Original Article

Laryngeal Mask Airway for Cesarean Delivery: A 5-Year Retrospective Cohort Study

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Abstract

Background: The laryngeal mask airway (LMA) is the most commonly used rescue airway in obstetric anesthesia. The aim of this retrospective cohort study was to evaluate the application of the LMA in parturients undergoing cesarean delivery (CD) for 5 years in our hospital. As a secondary objective, we investigated the incidence of airway-related complication in obstetric general anesthesia (GA).

Methods: We collected electronic data for all obstetric patients who received GA for CD between January 2010 and December 2014 in Peking University First Hospital. Based on the different types of airway device, patients were divided into endotracheal intubation (ET) group and LMA group. The incidences of regurgitation and aspiration, as well as maternal and neonatal postoperative outcomes were compared between groups.

Results: During the 5-year study, GA was performed in 192 cases, which accounted for 2.0% of all CDs. The main indications for GA were contraindication to neuraxial anesthesia or a failed block. Among these, ET tube was used in 124 cases (68.9%) and LMA in 56 cases (31.1%). The percentage of critical patients above the American Society of Anesthesiologists' Grade II was 24/124 in ET group and 4/56 in LMA group ($P = 0.036$). The emergent delivery rate was 63.7% for ET group and 37.5% for LMA group ($P = 0.001$). None of the patients had regurgitation or aspiration. There were no significant differences in terms of neonatal Apgar scores, maternal and neonatal postoperative outcomes between the two groups.

Conclusions: Our results suggested that GA was mainly used for contraindication to neuraxial anesthesia or a failed block, and emergent CDs accounted for most cases. The second-generation LMA could be used for obstetric anesthesia, but correct position to achieve a good seal is the key to prevent reflux and aspiration. Whether they could replace the tracheal tube in routine practice needs further large prospective studies.

Key words: Anesthesia, General; Anesthesia, Obstetric; Cesarean Section; Laryngeal Masks

Introduction

The laryngeal mask airway (LMA) is an extremely important supraglottic airway device (SAD) and has advantages over tracheal intubation such as less hemodynamic stimulation, easy insertion, and higher success rate. Its use has gained popularity in elective surgeries for the nonpregnant population. In addition, it has proved valuable as a rescue device in managing difficult airways.[1-3] Many reports have shown successful or even lifesaving use of the LMA in providing ventilation and oxygenation when tracheal intubation has failed, including the "cannot intubate, cannot ventilate" situation during obstetrical anesthetic practice.[4-10]

Most notably, obstetric patients are a high-risk population of difficult airway, and most of the failed intubation occurs during emergencies. Failed intubation and pulmonary aspiration of gastric contents may cause maternal hypoxemia and neonatal respiratory depression.[11] Airway-related complications are the major causes of anesthesia-related maternal and fetal morbidity and mortality.[1]

Three large-sample prospective observational studies successfully reported their experience of using different types of the LMAs in more than 4700 parturients and reported no cases of aspiration but one case of regurgitation,

Access this article online

Quick Response Code:

Website: www.cmj.org

DOI: 10.4103/0366-6999.199833

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Received: 13-10-2016 **Edited by:** Qiang Shi
How to cite this article: Geng ZY, Wang DX. Laryngeal Mask Airway for Cesarean Delivery: A 5-Year Retrospective Cohort Study. Chin Med J 2017;130:404-8.

although it should be noted that low-risk patients were selected in these studies.[12-14]

The gold standard of general anesthesia (GA) for cesarean delivery (CD) is rapid sequence induction with tracheal intubation. However, the LMA was introduced in 1988, and we have seen an increased use of LMA over the past years in clinical trial. Recent guidelines for the management of unanticipated difficult intubation in adults have also recommended that SAD should be available for both routine use and rescue airway management.[3] Large successful uses of the LMA in obstetric practice might have challenged the airway management in obstetric patients.

