ORIGINAL ARTICLE

Validity of MACOCHA Score in Predicting First-pass Success of Endotracheal Intubation in Emergency Department: An Observational Study

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Abstract

Aim and background: In the emergency department (ED), endotracheal intubation (ETI) is a critical, life-saving procedure. The MACOCHA score predicts difficult intubations in intensive care units (ICUs), but it has not been validated in the ED setting. This study aimed to validate the MACOCHA score for predicting first-pass success of ETI performed in the ED.

Materials and methods: This prospective observational study was performed in the ED of a tertiary care institute, over a period of 18 months (September 2020 to February 2022). The study included 74 adult patients who underwent emergency ETI performed by emergency medicine residents. Number of ETI attempts, first-pass success rate, and complications were noted. The MACOCHA score was calculated, and its predictive performance was evaluated.

Results: The first-pass success rate was 54.1%, and 54.1% of patients experienced complications, with hypoxia (18.9%) and hypotension (17.6%) being the most common. Four ETI attempts ($p = 0.009$) as well as presence of arrhythmia ($p = 0.004$) and cardiac arrest followed by death ($p = 0.001$) were significantly associated with a higher MACOCHA score, while MACOCHA score was not significantly associated with first-pass success, aspiration, hypotension, hypoxia, and local injury ($p > 0.05$). The number of ETI attempts and the number of complications were significantly correlated ($r = 0.258$, $p = 0.026$). At a cut-off score of 2.50, the MACOCHA score had a sensitivity and specificity of 50.0% and 35.3%, respectively, for the prediction of first-pass success rate [area under the curve: 0.593; 95% confidence interval (CI): 0.463–0.723].

Conclusion: MACOCHA score demonstrated limited performance in predicting the first-pass success rate of ETI in the ED.

Keywords: Airway management, Critical care, Emergency department, Endotracheal tube, Intubation, MACOCHA score.

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Highlights

- Higher MACOCHA scores are linked to more endotracheal intubation attempts and complications.
- The MACOCHA score showed limited predictive ability for first-pass success (sensitivity: 50.0%, specificity: 35.3%).
- Study emphasizes the need for better predictors in emergency department (ED) settings.

Introduction

Endotracheal intubation (ETI) is an essential skill for airway management, especially in emergency departments. Although common, difficult intubations remain a significant challenge. The incidence of difficult intubations is high in the ED (3.0–5.3%) compared with operating rooms (1.15–3.8%).[1] Achieving first-pass success is crucial, as repeated intubation attempts increase the risk of complications, including hypoxia, aspiration, and others.[2]

A variety of airway tools, as well as difficult airway scoring algorithms, have been developed to support decision-making. In fact, multiple strategies are currently in practice.[3,4] Clinical risk scores include an anatomical assessment of relevant airway structures, the urgency of intubation, and the skills of the operator. While risk factors predicting difficult intubation have previously been well established in operating rooms and intensive care units (ICUs), prediction scores in the ED setting still remain to be validated.[5]

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De Jong et al. developed a seven-item MACOCHA score to predict difficult intubations in ICU settings. With a sensitivity of 73%, the score helps distinguish routine from difficult intubations.[5] Higher scores, particularly between 10 and 12 points, are strongly associated with complications. The high discriminative ability of the MACOCHA score, reflected by an area under the curve (AUC) of 0.86, highlights its potential value in clinical practice.[6]

The MACOCHA score is reported to be beneficial in preventing peri- and postintubation complications.[7] However, to the best of our knowledge, its validity has not been tested in ED settings. Thus, the primary objective of the present study was to assess the validity of the MACOCHA score in predicting first-pass success of ETI in the ED, while the secondary objective was to evaluate the complications during and up to 60 minutes following ETI.

Materials and Methods

Study Design and Ethics

This observational study was conducted over a period of 18 months (September 2020 to February 2022). in the ED of a tertiary care institute. The study was approved by the Institutional Ethics Committee (AIIMS/IEC/21/10, dated: 09/01/2021) and written informed consent was obtained from the patients and/or their relatives.

Population

The study included adult patients, of either sex, who required emergency ETI, and in whom complete MACOCHA score could be noted. Patients who presented with respiratory distress, CO_2 narcosis, altered mental status, and cardiac arrest; who have been managed by definitive airway outside ED; and pregnant women were excluded from the study.

