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Original Research Article

Incidence and Management of Difficult Airway and Failed Endotracheal Intubation in Emergency General Surgery: A Prospective Observational Study

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Abstract:

Background: Difficult airway and failed endotracheal intubation remain major causes of perioperative morbidity and mortality, particularly in emergency general surgery where rapid airway control is often required.

Aim: To determine the incidence of difficult airway and failed endotracheal intubation and evaluate the airway management strategies and related complications in emergency general surgery.

Methodology: This prospective observational study was conducted over one year in the Department of Anesthesiology at Katihar Medical College and Hospital, Bihar. Eighty adult patients undergoing emergency general surgery under general anesthesia were enrolled. Preoperative airway assessment, intubation characteristics, airway management techniques, and airway-related complications were prospectively recorded and analyzed using SPSS version 27.0.

Results: Most patients had Modified Mallampati Grade I–II (72.5%), and 75% were successfully intubated on the first attempt. Difficult airway occurred in 15% of patients, while failed endotracheal intubation was observed in 2.5%. Bougie-assisted intubation (35.7%) and videolaryngoscopy (28.6%) were the most frequently used rescue techniques. Airway-related complications were absent in 81.3% of patients, with oxygen desaturation (7.5%) being the most common adverse event.

Conclusion: Difficult airway remains a significant challenge in emergency general surgery. Comprehensive preoperative airway assessment, availability of advanced airway devices, and timely use of rescue techniques improve intubation success and reduce airway-related complications.

Keywords: Difficult Airway, Failed Endotracheal Intubation, Emergency General Surgery, Airway Management, Videolaryngoscopy, Bougie-Assisted Intubation, General Anesthesia.

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Introduction

Airway management remains one of the most critical responsibilities of the anesthesiologist during emergency general surgery [1]. Adequate oxygenation, ventilation, and protection of the pulmonary system from pulmonary aspiration is achieved by securing the airway by means of endotracheal intubation, especially if urgent surgical intervention is required. But, emergency surgical patients are frequently poorly physiologically reserve, not optimised prior to surgery, with full stomach, trauma, sepsis, obesity or altered consciousness, which all are likely to make airway management challenging. Thus, despite the continuous improvement in airway management techniques and equipment, difficult airway and failed endotracheal intubation remain important causes of morbidity and mortality in the perioperative period [2].

Difficult airway management (DAM) is a challenge of general anesthesia that is one of the most significant problems for anesthesiologists [3]. Difficult intubation was cited as the principle cause of adverse events in 42% of these events reported in the Fourth National Audit Project (NAP4) of the Royal College of Anaesthetists in the United Kingdom, and 13% of the events were attributed to airway-related deaths. In a similar fashion, the American Society of Anesthesiologists (ASA) Closed Claims Project showed that 77% of the airway-related claims involved a difficult endotracheal intubation (ETI), and 78% of these claims resulted in permanent brain damage or death. In addition, Canadian Medical Protection

Association statistics revealed that complications related to airways were responsible for 11% of closed anesthesiology cases, with 24% of those cases ending in anoxic brain injury and 52% in patient death. Thus, it is emphasized that failed, difficult or delayed intubation and inadequate ventilation continue to be the most common causes for serious adverse events related to anesthesia and are important to assess and intervene promptly [4].

There are several definitions of difficult intubation, and the incidence of such intubation reported in the literature varies with the definition [5]. If only the Cormack-Lehane grading system is taken into account, then difficult intubation has been reported in about 4 - 10 % of patients. The incidence falls to around 1.5-2.5% in the general adult surgical population, however, when other factors are included like the number of intubation attempts. The most common definition of failed endotracheal intubation is the inability to achieve a successful intubation with an alternative airway management strategy or by allowing the patient to awaken [6]. Although these are rare in elective general surgery, it has been reported to happen in about 1 in 1,000–2,000 anesthetic procedures, and can have devastating effects, especially in emergency surgery where postponing the operation or waking up the patient may not be an option."

