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Comparative study of outcome of general anaesthesia using intubation versus LMA in paediatric cardiac device closure interventions

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Abstract

Background: With a view to minimize the anaesthesia related risks in paediatric cardiac cases, we proposed using LMA for short period procedures. Present study was aimed to compare the outcome of using LMA as against the traditional intubation with ETT in patients undergoing general anaesthesia for paediatric device closure interventions. **Material and Methods:** Present study was single-center, comparative study, conducted in paediatric patients with ASD, PDA requiring device closure. Patients were randomly allocated to LMA or ETT group. **Results:** In present study, 30 cases were operated in each group. Gender, body weight, admission to procedure interval (days), hospital stay (days) & procedure total time (minutes) were comparable in both groups. Among ETT group majority cases required 4.5 size ETT (53.33 %) & 4/5 size ETT (23.33 % each). Among LMA group majority cases required 2 size LMA (40 %) followed by 1.5 size LMA (33.33 %) & 1 size LMA (26.67 %). Emergence time was comparable in both groups. We observed that less sevoflurane (1.5 ± 0.3 vs 1.8 ± 0.4), less propofol (22 ± 8 mg vs 58 ± 14 mg), less glycopyrrate (43 ± 13 mg vs 84 ± 31 mg), less midazolam (0.6 ± 0.2 mg vs 0.9 ± 0.3 mg) & less fentanyl (24 ± 7 mg vs 51 ± 14 mg) was required in LMA group as compared to ETT group & difference was statistically significant. We measured vitals such as pulse, systolic and diastolic blood pressures, SpO_2 prior induction, at induction and every 5 mins thereafter till the end of procedure, no hemodynamic instability noted among both groups & difference was not significant statistically. **Conclusion:** In paediatric cardiac device closure interventions under general anaesthesia, LMA is relatively non-invasive, requires less anesthetic drugs as compared to endotracheal intubation.

Keywords: paediatric cardiac device closure, general anaesthesia, LMA, endotracheal intubation

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Introduction

Paediatric cardiac anaesthesia is required done mainly for diagnostic (defining anatomy, pressure mapping, angiography, EP studies etc.) and therapeutic (device closure: ASD, PDA; pulmonary coiling, radio-ablation etc.). It requires general anaesthesia with airway protection as intervention may last longer or lead to complication and hybrid surgeries.[1,2] Airway management of the paediatric patients is a challenge for anesthesiologists. Anatomical and physiological changes continue till 10-12 years of age. The development of critical skill is utmost necessary for the anesthesiologists for successful management of airway.[3]

Paediatric airway due to physiological reasons, is the most difficult to handle both while intubation and during extubation. With the advent of LMA a relatively safer alternative to invasive airway; became an equipment of choice for airway protection during GA for short period. Owing to ease of insertion, it has gained a place in difficult airway algorithm, ACLS and trauma protocols. Also, negating the requirement of paralyzing agent for insertion gives LMA an advantage over endotracheal tube.[4,5]

With a view to minimize the anaesthesia related risks in paediatric cardiac cases, we proposed using LMA for short period procedures. Present study was aimed to compare the outcome of using LMA as against the traditional intubation with ETT in patients undergoing general anaesthesia for paediatric device closure interventions namely, atrial septal defect and patent ductus arteriosus.

Material And Methods

Present study was single-center, comparative study, conducted in department of anaesthesiology, at XXX medical college & hospital, XXX, India. Study duration was of 2 years (January 2021 to December 2022). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- All paediatric patients with ASD, PDA requiring device closure, parents willing to participate in present study

Exclusion criteria

- Cases planned for hybrid surgeries

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- Cases converted to open surgeries
- Cases abandoned due to cardiac reason

Study was explained to parents in local language & written consent was taken for participation & study. All patients underwent a preoperative anaesthetic check-up and fitness from paediatrician was obtained. Prophylactic antibiotic was given one hour prior to surgery: ampicillin and gentamycin intravenously. Nil by mouth 6 hours prior and patient started on 0.9% NS at 2ml/kg/hr. Patients were randomly allocated to LMA or ETT group.

Preoperatively, Inj glycopyrrolate 2-4 mic/kg; Inj midazolam 0.02-0.05 mg/kg. Induction was done with Inj propofol max 2mg/kg. For intubation inj scoline 2mg/kg was given while LMA was inserted without muscle relaxant. ETT was selected according to age formula and on direct visualization of the vocal cords confirmed and placed inside. Air entry checked both sides and airway secured by inflating the cuff. For LMA, depth of anaesthesia was ascertained, mouth opening confirmed and appropriate size chosen to insert. Bilateral air entry confirmed and LMA was secured; cuff inflated.

