

Retrospective Assessment of Difficult Airway Management Practices and Outcome MeasuresSatyendra Nawal¹, Sumit Kumar Singh², Ashutosh Sahu³¹Assistant Professor, Department of Anaesthesiology, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India²Assistant Professor, Department of Anaesthesiology, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India³Assistant Professor, Department of Anaesthesiology, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India

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Abstract:**Background:** The problem of hard-to-manage airways has been a chronic burden in the sphere of anesthesiology and emergency medicine, which is usually characterized by a high morbidity and mortality rate associated with the unsuccessful intubation, hypoxia, and airway trauma. The patient outcomes should be improved with early detection and effective management measures.**Aim:** To retro-evaluate the clinical characteristics, airway management techniques and patient outcome of patients with challenging airways.**Methodology:** The study was a retrospective observational study carried out in the Department of Anaesthesiology, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India. A total of 150 patient records for 12 months were reviewed. The demographic profile, airway evaluation and intubation procedure, complications and outcomes data were collected and analyzed with the help of descriptive statistics and logistic regression.**Results:** Most of the patients were aged 40-60 years (42%) and male (60%). Difficult airway was anticipated in 46 percent of the cases, and 54% were not anticipated. Most cases (70% attempted direct laryngoscopy) and the first-attempt success rate was 68%. Supraglottic airway devices and video laryngoscopy increased the success rates in challenging cases. Hypoxia (18%), airway trauma (12%), and unsuccessful intubation (6%), were some complications. Additional airway measures led to a great improvement.**Conclusion:** Difficult airway management is associated with significant risks but can be effectively managed with proper assessment and use of advanced airway devices. Early anticipation and readiness are the major contributors towards enhancing patient safety and outcomes.**Keywords:** Difficult airway, Intubation, Airway management, Video laryngoscopy, Complications, Outcomes.

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Introduction

A problematic airway management is one of the primary issues in clinical anesthesiology and emergency medicine because it is closely linked to life-threatening conditions including hypoxia, aspiration, brain damage, and cardiac arrest [1]. A difficult airway is usually characterized as a clinical scenario where face mask ventilation, tracheal intubation, or both face mask ventilation and tracheal intubation are challenging to a conventionally trained anesthesiologist, and may often necessitate numerous attempts or other methods. Difficult intubation is not only more common in 1-10% of patients, depending on patient population and clinical environment, but also causes more failures of intubation, although with much more serious consequences [2]. Airway

management is one of the most urgent and most perilous processes in clinical practice, even a slight delay in securing the airway may lead to rapid oxygen desaturation, especially in patients in critical condition or those who are obese, and hence airway management becomes one of the most time-sensitive and high-stakes processes in the clinical environment.

The process of airway management has changed much during the last several decades as the new tools and technologies were presented aiming to increase the visualization and success rates [3]. Video laryngoscopes, fiberoptic bronchoscopes, supraglottic airway devices, and other devices have revolutionized the management of difficult airways

by offering improved glottic visualization and alternative airway routes to oxygenation [4]. These developments have led to a decrease in the reliance on the old-fashioned direct laryngoscopy and have led to safety of patients in most clinical situations. Regardless of these improvements, there are still unexpected challenging airway scenarios that occur because of the anatomical variations, emergency circumstances, or poor preoperative evaluation. This highlights the criticality of careful planning, presence of backup devices, and following the structured airway management algorithms to provide quick and efficient intervention [5].

A difficult airway is caused by a number of anatomical, physiological, and pathological factors, which complicate its prediction and make it multifactorial. Obesity, limited neck range, limited mouth opening, macroglossia, facial injuries and congenital cranioglossia of the face may severely impair the access to the airway and visualization [6]. Also, physiological conditions like decreased pulmonary reserve and elevated oxygen use also complicate the management of airways in some patients. Widely used bedside airway evaluation instruments are the Mallampati classification, measurement of thyromental distance, inter-incisor gap, and assessment of neck mobility [7]. Although the tools present good insights, none of the parameters has been found to be totally reliable in predicting difficult airway, and there is a need to have a combined and holistic approach to assessment in order to have a reliable prediction.