Data Collection

All the intubations were done by third-year emergency medicine resident doctors (average experience of 2 years and average of 50 independent intubations) under the supervision of an intubating senior physician, and data was recorded in structured proforma. When the patient was found to have met the eligibility criteria by the triage or initial treating emergency physician, the patient was evaluated in detail. Patient demographics, diagnoses, indications for intubation, the number of attempts, methods of intubation, including rescue methods, success rates, and complications were recorded. The patients were sorted accordingly, and each parameter was assessed along with the MACOCHA score at the presentation.

Standard Intubation Protocol

The patients presenting to the ED were triaged based on the institutional guidelines. On arrival, airway, breathing, circulation, and disability were assessed on a primary survey. If the airway was compromised on arrival or during ED stay, definitive airway management was done with ET or surgical airway if needed. Subsequently, the patients were evaluated using the MACOCHA score.

Intubation was performed using the rapid sequence intubation technique, and the number of attempts were recorded.[8] Two operators were present, and patients were monitored via electrocardiography (ECG), pulse oximetry, and noninvasive blood pressure (BP) cuff. Hemodynamic stability was maintained using fluids and vasopressors, if needed. Preoxygenation was followed by induction with ketamine (1–2 mg/kg), propofol (1–2.5 mg/kg), or etomidate (0.2–0.3 mg/kg), and paralysis was achieved using either succinylcholine (1.5 mg/kg) or rocuronium (0.6–1.2 mg/kg).

After 60 seconds, laryngoscopy was performed using conventional techniques, and the first attempt at ET was made. Patients with successful ET on the first attempt were placed in group I. If the first attempt failed, subsequent attempts involved adjustments, such as changing position, switching operators or airway devices, applying external laryngeal maneuvers, and using a bougie or stylet while maintaining ventilation and hemodynamic stability; these patients were included in group II (Fig. 1).

Vital parameters were recorded before, during, and 60 minutes postintubation, along with arterial blood gas (ABG) analysis. Patients were monitored for complications for 60 minutes postintubation and managed accordingly. Additionally, the MACOCHA score was analyzed to assess its association with the first-pass success rate of ET.

Outcomes

MACOCHA Score

The MACOCHA score ranges from 0 (easy intubation) to 12 (difficult intubation). It includes factors related to the patient [Mallampati score III or IV, obstructive sleep apnea (OSA) syndrome, reduced cervical spine mobility, and restricted mouth opening <3 cm], pathology [Glasgow Coma Scale (GCS) score ≤ 8, severe hypoxia with peripheral oxygen saturation (SpO_2) < 80%], and the operator (nonanesthesiologist).[5]

The Mallampati score was used to assess the difficulty of ETI by evaluating the space between the tongue base and the roof of the mouth. Patients who were obtunded or uncooperative were excluded.

Obstructive sleep apnea was identified by recurrent episodes of partial or complete airway collapse, causing apnea or hypopnea. Reduced cervical spine mobility was noted in trauma patients, requiring cervical spine stabilization, as well as in those with spondylitis, cervical myelopathies, or a history of hanging. Mouth opening was measured by asking patients to open their mouths fully, with the distance between the upper and lower incisors measured using a calibrated fiber ruler. Coma was defined as a GCS score of 8 or less.[9] Severe hypoxia was defined as SpO_2 less than 80%, recorded at presentation and during the peri-intubation period.[10] Concurrent ABG analysis was performed at presentation, before intubation, and 1-hour postintubation, with severe hypoxemia defined as a partial pressure of oxygen (PaO_2) less than 60 mm Hg.

Since the study was conducted in an ED setting, anesthesiologists were not involved in airway management. After assessing all the relevant parameters, the MACOCHA score was recorded.

Sample Size Calculation

Assuming a fair expected area under receiver operating characteristic (ROC) curve of 0.7, and an allocation ratio of 1, the sample size was calculated to be 33 per group for an alpha of 0.05 and power greater than or equal to 90%. Thus, a total of 74 patients were enrolled in the study.

