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Endotracheal intubation practice from a pediatric emergency clinic of a tertiary hospital in Turkey

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Abstract

Aim: Airway management has primary importance to provide optimal ventilation and oxygenation in emergency services.

Material and Methods: In the study, the resuscitation room records of patients aged 0-18 years in the pediatric emergency room of Healt Sciences University, Tepecik Education and Research Hospital between January 2017 and January 2020. We evaluated the patients who were admitted to the resuscitation room and underwent emergency or rapid sequential intubation. We compared the time elapsed from admission to the emergency room until the time of successful tracheal intubation in the resuscitation room.

Results: The mean age of 111 patients in the study was 14.47 months (3.93-42.27), 65 (58.6%) of them were boys and 46 (41.1%) of them were girls. Nine (8.1%) patients were resuscitated outside the hospital and it continued in the resuscitation room. Successful tracheal intubation was achieved in 95 (85.5%) patients after the first attempt. Sedative or neuromuscular blocker agents were given to 71 (63.9%) patients before intubation and cardiopulmonary resuscitation was performed in only one of them. When the time elapsed from the time of admission until the patient was taken to the resuscitation room, vascular access was provided and successful intubation was achieved, there was no significant difference between working hours and out of working hours.

Discussion: The intubation procedure, besides being a life-saving intervention, requires attention and care in terms of its risks and timing. It is very important to carry out the tracheal intubation procedure on time and the records should be kept properly and completely during the procedure.

Keywords

Airway Management, Pediatric Emergency, Tracheal Intubation

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Introduction

Tracheal intubation (TI) is a fundamental and vital procedure in critically ill child resuscitation. It is indicated in the presence of acute progress of many clinical conditions that cause deficiency of oxygenation, ventilation failure, or unable to protect airway reflex, and when clinical deterioration is anticipated during transport. Neurological problems (traumatic brain injury, status epilepticus, cardiac arrest) in children are common indications of TI compared to primary respiratory failure [1]. Rapid sequential intubation, on the other hand, describes the sedation and paralysis processes performed with sequential preparation to facilitate emergency tracheal intubation [2]. Although it is a life-saving intervention in children, it has some risks. Studies have reported that adverse events develop in 20-40% of TI attempts [3,4]. To minimize the risks associated with intubation, the intubation team should be well prepared for an unexpected difficult airway wherever possible. Intubations may be performed under time pressure and in stressful situations in emergency services, and this team's mission becomes more important. Ideally, employees, types of equipment, and medications should be readily available at each intubation as needed. In addition, in emergency services and intensive care units where intubated patients are found commonly, all physicians should have upgraded skills in airway management, endotracheal intubation, and management of intubated patients [5]. In a study conducted by Ruth et al., during intubation, intravenous access, equipment failure, and incorrect drug use were found among the risk factors [6]. Kerrey et al, on the other hand, recently described a reduction in the occurrence of desaturation from 33% to 16% after the implementation of the rapid sequential intubation checklist and other safety interventions [7]. In this study, we aimed to compare the pre-intubation practices performed in our clinic in terms of the duration of intubation of the patients, to determine the points to be considered, to determine the deficiencies from the results to be drawn and to activate the necessary practices for the correction of the detected errors or complications.

Material and Methods

This research was conducted in the Pediatric Emergency and Trauma Center of the University of Health Sciences, Tepecik Education and Research Hospital between January 2017 and January 2020, which received an average of 170000 patient applications annually. The records of patients aged 0-18 years who were admitted to the pediatric emergency clinic by ambulance (112 Emergency Health Service) or by their parents/caregivers and who were taken to the resuscitation room (Single stretcher room for patients with severe respiratory or cardiac failure or severe trauma who were prescribed basic-advanced life support - RR) and underwent emergency or rapid sequential intubation, were reviewed retrospectively. The demographic data of the patients, the admission type and time to the emergency room (ER), the presence and measurement of vital signs, the time of admission to the RR, the time of first intravenous (IV) drug administration, the time of successful intubation, the number of intubation attempts, the names and the numbers of the drugs used before intubation and mortality rates were recorded. In addition, the shifts were separated into two groups. The first group consisted of all specialists and pediatric assistants between 08:00 and 16:00 on weekdays, and the other group included night-shift specialists and pediatric assistants between 16:00 and 08:00 on weekends and weekdays.