To evaluate the application of the LMA in obstetric airway management, we performed a retrospective cohort study on the use of the LMA in parturients undergoing CD for 5 years in our university hospital. As a secondary objective, we investigated the incidence of airway-related complications such as regurgitation and aspiration in obstetric GA.

Methods

This was a retrospective cohort study, and the study protocol was approved by the Ethics Committee of Peking University First Hospital (No. 2016-1049). Written informed consent was waived because of its retrospective nature.

Peking University First Hospital is one of the largest general teaching hospitals in China. The obstetric unit handles more than 5000 deliveries annually, providing full obstetric care including treatment for high-risk pregnancy. At our institution, all attending anesthesiologists supervise certified residents at various training levels to carry out the anesthetic practice. We have no dedicated obstetric anesthesiologists, and all anesthesiologists should complete anesthetic practice for different kinds of surgery before become an attending. The attending makes the decision about the choice of anesthetic method and airway devices.

In our current practice, combined spinal epidural technique is the commonly used anesthetic method for CD, and 24 h epidural labor analgesia service has been available for many years. As a matter of routine, rapid sequence induction using propofol and suxamethonium is provided for the induction of GA for CD and cricoids pressure is applied. Opioids are provided after clamping the umbilical cord.

We used the hospital electronic medical database to determine the total number of CDs, both elective and emergent, from January 2010 to December 2014. The medical records of all obstetric patients who received GA for CD were subsequently extracted. Parturients with intrauterine dead fetus were excluded.

The baseline maternal information including age, height, weight, body mass index (BMI), parity, and gestation was recorded. Preoperative status including maternal diseases (i.e., preexisting cardiac, hypertension, respiratory, renal, hematologic, neurologic, and neoplastic disorders), pregnancy-related complications, American Society of Anesthesiologists' Physical Status (ASA) grade, history of anesthetic difficulties, and preoperative Mallampati (MLP) score was documented. Perioperative data including the indications for CD and GA, urgency of case, fast time, mode of airway management; anesthetic medications used for induction and maintenance, complications related to airway management such as regurgitation, aspiration, bronchial and laryngeal spasm, hypoxemia, maternal and fetal outcomes including neonatal Apgar scores and admitting to the Intensive Care Unit were also collected.

Regurgitation was defined as identification of gastric content in the mouth during the procedure or at extubation. Aspiration was diagnosed if bile-stained fluid was seen in the lungs with a fiber-optic endoscope or with postoperative radiological evidence.[13]

Based on the types of airway device, patients were divided into endotracheal intubation group (ET group) and the Supreme LMA group.

Statistical analysis

Categorical data were presented as number and percentage and analyzed using Chi-Square test or Fisher's exact test as appropriate. Continuous data were presented as mean ± standard deviation (SD) and compared using the unpaired Student's *t*-test. A two-sided $P < 0.05$ was considered statistically significant. The analyses were performed using the SPSS software version 14.0 (SPSS, Inc., Chicago, IL, USA).

Results

During the 5-year study from 2010 to 2014, there were 22,355 deliveries, of which 9761 occurred through CD (43.7%). GA was performed in 192 cases (2.0%), of which 110 (57.3%) were for emergent surgery. The most common indication for GA was maternal contraindications to neuraxial anesthesia or a failed block (75.5%) such as previous back surgery, spinal deformity, thrombocytopenia, and other coagulation defects [Table 1].

We excluded 12 patients who were supplemented with intravenous propofol or fentanyl for sedation without airway intervention. Among the remaining 180 patients who underwent GA, ET tube was used in 124 cases (68.9%) and LMA in 56 cases (31.1%). Use of the LMA has also showed an increasing trend in obstetrical anesthetic since 2010 [Table 2].

The percentage of critical patients above ASA Grade II was 24/124 in ET group and 4/56 in LMA group ($P = 0.036$). The emergency CD rate was 63.7% for ET group and 37.5% for LMA group ($P = 0.001$) [Table 3].