"The "cannot intubate, cannot oxygenate" (CICO) situation is one of the most dreaded complications associated with airway management [7]. This important event happens in around 1 in every 5,000 to 10,000 general anaesthetic procedures, and emergency surgical airway access is needed in almost 1 in every 50,000 procedures. However, CICO is a leading cause of anaesthetic-related deaths, accounting for almost 25% of them. However, these are rare occurrences and documentation is still difficult, and many of the current understandings are based on closed legal claim analysis, critical incident reporting systems and retrospective observation studies. These investigations have been helpful in recognizing trends in poor airway care and the need for better practice [8].

Airway management has changed significantly in the last 20 years with the introduction of new airway equipment and a consensus difficult airway algorithm [9]. Videolaryngoscopy has come out as one of the most important developments among these. Even with the availability of videolaryngoscopes, difficult and failed intubation are still happening, especially in emergency surgical patients who can have anatomy, physiology, and time constraints all present.

There are unique challenges in emergency general surgery versus elective surgery. Often there is a need for urgent airway control, and little time for thorough pre-op evaluation. Bowel obstruction, perforation, overwhelming infection, trauma, obesity, limitation of cervical spine motion and facial edema can also make airway management more difficult. Thus, it is crucial to identify the signs and symptoms of a difficult airway early, select the appropriate airway devices to use, follow difficult airway guidelines and ensure the use of rescue techniques.

Given the continuing challenge of challenging airway management in emergency surgery, prospective assessment of the incidence, risk factors, management and outcome of difficult airway management is still relevant. The purpose of the present prospective observational study is to establish the incidence of difficult airway and failed intubation of the endotracheal tube in patients undergoing emergency general surgery. In addition, the study aims to assess the methods of airway management used, the use of rescue airway devices and the perioperative complications that occurred. The results are anticipated to help optimize airway management strategies, patient safety during emergency anesthesia and clinical decision making.

Methodology

Study Design: The present study was conducted as a prospective observational study to determine the incidence and management of difficult airway and failed endotracheal intubation among patients undergoing emergency general surgery under general anesthesia.

Study Area: The study was conducted in the Department of Anesthesiology collaborate with surgery, Katihar Medical College and Hospital, Katihar, Bihar, India.

Study Duration: The study was carried out over a period of one year from January 2025 to December 2025.

Study Participants: The study included patients undergoing emergency general surgical procedures under general anesthesia requiring endotracheal intubation. Eligible participants were enrolled consecutively during the study period after fulfilling the selection criteria.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients of either gender.
- Patients undergoing emergency general surgery under general anesthesia requiring endotracheal intubation.
- Patients who underwent airway assessment before induction of anesthesia.
- Patients who provided informed written consent or whose legally authorized representative provided consent when applicable.

Exclusion Criteria

- Patients younger than 18 years of age.

- Patients undergoing elective surgical procedures.
- Patients receiving regional anesthesia without endotracheal intubation.
- Patients with a pre-existing tracheostomy.
- Patients with incomplete clinical records or missing airway assessment data.
- Patients who refused to participate in the study."

Sample Size: A total of 80 patients who fulfilled the eligibility criteria were included in the study using a consecutive sampling technique during the study period.

Procedure: After obtaining approval from the Institutional Ethics Committee, the study was conducted in the Department of Anesthesiology at Katihar Medical College and Hospital. Patients undergoing emergency general surgery under general anesthesia were screened for eligibility, and those fulfilling the inclusion criteria were enrolled consecutively until the sample size of 80 was achieved.

A detailed pre-anesthetic evaluation was performed for each patient. Baseline demographic details, medical history, comorbidities, body mass index, ASA physical status, and surgical details were recorded. Preoperative airway assessment included Modified Mallampati classification, mouth opening, thyromental distance, neck mobility, and other predictors of difficult airway.

