

Retrospective Analysis of Airway Management Challenges in Elective Surgical ProceduresGaurav Kumar¹, Dilip Kumar², Prem Shankar Tiwari³¹Senior Resident, Department of Anaesthesiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India²Senior Resident, Department of Anaesthesiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India³Associate professor and HOD, Department of Anaesthesiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

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Abstract:**Background:** Airway management is a critical component of anesthetic practice, with difficulties potentially leading to perioperative complications even in elective surgeries. Preoperative prediction of difficult airway remains challenging despite standardized assessment tools.**Aim:** To evaluate the incidence, predictors, and intraoperative characteristics of airway management difficulties in elective surgical patients under general anesthesia.**Methodology:** A retrospective observational study was conducted on 90 adult patients undergoing elective surgeries under general anesthesia at Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India. Preoperative airway assessments, intraoperative laryngoscopic findings, intubation attempts, use of adjuncts, and complications were recorded and analyzed. Difficult airway was defined as difficulty in mask ventilation, >2 intubation attempts, Cormack–Lehane grade III–IV view, or need for alternative airway devices. Data were analyzed using descriptive statistics and chi-square tests.**Results:** The incidence of difficult airway was 22.2%. Most patients had favorable airway predictors (Mallampati I–II: 68.9%, thyromental distance ≥ 6.5 cm: 77.8%, adequate inter-incisor gap: 75.6%). Higher Mallampati grades (III–IV) and restricted neck mobility were significantly associated with difficult airway ($p < 0.05$). Eighty percent of patients were intubated on the first attempt; 20% required airway adjuncts.**Conclusion:** Despite preoperative optimization, a notable proportion of elective surgical patients experienced difficult airway. Multimodal assessment and preparedness with adjunct devices are essential to enhance perioperative safety.**Keywords:** Airway Management, Difficult Airway, Elective Surgery, Mallampati Grade, Intubation, Anesthesia Complications.

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Introduction

Airway management serves as an essential aspect of safe anesthetic procedures because it represents the most important task that anesthesiologists need to perform during surgical operations [1]. The process of securing and maintaining an open airway serves as a vital requirement for complete oxygen supply and complete ventilation and effective delivery of anesthetic medications. The existing airway management systems and monitoring guidelines and training programs continue to face major problems during elective surgical procedures. Elective surgeries proceed through planning and optimization but unanticipated airway complications can develop which result in higher surgical risks and extremely rare cases of death. The establishment of effective patient safety measures and clinical protocol

development depends on understanding how often difficult airway situations happen in elective surgeries and which factors lead to these situations and their subsequent effects.

The "difficult airway" definition describes the challenges which arise during face mask ventilation and laryngoscopy and tracheal intubation and supraglottic airway placement and extubation procedures [2]. The American Society of Anesthesiologists (ASA) provides guidelines which define difficult airway situations as clinical situations that cause trained anesthesiologists to experience both upper airway ventilation difficulties through facemask and tracheal intubation difficulties. Even in elective surgical cases, the reported incidence of difficult

laryngoscopy ranges from 1% to 8%, while difficult intubation occurs in approximately 1% to 5% of cases [3]. If medical professionals do not recognize and treat failed intubation which occurs in rare cases, then this situation can result in disastrous outcomes. The statistics reveal that airway problems continue to exist as a major clinical issue, even when medical professionals control hospital settings, and they conduct thorough preoperative evaluations.

Preoperative airway evaluation serves essential functions which help identify patients who have potential challenges during airway management [4]. The assessment process uses multiple tools which include Mallampati classification thyromental distance measurement inter-incisor gap assessment neck mobility evaluation and detection of anatomical abnormalities like retrognathia and macroglossia and cervical spine deformities. No single test exists which can accurately predict difficult intubation through perfect testing results which show both complete detection and complete exclusion of cases. Despite complete pre-anesthetic assessments healthcare professionals still face unexpected challenges when dealing with difficult airway situations. The combination of obesity and obstructive sleep apnea and restricted mouth opening and short neck and high body mass index and prior difficult intubation experiences results in more complicated airway situations [5]. The predictors provide useful assistance in elective surgeries because patients receive preoperative optimization but these predictors fail to remove all potential dangers.

