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Clinical Evaluation of i-gel in Pediatric Patients Undergoing Surgery Under General Anaesthesia with Controlled Ventilation: A Prospective Observational Study

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Abstract

Background: The i-gel® is a second-generation supraglottic airway device featuring a non-inflatable cuff designed to provide an anatomical seal. Its use in pediatric patients is increasing due to ease of insertion and reduced airway trauma.

Objectives: To evaluate the efficacy and performance of the pediatric i-gel in terms of ease of insertion, fiberoptic view, first-attempt success rate, ease of gastric tube insertion, hemodynamic response, and perioperative complications.

Methods: This prospective observational study included 100 pediatric patients (ASA I–II), aged 6–12 years, undergoing elective surgery under general anesthesia with controlled ventilation. Parameters assessed included ease of insertion, number of attempts, fiberoptic grading, gastric tube insertion, hemodynamic changes, and complications.

Results: First-attempt success rate was 98%. Insertion was graded as very easy in 90% of cases. Fiberoptic evaluation showed optimal positioning (Grade I) in 88% of patients. Hemodynamic parameters remained stable. No major complications were observed.

Conclusion: The i-gel is a safe, effective, and reliable supraglottic airway device in pediatric patients, with high success rates and minimal complications.

Keywords: Pediatric anesthesia, i-gel, Supraglottic airway device, Airway management, Controlled ventilation, Fiberoptic evaluation, Gastric tube insertion, Hemodynamic stability, Pediatric airway

Introduction

Airway management remains a cornerstone of safe anesthetic practice, particularly in pediatric patients where anatomical and physiological differences pose unique challenges. Compared to adults, children have a relatively larger tongue, a more cephalad and anterior larynx, a floppy epiglottis, and a narrower airway, all of

which increase the difficulty of securing and maintaining a patent airway. Additionally, reduced functional residual capacity and higher oxygen consumption predispose pediatric patients to rapid desaturation during airway manipulation. These factors underscore the importance of selecting airway devices that are both effective and minimally traumatic.[1]

Supraglottic airway devices (SADs) have gained widespread acceptance as valuable tool in pediatric anesthesia due to their ease of insertion, reduced hemodynamic response, and lower incidence of airway trauma compared to endotracheal intubation. Among these, the i-gel® represents a second-generation SAD that has been increasingly adopted in both adult and pediatric populations. Unlike first-generation devices such as the classic laryngeal mask airway (LMA), the i-gel features a non-inflatable cuff made of medical-grade thermoplastic elastomer. This cuff is designed to anatomically conform to the perilaryngeal structures, thereby creating an effective seal without the need for cuff inflation. This not only simplifies insertion but also reduces the risk of mucosal ischemia and nerve compression associated with overinflation.[2]

The i-gel incorporates several design advantages, including an integrated bite block, a widened and anatomically shaped airway tube that minimizes rotation, and a gastric drainage channel that allows for the insertion of a nasogastric tube. The presence of this drain tube is particularly important during controlled ventilation, as it reduces the risk of gastric insufflation and aspiration. The device is available in a range of sizes (1–5), with pediatric sizes (1–2.5) suitable for children weighing between 2 and 35 kg, making it versatile across a wide pediatric age group.[3]

Previous studies have demonstrated that the i-gel provides high oropharyngeal leak pressures, good fiberoptic positioning, and high first-attempt insertion success rates in children. Furthermore, its relatively atraumatic design has been associated with a low incidence of postoperative complications such as sore throat, coughing, and airway injury. Despite these advantages, concerns have been raised regarding potential device displacement and variability in positioning, especially in younger patients or during changes in patient positioning.[4,5]

Given the increasing use of the i-gel in pediatric anesthesia, it is important to systematically evaluate its clinical performance in terms of ease of insertion, adequacy of ventilation, positioning, and safety profile. This study was therefore undertaken to assess the efficacy and performance of the pediatric i-gel in children undergoing elective surgical procedures under general anesthesia with controlled ventilation.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted at Justice K.S. Hegde Hospital, Deralakatte, Mangalore, over a period of two years from 2016 to 2018. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from the parents or guardians of all participants prior to enrollment.

