Comparison of standard and reverse methods of laryngeal mask airway (LMA) insertion in pediatric airway management: A clinical trial study

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Abstract

Background: Successful airway management needs extensive knowledge and skills. In this study, we aimed to compare standard and reverse methods of laryngeal mask airway insertion in pediatric airway management.

Materials and methods: This clinical trial carried out on 68 children aged 6 months to 15 years with body weight of 5 to 7 kilograms undergoing elective inguinal hernia repair surgery and were divided into two groups of 34 people. Anesthesia induction was performed with midazolam 0.05 mg/kg, fentanyl 2 mcg/kg, lidocaine 1 mg/kg, and propofol 3 mg/kg and for airway management, laryngeal mask airway (LMA) was inserted. In the first group, laryngeal mask airway was inserted using standard method and in the second group, it was inserted using reverse method. Chest movements, time needed for mask insertion, airway pressure, and number of attempts to insert the LMA compared between the groups.

Results: In this study, 68 patients (45 males and 23 females) with the mean age of 35.23 ± 31.83 months were studied. The mean duration of laryngeal mask insertion in all patients was 45.0 ± 11.60 seconds. We observed a significant difference in laryngeal mask insertion duration (P<0.001), the number of attempts for laryngeal mask insertion (P=0.016), and mucosal injury (P=0.039) between the two groups.

Conclusion: Laryngeal mask insertion using reverse method is introduced as a facilitator in LMA insertion and a preferred selective method, due to lesser time needed for its insertion and fewer complications.

Keywords: Laryngeal mask, Airway management, Insertion method, Complications

Introduction

Successful airway management requires a wide range of specific knowledge and skills. Accurate understanding of airway anatomy and familiarity with airway physiology, the ability to assess the anatomical features of the patient's airway associated with difficult airway, opening airway skills with a variety of equipment are essential for anesthesia [1]. Failure in airway management is a major morbidity factor of anesthesia such as pulmonary aspiration, airway trauma, unforeseen tracheostomy, anoxic brain injury, cardiopulmonary arrest and death. Therefore, laryngeal mask airway (LMA) has been one of the most important emerging developments in airway management to maintain and manage the airway and spontaneous breathing or control during short-term surgery [1]. LMA has traditionally become an alternative to airway management. This device is more easily used by inexperienced people and provides proper airway management in both mechanically ventilated and spontaneously breathing patients [2]. LMA is more tolerable compared to endotracheal intubation at lower concentrations of anesthetic drugs and is less likely to cause airway edema [3, 4] and due to the anatomical differences in children and infants compared to adults, the size of LMA used in them is smaller than adults. Lso, LMA has been used even in peroneal and lateral positions [2, 5-8]. Several methods for LMA insertion have been described to succeed and reduce its complications [9-13]. Classic method with/without slightly inflating the cuff is one of the most common methods [11, 12, 14]. Another method is triple airway maneuvering to place LMA in paralyzed patients, which involves opening the mouth, extending the head, and pushing the jaw forward [16, 15]. In the standard method, the cuff is usually empty and the success rate in the first attempt is 67-90% [6, 7, 13]. Slight inflation of the cuff plays a beneficial role in its passage through the posterior arch of the throat, making it easier to insert successfully [13]. But in the reverse method, LMA was held at the proximal end, near the point of connection to the anaesthetic circuit. Insertion was conducted with the cuff fully deflated, facing the palate, and then rotated anti-clockwise through 180

degrees as it was pushed into the hypopharynx.. Therefore, it may be considered as an alternative to the standard method when predicting or having difficulty locating supraglottic airways [17, 18]. The aim of this study was to use the reverse method to have better conditions regarding ease of insertion and less complications (mucosal trauma and bleeding), increase the success rate of the first attempt and the overall success rate in the patient. In addition, we can reduce some of the problems of the classic method, such as inserting the hand into the patient's mouth and contact with the teeth, which causes severe damage to the hand, so this study compared both standard and inverse methods.