Source of support: Nil

Conflict of interest: None

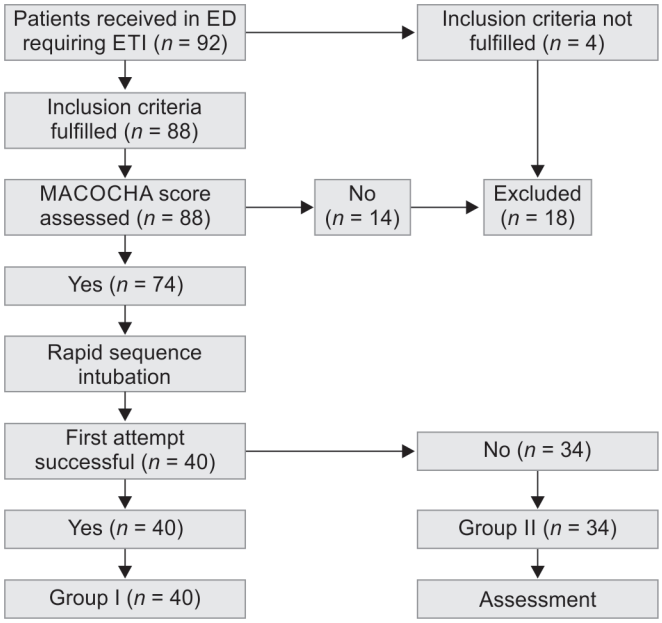

Fig. 1: Study flowchart

Statistical Analysis

The data was analyzed using Statistical Package for the Social Sciences software version 23 (SPSS Inc., Chicago, Illinois, USA). The ROC curves were plotted for each of the two scores, and the AUC was examined. For secondary objectives, continuous variables were analyzed using the Student's *t*-test, while categorical variables were analyzed with the Chi-square test and presented as frequencies and percentages. The level of significance was set at $p < 0.05$. The Pearson correlation coefficient was used to assess the correlation between the number of intubations attempts and the occurrence of complications. Binary logistic regression analysis was performed to evaluate the individual components (covariates) of the MACOCHA score in predicting the first-pass success rate of intubation.

Results

The study population mainly comprised of males (66.2%), with a mean age of 48.54 ± 17.21 years. More than one-third of the patients were smokers (37.8%). The predominant diagnosis and indications of ETI were lower respiratory tract infection (25.7%) and airway protection (47.3%), respectively. The ABG analysis mainly revealed normal findings and metabolic acidosis (each 24.3%). The mean MACOCHA score was 3.57 (2.61) (range: 1–11). The OSA syndrome, cervical spine reduced mobility, limited mouth opening, coma, and severe hypoxia were present in 5.4, 16.2, 23.0, 50.0, and 35.1% patients, respectively. Moreover, nonanesthesiologist operator performed ETI in all the patients (100.0%) (Table 1).

Various laboratory and vital parameters were assessed at presentation, during intubation, and 60 minutes postintubation. During the assessment period, there was a significant decrease in blood pH ($p = 0.001$), hemoglobin levels ($p = 0.022$), and diastolic BP ($p = 0.016$) as well as increase in heart rate ($p = 0.001$), SpO_2 ($p = 0.001$), pO_2 ($p = 0.001$), pCO_2 ($p = 0.001$), and base excess ($p = 0.022$). Other parameters, including HCO_3– ($p = 0.369$), Na+ ($p = 0.495$), K+ ($p = 0.167$), and systolic BP ($p = 0.337$), did not differ significantly (Table 2).

Table 1: Demographic and clinical characteristics

Characteristics	*N = 74*
Age, years (mean ± SD)	48.54 ± 17.21
Gender, *n* (%)	
Male	49 (66.2)
Female	25 (33.8)
Smoker, *n* (%)	28 (37.8)
Diagnosis, *n* (%)	
Lower respiratory tract infection	19 (25.7)
Central nervous system cause	17 (23.0)
Renal cause	8 (10.8)
Chronic obstructive pulmonary disease	7 (9.5)
Poisoning	5 (6.8)
Hepatic causes	4 (5.4)
Infections with definite source	3 (4.1)
Renal tubular acidosis	3 (4.1)
OSA	2 (2.7)
Heart failure	2 (2.7)
Others	4 (5.4)
Indication for intubation, *n* (%)	
Airway protection	35 (47.3)
Oxygenation	16 (21.6)
Ventilation	9 (12.2)
Anticipated clinical course	13 (17.6)
Respiratory distress	1 (1.4)
ABG finding at presentation, *n* (%)	
Normal	18 (24.3)
Metabolic acidosis	18 (24.3)
Respiratory alkalosis	16 (21.62)
Respiratory acidosis	13 (17.56)
Mixed acid–base disorder	5 (6.75)
Metabolic alkalosis	4 (5.4)
MACOCHA score, *n* (%)	
Mallampati score 3 or 4	18 (24.3)
OSA syndrome	4 (5.4)
Cervical spine reduced mobility	12 (16.2)
Limited mouth opening	17 (23.0)
Coma	37 (50.0)
Severe hypoxia	26 (35.1)
Nonanesthesiologist operator	74 (100.00)

