

Airway Management Difficulties During General Anesthesia in Elective Surgical Procedures: A Retrospective Analysis

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Abstract:

Background: Airway control is an essential part of safe anesthetic practice for patients receiving general anesthesia. Despite advances in airway devices and monitoring, unanticipated airway issues can arise during elective surgical procedures and may lead to perioperative morbidity.

Aim: The objective of this study was to retrospectively determine the occurrence of airway management problems during general anesthesia in patients having elective surgical procedures and to identify associated preoperative predictors and peri-intubation complications.

Methodology: We conducted a retrospective observational study in 180 individuals undergoing elective surgery under general anesthesia. Demographic characteristics, preoperative airway evaluation measures such as Modified Mallampati grade, thyromental distance, inter-incisor gap and neck mobility were reviewed. Intraoperative parameters evaluated included Cormack–Lehane grading, number of intubation attempts, use of airway adjuncts, incidence of difficult airway, and peri-intubation problems.

Results: Most of the patients had good preoperative airway features and straightforward care of the airway. However difficult airway was noted in 40 patients (22.2%). The incidence of difficult airways increased with the Modified Mallampati grade and restriction of neck movement. Most patients had effective first-attempt intubation; some patients required several tries or adjuncts for airway management. Peri-intubation problems were few and the most prevalent was oxygen desaturation.

Conclusion: Difficult airways continue to pose a serious problem for elective general anesthesia. A thorough preoperative airway examination, early awareness of risk factors, and adequate preparedness with advanced airway devices can improve patient safety.

Keywords: Airway management, difficult airway, general anesthesia, elective surgery, Mallampati grade, intubation.

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Introduction

Airway management is one of the most basic roles of anesthesiologists and remains a cornerstone of safe anesthetic practice. The establishment and maintenance of a patent airway is crucial to ensure adequate oxygenation, ventilation and delivery of inhalational anesthetic drugs during surgical procedures. Ineffective airway securing can lead to major problems such as hypoxemia, aspiration, brain damage, cardiac arrest, and even death. Despite major developments in anesthetic procedures, monitoring standards, and airway devices, airway-related problems remain a major source of anesthesia-associated morbidity and mortality worldwide. Thus, airway examination and treatment are essential components of perioperative patient care, especially in patients

undergoing elective surgical operations under general anesthesia [1].

Difficult airway is a term used to describe a range of clinical scenarios in which anesthesiologists trained in traditional techniques find trouble with facemask ventilation, tracheal intubation, placement or extubation of a supraglottic airway. The American Society of Anesthesiologists (ASA) defines a difficult airway as difficulty in facemask ventilation, difficulties in tracheal intubation or both [2]. Elective surgery has the benefit of allowing time for pre-operative examination and optimization, although unexpected airway issues may still occur. The incidence of difficult laryngoscopy has been quoted to be about 1% to 8% in published research. Difficult tra-

cheal intubation is seen in roughly 1% to 5% of individuals having general anesthesia [3]

These numbers demonstrate the continuing problem of airway management even in the controlled environment of the operating theatre when all preparation can be made. A preoperative examination of the airway is useful for identifying people at increased risk for airway complications. Various predictive methods and clinical tests have been developed to help anesthesiologists predict possible difficulties. The most often utilized assessments include: Mallampati classification, thyromental distance, sternomental distance, inter-incisor gap, upper lip bite test and neck mobility [4]. Further, anatomical and physiological features of the patient such as obesity, short neck, macroglossia, retrognathia, limited cervical spine mobility, obstructive sleep apnea and history of difficult intubation have been identified as important predictors of airway difficulty [5]. However, after considerable study and risk stratification, no single prediction test has been shown to be sensitive and specific enough to reliably predict all problematic airways. So, unanticipated airway problems continue to happen in everyday anesthetic practice. In the last few decades there have been major technological advances in the field of airway control. The advent of video laryngoscopes, fiberoptic bronchoscopes, optical stylets and a variety of supraglottic airway devices has boosted the ability of anesthesiologists to treat problematic airways efficiently. Video laryngoscopy has particularly improved glottic visualization and first attempt intubation success in numerous clinical contexts [6]. In addition, organized challenging airway algorithms and evidence-based guidelines have given systematic ways to manage expected and unexpected airway difficulties. These advancements have helped significantly with patient safety, although their efficacy often rely on operator experience, availability of equipment and institutional preparedness. Therefore, assessing the actual world practice of airway management is important to evaluate the practical impact of these innovative developments.

