

Comparison of laryngeal mask airway and endotracheal intubation in gynecological cancer operation

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Abstract. Endotracheal intubation (ETI) and laryngeal mask airway (LMA) in terms of hemodynamics and reaction were compared. A total of 54 general anesthesia patients were randomized into two groups with 27 cases in each group. Acceleration index (ACI), cardiac index (CI), cardiac output (CO), left cardiac work (LCW), systemic circulation resistance (SVR), mean arterial pressure (MAP), heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded at 12 time-points: before surgery (T0), start effect (T1), lost consciousness (T2), before ETI or LMA (T3), 1 min (T4), 3 min (T5), 5 min (T6) after ETI or LMA, the beginning of surgery (T7), 30 min (T8), 1 hour (T9) after surgery, the end of surgery (T10) and extubation (T11). In each group these indexes went down and rose up gently during surgery except for T4 (intubation) and T11 (extubation) in ETI. These indexes reached the highest at T11 (extubation). This is due to the stimulus on mucosa and muscle of root of tongue, throat and epiglottis from the windpipe. The stimulus excites sympathetic nerve and increases the release of catecholamine. As a result, the heart beats faster and blood pressure rises. However, the range in the LMA group is smaller especially at T4 and T11. This is most likely due to LMA not stimulating the trachea. SVR, MAP, HR, SBP and DBP were lower in LMA with statistical significance in some time-points. The other indexes such as ACI, CI, CO and LCW were significantly higher in LMA ($P < 0.05$). These results indicated that LMA can be suitable for use in general anesthesia for less stimulation. The airway with LMA in patients undergoing gynecological cancer operation is better than ETI in keeping stable hemodynamics and producing less anesthetic complications with smooth recovery from general anesthesia.

Introduction

Elective lower abdominal surgery is frequently performed under general anesthesia among gynecological cancer patient population. Gynecology tumor patients are mostly middle-aged and old, and they often have internal diseases such as hypertension, cardiovascular and cerebrovascular disease and other medical problems. Anesthetization is highly demanding in these operations due to the long time, wide expansion and large wound. Thus, it is important to choose the appropriate airway management.

Developments in anesthesia practice and airway management have increased safety of pediatric anesthesia (1,2). We improved airway management efficiency by using endotracheal intubation (ETI) or laryngeal mask airway (LMA) (3). There has been progress in the development of the design in the past ten years, changes in production material, and availability of various types. Anesthetists widely use ETI because of the advantages of good seal at the cricoid rings, decreased pressure, and thus a lower risk for mucosal injury (4). However, subglottic stenosis caused by a lack of cuff related mucosal perfusion due to cuff tube use, making their use controversial. In contrast, LMA has the advantages of a lack of direct contact with the trachea, no requirement for direct laryngoscopy, and a lower incidence of coughing (5-7).

We compared hemodynamics and respiratory function between LMA and ETI in gynecological cancer patients undergoing elective lower abdominal surgery (8,9).

Patients and methods

Study design. A prospective, double-blind, randomized clinical trial was performed to evaluate the usefulness of the LMA compared to ETI by analyzing changes in clinical symptoms before and after surgery. The Ethics Committee of Jiangsu Cancer Hospital (Nanjing, China) approved the study.

Patients. After obtaining informed consents, 54 women, aged 32-55 years, with cervical and ovarian cancer were included in the study. The patients were scheduled for lower abdominal surgery at Jiangsu Cancer Hospital, between June 2012 and December 2012. The patient who took part in our research were randomized from 1 to 100. Then they were divided into two groups according the odd/even

