampati scoring, head and neck circumference, thyromental distance measurements, and head circumference/neck circumference ratio were performed. Cormack-Lehane (CL) scoring and endotracheal intubation were applied during direct laryngoscopy of the operated patients. Children with easy intubation (CL grade 1 and 2) group 1; children who underwent difficult intubation (CL grade 3 and 4) were defined as group 2.

Results: There was no significant relationship between Groups I and II in terms of age, height and weight values. There was no significant relationship between the two groups with BSA and thyromental distance measurements. Mallampati scores were found to be grades 3 and 4 (3.3%) in three of the 90 patients, and CL scores of 3 and 4 (4.4%) in four patients. A significant correlation was found between Mallampati scoring and CL scoring. A statistically significant difference was found between the two groups regarding head/neck ratios and BMI.

Conclusion: In our study, head circumference/neck circumference ratio and BMI were found to be helpful while predicting difficult intubation in children with normal physical characteristics, 2-14 years of age, who underwent elective surgery. Our findings can be supported by further studies that will be planned and include more patients.

Keywords: Difficult intubation, head/neck ratio, body mass index, Cormack-Lehane score, Mallampati score

Öz

Amaç: Zor trakeal entübasyon, perioperatif morbidite ve mortalitenin önemli bir nedenidir. Pediatrik yaş grubunda anatomik ve fizyolojik yapıların farklı olması nedeniyle zor entübasyon sıklığının daha fazla olduğu düşünülmekte olup, bunu önceden saptamak kolay olmayabilir. Elektif operasyon öncesinde değerlendirilen antropometrik ölçümler ve bazı parametrelerin zor entübasyanla ilişkisi değerlendirilmiştir.

Materyal ve Metot: Bu kesitsel prospektif çalışma, genel anestezi altında elektif cerrahi uygulanan, 2-14 yaş arasındaki 90 çocuk hastada yapılmıştır. Operasyon öncesinde tüm hastaların yaş, cinsiyet, boy, kilo, vücut yüzey alanı (VYA) ve vücut kitle indeksi (VKI) kayıtları yapıldı. Mallampati skorlaması, baş ve boyun çevresi, tiromental mesafe ölçümleri, baş çevresi/boyun çevresi oranlaması yapıldı. Operasyona alınan hastaların, direk laringoskopi işlemi sırasında Cormack-Lehane (CL) skorlaması ve endotrakeal entübasyon uygulandı. Kolay entübasyon uygulanan çocuklar (CL grade 1 ve 2) Grup 1; zor entübasyon uygulanan çocuklar (CL grade 3 ve 4) Grup 2 olarak tanımlandı.

Bulgular: Grup I ve II arasında yaş, boy ve kilo değerleri açısından anlamlı ilişkisi saptanmadı. İki grup arasında, vücut yüzey alanı ve tiromental mesafe ölçümleriyle de anlamlı ilişki saptanmamıştır. 90 hastanın 3 tanesinde Mallampati skoru grade 3 ve 4 (%3.3), 4 tanesinde CL skoru 3 ve 4 (%4.4) saptandı. Mallampati skorlaması ile Cormack-Lehane skorlaması arasında anlamlı bir ilişki saptandı. İki grup arasında, baş/boyun oranları ve VKI açısından anlamlı fark saptanmıştır.

Sonuç: Çalışmamızda, elektif ameliyat edilen, normal fiziksel özellikteki, 2-14 yaş çocuk hastalarda, baş çevresi/boyun çevresi oranı ve VKI zor entübasyonu öngörmede prediktif olabileceği bulunmuştur. Bulgularımız, yeni planlanacak ve daha çok sayıda hastayı içeren farklı çalışmalarla desteklenebilir.

