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CLINICAL REPORT

An evaluation of the I-gel supraglottic airway in 70 pediatric patients

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Abstract The I-gel is a supraglottic airway device which is commonly used in adult patients undergoing general anesthesia. In this study, we evaluated the speed of insertion, adequacy of ventilation, leak pressure, gastric tube insertion, and problems when using the I-gel in children. We included 70 patients aged between 1 and 16 years old with ASA physical status classification I or II, undergoing elective surgery requiring general anesthesia, for which use of a supraglottic airway would be appropriate. The overall insertion success rate was 96 % with a median insertion time of 25 (18–34) [7–100] s. Seventeen patients (24.3 %) experienced problems including the need for change of airway device, laryngospasm, device displacement, blood on device after removal, and postoperative sore throat. In conclusion, there was a moderate rate of problems when using the I-gel in children, and it was necessary to change the airway in a few patients to optimize ventilation.

Keywords I-gel supraglottic airway · Pediatrics · Elective surgery · Airway complications

Introduction

The I-gel (Intersurgical Ltd., Wokingham, Berkshire, UK) is a supraglottic airway device that has been used in adult patients since 2007. Pediatric-sized I-gels were developed in 2009. The I-gel's novel feature is its cuff, which is made of medical grade thermoplastic elastomer, and does not require inflation with air. This allows an airtight seal over the perilaryngeal structure to be achieved without causing compression trauma. The I-gel has a channel for gastric tube insertion (except for size 1), and an integral bite block [1].

The safety and effectiveness of supraglottic airway devices, especially laryngeal mask airways, for airway management in children undergoing general anesthesia is well established [2]. As there is relatively little pediatric data on the I-gel, we evaluated the insertion, ventilation, and problems when using the I-gel in children having general anesthesia for elective surgery.

Case series

This study was approved by the local Domain-Specific Review Board (DSRB). We included children aged between 1 and 16 years with American Society of Anesthesiologists physical status classification (ASA) I or II, undergoing any elective surgery requiring general anesthesia, for which use of a supraglottic airway would be appropriate. Patients with known lung disease, increased risk of aspiration, and potential difficult airway management were excluded. Informed consent was obtained from parent or legal guardian of the child. Patients were fasted from solids and milk for at least 6 h. Clear fluids were allowed up to 2 h before induction of anesthesia. The anesthetic management of every patient was determined by the principal anesthesiologist.

We used I-gel sizes 1.5, 2, 2.5, 3 and 4 in this study. The size of the I-gel was selected based on patient's body

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Table 1 Patient characteristics and types of surgery

Patient characteristics	Total patients ($N = 70$)
Male: female	49 (70 %): 21 (30 %)
Age, years	7.5 (5–11) [1–16]
Weight, kg	25.1 (16.5–34.9) [7.4–92.6]
ASA class I: II	53 (76 %): 17 (24 %)
Types of surgery	
General surgery and urology	37 (53 %)
Orthopedics	16 (23 %)
Plastics	9 (13 %)
Ear, nose and throat	6 (8 %)
Ophthalmology	2 (3 %)
Duration of surgery, min	30 (20–45) [10–150]

Data presented as number of patients or surgeries (percentage) or median (interquartile range) [range] for continuous variables

ASA class American Society of Anesthesiologists physical status classification

weight, in accordance with the manufacturer's recommendation [1]. We defined an insertion attempt as starting from removal of the facemask to insertion of the I-gel into the oropharynx. A failed attempt was recorded if the I-gel had to be removed, and the next insertion was recorded as a second attempt. We limited insertions to three attempts, after which we changed to either a laryngeal mask airway or tracheal tube, and considered I-gel use a failure.

We measured the time for I-gel insertion as the time from picking up the device to confirmation of successful insertion and adequate ventilation, as defined by tidal volume ≥8 ml/kg, presence of normal capnography waveform, and absence of a leak. A leak would be detected as audible leak from the mouth, or sensation of a thrill when palpating the patient's neck. Leak pressure was measured by closing the expiratory valve on the anesthesia machine (using a closed circle system), and setting the fresh gas flow at 3 l/min until equilibrium was achieved. The inflation pressure was limited to 40 cmH_2O. The principal anesthesiologist would decide if a gastric tube was necessary and check its correct placement whenever one was inserted.