There were 56 parturients in LMA group with a mean BMI of 28.1 ± 3.4 kg/m^2. In LMA group, we routinely used the Supreme LMA (LMA Supreme™, Teleflex Medical Inc.,

Ireland) with a gastric drain tube inserted in all patients. One case was associated with a difficult intubation. A size 3 LMA was rescued successfully after two attempts with direct laryngoscopy. Two obese patients with a BMI of 37 fasted for 6 h were also selected for LMA due to failed epidural puncture or block. No case of regurgitation or aspiration occurred including 21 emergent surgeries.

No episode of laryngospasm or bronchospasm was observed. None of the patients had regurgitation or aspiration. We found no significant differences in neonatal Apgar scores, maternal and neonatal postoperative outcomes between two groups. All patients recovered well without sequelae when followed up postoperatively. There was no anesthesia-related mortality during the study period.

Table 1: Indications for general anesthesia

Items	*n* (%)
Contraindication to regional anesthesia	92 (47.9)
Failed regional anesthesia	53 (27.6)
Obstetric factors	31 (16.1)
Maternal factors	16 (8.3)

Table 2: Airway tool choice for 5 years, *n* (%)

Year	ET group	LMA group	χ^2	*P**
2010	21 (84.0)	4 (16.0)	–	–
2011	27 (77.1)	8 (22.9)	0.429	0.513
2012	16 (61.5)	10 (38.5)	3.229	0.072
2013	32 (68.1)	15 (31.9)	2.128	0.145
2014	28 (59.6)	19 (40.4)	4.479	0.034
Total	124 (68.9)	56 (31.1)	–	–

*Compared with year 2010. –: Not applicable; ET: Endotracheal intubation; LMA: Laryngeal mask.

Discussion

Our current study showed that for the 5 consecutive years, ET tube was used in 124 cases (68.9%) and LMA in 56 cases (31.1%) for CD under GA. GA was mainly used for contraindication to neuraxial anesthesia or a failed block, and emergent CDs accounted for most cases. None of the patients had regurgitation or aspiration during the study period. LMA could be used safely for obstetric anesthesia, but correct position to achieve a good seal is the key to prevent reflux and aspiration.

The primary limitation of LMA is that it does not reliably protect the lungs from regurgitation and it is important to recognize that high-risk patients including gastroesophageal reflux, full stomach, and intestinal ileus are contraindicated.[15] However, another research demonstrated that the estimated frequency of aspiration associated with LMA was 0.02%, comparable with tracheal intubation (0.03%) in surgical patients.[16,17] More case reports described successful uses of LMA in CDs when tracheal intubation or facemask ventilation was impossible.[4-10] Three large-sample studies also successfully reported their experience of using different types of the LMAs in more than 4700 parturients and reported no cases of aspiration but one case of regurgitation, although it should be noted that low-risk patients were selected in these studies. Patients who had a potentially difficult airway, BMI ≥35 kg/m^2, or gastroesophageal reflux were excluded.[12-14]

Parturients were a high-risk population for difficult airway because physical changes associated with pregnancy, including weight gain, enlarged breasts, and oropharyngeal edema, could complicate ET intubation. Progesterone reduces lower esophageal sphincter tone and gastrointestinal motility, resulting in gastric reflux. Enlarged uterus makes stomach cephalad movement as abdominal pressure