The challenging management of airways is not only associated with short term perioperative outcomes but also has a long term impact on patient health and the use of health care resources [8]. Repeated or forceful attempts of intubation can result in complications like airway trauma, dental injury, and laryngeal edema, as well as in aspiration pneumonia [9]. Moreover, delayed hypoxia of unsuccessful airway management may cause an irreparable neurological injury or even death. Such complications usually lead to prolonged hospitalization, excess health expenditure as well as patient morbidity. The psychological effects on patients and healthcare practitioners especially when there are adverse outcomes also highlight the necessity to enhance airway management practices and reduce avoidable errors [10].

The airway management is further complicated in developing countries such as India by other problems such as poor access to advanced airway equipment, variation in skills of clinicians and patient lateness [11]. The resource constraints (especially on the peripheral or rural level of healthcare) can be used to access the video laryngoscopes or fiberoptic devices. Also, the lack of a standard training and guidelines can lead to the discrepancy of the management practices across the

institutions [12]. The timely medical intervention may also be delayed because of cultural/socioeconomic issues thereby exposing the individual to the risk of experiencing complicated airway situations. These problems highlight the role of institution-specific data and contextually-based methods to optimize airway management practice in these settings [13].

The aim of the present study is to retrospectively evaluate the clinical profile, treatment of airway management and outcome of the patients with difficult airway over one year period [14]. The research will identify overall trends, risk factors and effective management strategies in difficult airway cases through the evaluation of clinical evidence in the real life. It is hoped that the results will result in improved clinical judgments, uniformity of the protocols and patient safety in the airway management practices [15].

Methodology

Study Design: This was a retrospective observational study to assess the difficult airway management, and related clinical outcomes in a tertiary care unit. The retrospective design enabled the analysis of existing patient records without affecting clinical decision making and patient care. This method is especially effective with relatively infrequent clinically important events like difficult airway situations. Through historical analyses, the study aimed to establish trends in the process of assessing airways, the methods of management, the success rates, and complications that are faced in the process of airway manipulations. Observational design of the study meant that the results were based on clinical practice in the real world and not experimental conditions.

Study Area: This research was carried out in the Department of Anaesthesiology, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India.

Study Duration: The research was done in 12 months.

Study Participants: The sample population was comprised of adult patients who were put under anesthesia to get airway management and were diagnosed to have difficult airway as per clinical documentation.

Inclusion Criteria

- Adult patients (18 years old) who were in need of airway control during anesthesia
- Patients who were reported to have difficult airway (anticipated or unanticipated)
- Full medical history with airway evaluation and management information

Exclusion Criteria

- Incomplete medical records of patients
- Pediatric patients (<18 years)
- Patients who are having minor procedures, which do not involve airway intervention

These criteria were created to make sure that only pertinent and credible data were used in the analysis, and thus reduced the chances of bias and increased the validity of the study results.

Sample Size: A total of 150 patient records meeting the inclusion criteria were included in the study. The number of cases was used to select the sample size according to the availability of the eligible cases during the study period. The efforts were placed to have various patients with varying clinical characteristics and airway difficulties to boost the external validity of the results. The sample size was considered as a sufficient sample to conduct both descriptive and inferential statistics analysis in a study design of retrospectives.

Procedure: Access to the medical records department and electronic database of the hospital was made and predefined inclusion criteria were used to search the databases systematically to find relevant clinical and procedural information regarding the patients. The data collected was in terms of demography (age and gender), airway assessment results (Mallampati classification, mouth opening, thyromental distance and neck mobility). The type of airway difficulty (anticipated or unanticipated) and the airway management techniques used—such as direct laryngoscopy, video laryngoscopy, fiberoptic intubation, and supraglottic airway devices—were recorded. The number of attempts of intubation, the necessity of other methods and the necessity to perform a surgical airway intervention were observed as well.

Final outcomes and complications (hypoxia, airway trauma, aspiration, cardiovascular instability) were recorded. A standardized proforma was used to record all the data and patient confidentiality was ensured by anonymizing records. Data collection was done with the permission of the Institutional Ethics Committee.