We noted these data: age, weight, gender, ASA physical status; type and duration of surgery; I-gel size; number of insertion attempts; time taken for insertion; peak airway pressure to achieve adequate ventilation; leak pressure; and the ease of insertion of the gastric tube when one was used. We also noted any problems such as laryngospasm, I-gel displacement, desaturation below 92 %, blood staining on the I-gel at removal, and oral or dental trauma. Children aged ≥6 years were interviewed in the post anesthesia care unit (PACU) for problems such as sore throat, dysphagia and hoarseness.

We recruited 70 patients in total. The patients' characteristics and operations are in Table 1. Table 2 summarizes the insertion and ventilation data with the different I-gel sizes. The overall success rate of I-gel usage was 96 % (67

Table 2 Insertion success, insertion time, peak airway pressure, leak pressure, mode of ventilation, and success of nasogastric tube insertion for each size of I-gel used

	Size 1.5 ($N = 9$)	Size 2 ($N = 28$)	Size 2.5 ($N = 16$)	Size 3 ($N = 14$)	Size 4 ($N = 3$)	Total ($N = 70$)
Insertion success						
1st attempt	7 (78 %)	25 (89 %)	14 (88 %)	13 (93 %)	1 (33 %)	60 (86 %)
2nd attempt	2 (22 %)	2 (7 %)	0	1 (7 %)	2 (67 %)	7 (10 %)
Failed insertion	0	1 (4 %)	2 (12 %)	0	0	3 (4 %)
Insertion time (s)	25 (20–35) [20–60]	25 (18–30) [10–40]	30 (25–35) [11–60]	17 (13–36) [7–50]	40 (28–70) [15–100]	25 (18–34) [7–100]
Mode of ventilation						
Controlled ventilation	4 (44 %)	12 (43 %)	9 (56 %)	10 (71 %)	2 (67 %)	37 (55 %)
Spontaneous ventilation	5 (56 %)	15 (57 %)	5 (44 %)	4 (29 %)	1 (33 %)	30 (45 %)
Peak airway pressure to achieve tidal volume of 8 ml/kg, cmH_2O	12 (10–13) [8–20]	12 (10–13) [7–19]	12 (11–13) [10–16]	14 (12–16) [8–20]	13 (12–14) [11–15]	12 (11–14) [7–20]
Leak pressure, cmH_2O	30 (25–30) [25–30]	25 (23–28) [20–35]	25 (24–26) [20–40]	26 (22–28) [20–32]	28 (24–28) [20–28]	25 (23–28) [20–40]
Nasogastric tube insertion						
1st attempt	9	25	11	9	3	57
2nd attempt	0	0	0	1	0	1
Not attempted	0	2	3	4	0	9

Data presented as number of patients (percentage) or median (interquartile range) [range] for continuous variables

Table 3 Complications related to use of the I-gel airway device

Complications	Number of events (%)
Change of device to laryngeal mask airway	3 (4)
Laryngospasm	2 (3)
Coughing during insertion	1 (1)
Displacement of device intraoperatively	1 (1)
Inadequate ventilation due to leak	1 (1)
Blood on device at removal	6 (9)
Sore throat after removal	6 (9)

Data presented as number of events (percentage of total patients)

out of 70 patients). The median time for insertion was 25 (18–34) [7–100] s and adequate ventilation was achieved with a median peak pressure of 12 (11–14) [7–20] cmH_2O. The median oropharyngeal leak pressure was 25 (23–28) [20–40] cmH_2O. A change in I-gel size was required in 4 patients to optimize ventilation. Gastric tube insertion was performed in 58 patients and insertion was successful in all.

