ANAESTHESIA, PAIN & INTENSIVE CARE
www.apicareonline.com

ORIGINAL ARTICLE

Study of dose related effects of dexmedetomidine on laryngeal mask airway removal in children -a double blind randomized study

Ravi Bhat, MD[1], Mahantesh Mudukanagoudar[1], Sandeep Shetty, MD[2], Shyamsundar Kamath[3] MD

[1]Associate Professor; [2]Junior Resident; [3]Professor
Department of Anesthesiology, SDM College of Medical Sciences & Hospital, Dharwad, (India)

Correspondence:
Dr Ravi Bhat, Department of Anesthesiology, SDM College Of Medical Sciences & Hospital, Dharwad, (India) -580009;
E-mail: kakkodravi@yahoo.co.in

Received: 4 Jun 2018
Reviewed: 14 Jun, 18 Jul 2018
Revised: 21 Jun 2018
Re-reviewed: 2 Jul 2018
Accepted: 8 Sep 2018

ABSTRACT

Background and objective: Respiratory complications during removal of airway device and postoperative agitation are commonly experienced problems in pediatric anesthesia. Dexmedetomidine being a potent α2 adrenergic receptor agonist has the capability to circumvent this problem. This study was designed to evaluate efficacy of two doses of dexmedetomidine on laryngeal mask airway removal.

Methodology: Ninety children of 1 to 8 years were recruited for this randomized double blind study. The patients were randomly allocated into three groups and received either normal saline (Group S), dexmedetomidine 0.5 µg /kg (Group D0.5) or dexmedetomidine 1 µg /kg (Group D1) with 30 patients in each group. Anesthesia was induced with Sevoflurane in oxygen. All patients received intravenous fentanyl 1µg/kg followed by caudal block. LMA of appropriate size was inserted when jaw relaxation was adequate and then 5 ml of the study drug was administered over 10 minute. LMA removal was assessed according to preset criteria. Assessment of emergence agitation was done using Aonos four point scale.

Result: Incidence of smooth LMA removal was significantly more in Group D1 compared to Group S (p = 0.0001) and in Group D1 compared to Group D0.5 (p = 0.0020) but difference was not significant between Group D0.5 and Group S (p = 0.1142).Patients who did not have emergence agitation was significantly more in Group D0.5 (p = 0.05) and Group D1 (p = 0.0001) compared to Group S and also in Group D1 compared to Group D0.5 (p = 0.0102).

Conclusion: A single dose of dexmedetomidine 1 µg /kg provides better conditions for smooth removal of laryngeal mask airway in children. Dexmedetomidine 1 µg /kg is more effective than 0.5 µg /kg in reducing emergence agitation.

Key words: Dexmedetomidine, emergence agitation, laryngeal mask airway,

Citation: Bhat R, Mudukanagoudar M, Shetty S, Kamath S. Study of dose related effects of dexmedetomidine on laryngeal mask airway removal in children -a double blind randomized study. Anaesth Pain & Intensive Care 2018;22(3):368-373

INTRODUCTION

Dexmedetomidine - an α2-adrenergic receptor agonist potentiates anesthetic effect of all the anesthetic agents irrespective of the mode of administration (intravenous, inhalational, regional blockade). Intraoperative administration of dexmedetomidine in lower concentrations has reduced the requirement of other anesthetic agents, fewer interventions to treat tachycardia and a reduction in the incidence of myocardial ischemia.[1]

Dexmedetomidine has been used for the sedation in pediatric patients undergoing different type

of procedures such as cardiac catheterization and magnetic resonance imaging. Agitation during recovery from anesthesia is an important issue in pediatric age group. Dexmedetomidine has been successfully used in children for smooth removal of laryngeal mask airway (LMA) with decreased postoperative respiratory complication and agitation.[2] Dexmedetomidine 0.75 μg/kg administered fifteen minutes before extubation, stabilizes hemodynamics and facilitates smooth extubation.[3] Not many studies have been conducted to evaluate the efficacy of different doses of dexmedetomidine on LMA removal and postoperative recovery in pediatric age group.

