Rev Bras Anestesiol. 2018;68(6):571–576

Sociedade Brasileira de Anestesiologia

REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br

SCIENTIFIC ARTICLE

Effect of two different doses of dexmedetomidine on the incidence of emergence agitation after strabismus surgery: a randomized clinical trial

Khaled Abdel-Baky Abdel-Rahman, Sayed Kaoud Abd-Elshafy*, Jehan A. Sayed

Assiut University, College of Medicine, Assiut, Egypt

Received 19 July 2017; accepted 10 May 2018
Available online 20 June 2018

KEYWORDS
Children;
Dexmedetomidine;
Emergence agitation;
Sevoflurane;
Strabismus surgery

Abstract
Background and objective: Emergence agitation is a postoperative negative behavior that affects mainly children. We studied the effect of two different doses of dexmedetomidine on the incidence and degree of EA in children undergoing strabismus surgery.
Methods: 90 patients were allocated into three equal groups; patients received 0.5 $\mu g.kg^{-1}$ of dexmedetomidine in high Dex group, 0.25 $\mu g.kg^{-1}$ of dexmedetomidine in low Dex group, or normal saline in the placebo group. All drugs were received with the closure of the conjunctiva before the end of the surgery. Pediatric Anesthesia Emergence Delirium (PAED) scale was used to evaluate the agitation, and Face, Legs, Activity, Cry, Consolability (FLACC) scale was used for pain assessment. Adverse effects of dexmedetomidine and recovery times were recorded.
Results: The incidence of agitation was significantly lower in high Dex group compared to other groups and it was significantly lower in low Dex group compared to placebo group. The median (range) of FLACC score was significantly lower in both Dex groups compared to placebo group. Recovery times; time from removal of laryngeal mask to eye opening and time stay in post anesthesia care unit was significantly longer in high Dex group compared to other groups. No significant bradycardia or hypotension was recorded. Recovery time was significantly longer in high Dex group compared to the other two groups.
Conclusion: Dexmedetomidine (0.5 $\mu g.kg^{-1}$) before emergence from general anesthesia resulted in a reduction in the incidence of emergence agitation compared to a dexmedetomidine (0.25 $\mu g.kg^{-1}$) but on the expense of recovery times without adverse effects.

* Corresponding author.
E-mail: sayed_k_72@yahoo.com (S.K. Abd-Elshafy).

https://doi.org/10.1016/j.bjane.2018.05.001

PALAVRAS-CHAVE
Crianças;
Dexmedetomidina;
Agitação ao despertar;
Sevoflurano;
Correção de estrabismo

Efeito de duas doses diferentes de dexmedetomidina na incidência de agitação ao despertar após cirurgia para correção de estrabismo: um ensaio clínico randômico

Resumo
Justificativa e objetivo: A agitação ao despertar é um comportamento pós-operatório negativo que afeta principalmente as crianças. Avaliamos o efeito de duas doses diferentes de dexmedetomidina na incidência e grau de agitação ao despertar em crianças submetidas à correção de estrabismo.
Métodos: Noventa pacientes foram alocados em três grupos iguais: receberam 0,5 $\mu g.kg^{-1}$ de dexmedetomidina (grupo Dex-alta), 0,25 $\mu g.kg^{-1}$ de dexmedetomidina (grupo Dex-baxia) ou solução salina normal (grupo placebo). Todos os medicamentos foram administrados com o fechamento da conjuntiva antes do fim da cirurgia. A escala pediátrica de delírio ao despertar da anestesia (PAED – *Pediatric Anesthesia Emergence Delirium*) foi usada para avaliar a agitação e a escala dos padrões de face, pernas, atividade, choro e consolabilidade (FLACC – *Face, Legs, Activity, Cry, Consolability*) foi usada para avaliar a dor. Os efeitos adversos de dexmedetomidina e os tempos de recuperação foram registrados.
Resultados: A incidência de agitação foi significativamente menor no grupo Dex-alta em comparação com os outros grupos, foi significativamente menor no grupo Dex-baxia em comparação com o grupo placebo. A mediana (variação) do escore FLACC foi significativamente menor em ambos os grupos Dex em comparação com o grupo placebo. O tempo de recuperação, o tempo transcorrido desde a remoção da máscara laríngea até a abertura dos olhos e o tempo de permanência na sala de recuperação pós-anestesia foram significativamente maiores no grupo Dex-alta em comparação com os outros grupos. Não houve registro de bradicardia ou hipotensão significativa. O tempo de recuperação foi significativamente maior no grupo Dex-alta em comparação com os outros dois grupos.
Conclusão: Dexmedetomidina (0,5 $\mu g.kg^{-1}$) antes do despertar da anestesia geral resultou em uma redução da incidência de agitação ao despertar em comparação com dexmedetomidina (0,25 $\mu g.kg^{-1}$), mas em detrimento dos tempos de recuperação sem efeitos adversos.