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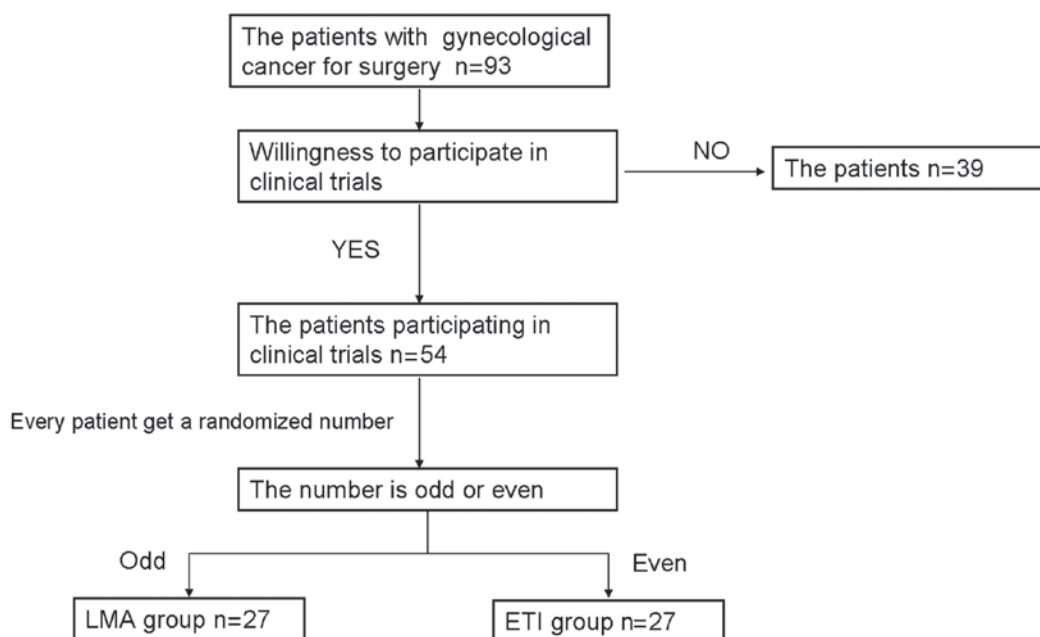


Figure 1. The diagram demonstrates the patient recruitment. ETI, endotracheal intubation; LMA, laryngeal mask airway.

numbers (Fig. 1). Then, the 54 patients were randomized into the LMA group (n=27) and ETI group (n=27). Patients with congenital abnormalities, risk of aspiration, upper respiratory tract infection, acute or chronic pulmonary diseases, or risk for difficult intubation were excluded from the study.

Statistical analysis. Continuous data were expressed as the number of participants (n), mean \pm SD, whereas categorical data were expressed as frequencies and percentages. Comparisons between the two groups were done using independent Student's t-test. Statistical analysis was carried out using Statistical Product and Service Solutions (SPSS) 16.0 (SPSS Inc., Chicago, IL, USA). A P-value <0.05 was considered statistically significant.

Results

A total of 54 patients were randomized in this study: 27 in the LMA group and 27 in the ETI group. The sex and age of the two groups were similar. The demographic and surgical data are presented in Table I.

Acceleration index (ACI), cardiac index (CI), cardiac output (CO), left cardiac work (LCW), systemic circulation resistance (SVR), mean arterial pressure (MAP), heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded at 12 time-points: before surgery (T0), start effect (T1), lost consciousness (T2), before ETI or LMA (T3), 1 min (T4), 3 min (T5), 5 min (T6) after ETI or LMA, the beginning of surgery (T7), 30 min (T8), 2 hours (T9) after surgery, the end of surgery (T10) and extubation (T11) (Table II).

We found that in each group these indexes declined and then increased gently during surgery except for T4 and T12 especially in the ETI group. These indexes reached the highest at T11 (extubation). This is due to the stimulus on mucosa and muscle of root of tongue, throat and epiglottis from

the windpipe. The stimulus excites sympathetic nerve and increases the release of catecholamine. As a result, the heart beats faster and blood pressure rises. However, the range in the LMA group is smaller especially at T4 and T11. This is most likely due to LMA not stimulating the trachea. ACI, CI, CO and LCW were higher in LMA with statistical significance at certain time-points ($P<0.05$) (Fig. 2A-D). Indexes such as SVR, MAP, HR, SBP and DBP were significantly higher in ETI (Fig. 2E-I).

Discussion

LMA was developed by A. Brain in 1981, and since then, it has flourished in practice and has been used to treat millions of patients worldwide (10,11). The LMA provides more hands-free anesthesia than a facemask does, avoids many morbidities associated with tracheal intubation because there is no stress from the laryngoscope, and allows a faster recovery that does not require muscle relaxation (12,13). The LMA has become an important choice for routine use, particularly in outpatient surgeries (14-16).