Participants

A total of 100 pediatric patients aged between 6 and 12 years, classified as American Society of Anesthesiologists (ASA) physical status I and II, and scheduled for elective surgical procedures under general anesthesia with controlled ventilation were included in the study.

Patients were excluded if parental or guardian consent could not be obtained, or if they had a known allergy to study drugs, acute or chronic respiratory disease, increased risk of aspiration, anticipated difficult airway, or were scheduled for airway-related surgeries.

Sample Size

A convenience sample of 100 patients was included during the study period. No formal sample size calculation was performed.

Preoperative Preparation

All patients were kept nil per oral according to standard fasting guidelines. Oral premedication was administered on the morning of surgery based on body weight: syrup triclorfos 10 mg/kg for patients weighing less than 10 kg, oral midazolam 0.5 mg/kg for those weighing between 10 and 20 kg, and diazepam 5 mg for patients weighing more than 20 kg.

Anaesthetic Technique

Upon arrival in the operating room, standard monitoring including electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry (SpO_2) was applied, and baseline vital parameters were recorded. All patients were preoxygenated with 100% oxygen at a flow rate of 10 L/min for 3 minutes using an appropriately sized face mask and a circle breathing system.

General anesthesia was induced with intravenous propofol at a dose of 2 mg/kg. Analgesia was provided using fentanyl 2 µg/kg intravenously, and neuromuscular blockade was achieved with atracurium 0.5 mg/kg. Adequate depth of anesthesia was confirmed by loss of eyelash reflex and decreased mandibular tone.

Intervention (i-gel Insertion Technique)

An appropriately sized i-gel® device was selected based on the patient's body weight and inserted by an experienced consultant anesthesiologist in the sniffing position according to the manufacturer's instructions. A water-based lubricant was applied to the device prior to insertion. The i-gel was introduced along the hard palate with gentle continuous pressure until resistance was felt.

A maximum of three attempts at insertion was permitted. If insertion was unsuccessful after three attempts, an alternative airway device was to be used. Any additional maneuvers required to facilitate insertion, including jaw thrust, chin lift, head extension, or neck flexion, were recorded.

Correct placement of the device was confirmed by bilateral chest expansion, auscultation, and square waveform capnography.

Ventilation Protocol

Following successful insertion, patients were ventilated using pressure-controlled ventilation. Tidal volume was maintained at 6–8 mL/kg, and respiratory rate was adjusted to maintain end-tidal carbon dioxide ($EtCO_2$) between 35 and 40 mmHg.

Outcome Measures

Primary Outcomes

The primary outcomes assessed were:

- Ease of i-gel insertion
- First-attempt success rate

Ease of insertion was graded as follows:

- Grade 1 (very easy): no additional maneuver required
- Grade 2 (easy): one additional maneuver required
- Grade 3 (difficult): more than one maneuver required

Secondary Outcomes

Secondary outcomes included:

- Fiberoptic view of the larynx
- Ease of gastric tube insertion
- Hemodynamic changes during insertion and removal
- Incidence of perioperative complications

Fiberoptic view was graded according to the Cook and Cranshaw classification:

- Grade 1: clear view of laryngeal structures
- Grade 2: partial view with epiglottis partially obscuring the larynx
- Grade 3: only epiglottis visible

Data Collection

Hemodynamic parameters, including heart rate and blood pressure, were recorded at baseline, during insertion of the device, during removal, and three minutes after each event. The number of insertion attempts, need for manipulations, fiberoptic grading, and ease of gastric tube insertion were documented.

Patients were monitored throughout the intraoperative and immediate postoperative period for complications such as airway trauma, blood staining of the device, desaturation, bronchospasm, laryngospasm, aspiration, coughing, sore throat, and hoarseness.

Statistical Analysis

Data were recorded and entered into a structured proforma. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Hemodynamic parameters at different time points were compared with baseline values using appropriate statistical tests. A p-value of <0.05 was considered statistically significant.

Results

In this study of 100 pediatric patients, the i-gel® demonstrated a high success rate and excellent performance as a supraglottic airway device. The first-attempt insertion success rate was 98%, with 90% of insertions achieved without the need for additional maneuvers. Fiberoptic evaluation confirmed optimal positioning in 88% of cases, and adequate ventilation was maintained in all patients irrespective of device position.

