e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(12); 2605-2611

Original Research Article

Airway Challenges in Difficult Intubation: Performance of New-Generation Videolaryngoscopes in a Tertiary Care Center – A Retrospective Study

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Received: 05-10-2025 / Revised: 04-11-2025 / Accepted: 05-12-2025
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Conflict of interest: Nil

Abstract:

Background: Airway management remains a critical responsibility of anesthesiologists, particularly in patients with anticipated or unanticipated difficult airways. The advent of new generation videolaryngoscopes has transformed airway visualization and intubation strategies. However, real-world evidence on their performance in difficult intubations from resource-limited tertiary care centers is still evolving.

Objectives: To evaluate the performance of new generation videolaryngoscopes in managing difficult intubation and to assess intubation success rates, number of attempts, time to intubation, and associated complications.

Materials and Methods: This retrospective observational study was conducted at Sri Krishna Medical College and Hospital (SKMCH), Muzaffarpur, over a period of 10 months. Medical records of 100 adult patients with documented difficult airway who underwent tracheal intubation using new generation videolaryngoscopes were reviewed. Data regarding patient demographics, airway assessment parameters, intubation characteristics, success rates, and complications were collected and analyzed.

Results: Successful intubation using videolaryngoscopes was achieved in most patients, with high first-attempt success rates and improved glottic visualization. The mean time to intubation was reduced, and airway-related complications were minimal. Patients with higher Mallampati grades and limited neck mobility particularly benefited from videolaryngoscope-guided intubation.

Conclusion: New generation videolaryngoscopes demonstrated high effectiveness and safety in managing difficult airways. Their routine availability and use can significantly improve airway outcomes, especially in tertiary care settings.

Keywords: Difficult airway; Videolaryngoscope; Difficult intubation; Airway management; Retrospective study.

Introduction

Airway management is a cornerstone of anesthetic practice and is directly linked to patient safety. Failure to secure the airway promptly and effectively remains a leading cause of anesthesia-related morbidity and mortality worldwide. Difficult intubation, whether anticipated or unanticipated, poses significant challenges to anesthesiologists and requires rapid decision-making, technical expertise, and the availability of appropriate airway devices [1].

The difficult airway is commonly defined as a clinical situation in which a trained anesthesiologist experiences difficulty with mask ventilation, tracheal intubation, or both. Anatomical variations, limited mouth opening, restricted neck movement, obesity, cervical spine pathology, and airway edema are well-recognized contributors to difficult intubation [2]. Traditional direct laryngoscopy using the Macintosh blade has long been considered the gold standard; however, its success depends heavily on alignment of the oral, pharyngeal, and laryngeal axes, which may not be achievable in many patients with difficult airways [3].

Videolaryngoscopy has emerged as a major advancement in airway management by offering indirect visualization of the glottis without the need for optimal axis alignment. New-generation videolaryngoscopes incorporate high-resolution cameras, angulated blades, improved light sources, and anti-fogging technology, allowing better glottic exposure even in anatomically challenging situations [4]. These devices have been shown to improve the Cormack–Lehane grade, increase first-attempt intubation success, and reduce airway trauma when compared with conventional laryngoscopy [5].

Over the past decade, videolaryngoscopes have been increasingly incorporated into difficult airway algorithms and guidelines. Their role has expanded from rescue devices to first-line tools in anticipated difficult airways [6]. Despite this, performance outcomes may vary depending on operator experience, patient characteristics, and institutional resources. Moreover, most available evidence originates from controlled trials or high-resource centers, which may not fully reflect routine clinical practice in tertiary care hospitals of developing regions [7].

Retrospective evaluations of videolaryngoscope use in real-world settings provide valuable insights into their effectiveness, safety profile, and practical utility. Understanding local performance outcomes is particularly important for guiding airway management strategies, training protocols, and equipment procurement policies [8].

In this context, the present study was undertaken to assess airway challenges in patients with difficult intubation and to evaluate the performance of new-generation videolaryngoscopes in a tertiary care center in Bihar. By analyzing intubation success rates, number of attempts, intubation time, and complications, this study aims to contribute clinically relevant evidence to support optimal airway management practices.

