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COMPARISON OF THE I-GEL WITH THE CUFFED TRACHEAL TUBE IN GYNECOLOGICAL LAPAROSCOPIC SURGERY DURING PRESSURE-CONTROLLED VENTILATION

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СРАВНЕНИЕ ЛАРИНГЕАЛЬНОЙ МАСКИ I-GEL И ЭНДОТРАХЕАЛЬНОЙ ТРУБКИ ПРИ ОБЩЕЙ АНЕСТЕЗИИ С ИСКУССТВЕННОЙ ВЕНТИЛЯЦИЕЙ ЛЕГКИХ В ЛАПАРОСКОПИЧЕСКОЙ ГИНЕКОЛОГИИ

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Ларингеальная маска i-gel — надгортанный воздуховод второго поколения без раздувной манжеты, особенностями которой является удобство и простота в использовании, меньшая выраженность гемодинамической реакции на установку, а также наличие канала для дренирования желудка, что значительно снижает риск аспирации.

Проведена сравнительная оценка утечки дыхательной смеси во время ИВЛ при общей анестезии с использованием i-gel и эндотрахеальной трубки в эндоскопической гинекологии.

Нами обследовано 58 пациенток (ASA I–II, 18–75 лет), которым была проведена общая анестезия в условиях ИВЛ в режиме контроля по давлению при выполнении лапароскопических вмешательств. Разделение на 2 группы (n=29) было проведено в зависимости от выбора метода поддержания проходимости верхних дыхательных путей: i-gel и эндотрахеальная трубка. Был осуществлен сравнительный анализ утечки дыхательной смеси в обеих группах.

Согласно результатам нашего исследования, не было достоверной разницы между объемом и фракцией утечки при проведении ИВЛ во время анестезии в лапароскопической гинекологии, что позволяет использовать ларингеальную маску i-gel в качестве разумной альтернативы эндотрахеальной трубке.

Ключевые слова: i-gel, лапароскопическая гинекология, общая анестезия.

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Background. Laparoscopy is one of the most common surgical procedures performed by gynecologists. Although the ideal role of laparoscopy in gynecologic surgery continues to be defined, it has become a standard approach for a numerous gynecologic procedures. The i-gel is a novel device that differs from other supraglottic airway devices in that it has a softer and a non-inflatable cuff. Our study was assess whether the i-gel is suitable to provide pressure-controlled ventilation (PCV) during anesthesia in laparoscopic surgery by measuring the gas leaks and comparing these values with that of the tracheal tube.

Methods. 58 female patients (ASA I–II, 18–75 years) undergoing elective gynecological laparoscopic surgery in the lithotomy position were studied. Patients were allocated into two groups: airway management in one group was conducted with a tracheal tube (n=29), and in the other one — with an i-gel (n=29). The lungs were then ventilated using PCV (15 mm H₂O). The difference between the inspired and expired tidal volumes was used to calculate the leak volume. The leak fraction was defined as the leak volume divided by the inspired tidal volume.

Results. There was no significant difference between the leak fractions of the i-gel and the tracheal tube at 15 mm H₂O PCV.

Conclusions. We suggest that the i-gel can be used as a reasonable alternative to tracheal tube in gynecological laparoscopic surgery during PCV with moderate airway pressures.

Key words: i-gel, gynecological laparoscopic surgery, general anesthesia.

During the last 35 years, gynecologic laparoscopy has evolved from a limited surgical procedure used only for diagnosis and tubal ligations to a ma-

ajor surgical tool used to treat a multitude of gynecologic indications. Today, laparoscopy is one of the most common surgical procedures performed by gynecolo-

gists. For many procedures, such as removal of an ectopic pregnancy, treatment of endometriosis, or ovarian cystectomy, laparoscopy has become the



treatment of choice. As compared to laparotomy, multiple studies have shown laparoscopy to be safer, less expensive, and having a shorter recovery time. Laparoscopy is one of the most common surgical procedures performed in the world today. In addition to diagnostic laparoscopy, operative endoscopy is used to perform common procedures, including removal of ectopic pregnancy, treatment of endometriosis, and pelvic adhesiolysis. Almost one third of the 600,000 hysterectomies performed annually in the United States are now performed with the aid of a laparoscope. Although the ideal role of laparoscopy in gynecologic surgery continues to be defined, it has become a standard approach for a large number of gynecologic procedures.

The laryngeal mask airway (LMA) is a supraglottic airway device developed by a British anesthesiologist Dr. Archie Brain. The classic laryngeal mask airway was introduced into clinical practice in 1988 it had been purchased by almost every hospital in the UK by 1989. Over the next few years, anesthetists widened the indications for its use dramatically. Since that revolution, although there have been numerous attempts to compete with the LMA further progress has largely been by evolution [1]. Dr Brain's LMA was introduced into clinical practice in 1988 and has an enormous body of evidence to support its use: both in terms of efficacy and safety. There are over 2500 articles and more than 270 million uses. The majority of general anesthesia's are now delivered with a supraglottic airway device maintaining the airway.

The i-gel (Intersurgical, Wokingham, UK) is a novel SAD designed by UK anesthetist, Muhammad Nasir. It has a soft, gel-like, non-inflatable cuff, designed to provide an anatomical, impression fit over the laryngeal inlet. The shape, softness and

contours accurately mirror the perilaryngeal anatomy. This innovative concept mean that no cuff inflation is required [2].

The i-gel has the following features:

1. Cuffless: the mask is made of a soft polymer and is shaped similarly to an inflated LMA posteriorly with its anterior shape designed to "fit the perilaryngeal structures" [3; 4].
2. Oesophageal drain tub.
3. Integral bite block.
4. Short, wide-bore airway tube.