General anesthesia was administered according to the institutional protocol. Endotracheal intubation was performed using direct laryngoscopy or alternative airway devices when required. The Cormack–Lehane grade, number of intubation attempts, airway devices used, and rescue airway techniques were documented. Difficult mask ventilation, difficult laryngoscopy, difficult or failed intubation, and cannot-intubate-cannot-oxygenate situations were recorded.

Management strategies adopted for difficult airway cases and the final successful airway technique were documented. Airway-related complications, including oxygen desaturation, aspiration, airway trauma, bleeding, laryngospasm, bronchospasm, airway edema, dental injury, hypoxia, and emergency surgical airway intervention, were observed and recorded. All study data were entered into a structured case record form and maintained confidentially for statistical analysis.

Statistical Analysis: The collected data were entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Continuous variables were expressed as mean ± standard deviation (SD) or median with range, wherever appropriate. Categorical variables were presented as frequencies and percentages. Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test whenever applicable. A p-value of <0.05 was considered statistically significant."

Result

Table 1 presents the distribution of preoperative airway assessment based on the Modified Mallampati Classification among the 80 study participants. The largest proportion of patients belonged to Grade II (37.5%), followed closely by Grade I (35%), indicating that the majority had a relatively favorable airway for endotracheal intubation. Grade III was observed in 20% of patients, while Grade IV, which is associated with the highest likelihood of difficult airway management, was present in only 7.5% of cases. Overall, the findings suggest that most patients had low-risk airway anatomy, although a notable proportion exhibited higher Mallampati grades requiring increased vigilance and preparedness for potential difficult intubation.

Table 1: Preoperative Airway Assessment (Modified Mallampati Classification)

Modified Mallampati Grade	Frequency (n=80)	Percentage (%)
Grade I	28	35
Grade II	30	37.5
Grade III	16	20
Grade IV	6	7.5
Total	**80**	**100**

Table 2 shows the distribution of the number of endotracheal intubation attempts among the 80 study participants. The majority of patients (75%) were successfully intubated on the first attempt, indicating a high rate of successful initial airway management. A second attempt was required in 17.5% of cases, while only 7.5% of patients required three or more attempts, reflecting the presence of difficult airway situations in a small proportion of the study population. Overall, the findings suggest that first-pass intubation was achieved in most patients, whereas repeated attempts were relatively uncommon but highlighted the importance of preparedness for difficult airway management in emergency general surgery.

Table 2: Number of Endotracheal Intubation Attempts		
Number of Attempts	**Frequency (n=80)**	**Percentage (%)**
First attempt	60	75
Second attempt	14	17.5
Third or more attempts	6	7.5
Total	**80**	**100**

Table 3 presents the incidence of difficult airway and failed endotracheal intubation among the 80 patients included in the study. The majority of patients (82.5%) had a normal airway, indicating successful airway management without significant difficulty. A difficult airway was encountered in 15% of patients, demonstrating that airway challenges were present in a considerable minority of emergency surgical cases. Failed endotracheal intubation occurred in only 2.5% of patients, suggesting a low incidence of complete intubation failure. Overall, the findings indicate that although most patients had uncomplicated airway management, difficult airway situations and occasional failed intubations emphasize the need for careful preoperative assessment and readiness with alternative airway management strategies."

Table 3: Incidence of Difficult Airway and Failed Endotracheal Intubation		
Airway Outcome	**Frequency (n=80)**	**Percentage (%)**
Normal airway	66	82.5
Difficult airway	12	15
Failed endotracheal intubation	2	2.5
Total	**80**	**100**

"Table 4 shows the final airway management techniques used in the 14 patients who experienced difficult airway or failed endotracheal intubation. Bougie-assisted intubation was the most commonly employed technique (35.7%), followed by video laryngoscope-assisted intubation (28.6%), indicating that these adjuncts were effective in securing the airway in most difficult cases. Supraglottic airway devices and emergency surgical airways were each required in 14.3% of patients, while fiberoptic bronchoscope-guided intubation was used in 7.1% of cases. Overall, the findings demonstrate that advanced airway management techniques played a crucial role in successfully managing difficult airways, with invasive procedures being reserved for a small proportion of patients when conventional methods were unsuccessful.