The aim of the present study was to compare two doses of dexmedetomidne on LMA removal in children. The secondary objectives were complications of LMA removal, incidence of emergence agitation and postoperative recovery.

METHODOLOGY

After obtaining ethical committee clearance and informed consent from patient's parent, 90 patients belonging to age group of 1 to 8 years, scheduled to undergo inguinal hernia were recruited during October 2013 to June 2015 for this randomized double blind study. Patients having arrhythmias, congenital heart disease, respiratory tract infection, difficult airway or allergies to the study drugs, were excluded from the study. All the patients were kept nil-per-os for 6 h for solids, 4 h semisolids and 2 h for clear fluids. Sedative premedication midazolam 0.5 mg/kg oral was given half an hour before surgery. The patients were randomly allocated into either of the three groups; saline (Group S), dexmedetomidine 0.5 μg/kg (Group D0.5) or dexmedetomidine 1 μg/kg (Group D1) using computer generated random numbers. Blinding was maintained, anesthesiologist A, who was consultant anesthetist for the procedure, administered the study drug and anesthesiologist B, junior resident performing this study, who was blinded to the administered drug, assessed and recorded different parameters in all the cases.

In the operating room, standard monitoring was done during the whole study. Anesthesia was induced with sevoflurane in oxygen. Appropriate intravenous (IV) access was secured after achieving adequate depth of anesthesia; and an infusion of Ringer's Lactate (RL) was started. All patients received 1 μg/kg of fentanyl citrate. Caudal block was administered in left lateral position, with 1 ml/kg of 0.25% bupivacaine for perioperative analgesia. LMA of appropriate size was inserted when jaw relaxation was adequate. The LMA was selected as size 1 for < 5 kg, size 1.5 for 5-10 kg, size 2 for 10-20 kg and size 2.5 for 20 to 30 kg. Soon after insertion of LMA patients received 5 ml of the study drug drawn in 5 ml syringe given over 10 min. Group D0.5 received dexmedetomidine 0.5 μg/kg, Group D1 received dexmedetomidine 1 μg/kg and Group S received 5 ml of normal saline.

Anesthesia was maintained with sevoflurane in oxygen and nitrous oxide and hemodynamic parameters were maintained within 20% of baseline value. Spontaneous ventilation was maintained during operation, ventilation was assisted manually in patients who became apneic or end tidal carbon dioxide increased over 45 mmHg.

After the end of surgery sevoflurane and nitrous oxide was cut off and waited for emergence with patient breathing on 100% oxygen. LMA was removed with the cuff inflated when the patient met recovery criteria i.e. spontaneous eye opening, facial grimace or purposeful arm movements.

The definition of smooth removal was absence of development of vigorous coughing (coughing > 4 times continuously), breath holding, LMA biting, gross head movements, teeth clenching, vomiting during or within one minute of LMA removal. Adverse events like laryngospasm or desaturation immediately after LMA removal was documented.

Assessment of recovery: Recovery time or time to discharge was the time spent in postanesthesia care unit to reach discharge criteria. Patients were kept in PACU until they attained an Aldrete score of 9 or more. The postoperative recovery including respiratory complications like laryngospasm, breath holding (more than 10 sec), severe coughing (> 4 times continuously), desaturation (< 95%), excessive salivation (requiring suctioning) was noted.

Assessment of emergence agitation (EA): The incidence of EA was evaluated using Aonos four point scale,1 according to which 1 = calm; 2 = not calm but could be easily consoled; 3 = moderately agitated or restless and not easily calmed; 4 = combative, excited, or disoriented, thrashing around. Scores of one and two were considered as absence of EA, and scores of three and four as presence of EA. Patients who seemed to have pain were given fentanyl 1 μg/kg.

