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Original Article

Observations of clinical effects resulting from use of the laryngeal mask airway on combined hysteroscopy and laparoscopy explorations

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Abstract: Objective: To compare the clinical effects of laryngeal mask airway (LMA) and endotracheal tube (ETT) placement and removal on infertile patients receiving combined hysteroscopy and laparoscopy. Methods: A total of 120 patients diagnosed with infertility and undergoing hysteroscopy-laparoscopy were randomly and equally divided into Group A (LMA group) and Group B (ETT group). Both groups received total intravenous anesthesia of propofol and remifentanil. The mean arterial pressure (MAP) and heart rate (HR) values were recorded for the two groups across a range of time points. The bucking and adverse events during tube pulling, body movement score and the extubation time were also recorded. Results: Within 3 min after the ETT intubation/insertion of the LMA, the MAPs and HRs were significantly lower in Group A than those in Group B. The number of patients with intra-operative bucking, oxygen saturation < 90%, as well as postoperative bucking and sore throat in Group A was significantly smaller than that in Group B. Group A has the shorter extubation time and lower body movement score after extubation than Group B. Conclusion: LMA placement and removal causes less impact on measured circulatory system parameters and stress response of patients, showing more favorable clinical effects than tracheal intubation.

Keywords: Adverse reactions, drug-related side effects, laryngeal mask airway, intubation

Introduction

The laryngeal mask airway (LMA) is a special type of ventilation tube for blind insertion of the larynx. It does not require the help of a laryngoscope to expose the glottis, which results in less manipulative damage to the larynx. The use of LMA is also beneficial to keeping the airway unobstructed. It is usually applied in situations where outpatient surgeries and minor operations are performed on adults and children under general anesthesia [1, 2]. LMA introduction of anesthesia to the patient was first applied in clinical practice in 1983. Several beneficial characteristics justify its utility: 1) there is no need to expose the glottis with the aid of a laryngoscope; 2) the LMA does not need to enter the trachea; 3) while ensuring normal ventilation, it causes little cardiovascular response and can even be applied to structurally difficult airways [3].

Combined exploration with the use of hysteroscopy and laparoscopy plays an important role in the treatment of infertility [4]. At present, the gold standard for the diagnosis of female infertility is through this combined method [5, 6]. Combination of these techniques allows for both observing the condition within the uterine cavity, and also potentially treating the disease to increase the chance of pregnancy [7]. The operation is short in duration and has few side effects on patients. As such it is often a procedure completed during the daytime as an outpatient surgery [8]. There are few studies on the application of LMA in combined hysteroscopy and laparoscopy explorations. Therefore, this study explored the effect of LMA on the circulatory system, stress response of patients during and after their operation, and provides recommendations to clinical practice.

Materials and methods

General data of patients

A total of 120 infertility patients, admitted to the daytime ward of Beijing Jishuitan Hospital for a combined hysteroscopy-laparoscopy procedure, participated in the study. Patients were randomly divided into LMA (A) and ETT (B) groups, with 60 cases in each group. The patients were aged from 20 to 40 years old, with weights of 45-80 kg. The operation time of 20-40 min was maintained for all participants. All surgical recipients were classified as ASA grade I-II for fitness assessment. This study was approved by the Ethics Committee of Beijing Jishuitan Hospital, and informed consent was signed by all group members before surgery.

Patients were eligible for inclusion in the study by meeting four key criteria. First, patients were infertile with unknown etiology. Second, patients were physically fit and capable of undergoing the combined uteroscope and laparoscope operation. Third, candidates for the study were informed of the surgical risks and voluntarily chose to be involved in the study. Finally, patients whose heart function, respiratory function, and liver and kidney functions were normal before the operation.

Exclusion criteria for the study were based on contra indicatory clinical presentations relative to the study objectives. Namely, patients with (1) hoarseness and sore throat symptoms before surgery; (2) serious diseases of either the cardiovascular or urinary systems; patients who (3) received radiotherapy, chemotherapy, and immunotherapy before surgery; (4) reported abnormal throat development, were excluded from the study.

Anesthesia method

After entering the operating room, peripheral IV lines were placed in all patients. Monitoring of multi-lead ECG signals, oxygen saturation values, and non-invasive blood pressure readings were also initiated. Anesthesia induction was performed by administering oxygen (flow rate was maintained at 8 L/min) for 2 min, followed by intravenous injection of propofol (2 mg/kg), fentanyl (0.01 mg/kg), and cisatracurium besilate (0.2 mg/kg). Insertion of the LMA or ETT was performed after the patient stopped breathing autonomously.

