I-GEL LARYNGEAL MASK AIRWAY: AN EFFECTIVE SUPRAGLOTTIC AIRWAY FOR SPONTANEOUS BREATHING GENERAL ANESTHESIA IN NON-INTUBATED UNIPORTAL THORACOSCOPIC RESECTION

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ABSTRACT

Background and objective: *Pulmonary bullae can be resected via non-intubated uniportal video-assisted thoracoscopic surgery with a laryngeal mask airway (LMA). I-gel is a novel LMA that avoids invasion of the airway. This study compared the feasibility and safety of I-gel with the classic laryngeal mask airway (cLMA) in non-intubated uniportal thoracoscopic resection of pulmonary bullae.*

Methods: *Forty consecutive patients who underwent non-intubated uniportal thoracoscopic resection of pulmonary bullae were included in this prospective study. They were randomized into two equal groups: I-gel group (Group I) and classic LMA group(Group C). All patients received general anesthesia without muscle relaxants, allowing spontaneous breathing. I-gel or classic LMA of appropriate size for patients' weight was inserted. The time required for insertion, success rates of first insertion attempt, airway-leak pressure, and complications were recorded for each patient.*

Results: *The time required for insertion was significantly less for Group I patients (15.6 ± 4.9 s) than for Group C patients (27.3±12.6 s) (P=0.016). The success rate for first insertion attempt was significantly higher for Group I patients (16/20) than for Group C patients (4/20) (P=0.025). Airway-leak pressure was significantly higher for Group I patients (26.6±5.1 cm H2O) than for Group C patients (18.2±16.2 cm H_2O) (0.023). The incidence of operative complication (blood-tinged airway) and postoperative complication (sore throat) was higher for group C patients than for group I patients (P=0.015 and P=0.021, respectively).*

Conclusion: *I-gel is superior to classic LMA in several criteria for non-intubated uniportal thoracoscopic resection of pulmonary bullae under spontaneous breathing general anesthesia.*

Keywords: *I-gel, spontaneous breathing anesthesia, uniportal thoracoscopy, pulmonary bullae resection, thoracoscopy*

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Introduction

Non-intubated uniportal thoracoscopic resection of pulmonary bullae has been extensively improved in the recent years[1-3]. This minimally invasive approach has been reported to have fewer complications, shorter hospital stays, faster patient recovery, and improved patient satisfaction[1-3]. Also, general anesthesia without intubation has had fewer adverse effects, including ventilator-induced lung injury, coughing, and delayed muscle-relaxant effects[4].

Laryngeal mask airway (LMA) is a widely used supraglottic airway that has been used in non-intubated thoracoscopic surgery, such as treatment of pneumothorax, resection of pulmonary nodules, and lung lobectomy[5-6]. In recent years, I-gel has been introduced as a novel LMA, with easy-to-use and simple features. I-gel provides a firm seal, which protects against aspiration and provides effective ventilation during general anesthesia[7-8]; thus, I-gel is expected to be an alternative to classic LMA[7-8]. However, we are aware of no studies purporting advantages of I-gel in non-intubated uniportal thoracoscopic resection of pulmonary bullae under spontaneous ventilation. The aim of the present study was to compare the time required for insertion, success rates of first insertion attempt, airway-leak pressure, and complications of I-gel with those of classic LMA for airway management in non-intubated uniportal resection of pulmonary bullae in spontaneously ventilated anesthetized patients.

Patients and methods

Patients

The study was conducted in the department of anesthesiology in our hospital from January 1, 2016 to October 31, 2016. The study was approved by the Ethics Committee, and written informed consent was obtained from each patient. This prospective study was conducted on 40 patients of both sexes, aged 16 to 35 years and American Society of Anesthesiologists (ASA) class I~II, who were scheduled for uniportal thoracoscopic resection of pulmonary bullae under general anesthesia with spontaneous breathing.