Statistical Analysis: Statistical analysis was done using SPSS version 18.0 for windows and descriptive statistics was applied. Data were analyzed by rates, ratios, percentages and proportions. Data were presented as mean ± standard deviation or numbers (percentage). Chi-square test used to find out the association between two attributes. Analysis of

Table 1: demographic data

Variable	Group S (n = 30)	Group D0.$_5$ (n = 30)	Group D1 (n = 30)	p- value
Male/female	29/1	25/5	29/1	0.083
Age (months)	36.70 ± 24.78	40.70 ± 14.14	42.97 ± 23.98	0.527
Weight (kg)	11.08 ± 3.92	11.82 ± 2.83	12.07 ± 3.94	0.548
Anesthesia time	48.10 ± 8.01	49.33 ± 8.16	56.23 ± 6.79	0.0001
Emergence time	4.20 ± 1.86	8.57 ± 3.92	13.13 ± 4.62	0.0001
Recovery time	54.90 ± 10.08	74.0 ± 9.32	94.0 ± 14.17	0.0001
Surgery time	32.13 ± 7.10	31.57 ± 7.25	32.27 ± 5.15	0.910

Table 2: Comparison of three groups with respect to LMA removal

LMA removal	Group D0.5 (n = 30)	Group D1 (n = 30)	Group S (n = 30)
Smooth	15 (50%)	26 (86.6%)	8 (26.8)
Non-Smooth	15 (50%)	4 (13.3%)	22 (73.2%)
Chi-square = 20.0702, p = 0.0001* Between D0.5 vs D1, chi-square = 9.3200 P = 0.0020* Between D0.5 vs S, chi-square = 2.5010 P = 0.1142 Between D1 vs S, chi-square = 19.8176, P = 0.0001*			

Table 3: Comparison of complications on LMA removal in three groups.

Complication	Group D0.5 (n = 30)	Group D1 (n = 30)	Group S (n = 30)
None	50	86.66	26.66
Coughing	6.66	0	43.33
Tube biting	40	13.33	20
Gross movement	3.33	0	6.66
Breath holding	0	0	3.33

Table 4: Comparison of three groups with respect to emergence agitation

Agitation score	Group D0.5 (n = 30)	Group D1 (n = 30)	Group S (n = 30)
Agitation	6 (20%)	0	13(43.33%)
No agitation	24(80%)	30	17(56.67%)
Chi-square = 16.9462,p = 0.0002*			
Between D0.5 vs D1, chi-square = 6.6671 P = 0.0102*			
Between D0.5 vs S, chi-square = 3.7741 P = 0.0500*			
Between D1 vs S, chi-square = 16.5963, P = 0.0001*			

variance statistical model was used to analyze the differences among and between groups. $P < 0.05$ was considered to be statistically significant.

RESULTS

The mean age in our study was 40.12 months and comparable between the three subgroups. Male-female distribution, weight, surgery time were comparable between the groups (Table 1). Emergence from anesthesia and recovery was significantly delayed in Group D1 when compared to Group D0.5 and Group S. Dexmedetomidine 0.5 μ/kg also delayed emergence and recovery when compared to Group S.

The number of patients who had smooth LMA removal was significantly more in Group D1 (86.67%) when compared with both Group D0.5 (50%) and Group S (26.67%)., whereas the difference between Group D0.5 vs Group S (p = 0.1142) was not significant (Table 2). Coughing and tube biting were the most common complications of LMA removal (Table 3).

Emergence agitation was significantly less in D0.$_5$ and D$_1$ when compared with normal saline group (p = 0.0001) (Table 4).

Hemodynamic variation:

The decrease in heart and blood pressure was less than 20% from the baseline and change in hemodynamic parameters at 20 min after study drug infusion and discharge was not statistically significant in each of the group compared to their baseline. But statistically significant decrease in HR and SBP was found between Group D0.5 and Group D1 compared to Group S ten minutes from start of infusion (Figure 1).

DISCUSSION

In our study, we compared the efficacy of dexmedetomidine 0.5 μg /kg and dexmedetomidine 1 μg /kg as single bolus dose for smooth removal of LMA in children. In this study the percentage of patients who had a smooth removal of LMA was significantly higher in patients who received dexmedetomidine 1 μg / kg compared to placebo (normal saline) as well as dexmedetomidine 0.5 μg /kg. There was no significant

difference in smooth LMA removal between dexmedetomidine 0.5 μg /kg and normal saline.