Intubation method

The intubation method for Group A (LMA) began after induction of the IV-delivered anesthesia. The anesthesiologist pushed the patient's occiput from behind with his left hand to stretch the patient's neck and tilted the head back, holding the fully lubricated LMA with his right forefinger and thumb. The opening of the LMA faced the chin of the patient. The LMA was placed against the inner surface of the upper incisors and the front end of the LMA was inserted into the patient's mouth. Next, the LMA was pushed into the mouth by firmly pressing against the hard palate. The anesthesiologist's forefinger was placed in the joint of the ventilation catheter and the vent hood in order to push the LMA inward. The LMA was pushed as far as possible to the hypopharynx with the forefinger. The lower end of the LMA thereafter entered the upper esophageal orifice, with the upper end close to the bottom of the ventral surface of the epiglottis, and the vent in the mask opposite to the glottis. The LMA was then fixed and connected to the ventilator to ensure proper ventilation of LMA. Once the LMA was in place, the doctor would have a feeling of sudden disappearance of resistance but continue to feel resistance if pushing in.

The intubation method for Group B (ETT) began after anesthesia induction, as with the LMA group. The anesthesiologist intubated the tube under the guidance of a laryngoscope (inner diameter: 6.5 cm). First, the catheter's front-end was curved upward and inserted into the glottis, 21-23 cm from the incisors, followed by pulling out the catheter core. After the air bag was inflated, it was connected to the ventilator and the latter was adjusted to manual mode. By squeezing the ETT's ball, the doctor auscultated the lung breath sounds, determined the position of the ETT, and adjusted its final position. Finally, the ventilator was connected and the ETT was fixed.

Observation indicators

The mean arterial pressure (MAP) and heart rate (HR) were taken when each patient entered the room (T0). Additional time points for primary indicators were taken before the ETT intubation/insertion of the LMA (T1), immediately after the ETT intubation/insertion of the LMA (T2), 3 min after the ETT intubation/insertion of the LMA (T3), 1 hour after the ETT intubation/insertion of the LMA (T4), 2 hours after the ETT intubation/insertion of the LMA (T5), and 1 min after extubation/pulling out of the LMA (T6).

Additionally, bucking, body movement scores, and extubation times were recorded.

The evaluation of body movement was scored to include the degree of (1) wakefulness, (2) airway patency, and (3) limb activity. The degree of wakefulness was assessed for full wakefulness (2 points), response to stimulation (1 point), and no response to stimulation (0 point).

The degree of airway patency was graded for being completely unobstructed (2 points), relatively unobstructed (1 point) and obstructed (0 point).

Limb activity degree was measured according to whether the body can make conscious activities (2 points), the body had unconscious activities (1 point), and the body had no activities (0 point).

The sum of the three scores was the score of the study's body movement value, and more than 4 points indicated the recovery of body movement [9].

Extubation of the device yielded additional observational indicators for the study. Indication for extubation was that when deoxygenated, spontaneous breathing oxygen saturation reached over 90%. The throat reflex recovered and there was no secretion in the nasal cavity, oral cavity and trachea. Finally, the time from the end of the operation to tracheal tube extraction was recorded as the extubation time.

Secondary indicators: Adverse events such as laryngeal spasm and stridor. Laryngeal spasm: Patients suffered from sudden onset of dyspnea, characterized as inhaling thickly and long accompanied by wheezing, exhaling sounds like intermittent barking. Patients tended to confound. It usually lasted for a short time, often happening after deep breathing. After that, patient breathed as usual. Stridor happened when the patient was inhaling who often suffered from inspiratory dyspnea. It also occurred immediately after a slight stimulation while there was no obvious symptom originally.

Statistical analysis

SPSS 19.0 was used for statistical analysis of the data. Enumeration data was expressed as frequency, and chi-square testing was used for comparisons between groups. The measurement data were expressed as means ± standard deviations ($\overline{x}$ ± sd). Comparison of data from multiple time points in the two groups was performed by repeated measures ANOVA. Differences were considered statistically significant when $P < 0.05$.