In our investigation, we assessed the eligibility of LMA by comparing hemodynamics and respiratory function between LMA and ETI in gynecological cancer operation. The results showed that LMA can be used safely and induces less stress reaction in gynecological cancer patients undergoing lower abdominal surgery. The correlated clinical indexes recorded in 12 time-points declined and then increased gently during surgery except for the time-point of intubation (T4) and extubation (T11) especially in the ETI group. These indexes reached the highest at extubation (T11). This is due to the stimulus on mucosa and muscle of root of tongue, throat and epiglottis, from the windpipe. The stimulus excites sympathetic nerve and increases the release of catecholamine (17-21). As a result, hearts beat faster and blood pressure rises. However, the range in the LMA group

Table I. Demographic and surgical data.

| Items | LMA | ETI |
|-----------------------------|--------------|--------------|
| Age (year) | 44.30±8.05 | 46.81±8.41 |
| Sex (F/M, no.) | 28/0 | 28/0 |
| Weight (kg) | 60.22±7.73 | 61.93±8.87 |
| Height (cm) | 160.93±4.75 | 159.19±3.94 |
| Surgery time (min) | 125.19±17.70 | 110.85±15.40 |
| Total anesthesia time (min) | 137.56±17.92 | 121.22±16.28 |

LMA, laryngeal mask airway; ETI, endotracheal intubation.