Statistical Analysis: The data gathered were inputted into Statistical Package of the Social Sciences (SPSS) version 27.0 to be analyzed. The data were summarized with descriptive statistics where the continuous variables were represented in the form of mean \pm standard deviation and categorical variables as percentage, frequency, and giving an overview of demographic variables, airways evaluation results, management methods, and outcomes. To find out the relationship between variables, inferential statistical tests were used. Categorical variables were analyzed through the chi-square test and logistic regression was conducted to determine the independent predictors of difficult airway outcomes and complications and adjusting the potential confounders. A p-value less than 0.05 was regarded as of statistical significance and the results were explained based on clinical relevance.

Result

Table 1 shows the demographic features of 150 participants of the study. The age distribution indicates that the patients were mostly in the 40-60 years age category (63, 42%), then 18-39 years (45, 30%), and then over 60 years (42, 28%). In terms of gender ratio, the proportion of males was higher (90, 60%) than that of females (60, 40%). All in all, the results have shown that the challenging cases with the airways were more frequently found in the middle-aged population and among the male patients.

Parameter	Frequency (n)	Percentage (%)
Age (years)		
18-39	45	30
40-60	63	42
>60	42	28
Gender		
Male	90	60
Female	60	40

Table 2 presents the results of the airway assessment of the study participants. Mallampati III-IV was detected in 70 patients (46.7%), which indicates a great percentage of patients with possibly challenging airway anatomy. The lack of neck mobility occurred in 40 patients (26.7%), and lack

of mouth opening in 35 patients (23.3%). Also, 30 patients (20%), were found to be obese (BMI >30). These results imply that there are several anatomical and physiological processes that played a role in the difficult airway in this study sample

Parameter	Frequency (n)	Percentage (%)
Mallampati III-IV	70	46.7
Limited neck mobility	40	26.7
Reduced mouth opening	35	23.3
Obesity (BMI >30)	30	20

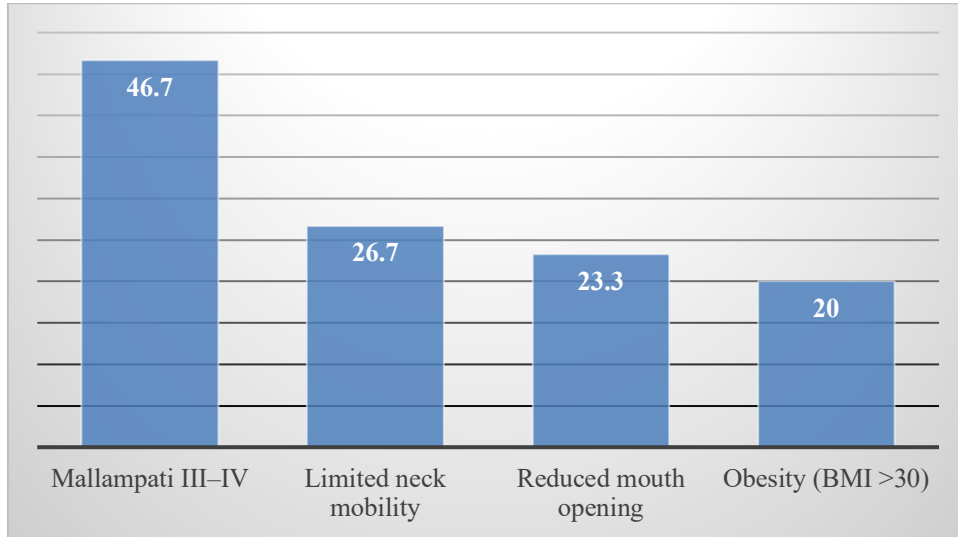


Figure 1: Visual Representation of Airway Assessment Findings

Table 3 shows the airway management methods of the study. The method most frequently utilized was direct laryngoscopy (105 cases or 70%). Video laryngoscopy was applied in 60 patients (40%), and supraglottic airway devices in 45 cases (30%). In 20 patients (13.3%), fiberoptic intubation was

undertaken, usually of more difficult airway situations. These results show that despite the prevalence of conventional methods, some sophisticated airway apparatuses were significant in dealing with challenging cases.