Results

General data

There were no statistically significant differences between the two groups in age, weight, operation time, anesthetic time, pneumoperitoneum time, total propofol amount, remifentanil amount and co-existing diseases ($P > 0.05$, **Table 1**).

Circulatory system indicators

No significant differences were found in MAPs and HRs between the two groups at T0, T1, T4, T5 and T6. However, at T2 and T3, the MAPs and HRs were significantly lower in Group A than those in Group B ($P < 0.05$, **Table 2**; **Figure 1A**, **1B**).

Adverse reactions during intubation and extubation time

The number of patients with adverse reactions during intubation such as bucking, bleeding, tachycardia, and oxygen saturation < 90% in Group A was significantly less than that in Group B (all $P < 0.05$). The time from induction to mechanical ventilation in Group A was significantly shorter than that in Group B ($P < 0.001$), but there was no significant difference in the incidence of mis-aspiration between the two groups (all $P > 0.05$). The extubation time in Group A was significantly shorter than that in Group B ($P < 0.001$, **Table 1**).

Comparison of adverse reactions after extubation

Body movement score after extubation in Group A was lower than that in Group B ($P < 0.05$). The number of patients with postoperative bucking and sore throat in Group A was also significantly lower than that in Group B (both $P < 0.05$), while no significant difference was found in the number of patients with hoarseness when comparing Group A and Group B ($P > 0.05$, **Table 1**).

Table 1. Comparison of general information

	Group A (n = 60)	Group B (n = 60)	t/χ^2	P
General information				
Age (year)	35.2 ± 5.3	34.5 ± 6.1	0.671	0.504
Weight (kg)	55.35 ± 3.65	54.48 ± 4.37	1.184	0.239
Operation time (min)	35.27 ± 4.56	34.57 ± 5.64	0.748	0.456
Anesthetic time (min)	40.34 ± 4.29	41.28 ± 5.28	1.070	0.287
Pneumoperitoneum time (min)	20.35 ± 2.46	19.74 ± 3.52	1.100	0.274
Total propofol amount (mg)	253.47 ± 45.61	250.38 ± 50.32	0.352	0.725
Remifentanil amount (μg)	203.28 ± 35.61	205.37 ± 36.39	0.318	0.751
Co-existing diseases				
Hypertension (n, %)	12 (20.00)	10 (16.67)	0.223	0.637
Diabetes (n, %)	3 (5.00)	4 (6.67)	0.152	0.687
Adverse reactions during intubation				
Bucking (n, %)	2 (3.33)	10 (16.67)	5.926	0.015
Bleeding (n, %)	2 (3.33)	12 (20.00)	8.086	0.004
Mis-aspiration (n, %)	3 (5.00)	2 (3.33)	0.209	0.648
Tachycardia (n, %)	3 (5.00)	17 (28.33)	11.760	0.001
Oxygen saturation < 90% (n, %)	1 (1.67)	8 (13.33)	4.821	0.028
The time from induction to mechanical ventilation (min)	5.44 ± 1.28	6.38 ± 1.46	4.841	< 0.001
Extubation time (min)	12.56 ± 2.48	22.47 ± 2.16	23.340	< 0.001
Adverse reactions after intubation				
Limb movement score	3.46 ± 1.35	4.75 ± 1.38	5.176	< 0.001
Bucking (n, %)	1 (1.67)	7 (11.67)	4.821	0.028
Postoperative sore throat (n, %)	3 (5.00)	24 (40.00)	21.075	0.000
Hoarseness	0	2 (3.33)		0.496*

Note: *Fisher exact test.

Table 2. Comparison of MAP and HR

	MAP		HR	
	Group A (n = 60)	Group B (n = 60)	Group A (n = 60)	Group B (n = 60)
T0	84.38 ± 9.32	85.37 ± 8.38	73.77 ± 7.38	72.47 ± 8.49
T1	68.28 ± 10.29	70.38 ± 9.38	65.83 ± 7.89	66.73 ± 6.72
T2	75.48 ± 8.37	105.68 ± 10.38*	67.38 ± 5.89	89.38 ± 7.38*
T3	72.38 ± 7.49	96.44 ± 7.38*	65.18 ± 6.66	83.47 ± 5.67*
T4	84.38 ± 9.33	85.37 ± 10.14	72.37 ± 5.88	75.38 ± 6.02
T5	93.49 ± 9.37	94.38 ± 10.03	80.39 ± 6.39	81.27 ± 6.79
T6	91.25 ± 4.38	95.22 ± 5.38	83.48 ± 8.42	82.67 ± 5.38

