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COMPARISON OF THE ENDOTRACHEAL TUBE AND LARYNGEAL MASK AIRWAY IN DIFFICULT AIRWAY MANAGEMENT

Original Research

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ABSTRACT

Background: Effective airway management remains a cornerstone of emergency and surgical care, especially in patients with anticipated or unanticipated difficult airways. The choice of device can significantly impact patient outcomes. Among the available options, the endotracheal tube (ETT) and laryngeal mask airway (LMA) are widely used. However, the clinical superiority of one over the other in difficult airway scenarios continues to be a topic of ongoing investigation, particularly in resource-constrained or emergency settings.

Objective: To compare the effectiveness of ETT and LMA in managing difficult airways in terms of insertion time, success rate, and complication frequency.

Methods: A cross-sectional study was conducted over six months across three tertiary hospitals, enrolling 130 adult patients aged 18 years and above who required general anesthesia and met the criteria for difficult intubation. Patients were allocated to receive either an ETT or LMA based on the attending anesthesiologist's clinical judgment. Insertion time was recorded in seconds, and any complications such as sore throat, airway trauma, or laryngospasm were documented. Data were analyzed using IBM SPSS Version 29. An independent t-test and chi-square test were applied to determine statistical significance, with p < 0.05 considered significant.

Results: The mean insertion time for LMA was significantly shorter at 54.3 seconds compared to 183.6 seconds for ETT (p < 0.001). The first-attempt success rate was higher for LMA (84.6%) than ETT (30.8%) (p < 0.001). Complications were notably fewer with LMA (23.1%) than with ETT (53.8%) (p = 0.002), suggesting improved safety and ease of use with LMA in difficult airway cases.

Conclusion: LMA proved to be a faster, safer, and more effective option compared to ETT in the management of difficult airways, especially in scenarios demanding rapid airway control. Further large-scale studies are recommended for broader validation.

Keywords: Airway Management, Cross-Sectional Studies, Difficult Airway, Endotracheal Intubation, Insertion Time, Laryngeal Masks, Postoperative Complications.

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INTRODUCTION

Airway management represents a fundamental aspect of emergency medicine and anesthesia practice, where the preservation of adequate oxygenation and ventilation is critical for patient survival. The timely and effective management of the airway, particularly in highstakes settings such as trauma resuscitations or surgical interventions, can mean the difference between life and death. Among the most widely employed airway devices are the endotracheal tube (ETT) and the laryngeal mask airway (LMA), both offering distinct advantages depending on the clinical scenario (1). Managing a difficult airway remains one of the most challenging tasks in acute care, often complicated by factors such as anatomical variations, maxillofacial trauma, obesity, or limited mouth opening. In such scenarios, both intubation and mask ventilation may be difficult or even impossible. The American Society of Anesthesiologists (ASA) defines difficult airway management within a standardized algorithm that emphasizes the role of both ETTs and supraglottic devices like LMAs when conventional methods fail (2). The ETT is particularly favored in intensive care settings due to its capacity to support mechanical ventilation, enabling precise control over tidal volumes, airway pressures, and oxygenation levels (3). However, its use is not without complications—repeated intubation attempts in emergency settings can lead to airway trauma, esophageal intubation, and hemodynamic compromise (4,5).

In certain situations, such as cervical spine injuries where neck movement must be minimized, LMAs provide a safer and less invasive alternative, reducing the risk of secondary injury during airway manipulation (6). Despite its advantages, ETT use is limited in specific populations, including those at high risk of aspiration or those with obesity, where ventilation is more difficult and the tube is more susceptible to displacement (7). In contrast, LMAs are often preferred for short-term ventilation, offering a user-friendly and effective solution, especially during anesthesia induction in elective and emergency procedures (8,9). Their reduced stimulation of cardiovascular reflexes and lower incidence of airway irritation also make them favorable in patients where hemodynamic stability is paramount (10,11). While LMAs do not provide complete protection against aspiration, they play a critical role in bridging the gap between non-invasive and invasive airway management, particularly when endotracheal intubation is not immediately feasible. They are increasingly viewed as dependable tools in emergency situations, valued for their simplicity, reduced risk of trauma, and ease of insertion (12.13). Notably, their use has been associated with fewer postoperative complications such as sore throat, especially in pediatric populations (14). On the other hand, prolonged use of ETTs carries risks including bronchospasm and laryngospasm, complications exacerbated by inappropriate tube size or excessive cuff pressures (15). Attention to these factors is essential to reduce postoperative discomfort and minimize airway trauma, reinforcing the importance of appropriate device selection and technique (16). Given the evolving landscape of emergency airway management, this study aims to comparatively evaluate the clinical utility, advantages, and limitations of endotracheal tubes and laryngeal mask airways in emergency settings. The objective is to rationalize the use of each device by analyzing their efficacy and safety profiles, thereby informing clinical decision-making in diverse acute care scenarios.