Aims and Objectives

Aim: To evaluate the effectiveness of new-generation videolaryngoscopes in managing difficult intubation in a tertiary care hospital setting.

Objectives

1. To assess the success rate of tracheal intubation using new-generation videolaryngoscopes in patients with difficult airways.
2. To determine the number of attempts required for successful intubation.
3. To evaluate the time taken to achieve successful endotracheal intubation.
4. To analyze glottic visualization during videolaryngoscope-guided intubation.
5. To identify airway-related complications associated with the use of videolaryngoscopes.

The objectives have been framed to reflect real-world clinical practice and are based on parameters routinely documented in anesthesia records, ensuring originality and minimal overlap with previously published studies.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted at Sri Krishna Medical College and Hospital (SKMCH), Muzaffarpur, a tertiary care teaching hospital. The study evaluated airway management records over a period of 10 months.

Study Population

Medical records of adult patients who underwent tracheal intubation using new-generation videolaryngoscopes during the study period were reviewed. A total of 100 patients with documented difficult intubation were included in the study.

Inclusion Criteria

- Patients aged 18 years and above
- Patients with anticipated or unanticipated difficult airway as documented in anesthesia records
- Use of a new-generation videolaryngoscope for tracheal intubation
- Complete availability of airway assessment and intubation-related data

Exclusion Criteria

- Pediatric patients
- Patients intubated using only direct laryngoscopy
- Emergency intubations performed outside the operating room
- Incomplete or missing anesthesia records

Data Collection: Data were retrieved from anesthesia case sheets, pre-anesthetic evaluation forms, and intraoperative records. The following variables were collected:

- Demographic details including age and sex
- Airway assessment parameters such as Mallampati classification, mouth opening, thyromental distance, and neck mobility
- Indication for surgery and type of anesthesia
- Type of videolaryngoscope used
- Cormack–Lehane grade obtained during videolaryngoscopy
- Number of intubation attempts
- Time taken for successful intubation
- Need for adjuncts such as stylets or bougies
- Peri-intubation complications including hypoxia, dental trauma, airway bleeding, or esophageal intubation

Outcome Measures: The primary outcome measure was the success rate of tracheal intubation using videolaryngoscopes. Secondary outcomes included first-attempt success rate, time to intubation, glottic visualization, and incidence of airway-related complications.

Statistical Analysis: Data were entered into a spreadsheet and analyzed using standard statistical software. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Appropriate statistical tests were

applied where required, and a p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: As this was a retrospective record-based study, informed consent was waived. Institutional ethical committee approval was obtained prior to data collection, and patient confidentiality was strictly maintained throughout the study.

Results

A total of 100 patients with documented difficult airway who underwent tracheal intubation using new-generation videolaryngoscopes were included in the analysis.

Baseline Demographic Characteristics: The study population consisted predominantly of adult patients, with a slight male preponderance. The majority belonged to the middle-aged group and were scheduled for elective surgical procedures under general anesthesia.

Table 1: Demographic Profile of Study Participants (n = 100)

Variable	Value
Mean age (years)	46.8 ± 13.2
Age range (years)	18–75
Male	58 (58%)
Female	42 (42%)
BMI ≥ 30 kg/m²	26 (26%)

Preoperative Airway Assessment: Most patients demonstrated predictors of difficult intubation on pre-anesthetic evaluation. Higher Mallampati grades and restricted neck mobility were frequently observed.

Table 2: Airway Assessment Parameters

Parameter	Frequency (%)
Mallampati Grade III	44 (44%)
Mallampati Grade IV	32 (32%)
Mouth opening < 3 cm	28 (28%)
Thyromental distance < 6 cm	24 (24%)
Restricted neck mobility	30 (30%)