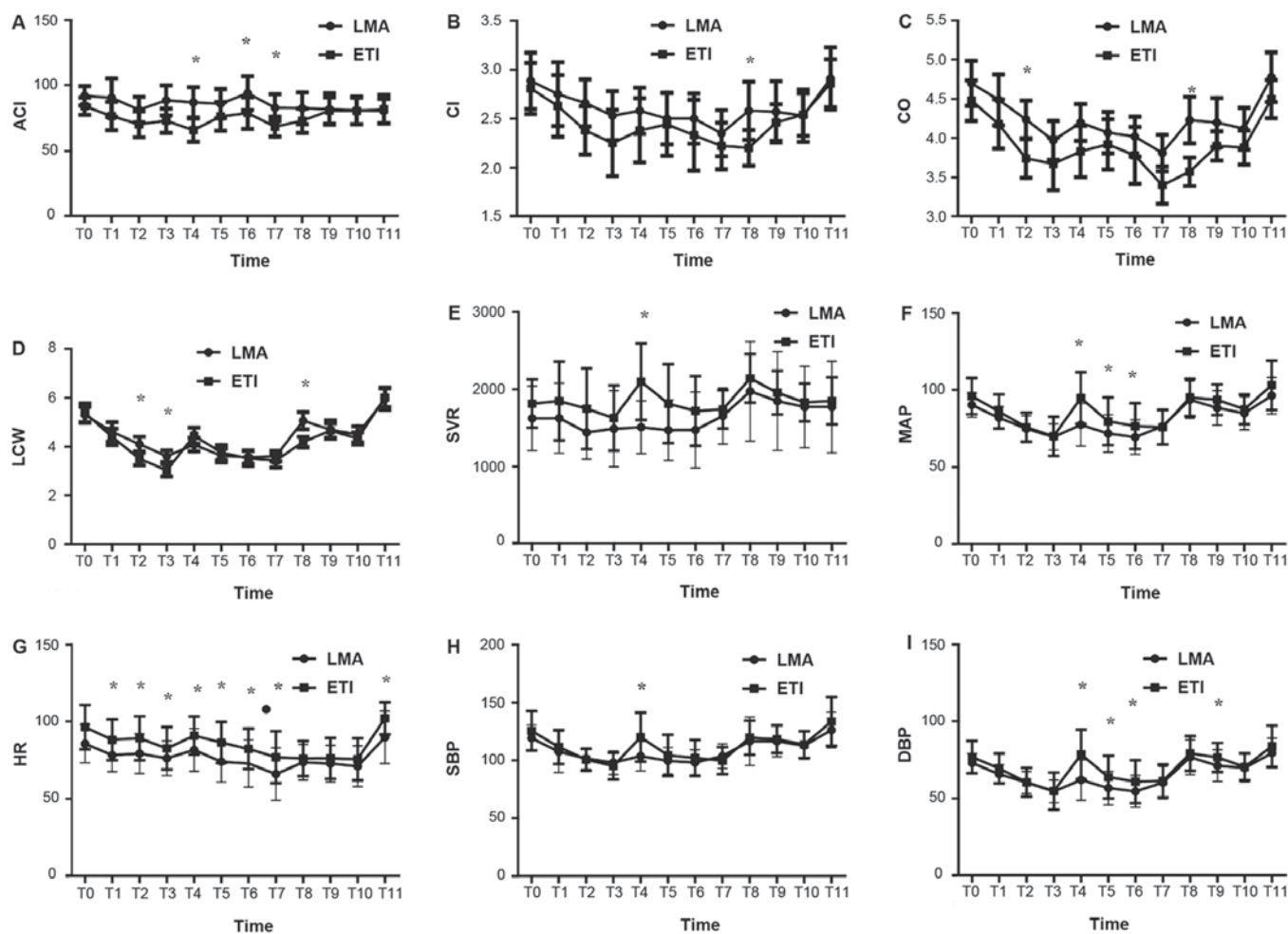


Figure 2. Comparison of clinical indexes between the two groups. (A) ACI of the 2 groups at each time-point as indicated; (B) CI of the 2 groups at the time-points; (C) CO of the 2 groups at the time-points; (D) LCW of the 2 groups at time-points; (E) SVR of the 2 groups at time-points; (F) MAP of the 2 groups at time-points; (G) HR of the 2 groups at time-points; (H) SBP of the 2 groups at time-points; (I) DBP of the 2 groups at time-points. *P<0.05; ACI, acceleration index; CI, cardiac index; CO, cardiac output; LCW, left cardiac work; SVR, systemic circulation resistance; MAP, mean arterial pressure; HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; ETI, endotracheal intubation; LMA, laryngeal mask airway.

is smaller especially at T4 and T11. This is possibly due to LMA not stimulating the trachea (22-25). One weakness of our design is that we could not get meaningful results using a multivariate logistic regression analysis. This may have been caused by the small number of samples. We will use a multivariate logistic regression analysis in future studies when a larger number of samples is available.

There were higher incidences of bucking in the ETI group in similar anesthesia in extubation. In addition, there were more postoperative complications in the ETI group such as pharyngalgia compared with LMA. This may be relevant to improper operation or excessive inflation of the catheter sleeve. This indicates that the stimulation of ETI is stronger than LMA. Most patients with ETI experience varying

Table II. Comparison of clinical indexes between LMA and ETI (means \pm SD).