The exclusion criteria were:

- ASA class III or IV;
- Significant acute or chronic lung disease;
- Known difficult airway;
- Potential difficult intubation (Mallampati score 3 or 4);
- Thyromental distance <60 mm;
- Mouth opening <35 mm) and risk of aspiration (body mass index [BMI] >35, gastroesophageal reflux disease, neuromuscular disease, pharyngeal dysfunction), and risk for conversion to open surgery. Randomization was performed with an envelope method.

After enrollment, the patients were randomly assigned to two equal groups of 20: I-gel group (Group I) and classic LMA group (Group C).

Operative methods

All patients fasted before surgery. Routine monitoring consisted of electrocardiography, heart rate, pulse oximetry, invasive blood pressure, and end-tidal CO_2. Patients were placed in the supine position with the head elevated slightly on a pillow. After preoxygenation with 100% oxygen, anesthesia was induced with intravenous propofol 2 mg/kg, sufentanil 0.4 μg/kg and dexmedetomidine 0.4 μg/kg (pump injection, more than 15 minutes). The I-gel or classic LMA was inserted with standard technique by a single experienced anesthesiologist (Yang Sun). Two sizes of LMAs were selected according to the patient's weight: size 3 for patients < 50 kg; size 4 for those between 50 and 90 kg. Anesthesia level was maintained with target-controlled infusion of propofol and remifentanil. The Narcotrend index was maintained between 40 and 50. During the operation, spontaneous ventilation was provided with 100% inspired oxygen. Surgeons performed an intercostal nerve block and vagal nerve block with 0.5% ropivacaine mixed with 1% lidocaine to relieve postoperative pain and reduce coughing. Two percent lidocaine was sprayed on the surface of the lung under thoracoscopic guidance.

A 2.5-cm incision, with a soft incision protector, was made at the 5th intercostal space between the median axillary line and the anterior axillary line. A thoracoscope and two laparoscopic instruments (Storz, German) were introduced through the incision. After stanching the bleeding and verifying no air leak, an 18F chest tube was positioned.

Leak pressure was measured with the expiratory valve of the circle system closed and 3L/min gas flowing until air-way pressure equilibrium was reached; gas leakage was recognized by hearing it at the mouth or seeing it coming out the drainage tube of the LMA. Other variables (age, sex, weight, BMI, heart rate, SpO_2, mean arterial pressure and end-tidal $CO)_2$ were recorded by a person blinded to the mask used. The resected specimen was usually extracted into a bag. After the operation, the LMA was removed when the patient regained consciousness and responded to a verbal command to open the mouth. Sore throat, blood adherent to the airway, and other complications were recorded after removing the LMA.

Statistical methods

Measurement data were analyzed for normal distribution with the two sample of student's t test. Categorized data among the groups was performed with the chi-square test. The Statistical Package for Social Sciences (SPSS/version 17) software was used for statistical analyses. Data were presented as mean ± SD.P values less than 0.05 were considered statistically significant.

Results

The two groups did not differ significantly in clinical characteristics: sex, age, BMI, PaO2, ASA score and operation time (P>0.05) (Table 1).

	Group I (n =20)	Group C (n = 20)	*P*-value
Sex (M/F)	11/9	10/10	0.51
Age (years)	25.5±8.9	26.2±9.7	0.95
BMI[1]	19.1±2.2	21.2±4.1	0.86
PaO_2 (mmHg)	89.9±8.3	91.2±7.8	0.83
ASA[2] score (I: II)	14:6	15:5	0.67
Operation time (min)	43±19.9	50±16.6	0.32

Table. 1: Patient demographic characteristics.
[1]Body mass index; [2]American, Anesthesiologists, Association.

Table 2 presents performance assessment of the two airways. The mean time required for successful insertion was significantly less in the I group than in the C group (P=0.016); the success rate of insertion at the first attempt was higher in group I than in group C (P<0.025); and airway-leak pressure was higher in group I than in group C (P=0.023).

	Group I (n = 20)	Group C (n = 20)	*P*-value
Time required for successful insertion (seconds)	15.6±4.9	27.3±12.6	0.016*
Successful insertion at first attempt	16	4	0.025*
Leak pressure (cm H_2O)	26.6±5.1	18.2 ±16.2	0.023*

Table. 2: Performance assessment of I-gel (Group I) and classic mask airway (Group C).
**Statistically significant difference (P<0.05).*

In Table 3, complications with the two airways are listed. Sore throat and blood-tinged equipment were statistically more frequent in the I group than in the C group (P=0.015 and 0.021, respectively). No statistically significant difference was found in hypoxia, regurgitation or laryngospasm.

