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Ketamine 0.5 mg.kg^{-1} as Co-induction Agent with Propofol 2.5 mg.kg^{-1} Vs Propofol 3.5 mg.kg^{-1} for Laryngeal Mask Airway Insertion in Children: A Clinical Comparative Study

Kumara AB[1], Ashwini S[2], Gurudatta KN[3]

[1,2]Assistant Professor, [3]Professor and Head, Department of Anesthesiology, Shivamogga Institute of Medical Sciences, Shivamogga, Karnataka 577201, India.

Abstract

Introduction: Propofol is the widely used induction agent for smooth insertion of laryngeal mask in children who require a larger dose compared to adults[1–3] and hemodynamic and respiratory effects like hypotension,[2,4] bradycardia, apnoea, hypoventilation[4] may be exaggerated. The present study was undertaken with the objectives to assess (i) effectiveness of ketamine as a co-induction agent in lowering the induction dose of propofol while producing favorable insertion characteristics for Laryngeal Mask Airway insertion in children (ii) safety in producing hemodynamic stability (iii) recovery of the patient. *Methods:* ASA I and II, aged 3–10 years children posted for elective short surgical procedures were allocated randomly into two groups of 30 each. Patients in Group P received propofol 3.5 mg.kg^{-1} and Group KP received intravenous ketamine 0.5 mg. kg^{-1} two minutes prior to propofol 2.5 mg.kg^{-1}. LMA insertion characteristics assessed in the next 30s using (1) "mouth opening" graded on a three-point scale-full, partial and impossible (2) "the ease of LMA insertion" graded on a four-point scale-easy, some difficulty, difficult and impossible. The hemodynamic parameters recorded immediately after ketamine, propofol (0 min), thereafter at 1 minute interval for 5 minutes. At the end of surgery, LMA removed once the child was adequately recovered. Statistical evaluation done using Frequencies and Crosstabs, Paired Sample *t* - test and Repeated measure ANOVA. *Results:* Ketamine as a co-induction agent with propofol produced favorable conditions for smooth insertion of laryngeal mask in children while providing greater hemodynamic stability.

Keywords: Co-induction; Ketamine; Propofol; Laryngeal mask airway.

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Introduction

Various induction methods are available for induction of anesthesia and Laryngeal Mask Airway (LMA) insertion. The widely used intravenous induction agent Propofol facilitates smooth insertion of laryngeal mask in children who will require a larger dose of propofol compared to adults when used as the sole agent[1–3] and the hemodynamic and respiratory effects like bradycardia, hypotension,[2,4] hypoventilation,[4] apnoea may be exaggerated. The addition of a small dose of other anesthetic agent (in sub-anesthetic doses) or a sedative *viz*. ketamine, propofol (auto co-induction), midazolam, fentanyl,

Corresponding Author: Ashwini S, Assistant Professor, Department of Anesthesiology, Shivamogga Institute of Medical Sciences, Shivamogga, Karnataka 577201, India.

E-mail: ashwini.satrasala@gmail.com

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alfentanil greatly reduces these side effects by reducing the requirement of the induction agent[4–11] and is known as co-induction.[7] Ketamine *via* additive action[4,6–9] reduces the dose of Propofol required for induction. The hemodynamic stability provided thereby improves the ratio of desired *vs* adverse effects with variable effect on recovery.

Hence, the present clinical comparative study was undertaken to study the effectiveness of ketamine as co-induction agent with propofol *vs* propofol alone for laryngeal mask insertion in children with objectives to assess (i) the effectiveness of ketamine as a co-induction agent in lowering the induction dose of propofol while producing favorable insertion characteristics for Laryngeal Mask Airway insertion (ii) the safety in producing hemodynamic stability (iii) the recovery of the patient.

Materials and Methods

This clinical study was conducted on sixty children of age *3 years* to *10 years* of either gender scheduled for elective short surgical procedures like circumcision, herniotomy, hydrocele disconnection, orchidopexy and rectal polyp excision under general anesthesia, belonging to ASA Grade I and II admitted at McGann Teaching Hospital attached to Shivamogga Institute of Medical Sciences, Shivamogga during *June 2015* to *May 2017*. The institution scientific and ethical committee approval obtained for the conduct of study and informed consent from child's parent/ guardian was also taken.

Children of age less than *3 years* or more than *10 years*, belonging to ASA Grade other than I and II and subjects with full stomach, allergy to egg or lignocaine, hyper reactive airway disease, epilepsy, head injury/raised ICP and neuromuscular diseases were exclusion criteria.