Guler et al. in their study concluded that a single-dose bolus injection of dexmedetomidine 0.5 μg /kg before tracheal extubation attenuates airway-circulatory reflexes during extubation in adult patients.[4] In our study incidence of coughing was significantly more in saline group (43.33%) compared to dexmedetomidine 0.5 μg /kg (6.66%) similar to the findings of a study conducted by Guler et al. but other parameters were comparable and we did not find any significant difference in smooth removal of LMA between these two groups. Smooth removal of LMA cannot be defined by merely by absence of coughing; other parameters need also to be considered. Therefore, our finding that dexmedetomidine 0.5 μg /kg does not provide smooth removal of LMA is more justified.

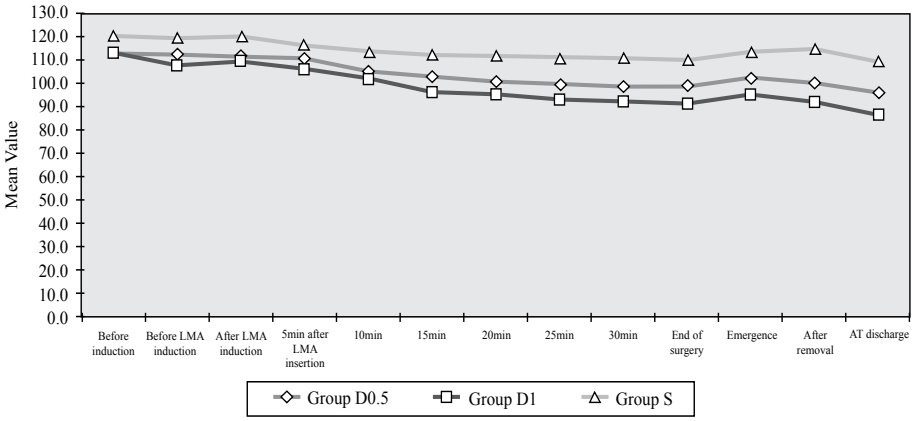

Figure 1: comparison of three groups with respect to heart rate

Guler et al.[5] conducted similar study in pediatric age group and concluded that dexmedetomidine 0.5 μg /kg provides smooth extubation, here again cough was the only parameter considered. In our study dexmedetomidine was administered soon after induction, whereas in other studies it was given five minutes prior to extubation, this may well be the cause for variation in the results.

Le He et al.[2] concluded that single bolus dose of dexmedetomidine given soon after induction produces a dose dependent decrease in end tidal concentration of sevoflurane required for smooth removal of LMA in children. Dexmedetomidine 1 μg /kg produced more significant decrease in sevoflurane concentration compared to dexmedetomidine 0.5 μg /kg to provide smooth removal of LMA. The findings of our study support that higher dose of dexmedetomidine would be required to provide smooth LMA removal.

Fan Q et al.[6] found that the rate of smooth tracheal extubation was the same for remifentanil and dexmedetomidine 0.7 μg/kg, but the rate of smooth extubation was significantly lower for group receiving dexmedetomidine 0.5 μg/kg compared to the other two groups. In our study too, it was found that higher dose of dexmeditomidine is useful for smooth removal of LMA.

Kim S Y et al.[7] concluded that intraoperative infusion of dexmedetomidine 0.4 μg/kg provided smooth and hemodynamically stable emergence in adult patients undergoing nasal surgery. In the study conducted by Kim S Y et al. the incidence of coughing was comparable between two groups during emergence and that dexmedetomidine 0.4 μg/kg/h did not provide added advantage with respect to decreasing incidence of coughing. Higher dose will provide better extubation condition as observed in our study.

Lee et al.[8] found that after a loading dose of dexmedetomidine 2.5 μg /kg/h for ten minute that is about 0.42 μg/kg infused before induction of anesthesia, followed by a maintenance dexmedetomidine at 0.4 μg /kg/h till 30 min before the end of the operation, the median degree of strain was significantly lower in the dexmedetomidine group compared to control group. Therefore dexmedetomidine if used in low loading dose, has to be substituted with maintenance dose to produce desired smooth extubation.

