

## ORIGINAL RESEARCH

## AMBULATORY ANESTHESIA

# Airway management with I-gel™ for ambulatory laparoscopic inguinal hernia repair in children; a retrospective review of 230 cases

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## Abstract

**Background:** Inguinal hernia is one of the most common conditions presented for surgical repair in children and laparoscopic approaches are increasingly performed. Previous studies have shown safety and efficacy in the use of supraglottic devices (SGD) as an alternative to tracheal intubation, which fits particularly well with outpatient anesthesia.

**Methodology:** we conduct a retrospective observational study, collecting data from the electronic anesthetic form, from all patients aged 0 to 17 y who underwent ambulatory laparoscopic percutaneous internal ring suturing between February 2015 and August 2019, if I-gel™ was used to airway management.

**Results:** We found 230 patients meeting the inclusion criteria. The mean age was 5.2 y old, mean weight 20.1 kg. All patients were ASA I (n=203) or ASA II (n=27). The mean surgery duration was 38 minutes. We found 4 respiratory adverse events, three bronchospasms, and one laryngospasm, managed in the operating room. Ninety percent of the surgeries were performed without neuromuscular blockade.

**Conclusion:** I-gel™ was a safe, effective, and convenient alternative to airway management to laparoscopic inguinal hernia repair in the ambulatory setting. According to available literature, our practice did not represent an increased risk for the studied respiratory events. SGD obviates the need for neuromuscular blockade.

**Key words:** I-gel; Supraglottic devices; Laparoscopy; Inguinal hernia repair; Pediatrics; Anesthesia, ambulatory

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## 1. Introduction

Inguinal hernia (IH) is one of the most common conditions presented for surgical repair in the pediatric population, accounting itself for more than 15% of surgical interventions<sup>1</sup>. Its incidence has been reported to be 0.8 to 4.4% in children of all ages<sup>2</sup>.

In recent years, we have witnessed the increasing development of minimally invasive surgical techniques and its increasing use in clinical practice.

Some of those surgical techniques, such as percutaneous internal ring suturing (PIRS), allow shorter surgical duration and lower insufflation pressures<sup>3</sup>, raising questions about the need for endotracheal intubation and neuromuscular blockade.

Previous studies have shown safety and efficacy in the use of supraglottic devices (SGD) as an alternative to tracheal intubation in pediatric laparoscopic surgeries based on intragastric pressure, risk of aspiration, and ventilation parameters.<sup>4,5,6,7</sup> However, in a survey of

practice patterns among pediatric anesthesiologists, only 6.21% of respondents use SGD in laparoscopic procedures<sup>8</sup>.

SGD fits particularly well with outpatient anesthesia. The use of SGD has proved to reduce the incidence of postoperative desaturation, laryngospasm, cough, breath-holding, sore throat, and the post-anesthesia care unit duration of stay when compared with endotracheal tube.<sup>9,10</sup> SGD insertion may be less stimulating, better tolerated at lighter levels of anesthesia, and usually doesn't require neuromuscular blockade, potentially decreasing morbidity and the side effects of hypnotics, opioids, neuromuscular blocking drugs, and its antagonists.

Our objective is to report our experience in airway management using I-gel™ during elective laparoscopic repair of inguinal hernia by PIRS technique. Our primary outcome is the incidence of observed respiratory adverse events and the secondary outcome is the use of neuromuscular blocking drugs.

## 2. Methodology

This retrospective observational study was conducted after obtaining the approval of the hospital's ethics committee, complying with the principles of the Declaration of Helsinki.

Patients aged 0 to 17 y who underwent PIRS in ambulatory settings between February 2015 and August 2019 were included if the selected airway device was I-gel™. We didn't exclude any patients.

### 2.1. Anesthesia technique and patient monitoring

Due to the retrospective nature of the study, there was not a standard protocolized anesthetic technique. Premedication, type of induction, and timing for device placement were variable and an anesthesiologist's option. It is common practice in our unit to place a gastric tube through the I-gel™. The fasting protocol applied in our institution during the recruitment period was 6 hours for light meals, 4 hours for breast milk, and 2 hours for clear liquids. Monitoring was performed according to basic anesthetic ASA standards.

### 2.2. Data collection

Data were collected from electronic anesthetic form, which included patient demographics, anesthetic

technique, surgical times (induction, skin incision, skin closure, the end of anesthesia), timing and dosage of administered drugs, airway devices, and any occurred complications during the procedure. The computerized system automatically records real-time vital signs.