Airway problems are still a major cause of perioperative adverse outcomes. Difficult airway circumstances can cause repeated efforts at intubation, lengthy periods of apnea, hypoxemia, airway trauma, tooth injury, aspiration of gastric contents, laryngospasm, bronchospasm, and hemodynamic instability [7]. Rarely, under catastrophic conditions, patients may face a “cannot intubate, cannot oxygenate” (CICO) scenario, requiring immediate surgical airway access. Repeated analyses of anesthesia-related malpractice lawsuits have indicated that issues with airway control account for a large proportion of major adverse outcomes [8]. These findings underline the necessity for ongoing surveillance, assessment and improvement of airway management procedures across all surgical specialties.

Analysis of data retrospectively offers useful opportunity to investigate the incidence and features of airway issues in everyday clinical practice. The incidence of difficult mask ventilation, difficult laryngoscopy, repeated intubation attempts, unsuccessful intubation, and usage of advanced airway devices will be identified in the investigation by assessment of anesthesia records, perioperative paperwork, and patient medical files. Moreover, retrospective studies can be used to analyze demographic features, comorbid diseases, surgical characteristics, and airway evaluation findings related to airway-related problems [9]. Although retrospective studies have drawbacks, including poor documentation and potential reporting bias, they provide valuable real-world evidence that can support quality improvement programs and inform institutional airway management practices.

The rising incidence of obesity, diabetes mellitus, hypertension and other chronic medical diseases has made studies in airway management increasingly relevant. Patients having elective surgery generally have several comorbidities that can affect airway anatomy and physiology and hence increase the likelihood of challenging airway encounters. Moreover, the increased number and complexity of surgical procedures performed under general anesthesia require continuous assessment of airway management outcomes. Enhanced knowledge about the incidence, predictors and impact of airway problems would allow healthcare organizations to optimize resource allocation, improve pre-operative evaluation techniques and improve training curricula for anesthesiology specialists [10].

The Department of Anesthesiology, Government Medical College and Hospital, Chandigarh performs a high number of elective surgeries in many specialties and hence provides a good setting to assess the practices of airway management. A retrospective review of airway management challenges in this population may yield useful information on the incidence of problematic airways, associated risk factors, airway management approaches adopted, and associated perioperative outcomes. Such information could be useful for improving patient safety, preparing for difficult airway conditions, and the development of evidence-based methods to minimize airway related problems during general anesthesia.

Methodology

Study Design: This study was a retrospective observational study to investigate the prevalence, predictors and clinical features of airway management issues observed during general anesthesia in patients undergoing elective surgical procedures. A retrospective approach was chosen to enable systematic review and analysis of previously documented perioperative anesthesia records to identify factors associated with difficult airway management in routine

clinical practice without influencing patient care or anesthetic decision-making.

Study Area: The study was conducted in Department of Anesthesiology, Government Medical College and Hospital, Chandigarh, India.

Study Duration: The study was conducted over a period of one year.

Sample Size: One hundred and eighty people were included in the trial. The sample size was established on the basis of availability of complete anesthesia data that meet the study eligibility requirements within the defined study period.

Sample Population: The study population included adult patients undergoing elective surgical procedures under general anesthesia with endotracheal intubation at Government Medical College and Hospital, Chandigarh during the study period.

Data Collection: Data were obtained retrospectively from hospital medical records, including preanesthetic evaluation forms, intraoperative anesthesia charts, airway assessment forms, and postoperative recovery room records. A standardized data extraction form was created to consistently capture key demographics, clinical and airway related characteristics.

Inclusion Criteria

- Patients aged 18 years or older.
- Patients of either sex.
- Patients undergo elective surgical operations with general anesthesia.
- Patients undergoing airway control by endotracheal intubation
- Properly documented anesthesia records and complete data of the patients

Exclusion Criteria

- Patients have emergency surgical operations.
- Patients undergoing regional or local anesthesia without airway instrumentation.
- Partial, lost or illegible anesthesia records of patients
- Patients have a pre-existing tracheostomy.
- Patients with known congenital abnormalities of the airway for whom advanced airway management measures had been pre-planned.

Procedure: Medical data of 180 patients who underwent elective surgery under general anesthesia during the research period of one year were obtained from the Department of Anesthesiology. Data were collected on pre-designed data collecting proforma from pre-anesthetic evaluation forms, intraoperative

anesthesia records and postoperative recovery notes. Information on demographics, ASA physical state, preoperative airway assessment parameters (Modified Mallampati grade, thyromental distance, interincisor gap and neck mobility) and intraoperative airway management data were noted. Difficulty in airway management was defined as documentation of difficult mask ventilation, Cormack-Lehane grade III/IV view, more than two attempts of intubation, use of airway adjuncts or alternative airway devices, or need for senior anesthesiologist support. Peri-intubation problems such as oxygen desaturation, airway trauma, tooth injury, laryngospasm, bronchospasm and aspiration were also noted. All patient information was anonymized to protect confidentiality.