Introduction

Emergence agitation (EA) includes disorientation, crying, non-purposeful combative movement, and inconsolably during the early stage of emergence from general anesthesia (GA).[1] This abnormal behavior results in delayed discharge from the recovery room, anxiety, and dissatisfaction of child relatives and it may also lead to injury to the child or the surgical site. Although EA was described at the beginning of the 1960s.[2] the recent interest in this syndrome was linked to the widespread use of sevoflurane with its high incidence of EA.[3] The incidence of EA varies widely between studies; it ranges from 10% to 80%.[3–5] This wide variation may be due to many different definitions of this syndrome. Although the exact etiology of EA is still unidentified; it is associated with various risk factors such as preschool age, preoperative anxiety, certain surgical procedures like otolaryngologic or ophthalmologic surgery and pain.[6] Many drugs were used to avoid or to control EA; these include opioids especially fentanyl, propofol, and benzodiazepines.[6] Among these drugs dexmedetomidine with its highly selective α_2-adrenoreptor agonist activity, which provides better sedation criteria, analgesic, and antiemetic effects, with no respiratory depression at usual doses.[7] Dexmedetomidine was studied with different doses and routes of administration, various types of operation, different co-anesthetic agents, either as a single shot or continuous infusion. Authors have not been agreed to the optimal clinical dose.

The primary outcome of the present study was to evaluate the effect of two different single-intravenous shot doses of dexmedetomidine given during intraoperative period on the incidence of degree of EA in children undergoing strabismus surgery.

Methods

The study was a double-blind, randomized controlled clinical trial, carried out during March and December 2016. Our local ethics committee approved the study protocol before the beginning of the survey. A written informed consent was obtained from the parents of children or their legal guardians. Ninety children of both sexes, between 3 and 8 years of age, who were scheduled for strabismus surgery, were included in this study. Patients with developmental delay, cardiovascular disorder, and known allergy to study drugs, previous eye surgery, ear or hearing problems, and patients on medical treatment which has any sedative effect were all excluded from participation in this study.

Patients were randomly allocated into one of three study groups using computer-generated random number table; allocation concealment was done using sealed opaque envelopes. The first group was high Dex group ($n = 30$), in which children received 0.5 $\mu g.kg^{-1}$ of dexmedetomidine diluted in 10 mL of normal saline. The second group is low Dex group ($n = 30$) in which children received 0.25 $\mu g.kg^{-1}$ of dexmedetomidine diluted in 10 mL of normal saline. The third group was the placebo group in which children received 10 mL of normal saline. Drugs in the three studied groups were administered over 10 min through intravenous route at the end of the surgery with the closure of the conjunctiva. The syringes containing I.V. solutions were prepared by one of the investigator physicians or anesthesia technicians not included in the follow-up of the patients during recovery in three identical unlabeled syringes according to patient grouping. All Intra- and postoperative data were collected by the attending anesthesia doctor who was blinded to the patient grouping.