Patients above the age of 18, premature births, the patients who were considered to have difficult airways and were expected to have anesthesiology and/or otorhinolaryngology consultation for successful intubation, those who were intubated using a video laryngoscope or laryngeal mask, who were taken to the resuscitation room for critical patient follow-up and intubated after, and patients with missing data were excluded. Successful TI procedure is described as the insertion of the intubation tube into the trachea, to the distal part of the glottis with the help of a laryngoscope and performing of the positive pressure ventilation, the chest lift, and the measurement of the end-tidal carbon dioxide (EtCO2) value with a capnometer (which correctly takes the trace).

Statistical Analysis

We evaluated the data in the statistical package program IBM SPSS Statistics 25.0 (IBM Corp., Armonk, New York, USA). Descriptive statistics were given a number of units (n), percent (%), median, mean ± standard deviation, minimum and maximum value, and percentile values. The normal distribution of the data of numerical variables was evaluated with the Shapiro-Wilk test of normality and Q-Q graphs. We examined the homogeneity of variances with Levene's test. Comparisons between groups for numerical variables were used for two groups in case of normal distribution of the data, an independent two-sample t-test was used for two groups. If the data were not normally distributed, the Mann-Whitney U test was used for both groups. Pearson's chi-square test was used for categorical extremes, and Fisher's exact test was used when variables were few in number. The $p<0.05$ value was considered statistically significant in all comparison groups. The University of Health Sciences, Tepecik Training and Research Hospital, Clinical Research Ethics Committee (Number: 2020/6-13) approved this study. Our study was retrospective and written informed consent was not obtained. Patients' personal information is kept private.

Results

The mean age of the 111 patients included in the study was 14.47 months (3.93-42.27), with 65 (58.6 %) being boys and 46 (41.1 %) being girls. Eighty-six (76.8%) of the patients were brought by their parents/caregivers, and 26 (23.2%) of them were admitted by ambulance. On admission to the hospital, 31 (27.9%) patients had no measured vital signs. Resuscitation started in 9 (8.1%) patients outside the hospital and continued in the RR. Demographic and clinical data of the patients who applied during and out of working hours are shown in Table 1. Median values of the time of admission to the ER-RR (T1), the time starting from entrance to the RR to successful intubation (T2), the time starting from the entrance to the RR and the first IV drug given (T3), and the period from a very first drug given to successful intubation (T4) are presented in Table 2. Successful tracheal intubation was performed in 95 (85.5%) patients at first attempt (Table 3). A sedative or neuromuscular blocker (NMB) agent was given to 71 patients (63.9%)

before intubation, and only one of these patients underwent cardiopulmonary resuscitation, and after 12 minutes, pulses came back and resuscitation was terminated. These drugs are shown in Figure 1.

Discussion

Children are more difficult to be intubated because they have smaller airways and larger heads than adults. Since they have less physiological reserves, they are more prone to complications [8]. Rapid sequential intubation (RSI) is a method that is increasingly used in patients requiring intubation in pediatric ERs and is trained in pediatric resuscitation courses. However, considering the critical conditions of the patients who are brought to the RR and the chaotic situation of the ER, this procedure sometimes cannot be applied completely to all patients. In our study, we reviewed the patients who were taken to the RR and underwent intubation, retrospectively.