Technique	Frequency (n)	Percentage (%)
Direct laryngoscopy	105	70
Video laryngoscopy	60	40
Supraglottic airway device	45	30
Fiberoptic intubation	20	13.3

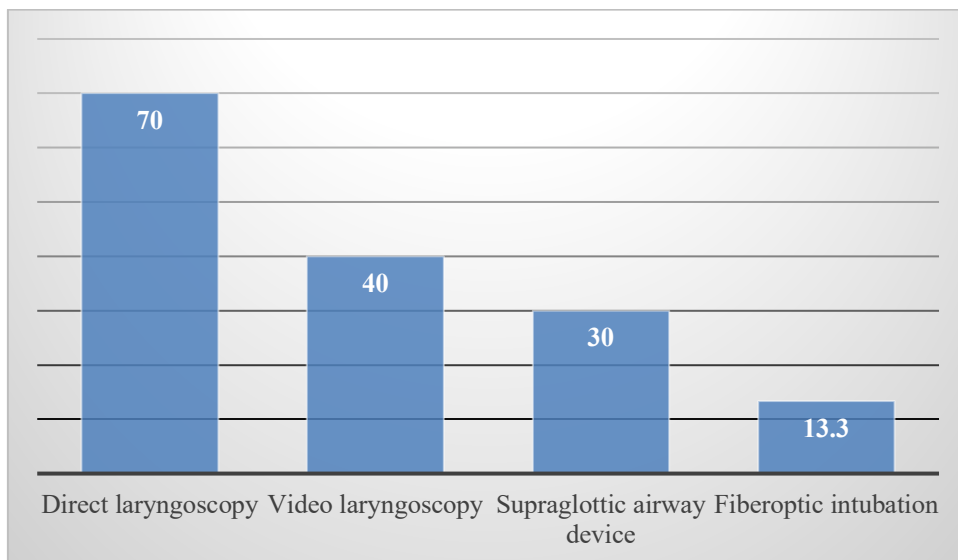


Figure 2: Visual Representation of Airway Management Techniques

Table 4 shows the results of intubation in the participants of the study. A total of 102 patients (68%) were successfully intubated on the first attempt and 30 patients (20%) needed a second attempt. There were 9 cases (6%), which failed intubation, and 9 cases (6%), which needed surgical

intervention of the airway. These findings prove that despite the fact that most cases could be effectively handled initially, significant numbers of cases had to be handled more than once or underwent more drastic measures.

Outcome	Frequency (n)	Percentage (%)
First attempt success	102	68
Second attempt success	30	20
Failed intubation	9	6
Surgical airway required	9	6