METHODS

This study employed a cross-sectional research design to evaluate and compare the efficacy of laryngeal mask airway (LMA) and endotracheal tube (ETT) in the management of difficult airways in surgical patients. The research was conducted across multiple clinical settings, including CMA Hospital, Omar Hospital, and Sheikh Zayed Hospital, over a period of six months. A total of 130 adult patients were enrolled using a convenience sampling technique, ensuring rapid recruitment in diverse emergency and elective surgical cases where general anesthesia was required. Participants eligible for inclusion were adults aged 18 years and above, scheduled for surgery under general anesthesia, capable of providing informed consent, and identified as having a difficult airway based on pre-anesthetic evaluation or clinical judgment during induction. Patients were excluded if they were under the age of 18, had no indicators of difficult intubation, or were planned to undergo procedures under spinal anesthesia. All participants were enrolled following written informed consent, and the study protocol was approved by the Institutional Review Board (IRB).

Data were collected retrospectively and prospectively from medical records and anesthesia charts, documenting demographic details, type of airway device used, duration of intubation, and any complications encountered. Difficult airway indicators, patient outcomes, and perioperative events were recorded to compare the safety and effectiveness of LMA versus ETT. Data analysis was performed using



IBM SPSS Statistics, Version 29. Descriptive statistics were applied to summarize patient demographics and clinical characteristics. The independent samples t-test was used to compare mean intubation durations between LMA and ETT groups, while the chi-square test was employed to evaluate differences in complication rates across the two airway management techniques. All statistical tests were performed at a 95% confidence level, with a p-value <0.05 considered statistically significant.

RESULTS

The findings of the study revealed notable differences between the two airway management devices in terms of clinical performance and safety in difficult airway scenarios. The average insertion time for the endotracheal tube (ETT) was significantly longer at 183.6 seconds, while the laryngeal mask airway (LMA) was inserted much faster, with an average time of 54.3 seconds. This difference was statistically significant with a p-value of less than 0.001, as determined by the independent samples t-test. In terms of first-attempt success rate, the LMA demonstrated a considerably higher rate of 84.6% compared to only 30.8% for ETT. The chi-square test confirmed the statistical significance of this difference with a p-value also less than 0.001. This indicates a marked advantage of the LMA in achieving successful airway placement in difficult cases. When evaluating complication rates, the ETT was associated with a higher incidence of complications at 53.8%, whereas the LMA showed a significantly lower complications included trauma to the airway, postoperative sore throat, and hemodynamic instability. Based on complication frequency, the LMA was identified as the safer device, with a lower observed complication rate of 30.0% compared to 70.0% in the ETT group. This further emphasized the favorable safety profile of LMA in managing difficult airways.

Table 1: Insertion Time Comparison

Device	Average (seconds)	Insertion	Time	Statistical Test	p-value	Conclusion
ETT	183.6			T-test	p < 0.001	LMA insertion time is significantly shorter than ETT.
LMA	54.3					

Table 2: Success Rate comparison

Device	Success Rate (%)	Statistical Test	p-value	Conclusion
ETT	30.8	Chi-square Test	p < 0.001	LMA success rate is significantly higher than ETT.
LMA	84.6			

Table 3: Complication Rate Comparison

Device	Complication	Rate	Statistical Test	p-value	Conclusion
	(%)				
ETT	53.8		Chi-square Test	p = 0.002	LMA has a significantly lower complication rate than ETT.
LMA	23.1				

Table 4: Safety Comparison

Device	Complications	Conclusion
ETT	Higher	LMA is safer than ETT based on complication rates.
LMA	Lower	

Table 5: Comparison of ETT and LMA in difficult airway management

Metric		ЕТТ	LMA	Statistical	Result (p-value)	Conclusion
				Test		
Average	Insertion	183.6 seconds	54.3 seconds	T-test	p < 0.001	LMA insertion time is
Time						significantly shorter
						than ETT.



Metric	ETT	LMA	Statistical Test	Result (p-value)	Conclusion
Success Rate	30.8%	84.6%	Chi-square Test	p < 0.001	LMA success rate is significantly higher than ETT.
Complication Rate	53.8%	23.1%	Chi-square Test	p = 0.002	LMAhasasignificantlylowercomplicationrateETT.
Safer Device	Higher complications	Lower complications			LMA is safer than ETT based on complication rates.