| Item | T0 | T1 | T2 | T3 | T4 | T5 |
|---------|-----------------------|-------------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| ACI | | | | | | |
| LMA | 92.31 \pm 37.33 | 90.79 \pm 44.29 | 81.62 \pm 29.31 | 88.81 \pm 34.65 | 87.24 \pm 34.84 | 86.21 \pm 33.31 |
| ETI | 84.28 \pm 32.73 | 76.76 \pm 32.60 | 70.40 \pm 30.03 | 73.16 \pm 27.77 | 65.96 \pm 26.86 | 76.44 \pm 32.59 |
| P-value | 0.377 | 0.174 | 0.138 | 0.059 | 0.011 | 0.246 |
| CI | | | | | | |
| LMA | 2.886 \pm 0.73 | 2.75 \pm 0.79 | 2.66 \pm 0.61 | 2.53 \pm 0.63 | 2.58 \pm 0.58 | 2.50 \pm 0.64 |
| ETI | 2.808 \pm 0.53 | 2.63 \pm 0.65 | 2.38 \pm 0.63 | 2.25 \pm 0.58 | 2.38 \pm 0.56 | 2.44 \pm 0.60 |
| P-value | 0.643 | 0.532 | 0.081 | 0.076 | 0.154 | 0.735 |
| CO | | | | | | |
| LMA | 4.70 \pm 1.15 | 4.49 \pm 1.30 | 4.24 \pm 0.96 | 3.97 \pm 1.00 | 4.20 \pm 0.94 | 4.07 \pm 1.06 |
| ETI | 4.48 \pm 1.04 | 4.18 \pm 1.26 | 3.74 \pm 0.99 | 3.67 \pm 1.35 | 3.83 \pm 1.31 | 3.92 \pm 1.28 |
| P-value | 0.43 | 0.352 | 0.049 | 0.296 | 0.187 | 0.612 |
| LCW | | | | | | |
| LMA | 5.30 \pm 1.31 | 4.60 \pm 1.57 | 4.10 \pm 1.22 | 3.61 \pm 0.95 | 4.08 \pm 1.10 | 3.63 \pm 1.11 |
| ETI | 5.38 \pm 1.53 | 4.40 \pm 1.35 | 3.50 \pm 1.05 | 3.03 \pm 1.06 | 4.45 \pm 1.32 | 3.76 \pm 1.21 |
| P-value | 0.812 | 0.571 | 0.047 | 0.024 | 0.228 | 0.663 |
| SVR | | | | | | |
| LMA | 1,623.05 \pm 836.75 | 1,625.98 \pm 906.83 | 1,440.45 \pm 685.12 | 1,489.32 \pm 986.32 | 1,509.00 \pm 681.90 | 1,470.14 \pm 786.71 |
| ETI | 1,814.80 \pm 627.03 | 1,849.32 \pm 1,024.45 | 1,749.32 \pm 1,046.70 | 1,628.00 \pm 844.12 | 2,099.04 \pm 990.98 | 1,813.28 \pm 1,022.65 |
| P-value | 0.291 | 0.356 | 0.149 | 0.545 | 0.005 | 0.128 |
| MAP | | | | | | |
| LMA | 90.29 \pm 7.86 | 81.98 \pm 7.31 | 74.88 \pm 8.60 | 69.52 \pm 8.43 | 77.40 \pm 13.75 | 71.76 \pm 12.12 |
| ETI | 96.00 \pm 11.67 | 86.04 \pm 11.06 | 75.84 \pm 9.40 | 69.96 \pm 12.70 | 94.76 \pm 16.77 | 79.64 \pm 15.43 |
| P-value | 0.019 | 0.075 | 0.671 | 0.866 | 0 | 0.023 |
| HR | | | | | | |
| LMA | 85.74 \pm 12.43 | 78.41 \pm 10.71 | 79.43 \pm 12.89 | 76.33 \pm 11.25 | 81.76 \pm 13.76 | 74.12 \pm 13.28 |
| ETI | 96.56 \pm 14.38 | 88.36 \pm 13.28 | 89.36 \pm 14.27 | 82.80 \pm 13.73 | 91.08 \pm 12.42 | 86.60 \pm 13.39 |
| P-value | 0.546 | 0.043 | 0.343 | 0.04 | 0.006 | 0.001 |
| SBP | | | | | | |
| LMA | 119.29 \pm 11.35 | 107.64 \pm 17.99 | 101.62 \pm 9.27 | 98.14 \pm 10.21 | 103.79 \pm 12.77 | 99.76 \pm 11.49 |
| ETI | 125.60 \pm 16.89 | 111.64 \pm 14.63 | 100.68 \pm 9.39 | 95.20 \pm 11.53 | 120.16 \pm 21.12 | 104.48 \pm 17.75 |
| P-value | 0.072 | 0.351 | 0.691 | 0.281 | 0 | 0.191 |
| DB | | | | | | |
| LMA | 72.95 \pm 6.14 | 65.71 \pm 6.15 | 60.26 \pm 7.18 | 54.52 \pm 7.39 | 61.95 \pm 13.09 | 56.64 \pm 10.87 |
| ETI | 76.80 \pm 10.40 | 69.40 \pm 9.63 | 60.44 \pm 9.39 | 54.72 \pm 12.10 | 78.52 \pm 16.13 | 63.76 \pm 13.83 |
| P-value | 0.061 | 0.06 | 0.931 | 0.934 | 0 | 0.022 |

Table II. Continued.