	Group I (n = 20)	Group C (n =20)	*P*-value
Sore throat	1	14	0.015*
Blood-tinged airway	3	17	0.021*
hypoxia	0	0	0
regurgitation	4	4	1
laryngospasm	0	2	0.91

Table.3: Complications with I-gel (Group I) and classic laryngeal mask airway (Group C).
**Statistically significant difference (P<0.05).*

Discussion

In this study, we found that non-intubated uniportal thoracoscopy with I-gel LMA is technically feasible and safe for resection of pulmonary bullae. Traditionally, bronchial intubation with one-lung ventilation has provided a quiet operation field. However, risks, including tracheobronchial injuries, volutrauma, barotrauma, atelectasis, and even mortality, with this method are significant[9-10]. The first reported study of LMA anesthesia under spontaneous ventilation was performed by Rocco et al.;[11] they established that the technique could control the airway and provide adequate oxygenation. Subsequent studies have shown that LMA anesthesia saves time, is easier to perform and prevents complications compared with general anesthesia[12-14]. However, gas leakage, sore throat and other side effects were encountered with various types of LMA.

Before conducting the present study, we conducted preliminary experiments to evaluate the safety and effectiveness of I-gel LMA general anesthesia under spontaneous breathing for treatment of primary spontaneous pneumothorax. I-gel is a new, single-use, noninflatable supraglottic airway for use during spontaneous ventilation. Its perilaryngeal framework and epiglottis-like shape are major features of the airway. Also, a favorable seal is attained for spontaneously breathing patients because of the soft, gel-like, non-inflatable design[15]. Gabbot et al[16]. reported that the seal pressure with I-gel is better than that with other LMAs; they reported leak airway pressures of 24 to 30 cm H2O, which were like those we found. Conversely, we found the relatively low leakage pressure with classic LMA to be a disadvantage.

In this study, we found I-gel to be easily and rapidly inserted, even at the first attempt. Richez et al[17] found that success rate of first insertion to be 97%[17]; our rate was 80%. One study[18] has mentioned that there is no need to maneuver insertion of the I-gel. However, to improve the first success rate, we consider that the anesthesiologists may have an experience advantage, such as techniques for depressing the tongue by fingers and choosing the appropriate sizes of LMA for selected patients. Our research shows that success rate of first attempted passage of the classic LMA group is lower than that with I-gel. One reason for this resultE is that the body of classic LMA may be displaced after inflation.

Postoperative complications are important measures of ELMA performance. We found that I-gel causes minimal airway trauma during operations as evidenced by infrequent presence of blood on the airway after removal. The more frequent appearance of blood on the inflatable cuffs of classic LMA may indicate that they can cause mucosal injury during insertion or during operations. Hypoxia was not recorded in our patients treated with either I-gel or classic LMA, and the rates of regurgitation and laryngospasm were not significantly different; thus, it appears that the two airways performed similarly according to these criteria, although differences have been reported by others[19-20].

Our study has limitations: First, Ewe studied only patients with normal airway and low risk (ASA I–II). Thus, our results may not apply to patients with

difficult airways or to high-risk Epatients. Second, the anesthesiologist had more experience with classic LMA than with I-gel, which may have biased the results; if it did, though, it would have led to more favorable results with the classic LMA. Third, the study is a small study, but resection of bullae is not a common operation, so study of large populations with this indication may be difficult to achieve.

In conclusion, I-gel laryngeal mask airway is superior to classic laryngeal mask airway in time required for insertion, success rates of first insertion attempt, airway-leak pressure, and complications for non-intubated uniportal thoracoscopic resection of pulmonary bullae operated with spontaneous-breathing general anesthesia. Whether the observed advantages of I-gel laryngeal masks will apply to other kinds of operation should be tested.

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