The children were allocated randomly by a computer generated random table into two Groups of 30 patients each:

Group P (n = 30): Received intravenous propofol *3.5 mg.kg^{-1}*

Group KP (n = 30): Received intravenous ketamine *0.5 mg.kg^{-1} two minutes* prior to intravenous injection propofol *2.5 mg.kg^{-1}*

All children were assessed for pre-anesthetic fitness on previous day and the subjects were pre-medicated with Syrup Promethazine *0.3 mg.kg^{-1}* orally at night before surgery and EMLA cream with occlusive dressing applied over identified peripheral line on the dorsum of both hands *1 hour* before surgery.

The child received in the operating room, an intravenous line secured and multi-channel monitor for heart rate, Non-invasive Blood Pressure (NIBP), oxygen saturation and continuous ECG monitoring connected.

All the basal parameters noted and pre-oxygenated for *3 minutes* using appropriate size facemask and breathing circuit, induced with propofol *3.5 mg.kg^{-1}* given intravenously over *30 seconds* in Group P or ketamine *0.5 mg.kg^{-1}* intravenously and *2 minutes* later, propofol *2.5 mg.kg^{-1}* given IV over 30 seconds in Group KP. Inj 1% lignocaine *0.5 mg.kg^{-1}* was added to propofol to prevent the pain on injection. The appropriate size laryngeal mask airway (#2 if child weighed *10–20 kg*, #2.5 if child weighed *20–30 kg*) was inserted after another *30 seconds* as per standard insertion technique advocated by Archie Brain.

The insertion characteristics were compared among the two Groups using:

1. Extent of Mouth opening graded on three point scale;
2. Ease of laryngeal mask airway insertion graded on four point scale as given under assessment.

A bolus of *0.5 mg.kg^{-1}* propofol was given, if failed on first attempt. LMA use abandoned and alternative technique considered if insertion graded impossible.

Patients allowed to breath spontaneously under anesthesia maintained using 66% nitrous oxide and 33% oxygen, assisted if in apnoea. No stimulus was allowed during *5 minute* study period. Halothane 0.5% to1.5% added later as per requirement. LMA was removed once the child adequately recovered *i.e.*, being awake and breathing spontaneously with adequate tidal volume. The child was observed for *30 min* in the recovery room for any post-operative undesirable responses before transfer to post-operative ward.

Assessment of LMA insertion characteristics

1. Extent of mouth opening graded on Three Point Scale;
   - Full (fully relaxed jaw);
   - Partial (some resistance);
   - Impossible.
2. Ease of insertion of laryngeal mask graded on Four Point Scale:
   - Easy (placement at first attempt);
   - Some difficulty (placement at second attempt);

- Difficult (more than two attempts);
- Impossible.

Hemodynamic monitoring

Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Oxygen saturation (SpO_2) were recorded at basal, immediately after ketamine, *zero minute* (immediately after propofol), *one, two, three, four, five minutes* after propofol and the readings compared within the group and between the Groups P and KP.

- Hypotension was defined as > 20% fall in systolic blood pressure compared to basal value;
- Bradycardia was defined as heart rate less than *60 bpm*;
- Duration of anesthesia–from induction to removal of LMA;
- Duration of surgery–from surgical incision to closure.

Statistical evaluation of the observations done using Frequencies and Crosstabs, Paired Sample *t* - test and Repeated measure ANOVA.

Results

The demographic data: Mean age, mean weight and gender distribution of the children in two groups were comparable (Table 1) and $p > 0.05$.

Table 1: Demographic data

Demographic data	Group P (n = 30)	Group KP (n = 30)
Gender (Male/Female)*(%)	76/24	82/18
Mean Age (*years*)	7	7.5
Mean Weight (*kgs*)	18	18.5

The LMA insertion characteristics assessed: The mouth opening was full in 93.3% of patients in Group P and 96.7% of patients in Group KP while the mouth opening was partial in 6.7% and 3.3% in Group P and KP respectively (Table 2). The mouth opening was not found to be impossible in either groups. The extent of mouth opening was not statistically significant between Groups P and KP ($p > 0.05$).

Table 2: Showing Extent of Mouth opening for LMA Insertion

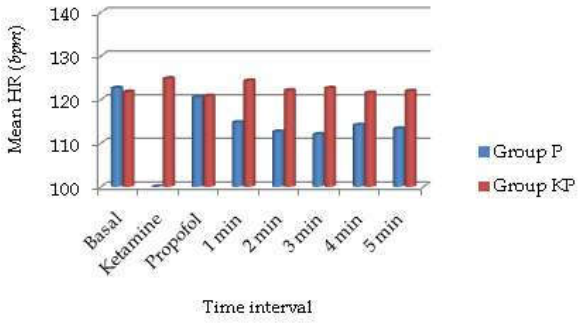
Scale	Group P n (%)	Group KP n (%)
Full	28 (93.3)	29 (96.7)
Partial	2 (6.7)	1 (3.3)
Impossible	0	0

The LMA insertion was Easy in 93.4% in Group P and 96.7% in Group KP. Some difficulty was observed in 3.3% in both the Groups and was Difficult in 3.3% of cases in Group P and none in Group KP. The insertion of LMA was not impossible in both the Groups (Table 3).