The ECG was performed during intubation and at 60 minutes postintubation, and more than half of the patients had sinus tachycardia (60.81% and 56.75%, respectively) and around one-third had normal sinus rhythm (35.15% and 39.18%, respectively). Atrial fibrillation was observed in one patient, while ventricular tachycardia was observed at 40 minutes postintubation in only one patient. Asystole was seen in two patients with cardiac arrest in peri-intubation period (Table 3).

The mean number of ETI attempts was 1.57, with one, two, and more than two attempts required in 54.1, 36.5, and 9.5% patients,

Table 2: Laboratory and vital parameters

Parameters	*N = 74*	*p*
ABG parameters, mean (SD)		
pH		0.001
At presentation	7.34 (0.11)	
Immediately after intubation	7.29 (0.15)	
60 min after intubation	7.32 (0.1)	
pO_2		0.001
At presentation	71.22 (19.48)	
Immediately after intubation	98.53 (38.32)	
60 min after intubation	87.46 (21.07)	
pCO_2		0.001
At presentation	36.34 (15.43)	
Immediately after intubation	44.05 (25.21)	
60 min after intubation	42.31 (14.23)	
HCO_3-		0.369
At presentation	20.28 (6.17)	
Immediately after intubation	20.16 (7.98)	
60 min after intubation	20.65 (6.78)	
Na^+		0.495
At presentation	141.37 (7.35)	
Immediately after intubation	141 (6.71)	
60 min after intubation	141.07 (6.81)	
K^+		0.167
At presentation	4.4 (0.89)	
Immediately after intubation	4.36 (0.75)	
60 min after intubation	4.28 (0.68)	
Base excess		0.022
At presentation	−5.65 (6.62)	
Immediately after intubation	−6.38 (7.67)	
60 min after intubation	−5.62 (6.85)	
Hemoglobin		0.022
At presentation	11.45 (3.04)	
Immediately after intubation	11.37 (2.94)	
60 min after intubation	11.29 (2.98)	
Hemodynamic parameters		
Heart rate (beats/min)		0.001
Preintubation	103.62 (27.04)	
During intubation	118.43 (21.52)	
60 min after intubation	110.04 (25.39)	
Systolic BP (mm Hg)		0.337
Preintubation	118.95 (19.86)	
During intubation	120.98 (22.62)	
60 min after intubation	127.59 (95.51)	
Diastolic BP (mm Hg)		0.016
Preintubation	77.39 (10.49)	
During intubation	78.74 (12.02)	
60 min after intubation	75.28 (12.28)	
SpO_2 (%)		0.001
Preintubation	0.92 (0.05)	
During intubation	0.91 (0.09)	
60 min after intubation	0.95 (0.05)	

Table 3: Distribution of patients according to ECG findings

ECG findings	*N = 74*
Normal sinus rhythm, *n* (%)	
During intubation	26 (35.15)
60 min after intubation	29 (39.18)
Atrial fibrillation, *n* (%)	
During intubation	1 (1.35)
60 min after intubation	1 (1.35)
Sinus bradycardia, *n* (%)	
During intubation	2 (2.7)
60 min after intubation	0 (0.00)
Sinus tachycardia, *n* (%)	
During intubation	45 (60.81)
60 min after intubation	42 (56.75)
Asystole, *n* (%)	
During intubation	0 (0.00)
60 min after intubation	2 (2.7)
Ventricular tachycardia, *n* (%)	
During intubation	0 (0.00)
60 min after intubation	0 (0.00)

respectively. Nearly 90% patients did not require another airway device. Around 10% patients required change of operator, and 54.1% patients developed complications, with hypoxia (18.9%) and hypotension (17.6%) being most common (Table 4).