Methods

This randomized double-blind clinical trial study was performed on 68 children aged 6 months to 15 yeard with a weight of 5-7 kg undergoing elective hernia repair surgery in the operating room of Shahid Motahari hospital in Urmia, Iran, in 2020. Exclusion criteria were history of mental and behavioral disorders, emergency surgery, ASAIII ≥, surgeries longer than one hour, presence of active disease in the respiratory system, history of sleep apnea, febrile seizures, developmental disorders and heart disease. According to the study by Ghai *et al* (11.43±3.2 minutes in the rotational method; 14.37±4.1 minutes in the standard method; $Z_{1-\alpha}$ = 2.96; $Z_{1-\beta}$ = 1.28), 34 people were randomly allocated (through random allocation software) in each group [23] (Figure 1). Sampling method was convenience. Induction of general anesthesia was done by midazolam 0.05 mg/kg, fentanyl 2 µg/kg, lidocaine 1 mg/kg and propofol at 3 mg / kg. For airway management, LMA was inserted for patients and continued anesthesia by spontaneous breathing with isoflurane inhaler anesthetic with one Minimum alveolar concentration (MAC), oxygen 50% and N2O 50%.

In the first group (standard group), LMA cuff is completely deflated and inserted into the patient's mouth like a pen using the index finger of the right hand, which is located at the junction of the tube and the laryngeal cuff, while the index finger is hard on the palate in the back of the larynx. In the second group (reverse group), the LMA was held at the proximal end, near the point of connection to the anaesthetic circuit. Insertion was conducted with the cuff fully deflated, facing the palate, and then rotated anti-clockwise through 180 degrees as it was pushed into the hypopharynx. The size of the laryngeal mask and the volume of air entering the cuff were selected according to the manufacturer's instructions. Success of laryngeal mask insertion based on displacement of anesthesia bag with spontaneous breathing of patients or chest expansion (based on observation as Grade 1: motionless movement; Grade 2: relatively good movement; Grade 3: good and sufficient movement) with manual ventilation. The time required to insert LMA and airway pressure based on the number of APL pressures on the CmH2O scale as well as the number of attempts to insert in both groups during anesthesia in the operating room were compared. In both groups, before induction, ECG, heart rate, blood pressure and pulse oximetry were basically measured by digital monitoring and during surgery for hypoxia (drop in o_2 saturation below 90%), airway obstruction, cough, laryngospasm and trauma (presence of blood on the LMA when removed) were assessed.

Ethical issue

The ethics committee of Urmia University of Medical Sciences (#IR.UMSU.REC.1397.200) approved this study. The protocol of this study was registered in Iranian Registry of Clinical Trial (#IRCT20170516033992N3). Written and oral consent was received from the parents of children.

Statistical analysis

Quantitative variables were reported as mean andfrequen standard deviation and qualitative variables as number (percentage). Independent t-test was used to compare the mean of quantitative variables between the two methods and Chi-square test to compare qualitative variables (Fisher test if necessary). The data analysis was performed using SPSS software version 16 and the significance level was considered less than 0.05.

Results

In this study, 68 patients were studie in which 34 patients (50%) underwent laryngeal mask insertion by standard method and 34 patients (50%) by reverse method.

