Original Article

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Prospective Randomised Comparative Study of Laryngeal Mask Airway in Relation to Laryngeal Inlet between Standard and Rotational Insertion Techniques using Fibreoptic Bronchoscope in Children

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Abstract

Background and Aims: Laryngeal mask airway is a novel device that bridges the gap in airway management between endotracheal intubation and face mask. In this study we wanted to determine the optimal insertion technique of LMA in children. The aim of this study is to compare the position of LMA in relation to laryngeal inlet between the two insertion techniques - the standard brain technique and rotational technique by using fibre optic bronchoscopy in children.

Methods: This is a randomised controlled study which included 60 patients divided in two groups of 30 each based on technique of insertion of LMA. After successful insertion, position of LMA is graded using fibre optic bronchoscope.

Results: In patients belonging to rotational technique group the incidence of FOB grade 1 is 96.67%and FOB grade 3 is 0%. Similarly, in standard technique group the incidence of FOB grade 1is 60% and FOB grade 3 is 3.33%.

Conclusion: Rotational technique of LMA insertion is associated with better positioning in relation to laryngeal inlet compared to standard technique as well as lesser attempts and decreased complications.

Keywords: Paediatric LMA insertion; Rotational technique LMA.

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Introduction

Many techniques are described to improve success rate of LMA placement in children. Fibreoptic assessment in paediatric population around the larynx demonstrates a high incidence of malposition of LMA. Suboptimal position of LMA can cause partial obstruction and incomplete seal around the larynx, thereby increasing the chance of regurgitation. In this study we have compared

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two LMA insertion techniques- the standard brain technique and rotational technique by using fibreoptic bronchoscope in children.

Methods

This study is a prospective randomised case control study conducted after getting approval from institutional ethics committee. Patients undergoing surgeries in day care surgery theatre at Institute of child health and hospital were assessed for inclusion and exclusion criteria after obtaining written informed consent from parents.

The study included 60 patients, divided into two groups. Group S, standard technique (standard brain technique) and group R, rotational technique. The primary objective was fibreoptic assessment of LMA position in relation to glottis. The secondary objectives are time taken for LMA insertion, number of attempts for LMA insertion, hemodynamic parameters and complications during LMA insertion intraoperatively and during postoperative period. The following are inclusion criteria: ASA 1 and 2, children aged 3 to 8 years, elective surgeries, valid informed consent obtained from parents or guardians. The following are excluded: ASA 3, 4, patients at risk of aspiration, anatomical abnormalities of airway or anticipated difficult airway, upper respiratory tract infection, patients with full stomach and history of asthma. Randomisation was done by computer generated table.

The children were premedicated with oral midazolam 0.5mg/kg 30 mins prior to shifting. In the operation theatre standard monitors attached. Baseline Heart rate, NIBP, Oxygen Saturation, and respiratory rate are recorded. After securing intra venous line, inj glycopyrrolate 10 mcg /kg i.v, fentanyl 2 mic/kg i.v are given. Child is induced with propofol 3.5mg/kg, inj xylocard 1.5mg /kg followed by insertion of LMA after adequate jaw relaxation. Vital parameters are monitored and FOB grading done. Following LMA insertion in both techniques, LMA was inflated with 10ml of air in size 2 and 15ml of air in size 2.5 LMA and seal was obtained. Cuff was inflated to maintain pressure around 45cms of water, measured using cuff pressure manometer. Successful placement was checked by chest expansion, reservoir bag movement and appearance of capnographic tracing in monitor. Maintenance of anaesthesia is with 50% O2 and N2O and 2% sevoflurane. Child is allowed to breathe spontaneously, airway patency checked clinically. The grading of FOB is as follows

Grade 1: larynx only seen

Grade 2: larynx and posterior epiglottis surface seen

Grade 3: larynx, epiglottis tip or anterior surface seen

Grade 4: Epiglottis downfolded and anterior surface seen

Grade 5: Epiglottis downfolded and larynx cannot be seen directly

Various grading scales are available. Brimacombe[1] proposed a similar grading scale and another fibreoptic grading scale was proposed by Julian Arevalo[2] using I gel.