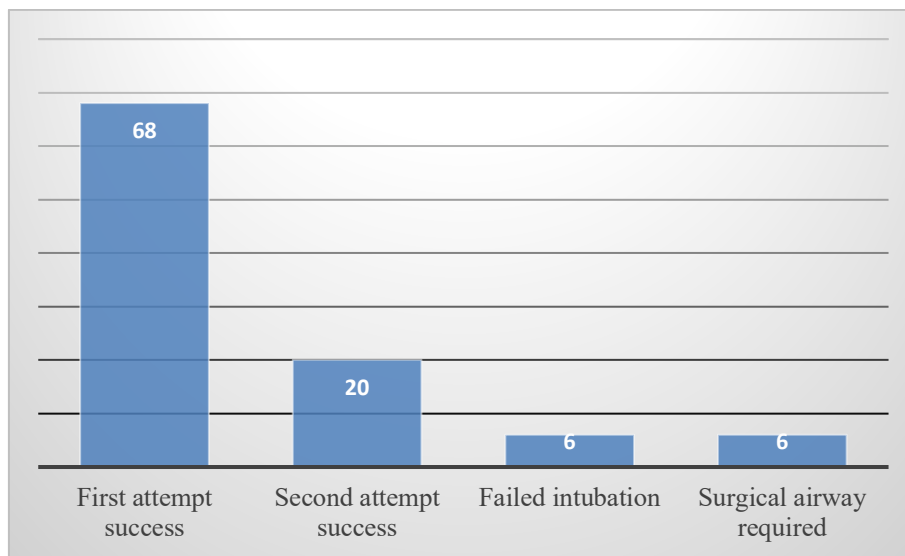


Figure 3: Visual Representation of Intubation Outcomes

Table 5 presents the complications that were experienced during airway management. The most frequent complication was hypoxia, which was present in 27 patients (18%), and airway trauma in 18 patients (12%). In 6 cases (4%), aspiration was

reported, and in 3 patients (2%), cardiac arrest was reported. The results of the study point to the fact that the challenge of airway management is linked to a variety of complications, the most common and clinically important of which is hypoxia.

Complication	Frequency (n)	Percentage (%)
Hypoxia	27	18
Airway trauma	18	12
Aspiration	6	4
Cardiac arrest	3	2

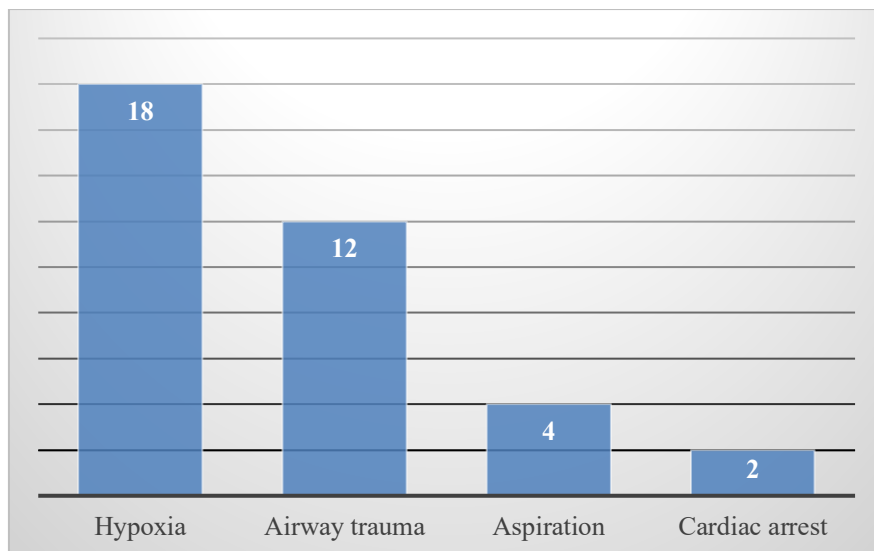


Figure 3: Visual Representation of Complications Observed

Discussion

The current retrospective study assessed challenging airway management and outcomes in 150 patients and proved significant trends in demographic distribution, airway predictors, management approaches, and complications. The majority of patients belonged to the 40–60-year age group (42%), followed by 18–39 years (30%) and above 60 years (28%). This suggests that almost twenty percent (70%) of challenging airway cases occurred in patients over 40 years of age (almost two-thirds) indicating that age is a significant causal agent due to progressive alterations in the airway (anatomy and physiology) that become burdened with comorbid conditions that further complicate airway visualization and intubation (Nemeth et al., 2012) [16]. The age distribution of the cases with the middle and older age groups further indicates the cumulative effects of chronic disease conditions and degenerative changes with age on the airway anatomy and function.

The gender distribution was found to be more of the male population (60%) than the female population (40%), which means that male was 1.5 times more likely to be affected in the study population. This disparity can be explained by the fact that males have more risk factors, such as smoking, alcohol use, occupational exposure to respiratory irritants, and more frequent comorbidities, such as hypertension and obesity (Pacheco-Lopez et al., 2014) [17]. In addition, the subtle variations in anatomy in airway size and more common cervical spine stiffness in males, could also be included in the trend. These findings suggest that gender-based physiological/behavioral variations can be a contributing factor in the occurrence and severity of the hard-to-treat cases of airways.