We note the problems encountered in Table 3. Three patients required a change to laryngeal mask airways after three failed attempts to achieve a patent airway and gas seal with the I-gel. Small amounts of blood staining were noted on the I-gel after removal in six patients. Six patients had mild sore throat. None of the patients had tongue, lip or dental trauma. The I-gel was displaced in one patient having eyelid surgery but this did not affect ventilation during surgery. In another patient, adequate positive pressure ventilation could not be achieved due to a leak, likely caused by displacement of the I-gel during head positioning. This leak occurred despite an oropharyngeal leak pressure of 28 cmH_2O prior to positioning. The I-gel was not removed as the patient started breathing spontaneously and had adequate ventilation.

Discussion

Our study showed that the I-gel can be used effectively in pediatric patients for elective general surgical procedures, although change of airway devices may be required in a small proportion of patients. The 96 % overall success of usage and insertion times (25 s) in our series are comparable with earlier studies [3–7]. Beylacq et al. (2009) reported an overall insertion success rate of 100 % and low complication rate of 14 % with the size 3 I-gel in 50 pediatric patients [3]. Hughes et al. reported a success rate of 95.5 % and median insertion time of 14 s in a study of 154 children [5]. In our study, there were minor differences in the insertion times for different sizes of I-gel, although this could be due to the need for second insertion attempts in a few patients.

The lack of a horizontal line to indicate optimal positioning on the integral bite block of a pediatric I-gel as compared to an adult could cause difficulty in optimal positioning of the I-gel in children. Our results showed that adequate ventilation and normocapnia were achieved with airway pressures of 12 cmH_2O in 37 (55 %) of our patients who had pressure controlled ventilation, comparable to the peak pressures of 13 cmH_2O in two studies [3, 7].

In our patients, the median oropharyngeal leak pressure, which reflects the effectiveness of gas seal within the upper airway, was 25 cmH_2O. This compares favorably with that reported for laryngeal mask airways: LMA Classic (12.5–18 cmH_2O) [8–10], LMA Supreme (19–22 cmH_2O) [11, 12], and LMA ProSeal (25–33 cmH_2O) [13–15], and consistent with earlier I-gel reports of 20–28 cmH_2O [3–7, 16]. Despite this, our study showed that leaks can still occur during surgery, especially if the device is moved.

The rigid stem of the I-gel may partially obstruct the surgeon's hands during eye or nose surgery and the surgeons may inadvertently shift the I-gel. Also, the rigidity and length of the stem, relative to the size and conical shape of a child's hypopharynx, may result in easier displacement of I-gel during head positioning, compared to adults. These displacements can potentially lead to airway obstruction [4, 5]. The manufacturer recommends bimaxillary taping after I-gel insertion to prevent displacement [1, 4, 5].

In our series, we had included all problems as part of the overall complication rate of 24.3 % to truly reflect what may be encountered with the use of I-gel in children. A wide range of complication rates has been reported: 5.7–23 % for I-gel [3–6] and 11.5–42 % for other supraglottic airway devices [2, 15, 17, 18]. The rates of blood staining of the I-gel noted at removal (8.6 %) and postoperative sore throat (8.6 %) are comparable to previous studies of the I-gel (3–7 %) [4, 5], and LMA ProSeal and LMA Classic (3–9 %) [14, 19]. However, the severity of blood staining is much less than we have observed with the LMA ProSeal in children.

There are several limitations in this small study of 70 patients. Firstly, only ASA I and II patients having elective surgery were included. Secondly, all the I-gel insertions were carried out by anesthesiologists with at least 5 years of experience and considerable prior experience with other supraglottic airway devices. Less experienced users may encounter more or different complications. Thirdly, the size 1 I-gel was not used in this study, as our very small patients required tracheal intubation for their surgery. Thus, we cannot definitively conclude about the safety and efficacy of I-gel in all pediatric patients.

In summary, we found that the I-gel airway can be used to achieve a patent airway and adequate ventilation within a short time in children. There was a moderate rate of

problems, and it was necessary to change to an alternative device in a small proportion (4 %) of patients.

Conflict of interest The authors have no competing interests or external funding to declare.

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