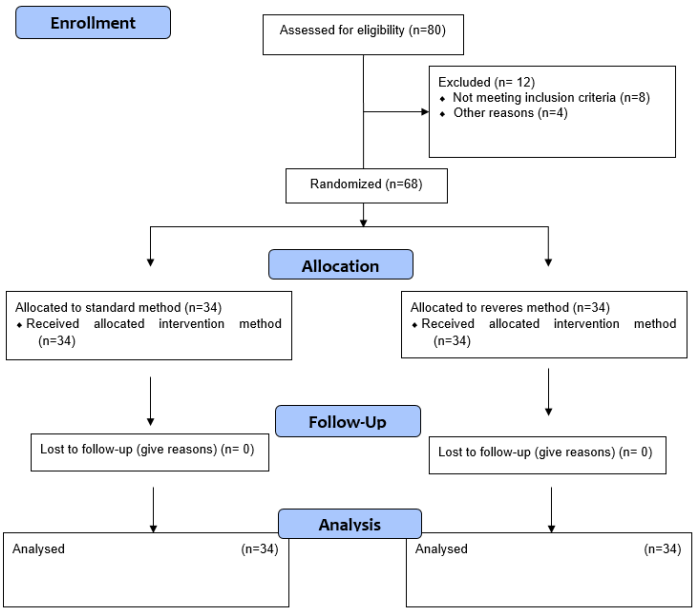

Fig 1: CONSORT flow chart

The mean age of the patients was 35.23±31.83 months. In both groups, most of the participants were male. Regarding chest movement in standard and reverse methods, most patients had good and sufficient chest movement. The mean duration of laryngeal mask insertion in the standard method group was 62.79±10.81 seconds and in the reverse method group was 27.21±12.38 seconds. The mean airway pressure in all patients was 8.34±5.21 cmH_2o. There was a significant difference between the two groups in respect of laryngeal mask insertion time (P <0.001). There was no significant difference between the two groups in terms of age (P = 0.185) and weight (P = 0.331). None of the patients in the two groups had a motionless chest. There was no significant difference between the two groups in terms of chest movement (P = 0.642) and airway pressure (P = 0.572) (Table 1).

Regarding the number of attempts to insert LMA in the standard method group, once attemp for 23 patients (67.6%) and two attempts for 11 patients (32.4%) was recorded. In the reverse method group, one attempt for 31 patients (91.2%) and two attempts for laryngeal mask for 3 patients (8.8%) was recorded. In total, for 54 patients (79.4%) one attempt was made and for 14 patients (20.6%) two attempts were made to insert LMA. There was a significant difference between the two groups regarding the number of attempt to insert LMA (P=0.016). Regarding mucosal damage in the standard method group, 4 patients (11.8%) had mucosal damage and 30 patients (88.2%) had no mucosal damage. In the reverse method group, all patients were without mucosal damage. In total, 4 patients (5.9%) had mucosal damage and 64 patients (94.1%) had no mucosal damage. There was a significant difference between the two groups in terms of mucosal damage (P=0.039) (Table 2).

Table 1: Demographic characteristics of the patients

Variabel		Group		P value
		Reverse	Standard	
Age		40.41±30.21	30.06±33.45	0.18
Weight		14.51±5.26	13.03±7.04	0.33
Gender	Girl	11(32.4)	12(35.3)	0.79
	Boy	23(67.6)	22(64.7)	

Table 2: Demographic characteristics of the patients

Variabel		Group		P value
		Reverse	Standard	
Gender	Girl	11(32.4)	12(35.3)	0.79
	Boy	23(67.6)	22(64.7)	
Chest movement	Motionless	0 (0)	0 (0)	0.64
	Relatively good	2(5.9)	3(8.8)	
	Good and sufficient	32(94.1)	31(92.2)	
LMA insertion time		27.21±12.38	12.79±10.81	0.001
Airway pressure		8.74±7.69	7.94±2.73	0.57
Number of attemps	One	23(67.6)	31(92.2)	0.016
	Two	11(32.4)	3(8.8)	
Mucosal damage	Yes	0 (0)	4 (11.8)	0.039
	No	34 (100)	30 (88.2)	

Discussion

Failure in airway management in children is a major cause of cardiac arrest which was reported to be 1.4 per 10,000 children. By replacing halothane with sevoflurane, the figure has dropped from 37% to 18%. Infants less than 30 days old had the highest rates of cardiac arrest and respiratory problems. In this age group, the most common cause is laryngospasm [24, 25]. Therefore, finding a technique to help maintain the airway in such cases is one of the main responsibilities of an anesthesiologist. LMA introduced in the early 1980s with widespread popularity as a means of the supraglottic airway. Pediatric airways are different from adults in some respects, making LMA insertion more difficult in children. For example, in children with large tongue, laryngeal height, missing teeth, and short neck all contribute to the success rate of LMA insertion in such a way that 67 to 92% of LMA insertion was done in the first attempt. Several techniques have been proposed for LMA insertion, which indicates that its correct insertion requires a wide range of knowledge and skills [26, 27]. Complications of intubation are common and affect up to about 4% of all patients. Previous research has shown that the use of LMA has been associated with voice violence and trauma to the throat and dry mouth. Patients also experienced hemodynamic changes in systolic and diastolic blood pressure and heart rate during surgery following inflating the LMA cuff [28, 29]. In this study, we examined and compared two standard and inverse methods of laryngeal mask airway insertion in pediatric. Totally 68 patients were studied, 34 of whom underwent standard method and 34 by reverse method. In examining other demographic information such as age and weight, no statistically significant difference was observed between the inverse and standard groups. In a study by Haghighi *et al* [21], 100 patients were divided into two groups of 50 people. In their study, age and weight did not show a statistically significant difference. In another study by Aghdashi *et al* [30] to compare the success rate between the two LMA methods, it was shown that there was no statistically significant difference between age, sex and weight. Preliminary results of our study, like other studies, show that the samples were selected from a community with a normal distribution. Our studies showed that in the standard method group, three patients had relatively good chest movement and 31 patients (92.2%) had good and sufficient chest movement. In the reverse method group, two patients had relatively good movement and 32 patients (94.1%) had good and sufficient movement. In total, 63 patients (92.6%) had good and adequate chest movement. None of the patients in the two groups had a motionless chest. There was no significant difference between the two groups in terms of chest movement. There was a significant difference in the mean duration of LMA insertion between the two groups (P <0.001), but no significant difference was observed between the two groups in terms of airway pressure (P = 0.572). The

