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International Journal of Current Research
Vol. 9, Issue, 12, pp.63423-63426, December, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

COMPARISON OF LARYNGEAL MASK AIRWAY INSERTION TECHNIQUES IN CHILDREN: STANDARD TECHNIQUE WITH FULLY DEFLATED CUFF VS LATERAL APPROACH WITH 90^0 ROTATION WITH PARTIALLY INFLATED CUFF

Vinay Ramesh Dhakate *Harshvardhan Bharadwaj and Agrawal, N.K.

Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, Maharashtra, India

ARTICLE INFO

Article History:
Received 08th September, 2017
Received in revised form
23rd October, 2017
Accepted 11th November, 2017
Published online 31st December, 2017

Key words:

Laryngeal Mask Airway,
Paediatric,
Standard technique,
Lateral approach

ABSTRACT

Background and Aims: Laryngeal Mask Airway (LMA) is widely used for airway management in paediatric anaesthesia. However, differences in paediatric airway anatomy compared to adults can make the correct placement of LMA difficult in paediatric patients. We conducted the study to compare the Standard Brain technique and Lateral approach with 90^0 rotation with partially inflated cuff for LMA insertion in paediatric patients.

Methods: 100 ASA I children aged between 2 to 12 years scheduled for short elective surgical procedures lasting for less than 60 minutes were included in the study. Patients were randomly allocated into one of the two groups, i.e group-S (Standard technique) or group- L (Lateral technique). The success rate at first attempt, overall success rate, time taken for LMA insertion and complications were assessed. Unpaired t-test and fisher's exact test were used for statistical analysis.

Results: Successful insertion at the first attempt was significantly higher in group-S (96 %) compared with group-L (90 %). Overall success rate was 100 % for group-S and 96 % for group-L (P= 0.593). Time for successful insertion was significantly lower in group- L (12.22 ± 3.16 s) compared to group-S (16.9 ± 5.99 s) (P< 0.001). The incidence of complications was lower in group-L.

Conclusion: Although, the standard technique with fully deflated cuff is associated with higher success rate of insertion, the lateral technique with partially inflated cuff has shorter insertion time and fewer complications.

Citation: Harshvardhan Bharadwaj, Vinay Ramesh Dhakate and Agrawal, NK, 2017. "Comparison of Laryngeal Mask Airway Insertion Techniques In Children: Standard Technique With Fully Deflated Cuff Vs Lateral Approach With 90^0 Rotation With Partially Inflated Cuff", *International Journal of Current Research*, 9, (12), 63423-63426.

INTRODUCTION

Laryngeal Mask Airway (LMA) is a supraglottic airway device that is designed to seal around the laryngeal inlet. It was designed by Dr Archie Brain in 1981 and came into clinical practice in 1988 (Brain, 1991). It allows adequate airway control during both controlled and spontaneous ventilation. LMA is frequently used for airway management in paediatric ambulatory anaesthesia because airway patency can be maintained under less anaesthetic doses and has low complication rate compared to endotracheal intubation (An *et al.,* 2013). However, changes in paediatric airway anatomy such as relatively large tongue, a higher and more anterior larynx, a relatively large floppy epiglottis and presence of tonsillar hypertrophy can make correct placement of the LMA more difficult in paediatric patients (Ghai *et al.,* 2008). Suboptimal positioning of the device can leads to air leak or airway obstruction.

Corresponding author:* **Harshvardhan Bharadwaj,
Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, Maharashtra, India.

A success rate of 67–90% had been reported for LMA insertion at the first attempt in children using the standard Brain technique (Ghai *et al.,* 2008; Mahin Seyedhejazi *et al.,* 2012; Nakayama *et al.,* 2002; Ghai and Wig, 2009; Soh and Ng, 2001; Kundra *et al.,* 2003). Various other techniques such as rotational technique, cuff partially inflated and lateral approaches had been described to improve the ease and success of LMA insertion in children (Ghai *et al.,* 2008; Mahin Seyedhejazi *et al.,* 2012; Nakayama *et al.,* 2002; Ghai and Wig, 2009; Soh and Ng, 2001; Kundra *et al.,* 2003; Nagai *et al.,* 2000; O' Neill *et al.,* 1994). Lateral approach with partially inflated cuff has been found to improve the ease and success of LMA insertion in children compared with the standard Brain technique (Kundra *et al.,* 2003). The meta-analysis has revealed that the rotation technique for inserting supraglottic airways produced a higher success rate of insertion, a shorter insertion time, and a lower incidence of airway complications compared to standard technique (Park *et al.,* 2016). We conducted the prospective randomized study to compare standard Brain technique with fully deflated cuff and lateral approach with 90^0 rotation with partially inflated cuff for LMA

insertion in paediatric patients. The ease of insertion, proper placement, and complications related to LMA insertion techniques were studied in two groups.