Note: T0, when enter the room; T1, before the ETT intubation/Insertion of LMA; T2, immediately after the ETT intubation/insertion of LMA; T3, 3 min after the ETT intubation/insertion of LMA; T4, 1 hour after the ETT intubation/insertion of LMA; T5, 2 hours after the ETT intubation/insertion of LMA; T6, 1 min after extubation/pulling out LMA. *P < 0.05 when compare with Group A. ETT, endotracheal tube; HR, heart rate; LMA, laryngeal mask airway; MAP, mean arterial pressure.

Comparison of body movement scores

The body movement scores of Group A and Group B reached their maximum values at T0, and decreased immediately after T1; there was no statistical difference between the two groups (P > 0.05). The body movement scores at T2 in both groups were higher than those at T1, and the increase observed in Group B was significantly higher than that in Group A (P < 0.05). There was no significant difference between the two groups at T3, T4 and T5 (all P > 0.05). The score of Group B at T6 was significantly higher than that of Group A (P < 0.05, **Figure 1C**).

Discussion

Infertility is a reproductive health defect and disease, belonging to the group of global reproductive health problems which seriously affects quality of life and marital harmony [10, 11]. Currently, the treatment of infertility mainly includes the use of hysteroscopy, laparoscopy and the com-

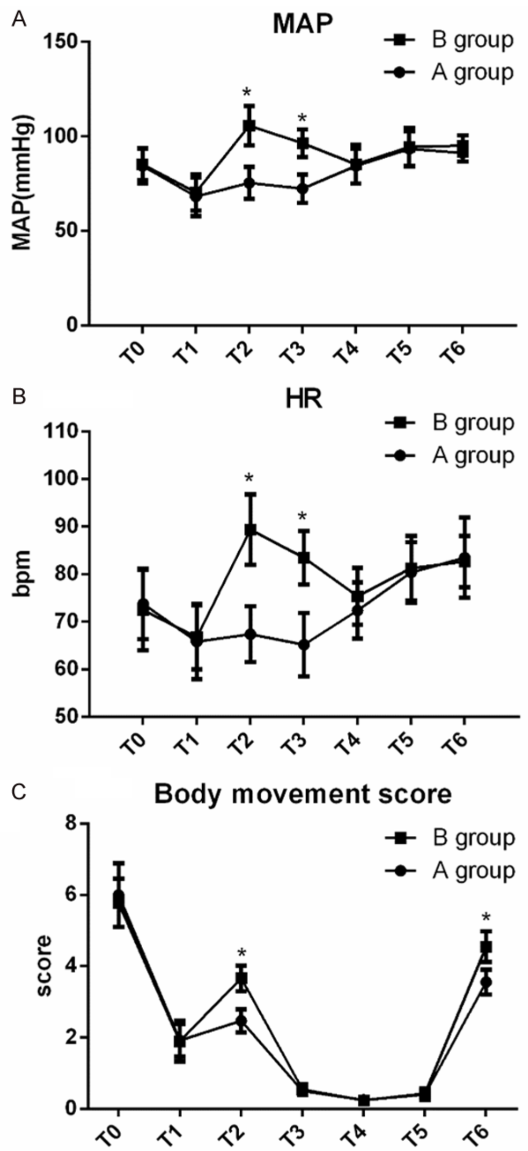

Figure 1. Comparison of MAP, HR and body movement scores between the two groups. A: Comparison of MAP; B: Comparison of HR; C: Comparison of body movement scores. T0, when enter the room; T1, before the ETT intubation/insertion of LMA; T2, immediately after the ETT intubation/insertion of LMA; T3, 3 min after the ETT intubation/insertion of LMA; T4, 1 hour after the ETT intubation/insertion of LMA; T5, 2 hours after the ETT intubation/insertion of LMA; T6, 1 min after extubation/pulling out LMA. $^{*}P < 0.05$ when compared with Group A. ETT, endotracheal tube; HR, heart rate; LMA, laryngeal mask airway; MAP, mean arterial pressure.

bination of hysteroscopy and laparoscopy [12]. Hysteroscopy observes the intrauterine conditions and examines the causes of intrauterine diseases of patients, while also identifying necessary surgical treatments for abnormal conditions [13]. Using hysteroscopy, the fallopian tube can also be dredged to check its fluidity [14]. Laparoscopy can be used to either remove lesions by point burning or to dissect slight tubal adhesions, thereby increasing the chance of pregnancy [15]. Combination of hysteroscopy and laparoscopy pool the advantages of both techniques, which then allows not only for detecting the causes of infertility but also avails treatment of the disease [16].