A significantly higher MACOCHA score was observed for patients requiring four attempts ($p = 0.009$), as well as for those experiencing arrhythmia ($p = 0.004$) and cardiac arrest followed by death ($p = 0.001$). In contrast, MACOCHA score was not significantly associated with first-pass success ($p = 0.102$), aspiration ($p = 0.349$), hypotension ($p = 0.220$), hypoxia ($p = 0.118$), and local injury ($p = 0.321$) (Table 5).

The number of ETI attempts had a significant and positive correlation with the number of complications ($r = 0.258$, $p = 0.026$).

The ROC curve analysis revealed that at a cut-off score of 2.50, the MACOCHA score had a sensitivity and specificity of 50.0% and 35.3%, respectively for the prediction of first-pass success rate of ETI (AUC: 0.593; 95% confidence interval (CI): 0.463–0.723) (Fig. 2).

The binary logistic regression analysis indicated that various factors, including gender, smoking, Mallampati score 3 or 4, arrhythmia, aspiration, cardiac arrest, hypotension, hypoxia, local injury, OSA syndrome, reduced cervical spine mobility, limited mouth opening, coma, severe hypoxemia, and change of operator required, were not significant predictors of first-pass success (all $p > 0.05$) (Table 6).

Discussion

The principal findings of the study suggest that the first-pass success rate of ETI was 54.1%, and the MACOCHA score demonstrated moderate performance in predicting this outcome. Notably, the number of ETI attempts was significantly associated with an increase in complications. More than half of the patients experienced complications during or within 60 minutes post-ETI, with hypoxia (18.9%), hypotension (17.6%), injury (12.2%), and esophageal intubation (9.5%) being the most prevalent.

Table 4: Summary of outcomes

Outcomes	*N = 74*
Number of attempts taken, mean ± SD	1.57 ± 0.70
First-pass success, *n* (%)	40 (54.1)
Need of another airway device, *n* (%)	
No	67 (90.5)
Laryngeal mask airway	6 (8.1)
Oropharyngeal airway	1 (1.4)
Change of operator required, *n* (%)	7 (9.5)
Any complication, *n* (%)	40 (54.1)
Complications, *n* (%)	
None	34 (45.9)
Hypotension	13 (17.6)
Arrhythmia	1 (1.4)
Aspiration	4 (5.4)
Esophageal intubation	7 (9.5)
Hypoxia	14 (18.9)
Injury	9 (12.2)
Cardiac arrest	2 (2.7)

Table 5: Comparison of MACOCHA score with outcomes

Parameters	*Mean MACOCHA score*	*p*
Number of attempts needed		0.009
1	4.03 (2.75)	
2	2.59 (1.72)	
3	3.83 (3.12)	
4	10.00 (0.00)	
First-pass success/failure		0.102
First-pass success	4.03 (2.75)	
First-pass failure	3.03 (2.35)	
Complications		
Arrhythmia		0.044
Present	9.00 (0.00)	
Absent	3.64 (2.59)	
Aspiration		0.349
Present	2.50 (1.00)	
Absent	3.79 (2.70)	
Cardiac arrest followed by death		0.001
Present	9.50 (2.12)	
Absent	3.56 (2.49)	
Hypotension		0.220
Present	4.54 (2.54)	
Absent	3.54 (2.66)	
Hypoxia		0.118
Present	4.71 (2.61)	
Absent	3.48 (2.63)	
Local injury		0.321
Present	2.89 (1.76)	
Absent	3.83 (2.74)	

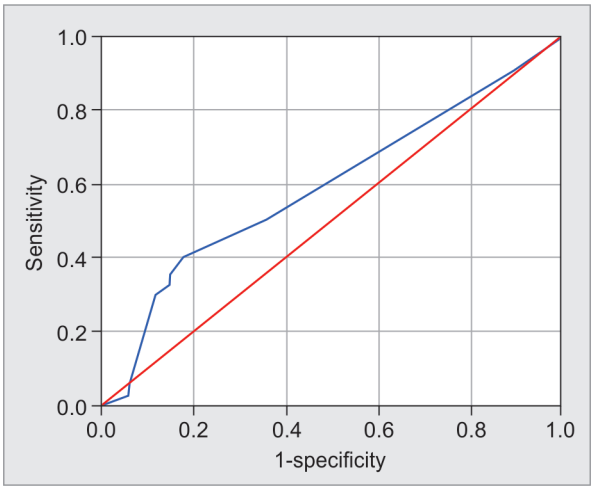

Fig. 2: Receiver operating characteristic curve analysis of the MACOCHA score for the prediction of first-pass success rate of ETI

