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Evaluation of endotracheal intubations in the emergency department of a tertiary care facility

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Abstract:

OBJECTIVE: In this study, we aimed to evaluate the performance of emergency department intubations for 1 year.

METHODS: This was a retrospective analysis of prospectively collected data. The collected variables were patient demographics, indication for intubation, preintubation hemodynamics, preoxygenation methods, medications used for premedication, induction and paralysis, type of laryngoscope used, Cormack-Lehane (C-L) grades, number of intubation attempts, and peri-intubation adverse events.

RESULTS: A total of 194 patients were included. The median age of the population was 66.5 years (53.75–79); 61.9% of the patients were male. The majority of the patients were intubated due to medical conditions. The main indication for endotracheal intubation was respiratory failure in 38.6% of the patients. Preoxygenation before intubation was performed in 87.2% of the patients. Fifty-eight percent of the population were hemodynamically stable before the intubation. Fentanyl was the agent used for premedication, induction agents of choice were ketamine and midazolam, and rocuronium was the neuromuscular blocking agent. The C-L grades 1 and 2 were detected in 87.6% of the patients. The first-pass success rate was 72.8%. The peri-intubation adverse events were mainly hypotension and desaturation observed in 82 (42%) patients. The patients with higher C-L grades needed more intubation attempts ($P < 0.001$). Peri-intubation adverse events were associated with the increased number of intubation attempts ($P < 0.001$).

CONCLUSION: This and similar studies or an airway registry on a national level may help improve the quality of service given and delineate the deficiencies of the airway-related procedures in the emergency department.

Keywords:

Airway management, emergency medicine, endotracheal intubation

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Introduction

Airway management is paramount in managing critically ill patients.[1] Endotracheal (ET) intubation in the emergency department (ED) is hampered by many factors such as hemodynamic instability, side effects of sedatives and neuromuscular blockers (NMBs), and recent food intake, leading to high incidence of major complications.[2] ET intubation is one of the core life-saving procedures performed in the context of emergency medicine. Rapid sequence intubation, defined as rapid induction and paralysis of patients for definitive airway management, is the preferred method in the ED. Although ED airway management is a part of emergency physicians' daily practice, the data regarding success and complications should be gathered for

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Box-ED section

What is already known on the study topic?

- Airway management has paramount importance in the management of critically ill patients
- Endotracheal intubation is one of the core life-saving procedures performed in the context of emergency medicine.

What is the conflict on the issue? Has it importance for readers?

- The data describing endotracheal intubation outcomes in Turkey are limited
- Surveillance of endotracheal intubations done in the emergency department is important in implementing hospital policy, training, and improving the quality.

How is this study structured?

- This is a retrospective analysis of prospectively collected data of 194 patients.

What does this study tell us?

- The first-pass success rate was lower than some of the published literature
- The higher the Cormack-Lehane grade, the more the intubation attempts
- The peri-intubation adverse events were mainly hypotension and desaturation
- The peri-intubation adverse events were associated with the increased number of intubation attempts.

quality improvement and educational purposes. The data describing ET intubation outcomes in Turkey are scarce. Surveillance of ET intubations done in the ED is important to implement hospital policies, staff training, and initiate quality improvement projects.[3]

In this retrospective study, we analyzed the data of a prospective registry of ED ET intubations. The data collected were ET intubation indications, methods, techniques, and adverse event rates in a single tertiary care facility.

Methods

This was a retrospective analysis of prospectively collected data. This study was carried out between February 2020 and January 2021 in the ED of a university hospital with an annual census of 100,000 patients. This study was approved by the Akdeniz University Clinical Research Ethics Committee and obtained data usage permission (Approval date: February 10, 2021–Approval number: KAEK-107).

All ED patients ≥18 years for whom an ET intubation was attempted were included in the study. In this study, we collected patient demographics, indications for ET intubation (head trauma, cardiac arrest, chest trauma, respiratory failure, airway obstruction, anaphylaxis, heart failure, sepsis, gastrointestinal bleeding, seizure, stroke or intracranial hemorrhage, intoxication, or altered mental status), hemodynamic status before ET intubation (systolic blood pressure >140 mmHg, 100–139 mmHg, or <100 mmHg), preoxygenation methods, use of apneic oxygenation, medications used during induction and paralysis, Cormack-Lehane (C-L) grade, type of laryngoscope, and the number of intubation attempts and adverse events. An ET intubation attempt was defined as an introduction of the laryngoscope into the mouth and its removal regardless of whether an ET tube was inserted or not. The intubations of suspected COVID-19 patients were performed using personal protective equipment and a chamber. After finalizing the procedure and stabilizing the patient, the ED physician recorded the variables we are looking for into the REDCap® database. To increase the compliance of data entry, all ET intubations were routinely checked within 24 h to identify the intubations that were not entered into the REDCap® by the operators.