Emergence agitation

The difference in number of patients who did not have emergence agitation was significantly more in Group $D0._5$ and Group D_1 compared to Group S and also in Group D_1 compared to Group $D0._5$. Le He[2] et al. found that incidence of agitation was significantly decreased in both dexmedetomidine 0.5 μg/kg (17%) and dexmedetomidine 1 μg/kg (6%) group when compared to control group (42%) but they did not find any significant added advantage of 1 μg/kg. In our study dexmedetomidine in dose of 1 μg/kg produced significant decrease in emergence agitation compared to 0.5 μg/kg.

M. Shukry et al.[9] concluded that the perioperative infusion of 0.2 μg/kg/hr dexmedetomidine decreases the incidence and frequency of emergence delirium

in children after sevoflurane based general anesthesia. Bispectral index was used in this study, which would have helped in titrating the sevoflurane concentration meticulously but, as the type of surgery and anesthesia time were not uniform, it might have confounded the results. In our study sevoflurane was titrated according to hemodynamic changes; whereas duration of anesthesia, pain management and type of surgery were uniform.

G. Guler et al.[5] concluded that 0.5 μg /kg IV dexmedetomidine reduces agitation after sevoflurane anesthesia in children undergoing adenotonsillectomy. We also concur with these findings. But we found that 1 μg /kg was clinically better than 0.5 μg /kg in decreasing emergence agitation and resulted in smooth removal of LMA.

Ibacache et al10 studied the effect of dexmedetomidine on recovery characteristics in 90 children scheduled to undergo superficial lower abdominal and genital surgery. They concluded that a dose of dexmedetomidine 0.3 μg /kg administered after induction of anesthesia reduces the sevoflurane induced agitation in children, whereas dexmedetomidine 0.15 μg /kg was not useful. However, our findings are that higher doses of dexmedetomidine are necessary to produce satisfactory results.

Isik b et al.[11] found that the incidence of emergence agitation was 47.6% in placebo group as compared to 4.8% in dexmedetomidine 1 μg/kg group in children anesthetized for MRI, which was significantly low. We found that no patients in our study with same dosage had any emergence agitation. Both dexmedetomidine 0.5 μg/kg and dexmedetomidine 1 μg/kg are useful in preventing emergence agitation. Increasing the dose of dexmedetomidine has positive effect in decreasing the incidence of emergence agitation.

Emergence and recovery:

Emergence time was significantly more in dexmedetomidine group compared to control group; and patients in dexmedetomidine 1 μg /kg had longer emergence time compared to 0.5 μg /kg.

Le He[3] et al. concluded that dexmedetomidine 0.5 μg/kg significantly reduced the emergence time and recovery time reasoning that decreased sevoflurane requirement introperatively may have led to early awakening. In their study anesthetist repeatedly called the patient's name and tapped the patient's shoulders every minute until the patient opened his or her eyes but in our study the patient was left undisturbed without external stimulus, this may have led to the difference in emergence times between the two studies. M Shukry et al.[9] studied the effects of continuous perioperative infusion of dexmedetomidine @0.2 μg/kg/h and concluded that there was no prolongation of emergence time.

Guler G et al.[5] found that time to emergence was significantly higher in dexmedetomidine 0.5 μg/kg group (9.30 $\pm$ 2.9 min) compared to placebo group (7.20 $\pm$ 2.7 min). Similar observation was made in our study, wherein emergence time increased with increasing dose of dexmedetomidine which may be attributed to sedative property of dexmedetomidine.

Recovery time was significantly longer in dexmedetomidine group compared to control and much longer in Group D_1 compared to Group $D0._5$. Similar results were found by many earlier researchers.[3,5,7]

LIMITATIONS

In our study sevoflurane concentration was adjusted to maintain hemodynamic variables in baseline value $\pm$ 20%. So we could not assess hemodynamic effects of single bolus doses of dexmedetomidine.