Table 6: Binary logistic regression analysis for identification of predictors of first-pass success

Variable	*Odds ratio*	*95% CI*	*p*
Gender	−0.03	0.24–3.99	0.970
Smoker	0.03	0.18–5.77	0.972
Mallampati score 3 or 4	1.29	0.48–27.75	0.211
OSA syndrome	15.93	0–0	0.999
Cervical spine reduced mobility	1.18	0.24–44.66	0.380
Limited mouth opening	2.31	0.69–144.67	0.090
Coma	−0.01	0.23–4.33	0.990
Severe hypoxemia	0.37	0.32–6.54	0.635
Change of operator required	−54.08	0–0	0.998
Arrhythmia	20.05	0–0	1.000
Aspiration	20.05	0–0	1.000
Cardiac arrest	18.47	0–0	0.999
Hypotension	−0.02	0.06–15.07	0.990
Hypoxia	2.58	0.24–712.46	0.205
Local injury	2.08	0.08–835.89	0.381
None	4.51	0.84–9,806.31	0.059

The study's first-pass success rate of 54.1% is lower than those reported in other studies, which typically range from 62.7% to 86.5%.[11,12] This difference may be explained by the inclusion of critically ill patients in this study, many of whom were in a coma (50%) or presented with severe hypoxia (35.1%). These conditions can significantly complicate intubation due to altered airway anatomy and physiology. The need for alternative airway devices in seven patients and operator changes in another seven patients highlights the challenges encountered during emergency airway management, particularly as all intubations were performed by nonanesthesiologists.

Notably, in the present study, only direct laryngoscopy was performed, which may have influenced the outcomes and highlighted the urgency for airway interventions, such as using

the MACOCHA score. Studies have shown that the choice of laryngoscope can significantly impact intubation outcomes. For instance, in a randomized controlled trial, Goksu et al. reported success rates of 62.7% with video laryngoscopy compared with 58.7% with direct laryngoscopy.[13] Similarly, Mosier et al. demonstrated that video laryngoscopy improved the first-attempt success rates compared with direct laryngoscopy, particularly in patients with difficult airways, suggesting that the choice of laryngoscope significantly impacts outcomes.[11] Li et al. further supported this, showing that video laryngoscopy was associated with improved success rates compared with direct laryngoscopy, reaching as high as 86.5% in certain populations.[12] The higher success rates reported in these studies may be due to the inclusion of more stable patients and the expertise of the operators, as many intubations were performed by anesthesiologists or experienced emergency physicians.[14] Rognås et al. reported that advanced airway management by experienced anesthesiologists led to higher first-pass success rates, emphasizing the role of operator expertise in successful intubation outcomes.[15] In contrast, the ETI in the present study were performed by nonanesthesiologists or emergency medicine resident doctors, who may not have the same level of experience as those performing intubations in controlled environments like operating theaters. Additionally, anatomical challenges, such as limited mouth opening in 23% of the patients, further complicated the procedure, leading to increased attempts and potential complications.[11]

Admass et al. highlighted the importance of achieving first-pass success to minimize complications, underscoring the need for operator expertise and appropriate equipment.[16] Interestingly, Yildirim et al. reported a 72.8% first-pass success rate in a cohort with significant comorbidities, including severe respiratory failure.[17] The higher rate in their cohort, despite similar challenges, could be attributed to the operator experience and a more stable cohort, which may have led to improved intubation outcomes.