Results were analyzed in SPSS 16.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Demographic and baseline characteristics were summarized as a median and interquartile range for nonnormally distributed data, and as a percentage of the group for categorical variables. The Chi-square test was used for group comparison in terms of nominal variables, and the Fisher's exact test was used where necessary. The Shapiro–Wilk test was used for the normal distribution of numerical variables. P <0.05 was considered a statistically significant result.

Results

During the 1-year study period (February 2020 to January 2021), a total of 194 ET intubations were performed. The median age was 66.5 (53.75–79) years, and 61.9% of the patients were male. The main indication for ET intubation was respiratory failure in 75 (38.6%) patients. The majority of patients were intubated due to medical conditions [Table 1].

Preoxygenation before intubation was performed in 87.6% of the patients. The main preoxygenation method was bag-valve-mask (BVM) ventilation. BVM was used in 68.6% of the total sample population, followed by nonrebreather mask in 10.8%. The rest of the patients who had preoxygenation needed a combination of preoxygenation methods [Table 1]. Apneic oxygenation through the nasal cannula was applied to 9.3% of the patients. 58.2% of the patients were hypertensive or normotensive before the intubation [Table 1].

Fentanyl was used for premedication in 64.4% of the patients. Lidocaine was only used in four patients. The

Table 1: Demographics of the study population

	n (%)
Age, median (IQR)	66.5 (53.75-79)
Gender (male)	120 (61.9)
Indications for intubation	
Respiratory failure	75 (38.6)
Cardiac arrest	29 (14.9)
Head trauma	28 (14.4)
Sepsis	11 (7.2)
AMS - not related to an overdose	9 (4.6)
Seizure	8 (4.1)
Stroke/intracranial bleeding	8 (4.1)
Heart failure	7 (3.5)
Anaphylaxis	5 (2.5)
Other	4 (2.1)
Gastrointestinal bleeding	3 (1.5)
Chest trauma	2 (1)
Airway obstruction	1 (0.5)
Intoxication	1 (0.5)
SBP before the intubation	
SBP >140 mmHg	34 (17.5)
SBP (100-139 mmHg)	79 (40.7)
SBP <100 mmHg (no fluid)	17 (8.8)
SBP <100 mmHg (fluid or blood product need)	14 (7.2)
SBP <100 mmHg (fluid or blood product and vasopressor need)	23 (11.9)
Cardiac arrest	27 (13.9)
Medications	
Fentanyl	125 (64.4)
Lidocaine	4 (2)
Midazolam	81 (41.8)
Ketamine	53 (27.3)
Propofol	6 (3.1)
Rocuronium	149 (76.8)
Laryngoscope type	
Macintosh laryngoscope	47 (24.2)
Miller laryngoscope	2 (1)
GlideScope T3	59 (30.4)
McGRATH MAC	73 (37.6)
>1 device	13 (6.7)
Preoxygenation methods	
Preoxygenated patients	170 (87.6)
None preoxygenated patients	24 (12.4)
BVM	133 (68.6)
Nonrebreather mask	21 (10.8)
Nonrebreather mask and BVM	8 (4.1)
CPAP/BiPAP	4 (2.1)
BVM and CPAP/BiPAP	4 (2.1)
Number of intubation attempts	
1	141 (72.7)
2	38 (19.6)
3	9 (4.6)
4	2 (1)
>4	4 (2.1)

AMS: Altered mental status, SBP: Systolic blood pressure, CPAP: Continuous positive airway pressure, BIPAP: Bi-level positive airway pressure, BVM: Bag-valve-mask, IQR: İnterquartile range

preferred induction agent was midazolam in 41.8% of the study population. The second choice was ketamine in 27.3%, followed by propofol in 3.1%. Rocuronium was the neuromuscular agent used for the paralysis of 149 patients. Only two patients had succinylcholine for neuromuscular blockage, and crash intubation was performed in 43 patients. Cardiac arrest patients did not receive any medication.

The C-L grades 1 and 2 were detected in 87.6% of patients. Fourteen and 10 patients were grouped as C-L 3 and C-L 4, respectively.