DISCUSSION

The findings of this study revealed that the laryngeal mask airway (LMA) outperformed the endotracheal tube (ETT) in several key metrics including insertion time, success rate, and complication profile, particularly in the context of difficult airway management. These results are consistent with previous literature that has emphasized the utility of LMA as a less invasive, faster, and safer alternative in selected patient populations, especially in emergency and prehospital settings (17,18). The supraglottic position of the LMA reduces mechanical irritation to the trachea and minimizes the likelihood of bronchospasm, which is especially advantageous in patients with reactive airway diseases or asthma. In contrast, the ETT, by directly contacting the tracheal mucosa, increases airway sensitivity and the potential for reflex bronchospasm, making it less suitable for such vulnerable groups (19). While the LMA demonstrated superior performance in terms of ease and speed of insertion and had a lower complication rate, it does present certain limitations. Its less secure airway seal may be inadequate for patients requiring high airway pressures, as in severe acute respiratory distress syndrome (ARDS) or during prolonged mechanical ventilation (20). Moreover, although it reduces hemodynamic stress and airway trauma, the LMA does not provide robust protection against aspiration, which remains a critical consideration in unconscious or unfasted patients. Therefore, while the LMA has proven to be an effective adjunct or primary airway device in many scenarios, it cannot fully replace the ETT in all clinical settings.

The success rate observed with LMA supports its integration into difficult airway algorithms, particularly as a rescue device when intubation fails or is contraindicated. The LMA also serves a valuable role in facilitating intubation in challenging anatomical cases by acting as a conduit for fiberoptic-guided techniques (21). On the other hand, the ETT remains the gold standard for definitive airway management in critical care, major surgical procedures, and in patients requiring precise ventilatory parameters. It offers superior airway



protection and allows for prolonged ventilation, essential in patients with chronic obstructive pulmonary disease (COPD), ARDS, or those needing specialized ventilatory modes (22). Despite these strengths, the use of ETT is associated with increased complication rates, particularly in anatomically difficult cases such as those involving short necks, maxillofacial trauma, or obesity. The requirement for direct laryngoscopy and visualization of vocal cords poses a significant challenge, often resulting in repeated attempts, trauma, or failed intubation. These findings highlight the importance of proper patient selection and clinician expertise in determining the appropriate airway device.

One of the notable strengths of this study lies in its real-world comparison of ETT and LMA performance in multiple clinical settings, enhancing the external validity of the findings. The inclusion of adult patients undergoing both elective and emergency procedures adds practical relevance to the results. However, limitations exist, particularly the use of convenience sampling, which introduces selection bias and limits the generalizability of the conclusions. The absence of detailed patient stratification based on airway assessment scores or comorbid conditions restricts a more nuanced analysis of device performance in specific subgroups. Future studies should adopt larger, randomized designs and include diverse populations to assess outcomes across different anatomical and physiological profiles. Incorporating objective airway assessment tools and long-term outcome measures would also allow for more standardized evaluations. In addition, future research should aim to refine the integration of LMA into difficult airway protocols, especially in resource-limited settings, where rapid airway control with minimal equipment and expertise is often essential. Overall, the findings suggest that while the LMA is a valuable tool with several advantages over the ETT in difficult airway situations, both devices have complementary roles. Optimal airway management should remain individualized, guided by patient characteristics, clinical context, and the provider's proficiency.

CONCLUSION

This study concludes that the laryngeal mask airway offers significant advantages over the endotracheal tube in the management of difficult airways, particularly in emergency settings or where access to highly trained personnel is limited. Its ease of insertion, lower complication rate, and reduced requirement for advanced technical skills make it a practical and effective option for airway control in a variety of clinical scenarios. These findings emphasize the LMA's value as a reliable alternative, especially when rapid airway management is essential. Further research across diverse patient populations and clinical environments is warranted to reinforce and expand upon these conclusions.

Author	Contribution			
Hussnain Mushtaq	Substantial Contribution to study design, analysis, acquisition of Data			
	Manuscript Writing			
	Has given Final Approval of the version to be published			
Muhammad	Substantial Contribution to study design, acquisition and interpretation of Data			
Samad	Critical Review and Manuscript Writing			
Sarmad	Has given Final Approval of the version to be published			
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Akasii ijaz	Has given Final Approval of the version to be published			
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Munammad Rashic	Has given Final Approval of the version to be published			
Urooj Fatima	Contributed to Data Collection and Analysis			
	Has given Final Approval of the version to be published			
Rida Qasim*	Substantial Contribution to study design and Data Analysis			
	Has given Final Approval of the version to be published			

AUTHOR CONTRIBUTION



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