Anahtar Kelimeler: Zor entübasyon, baş/boyun oranı, vücut kitle indeksi, Cormack-Lehane skoru, Mallampati skoru

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INTRODUCTION

Difficult tracheal intubation is a common problem in clinical practice and is an important cause of perioperative morbidity and mortality (1). It has been reported that difficult intubation is encountered in 1.5-13% of patients undergoing general anesthesia (2). Due to the different anatomical and physiological structures, it may not be easy to determine difficult intubation in the pediatric age group. Studies report that the difficult intubation frequency is higher in children (3,4). When difficult intubation is encountered in the pediatric age group, arterial oxygen saturation decrease rapidly, leading to a decrease in the opportunity for intubation and a life-threatening situation such as brain damage and cardiac arrest (5). Therefore, anesthesiologists need to detect difficult airways in advance, prepare special equipment, and have good experience in airway management in the pediatric age group.

Studies on parameters and tests evaluated in predicting difficult intubation were mainly conducted in the adult patient group. Mallampati and modified Mallampati tests are widely used in clinical practice. In addition, some measurements help predict difficult intubation in adult patients (6-12).

There is insufficient data for predictive factors for difficult intubation in pediatric patients, and there is no complete consensus on parameters that may be associated with difficult intubation (5,13,14). This study evaluated the relationship between anthropometric measurements, thyromental distance, head circumference/neck circumference ratio, and difficult intubation in children aged 2-14.

MATERIAL AND METHOD

This prospective study was conducted at İzmir Bakırçay University Çiğli Training and Research Hospital. İzmir Bakırçay University approved the study plan, Non-Interventional Clinical Research Ethics Committee (Date: 08.04.2021, Decision No: 240, Research No: 221). Consent was obtained from the parents of all patients. Ninety patients aged 2-14 years, who underwent elective surgery under general anesthesia, underwent endotracheal intubation, and with physical status, ASA I-II were included in the study. Those who did not accept to participate in the study, those who developed complications during surgery, those who had a mass in the head and neck region, who had previously undergone a surgical operation in the head and neck region, and/or those who received radiotherapy and cases of surgical emergencies were not included in the study.

Age and gender records, height, and weight measurements for all patients before the operation were done by the same medical staff. Body surface area (BSA) and body mass index (BMI) calculations were made. Mallampati scoring was done while the patient was in the sitting position. Head circumference, neck circumference, and thyromental distance were measured in the supine position with a non-flexible tape measure. Head circumference was measured at the widest part of the head, passing over the glabella, occipital protuberance, and ears. Neck circumference was measured at the level of the cricoid cartilage. The head circumference/neck circumference ratio was calculated. Thyromental distance was measured with the patient's head fully extended and mouth closed. The distance between the thyroid cartilage protrusion and the midpoint of the chin tip was measured.

Before the operation, standard monitoring of the patients in the operating theatre (electrocardiogram, blood oxygen saturation, non-invasive blood pressure measurement) was performed. For the induction of general anesthesia, intravenous 1-2mcgr/kg fentanyl, 2-3mg/kg propofol, and 0.5-0.6 mg/kg rocuronium were administered. Patients were ventilated with a balloon mask for 1.5-2 minutes by giving 100% oxygen. An experienced anesthesiologist performed Cormack-Lehane (CL) scoring and endotracheal intubation during the direct laryngoscopy procedure. The same anesthesiologist performed all procedures.

CL classification: grade 1; glottis fully visible, grade 2; glottis partially visible, grade 3; only the epiglottis visible, grade 4; defined as no epiglottis visible. Group I, 'easy intubation' (CL grades 1 and 2); group II was defined as children who underwent 'difficult intubation' (CL grade 3 and 4) (13,15).

Statistical analyses were performed using the IBM SPSS statistics 22 package program. The mean and standard deviation of descriptive statistics were used. The Kolmogorov-Smirnov test was used to check whether each data group conformed to the normal distribution. An Independent sample t-test was used to compare groups with normal distribution, and the Mann-Whitney U test was used to compare paired groups without normal distribution. Fisher Chi-square independence test was used to compare categorical data, and $p<0.05$ was considered significant.