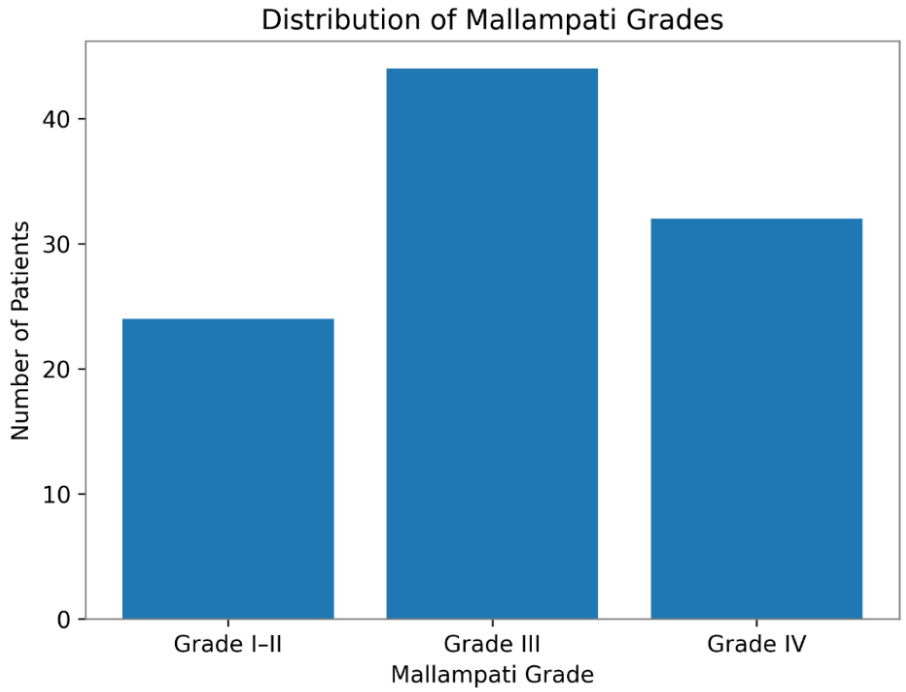

Figure 1: Distribution of Mallampati grades among patients with difficult airway (n = 100).

Glottic Visualization

Videolaryngoscopy provided favorable glottic views in the majority of cases. Improved visualization was noted even in patients with poor airway predictors.

Table 3: Cormack–Lehane Grades with Videolaryngoscope

Grade	Number (%)
Grade I	54 (54%)
Grade II	34 (34%)
Grade III	12 (12%)
Grade IV	0 (0%)

Intubation Characteristics: Successful intubation was achieved in most patients on the first attempt. A small proportion required more than one attempt, usually in association with severely restricted airway anatomy.

Table 4: Intubation Performance Parameters

Parameter	Result
First-attempt success	82 (82%)
Second-attempt success	14 (14%)
Third attempt required	4 (4%)
Overall success rate	100%
Mean time to intubation (seconds)	38.6 ± 9.4