### 2.3. Outcome measures

We defined primary outcomes; all respiratory adverse events, namely regurgitation, aspiration, laryngospasm, bronchospasm, airway obstruction, and conversion to an endotracheal tube. Adverse events were identified reviewing the medical records from the anesthetic computerized forms, either actively registered by the anesthesiologist or automatically registered desaturation associated with pharmacological intervention, namely bronchodilators, corticosteroids, or succinylcholine.

The secondary outcome was the administration of neuromuscular blocking drugs.

### 2.4. Surgical technique

The surgical technique was always PIRS. Pneumoperitoneum was established with an initial pressure of 8 cmH<sub>2</sub>O and variable Trendelenburg position adjusted to surgical demands.

## 3. Results

Over a period of 4.5 y, 230 pediatric laparoscopic IH repairs were performed in our ambulatory unit using I-gel laryngeal mask, 31 of which with associated hydrocele. There were 145 males and 85 females. The mean age was  $5.2 \pm 3.5$  y old (range 2.5 months - 17 y), mean weight  $20.1 \pm 10.6$  kg (range 5 – 68 kg). All patients were ASA I (n=203) or ASA II (n=27). Surgery duration ranged from 16 to 77 min, being the mean  $38 \pm 15$  min (Table 1).

Seventy-six percent of patients were submitted to surgery under general anesthesia, while 56 patients had combined anesthesia with caudal block (n=30) or rectus sheath block (n=26) (Table 1).

We found four adverse events. Three children developed bronchospasm, a two-year-old male after induction, a one-year-old female during maintenance, and a three-year-old male on-emergence. All cases were solved with pharmacological intervention, namely salbutamol and hydrocortisone. One laryngospasm was registered in a seven-year-old male, ASA I, 10 min before skin closure, with the need for endotracheal intubation. There were not any cases of

observed regurgitation or aspiration. The identified complications were managed in the operating room, the recovery was uneventful, and the children were discharged home on the same day.

Ninety percent of the surgeries were performed without neuromuscular blockade. Rocuronium was administered in 23 cases, in a mean dose of  $0.36 \pm 0.15$  mg/Kg (range 0.2 – 0.6 mg/Kg) (Table 1).

**Table 1: Data regarding demographic data, type of anesthesia and use of rocuronium of the studied population, n=230**

Parameter	N (%)	
Age (Mean $\pm$ SD)	5.2 $\pm$ 3.5	
Weight (Mean $\pm$ SD)	20.1 $\pm$ 10.6	
Gender	Male	145 (63)
	Female	85 (37)
ASA	I	203 (88)
	II	27 (12)
Type of anesthesia	General Anesthesia (GA)	174 (76)
	Combined: GA + epidural	30 (13)
	Combined: GA + nerve block	26 (11)
Rocuronium (0.36 $\pm$ 0.15 mg/kg)	Yes	23 (10)
	No	207 (90)
Surgery duration (Mean $\pm$ SD)	38 $\pm$ 15	

Although inpatient surgery is beyond the scope of this study, we found 8 patients submitted to laparoscopic IH repair whom airway was also successfully managed with I-gel. They were inpatients based on the recommendation for postoperative apnea monitoring because of their post-conceptual age at the time of the procedure.

## 4. Discussion

The most important finding of this case series is that over four and a half years and two hundred and thirty procedures, we did not find any serious complications. We identified three bronchospasms managed with pharmacological measures and one laryngospasm requiring endotracheal intubation. None of these

events led to long-term complications or delayed patient discharge.

Available literature point to an incidence of bronchospasm varying from 0.6 to 1.2%<sup>11,12</sup> and an incidence of laryngospasm from 0.5% to 14%<sup>11,12,13</sup> depending on risk factors in children under general anesthesia. According to these, our practice did not represent an increased risk for the studied respiratory events. Although no cases of pulmonary aspiration have been noticed, inferences of our practice on its occurrence cannot be taken in face of the low reported incidence (0.1%)<sup>10</sup> and the size of our sample.

PIRS is a minimally invasive technique for IH and communicating hydrocele repair in children. It has the advantage of diagnosing and treating contralateral hernia in the same surgical time, which can occur up to 22 and 32,7%.<sup>14,15</sup> Reported mean time of surgery varies from 14.3 to 20.5 minutes for unilateral and 20.4 to 26.4 minutes for bilateral hernia<sup>15,16</sup>, significantly lower than those in our study. This may be related to the learning curve for this procedure.