MATERIALS AND METHODS

The study was conducted at Acharya Vinoba Bhave Rural Hospital (AVBRH) affiliated to Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences (DU), Sawangi (Meghe), Wardha. After institutional ethics committee approval, hundred patients between 1-12 years of age, belonging to ASA I-II grading scheduled for elective surgery for less than 60 min were enrolled in the study. Patients were randomly allocated into one of the two groups using computer generated random numbers; standard technique with fully deflated cuff, Group-S (n=50) and lateral approach with 90^0 rotation with partially inflated cuff, Group-L (n=50). Pre anaesthetic check up was done a day prior to surgery. The procedure of General anaesthesia was explained to the parents and informed written consent was obtained. All the patients were kept nil per oral since midnight. All children were pre-medicated with inj. Glycopyrrolate 0.004 mg/kg, inj Midazolam 0.05 mg/kg, inj. Fentanyl 2 mcg/kg, 10 minutes before induction. Upon arrival to the operation theatre, standard anaesthesia monitoring were used, including non-invasive arterial blood pressure (NIBP), electrocardiography (ECG) and pulse oximetry. After preoxygenation for 3 minutes, patient were induced with inj Propofol 3 mg/kg iv. Adequate depth of anaesthesia was confirmed by jaw relaxation.

In the Standard technique (Group S), the LMA was inserted with cuff fully deflated using the standard method described by Brain. In the Lateral approach (Group L), cuff was partially inflated with half the amount of the air recommended by the manufacturer and then inserted along the right lateral border of tongue with its lumen facing laterally towards left and then rotating it 90^o clockwise as it passed downward into position behind the tongue. Once completely inserted, the cuff was inflated fully. The position of the LMA was confirmed clinically by adequate chest movement on ventilation and auscultating both lung fields to ensure symmetrical air entry. When the proper placement of LMA with one technique failed even after 3 attempts, the other technique was used. General anaesthesia was maintained with Oxygen, Nitrous oxide and Sevoflurane with suitable anaesthetic circuit with spontaneous or controlled respiration. Insertion time was defined as the time from mouth opening to confirmation of airway patency with the LMA in place. The ease of insertion was assessed by the time taken to complete the LMA insertion and the number of attempts before successful placement. The leak around the cuff was graded as follows: grade 1: No leak; grade 2: Palpable leak only; grade 3: Palpable and audible leak with satisfactory ventilation; grade 4: Palpable and audible leak with inadequate ventilation; grade 5: Total obstruction with no possible ventilation. After completion of surgery, Sevoflurane and Nitrous oxide were stopped. LMA was removed with the cuff inflated after complete awakening of the patient. The cuff of the LMA was examined for the presence of blood staining. Once the adequate recovery from general anaesthesia was confirmed, the patient was shifted to recovery room for observation and monitoring. The overall success rate of around 75% and 95% with standard and lateral techniques respectively has been reported. With an alpha error of 0.05, beta error level of 0.2 and statistical power of 80 %, sample size of 49 in each group was required. Therefore, sample size of 100 was selected for the study. The data was summarized and analyzed by using SPSS version 17. The values were represented in percentage (%) and mean ± standard deviation (SD) as appropriate. Unpaired t-test and Fisher's exact test were used for statistical analysis. The P-value < 0.05 was considered as statistically significant.