All children fasted for 6 h for solid food and 2 h for clear fluids. No premedication was given to any patient; all children were scheduled first in the operation list. On arrival to the operative room, Standard monitoring including electrocardiogram, pulse oximetry, non-invasive blood pressure were all applied to all patients with capnogram was attached after induction of anesthesia. Inhalational induction was performed for all patients with 8% sevoflurane in FiO_2 of 1.0. After the loss of consciousness and return to the regular respiratory pattern, the venous cannula was inserted in the dorsum of the hand on the contra-lateral side of the eye being operated. Then an appropriate size Laryngeal Mask Airway (LMA) was used for all patients as a maintenance airway. Maintenance of anesthesia was obtained using 2–4% sevoflurane in 100% oxygen. All patients received 1 $\mu g.kg^{-1}$ I.V. fentanyl as bolus dose just before surgical incision. Intraoperative hypertension and tachycardia was defined as >20% increase above their baseline values and sustained for more than 2 min, in this case, sevoflurane concentration was raised to control tachycardia or hypertension. If this measure failed to control tachycardia or hypertension the patient received 0.5 $\mu g.kg^{-1}$ fentanyl and excluded from the study as fentanyl may affect the incidence of emergence agitation. Intraoperative bradycardia and hypotension were defined as >20% decrease below their baseline values that lasts for more than 2 min. It was treated with 0.01 $mg.kg^{-1}$ of atropine I.V. in the case of bradycardia; hypotension has been processed with reduction of the level of anesthesia and with 10 $mL.kg^{-1}$ isotonic saline in dextrose 5%.

With the closure of the conjunctiva, patients received the study drugs according to their groups. At the end of the surgery sevoflurane was turned off, and after dressing of the eye and while patients still in the deep level of anesthesia LMA was removed and patients were observed for normal respiration and stable hemodynamics before transferring to the Post-Anesthesia Care Unit (PACU).

Data collection

Pediatric Anesthesia Emergence Delirium (PAED) scale[8] (Appendix 1) was used to measure the degree of agitation in each group. PAED scale consists of five items (eye contact, purposefulness of actions, awareness of surroundings, restlessness, and consolability). The first three items take a score of 0 (extremely) to 4 (not at all), while the last two items make a score of 0 (not at all) to 4 (extremely). The very quiet child takes 0 on PAED scale, and extremely agitated child takes 20 on this scale. PAED score was calculated for all patients at three time points; at PACU admission and 15 and 30 min later. Any child presented with PAED score >10 at any time after emergence from GA was considered as suffering from EA, the number of children with EA was recorded for each group.

Intraoperative hemodynamic changes related to drug administration were also recorded; this includes bradycardia and hypotension as defined above.

The effect of the studied drugs on the recovery of the patients was measured as time to eye opening from the discontinuation of anesthetic agent till eye opening in response to verbal or light tactile stimulation. The other time is the time taken till to discharge from the PACU when the Aldrete score[9] is 9 or 10. Aldrete score was first measured 10 min after PACU admission and then every 2 or 3 min till PACU discharge.

Assessment of postoperative pain was done using The Face, Legs, Activity, Cry, and Consolability (FLACC) scale.[10] The scale consists of 5 criteria; each takes a score of 0.1 and 2. The overall scale ranges between 0 and 10 with 0 representing no pain. FLACC score was assessed every 5 min in the PACU. The highest score reached by every patient at any time during PACU admission was recorded.

Data analysis

Statistical analysis was performed using statistical package for the social sciences (SPSS V.20), Normality of data distribution was evaluated with the Kolmogorov–Smirnov test. Parametric data were expressed as a mean ± standard deviation; only two parameters were non-parametric (PAED score and FLACC score) and were expressed as median (range). The incidence of certain events is expressed as number (percentage). The parametric data was analyzed using one-way ANOVA with LSD as a post Hoc test. Nonparametric data were analyzed using Kruskal–Wallis H test. Comparison of frequencies was performed using Chi-square test. p-Values less than 0.05 were considered statistically significant.

Results

A total of 103 pediatric patients were enrolled in this study. Fig. 1 shows flow diagram. All the three studied groups were matched as regarding patients and surgical characteristics (Table 1).