The anaesthesia was maintained on mix of oxygen, nitrous (60% - 40%) and sevoflurane adjusted to MAC of 1.5-2 on a JR circuit for weight less than 20 kg. Paediatric close circuit was used for weight more than 20 kg. A bolus of injection propofol if required was given at the time of puncture of the femoral artery. The patients' spontaneous breaths were with assisted after the scoline wear-off and depth of anaesthesia maintained. No top-up was required or given. Patients on LMA were allowed to breathe with assistance as required.

A top-up inj fentanyl dose was given for surgery lasting more than one hour. Paracetamol suppository adjusted to weight was inserted prior the procedure for post op pain. All vitals: pulse, systolic and diastolic pressures, Spo2 were monitored prior induction, at induction and every 5 mins thereafter till the end of procedure.

The emergence time from sevoflurane anaesthesia was calculated from the moment of turning off the dial to opening of eyes. Patient was shifted to recovery on achieving Modified Aldrete Score of 9. Any adverse event during or post operative was noted. Standard post operative protocol was observed.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.05 was considered as statistically significant.

Results

In present study, 30 cases were operated in each group. In LMA group majority children were from 1-3 years age group ()90 % as compared to 7-9 years (56.67 %) in ETT group & difference was statistically significant. In LMA group Procedure was PDA device insertion (86.67 %) as compared to ASD closure 26 (86.67 %)%) in ETT group & difference was statistically significant. Gender, body weight, admission to procedure interval (days), hospital stay (days) & procedure total time (minutes) were comparable in both groups.

Table 1: General characteristics

Characteristics	LMA (n=30)	ETT (n=30)	p value
Age (years)			0.043
1-3	27 (90 %)	4 (13.33 %)	
4-6	3 (30 %)	9 (30 %)	
7-9	0	17 (56.67 %)	
Gender			0.082
Male	10 (33.33 %)	17 (56.67 %)	
Female	20 (66.67 %)	13 (43.33 %)	
Body weight (Kgs)			0.077
<10	7 (23.33 %)	0	
10.1-15	16 (53.33 %)	8 (26.67 %)	
15-20	7 (23.33 %)	9 (30 %)	
21-25	0	4 (13.33 %)	
>25	0	9 (30 %)	
Admission to procedure interval (days)			0.077
1	3 (30 %)	9 (30 %)	
1-3	20 (66.67 %)	17 (56.67 %)	
>3	7 (23.33 %)	4 (13.33 %)	
Hospital stay (days)			0.063
<3	3 (30 %)	5 (16.67 %)	
3-6	17 (56.67 %)	21 (70 %)	
>6	10 (33.33 %)	4 (13.33 %)	
Procedure done			0.023
ASD closure	4 (13.33 %)	26 (86.67 %)	
PDA device insertion	26 (86.67 %)	4 (13.33 %)	

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Procedure total time (minutes)			0.073
<35	7 (23.33 %)	9 (30 %)	
35-40	16 (53.33 %)	9 (30 %)	
41-45	7 (23.33 %)	4 (13.33 %)	
>45	0	8 (26.67 %)	

In present study, among ETT group majority cases required 4.5 size ETT (53.33 %) & 4/5 size ETT (23.33 % each). Among LMA group majority cases required 2 size LMA (40 %) followed by 1.5 size LMA (33.33 %) & 1 size LMA (26.67 %).

Table 2: LMA & ETT size

Characteristics	LMA	ETT
ETT		
4	7 (23.33 %)	0
4.5	16 (53.33 %)	0
5	7 (23.33 %)	0
LMA size		
1	0	8 (26.67 %)
1.5	0	10 (33.33 %)
2	0	12 (40 %)
2.5		

Emergence time was comparable in both groups. We observed that less sevoflurane (1.5 ± 0.3 vs 1.8 ± 0.4), less propofol (22 ± 8 mg vs 58 ± 14 mg), less glycopyrrate (43 ± 13 mg vs 84 ± 31 mg), less midazolam (0.6 ± 0.2 mg vs 0.9 ± 0.3 mg) & less fentanyl (24 ± 7 mg vs 51 ± 14 mg) was required in LMA group as compared to ETT group & difference was statistically significant.

Table 3: Anaesthesia characteristics

Characteristics	LMA	ETT	p value
Emergence time (minutes)			0.084
<8	10 (33.33 %)	13 (43.33 %)	
>8	20 (66.67 %)	17 (56.67 %)	
Sevoflurane			
<1.4	7 (23.33 %)	4 (13.33 %)	
1.4-1.8	10 (33.33 %)	5 (16.67 %)	
>1.8	13 (43.33 %)	21 (70 %)	
Mean dose	1.5 ± 0.3	1.8 ± 0.4	0.042
Propofol (mg)			
15	17 (56.67 %)	0	
20	7 (23.33 %)	0	
25	3 (10 %)	0	
30	3 (10 %)	13 (43.33 %)	
35	0	0	
50	0	17 (56.67 %)	
Mean dose	22 ± 8	58 ± 14	0.020
Glycopyrrolate (mg)			
30	3 (30 %)		
40	13 (43.33 %)		
50	10 (33.33 %)	4 (13.33 %)	
60	4 (13.33 %)	9 (30 %)	
70-80		4 (13.33 %)	
>80		13 (43.33 %)	
Mean dose	43 ± 13	84 ± 31	0.002
Midazolam (mg)			
0.4	4 (13.33 %)		
0.5	13 (43.33 %)		
0.6	10 (33.33 %)	8 (26.67 %)	
0.7-0.8	3 (30 %)	9 (30 %)	
1		13 (43.33 %)	
Mean dose	0.6 ± 0.2	0.9 ± 0.3	0.012