RESULTS

One hundred patients between 1-12 years of age, scheduled for elective surgery for less than 60 min were randomly allocated into one of the two groups; standard technique with fully deflated cuff, Group-S (n=50) and lateral approach with 90^0 rotation with partially inflated cuff, Group-L (n=50). The patients in the two groups were comparable with respect to age, weight, gender distribution, ASA grading, duration of surgery and size of LMA (table 1). . Mean time for insertion of LMA in Group S was 16.65 ± 5.99 sec and in Group L it was 12.22 ± 3.16 sec. The time for LMA insertion was significantly less in Group L ($p< 0.001$). In Standard technique (Group S), LMA has been inserted in first attempt in 96% of patients and two attempts were required for remaining 4% of patients. Whereas in lateral approach (Group L), we were able to insert LMA in first attempt in 90% of patients, two attempts taken in 6% of patients, but LMA insertion failed even after three attempts in 4% of patients. Hence standard technique had been used in these 4% of failed cases. The overall success rate after 3 attempts was 100% for the Standard technique and 96% for the Lateral approach. 80% of patients in Group S had no leak (Grade 1) around the cuff and remaining 20% had palpable leak only (Grade 2), wherein Group L, 94% of patients had no leak (Grade 1) and remaining 4% patients had palpable Leak (Grade 2). Hence the Leak around the cuff was significantly less in Group L ($p = 0.043$).). None of the patients of Group S or Group L had grade-3 or above leak around the cuff. The only complication we observed was mucosal trauma (blood staining on the cuff) during insertion, seen in 5 out of 50 cases (10%) in Group S. There were no complications observed in lateral approach (Group L) (0% vs 10%, respectively). Hence the complications were significantly less in Group L ($p< 0.05$).

Table 1. Patient characteristics

	Group S (n=50)	Group L (n=50)	P value
Age (yr)	6.45 ± 3.25	6.25 ± 3.44	0.765 (NS)
Weight (Kg)	17.25 ± 5.25	17.59 ± 6.53	0.774 (NS)
Male / Female	31/19	30/20	0.841 (NS)
ASA Grade 1/2	50/0	50/0	>0.999 (NS)
Duration of Surgery	47.65 ± 10.97	49.75 ± 12.29	0.369 (NS)
LMA Size: 1.5/2/2.5	22 / 15 / 13	20 / 19 / 11	0.762 (NS)

S-Significant; NS-Non Significant

Table 2. Characteristics of LMA insertion between two groups

	Group S (n=50)	Group L (n=50)	p- value
Insertion time	16.65 ± 5.99 Sec	12.22 ± 3.16 Sec	<0.0001 (S)
No. of attempts			
1	48 (96 %)	45 (90 %)	
2	02 (4 %)	03 (6 %)	0.593 (NS)
Fail	00	02 (4 %)	
Leak around the cuff			
Grade 1	40	47	
Grade 2	10	03	0.043 (S)
Complications			
Trauma	05 (10 %)	00	0.028 (S)
Laryngospasm	00	00	0.999 (NS)
Desaturation	00	00	0.999 (NS)

S-Significant; NS-Non Significant

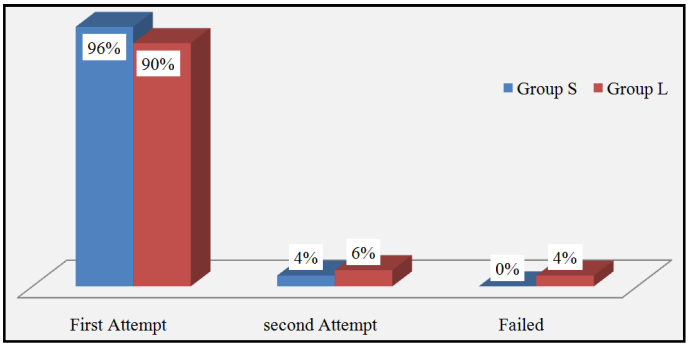

Figure 1: Distribution of Patients according to the Number of Attempts for LMA insertion in two Groups

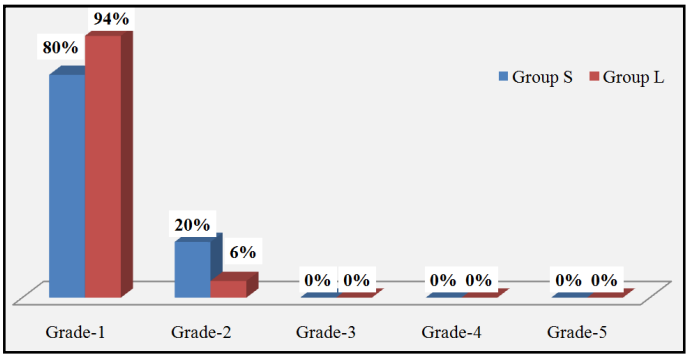

Figure 2: Distribution of Patients according to the Leak around the Cuff in two Groups