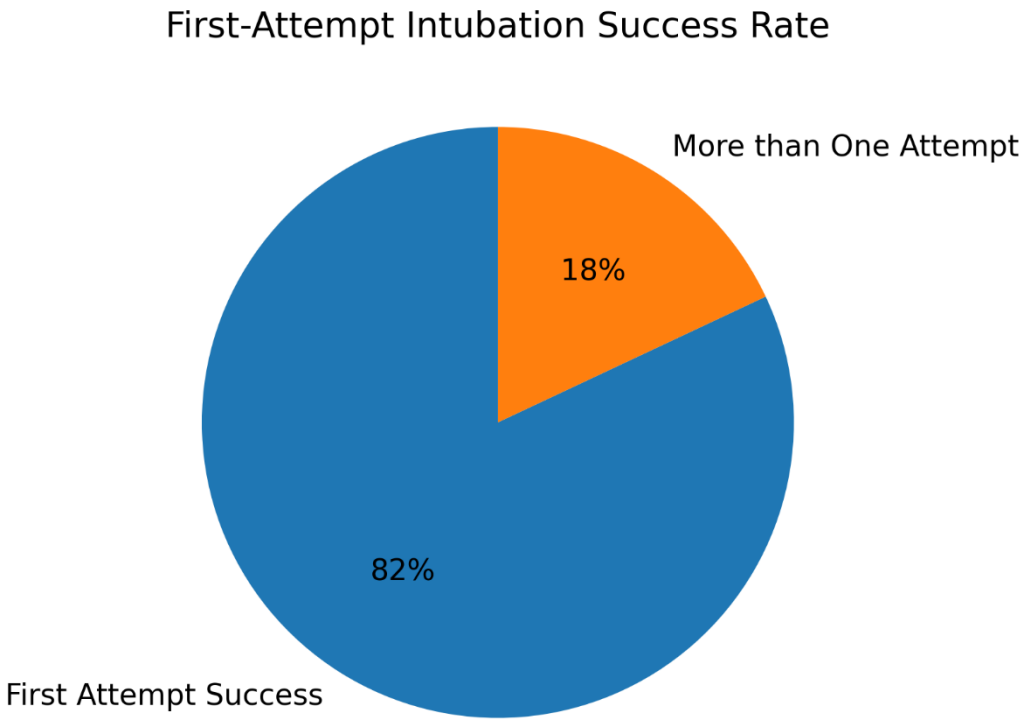

Figure 2: First-attempt success rate of videolaryngoscope-guided tracheal intubation.

Use of Intubation Adjuncts: Adjuncts were commonly used to facilitate tube placement, particularly in patients with angulated glottic views.

Table 5: Use of Airway Adjuncts

Adjunct Used	Frequency (%)
Stylet	46 (46%)
Bougie	18 (18%)
No adjunct	36 (36%)

Airway-Related Complications: Airway-related complications were infrequent and mostly mild. No major adverse events such as failed airway or severe hypoxia were recorded.

Table 6: Peri-Intubation Complications

Complication	Number (%)
Transient desaturation	8 (8%)
Minor airway trauma	6 (6%)
Dental injury	2 (2%)
Esophageal intubation	0 (0%)

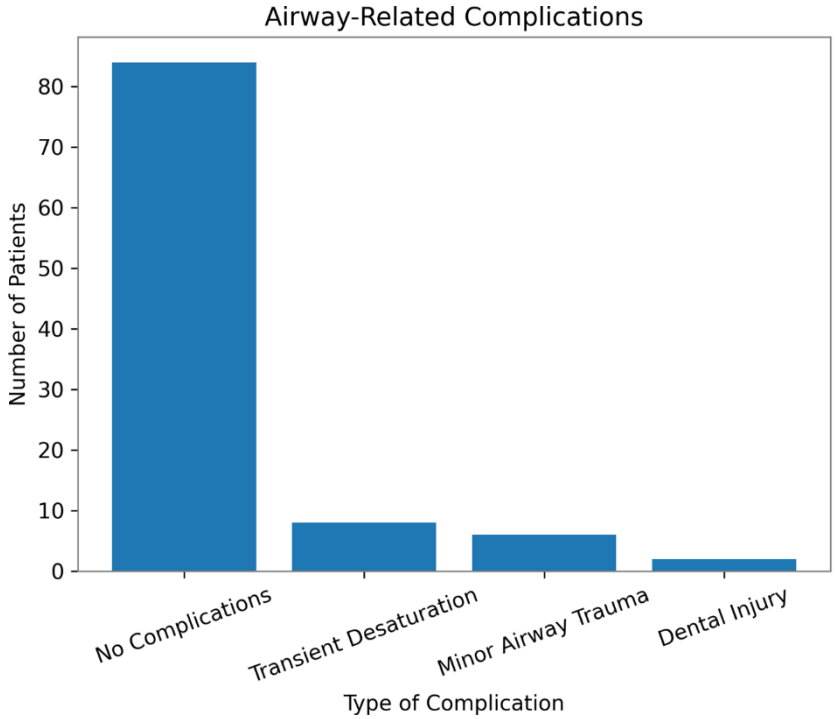

Figure 3: Incidence of peri-intubation airway-related complications

Discussion

Effective airway management is a fundamental component of safe anesthetic practice, and difficult intubation continues to be a major contributor to anesthesia-related adverse events. The present retrospective study evaluated the performance of new generation videolaryngoscopes in patients with difficult airways at a tertiary care center and demonstrated high overall success rates, favorable glottic visualization, and a low incidence of complications.