Of these 194 ET intubations, 47 were intubated with the direct laryngoscope (DL), two patients with the Miller laryngoscope, 59 were with the GlideScope T3, and 73 were with the McGRATH MAC, and 13 patients needed a shift of the laryngoscope type.

Overall, first-pass success was achieved in 72.7% of ET intubations, and 92.3% of the patients were intubated in ≤2 attempts [Table 1].

The ET tube position was confirmed clinically 95.4% of the time. The peri-intubation adverse events were observed in 71 (36.5%) patients, and 21 patients had at least two adverse events concurrently [Table 2].

The gender, blood pressure before intubation, the methods used for preoxygenation, oxygenation during apnea, the agent chosen for premedication or induction, the use of NMB, and the type of laryngoscope did not demonstrate a statistically significant difference between the first-pass success or multiple attempts groups (P = 0.40, 0.89, 0.82, 0.67, 0.24, 0.77, and 0.05, respectively). Patients necessitating more than one attempt to accomplish ET intubation had significantly higher C-L grades of 3 and 4 (P < 0.001) [Table 3]. Although C-L grades were originally defined for direct laryngoscopy, C-L grades identification with direct laryngoscopy and video laryngoscopy (VL) did not show a significant difference (P = 0.63). There was a significant association between intubation-related adverse events and the increased number of intubation attempts (P < 0.001) [Table 4].

Discussion

These prospectively collected data evaluated the detailed outcomes of ET intubations done in a tertiary care facility by ED physicians.

The first success rate at intubation is reported to have a wide range.[4,5] A previously published randomized-control study on blunt trauma patients from the same center had a first-pass success rate of

62.7% (95% confidence interval [CI] 0.51–0.72) for VL and 58.7% (95% CI 0.47–0.69) for direct laryngoscope.[6] Although the first-pass success in this study is higher than the previously mentioned study,[6] it is still lower than some of the published literature.[4,5] In one study, the first-pass success rate at ET intubation was 86.5%, which was not significantly different between video and direct laryngoscopy.[5] A possible explanation for our low first-pass success rate may be our sample population which constitutes mainly older age groups. Aging increases the risk of a difficult airway due to anatomical changes such as reduced neck mobility, edentulous mouth, and glottis muscle atrophy. Moreover, operators' experience might have affected the first-pass success as most of the intubations done in our study are by junior trainees. On the contrary, more than half of the intubations were performed by postgraduate year 5 trainees or attending physicians in the study of Chan *et al*.[5] The third explanation could be COVID-19. Intubating COVID-19 or COVID-19-suspected cases was extra stressful, time-consuming, and logistically challenging due to the extra-protective measures taken. These patients were only intubated through the McGRATH Mac VL; hence, affecting the high first-pass success rates of VL reported in the literature. In another study from Europe, the first-pass success rates for endotracheal intubations were reported to be 70.9%, which is comparable to our findings; this means first-pass success is multifactorial and needs more investigation and research.[7]

RSI (Rapid sequence intubation) was the most common method to secure the airway, and the literature reports similar frequencies of RSI use in the ED.[4,5,8]

Rocuronium was the most commonly used paralytic agent in our study. The paralytic agent of choice varies between studies; however, studies have shown that there was no association between the choice of the paralytic agent and the first-pass success or peri-intubation adverse events.[9] Due to the lack of succinylcholine in the market, rocuronium was the paralytic agent of choice. However, rocuronium is the go-to paralytic agent in our department for its excellent safety profile and the availability of an antidote (sugammadex) to use when indicated.

Midazolam was the mostly used sedative agent in our study. RSI is the simultaneous administration of sedatives and neuromuscular agents to facilitate the intubation of ED patients. However, the onset of action with midazolam is delayed compared to its counterparts. Hence, the use of midazolam in the literature is limited,[10,11] and we know the literature supports the use of etomidate due to its rapid onset of action and the ability to preserve the patient's hemodynamics. Unfortunately, it is not available in our market, and the culture of overusing midazolam in our department is something we are working on changing. Ketamine, which was the second-most utilized sedative agent in our study, is assumed to preserve cardiopulmonary function and support blood pressure; however, interestingly, in the analysis of a prospective registry, researchers found out that 18.3% of normotensive patients receiving ketamine developed peri-intubation hypotension. The adjusted odds ratio for peri-intubation hypotension with ketamine versus etomidate was 1.4 (95% CI = 1.2–1.7).