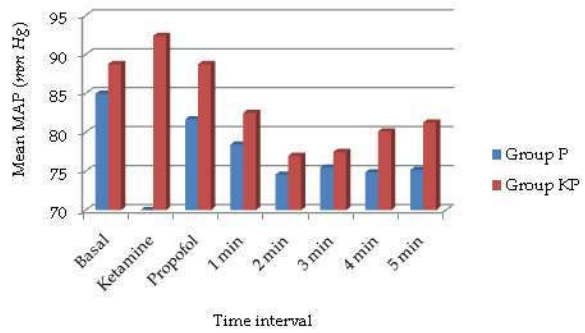
Table 3: Showing ease of insertion of Laryngeal Mask Airway

Scale	Group P n (%)	Group KP n (%)
Easy	28 (93.4)	29 (96.7)
Some difficulty	1 (3.3)	1 (3.3)
Difficult	1 (3.3)	0
Impossible	0	0

The mean heart rate and the mean arterial pressure showed significant decrease in comparison to its basal in Group P while they were not significantly different from the baseline in Group KP (Graphs 1 and 2). The difference was statistically significant between the groups though not amounted to bradycardia, hypotension.



Graph 1: Graph showing changes in Mean Heart Rate



Graph 2: Graph showing changes in Mean MAP

The undesirable responses like coughing, gagging and involuntary movements were observed in 3.3% of patients in Group KP while laryngospasm or desaturation was not encountered during insertion or removal of LMA in Group KP. None of the above undesirable responses were seen in Group P.

No statistically significant difference in mean

duration of surgery (*16 min* and *17 min*) and anesthesia (*26 min* and *31 min*) was observed between Groups P and KP ($p > 0.05$).

Discussion

Patel DK *et al*.[12] reported that children aged *1–12 yrs* both pre-medicated and unpremedicated, satisfactory anesthesia can be achieved with propofol in a larger dose of *2.5–3.5 mg.kg*$^{-1}$ as an induction agent. Allsop E *et al*.[13] also reported that a laryngeal mask airway can be immediately inserted after induction of anesthesia with propofol *3.5 mg.kg*$^{-1}$ which is safe and effective dose in children aged *4–9 yrs*. Propofol is needed in higher doses for induction in children is consistent with the larger volume of distribution as suggested by Saint-Maurice C *et al*.[14] in their study. Goel S *et al*.[4] used propofol *3.5 mg.kg*$^{-1}$ in propofol alone group and in co-induction groups used propofol *2.5 mg.kg*$^{-1}$ with either midazolam *0.05 mg.kg*$^{-1}$ or ketamine *0.5 mg.kg*$^{-1}$ IV *2 min* before propofol, both mixed with lignocaine *0.5 mg.kg*$^{-1}$, and inserted LMA 30s after propofol injection in children aged 1–8 yrs; found midazolam or ketamine improved conditions for laryngeal mask insertion while providing stable hemodynamics. Similarly, Riham Hussein[9] reported that ketamine *0.5 mg.kg*$^{-1}$ as coinduction agent with propofol provides better LMA insertion conditions in children aged *4–11 yrs*. R Latif Mohamad *et al*.,[6] Z Begec *et al*.,[8] Riham Hussein[9] reported that ketamine due to its antagonism on NMDA receptors acts additively with propofol. Thus, in the present study, we chose propofol *3.5 mg.kg*$^{-1}$ as optimal dose in Group P while in Group KP, ketamine *0.5 mg.kg*$^{-1}$ was administered as the co-induction agent *2 min* before propofol *2.5 mg.kg*$^{-1}$.

