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Research Article

Study of LMA performance in difficult pediatric airways: success rate and complications.

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Abstract: ***Introduction:*** Airway management in pediatric patients with difficult airways is a major challenge for anesthesiologists due to anatomical and physiological differences. The laryngeal mask airway (LMA) is a supraglottic airway device widely used as an alternative to endotracheal intubation. It allows rapid airway establishment with minimal airway manipulation and reduced airway trauma. Evaluating its performance in difficult pediatric airways is important to ensure safe and effective airway management.**Objectives:**To evaluate the performance of laryngeal mask airway in difficult pediatric airways, focusing on the success rate of insertion and associated complications.**Materials and Methods:**This prospective observational study was conducted in the Department of Anaesthesiology at a tertiary care hospital. A total of 60 pediatric patients aged 1–12 years with anticipated or unanticipated difficult airways undergoing surgery under general anesthesia were included. After induction of anesthesia, an appropriately sized LMA was inserted. Data recorded included demographic details, number of insertion attempts, success rate, time taken for insertion, and complications such as desaturation, laryngospasm, airway obstruction, and blood staining of the device. The collected data were analyzed using appropriate statistical methods.**Results**Among the 60 pediatric patients, successful LMA insertion was achieved in 56 patients (93.3%). The majority of insertions (80%) were successful on the first attempt, while 13.3% required a second attempt. LMA insertion failed in 6.7% of cases. Most insertions were completed within 20 seconds. Complications were minimal; desaturation occurred in 5%, laryngospasm in 3.3%, and airway obstruction in 3.3% of patients. The majority of patients (86.7%) experienced no complications.**Conclusion:**The laryngeal mask airway is a safe, effective, and reliable airway device for the management of difficult pediatric airways. It demonstrates a high success rate, ease of insertion, and low incidence of complications, making it a valuable alternative to endotracheal intubation in pediatric airway management.

Keywords: Laryngeal mask airway, pediatric airway, difficult airway, supraglottic airway device, anesthesia, airway management.

INTRODUCTION

Airway management in pediatric patients presents unique challenges due to anatomical and physiological differences compared to adults. The presence of a relatively larger tongue, a cephalad larynx, a narrow subglottic region, and increased airway reactivity makes airway control more difficult in children. These challenges become even more significant in the presence of a difficult airway, which may arise from congenital anomalies, trauma, infections, or anatomical variations. Failure to secure the airway promptly in such situations can lead to serious complications including hypoxia, aspiration, and cardiac arrest.

The laryngeal mask airway (LMA) has emerged as an important supraglottic airway device in pediatric anesthesia. Since its introduction by Archie Brain in the 1980s, LMA has been widely used as an alternative to endotracheal intubation for airway management during general anesthesia. It provides a relatively easy and less invasive method of airway maintenance while minimizing hemodynamic responses and airway trauma. In pediatric patients, LMA is particularly valuable because it avoids laryngoscopy and reduces airway stimulation.[1,2]

In cases of anticipated or unanticipated difficult pediatric airways, LMA can serve as a rescue device for ventilation and oxygenation when conventional mask ventilation or endotracheal intubation becomes challenging. It can also act as a conduit for fiberoptic-guided intubation in difficult airway situations. Several studies have reported high insertion success rates and favorable outcomes with LMA use in children, making it an essential component of modern pediatric airway management guidelines.

Despite its advantages, the use of LMA is not without limitations. Potential complications include airway obstruction, gastric insufflation, aspiration risk, laryngospasm, and malposition of the device. Additionally, the performance of LMA in difficult pediatric airways may vary depending on factors such as age, weight, underlying airway pathology, and operator experience.[3,4]

Although numerous studies have evaluated the efficacy of LMA in routine pediatric anesthesia, limited data are available regarding its performance specifically in difficult pediatric airway scenarios. Understanding the success rate and potential complications associated with LMA use in such situations is important for improving airway management strategies and patient safety.[5,6]
Therefore, the present study was undertaken to evaluate the performance of LMA in children with difficult airways, with particular emphasis on the success rate of insertion and the incidence of associated complications. The findings of this study may help guide anesthesiologists in selecting appropriate airway management techniques in challenging pediatric cases.