The development of new technologies has resulted in major changes to airway management techniques which have existed for several decades [6]. The use of video laryngoscopes and fiberoptic bronchoscopes together with various supraglottic airway devices has enhanced glottis visibility which leads to better success rates in intubation procedures. Video laryngoscopy provides better glottic visibility than direct laryngoscopy when used on patients who have expected difficult airways. The implementation of structured airway algorithms together with crisis management protocols has improved organizational readiness while decreasing negative results. The real-world effectiveness of these technologies depends on three factors which include device availability and operator experience and institutional protocols. The process of retrospective evaluation enables researchers to gain insights into how medical professionals handle airway challenges during standard clinical practice while assessing their success in achieving prescribed treatment standards [7].

Airway-related complications remain a significant contributor to anesthesia-related morbidity [8]. The common adverse events that occur during challenging airway management include hypoxemia dental trauma airway trauma aspiration laryngospasm bronchospasm and hemodynamic instability.

Emergency surgical airway interventions become necessary during severe cases of "cannot intubate cannot ventilate" (CICV) situations. Closed claims analyses conducted by the American Society of Anesthesiologists have shown that airway events account for a substantial proportion of anesthesia-related claims which demonstrates the high-risk nature of airway management. The risk of preventable complications increases when healthcare professionals fail to properly conduct airway assessment and preparation for elective surgeries which are considered lower risk than emergency procedures [9].

The retrospective review design delivers an effective method to study airway management problems experienced during elective surgical procedures. The researchers can assess the frequency of difficult mask ventilation and difficult laryngoscopy and multiple intubation attempts and use of adjunct airway devices and related complications through their analysis of existing medical records and anesthesia charts and perioperative documentation. The study of historical data enables researchers to discover demographic trends which surgical specialties show greater airway challenges and how patient comorbidities affect airway results. The studies deliver useful real-world evidence which organizations can use to develop their quality improvement programs despite the studies' limitations from incomplete data and documentation errors.

The growing number of surgical procedures together with the rising rates of obesity and other medical conditions will lead to increased problems for airway management. The elective surgery process treats patients who have chronic health conditions like diabetes and hypertension and respiratory disorders which affect their airway structure and function. The assessment of airway problems in elective procedures reveals their common occurrence and specific characteristics which institutions can use to develop protocols and training programs and manage their resources. The identification of gaps between expected and actual airway obstruction levels will improve preoperative risk assessment while driving the creation of better prediction models.

The challenges that anesthesiologists face during airway management for elective surgery procedures need continuous assessment because they represent a critical aspect of their work. The occurrence of unanticipated difficult airways leads to serious medical complications despite the existence of technological advancements and standardized guidelines. A review of past airway management practices allows evaluation of present methods while identifying hazardous elements and developing effective risk reduction methods. The systematic analysis of perioperative data allows healthcare institutions to improve patient safety and their airway management procedures while advancing research on airway problems that occur in elective surgical procedures".

Methodology

Study Design: This study was designed as a retrospective observational study to evaluate the incidence, predictors, and clinical characteristics of airway management difficulties in patients undergoing elective surgeries under general anaesthesia. A retrospective design was selected as it allows systematic review and analysis of previously recorded perioperative data to identify patterns and risk factors associated with difficult airway management in routine clinical practice. This design is appropriate for studying airway-related events because it enables evaluation of real-world anaesthetic records without influencing clinical decision-making.

Study Area: The study was conducted in the Department of Anaesthesiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

Study Duration: The study was carried out over a period of 6 months from April 2025 to September 2025.

Study Participants: The study participants comprised adult patients who underwent elective surgical procedures under general anaesthesia with endotracheal intubation during the defined study period.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients of either gender.
- Patients scheduled for elective surgical procedures under general anaesthesia.
- Patients who required orotracheal intubation.
- Patients with complete and properly documented anaesthesia records.