RESULTS

Of the 90 children participating in the study, 25 were girls, and 65 were boys. There were 83 children in group I and 7 children in group II.

Average age; 6.51/year in group I and 8.14/year in group II. Average height measurements were 119.26cm in group I and 125.14cm in group II. The mean weight measurements were 27kg in group I and 40.14 kg in group II (Table 1). No significant correlation was found between groups I and II, which showed the degree of intubation difficulty in terms of age, height, and weight ($p=0.161$, $p=0.417$, $p=0.053$; respectively). BSA averages; are 0.93/m2 in group I and 1.17/m^2 in group II. The mean thyromental distance measurements were 5.60cm in group I and 5.63cm in group II (Table 1). There was no significant relationship between the two groups with BSA and thyromental

distance measurements (p=0.116, p=0.716; respectively). Mallampati scores were grades 3 and 4 (3.3%) in three of the 90 patients, and CL scores of 3 and 4 (4.4%) in four patients. A significant correlation (dependence) was found between Mallampati scores and CL scores (p=0.014).

Head circumference was 51.74 cm in group I, 23.24cm in group II; neck circumference was 29.31 cm in group I and 32cm in group II (Table 1). While no significant difference was found between the groups in the mean head circumference ratios (p=0.136), a significant difference was found in the mean neck circumference (p=0.024). The head circumference/neck circumference ratio follows the normal distribution (p=0.200 in group I, p=0.200 in group II by Student's t-test). The mean head/neck ratio was 1.77 in group I; 1.67 was detected in group II. A statistically significant difference was found between the head/neck ratios and the two groups showing the risk of difficult intubation (p=0.023). In children with a large neck circumference, the head/neck ratio is reduced, the CL score and the risk of difficult intubation increase.

BMI was calculated as 17.61 kg/m² in group I and 24.21kg/m² in group II (Table 1). A significant difference was found between the two groups in terms of BMI (p=0.006). It was determined that the risk of difficult intubation increased as the BMI increased.

Table 1. Demographic and Anthropometric Characteristics of the Patients

Variable	Mean±SD		P value
	Group I	Group II	
n	83	7	
Age (years)	6.51±3.44	8.14±2.85	0.161
Height (cm)	119.26±22.42	125.14±22.32	0.417
Weight (kg)	27±14.72	40.14±17.24	0.053
Body surface area (m^2)	0.93±0.33	1.17±0.37	0.116
Body mass index	17.61±3.43	24.21±5.90	0.006
Thyromental distance (cm)	5.60±0.69	5.63±0.43	0.716
Head circumference (cm)	51.74 ±2.82	53.24 ±2.08	0.136
Neck circumference (cm)	29.31±2.75	32±2.94	0.024
Head/neck circumference ratio	1.77±0.11	1.67±0.11	0.023

Data are expressed as the mean ± SD

DISCUSSION

Although the incidence of complications in airway management in children is higher than in adults, the number of studies to identify predictors of difficult intubation is less. Airway management may become more difficult in craniopharyngeal and mandibular abnormalities due to various syndromes and congenital abnormalities. In this study, predictors of difficult intubation were compared in normal children aged 2-14 years without additional abnormalities and syndromes. The incidence of difficult intubation was around 3-5%, similar to many previous studies (2). We did not have any patients who could not be intubated. Our study was conducted with CL and Mallampati scores, shown in previous studies to be associated with difficult intubation and predict difficult intubation. Therefore, we think our study is more valuable than predictive studies with a single scoring system.

Vieira Santos et al. evaluated the correlation between the Mallampati scores, which were evaluated as a preanesthetic, and the CL scores, which were evaluated after anesthesia induction, in 108 pediatric patients aged 4-8 years who did not have congenital, genetic, and cognitive impairments that could cause difficult intubation. They showed that the two scoring systems were correlated and the applicability of the Mallampati score in this age group (16). In our study, children aged 2-14 years were evaluated, and in our findings, it was found that the two scoring systems were correlated with each other.