Several design features suggest that the i-gel will decrease aspiration risk:

1. Increased pharyngeal leak pressure reduces leak fraction during ventilation, reducing the risk of gastric inflation.
2. The drain tube vents any gas leaking into the oesophagus, reducing the risk of gastric inflation.
3. Should regurgitation occur, the drain tube vents fluid and small solids beyond the pharynx. This reduces the risk of aspiration and its appearance in the drain tube alerts the anesthetist to the existence of regurgitation.

There has been only one case of aspiration with the i-gel reported in the literature. Our study was designed to assess whether the i-gel is suitable to provide pressure controlled ventilation (PCV) during anesthesia in gynecological laparoscopic surgery by measuring the gas leaks and comparing these values with that of the tracheal tube.

Methods

Our study was performed in University clinic of the Odessa National Medical University. 58 female patients (American Society of Anesthesiologists grade I-II, 18-75 years) undergoing elective gynecological laparoscopic surgery (diagnostic, uni- and bilateral ovarian resection, ovarian cyst resection, endometriosis resection, laparoscopically-assisted vaginal hysterectomy) in the lithotomy position were studied. The exclusion

criteria were presence of any significant acute or chronic lung disease, pathology of the neck or upper respiratory tract, potential difficult intubation, an increased risk of aspiration (hiatus hernia, gastroesophageal reflux, full stomach), BMI > 35 kg/m². Patients were randomly allocated into two equal-sized groups: airway management in one group was with a tracheal tube (n=29), and in the other — with an i-gel (n=29). We used the LEON anesthetic machine ("Heinen and Löwenstein") with its built-in pressure gauge and spirometer attachment for the study. Before induction of anesthesia, the anesthetic machine and circuits were checked as per manufacturer's guidelines. Intravenous access was secured and standard monitors were attached (pulsoximetry, noninvasive blood pressure monitoring, electrocardiography, capnography). After preoxygenation, anesthesia was induced with propofol (2.5-3.0 mg/kg⁻¹) and fentanyl (1-4 mkg/kg⁻¹). On loss of verbal contact, the anesthetist checked that the patient could be hand-ventilated with a face-mask. A bolus dose of atracurium (0.4-0.5 mg/kg⁻¹) was then given. The anesthetist then inserted the i-gel in accordance with manufacturer's guidelines [5; 6]. Size selection of the i-gel depended on patient weight: size 3 was used for patients 50 kg, size 4 was used for those between 50 and 90 kg, and size 5 was used for those over 90 kg in weight [7]. Adequate placement of the device was assessed by auscultation, gently squeezing the reservoir bag and observing the end-tidal carbon dioxide wave form and chest movements [8; 9]. Tracheal intubation involved obtaining the best possible view of the vocal cords using a Macintosh laryngoscope blade, and inserting the tracheal tube through the vocal cords into the trachea. Any blood staining on the laryngoscope, tracheal tube or i-gel was documented [10]. Once a clear airway was



established, the lungs were ventilated at pressure (15 mm H₂O) using PCV at a rate of 15 bpm and an inspiratory-to-expiratory ratio of 1:2 with no positive end expiratory pressure. Inspired and expired tidal volumes (ETVs) were recorded. The difference between inspired tidal volume (ITV) and ETV was used to calculate leak volume (LV), i. e. LV = ITV – ETV. The aim of our study was evaluation of difference in the leak volume and leak fraction between two airway devices under investigation. The leak fraction was defined as leak volume divided by ITV (i. e. leak fraction LV/ITV).

Results and their Discussion

There were no important differences in demographic and anesthetic data (Table 1).

There was no statistically significant difference between the leak volumes and the leak fractions of the i-gel and the tracheal tube (Table 2).

The tracheal tube is conventionally used to ventilate the lungs of the patients during anesthesia, therefore any alternative device should be compared with this “gold” standard. There are several well-established advantages of using i-gel compared with a tracheal tube. The major ones include lower incidence of sore throat, less hemodynamic upset during induction and maintenance of anesthesia, better oxygenation during emergence. Therefore, recently there has been a trend towards substituting an i-gel for a tracheal tube for controlled ventilation in patients with a minimal risk of aspiration. Absence of an inflatable cuff in i-gel means that theoretically it may be more prone to gas leaks during PCV. Data from our study suggest that compared with a tracheal tube there is no significant difference in the gas leak when using an i-gel in gynecological laparoscopic surgery during pressure-controlled ventilation.

Table 1
Demographic, Anesthetic Data for Both Groups, n=29

| Parameters | Tracheal tube | i-gel |
|--------------------------------|---------------|-----------|
| Age, years | 37.2±10.2 | 38.4±9.9 |
| Height, cm | 166.4±5.7 | 166.2±6.2 |
| Weight, kg | 66.5±11.2 | 65.5±12.7 |
| BMI, kg/m ² | 24.1±4.1 | 23.7±4.3 |
| ASA I/II | 18/11 | 15/14 |
| Anesthesia time, min | 72±22 | 66±18 |
| Blood detected on laryngoscope | 7 | — |
| Blood detected on TT or i-gel | 5 | 2 |
| Systolic blood pressure, mmHg | 106±8 | 105±9 |
| Heart rate, beats per min | 66±8 | 66±8 |

Table 2
Results of Leak Volumes and Leak Fractions of the I-Gel and Tracheal Tube, n=29

| Groups | PCV 15 mm | | Sore troath |
|---------------|-----------------|------------------|-------------|
| | Leak volume | Leak fraction, % | |
| i-gel | 53 ¹ | 6.2 ² | 2 (7%) |
| Tracheal tube | 46 ¹ | 4.9 ² | 5 (17%) |

Note. ¹ — no statistically significant difference (P>0.11); ² — no statistically significant difference (P>0.6)

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