Hemodynamic parameters remained stable during insertion and removal of the device, with no statistically significant deviations from baseline. Gastric tube insertion was easy in most cases and correlated with proper device positioning.

Importantly, no perioperative complications such as airway trauma, desaturation, laryngospasm, bronchospasm, aspiration, or postoperative airway morbidity were observed. The device also remained stable without displacement during intraoperative change in position for surgery.

Overall, the i-gel® proved to be a safe, effective, and reliable airway device in pediatric patients undergoing general anesthesia with controlled ventilation

Discussion

The present study demonstrates that the i-gel® is an effective and reliable supraglottic airway device in pediatric patients undergoing general anesthesia with controlled ventilation. The device showed a high first-attempt success rate, ease of insertion, stable hemodynamic profile, and minimal complications.

The pediatric i-gel is a modification of the adult i-gel, specifically designed to accommodate the anatomical characteristics of the pediatric airway. One of its most significant advantages over first-generation supraglottic airway devices, such as the LMA Classic™, is the presence of a gastric drainage channel. This feature plays an important role during positive pressure ventilation by reducing the risk of gastric insufflation and aspiration, while also allowing passage of a gastric tube.[6]

In the present study, the first-attempt insertion success rate was 98%, which is comparable to previously published data. Lee et al.[7] reported first-attempt success rates of 28/30 with i-gel, compared to 26/30 and 27/30 with ProSeal LMA and Classic LMA, respectively.

Similarly, other studies have demonstrated first-attempt success rates ranging from 80% to over 90%, with near 100% success after a second attempt. These findings support the high reliability and ease of insertion associated with the i-gel.

Ease of insertion was another notable finding in our study, with 90% of insertions categorized as very easy and the remaining requiring only a single maneuver, most commonly jaw thrust. No patient required more than one maneuver, and no failed insertions were encountered. This is consistent with previous studies, where the majority of insertions were reported as easy or very easy, and minimal manipulation was required. The absence of a cuff inflation step further simplifies the insertion process and reduces the learning curve, making the device particularly useful in pediatric airway management.

Fiberoptic assessment in our study demonstrated optimal positioning (Grade I) in 88% of patients, which is comparable to previous reports showing complete or partial visualization of vocal cords in up to 97% of cases. Importantly, even in cases with suboptimal positioning (Grade II and III), adequate ventilation was achieved, indicating that effective airway sealing is maintained despite minor positional variations.[7]

The ease of gastric tube insertion observed in our study correlated well with proper positioning of the device. In most cases, the gastric tube could be inserted without resistance, which is consistent with existing literature suggesting that successful gastric tube placement is an indirect indicator of correct device positioning. The presence of a drain tube also serves as an additional safety feature by reducing the risk of aspiration.

Concerns have been raised in the literature regarding possible displacement of the i-gel during surgery or patient repositioning. However, in our study, no displacement was observed, even after repositioning for surgical procedures or caudal anesthesia. This finding aligns with studies comparing the i-gel with ProSeal LMA, which have shown similar stability profiles between the two devices.[8]

The incidence of complications in our study was negligible. No cases of airway trauma, blood staining, desaturation, laryngospasm, bronchospasm, aspiration, or postoperative airway morbidity were observed. These findings are in agreement with previous studies reporting a low incidence of complications with i-gel use in pediatric patients. The soft, gel-like cuff and absence of inflation contribute to reduced mucosal trauma and postoperative discomfort.[5]

Overall, the findings of this study reinforce existing evidence that the i-gel is a safe, efficient, and user-friendly airway device in pediatric anesthesia. Its high success rate, ease of use, minimal complication profile, and added safety features make it a valuable alternative to traditional supraglottic airway devices.

Conclusion

The i-gel® is a safe and effective supraglottic airway device in pediatric patients, demonstrating high first-attempt success rates and ease of insertion. It provides adequate ventilation with stable hemodynamics and minimal complications. Its reliability and favorable safety profile make it a valuable choice for airway management in children undergoing general anesthesia.

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