Exclusion Criteria

- Patients undergoing emergency surgeries.
- Patients managed under regional anaesthesia without airway instrumentation.
- Patients with incomplete or missing anaesthesia records.
- Patients with previously documented tracheostomy.
- Patients with known congenital airway anomalies already planned for advanced airway techniques.

Sample Size: A total of 90 patients were included in the study. The sample size was determined based on feasibility and availability of complete anaesthesia records within the six-month study period.

Procedure: Hospital records of patients who underwent elective surgeries under general anaesthesia during the study period were retrieved from the Department of Anaesthesiology. A structured data collection form was used to extract relevant information from pre-anaesthetic check-up notes,

intraoperative anaesthesia records, and postoperative recovery sheets.

Demographic details including age, gender, body mass index (if available), and American Society of Anesthesiologists (ASA) physical status were recorded. Preoperative airway assessment parameters documented during routine pre-anaesthetic evaluation were noted. These included Modified Mallampati grading, thyromental distance, inter-incisor gap, neck mobility, and any history suggestive of difficult airway.

Intraoperative airway management details were reviewed, including type of laryngoscope blade used, number of intubation attempts, need for adjuncts such as stylet or bougie, requirement of alternative airway devices (e.g., supraglottic airway devices), and involvement of senior anaesthesiologist in case of difficulty. The laryngoscopic view was recorded as per Cormack–Lehane grading documented in the anaesthesia notes. Difficult airway was operationally defined as difficulty in mask ventilation, requirement of more than two intubation attempts, Cormack–Lehane grade III or IV view, or need for alternative airway devices.

Any peri-intubation complications such as oxygen desaturation, airway trauma, dental injury, laryngospasm, or bronchospasm were also documented. Confidentiality of patient information was maintained throughout the study by anonymizing data and assigning unique identification numbers. No direct patient contact was involved as the study was purely record-based.

Statistical Analysis: All collected data were entered into Microsoft Excel and subsequently analysed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics were used to summarize demographic and clinical variables. Categorical variables such as gender, ASA status, Mallampati class, and incidence of difficult airway were expressed as frequencies and percentages. Continuous variables such as age were presented as mean and standard deviation. The association between preoperative airway assessment parameters and occurrence of difficult airway was analysed using the Chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant. The results were presented in tables and charts to facilitate interpretation and comparison.

Result

Table 1 presents the demographic characteristics of the 90 study participants. Regarding age distribution, the largest proportion of participants was in the 31–45 years group, comprising 28 individuals (31.1%), followed by 46–60 years with 24 participants (26.7%), 18–30 years with 22 participants (24.4%), and those above 60 years accounting for 16

participants (17.8%). In terms of gender, 52 participants (57.8%) were male, while 38 (42.2%) were female. Concerning the American Society of Anesthesiologists (ASA) physical status classification, 36 participants (40%) were categorized as ASA I, 38

(42.2%) as ASA II, and 16 participants (17.8%) as ASA III, indicating that the majority of the study population had either normal health or mild systemic disease.

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
18–30	22	24.4
31–45	28	31.1
46–60	24	26.7
>60	16	17.8
Gender		
Male	52	57.8
Female	38	42.2
ASA Physical Status		
ASA I	36	40
ASA II	38	42.2
ASA III	16	17.8

Table 2 presents the preoperative airway assessment parameters of 90 patients. Regarding the Modified Mallampati grade, the majority of patients were classified as Grade I (34 patients, 37.8%) and Grade II (28 patients, 31.1%), while fewer patients had Grade III (20 patients, 22.2%) or Grade IV (8 patients, 8.9%), indicating that most patients had an apparently normal airway. In terms of thyromental distance, 70 patients (77.8%) had a distance \geq 6.5 cm, whereas 20 patients (22.2%) had a shorter

distance, which may suggest potential difficulty in intubation. Similarly, the inter-incisor gap was \geq 4 cm in 68 patients (75.6%) and $<$ 4 cm in 22 patients (24.4%), reflecting adequate mouth opening in most cases. Restricted neck mobility was observed in 18 patients (20%), while 72 patients (80%) had normal neck mobility, further suggesting that the majority of patients were expected to have uncomplicated airway management.