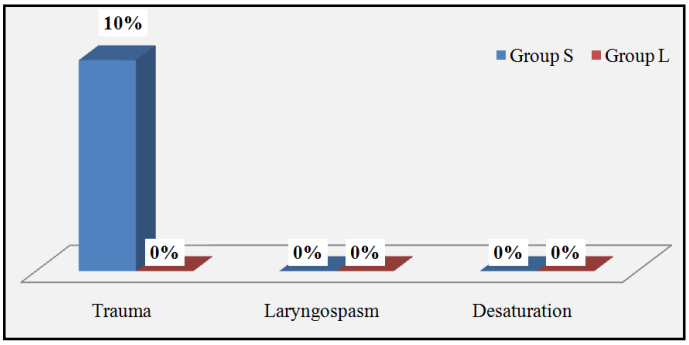

Figure 3: Distribution of Patients according to the Complications in two Groups

DISCUSSION

The results of our study show that, the success rate of insertion at first attempt and overall success rate was greater for the Standard technique than for the Lateral technique with 90-degree rotation. The difference in overall success rate of insertion was insignificant (P= 0.593). Failure after three attempts occurred in two children (4 %) in the lateral group due to tip of LMA folding against posterior pharyngeal wall. All patients in the standard technique (Group S) had the LMA inserted in two attempts. However, previous studies have shown better success rate with rotational technique with partially inflated cuff compared to standard Brain's technique. The overall success rate after three attempts was 100% for the rotational technique and 95% for the standard technique (P= 0.24) in the study conducted by Yun et al (2011). They noted greater success rate of insertion at the first attempt with rotational technique than the standard technique (97% vs 70%; p<0.001)]. Ghai et al. also observed that the first attempt success rate was significantly higher (96.2%) with 180^0 rotational technique compared with standard technique (80.7%). Overall success rate was 100% with rotational technique compared to 89.7% with standard technique (P=0.003) (Ghai *et al.,* 2011). Nakayama et al, also observed higher success rate at the first attempt and overall success rate with rotational technique with a partially inflated cuff against standard non-rotational technique respectively (99% vs 79%; P< 0.05 and 100% vs 96%) (Nakayama *et al.,* 2002). However, in our study, the mean time required for LMA insertion was significantly less with the lateral approach with 90^0 rotation with partially inflated cuff compared to standard technique with fully deflated cuff. (12.22±3.16 s vs 16.9±5.99 s; P< 0.001).The results are consistent with previous studies (Ghai *et al.,* 2008; Kundra *et al.,* 2003; Yun *et al.,* 2011). However, Nakayama observed no difference in insertion time between the rotational technique with partially inflated cuff and standard non rotational technique (14.3±2.5 s vs 14.6 ± 2.65 s) (Nakayama *et al.,* 2002).

The suboptimal position of LMA can cause partial obstruction as well as inadequate seal increasing the risk of aspiration. Also, the increased resistance to airflow during positive pressure ventilation will cause higher airway pressure. In our study, placement of LMA as determined by leak around the cuff was found to be better with rotational technique than standard technique. The incidence of grade-2 leak (Palpable leak around the cuff) was 20% (10/50) in group S as compared to 06% (03/50) in group L (P <0.043). Ghai et al. in their study of fibre optic assessment of LMA position in children reported better sealing of LMA with rotational technique than the standard technique (Ghai *et al.,* 2011). The incidence of mucosal injury during insertion of LMA as determined by blood staining on removal of LMA was lower in Group L (0%) as compared to Group S (10%) (P< 0.028), as shown in previous studies (Ghai *et al.,* 2008; Nakayama *et al.,* 2002; Soh and Ng, 2001; Yun *et al.,* 2011; Ghai *et al.,* 2011; Hwang *et al.,* 2009; Kumar *et al.,* 2012; Raghavan *et al.,* 2017). With lateral approach with partially inflated cuff, the rounded edges of LMA cuff seems to be less traumatic than sharp edges of fully deflated cuff. Also, smooth advancement due to reduced resistance between the LMA and the pharyngeal wall could be responsible for less injury to the upper airway tissues. The limitations of our study were that, the anaesthesiologists who performed the LMA insertion were not blinded to the study groups and fibre-optic examination through the LMA to assess anatomic placement was not done in our study. However, we do not believe that these limitations influenced our results.

Conclusion

Either technique can be used for LMA insertion in paediatric patients. Since lateral approach with 90-degree rotation has shorter insertion time, better placement and less complications, it should be used as a first technique of LMA insertion in children. If the lateral rotational technique fails, standard technique can be used as it has higher overall success rate.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

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