Fig. 2 shows PAED in the three studied groups. At PACU admission, the median PAED score was 4.5, 5, and 8.5 in the high Dex group, low Dex group, and placebo group respectively. PAED score was significantly lower in high Dex group compared to the other groups and also lower in low Dex group compared to placebo group. Fifteen minutes after PACU admission, PAED score began to decrease over time in all the studied groups. The high DEX group showed a median PAED score of 3.5. In the low Dex group the median PAED score decreased to 4, while in the placebo group the median was 6.5. At 15 min after PACU admission, the PAED score shows no significant difference between high and low Dex

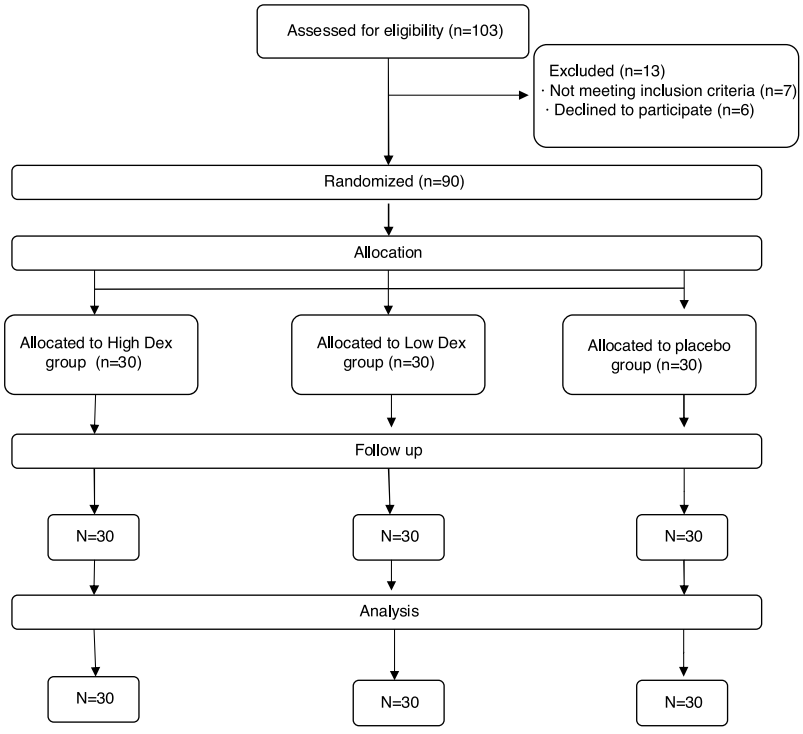

Figure 1 Study flowchart.

Table 1 Patients and surgical characteristics in the three studied groups.

	High Dex group	Low Dex group	Placebo group	*p*-Value
Age (years)	4.47 ± 1.01	4.35 ± 1.21	4.6 ± 1.24	0.70
Sex (male/female)	22/8	19/11	21/9	0.70
Weight (kg)	16.67 ± 1.73	16.5 ± 2.56	17.03 ± 2.59	0.54
Height (cm)	98.4 ± 8.1	97.8 ± 8.9	99.33 ± 8.61	0.75
Duration of surgery (min)	39.57 ± 6.27	40.27 ± 5.66	39.47 ± 6.69	0.76
Duration of anesthesia (min)	53.37 ± 6.59	55.23 ± 6.82	55.4 ± 6.85	0.41
Previous history of GA; *n* (%)	6 (20)	4 (13.3)	5 (16.7)	0.79

Data were represented as mean ± SD unless otherwise indicated.
GA, general anesthesia.

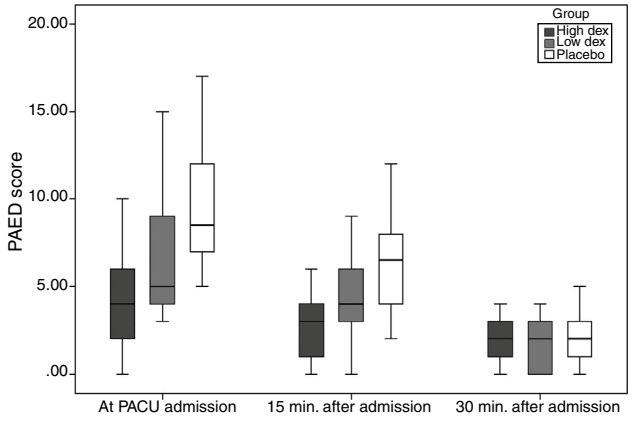

Figure 2 Box plot of Pediatric Anesthesia Emergence Delirium (PAED) score at different times in the three studied groups (minimum, 25th percentile, median, 75th percentile, maximum).

groups, but PAED score in the former both groups were significantly lower compared to placebo group. At 30 min after the PACU admission, the median PAED score continued to decrease in all studied groups; it was 2 in the three studied groups with no significant difference between the three studied groups.