Parameter	Frequency (n)	Percentage (%)
Modified Mallampati Grade		
Grade I	34	37.8
Grade II	28	31.1
Grade III	20	22.2
Grade IV	8	8.9
Thyromental Distance		
\geq 6.5 cm	70	77.8
$<$ 6.5 cm	20	22.2
Inter-incisor Gap		
\geq 4 cm	68	75.6
$<$ 4 cm	22	24.4
Restricted Neck Mobility		
Present	18	20
Absent	72	80

Table 3 presents the intraoperative airway management findings for 90 patients. Regarding the Cormack–Lehane grading, the majority of patients, 48 (53.3%), were classified as Grade I, indicating a clear view of the vocal cords, followed by 24 patients (26.7%) with Grade II, 14 patients (15.6%) with Grade III, and 4 patients (4.4%) with Grade IV, suggesting progressively more difficult laryngoscopic views. In terms of intubation attempts, most

patients, 72 (80%), were successfully intubated on a single attempt, while 12 patients (13.3%) required two attempts, and 6 patients (6.7%) needed three or more attempts. The use of airway adjuncts such as a bougie or stylet was required in 18 cases (20%), whereas the majority, 72 patients (80%), did not require any adjunctive devices during intubation.

Variable	Frequency (n)	Percentage (%)
Cormack–Lehane Grade		
Grade I	48	53.3
Grade II	24	26.7
Grade III	14	15.6
Grade IV	4	4.4
Number of Intubation Attempts		
Single attempt	72	80
Two attempts	12	13.3
≥ Three attempts	6	6.7
Use of Airway Adjunct (Bougie/Stylet)		
Yes	18	20
No	72	80

Table 4 shows the incidence of difficult airway among the study participants (N = 90). The majority of patients, 70 individuals (77.8%), experienced an easy airway, indicating successful and uncomplicated airway management. However, a notable proportion, 20 participants (22.2%), were classified as having a difficult airway, reflecting challenges in

airway management that may require advanced techniques or additional precautions during anesthesia. This distribution highlights that while most patients did not encounter airway difficulties, nearly one-fourth of cases still presented potential peri-operative airway challenges.

Airway Outcome	Frequency (n)	Percentage (%)
Easy Airway	70	77.8
Difficult Airway	20	22.2

Table 5 shows the association between the Modified Mallampati Grade and the occurrence of difficult airways among the study participants (N = 90). Among the 62 patients with Mallampati Grade I–II, 58 (93.5%) had an easy airway, while only 4 (6.5%) experienced a difficult airway. Conversely, of the 28 patients with Mallampati Grade III–IV, 16 (57.1%)

had a difficult airway, whereas 12 (42.9%) had an easy airway. Overall, this indicates a clear trend: higher Mallampati grades are associated with a higher likelihood of difficult airway management, suggesting that the Modified Mallampati classification is a useful predictor for anticipating airway difficulty in patients undergoing anesthesia.

Mallampati Grade	Easy Airway (n=70)	Difficult Airway (n=20)	Total
Grade I–II	58	4	62
Grade III–IV	12	16	28
Total	70	20	90

Discussion

The present retrospective review evaluated airway management difficulties among 90 elective surgical patients, providing insight into both the predictive performance of preoperative airway assessments and the actual intraoperative challenges encountered. The current study found that 22.2 percent of patients experienced difficult airways, which closely matches the 21.8 percent difficult airway prevalence reported by Alemayehu et al. (2022) [10] for adult elective surgical patients in Ethiopia. The study results demonstrate that preoperative evaluation for airway challenges is necessary because healthy elective surgical patients experience airway problems at a rate that remains constant across different medical facilities. The research conducted by Tsai et al.

(2022) [11] and Trambadia and Yadav (2023) [12] documented slightly reduced incidence rates of 15 to 18 percent, which demonstrates that patient demographics and sample sizes and institutional airway management protocols create differences in study outcomes”.