First of all, when the patient data were compared during the working hours (between 08:00-16:00 on weekdays: the entire specialists and pediatric residents are on), and out of the working hours (weekends and weekdays between 16:00-08:00; the night-shift specialist and the pediatric residents are on); we found no significant difference between age groups and gender. The vast majority of cases were brought by parents/ caregivers. A very low percentage of patients were started to resuscitate outside the hospital, all of whom were brought in

Table 1. Demographic and clinical data of patients who applied during working / non- working hours

	During working-hours n=36	Out of working-hours n=75	Total n=111	p value
AGE (median) (Q1-Q3)	12,57 (3,28-25,99)	15,8 (3,97-47,83)	14,47 (3,93-42,27)	0,340*
Age group (n, %)				
(0-1) years	16 (44,4)	30 (40)	46 (41,4)	0,400†
(1-12) years	20 (55,6)	42 (56)	62 (55,8)	
(12-18] years	0 (0)	3 (4)	3 (2,8)	
Sex (n, %)				
Male	20 (55,6)	45 (60)	65 (58,6)	0,811‡
Female	16 (44,4)	30 (40)	46 (41,4)	
Admission type (n, %)				
112 Emergency Health Services	9 (25)	17 (22,7)	26 (23,4)	0,974‡
Parents/caregivers	27 (75)	58 (77,3)	85 (76,6)	
CPR out of hospital (n, %)				
No	32 (88,9)	70 (93,3)	102 (91,9)	0,468§
Yes	4 (11,1)	5 (6,7)	9 (8,1)	
Any vital findings (n, %)				
No	9 (25)	22 (29,3)	31 (27,9)	0,802‡
Yes	27 (75)	53 (70,7)	80 (72,1)	
Number of intraosseous attempts (n, %)				
0	32 (88,9)	67 (89,3)	99 (89,2)	0,162†
1-2	2 (5,6)	8 (10,7)	10 (9)	
3<	2 (5,5)	0 (0)	2 (1,8)	
Cause of intubation (n, %)				
Trauma	6 (16,7)	15 (20)	21 (18,9)	0,668†
Status epilepticus	5 (13,9)	8 (10,7)	13 (11,7)	
Shock	6 (16,7)	21 (28)	27 (24,3)	
Respiratory failure	12 (33,3)	19 (25,3)	31 (27,9)	
Cardiopulmonary arrest	7 (19,4)	12 (16)	19 (17,1)	
Diagnosis (n, %)				
Neurologic problems	10 (27,7)	12 (16)	22 (19,8)	0,738†
Cardiovascular diseases	1 (2,8)	4 (5,3)	5 (4,5)	
Metabolic diseases	2 (5,6)	7 (9,4)	9 (8,1)	
Trauma	6 (16,7)	15 (20)	21 (18,9)	
Respiratory problems	8 (22,2)	15 (20)	23 (20,8)	
Other	6 (16,7)	8 (10,6)	14 (12,6)	
BRUE	3 (8,3)	4 (5,3)	7 (6,3)	
Septic shock	0 (0)	8 (10,7)	8 (7,2)	
Intoxication	0 (0)	2 (2,7)	2 (1,8)	
RESULT (n, %)				
Critical Care Unit transfer	30 (83,3)	57 (76)	87 (78,4)	0,527‡
Exitus in ER	6 (16,7)	18 (24)	24 (21,6)	

CPR: Cardiopulmonary Resuscitation, BRUE: Brief-resolved unexplained event. * Mann Whitney U test, † Pearson Chi-Square test, ‡ Continuity Correction test, § Fisher's Exact test

by 112 Emergency Health Services. We attributed the higher number of being brought of these risky patients by their caregivers to the central location of the hospital and the low socio-cultural level of the region it covers.

Considering the reasons for intubation of the patients, respiratory failure was the first, followed by shock and trauma patients. When we analyze the main diagnoses of these patients, we see that respiratory diseases, neurological problems, and traumatic causes take the first place apart from other reasons. In a study conducted by Yurtseven et al. where trauma patients were not cared for, in the same region in Turkey, respiratory distress similarly took the first place, followed by seizure and shock patients [9]. In the studies which are conducted in other trauma-centered emergency clinics, the number of intubations performed in traumatic and non-traumatic patients was found to be close to each other [10,11]. Although our study is similar in this aspect, the higher rates of trauma patients are because we are one of the two pediatric emergency trauma centers in the region.