As regard number of patients suffered from emergence agitation with PAED score >10, there was 1 (3.3%) case in high Dex group, 4 (13.3%) cases in low Dex group, and 10 (33.3%) cases in the placebo group. A significant difference was found in the incidence of EA between the three studied groups.

Intraoperative events related to the administration of the drugs were recorded as bradycardia and hypotension. Bradycardia was the most common complication associated with drug administration and occurred in five patients in the high Dex group, two patients in the low Dex group and no bradycardia associated with the administration of

Table 2 Incidence of intraoperative complications, recovery times and FLACC score in the three studied groups.

	High Dex group	Low Dex group	Placebo group	*p*-Value
Bradycardia following drug administration	5 (16.7)	2 (6.7)	0 (0.0)	0.049
Hypotension following drug administration	2 (6.7)	0 (0.0)	0 (0.0)	0.13
Time to eye opening (min)	6.40 ± 1.54[a]	4.73 ± 1.44	4.27 ± 1.39	0.00
Time to discharge from PACU (min)	27.93 ± 6.94	24.4 ± 5.61	22.67 ± 5.25	0.00
FLACC score	1.5 (1–2)	2 (2–3)	5 (3–6.25)	0.00

Data presented as number (%), mean ± SD, or median (range).
[a] High Dex group showed a significant difference from the two other groups using Tukey post hoc test.
PACU, Post Anesthesia Care Unit; FLACC, Face, Legs, Activity, Cry, and Consolability.

normal saline in the placebo group. A significant difference was found between the three studied groups ($p = 0.049$). No persistent bradycardia necessitating administration of atropine occurred in any patient. As regard hypotension, it was noticed in just two patients in the high Dex group but not in the other two groups. No significant difference was detected between the three studied groups ($p = 0.13$) (Table 2).

Time to eye opening measured from the discontinuation of sevoflurane till eye opening was significantly longer in the high Dex group (6.40 ± 1.54 min); compared to the low Dex group (4.73 ± 1.44 min), while in the placebo group (4.27 ± 1.39 min). No significant difference between low Dex and placebo groups. Time to discharge from PACU with Aldrete score of 9 or 10 was significantly longer in high Dex group compared to the other two groups (Table 2).

Maximum FLACC score measured in the median PACU was significantly lower in high Dex groups (1.5) while in the low Dex group it was (2) compared to placebo group (5), with no significant difference between both Dex groups (Table 2).

Discussion

In the current study, we used PAED scale to evaluate the incidence and degree of EA in children following strabismus surgery in the three groups of patients; high and low Dex groups and placebo group. PAED score was lower in the high Dex group compared to low Dex and placebo groups immediately after emergence from GA and after 15 min of emergence from GA. PAED score showed no difference between both Dex groups but their values still significantly lower than the placebo group. After 30 min of emergence from GA, no significant difference was found between the three studied groups.

Strabismus surgery is the most common ocular surgery carried out in children.[11] This type of surgery is associated with increased incidence of EA,[12] which cause major distress to patients after recovery from GA. As sevoflurane replaces halothane for induction and maintenance of anesthesia the problem of EA even gets worse.[13]

Dexmedetomidine is a potent α_2-adrenoceptors agonist, and it is about eight times more specific than clonidine for the target receptors.[14] The analgesic and sedative effects of this agent are thought to be due to activation of the α_2-adrenoceptors present in locus ceruleus.[15]