Additionally, the complications noted—hypoxia (18.9%), hypotension (17.6%), dental injury (12.2%), esophageal intubation (9.5%) aspiration (5.4%), cardiac arrest (2.7%), and arrhythmia (1.4%)—support previous findings on the risks of emergency intubation, underscoring the necessity for improved training and protocols to enhance patient safety.[18] Hypoxia is a frequent complication during intubation, often due to prolonged laryngoscopy or difficult airway management. Studies have reported hypoxia rates between 9 and 29% in various settings.[19] The risk increases with multiple attempts, as each can further compromise the airway and reduce oxygen saturation.[20] In the present study, the high hypoxia rate likely reflected the critical status of many patients, who had severe hypoxia at presentation (35.1%). Hypotension is another common issue, particularly in patients with unstable hemodynamics. Elmer et al. observed that reintubation in critically ill patients was linked to higher complications, including new-onset hypotension and hypoxia.[21] During ETI, decreased venous return can precipitate hypotension, especially in those with cardiovascular instability.[22] Dental injuries and esophageal intubation were also observed. Dental trauma occurs in approximately 0.5–7% patients, usually due to improper positioning or excessive force during laryngoscopy.[23] Esophageal intubation, seen in 9.5% of our patients, can cause severe complications like aspiration pneumonia, needing immediate correction.[11] Aspiration rates are reported between 2 and 4%.[23] In the present study, 5.4% rate likely reflected the high proportion of comatose or respiratory-distressed patients. Cardiac arrest and arrhythmias, though less frequent, are critical complications. Studies have linked failed intubation attempts with higher rates of these events, emphasizing the need for first-pass success.[20,21] In our cohort, cardiac arrest occurred in 2.7% patients, highlighting the importance of effective airway management in critically ill patients.

The MACOCHA score with an AUC of 0.593 indicated limited accuracy in predicting first-pass success, suggesting that while the score can identify risks, it may not reliably forecast first-attempt intubation success.[24] In comparison, other scoring systems have shown better predictive validity. For instance, a study demonstrated that the Difficult Airway score and the Intubation Difficulty Scale had AUC values often exceeding 0.7, indicating higher accuracy.[25] The discrepancy could be due to the fact that MACOCHA score focuses on specific anatomical and physiological factors, which may not fully capture the complexities of airway management in critically ill patients.

Notably, a higher MACOCHA score was linked to patients requiring multiple intubations attempts and those experiencing arrhythmias and cardiac arrest, indicating its utility in identifying high-risk cases.[5] This finding is consistent with studies supporting the role of MACOCHA score in predicting difficult intubations and complications.[5,7] However, no significant differences were found in first-pass success, aspiration, hypotension, hypoxia, or local injury, suggesting limitations in its predictive validity for these outcomes.[26] Moreover, a positive correlation between intubation attempts and complications ($r = 0.258$, $p = 0.026$) aligns with previous research linking increased attempts to adverse outcomes.[5,27]

The absence of significant predictors for first-pass success in the multivariate analysis further complicates the interpretation of the utility of the MACOCHA score. Factors such as gender, smoking status, and anatomical considerations (e.g., Mallampati score) did not yield significant associations, which contrasts with findings from other studies that have identified these variables as critical predictors of intubation success.[28] This discrepancy may stem from the study's focus on a specific cohort of critically ill patients, where traditional predictors may not hold the same weight due to the overarching severity of their conditions.[29]

While this is the first study to assess the validity of the MACOCHA score in predicting ETI success in ED settings, it has certain limitations. Firstly, being a single-center study restricts the generalizability of the findings to other settings with different patient demographics or practices. Secondly, all intubations were performed by nonanesthesiologist emergency medicine residents, introducing variability in technique and experience that could influence first-pass success rates.[24] Thirdly, the MACOCHA score exhibited limited predictive validity, as evidenced by a low AUC and sensitivity, indicating that it may not be sufficient as a standalone predictive tool.[5] Lastly, the exclusion of patients with specific conditions may have introduced selection bias, impacting the applicability of the results to a broader population requiring intubation.

Conclusion

In ED, more than half of the patients had successful ETI on first pass. In this setting, the MACOCHA score had a moderate performance in the prediction of the first-pass success rate of ETI. Moreover, ETI-associated complications are frequently observed, both during and 60-minute post-ETI. The number of complications had a significant correlation with the number of ETI attempts. However, none of the patients or operator characteristics were significant predictors of

first-pass success, indicating the need for improved predictive tools for emergency intubation outcomes.

Author Contributions

KS and BBB: conceptualization; KS, BBB, AK, SG, HM, SJ, and AR: methodology; BBB: formal analysis and investigation; KS and BBB: writing–original draft preparation; AK, SG, HM, SJ, and AR: writing, reviewing, and editing; BBB and AK: resources; AK: supervision. All authors approved the final draft.

Ethical Approval

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