Table 4: Final Airway Management Technique Used in Difficult Airway/Failed Intubation Cases (n=14)		
Final Airway Management Technique	**Frequency (n=14)**	**Percentage (%)**
Bougie-assisted intubation	5	35.7
Video laryngoscope-assisted intubation	4	28.6
Supraglottic airway device	2	14.3
Fiberoptic bronchoscope-guided intubation	1	7.1
Emergency surgical airway	2	14.3
Total	**14**	**100**

Table 5 presents the distribution of airway-related complications among the 80 study participants. The majority of patients (81.3%) experienced no airway-related complications, indicating that airway management was performed safely in most cases. Among the reported complications, oxygen desaturation was the most frequent (7.5%), followed by airway trauma or bleeding (3.8%). Aspiration and laryngospasm/bronchospasm each occurred in 2.5% of patients, while airway edema and dental injury were the least common complications, each affecting 1.2% of patients. Overall, the findings suggest a low incidence of airway-related adverse events, although the occurrence of potentially serious complications highlights the importance of careful airway assessment, skilled intubation, and prompt management during emergency general surgery."

Table 5: Airway-Related Complications		
Airway-Related Complication	**Frequency (n=80)**	**Percentage (%)**
No complication	65	81.3
Oxygen desaturation	6	7.5
Airway trauma/bleeding	3	3.8
Aspiration	2	2.5
Laryngospasm/Bronchospasm	2	2.5
Airway edema	1	1.2
Dental injury	1	1.2
Total	**80**	**100**

Discussion

This is a prospective observational study to assess the incidence and management of difficult airway and failed endotracheal intubation in patients undergoing emergency general surgery. As per our findings, majority of the patients had a good airway with 72.5% of patients having Modified Mallampati Grade I and II, while the other 27.5% had Grade III or IV. The more advanced grades of the Mallampati score are well known as a sign for difficult laryngoscopy. This was also noted by Lee et al (2006) who stated that as the Mallampati grade progressed, there was a significant increase in the risk of difficult intubation, but the Mallampati test alone is not accurate in predicting difficult intubation (Lee et al., 2006) [10]. Similarly, Lundstrøm et al. (2011) indicated that the Modified Mallampati score should be used together with other clinical parameters to assess the airway as no one of all the clinical tests was reliable in predicting difficult airway management [11]. For this reason, we believe that our findings further underline the necessity of thorough, pre-operative assessment of the airway, especially for emergency surgery in which time for assessment is limited.

First pass intubation success rate in the present study was 75% and 25% needed 2 or more intubation attempts. While the majority of patients were successfully intubated the first time, repeated attempts were relatively common and pose an important clinical concern as multiple laryngoscopy attempts can lead to hypoxemia, airway trauma, aspiration, and cardiovascular instability. Findings similar to those of the current study were reported by Apfelbaum et al. (2013) [12] who noted that repeated attempts at intubation can also heighten the incidence of airway-related complications and the advocates use of alternative airway devices before continuing direct laryngoscopy. Frerk et al. (2015) [13] also emphasized that increased attempts at intubation are a risk to patients and that a structured difficult airway algorithm decreases airway related morbidity. We believe the high primary pass rate noted in our study is due to careful planning of the airways and the use of adjunctive devices when difficulty was predicted."

"The incidence of difficult airway was found to be 15% and failed intubation was only 2.5% in our study. The incidence of difficult airway in our emergency surgical population is higher than that reported in large general surgical databases. Schnittker et al. (2020) [14] found that intubation failure or difficulty was about 0.43-0.52% in more than 861,000 patients undergoing general anesthesia in Australia. Similarly, Schroeder et al. (2018) [15] showed a decreasing rate of difficult intubation over time in community hospitals due to improvement in the practice of airway management. The higher incidence in the present study may be due to the emergency nature of surgery, where often patients are not adequately fasted, physiologically unstable, have suffered trauma, bowel obstruction or other factors that make intubation difficult. As a result, our failed intubation rate was relatively low, suggesting that suitable rescue strategies were able to prevent total airway failure in the majority of patients.