We observed that 21.6% of patients died. Although there were no significant differences in the period of working hours and out of working hours, the mortality rate was relatively lower during the period of working hours. The low socio-cultural and educational level of the region that our hospital cares for, the late awareness of the deteriorating conditions of high-risk patients, and the referral of patients with severe general conditions because our center is a tertiary trauma center increase our mortality rates. In the study by Michelson et al., which was conducted recently, mortality rates were similar to our study [12].

When calculating the period from admission to the ER until the patients were taken to the RR, and the vascular accesses were provided, successful intubation was analyzed one by one, there was no significant difference between working hours and non- working hours. However, although we did not find any significance, we found that the average time between entering the ER and being taken to the RR (T1) was shorter during working hours. We think that the lower mortality rates during working hours and the earlier admission of patients to the RR may be related to the presence of an excess number of experienced physicians (pediatric emergency medicine specialists and fellows) during working hours. We couldn't find any research on the effect of time duration to TI on successful intubation. Intubation success at the first attempt is a known quality and safety marker. Previous studies have shown that there is a strong correlation between repeated intubation attempts and serious complications such as hypoxemia and cardiac arrest [13,14,15]. In our study, the success rate for

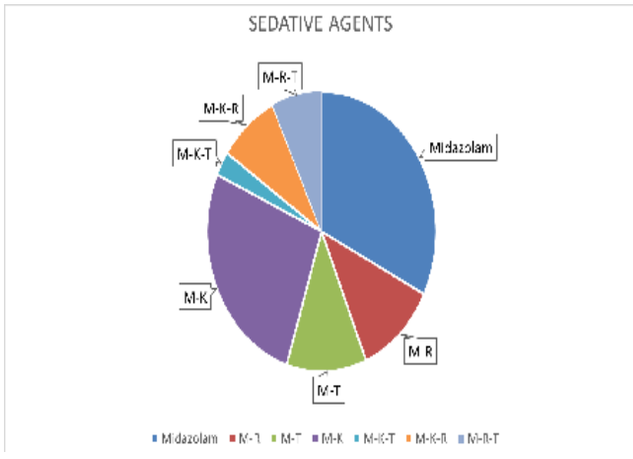

Figure 1. Figure 1: Sedative and NMB agents used before intubation * M: Midazolam; M-T: Midazolam andthiopental; M-K: Midazolam and ketamine; M-T-K: Midazolam, thiopental and ketamine; M-R: Midazolam and rocuronium; M-R-T: Midazolam, rokuronium and thiopental; M-K-R: Midazolam, ketamine and rocuronium

Table 2. The time period of patients who were applied during/ out of working hours

	n	During working hours	n	Out of working hours	n	Total	p value*
T1 (min)	36	9 (1-242,25)	75	25 (1-147)	111	16 (1-147)	0,815
T2 (min)	36	19 (9,25-28,75)	75	15 (10-26,5)	111	17 (10-28)	0,535
T3 (min)	35	5 (2-10)	75	5 (3-9,5)	110	5 (2,5-10)	0,551
T4 (min)	33	11 (5-20)	65	9 (3-17)	98	10 (4-17)	0,166

T1: Emergency room entrance time-resuscitation room entry time
T2: Entrance time to the resuscitation room time-intubation time
T3: Entry to the resuscitation room time-first IV drug administration time
T4: First iv drug administration time-intubation time