Table 2: The peri-intubation adverse events

	n (%)
Hypotension-IV fluid or vasopressor need	32 (16.5)
Hypoxia (SaO_2 <90%)	20-11 (5.7)
Cardiac arrest	6 (3.1)
Device malfunction	5 (2.6)
Esophageal intubation	5 (2.6)
Endobronchial intubation	5 (2.6)
Vomiting associated with aspiration	3 (1.5)
Vomiting - without aspiration	2 (1)
Dental trauma	1 (0.5)
Bradycardia <60 (beats/min)	1 (0.5)
Need for a second dose of paralytics	1 (0.5)

IV: Intravenous

Table 3: The number of intubation attempts and Cormack-Lehane grade

Number of intubation attempts	CL 1-2	CL 3-4
1	134	7
>1 attempt	36	17

C-L: Cormack-Lehane

Table 4: Comparison of intubation groups according to the number of attempts

	First-pass success, *n* (%)	Multiple attempts, *n* (%)	*P*
Male	90 (63.8)	30 (56.6)	0.40
SBP ≥100 mmHg before intubation	78 (65.5)	32 (66.7)	0.89
Preoxygenation	124 (87.8)	46 (86.8)	0.82
Premedication	95 (67.3)	34 (64.2)	0.67
Induction agent	100 (70.9)	42 (79.3)	0.24
Paralytic agent	109 (77.3)	42 (79.2)	0.77
Video laryngoscope	101 (71.6)	45 (84.9)	0.05
C-L grade 3-4	7 (5)	17 (32.1)	<0.001

SBP: Systolic blood pressure, C-L: Cormack-Lehane

We believe that this finding should be supported by randomized trials.[12] For such, etomidate or propofol might be a more appropriate first choice.[13]

Hypoxia and hypotension during the peri-intubation period were the most commonly encountered adverse events in many studies.[3,5] Some of the patients were hypoxic or hypotensive before ET intubation. Decision-making due to the patient's condition might have led to rapid ET intubation before optimal resuscitation and oxygenation. Such scenarios might increase the probability of having peri-intubation adverse events. In addition, peri-itubation hypotension may not be only secondary to hypovolemia or medications utilized but positive pressure applied during preoxygenation might contribute to such hypotension. In our study, we did not specifically follow and compared the outcomes of patients with hypotension or desaturation. However, peri-intubation adverse events may increase morbidity or mortality; it may be more appropriate to delay ET intubation and focus on supporting the hemodynamics and preoxygenation methods before intubating.[12]

The rate of adverse events reported after intubation across different studies varies a lot. Alkhouri *et al*. reported adverse events in 964 (26%; 95% CI 23.2–28.8) patients; these adverse events were mainly desaturation and hypotension.[14] Other studies reported much lower rates.[5,8] The rates of cardiac arrest after or during ET intubation, esophageal intubation, and endobronchial intubation we found in our study were comparable to the literature.[7]

The significant association we found between intubation-related adverse events and the number of intubation attempts was comparable to the literature.[14]

Limitations

The results reported are the experience of a single center; different centers with different clinical settings might have different results. The small sample size limits us from drawing conclusions that impact the clinical practice. Because data were self-reported, we cannot exclude reporter bias. The COVID-19 pandemic had a huge impact on the health-care systems worldwide; our study period was during the peak of this pandemic. Thus, a lot of unmeasured variables could have confounded the results.

Conclusion

In our study, the intubation success rate at the first attempt was found to be lower than some studies published in the literature, and this is based on multifactorial reasons. Although the reasons for this were not investigated in our study, challenges such as medication availability and the impact of COVID-19 might have affected the first-attempt success rate. However, this and similar studies in addition to an airway registry on a national level may help improve the quality of ET intubations done in the EDs.

Author contributions

Concept – M.K.Y., E.G., M.E.W.; Design – M.K.Y., E.G., M.E.W.; Supervision – E.G.; Resources – M.K.Y., E.G., M.E.W.; Materials – M.K.Y., E.G.; Data Collection and/or Processing - M.K.Y., E.G.; Analysis and/or Interpretation – M.K.Y., E.G.; Literature Search - M.K.Y., E.G.; Writing Manuscript - M.K.Y., E.G., M.E.W.; Critical Review - M.K.Y., E.G.

Conflicts of interest

None declared.

Ethical approval

This study was approved by the Akdeniz University Clinical Research Ethics Committee and obtained data usage permission (10.02.2021–KAEK-107).

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