Statistical Analysis: The data gathered were input in Microsoft excel and analyzed using Statistical package for social sciences (SPSS) version 27.0. Descriptive statistics were employed to summarize demographic and clinical features of the research population. Continuous variables, including age and BMI, were expressed as mean $\pm$ standard deviation, while categorical variables, including gender, ASA status, Mallampati grade, Cormack-Lehane grade, and incidence of airway management problem, were expressed as frequencies and percentages.

Associations between preoperative airway evaluation parameters and occurrence of airway management issues were analyzed using chi-square test or Fisher's exact test as applicable. Statistical significance was determined by using p-value < 0.05 . outcomes were provided in tables and charts for easy understanding and comparison of outcomes".

Result

Table 1. Demographic characteristics of the 180 study participants included in the retrospective analysis. The 31–45 years age group was the largest group of patients with 58 patients (32.2%) followed by the 46–60 years with 48 patients (26.7%). The patients in the age group 18–30 accounted for 42 cases (23.3%) while those above 60 years comprised 32 cases (17.8%). With respect to gender distribution, the study population included more males ($n = 104$ patients, 57.8%) than females ($n = 76$ patients, 42.2%). Most patients were classified as ASA II (42.2%), followed by ASA I (40.0%) and ASA III (17.8%) according to the American Society of Anesthesiologists (ASA) physical status categorization. These results suggest that most participants were middle-aged people with modest perioperative risk profiles.

Table 1: Demographic Characteristics of Study Participants (N = 180)		
Variable	Frequency (Number of Patients)	Percentage (%)
Age Group (Years)		
18–30	42	23.3
31–45	58	32.2
46–60	48	26.7
>60	32	17.8
Gender		
Male	104	57.8
Female	76	42.2
ASA Physical Status		
ASA I	72	40
ASA II	76	42.2
ASA III	32	17.8

The preoperative airway examination of the study participants is shown in Table 2. Modified Mallampati grading showed that the most common was grade I seen in 68 individuals (37.8%) and followed by grade II in 56 patients (31.1%). Higher grades were related with potentially challenging airway care, reported in 40 (22.2%) patients with Grade III and 16 (8.9%) patients with Grade IV. One hundred and forty (77.8 %) patients had a thyromental dis-

tance of 6.5 cm or more and 40 (22.2%) patients had a shorter thyromental distance. Similarly, 136 patients (75.6%) had an inter-incisor gap of 4 cm or higher whereas 44 patients (24.4%) had limited mouth opening. Restricted neck mobility was seen in 36 patients (20.0%) and normal neck movement in 144 patients (80.0%). These findings are generally consistent with the majority of patients having favorable airway features before surgery.

Table 2: Preoperative Airway Assessment Parameters (N = 180)		
Parameter	Frequency (Number of Patients)	Percentage (%)
Modified Mallampati Grade		
Grade I	68	37.8
Grade II	56	31.1
Grade III	40	22.2
Grade IV	16	8.9
Thyromental Distance		
≥ 6.5 cm	140	77.8
< 6.5 cm	40	22.2
Inter-incisor Gap		
≥ 4 cm	136	75.6
< 4 cm	44	24.4
Restricted Neck Mobility		
Present	36	20
Absent	144	80

Intraoperative airway management findings of the research population are summarized in Table 3. Cormack–Lehane grading showed Grade I laryngoscopic view in 96 patients (53.3%) as the most prevalent finding followed by Grade II in 48 patients (26.7%). Laryngoscopic view was difficult in 28 (15.6%) individuals with Grade III and 8 (4.4%) patients with Grade IV. Successful first attempt intu-

bation was obtained in 144 patients (80.0%), 24 patients (13.3%) required two tries and 12 (6.7%) required 3 or more attempts. Bougies or stylets as airway adjuncts were used in 36 (20.0%) patients and 144 (80.0%) patients were intubated without adjuncts. These findings suggest that airway control was straightforward in most patients, but that others required advanced airway management.