Primary outcome measured is fibreoptic assessment of LMA position in relation to glottis. The secondary outcomes measured are time taken for insertion of LMA, number of attempts made, complications encountered, hemodynamic parameters, use of manoeuvres to relieve airway obstruction. Caudal block of 0.25% bupivacaine 1ml/kg was given for analgesia to both the groups. The intraoperative and post-operative complications were recorded

In case of gastric distension, decompression was done using nasogastric tube. Intraoperative laryngospasm was managed with 100% oxygen and additional dose of 1mg/kg propofol and repositioning of LMA done. At the end of procedure LMA was removed in deep plane of anaesthesia and face mask was used. After the child became conscious, child was shifted to recovery room.

Statistical analysis

Sample size was determined using this formula.

Formula $n=(Z\alpha/2+Z\beta)2*(p1(1-p1) +p2(1-p2))/(p1-p2)2$,

where $Z\alpha/2$ is the critical value of the normal distribution at $\alpha/2$(e.g. for a confidence level of 95 % αis 0.05 and the critical value is 1.96

$Z\beta$ is the critical value of normal distribution at β (e.g. for a power of 80%, β is 0.2 and the critical value is 0.84) and p1 and p2 are the expected sample proportions of the two groups

Based on this the minimum sample size required for the study was calculated to be 27. Power of the study is 80%. In our study 60 subjects were chosen and divided into two groups of 30 each. (30 standard and 30 rotational) by computer allocated randomization number. Descriptive statistics was done for all data and were reported in terms of

mean values and percentages. Continuous variables were analysed with unpaired t tests and ANOVA single factor test. Categorical variables will be analysed with Chi square test and Fischer exact test. Statistical significance will be taken as $p<0.05$. The data will be analysed using SPSS version 16 and Microsoft excel 2007.

Both the groups were comparable in terms of age, gender, height, weight, LMA size, FOB grading, time for insertion, number of attempts, hemodynamic parameters , and complications.

By conventional criteria the FOB grading status between the rotational technique group and the standard technique group among study subjects is considered to be statistically significant since $p<0.05$ as shown in the table below.

By conventional criteria the time for insertion distribution between the rotational technique group and the standard technique group among study subjects is considered to be statistically significant since $p <0.05$ as shown in the table below.

Results

In patients belonging to the rotational technique group, the mean time for insertion is 8.43 minutes. Similarly, in standard technique group the mean time for insertion is 11 minutes. The decreased time for insertion in rotational technique group compared to standard technique group is statistically significant as the p value is <0.0001 as per unpaired t test indicating a true difference between the groups.

Table 1: Age Distribution.

Age Distribution	Rotational technique	%	Standard technique	%
≤4 years	6	20.00	3	10.00
5-6 years	14	46.67	14	46.67
7-8 years	10	33.33	13	43.33
>8 years	0	0.00	0	0.00
Total	30	100	30	100

P value unpaired test: 0.1015

Table 2: Gender Distribution.

Gender Status	Rotational technique	%	Standard technique	%
Male	28	93.33	23	76.67
Female	2	6.67	7	23.33
Total	30	100	30	100

P value Fischer's exact test: 0.0856

Table 3: Weight distribution.

Weight Distribution	Rotational technique	Standard technique
N	30	30
Mean	18.23	18.77
SD	3.46	3.43

P value unpaired t test: 0.5512

Table 4: FOB grading between two groups.

FOB Grading	Rotational Technique	%	Standard Technique	%
Grade 1	29	96.67	18	60.00
Grade 2	1	3.33	11	36.67
Grade 3	0	0.00	1	3.33
Total	30	100	30	100

P value Fischer's exact test: 0.0006.

Table 5: LMA size between two groups.

LMA Size	Rotational technique	%	Standard technique	%
Size 2	22	73.33%	18	60.00
Size 2.5	8	26.67%	12	40.00
Total	30	100	30	100

P value Fischer's exact test : 0.2910

Table 6: Time for insertion between groups.