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Fentanyl (mcg)			
15	4 (13.33 %)	0	
20	13 (43.33 %)	0	
25	10 (33.33 %)	0	
30	3 (30 %)	9 (30 %)	
35	0	0	
40	0	9 (30 %)	
50	0	8 (26.67 %)	
60	0	4 (13.33 %)	
Mean dose	24 ± 7	51 ± 14	0.023

We measured vitals such as pulse, systolic and diastolic blood pressures, SpO_2 prior induction, at induction and every 5 mins thereafter till the end of procedure, no hemodynamic instability noted among both groups & difference was not significant statistically.

Discussion

Interventions performed in cardiac catheterization laboratory (CCL) on paediatric and young adult patients are increasing due to better expertise, better availability of devices, non-operative advantage and shorter hospitalization with lesser morbidity.[6] ASD closure is indicated in the presence of a significant left-to-right shunt, defined by a significant right heart enlargement due to volume overload, regardless of symptoms.[7]

Laryngeal mask airway (LMA) and endotracheal tube (ETT) intubation are among the most important artificial airway devices used at the time of general anesthesia.[8] Traditionally, ETT insertion has been recognized as the foundation of maintaining adequate airway management. LMA offers a much less invasive way of maintaining airway as it does not pass-through glottis. Both are noxious stimuli which elicit transient or marked sympathetic response.[9]

The endotracheal tube remains the gold standard in securing the airway because of its features of maintaining positive pressure ventilation, prevention of gastric inflation and aspiration. The expertise of the airway physician is enormous in handling the device. Endotracheal intubation is associated with increased haemodynamic response, injury to oro-pharyngeal structures and sometimes failed intubation.

Hemodynamic response to laryngoscopy and intubation area reflection of an increase in sympathoadrenal activity due to oropharyngeal and laryngotracheal stimulation. Major afferent source of the stimuli responsible for the adrenergic response may be the supraglottic structures distorted by laryngoscopy.[10] Supraglottic airway devices forms an important adjunct in securing the airway with minimal injury to oro-pharyngeal structures and maintaining anaesthesia.

Compared with the LMA, endotracheal tube, speed and ease of placement is higher in LMA. It avoids need of muscle relaxants and there is no hoarseness of voice. However, it presents lower seal pressures and higher incidence of gastric insufflations. The McNicol technique or rotational and lateral insertion with the cuff partially inflated has been used to improve the ease and success of insertion in children.[11]

A meta-analysis by A et Patki A,[12] noted that the LMA was seen to have three advantages over the tracheal tube in the form of lower incidence of cough during emergence, lower incidence of postoperative sore throat and lower incidence of postoperative vomiting ($P<0.05$). It was seen to offer no advantage over the tracheal tube in incidence of bronchospasm or laryngospasm during emergence; also, it did not offer any advantage in increasing the efficacy of the airway seal. The only disadvantage the LMA had over the tracheal tube was its greater incidence of placement failure in the first attempt.

In study by Shahin N J et al.,[13] insertion of LMA was easier in 94% patients while endotracheal intubation was done easily in 53% of patients only ($p<0.05$). The changes in haemodynamic parameters were significantly higher after endotracheal intubation as compared to LMA placement. Furthermore, these changes persisted for longer duration after endotracheal intubation in comparison to LMA insertion (5 min vs 3 min). Incidence of postoperative complications i.e. bronchospasm, laryngospasm and soft tissue trauma was significantly higher($p<0.05$) after endotracheal intubation as compared to LMA insertion.

LMA is relatively non-invasive as compared to endotracheal intubation and causes minimal disturbances in cardiovascular and respiratory system.[14] ETT is considered safer than LMA under general anesthesia, although, in comparison, the advantages of LMA include faster insertion without the use of a laryngoscope and a higher rate of successful first attempts, even for a novice anesthesiologist. Additionally, LMA has been reported to be safe for use in all age groups for various surgical procedures.[15]

Conclusion

In paediatric cardiac device closure interventions under general anaesthesia, LMA is relatively non-invasive, requires fewer anesthetic drugs as compared to endotracheal intubation. Thus, LMA is a suitable and safe alternative to ETT for airway management in paediatric cardiac device closure interventions under general anaesthesia

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