Table 3: Intraoperative Airway Management Findings (N = 180)		
Variable	Frequency (Number of Patients)	Percentage (%)
Cormack–Lehane Grade		
Grade I	96	53.3
Grade II	48	26.7
Grade III	28	15.6
Grade IV	8	4.4
Number of Intubation Attempts		
Single Attempt	144	80
Two Attempts	24	13.3
Three or More Attempts	12	6.7
Use of Airway Adjunct (Bougie/Stylet)		
Yes	36	20
No	144	80

The incidence of problematic airways among study participants is seen in Table 4. Of 180 patients, 140 patients (77.8%) had easy airway and straightforward airway management. In contrast, 22.2% (40 patients) fulfilled the prescribed problematic air-

ways criteria. These results show that the majority of patients undergoing elective surgery were managed without airway problems, but about 20% of the population experienced airway problems that required extra care and management.

Table 4: Incidence of Difficult Airway (N = 180)		
Airway Outcome	Frequency (Number of Patients)	Percentage (%)
Easy Airway	140	77.8
Difficult Airway	40	22.2

Table 5 shows the association of Modified Mallampati grade with the incidence of difficult airway. In 124 patients classified as Mallampati Grade I–II, 116 patients had an easy airway and only 8 patients had problematic airway care. On the other hand, of the 56 patients with Mallampati Grade III–IV, 24 patients were simple airway, and 32 patients were dif-

ficult airway. These data reveal a clear correlation between increasing Mallampati grades and increased difficulties with airway control, suggesting that Modified Mallampati classification continues to be a useful tool in predicting at-risk individuals for difficult airway management in the setting of general anesthesia.

Table 5: Association Between Modified Mallampati Grade and Difficult Airway (N = 180)			
Mallampati Grade	Easy Airway (n = 140)	Difficult Airway (n = 40)	Total
Grade I–II	116	8	124
Grade III–IV	24	32	56
Total	140	40	180

Table 6 shows the relationship between neck mobility and difficult airway incidence. Among 144 patients with normal neck movement, 126 patients had easy airway, and 18 patients had problematic airway exclusively. Whereas, in 36 patients with restricted neck mobility, problematic airways were seen in 22

patients, more than the number of easy airway patients (14 patients). The results underscore the importance of limited cervical mobility in airway management and confirm its relevance as a predictor of difficult intubation in elective surgery.

Table 6: Association Between Neck Mobility and Difficult Airway (N = 180)			
Neck Mobility	Easy Airway (n = 140)	Difficult Airway (n = 40)	Total
Normal	126	18	144
Restricted	14	22	36
Total	140	40	180

Peri-intubation problems during airway management are shown in Table 7. No problems during intubation occurred in 146 (81.1%) of the patients. The most frequent complication was oxygen desaturation among the documented adverse events (12 patients, 6.7%) followed by airway damage (8 patients,

4.4%). Laryngospasm occurred in 6 individuals (3.3%). Dental injury and bronchospasm were recorded in 4 patients (2.2%). These data suggest that peri-intubation problems were rather rare, but they are of clinical importance and highlight the need for

meticulous airway evaluation and readiness in anesthetic treatment.

Table 7: Peri-intubation Complications Observed (N = 180)

Complication	Frequency (Number of Patients)	Percentage (%)
Oxygen Desaturation	12	6.7
Airway Trauma	8	4.4
Dental Injury	4	2.2
Laryngospasm	6	3.3
Bronchospasm	4	2.2
No Complication	146	81.1

Discussion

In this retrospective investigation, 180 patients undergoing elective surgery under general anesthesia were examined for the occurrence of airway management issues, related predictors, and perioperative outcomes. In the present study, Difficult airway was found in 22.2% of the patients, whereas uncomplicated airway management was seen in 77.8% of the patients. Similar to the findings of Alemayehu et al who reported difficult airway prevalence of 21.8% among elective surgical patients, this incidence is quite high. This indicates that airway related challenges are still common even in routine surgical population despite the advances in preoperative assessment and anesthetic techniques [11]. Likewise, Shiga et al. observed an incidence of difficult intubation between 1.5% and 20% depending on patient characteristics and assessment tools, demonstrating that difficult airway is still a major concern in anesthetic practice. The prevalence found in the present study is slightly greater than that reported by Nørskov et al. who found rates of difficult airway about 15–18% in elective surgeries which may be a reflection of differences in patient demographics and institutional policies”.

The analysis of the demographic features revealed that most of the study population were patients aged between 31 years and 45 years (32.2%) and patients aged between 46 years and 60 years (26.7%). 57.8% of the group were male patients and 42.2% were females. The majority of individuals were ASA physical status I (40.0%) or II (42.2%); just 17.8% were classed as ASA III. These results are comparable with the observations of Kheterpal et al. who reported that the majority of patients having elective surgery and airway assessment were in lower ASA categories and were mainly middle-aged adults [5]. Although these patients are usually regarded as low risk, airway problems can nevertheless occur unexpectedly and stress the importance of a complete preoperative assessment no matter what the general health state.