The LMA insertion characteristics assessed by grading mouth opening on three point scale as full, partial and impossible, and ease of LMA insertion graded on four point scale as easy, some difficulty, difficult and impossible by Driver IK *et al*.,[15] Driver I *et al*.[16] 30s after propofol bolus. Goel S *et al*.[4] assessed the insertion characteristics 30s after propofol bolus as excellent, satisfactory and unsatisfactory depending on the relaxation of jaw, presence or absence of coughing, gagging, swallowing, limb movement and laryngeal spasm. They reported excellent insertion conditions in 27.8% and 60% of patients, satisfactory in 50% and 40% of patients and unsatisfactory in 22.2% and nil in propofol and propofol-ketamine groups respectively. Similarly, Z. Begec *et al*.[8] and Latif Mohamad *et al*.[6] scored insertion conditions of PLMA using 6 variables on 3-point scale. In our study, we assessed the insertion characteristics based on mouth opening and ease of insertion of laryngeal mask airway similar to observations by Driver IK *et al*.[15] and Driver I *et al*.[16] Our findings on LMA insertion characteristics were similar to that reported by Goel S *et al*.,[4] Srivastava U *et al*.,[5] Z Begec *et al*.[8] indicating significant improvement in insertion characteristics in Group KP compared to Group P. In the present study, 3.3% patients in Group KP had undesirable responses like coughing, gagging, involuntary movements at insertion of LMA and our findings are similar to study by Z Begec *et al*.[8]

The hemodynamic parameters were stable and maintained close to baseline in Group KP compared to Group P. Our findings are similar to the observations made by Goel S *et al*.,[4] Srivastava U *et al*.,[5] Z Begec *et al*.[8] and Riham Hussein[9] who used ketamine as co-induction agent.

There was no undue delay in recovery in Group KP compared to Group P as the mean duration of surgery and anesthesia were comparable.

Conclusion

Ketamine as a co-induction agent used in combination with propofol produces most favorable conditions for smooth insertion of laryngeal mask airway in children with preservation of baseline hemodynamic parameters and undelayed recovery times when compared to propofol alone.

References

1. Hannallah RS, Baker SB, Casey WMB, *et al*. Propofol: Effective dose and induction characteristics in unpremedicated children. Anesthesiology. 1991;74:217–79.
2. Mirakhur RK. Induction characteristics of propofol in children; Comparison with thiopentone. Anesthesia. 1998;43:593–98.
3. Short TG, Chui PT. Propofol and midazolam acts synergistically in combination. British Journal of Anesthesia. 1991;67:539–45.
4. Goel S, Bhardwaj N, Jain K. Efficacy of ketamine and midazolam as co-induction agents with propofol for laryngeal mask insertion in children. Pediatric Anesthesia. 2008;18:628–34.
5. Srivastava U, Sharma N, Kumar A, *et al*. Small dose propofol or ketamine as an alternative to midazolam co-induction to propofol. Indian J Anesth. 2006;50(2):112–14.

6. Latif Mohamad R, Tang SSP. Comparison between effects of ketamine and midazolam as co-induction agents with propofol for ProSeal™ laryngeal mask insertion. Sri Lankan Journal of Anesthesiology. 2016;24(1):16–21.
7. Stoelting RK, Hillier SC. Pharmacology and physiology in anesthetic practice. 4th edition. Philadelphia: Lippincott Williams & Wilkins; 2006. pp. 140–47, 155–63.
8. Z Begec, S Demirbilek. Ketamine or alfentanil administration prior to propofol anesthesia: The effects on ProSeal™ laryngeal mask airway insertion conditions and hemodynamic changes in children. Anesthesia 2009;64:282–86.
9. Hussein R. Randomized double-blind comparison of fentanyl, ketamine and ketamine-midazolam; with propofol; for the insertion of laryngeal mask airway in children. AAMJ. 2012, Suppl-1;10:88–105.
10. Kumar AA, Sanikop CS, Kotur PF. Effect of priming principle on the induction dose requirements of propofol: A randomized clinical trial. Indian J Anesth. 2006;50(4):283–87.
11. Amrein R, Hetzel W, Allen SR. Co-induction of anesthesia: The rationale. Eur J Anesthesiol Suppl. 1995;12:5–11.
12. Patel DK, Keeling PA, Newman GB, *et al*. Induction dose of propofol in children. Anesthesia. 1988;43:949–52.
13. Allsop E, Innes P, Jackson M, *et al*. Dose of propofol required to insert the laryngeal mask airway in children. Pediatric Anesthesia. 1994;5:47–51.
14. Saint-Maurice C, Cockshott ID, Douglas J, *et al*. Pharmacokinetics of propofol in young children after a single dose. Br J Anesth. 1989;63:667–70.
15. Driver IK, Wiltshire S, Mills P, *et al*. Midazolam co-induction and laryngeal mask insertion. Anesthesia. 1996;51:782–84.
16. Driver I, Wilson C, Wiltshire S, *et al*. Co-induction and laryngeal mask insertion. A comparison of thiopentone *vs* propofol. Anesthesia. 1997;52:695–703.