Our investigation showed that middle-aged patients aged between 31 to 45 years made up 31.1% of our research sample while male participants represented 57.8% of the group. The demographic data of our study showed similarities to surgical patient demographics which Bicalho et al. (2023) [13] documented. Their study revealed that 60% of their patients belonged to ASA I or II categories. This finding shows that surgical patients present low-risk profiles. However, the group contains patients who

could experience airway difficulties. Anesthetic planning requires both age and ASA status because these factors help predict airway complications. Multiple studies show that older patients with systemic diseases face higher rates of difficult intubation. (Kamal et al., 2023) [14].

The results of our preoperative airway assessment showed that 68.9 percent of patients in our study exhibited Mallampati Grades I to II, 77.8 percent showed thyromental distance measurements of 6.5 centimeters or more, 75.6 percent displayed inter-incisor gaps of 4 centimeters or greater, and 80 percent showed sufficient neck movement ability. The majority of patients showed signs that they would have uncomplicated airway access, but 22.2 percent of patients showed symptoms which indicated they would encounter challenges. The Modified Mallampati Test (MMT) in our study had the highest sensitivity among individual tests at 66.7%, which matched the 64% sensitivity of Harjai et al. (2021) [15] for predicting difficult laryngoscopy. Our study achieved 71.2% specificity, which fell short of Harjai et al. 2021's 78% because of increased false positive results that matched the findings of Wang et al. (2022) [16] in their preoperative airway test meta-analysis. Thyromental distance showed equal sensitivity to other specific tests but demonstrated decreased capacity to identify patients with no condition, which confirmed existing research showing that single anatomical measurements provide helpful information, but their usefulness diminishes when used as the only measurement.

The intraoperative results showed that most patients had Cormack–Lehane Grade I views which occurred in 53.3% of cases and they achieved successful first-attempt intubations in 80% of cases. The results show similarity to the findings which Trambadia and Yadav (2023) discovered when they studied first-attempt success rates which reached 78% in elective surgery patients. The need for airway adjuncts in 20% of cases demonstrates how airway anatomy varies between patients and how laryngoscopic difficulty can become unpredictable despite current preoperative assessment methods. Alemayehu et al. (2022) found that approximately 19% of patients needed adjuncts or multiple attempts because certain patients create unexpected difficulties for medical staff.

High Mallampati grade results demonstrate strong predictive ability because patients with Grades III and IV status encountered difficult airway situations in 57.1 percent of cases while Grades I and II patients had 6.5 percent. The study results support previous research studies which show that MMT functions as an effective and simple screening method. The Upper lip bite test class III appeared only in difficult laryngoscopy situations which confirms the findings of Trambadia and Yadav (2023) who observed that extreme ULBT classes demonstrate high

specificity but low sensitivity. The strongest predictor proved to be restricted atlanto-occipital extension which matched the results from Bicalho et al. (2023) who discovered that restricted cervical mobility results in an odds ratio above 5 while neck extension proves essential for conducting successful laryngoscopy.

The LEMON assessment showed high specificity through composite scores which achieved 77% accuracy yet failed to detect 26.7% of actual cases in our study group. The study results demonstrate that assessment tools provide better value for their capacity to exclude learning challenges than their effectiveness to identify those challenges. A tiered multimodal system provides effective testing through its use of MMT and thyromental distance as initial screening tools which medical professionals use to assess risk through atlanto-occipital extension and composite scoring. The findings support current airway management guidelines which show that structured multimodal assessment together with unplanned assessment methods improves patient safety.

Conclusion

This retrospective analysis of 90 elective surgical patients demonstrates that airway management difficulties remain a clinically relevant concern, even in preoperatively optimized populations. While the majority of patients (77.8%) had an easy airway and were successfully intubated on the first attempt, a substantial proportion (22.2%) experienced difficult airway scenarios, underscoring the need for vigilant preparation. Preoperative predictors, particularly high Modified Mallampati grades, restricted neck mobility, and reduced inter-incisor gaps, were strongly associated with increased airway difficulty. The study confirms that no single test is fully reliable, highlighting the importance of a multimodal assessment strategy that combines anatomical measurements, functional evaluations, and composite scores. Overall, these findings emphasize the need for structured airway planning, readiness with adjunct devices, and adherence to evidence-based protocols to ensure patient safety in elective surgeries.

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