Intravenous single dose dexmedetomidine was tried in many studies to assess its effectiveness in reduction of EA. Guler et al., in 2005[16] studied the effect of 0.5 $\mu g.kg^{-1}$ dexmedetomidine vs. placebo administered 5 min before the end of adenotonsillectomy surgery. They found a significant reduction in the incidence of EA in dexmedetomidine group but at the expense of longer emergence time. They also found a significant reduction in postoperative pain in dexmedetomidine group compared to placebo. Another single dose trial was conducted by Ibacache et al.,[17] in 2004, they studied the effect of two doses of dexmedetomidine 0.3 $\mu g.kg^{-1}$ and 0.15 $\mu g.kg^{-1}$ on the incidence of EA in children undergoing inguinal hernia repair. Dexmedetomidine doses were administered after sevoflurane induction and followed by caudal block for postoperative pain relief. They found that higher dose is associated with significant reduction of EA compared to placebo. On the other hand, emergence time was not affected by dexmedetomidine administration. In the same context Sato et al.,[18] found that emergence agitation is significantly lower in patients receiving single dose of dexmedetomidine after induction of anesthesia (28%) compared to saline group (64%). Lili and co-authors[19] found that a dose of 0.5 $\mu g.kg^{-1}$ given as single shot just after induction of GA combined with Remifentanil 0.2 $\mu g.kg^{-1}.min^{-1}$ significantly reduces the incidence of EA after vitreoretinal surgery in children. Isik et al.[20] used a relatively large dose of dexmedetomidine 1 $\mu g.kg^{-1}$ in their study to control EA in patients undergoing magnetic resonance imaging as a non-painful procedure. Dexmedetomidine was administered just after induction. The study found about a 10 time reduction in the incidence of EA in dexmedetomidine group compared to placebo group.

The two noticeable side effects linked to the administration of dexmedetomidine are hypotension and bradycardia. Hypotension is due to the inhibition of sympathetic neurotransmission and sympatholysis.[21] Enhanced vagal activity and baroreceptor tone may add to decrease sympathetic tone as causes of bradycardia.[22] In children, many authors reported bradycardia after dexmedetomidine administration.[16,18] In our study bradycardia occurred in 5 patients in high Dex group, in 2 patients in low Dex group and did not happen in the placebo group. In our study, the time to eye opening and PACU discharge was longer in high Dex group compared to low Dex group and placebo group. These results are compatible with most of the former studies.[16,19,20,23] On the other hand, Shukry and co-authors found no difference in recovery time between dexmedetomidine group and normal saline group.[24]

There are some limitations to our study results that should be considered. The study did not restrict the age to

the preschool age; we instead included any child between 4 and 8 years of age. Due to a short period of the study, we did not assess the incidence of postoperative vomiting which may be affected by our doses, and it may also influence the incidence of EA. Further studies are essential to address these limitations.

Summary

Under sevoflurane anesthesia, the administration of a single shot dose of 0.5 $\mu g.kg^{-1}$ dexmedetomidine just before emergence from GA in children scheduled for strabismus surgery resulted in a reduction in the incidence of EA. This decrease compared to a smaller dose of dexmedetomidine (0.25 $\mu g.kg^{-1}$) and compared to placebo but on the expense of recovery time. No added analgesic benefits between both Dex groups, with no increase in the incidence of adverse effects and complications related to drug administration.

Conflicts of interest

The authors declare no conflicts of interest.

Appendix 1. The Pediatric Anesthesia Emergence Delirium Scale (PAED Scale)

Behavior	Not at all	Just a little	Quite a bit	Very much	Extremely
Make eye contact with care giver	4	3	2	1	0
Actions are purposeful	4	3	2	1	0
Aware of surrounding	4	3	2	1	0
Restless	0	1	2	3	4
Inconsolable	0	1	2	3	4