Traditionally, common tracheal intubation was used for ventilation, prior to and during operations, but the difficulties in placing the laryngoscope, as well as poor glottis exposure were identified as disadvantages to overcome. Development of the LMA device resulted in less difficult placement of an airway respiratory conduit, and gradually replaced tracheal intubation [17].

Since the invention of the LMA, combined infertility explorations using hysteroscopy and laparoscopy has been made available to greater numbers of surgical candidates. Total intravenous anesthesia induced by propofol combined with remifentanil has solved the problem of airway management, especially for patients with intraoperative respiratory depression [18]. Laryngeal mask ventilation technology has the advantages of being easy to grasp, high ventilation success rates with few complications, and is widely used in clinical anesthesia [2]. The LMA is tolerable under light anesthesia, and the amount of anesthetic used is reduced. In addition, the LMA device has advantages such as improved hemodynamic stability during anesthesia induction and convalescence, decreased circulation effects during catheterization, decreased coughing during anesthesia convalescence, increased oxygen saturation, and decreased incidence of pharyngeal pain in adults after surgery [19, 20]. Previous studies have shown that LMA methods are widely used in general anesthesia patients undergoing outpatient surgery, and the success rate of rapid airway control during the induction period is significantly higher than that of endotracheal intubation [2]. However, few studies have been reported on the clinical outcomes associated with a combination surgery composed of hysteroscopy and laparoscopy in patients diagnosed with infertility. The results of this study confirmed that LMA ventilation was less impacting on the circulatory system and stress responses in patients undergoing hysteroscopy combined with laparoscopy.

The LMA ventilation methodology does not need to expose the glottis, avoiding the deleterious stimulation on the tongue root and epiglottis valley when the glottis is exposed directly to laryngoscope contact. Being free of tongue root stimulation is thought to reduce the cardiovascular response caused by tracheal intubation [21]. The results of this study also showed that hemodynamic changes were most obvious in the endotracheal intubation group at 1 min after intubation and became stable slowly before extubation. Notably, the hemodynamic changes were immediately increased after extubation. Hemodynamics of the LMA group increased significantly only 1 min after intubation and remained stable during both the operation and extubation. This data suggests that the LMA reduces the cardiovascular response and duration of it under the conditions of the study.

Tracheal intubation causes more injuries to the pharynx and larynx than laryngeal mask implantation. The soft tissue of the pharynx is loose and fragile, and the upper respiratory tract space is narrow. Bleeding and edema of pharynx and larynx tissue are easy to incite [22]. Therefore, the use of tracheal intubation must be gentle and slow to avoid injury. The LMA is designed with double airbags, the ventilation mask is more suitable for the anatomy of the pharynx and has better sealing abilities for airway control. Furthermore, the far end of the laryngeal mask is located at the orifice of the esophagus, which is fixed well and is not easily displaced. In this study, the incidence of bucking and a decrease in oxygen saturation decreased significantly during LMA implantation [23].

The deficiency of this study is that there are few observational indices. In subsequent studies, we will detect serum inflammatory factor levels and the changes in blood glucose levels at each time point, thereby more fully evaluating the degree of stress response of patients to laryngeal mask and the tracheal duct invasiveness. Due to the small number of patients in each group and individual patient differences, we will expand the sample size at a later stage, striving to achieve 200 cases in each group, further allowing a greater detailed discussion of the effects of LMA ventilation in combined explorations using hysteroscopy and laparoscopy.

Overall, the laryngeal mask airway causes less harmful impact on the circulatory system and on stress responses of patients during their hysteroscopy-laparoscopy operation. Further, LMA use is associated with better clinical outcomes compared to tracheal intubation. Our findings support LMA as a technique more suitable for clinical promotion, and is warranted as the method of choice in ensuring effective conditions for hysteroscopy-laparoscopy procedures in infertile patients.

Disclosure of conflict of interest

None.

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