Airway assessment data showed that Mallampati class III-IV existed in 46.7% of the patients and thus,

had the greatest significance as a preoperative predictor of difficult airway in this study. Furthermore, the percentage of poor neck movements and poor mouth opening were 26.7% and 23.3% respectively and 20% of the patients were obese with BMI over 30 (Paolini et al., 2013) [18]. The fact that multiple risk factors are present among a significant percentage of patients points to the fact that tough airways are not typically brought about by an individual single risk factor and, rather, a combination of anatomic and physiological limitations. This validates the need to have a combined preoperative airway measurement system using a series of clinical criteria to increase predictive ability and reduce airway related complications.

Direct laryngoscopy was employed in 70% of airway management techniques, which it kept reflecting its ongoing use as the first and most common method of intubation in clinical practice. However, a significant proportion of the patients required advanced techniques of the airways, with video laryngoscopy used in 40% of the patients, supraglottic airways apparatuses in 30%, and fiberoptic intubation in 13.3%. The relatively high level of advanced equipment implies that the conventional laryngoscopy is inadequate in problematic airway scenarios. The findings also suggest that modern airway adjuncts are gaining significance in the visualization, first-pass success rates, and providing the effective rescue strategies in case of failures in the conventional approaches (Sunder et al., 2012) [19].

The intubation outcome data indicated that the patients were successfully intubated on the first attempt in 68% and 20% of patients needed a second attempt, indicating that moderate difficulty is fairly common in a sizeable proportion of cases. Nevertheless, only 12% of cases were severe airway

difficulty with 6% being unable to intubate airways and 6% emergency surgical airway intervention. This implies that they had approximately eight patients who were severely airway-obstructed and required their escalation to the point where it was not within the normal occurrences. The results highlight the importance of being prepared to use airway rescue strategies, limiting the number of tries, and using systematic difficult airway algorithms to decrease patient morbidity.

A significant percentage of patients were found to have complications with hypoxia being the most common complication in 18% of cases. This was preceded by airway trauma, 12%, aspiration, 4 percent and cardiac arrest, 2%. Almost half of all the complications reported could be attributed to hypoxia, which has proven to be the most life-threatening and the most immediate one when managing difficult airway. It is commonly connected with the long-term intubation efforts, the insufficiency of preoxygenation or with the delayed transfer to alternative airway approaches. The most common causes of airway trauma were probably due to repeated instrumentation and anatomical access requiring difficult instruments, and the occasional but severe incidence of aspiration and cardiac arrest is evidence of the riskiness of extended manipulation of the airways.

The results obviously indicate that prompt identification of risk factors like Mallampati class III–IV (46.7%), obesity (20%), and limited neck mobility (26.7%) is very important in predicting difficult airway and making proper plans (Thoeni et al., 2015) [20]. The success rate of first-attempts (68%) is relatively high, which means that the usual airway methods are still effective in the majority of cases; nonetheless, the necessity to make second attempts or use more complex interventions (32%) shows that constant preparedness, quick decision-making, and access to alternative airway equipment are required. These results are a good sign of the necessity to integrate structured airway assessment procedures into regular preoperative assessment.

Conclusion

This retrospective study proves that the problem of difficult airway management remains a significant clinical problem with high risks in the perioperative period. Middle-aged patients were found to have most of the cases and increased Mallampati grades were found to be a significant predictor of difficult airway. A complex of anatomical factors such as limited neck rotation, reduced mouth opening and obesity were also contributory factors suggesting the multifactorial nature of airway difficulty. The other study finding was that the high-technology techniques particularly the video laryngoscopy and supraglottic airway instruments could not only boost the success rate of intubation but also reduce the

complications of the traditional techniques. The Fiberoptic intubation also played a crucial role in the rescue mission in certain of the challenging scenarios and this explains the various airway options in clinical practice. Overall, the findings indicate that timely evaluation of the airway, proper planning, and availability of alternative airway management option are most crucial in ensuring safe handling of the hard airways cases. Preparedness of airways by using structured protocols and trained personnel can greatly enhance patient safety and clinical outcomes.

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