MATERIALS AND METHODS

Study Design and Setting
This prospective observational study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 12 months.

Study Population
Pediatric patients aged 1–12 years scheduled for elective or emergency surgical procedures under general anesthesia and identified as having anticipated or unanticipated difficult airway were included in the study.

Inclusion Criteria
- Pediatric patients aged 1–12 years.
- Patients with anticipated or unanticipated difficult airway.
- Patients requiring airway management under general anesthesia.
- ASA physical status I–III.
- Patients in whom laryngeal mask airway (LMA) was planned for airway management.

Exclusion Criteria
- Patients with high risk of aspiration (e.g., full stomach, gastroesophageal reflux disease).
- Upper airway obstruction or pathology contraindicating LMA placement.
- Severe cardiorespiratory instability.
- Patients with ASA physical status IV or above.
- Refusal of consent by parents or guardians.

Sample Size
The sample size was calculated based on previous studies[7] reporting a success rate of LMA insertion of approximately 90% in pediatric airway management. Using the formula for estimating sample size for proportions:
n=Z2×p×qd2n = \frac{Z^2 \times p \times q}{d^2}n=d2Z2×p×q
Where:
n = required sample size
Z = standard normal deviate at 95% confidence level (1.96)
p = expected success rate (0.90)
q = 1 − p (0.10)
d = allowable error (0.08)
The calculated minimum sample size was approximately 54 patients. Considering possible dropouts and incomplete data, a total of 60 pediatric patients were included in the study.

Preoperative Assessment
All patients underwent a thorough preoperative evaluation, including medical history, physical examination, airway assessment, and routine laboratory investigations. Difficult airway predictors such as limited mouth opening, craniofacial abnormalities, micrognathia, or restricted neck movement were noted.

Anesthetic Technique
Standard monitoring including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), and capnography was applied. General anesthesia was induced using standard pediatric anesthetic protocols. After achieving adequate depth of anesthesia, an appropriately sized laryngeal mask airway (LMA) was inserted according to the patient's body weight.
The number of attempts required for successful insertion, ease of insertion, and adequacy of ventilation were recorded. If LMA insertion failed after two attempts, an alternative airway management technique was used.

Data Collection
The following parameters were recorded:
- Demographic data (age, gender, weight)
- Type of surgery
- Type and size of LMA used
- Number of insertion attempts
- Success rate of LMA placement
- Time taken for insertion
- Hemodynamic parameters (heart rate, blood pressure, oxygen saturation)

Complications
Any complications related to LMA insertion or use were documented, including:
- Desaturation ($SpO_2 < 92\%$)
- Laryngospasm
- Airway obstruction
- Regurgitation or aspiration
- Trauma to airway (blood staining of device)
- Postoperative sore throat

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using statistical software such as SPSS version 22.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequency and percentage. Appropriate statistical tests such as Chi-square test and Student's t-test were used

where applicable. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 60 pediatric patients with difficult airways who required airway management under general anesthesia were included in the study. The performance of the laryngeal mask airway (LMA) was evaluated in terms of success rate, number of insertion attempts, and associated complications.

Table 1: Demographic Characteristics of Patients (n = 60)

Variable	Number of Patients	Percentage (%)
Age Group		
1–3 years	18	30%
4–6 years	20	33.3%
7–9 years	12	20%
10–12 years	10	16.7%
Gender		
Male	34	56.7%
Female	26	43.3%

Note: Most patients belonged to the 4–6 years age group (33.3%), and male patients (56.7%) were slightly more common than females.

Table 2: Success Rate of LMA Insertion

Parameter	Number of Patients	Percentage (%)
Successful insertion (1st attempt)	48	80%
Successful insertion (2nd attempt)	8	13.3%
Failed insertion	4	6.7%
Total successful insertions	56	93.3%

LMA insertion was successful in 93.3% of patients, with the majority (80%) achieved on the first attempt.

Table 3: Number of Attempts Required for LMA Placement

Number of Attempts	Number of Patients	Percentage (%)
One attempt	48	80%
Two attempts	8	13.3%
More than two attempts	4	6.7%

The majority of patients (80%) required only one attempt for successful LMA placement.