Kim WH et al. evaluated the relationship between neck circumference/thyromental distance ratio in adult patients and difficult intubation in obese patients. BMI, Mallampati score, Wilson score, neck circumference, thyromental distance, sternomental distance, the width of mouth opening, and history of difficult intubation were also included in the study. In obese patients, neck circumference/thyromental distance ratio, Mallampati score, and Wilson score have been reported as predictive parameters for difficult intubation (17). Unlike this study, our study was conducted on pediatric and non-obese patients. Although some of the parameters we evaluated were similar to those in this study, the head circumference/neck circumference ratio and BMI, which we found to be essential parameters in predicting difficult intubation in our patient age group, were not evaluated in this study. We think that these two parameters are significant findings.

Shirgoska et al. evaluated the CL and Mallampati scores, predictive tests for difficult intubation and airway, in 600 adults and 150 pediatric patients. They found Mallampati score of grades 3 and 4 in 3.2% of all patients and CL scores of 3 and 4 in 35%. They reported that evaluation of several parameters such as BMI, head and neck movement, tooth condition, upper lip bite test, incisor gap, and thyromental distance would be more effective and reliable for an effective and reliable estimation of difficult intubation (13). In our study, it was determined that Mallampati and CL scores were correlated with each other. However, it would be an essential advantage if other measurements supporting these two parameters were predictive in this challenging patient group. The head/neck circumference ratio can be evaluated for this purpose.

Mansano et al. evaluated the relationship between difficult intubation with some anthropometric measurements in 446 pediatric patients under 12 years of age, divided into three according to age group. Height, weight, neck circumference, BMI, the distance between incisors, thyromental distance, sternomental distance, distance from the frontal plane to the chin, and Mallampati score were determined. These

parameters were correlated with the CL score. CL scores of 3 and 4 were found in 3.58% of patients. In these patients, difficult intubation was significantly associated with short incisor distance, a considerable distance from the frontal plane to the jaw, thyromental distance, sternomental distance, and Mallampati score (14). Although some of the parameters evaluated in our study and this study are similar, there are also different parameters. Head/neck circumference ratio, which was not evaluated in this study, and BMI, which was not significantly correlated, were found to be associated with difficult intubation in our study. It may be because a significant number of patients under the age of two were also included in this study. Neither study found a relationship between the thyromental distance and difficult intubation.

Liu et al. evaluated parameters associated with difficult intubation in 96 infants with Pierre-Robin syndrome. BSA, gender, and weight were associated with difficult intubation. A correlation was also found between difficult tracheal intubation and the throat region (18). Our study was carried out in normal children who do not have additional problems and between the ages of 2-14; gender, weight, and BSA were not associated with difficult intubation in our study either. In addition, head circumference and thyromental distance, which we evaluated, were not evaluated in this study.

Shahhosseini et al. evaluated some parameters to predict difficult intubation in children under two years of age. 405 patients who underwent general anesthesia with elective surgery and endotracheal intubation were included in the study. Age, height, weight, sternomental distance, mouth opening, neck circumference, acromio-axillo-suprasternal paddy index, and intubation difficulty scale score were evaluated. They reported that age, height, weight, and sternomental distance could be significant predictors for difficult intubation. The age group in this study is entirely different from our patient group. In this study, parameters such as mouth opening, and neck circumference were not significant with difficult intubation due to the inability to fully evaluate the patients because they were under two years of age (5). We think that the head/neck circumference ratio and BMI parameters, which were not evaluated in this study, may be important indicators for our study.

CONCLUSION

In conclusion, head circumference/neck circumference ratio and BMI may predict difficult intubation in children aged 2-14 years with normal physical characteristics who underwent elective surgery. It can be used simultaneously to predict difficult preoperative intubation. Parameters such as gender, age, height, weight, and thyromental distance, which had different results in previous studies and our study, can be evaluated in the group of pediatric patients who are similar to each other in terms of various characteristics.

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