CONCLUSION

A single dose of dexmedetomidine 1 μg /kg provides better conditions for smooth removal of laryngeal mask airway in children and 0.5 μg /kg is inadequate to provide smooth LMA removal, hence higher dose should be used for a single bolus dose. However higher dose of dexmedetomidine is associated with delayed recovery from anesthesia. Both dexmedetomidine 0.5 μg/kg and 1 μg/kg are useful in preventing emergence agitation. Increasing the dose of dexmedetomidine has positive effect in decreasing incidence of emergence agitation.

Conflict of interest: Nil

Authors' contribution:

RB, SS-Concept, design of study, literature search, Statistical analysis, Manuscript preparation

MM- Concept, literature search, Statistical analysis, Manuscript editing

SK- Guarantor

REFERENCES

1. Aho M, Lehtinen AM, Erkola O, Kallio A. Korttila K. The effect of intravenously administered dexmedetomidine on perioperative hemodynamics and isoflurane requirements in patients undergoing abdominal hysterectomy. Anesthesiology. 1991;74(6):997-1002. [PubMed] [Free Full Text]
2. He L, Wang X, Zheng S, Shi Y. Effects of dexmedetomidine infusion on laryngeal mask airway removal and post operative recovery in children anaesthetized with sevoflurane. Anaesth Intensive Care. 2013;41(3):328-33. [PubMed] [Free Full Text]
3. Bindu B, Pasupuleti S, Gowd UP, Gorre V, Murthy RR, Laxmi MB. A double blind,randomized,controlled trial to study effect of dexmedetomidine on hemodynamic and recovery responses during tracheal extubation. J Anaesthesiol Clin Pharmacol. 2013;29(2):162-77. DOI: 10.4103/0970-9185.111665 [PubMed]
4. Guler G, Akin A, Tosun Z, Eskitascoglu E, Mizrak A, Boyaci A. Single dose dexmedetomidine attenuates airway and circulatory reflexes during extubation. Acta Anaesthesiol Scand. 2005;49(8):1088-91. DOI: 10.1111/j.1399-6576.2005.00780.x [PubMed]
5. Guler G, Akin A, Tosun Z, Ors S, Esmaoglu A, Boyaci A. Single-dose dexmedetomidine reduces agitation and provides smooth extubation after pediatric adenotonsillectomy. Paediatr Anaesth. 2005;15(9):762-66. DOI: 10.1111/j.1460-9592.2004.01541.x [PubMed]
6. Fan Q, Hu C, Ye M, Shen X. Dexmedetomidine for tracheal extubation in deeply anesthetized adult patients after otologic surgery: a comparison with remifentanil. BMC Anesthesiol. 2015;15:106. DOI: 10.1186/s12871-015-0088-7 [PubMed]
7. Kim SY, Kim JM, Lee JH, Song BM, Koo BN. Efficacy of intraoperative dexmedetomidine infusion on emergence agitation and quality of recovery after nasal surgery. Br J Anaesth. 2013;111(2):222-28. DOI: 10.1093/bja/aet056 [PubMed]
8. Lee YY, Wong SM, Hung CT. Dexmedetomidine infusion as a supplement to isoflurane anaesthesia for vitreoretinal surgery. Br J Anaesth. 2007;98(4):477-83. DOI: 10.1093/bja/aem040 [PubMed]
9. Shukry M, Clyde MC, Kalarickal PL, Ramadhyani U. Does dexmedetomidine prevent emergence delirium in children after sevoflurane-based general anesthesia? Paediatr Anesth. 2005;15(12):1098-104. DOI: 10.1111/j.1460-9592.2005.01660.x [PubMed]
10. Ibacache ME, Munoz HR, Brandes V, Morales AL. Single-dose dexmedetomidine reduces agitation after sevoflurane anesthesia in children. Anesth Analg. 2004;98(1):60-3. [PubMed] [Free Full Text]
11. Isik B, Arslan M, Tunga AD, Kurtipek O. Dexmedetomidine decreases emergence agitation in pediatric patients after sevoflurane anesthesia without surgery. Paediatr Anaesth. 2006;16(7):748-53. DOI: 10.1111/j.1460-9592.2006.01845.x [PubMed]

★★★★★