Table 3: Maternal and neonatal morbidity and postoperative outcomes

Items	ET group (*n* = 124)	LMA group (*n* = 56)	Statistics	*P*
Age (years)	31 ± 6	32 ± 4	1.973*	0.532
Gestation (weeks)	37 ± 3	38 ± 2	1.974*	0.093
Height (cm)	162 ± 5	162 ± 7	1.973*	0.529
Weight (kg)	75 ± 14	74 ± 11	1.974*	0.390
BMI (kg/m^2)	28.6 ± 4.8	28.1 ± 3.4	1.974*	0.489
ASA >II	24 (19.4)	4 (7.1)	4.380†	0.036
Emergency CD	79 (63.7)	21 (37.5)	10.733†	0.001
Regurgitation	0	0	–	–
Gastric aspiration	0	0	–	–
Maternal ICU	19 (15.3)	4 (7.1)	2.316†	0.128
Apgar score				
1 min <7	15 (12.1)	4 (7.1)	1.003†	0.317
1 min <4	6 (4.8)	0	1.503†	0.220
5 min <7	5 (4.0)	1 (1.8)	0.108†	0.742
Neonatal PICU	60 (48.4)	20 (35.7)	2.509†	0.113

Data are presented as mean ± SD or *n* (%). **t* values; †Chi-square values. –: Not applicable; BMI: Body mass index; CD: Cesarean delivery; ICU: Intensive Care Unit; PICU: Pediatric Intensive Care Unit; ASA: American Society of Anesthesiologists; SD: Standard deviation; ET: Endotracheal intubation; LMA: Laryngeal mask.

increases. In addition, decreased functional residual capacity and increased metabolic rate accelerate the onset of desaturation after induction and apnea, and these are exacerbated in the obese parturients.[2,18]

However, attributed to more new airway devices introduced into clinical practice and standardized management strategy of unanticipated difficulty intubation provided by guidelines in pregnant women, the risk of aspiration and failed intubation was probably comparable to those of general population, and the ASA recommends that the elective obstetric patients can consume clear fluids up to 2 h before surgery.[19-21] Heinrich *et al*.[22] showed that the rate of failed intubation was 0.4% in patients who underwent CD which may be equivalent to nonobstetric patients. McKeen *et al*.[23] demonstrated the low rates of failed intubation (0.08%) in obstetric population from 1984 to 2003, similar to those of general surgical patients. Saravanakumar and Cooper[24] analyzed the data from 1988 to 2004, giving an incidence of 1 in 543 of failed intubations. Djabatey *et al*.[25] showed the low rates of difficult airway and (0.7%) and failed (0) intubation in GA for 3430 CDs over an 8-year period.

Maternal mortality from failed intubation was 2.3/100,000 general anesthetics for cesarean section (one death per 90 failed intubations). Moreover, the main cause of maternal deaths was hypoxemia secondary to airway obstruction or esophageal intubation.[26] Insertion of LMA is a valuable alternative in case of difficult intubation when maternal hypoxemia occurs. As one of the second-generation LMAs, the Supreme LMA has a gastric drain tube and improved seal which enables positive airway pressure ventilation at a higher level. Factors affecting aspiration risk include fasting status, use of anti-acid drugs, the depth of anesthesia, and correct position. The experience of the operator also influences the chance of successful insertion, and malposition may cause increased airway pressure, gastric insufflation, and poor drainage when regurgitation occurs.[2,3,27] The Supreme LMA was routinely used in our practice because of its efficacy and safety. In this 5-year retrospective research, we reported successful use of the Supreme LMA in 56 parturients including one rescued case. Two obese patients with a BMI of 37 fasted for 6 h also selected the Supreme LMA due to failed epidural puncture or block. No case of regurgitation or aspiration occurred including 21 emergent surgeries. We contributed this perfect result to good clinical training and lot of practices in our daily work.

The present study has certain limitations related to its retrospective nature. There was considerable choice bias in the demographics between two groups. The sample size was too small to find the difference of small probability event such as regurgitation or aspiration between two groups. Whether the LMA could replace the tracheal tube in routine obstetric practice needs further large prospective studies.

In summary, our results suggested that GA was mainly used for contraindication to neuraxial anesthesia or a failed block, and emergent CDs accounted for most cases. The second-generation LMA could be used for obstetric anesthesia, but correct position to achieve a good seal is the key to prevent reflux and aspiration. Whether they could replace the tracheal tube in routine practice needs further large prospective studies.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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