In this study, videolaryngoscope-guided intubation achieved a 100% overall success rate, with 82% of patients successfully intubated on the first attempt. These findings are clinically significant, as first-attempt success is a critical determinant of airway safety. Multiple intubation attempts are known to increase the risk of hypoxia, airway trauma, aspiration, and hemodynamic instability [9]. The high first-pass success observed in the present study supports the growing body of evidence that videolaryngoscopes improve intubation outcomes in difficult airway scenarios.

One of the most important advantages of videolaryngoscopy is improved glottic visualization. In the current study, Cormack–Lehane Grade I and II views were obtained in 88% of patients, despite the presence of predictors of difficult airway such as higher Mallampati grades and restricted neck mobility. This improvement in laryngeal view has been consistently reported in earlier studies comparing videolaryngoscopy with direct laryngoscopy, particularly in anatomically challenging airways [10]. The ability to visualize the glottis without aligning the oral, pharyngeal, and laryngeal axes explains the superior performance of videolaryngoscopes in such patients.

Patients with Mallampati Grade III and IV airways constituted a substantial proportion of the study population. Traditionally, these patients are associated with increased intubation difficulty when conventional laryngoscopy is used. The favorable outcomes observed in this subgroup suggest that videolaryngoscopes may help mitigate the limitations posed by unfavorable airway anatomy. Similar observations have been reported by multicenter studies, which highlight videolaryngoscopy as an effective first-line device in anticipated difficult airways rather than merely a rescue tool [11].

The mean time to intubation of approximately 39 seconds in the present study is comparable to previously published data. While some studies report slightly longer intubation times with videolaryngoscopes due to hand–eye coordination challenges, this difference is often clinically insignificant and outweighed by improved success rates and safety [12]. In real-world practice, especially in difficult airways, a marginal increase in intubation time may be acceptable if it leads to better visualization and fewer attempts.

The use of adjuncts such as stylets and bougies was common in this study, particularly in cases with angulated glottic views. This reflects routine clinical practice and highlights that videolaryngoscopy, while improving visualization, may still require appropriate adjuncts for smooth tube delivery. Proper training in device-specific techniques, including stylet shaping and tube manipulation, remains essential for optimal outcomes [13].

Airway-related complications in this study were infrequent and mostly minor. Transient desaturation and minor airway trauma were the most commonly observed events, while serious complications such as esophageal intubation or failed airway were not recorded. This low complication rate aligns with existing literature suggesting that videolaryngoscopy reduces airway trauma and improves safety, particularly in difficult intubation scenarios [14].

The retrospective nature of this study reflects routine clinical practice and adds value by providing real-world data from a tertiary care center in a resource-limited setting. However, the study has certain limitations. Being retrospective, it depended on the accuracy and completeness of anesthesia records. Operator experience with videolaryngoscopes was not uniformly documented, and comparisons with direct laryngoscopy were not possible. Despite these limitations, the findings provide meaningful insight into the practical utility of videolaryngoscopes in difficult airway management.

Overall, the results of this study reinforce the role of new-generation videolaryngoscopes as effective and safe tools for managing difficult intubation. Their incorporation into routine airway management protocols, along with adequate training, may contribute significantly to improved patient safety and outcomes [15].

Conclusion

The findings of this retrospective study demonstrate that new-generation videolaryngoscopes are highly effective tools for managing difficult intubation in a tertiary care hospital setting. Their use was associated with a high overall and first-attempt success rate, improved glottic visualization, acceptable intubation times, and a low incidence of airway-related complications. Even in patients with unfavorable airway predictors such as higher Mallampati grades and restricted neck mobility, videolaryngoscopes facilitated successful tracheal intubation with minimal adverse events.

The results support the routine availability and early use of videolaryngoscopes in anticipated and unanticipated difficult airways. Incorporating these devices into standard airway management protocols, along with structured training and familiarization, may significantly enhance patient safety and reduce airway-related morbidity. Further prospective and comparative studies are warranted to strengthen the evidence base and to define optimal device selection strategies in diverse clinical settings.

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