Table 3. Comparison of single and multiple intubation attempts

	Single Intubation n=95	Multiple Intubation n=16	Total n=11	p value
Age group (n, %)				
0-1 years	42 (44,2)	4 (25)	46 (41,4)	
1-6 years	40 (42,1)	7 (43,8)	47 (42,3)	0,111*
6-12 years	10 (10,5)	5 (31,2)	15 (13,5)	
12-18 years	3 (3,2)	0 (0)	3 (2,7)	
Working hours (n, %)				
During	29 (30,5)	7 (43,7)	36 (32,4)	0,449†
Out of	66 (69,5)	9 (56,3)	75 (67,6)	
CPR out of hospital (n, %)				
No	86 (90,5)	16 (100)	102 (91,9)	0,353‡
Yes	9 (9,5)	0 (0)	9 (8,1)	
Any vital findings (n, %)				
No	27 (28,4)	4 (25)	31(27,9)	1,000‡
Yes	68 (71,6)	12 (75)	80 (72,1)	
Cause of intubation (n, %)				
Trauma	17 (17,9)	4 (25)	21 (18,9)	
Status epilepticus	12 (12,6)	1 (6,3)	13 (11,7)	
Shock	26 (27,4)	1 (6,3)	27 (24,3)	0,342*
Respiratory failure	25 (26,3)	6 (37,4)	31 (27,9)	
Cardiopulmonary arrest	15 (15,8)	4 (25)	19 (17,1)	
Diagnosis (n, %)				
Neurologic problems	18 (18,9)	4 (25)	22 (19,8)	
Cardiovascular diseases	5 (5,3)	0 (0)	5 (4,5)	
Metabolic diseases	8 (8,4)	1 (6,3)	9 (8,2)	
Trauma	17 (17,9)	4 (25)	21 (18,9)	0,958*
Respiratory problems	20 (21,1)	3 (18,7)	23 (20,7)	
Other	23 (24,2)	4 (25)	27 (24,3)	
Intoxication	2 (2,1)	0 (0)	2 (1,8)	
Hematologic-oncologic diseases	2 (2,1)	0 (0)	2 (1,8)	

CPR: Cardiopulmonary resuscitation * Pearson Chi-Square test, †Continuity Correction test, ‡ Fisher's Exact test

first-time intubation attempts was 85.5%. This rate is similar to other studies [16]. There was no significant difference in the comparison of single and multiple successful interventions according to the patients' age, the reason for intubation, main diagnosis, the start of CPR in the hospital and the presence of any vital findings in the patient at the time of admission. We believe that the results can be clearer in studies done prospectively with a larger population.

Although intubation is a painful procedure, sedation of the patients is an important issue both for the comfort of the patient and to prevent complications that may occur during the procedure [17]. Midazolam was the first choice among sedative drugs chosen in most of our patients due to its wide confidence interval, and ketamine and thiopental were used in addition to midazolam in patients who could not be sedated with midazolam. Rocuronium, an NMB agent, was used in selected patients and as a last resort. Although many studies show the advantages of rocuronium, some disadvantages and complications are not mentioned [18,19,20]. Since we have limited experience in the use of the first choice in children, and we can provide successful intubation in patients with sedative drugs with a wider confidence interval, the use of NMB agents seems to be more limited, but we think that the more studies on this subject and withdrawing their use to earlier stages will reduce the success and complications of intubation.

Limitations

There are some limitations in our study. First of all, since our study is single-centered, the results cannot be generalized. Most of the patients included in our study had missing data. The fact that the EtCO2 and oxygen saturation levels, which were actively monitored in the RR, were not recorded in the registration forms, limited the ability to obtain more efficient information about the intubation processes of the patients. In addition, clear records of the clinical conditions of the patients before and after intubation could not be reached. The biggest benefit of our work is that we paid attention to the arrangements in the registration forms and the training of the employees on this subject.

Conclusion

The intubation procedure, besides being a life-saving intervention, requires attention and care in terms of its risks and timing. It is very important to carry out the tracheal intubation procedure on time and the records should be kept properly and completely during the procedure. In our study, the fact that the time between entering the ER and being taken to RR was shorter and the number of deaths in ER were lower during working hours of pediatric emergency fellows and specialists emphasizes the importance of having an experienced and competent team on hand in pediatric emergencies. In addition, the highest rate of first attempt intubation (42/46) was found to be more likely in infants.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of interest

The authors declare no conflict of interest.

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