Time for Insertion	Rotational technique	Standard technique
N	30	30
Mean	8.43	11
SD	0.86	1.31

P value unpaired t test: <0.0001

Discussion

Endotracheal intubation is the procedure for administration of general anaesthesia and a secured way of airway control. Laryngeal mask is a useful airway device both for GA and emergency airway maintenance. Advantages of LMA over endotracheal tube include speed of placement, improved hemodynamic stability during induction and emergence, lower incidence of coughing, sore throat and reduced anaesthetic requirement. Various studies including the one by SM Asida et al.,[3] and Wen Xian et al.,[4] have shown that LMA is a reliable paediatric supraglottic airway device demonstrating relatively low failure rates. Paediatric LMA plays a role in short day care procedures, maintenance of airway in inhalational anaesthesia or as a conduit for intubation using FOB and also plays a role in new-born resuscitation. Various insertional techniques have been studied to find an optimal method of LMA insertion. The

various methods of insertion include standard, rotational and lateral techniques with cuff inflated or partially inflated.[5,6] There are several methods to confirm the position of LMA and the gold standard being use of fibre optic bronchoscope.

In our study sample size was calculated based on study conducted by Babitha ghai et al.,[7] using FOB grading as the parameter. The induction can be either intravenous or inhalational induction. In our study we used inj fentanyl 2µg /kg with inj. Propofol 3.5mg/kg. This was similar to the study Seyedhejazi et al.,[8] which concluded that propofol 3.5mg/kg is equally effective for LMA insertion. in another study Ranju Singh et al.,[9] compared ketamine with propofol and fentanyl with propofol for LMA insertion in children and concluded that fentanyl with propofol provided the ideal insertion condition. There are several techniques described for LMA insertion, few common ones are standard, rotational and lateral. Standard technique is placement of LMA with the LMA aperture facing caudally which is advanced into hypopharynx till resistance is felt. McNicol et al.,[10] described an alternate technique of LMA insertion in which the LMA was introduced with aperture facing cranially with partially inflated cuff into pharynx and now turned to 180 degrees before it was advanced to final position. This was the reason why we took this study to know which method will be ideal in paediatric anaesthesia practice.

In our study success rate of LMA insertion by rotational technique was 100% in 1st attempt and in standard technique it was 83.3% in 1st attempt and 16.67% in second attempt. The attempt status was not statistically significant since p value was more than 0.4 which correlates with the study conducted by Babitha Ghai et al.,[12] comparing three techniques and found success rate at 1st attempt more with Rotational (96%), lateral (84%) and standard (80%). Further the airway seal provided by LMA is well maintained during surgery. This is also proved in a study by Richard et al where they showed that increase in cuff pressure during surgery in presence of no 2 is small and probably not a cause for clinical concern.

In our study the time for LMA insertion on an average mean was around 8.43 seconds in Rotational technique and 11 seconds in standard technique with mean difference of 2. 57 seconds. This was found to be statistically significant with p value of <0.0001 determined by unpaired t test indicating true difference among the study groups. This correlates with the study conducted by Babitha et al.,[12] in which the time taken for successful insertion is 12.24 seconds in rotational technique and 15.94 seconds in standard technique with significant p value of < 0.001.

In our study the incidence of FOB grade 1 was meaningfully more in rotational technique group compared to the standard technique group by 60% with percentage difference of 36.67 points. The incidence of FOB grade 3 was meaningfully less in rotational technique group compared to standard technique group by 3.33% with a percentage difference of 3.33 points. This difference is true and significant. Hence, we can infer that rotational technique significantly results in better seating of LMA than standard technique during positioning of laryngeal mask airway in relation to laryngeal inlet, studied using fibre optic bronchoscope in children. The above result was similar to the study conducted by Soh et al 13in which they found FOB grade 1 and 2 view with rotational technique was 92.3% and with standard technique was 61.5%. A similar study in adults by Kumar et al.,[14] also showed rotational technique to be easier with lesser complications compared to standard technique.

Common complications during LMA placement include coughing, gagging, apnoea, bleeding, laryngospasm and gastric distension. In our study the incidence of complications during insertion was more with standard technique when compared to rotational technique but not statistically significant. The incidence of intraoperative and post-operative complications were more with standard technique but were not statistically significant. Similar results were seen in study conducted by Nakayama et al[14] where there was lower incidence of complications like laryngospasm, apnoea and trauma in rotational technique compared to standard technique

In our study the heart rate, respiratory rate distribution oxygen saturation and blood pressure distribution between the two groups were compared and there was no statistical significance with p value >0.05.

Conclusion

In this study we conclude that rotational technique of LMA insertion is associated with better positioning of LMA in relation to laryngeal inlet when compared to Standard technique by using Fibre optic bronchoscope in children. Also, the LMA insertion time, number of attempts for LMA insertion and incidence of complications were less with rotational technique than standard technique.

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