References

1. Mountain BW, Smithson L, Cramolini M, et al. Dexmedetomidine as a pediatric anesthetic premedication to reduce anxiety and to deter emergence delirium. AANA J. 2011;79:219–24.
2. Eckenhoff JE, Kneale DH, Dripps RD. The incidence and etiology of postanesthetic excitement a clinical survey. Anesthesiology. 1961;22:667–73.
3. Keaney A, Diviney D, Harte S, et al. Postoperative behavioral changes following anesthesia with sevoflurane. Pediatr Anesth. 2004;14:866–70.
4. Voepel-Lewis T, Malviya S, Tait AR. A prospective cohort study of emergence agitation in the pediatric postanesthesia care unit. Anesth Analg. 2003;96:1625–30.
5. Lapin SL, Auden SM, Goldsmith LJ, et al. Effects of sevoflurane anaesthesia on recovery in children: a comparison with halothane. Pediatr Anesth. 1999;9:299–304.
6. Kanaya A. Emergence agitation in children: risk factors, prevention, and treatment. J Anesth. 2016;30:261–7.
7. Arain SR, Ruehlow RM, Uhrich TD, et al. The efficacy of dexmedetomidine versus morphine for postoperative analgesia after major inpatient surgery. Anesth Analg. 2004;98:153–8.
8. Sikich N, Lerman J. Development and psychometric evaluation of the pediatric anesthesia emergence delirium scale. Anesthesiology. 2004;100:1138–45.
9. Aldrete JA. The post-anesthesia recovery score revisited. J Clin Anesth. 1995;7:89–91.
10. Voepel-Lewis T, Shayevitz JR, Malviya S. The FLACC: a behavioral scale for scoring postoperative pain in young children. Pediatr Nurs. 1997;23:293–7.
11. McGoldrick K, Gayer S. Anesthesia and the eye. Clin Anesth. 2006;2:1095–112.
12. Aouad MT, Nasr VG. Emergence agitation in children: an update. Curr Opin Anesthesiol. 2005;18:614–9.
13. Dahmani S, Stany I, Brasher C, et al. Pharmacological prevention of sevoflurane-and desflurane-related emergence agitation in children: a meta-analysis of published studies. Br J Anaesth. 2010;104:216–23.
14. Gertler R, Brown HC, Mitchell DH, et al. Dexmedetomidine: a novel sedative-analgesic agent. Paper presented at: Baylor University Medical Center. Proceedings; 2001.
15. Guo TZ, Jiang JY, Buttermann AE, et al. Dexmedetomidine injection into the locus ceruleus produces antinociception. Anesthesiology. 1996;84:873–81.
16. Guler G, Akin A, Tosun Z, et al. Single-dose dexmedetomidine reduces agitation and provides smooth extubation after pediatric adenotonsillectomy. Pediatric Anesth. 2005;15:762–6.
17. Ibacache ME, Muñoz HR, Brandes V, et al. Single-dose dexmedetomidine reduces agitation after sevoflurane anesthesia in children. Anesth Analg. 2004;98:60–3.
18. Sato M, Shirakami G, Tazuke-Nishimura M, et al. Effect of single-dose dexmedetomidine on emergence agitation and recovery profiles after sevoflurane anesthesia in pediatric ambulatory surgery. J Anesth. 2010;24:675–82.
19. Lili X, Jianjun S, Haiyan Z. The application of dexmedetomidine in children undergoing vitreoretinal surgery. J Anesth. 2012;26:556–61.
20. Isik B, Arslan M, Tunga AD, et al. Dexmedetomidine decreases emergence agitation in pediatric patients after sevoflurane anesthesia without surgery. Paediatr Anaesth. 2006;16:748–53.
21. MacMillan LB, Hein L, Smith MS, et al. Central hypotensive effects of the alpha2a-adrenergic receptor subtype. Science. 1996;273:801.
22. Penttilä J, Helminen A, Anttila M, et al. Cardiovascular and parasympathetic effects of dexmedetomidine in healthy subjects. Can J Physiol Pharmacol. 2004;82:359–62.
23. Ali MA, Abdellatif AA. Prevention of sevoflurane related emergence agitation in children undergoing adenotonsillectomy: a comparison of dexmedetomidine and propofol. Saudi J Anaesth. 2013;7:296–300.
24. Shukry M, Clyde MC, Kalarickal PL, et al. Does dexmedetomidine prevent emergence delirium in children after sevoflurane-based general anesthesia? Pediatric Anesth. 2005;15:1098–104.