Clinical recommendations for SGD are continuously being updated, but its use in laparoscopic surgery remains to debate.<sup>8,17</sup> Despite endotracheal tube (ETT) being the gold standard of airway protection from aspiration of gastric contents, the incidence of pulmonary complications and ICU admission is not significantly different from SGD, as showed in a large retrospective analysis with over 60000 procedures with positive pressure ventilation.<sup>18</sup> In adults, SGD has been used in laparoscopic cholecystectomy and gynecological procedures<sup>19,20</sup> and a comparison between I-gel and ETT found no differences in complications and adequacy of positive pressure ventilation between groups.<sup>21</sup>

In laparoscopic pediatric surgery, Ozdamar *et al.*<sup>5</sup> compared the use of ETT and Classic LMA<sup>TM</sup>, demonstrating that the use of supraglottic devices did not significantly influence intragastric pressure, risk of gastric contents aspiration or ventilation parameters. Sinha *et al.*<sup>4</sup> found similar results using the ProSeal LMA<sup>TM</sup>. A recent comparative study between ETT and I-gel<sup>TM</sup> in laparoscopic procedures in pediatrics concluded that I-gel is comparable to ETT in terms of hemodynamics and adequacy of ventilation, being associated with less postoperative complications.<sup>7</sup>

I-gel™ is a second-generation SGD with airway leak pressure identical to other SGD in the pediatric population.<sup>22,23</sup> Measures to prevent aspiration must be guaranteed, namely respect for airway leak pressure, appropriate patient and SGD selection, as well as gastric tube placement.

The use of neuromuscular blockers (NMB) in laparoscopy is commonly thought to improve surgical conditions and prevent high intraabdominal and intrathoracic pressures. However, a large multicenter trial concluded that NMB are associated with an increased risk of postoperative pulmonary complications<sup>24</sup>. Previous studies using SGD in both adult<sup>25</sup> and children<sup>6</sup> in laparoscopic surgeries showed good surgical conditions, adequate ventilation, shorter anesthesia time, and faster recovery without using NMB. Airway management with SGD may obviate the use of NMB, reducing the associated morbidity and side-effects directly related to it or its antagonists.

The evidence supports that laparoscopic surgery is associated with lower levels of pain<sup>14,3</sup> and faster recovery. Also, airway management that avoids laryngoscopy will have, along with a lower incidence of respiratory adverse events, a possible reduction in the total opioid dose, minimizing its well-known side-effects. In our review, we found that the patients primarily managed with endotracheal intubation were the smaller infants, weighing less than 5 Kg, for whom we didn't have appropriate I-gel™ sizes with gastric access.

We analyzed only patients whose attendant anesthesiologist decided to use I-gel™. However, it is crucial to point out that they represent most patients, as this is the current practice in our unit. Tracheal intubation has been only performed in smaller infants for whom the I-gel size 1 is the adequate one, once it has no gastric access, and for patients who are expected not to fit well with SGD regardless of the procedure (for example obesity or cleft palate).

In this study, the mean procedure duration was 38 min, and the surgery performed under low insufflation pressure (8 cmH<sub>2</sub>O). Under these circumstances, we found a low rate of complications, namely three bronchospasms and one laryngospasm that were managed successfully in the intraoperative period, without compromising the procedure, recovery, or home discharge.

To our best knowledge, our report is the largest published case series of I-gel™ use in laparoscopic pediatric surgery.

Despite the recognized limitations, we believe that our results can be the basis for further prospective randomized studies, to validate the efficacy and safety of I-gel™ in selected patients and selected laparoscopic procedures and to assess its ideal conditions of application.

## 5. Limitations

Our study has several limitations. It was a retrospective, observational, and non-comparative study, so we did not measure intragastric pressures, peak inspiratory pressures or oropharyngeal leak pressures. We do not know if accurate methods to exclude regurgitation or aspiration, e.g., pH monitoring, was used. This factor made it difficult to estimate its exact incidence.

## 6. Conclusion

The use of laparoscopy in children has rapidly increased, and minimally invasive approaches have become the standard of care for many abdominal procedures. According to our experience, I-gel is a safe and convenient method for airway management in children submitted to laparoscopic short-lasting procedures with low insufflation pressures such as an inguinal hernia or communicating hydrocele repair using percutaneous internal ring suturing technique. It has special relevance in outpatients as it precludes the use of neuromuscular blocking drugs and allows lower doses of opioids, leading to a faster recovery.

## 7. Declaration of interests

The authors declare that they have no conflict of interest.

## 8. Authors' contribution

CH – concept, conduction of the study work, literature research, manuscript writing

VV, MJS – concept, conduction of the study work, manuscript editing

VA – conduction of the study work, literature research, manuscript writing

PA – conduction of the study work, literature research, data analysis

AR – conduction of the study work, manuscript writing

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