Difficult airway management in our study showed bougie-assisted intubation was the commonest rescue technique used followed by video laryngoscopy. Supraglottic airway devices were used successfully in selected patients to maintain oxygenation and fiberoptic bronchoscopy was only needed in 1 patient. Two required emergency surgery for airway. This is in line with current difficult airway guidelines that endorse early use of adjunctive airway devices, following an unsuccessful direct laryngoscopy. Lewis et al. (2017) [16] in a Cochrane systematic review of 7,044 patients, found that videolaryngoscopy reduced failed intubation (OR 0.35), enabled better visualization of the glottis and reduced difficult laryngoscopic view compared to conventional Macintosh laryngoscopy. Similarly, Aziz et al. (2011) [17] found a high rate of success with videolaryngoscopy as a tool for difficult airway management with successful rescue intubation in most of their patients for whom direct laryngoscopy had failed. In addition, we found evidence that video-laryngoscopy is a useful rescue tool, but bougie-assisted intubation was the most popular method as it is simple, readily available and easy to use in emergencies."

"The number of patients with airway related complications was relatively small in the present study with 81.3% having no airway related complications. The most frequent adverse event was oxygen desaturation (7.5%), followed by airway trauma/bleeding (3.8%), aspiration (2.5%),

laryngospasm/bronchospasm (2.5%), airway edema (1.2%), dental injury (1.2%). These findings are similar to earlier studies which have shown oxygen desaturation to be the most common complication of difficult airway management. Cook and MacDougall-Davis (2012) [18] highlighted the need to minimise repeated laryngoscopy as it can place a person at significant risk of hypoxia and damage to the airways if they are subjected to repeated or prolonged laryngoscopy. Likewise, the Fourth National Audit Project (NAP4) identified that early identification of difficulty with the airway, keeping the air way patent/working and early use of alternative air ways techniques greatly diminish serious airway complications [19]. In our study, complications were relatively low indicating that following the principles of structured airway management and prompt rescue efforts led to favorable patient outcomes despite being an emergency scenario.

Overall, the results of the present study highlight the challenges in the management of the airway in emergency general surgery as compared with elective surgery. While the majority of patients could be managed with conventional endotracheal intubation, about 1 in 7 patients required advanced airway interventions for the management of difficult airway. The low rates of failed intubation and major airway complications highlight the importance of good assessment of the airway, having difficult airway equipment on hand, experienced anesthetists, and following difficult airway algorithms. We corroborate the international guidelines which recommend routine airway assessment, early recognition of expected airways problems, limitation of repeated intubation attempts and prompt use of rescue equipment like bougies, videolaryngoscopes, supraglottic airway devices and surgical airway as indicated. However, the small size of the series and the single-center design may limit generalizability and larger multicenter prospective studies are needed to better delineate the incidence and best management algorithm for difficult emergency general surgery airway."

Conclusion

The present prospective observational study concludes that although the majority of patients undergoing emergency general surgery had favorable airway characteristics and were successfully intubated on the first attempt, difficult airway remained a clinically significant challenge. Difficult airway was encountered in 15% of patients, while failed endotracheal intubation occurred in only 2.5%, indicating that timely recognition and appropriate rescue interventions were effective in preventing adverse outcomes. Bougie-assisted intubation and videolaryngoscopy were the most commonly used successful rescue techniques, highlighting their importance in emergency airway management. Most patients experienced no airway-related complications, with oxygen desaturation being the most frequent adverse event. Overall, comprehensive preoperative airway assessment, preparedness with advanced airway devices, adherence to difficult airway algorithms, and prompt implementation of alternative airway strategies are essential for improving patient safety and optimizing airway management outcomes in emergency general surgery.

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