results of Bagi *et al*'s study [19] showed that the difference in LMA insertion time was significantly different based on the experience of residents and also LMA insertion by residents performed significantly faster than combitube insertion. In the standard method group, one attempt was made for 23 patients and two attempts were made to insert LMA for 11 patients. In the reverse method group, one attempt was made 31 patients and two attempts was made 3 patients. In total, one attempt was made to insert LMA for 54 patients and two attemps for 14 patients. There was a significant difference between the two groups in respect of the number of attemps. Numerous other studies confirm the results of our study.

In a study by Roodneshin *et al* [3], the results showed that in all 30 cases, LMA insertion by specialists in the classical method was performed after two unsuccessful attempts. Their results showed that due to the increased sensitivity of children to hypoxia and the risk of LMA failure with the classical method, an alternative method is recommended in children with macroglossia-related disorders. In another study [21], the overall success rate (LMA insertion after 2 attempts) was 100% for the simplified group, compared to 82% for the classical group ($P < 0.05$). Successful insertion time in simplified group was significantly lower than the classical group ($P < 0.0001$). The presence of blood on LMA was 32% in the classical group and 16% in the simplified group, which did not show a statistically significant difference. There were no side effects such as laryngospasm or a decrease in arterial blood oxygen saturation.

A study by Ghai *et al* [23] on LMA insertion in children using rotational, lateral and standard methods on 168 children aged 6 months to 6 years showed that the success rate in Tthe first attempt was significantly higher in the rotational method (96%) compared to the lateral method (84%) and the standard method (80%) ($P=0.03$). The overall success rate of the rotational method (100%) was higher than the lateral method (93%) and the standard method (87%) ($P=0.003$). Mahmoodpoor *et al* [18] in their study inserted LMA on 150 adult patients under general anesthesia. LMA insertion time, number of attempts, and success rate were determined for all patients. There was no significant difference in the demographic characteristics of the patients between the three groups. LMA insertion time in the lateral method was significantly shorter. The overall success rate for LMA insertion was not significantly different between the three groups. However, there was a positive trend towards the lateral insertion group. Their studies showed that the lateral method is practically easy, does not require pushing the back of the mouth, and therefore has minimal side effects. Therefore, 90-degree rotational or lateral techniques seem to be the best way to insert LMA. The results of the above studies are consistent with our studies. In the standard method group, 11.8% of patients had mucosal damage and 88.2% had no mucosal damage. In the reverse method group, no disease had mucosal damage and all patients were without mucosal damage. In total, 5.9% of patients had mucosal damage and 94.1% had no mucosal damage. There was a significant difference between the two groups in terms of mucosal damage.

Conclusion

Based on the data of this study, it is observed that the use of the reverse method is more successful in terms of the LMA insertion time, the number of attempts to insert LMA and the frequency of mucosal damage were less than the classical method. The success of the reverese method indicates that this is able to play an acceptable role in proper ventilation of the patient. In general, comparison of the success and failure rate in using the reverse method, it can be said that if we put the time component together with the small side effects of this method, the reverse method will be able as a facilitator method with low complication and also be introduced as a preferred choice.

Conflict of interest

The authors declare that there is no conflict of interest in this study.

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