The pre-operative examination of the airway showed majority of the patients had good airway features. Mallampati Grade I and II were seen in 68.9% while Grades III and IV accounted for 31.1%.

Likewise, 77.8% of the patients had a thyromental distance ≥ 6.5 cm, 75.6% had an inter-incisor gap ≥ 4 cm and 80.0% had typical neck mobility. The results show that most patients had physically straightforward airways before surgery. Khan et colleagues reported similar observations who observed that over 70% of the elective surgery patients had Mallampati Grades I–II and favorable airway measures [12]. However, problematic airways still occurred in over one-fifth of instances in the present investigation although airway anatomy was apparently normal in a large proportion of patients, emphasizing the difficulties of relying on single predictors. Intraoperative results again show the heterogeneity in results of airway control. A Cormack–Lehane Grade I view was seen in 53.3% of patients, with Grades II, III and IV in 26.7%, 15.6% and 4.4% of patients, respectively. The intubation was successful on the first attempt in 80.0% of the patients, 13.3% required two efforts and 6.7% required three or more attempts. Airway adjuncts such as bougies or stylets were also required in 20.0% of patients. These results are very similar to those published by Ezri et al. who found first-attempt success rates of about 78–82% in patients undergoing elective surgery and indicated that adjunct devices were often needed when difficult laryngoscopy was encountered [13]. In a similar study, Rose and Cohen found that about one-fifth of patients with problematic airways required extra airway maneuvers or devices to secure the airway satisfactorily [14].

Correlation of Mallampati grade with airway difficulty was statistically significant. In patients with Mallampati Grades I–II, only 8 of 124 patients (6.5%) had difficult airway management. On the other hand, 32 of 56 patients (57.1%) with Grades III–IV developed problematic airway. This significant difference confirms the high predictive usefulness of Mallampati classification in identifying patients at risk for airway problems. Lee et al. also reported similar findings in their study, with significantly increased rates of difficult laryngoscopy among patients with higher Mallampati grades, validating its value as a simple bedside screening technique [15]. However, past studies have also shown that Mallampati classification alone has insufficient sensitivity and should be interpreted in conjunction

with other airway indicators to improve predictive accuracy.

Another significant predictor in the present investigation was neck mobility. In patients with normal neck range of motion, only 12.5% had problematic airway in comparison to 61.1% of patients with limited neck range of motion. The findings are in agreement with the observations of Wilson et al. who had reported restricted cervical spine extension was among the strongest independent predictors of difficult laryngoscopy and intubation [16]. Adequate atlanto-occipital extension allows for alignment of oral, pharyngeal and laryngeal axis during direct laryngoscopy. Hence, reduced neck mobility greatly raises the probability of airway management problems.

Perioperative complications were assessed and the most frequent adverse event was oxygen desaturation in 6.7% of patients followed by airway trauma (4.4%), laryngospasm (3.3%), tooth injury (2.2%), and bronchospasm (2.2%). Importantly, 81.1% of patients had no airway-related problems. These findings are comparable to those reported by Rose and Cohen who reported low but clinically significant rates of airway damage and desaturation in individuals with difficult intubation. The comparatively low complication rates in our study may be related to early diagnosis of problems with the airway and proper use of airway adjuncts and alternate intubation methods.

The overall results of the present study show that although majority of the elective surgery patients have good airway features and successful airway care, the difficult airway nonetheless remains a substantial clinical problem involving about one fifth of the patients. Higher Mallampati grades and reduced neck mobility were strongly linked to challenging airway outcomes, confirming prior findings that a combined approach to airway evaluation is more effective than only one predictor. Such findings emphasize the need for careful preoperative airway assessment and readiness for alternative airway management approaches to improve patient safety during general anesthesia.

Conclusion

The present retrospective analysis points out that airway management challenges are nevertheless a matter of concern with general anesthesia in elective surgical procedures even in individuals with apparently favorable preoperative characteristics. Higher Modified Mallampati grades and limited neck movement were found to be significant predictors of possible airway problems emphasizing the importance of a thorough and systematic preoperative airway assessment. Although most patients were intubated without complication, others required more efforts, airway adjuncts and increased clinical attention. Peri-intubation problems were somewhat infre-

quent but clinically significant, reiterating the need for readiness, availability of advanced airway equipment and adherence to challenging airway protocols. In conclusion, the study supports the use of systematic airway assessment, early identification of risk factors, and proactive planning to improve patient safety and perioperative outcomes.

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