| Item | T6 | T7 | T8 | T9 | T10 | T11 |
|---------|-----------------|-----------------|-------------------|-------------------|-------------------|-------------------|
| ACI | | | | | | |
| LMA | 94.31±50.85 | 83.19±30.98 | 82.69±36.48 | 82.12±36.12 | 81.14±32.01 | 80.64±27.92 |
| ETI | 79.04±42.48 | 68.60±23.01 | 73.20±27.88 | 80.88±30.35 | 80.68±30.37 | 82.00±33.26 |
| P-value | 0.049 | 0.045 | 0.267 | 0.886 | 0.954 | 0.858 |
| CI | | | | | | |
| LMA | 2.50±0.63 | 2.35±0.50 | 2.58±0.66 | 2.57±0.76 | 2.53±0.64 | 2.91±0.75 |
| ETI | 2.33±0.61 | 2.22±0.49 | 2.20±0.33 | 2.46±0.43 | 2.54±0.38 | 2.86±0.60 |
| P-value | 0.271 | 0.327 | 0.011 | 0.529 | 0.94 | 0.763 |
| CO | | | | | | |
| LMA | 4.02±1.02 | 3.81±0.94 | 4.23±1.19 | 4.20±1.25 | 4.12±1.07 | 4.78±1.27 |
| ETI | 3.78±1.45 | 3.40±0.95 | 3.57±0.73 | 3.90±0.75 | 3.88±0.87 | 4.50±0.98 |
| P-value | 0.443 | 0.093 | 0.014 | 0.288 | 0.331 | 0.335 |
| LCW | | | | | | |
| LMA | 3.57±1.11 | 3.61±0.86 | 5.06±1.42 | 4.69±1.51 | 4.50±1.32 | 5.96±1.82 |
| ETI | 3.52±1.23 | 3.43±1.13 | 4.19±0.87 | 4.65±1.18 | 4.33±1.00 | 6.00±1.52 |
| P-value | 0.884 | 0.482 | 0.007 | 0.899 | 0.596 | 0.929 |
| SVR | | | | | | |
| LMA | 1,473.17±985.63 | 1,654.62±727.71 | 1,974.33±1,288.26 | 1,848.48±1,279.64 | 1,771.33±1,052.80 | 1,771.69±1,189.15 |
| ETI | 1,720.08±905.25 | 1,741.44±495.27 | 2,142.88±631.07 | 1,957.08±564.22 | 1,830.48±489.35 | 1,850.28±611.97 |
| P-value | 0.301 | 0.6 | 0.477 | 0.69 | 0.793 | 0.76 |
| MAP | | | | | | |
| LMA | 69.43±11.15 | 76.50±11.14 | 93.69±12.05 | 88.33±11.14 | 84.86±10.66 | 96.31±11.89 |
| ETI | 76.56±14.80 | 75.80±11.19 | 95.16±12.05 | 93.60±9.94 | 87.44±9.62 | 103.08±16.02 |
| P-value | 0.029 | 0.805 | 0.631 | 0.056 | 0.324 | 0.052 |
| HR | | | | | | |
| LMA | 72.98±15.23 | 66.17±16.98 | 73.79±11.59 | 72.83±11.84 | 71.21±13.20 | 89.91±17.04 |
| ETI | 82.44±13.11 | 77.04±16.80 | 76.20±11.37 | 76.32±13.32 | 75.76±13.64 | 102.32±10.47 |
| P-value | 0.009 | 0.013 | 0.409 | 0.27 | 0.183 | 0.002 |
| SBP | | | | | | |
| LMA | 98.26±10.85 | 103.71±10.67 | 116.60±21.00 | 116.69±13.51 | 112.95±11.70 | 126.33±15.41 |
| ETI | 102.24±15.59 | 99.84±11.67 | 119.76±14.79 | 118.36±11.85 | 113.72±11.64 | 133.72±20.98 |
| P-value | 0.223 | 0.17 | 0.511 | 0.611 | 0.795 | 0.103 |
| DBP | | | | | | |
| LMA | 54.57±10.32 | 60.24±10.54 | 76.69±11.33 | 71.21±10.30 | 69.74±9.18 | 79.38±9.67 |
| ETI | 60.84±13.96 | 61.32±10.68 | 79.12±11.24 | 76.52±9.44 | 70.44±8.72 | 83.72±13.42 |
| P-value | 0.039 | 0.687 | 0.397 | 0.036 | 0.759 | 0.13 |

degrees of pharyngeal pain and have significant change in HR. However, patients with LMA do not have this complication. This is because LMA does not need to use laryngoscope and there is no need to enter trachea, thus avoid damaging tracheal mucosa and influencing circulation system. LMA has become complementary technology of ETI to offer a safe, effective, and simple ventilation method especially to the patient with microstomia. LMA is simpler to operate than ETI for medical workers and gains more time during emergency treatment. In addition, LMA is specifically suitable for the patient with microstomia (26).

In conclusion, the LMA may be a suitable method for airway management of patients with gynecological cancer under-going lower abdominal surgery (27,28). Furthermore, LMA is a good alternative to ETI with easier insertion, and lower incidence of cardiovascular response.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

JT and LG designed the study and performed the experiments, ZS, JF and QB collected the data, JT and ZS analyzed the data, JT and LG prepared the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Jiangsu Cancer Hospital (Nanjing, China). Signed informed consents were obtained from the patients or their guardians.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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