Table 4: Complications Associated with LMA Use

Complication	Number of Patients	Percentage (%)
Desaturation	3	5%
Laryngospasm	2	3.3%
Airway obstruction	2	3.3%
Blood staining of device	1	1.7%
Regurgitation/Aspiration	0	0%
No complications	52	86.7%

Most patients (86.7%) did not experience any complications. The most common complication observed was desaturation (5%), followed by laryngospasm and airway obstruction (3.3%).

Table 5: Duration of LMA Insertion

Time Taken for Insertion	Number of Patients	Percentage (%)
< 10 seconds	28	46.7%
10–20 seconds	24	40%
> 20 seconds	8	13.3%

In most patients (86.7%), LMA insertion was completed within 20 seconds, indicating rapid airway establishment.

DISCUSSION

Airway management in pediatric patients with difficult airways remains a significant challenge for anesthesiologists due to anatomical and physiological differences compared with adults. Supraglottic airway devices such as the laryngeal mask airway (LMA) have gained widespread acceptance as an effective alternative to endotracheal intubation, especially in situations where intubation may be difficult or unsuccessful. Recent guidelines and reviews emphasize the importance of supraglottic airway devices in difficult airway algorithms because they can provide rapid oxygenation and ventilation while minimizing airway trauma.

In the present study involving 60 pediatric patients with difficult airways, the overall success rate of LMA insertion was 93.3%, with 80% of insertions successful on the first attempt. These findings are consistent with several recent studies that have demonstrated high success rates for LMA insertion in pediatric patients. A study by Katzenschlager et al.[8] reported a first-attempt success rate of 90.5% and an overall success rate of 97.3% with laryngeal mask airway use in children, highlighting its reliability for airway management. Similarly, Farbood et al[9] reported first-attempt success rates of approximately 86% and overall success rates above 93% for LMA placement in pediatric patients. These results closely resemble the findings of the present study, suggesting that LMA insertion is generally easy and successful in most pediatric cases, even when airway difficulty is anticipated. Another recent prospective study[10] comparing LMA with other airway management methods in children also demonstrated a first-attempt success rate of approximately 86.7%, indicating that LMA provides reliable airway control and requires fewer airway manipulations. This supports the current study's observation that most insertions were successful on the first attempt.

Complications associated with LMA use in the present study were minimal, with desaturation (5%), laryngospasm (3.3%), and airway obstruction (3.3%) being the most commonly observed events. The majority of patients (86.7%) experienced no complications. Similar findings have been reported in recent literature, where supraglottic airway devices were associated with relatively low complication rates compared with repeated attempts at direct laryngoscopy. [11] Reducing repeated intubation attempts is particularly important in pediatric patients, as multiple attempts are known to increase the risk of hypoxia and other serious complications.

Recent advances in pediatric airway management also emphasize early use of alternative airway devices such as LMAs to improve patient safety in difficult airway situations. [12] Large registries and observational studies have shown that limiting repeated direct laryngoscopy attempts and utilizing supraglottic airway devices can significantly reduce severe complications in children with difficult airways. [13,14]]

Overall, the findings of the present study are consistent with recent evidence suggesting that LMA is an effective and safe airway device in pediatric difficult airway management. Its high success rate, ease of insertion, and low incidence of complications make it a valuable tool for anesthesiologists, particularly when rapid airway control is required.

CONCLUSION

The present study evaluated the performance of the laryngeal mask airway (LMA) in the management of difficult pediatric airways with respect to success rate and associated complications. The results demonstrated that LMA is a reliable and effective supraglottic airway device for airway management in pediatric patients with difficult airways.

In this study, LMA insertion showed a high overall success rate of 93.3%, with the majority of insertions being successful on the first attempt. The procedure was found to be quick and easy to perform, allowing rapid establishment of a secure airway and adequate ventilation. Furthermore, the incidence of complications such as desaturation, laryngospasm, and airway obstruction was relatively low, and most patients experienced no adverse events.

These findings suggest that LMA can serve as a valuable alternative to endotracheal intubation, particularly in situations where airway management is challenging. Its ease of insertion, minimal airway stimulation, and low complication rate make it a useful device in the pediatric difficult airway algorithm.

Therefore, LMA can be considered a safe and effective airway management device in pediatric patients with difficult airways, and its early use may help improve patient safety and reduce airway-related complications during anesthesia.

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