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The effects of desflurane and sevoflurane on the peri- and postoperative bleeding of adenotonsillectomy patients

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ABSTRACT

Objective: To compare the effects of, volatile anesthetics, desflurane and sevoflurane on intra-operative and postoperative bleeding in patients who underwent tonsillectomy and adenoidectomy.
Material and method: Totally 40 children (14 girl and 26 boys) aged between 2 and 16 years were included in this prospective randomized double-blind clinical trial. The patients underwent conventional cold tonsillectomy and curettage adenoidectomy under general anesthesia. For the maintenance of anesthesia, the patients were randomized into two groups; desflurane group and sevoflurane group, each including 20 subjects. Desflurane concentration was set between 4% and 6% (0.7–0.9 MAC), whereas sevoflurane concentration was set between 2% and 2.5% (0.7–0.9 MAC). The amount of perioperative bleeding in milliliters was measured by using separate aspirator bags for each patient.
Results: Desflurane caused significantly lower amount of perioperative bleeding compared to sevoflurane ($p = 0.03$). No significant difference was observed between the two groups in terms of age, body mass index and operation duration, respectively ($p = 0.20$, $p = 0.49$, $p = 0.07$).
Conclusion: Desflurane, which is one of the volatile anesthetics, leads to a lower amount of intraoperative bleeding than sevoflurane during tonsillectomy and adenoidectomy operations.

1. Introduction

Tonsillectomy is one of the oldest and most frequently performed surgical operations in pediatric population. However, there is no "ideal" tonsillectomy technique that has been universally approved [1]. With the new technologies, various techniques, such as electrocauterization, coblation, harmonic scalpel, CO_2 laser, bipolar scissor, plasma coagulation and microdebrider intracapsular tonsillectomy, have been added to the "cold dissection" technique, which is the standard procedure [2].

Until today, tonsillectomy techniques have been blamed for the bleeding and pain after tonsillectomy operations and, postoperative and intra-operative complications have been attributed to the technique used. Comparisons were made between the techniques and the studies mostly emphasized the identification of the better technique [3].

Considering that pediatric tonsillectomy has to be performed under general anesthesia, the effects of anesthetic agents, used for general anesthesia, on body hemodynamics appears as an important issue.

Therefore, in this present study, it was aimed to compare the effects of the volatile anesthetics desflurane and sevoflurane, on the amount of intra-operative and postoperative bleeding in two groups which were similar in age, gender, height, weight and body mass index.

2. Materials and methods

After the local clinical ethical committee approval was obtained, written and oral informed consents of all patients were obtained and the study was initiated. Totally 40 children (14 girls and 26 boys) between the ages of 2 and 16 years were recruited in this prospective randomized double-blind clinical study. The patients, who were admitted to the Haseki Research and Training Hospital for tonsillectomy and adenoidectomy operation underwent preoperative anesthesia evaluation and otolaryngology examination.

Exclusion criteria were history of hypertension, contraindication for general anesthesia, foreknown allergy against sevoflurane

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or desflurane, bleeding diathesis, suspicion of malignancy, aspirin or anticoagulant agent usage, and identification of an infection during systemic examinations.

The patients were monitored. An intravenous line was inserted and 0.9% saline solution was infused. After preoxygenation with 100% O_2 with a dose of 10 L/min for 2 min, 0.1 mg/kg midazolam (Dormicum), 1 μg/kg Fentanyl, 5 mg/kg Thiopental Sodium (Pentothal), and 0.6 mg/kg rocuronium bromide (esmeron) were used for the induction of anesthesia. After 2 min, orotracheal intubation was performed; volume-controlled ventilation with a tidal volume of 8 ml/kg and a respiratory frequency of 14/min, was initiated.

All the patients underwent conventional cold tonsillectomy and curettage adenoidectomy operated same surgeon with under general anesthesia. For the maintenance of anesthesia, the patients were randomized into two groups, desflurane group and sevoflurane group, each including 20 subjects. The concentration of desflurane was set between 4% and 6% (0.7–0.9 MAC), whereas the concentration of sevoflurane was set between 2% and 25% (0.7–0.9 MAC). Gas flow was continued until the end of the operation. At the end of the surgery, the neuromuscular blockade was antagonized with Atropine (0.02 mg/kg) and neostigmine (0.04 mg/kg), and extubation was performed.

The amount of postoperative bleeding was measured in milliliters, using separate aspirator bags for each patient. The patients were clinically monitored in terms of postoperative recovery, secretion, spasm, cough, agitation, and minor and major bleeding.

"MedCalc® v11.1.1" program was used for the statistical analyses. Mann Whitney *U* test was used for the evaluation of two independent groups that did not show normal distribution. A p value <0.05 was considered statistically significant.

3. Results

Totally 40 children (14 girls and 26 boys) between the ages of 2 and 16 years were included in the study. Desflurane group consisted of 8 girls and 12 boys, with a mean age of 7.8 years (range: 3–16 years, whereas sevoflurane group consisted of 6 girls and 14 boys, with a mean age of 7.2 years (range: 2–16 years).

Cough, agitation, increased amount of secretion and mild bronchospasm-like symptoms were observed in only 3 patients in each group during the postoperative recovery period, whereas no difficulty was encountered in 34 patients.

Nineteen patients underwent adenoidectomy together with tonsillectomy in the desflurane group, whereas tonsillectomy only was performed to one patient. All patients in the sevoflurane group underwent adenoidectomy together with tonsillectomy.

Desflurane group peri-operative mean bleeding 73,350 ml (max–min: 160–30 ml), Sevoflurane group peri-operative mean bleeding 103,150 ml (max–min: 240–30 ml). Desflurane significantly caused a lower amount of perioperative bleeding in comparison to sevoflurane ($p = 0.03$) (Fig. 1, Table 1).

No significant difference was observed between the two groups in terms of age, body mass index and operation duration, respectively ($p = 0.20$, $p = 0.49$, $p = 0.07$ respectively) (Table 1).

Postoperative bleeding (day 5 and 7) was identified in 2 patients in the desflurane group and controlled by local hemostatic measures (lidocaine and epinephrine 1:100,000). No postoperative bleeding was observed in the sevoflurane group.

4. Discussion

The effects of desflurane and sevoflurane, two commonly used inhalation anesthetics for the maintenance of general anesthesia, on peri- and postoperative bleeding is a focus of interest. The present study was conducted to test the difference on the amount of bleeding by the use of these two different inhalation anesthetics.

In clinical and experimental studies performed in animals and human beings, desflurane was compared with the other volatile anesthetics in terms of cardiovascular effects, and it was found that desflurane dose-dependently reduced the systemic vascular resistance. Reduction in cardiac output may also be seen with higher doses [4,5].

In contrast with the tachycardia observed with the use of isoflurane, the heart rate remains stable with sevoflurane. However, similar to the other volatile anesthetics, sevoflurane dose-dependently causes cardiac depression by means of reducing the cardiac output and systemic vascular resistance. In contrast with isoflurane, stimulation of the sympathetic system with the rapid increase in end-tidal concentration, and the consequent hyperactivity in the cardiovascular system, has not been observed with sevoflurane [6]. In another study, it was shown that 0.5 MAC sevoflurane did not affect homeostasis whereas 0.5 MAC desflurane disturbed homeostasis. However, further larger studies are needed to support these findings [7].

In previous in vitro studies, platelet aggregation induced by ADP, epinephrine, arachidonic acid, Prostaglandin G2 and Thromboxane A2 receptor agonists was shown to be supressed by sevoflurane [8]. This inhibition is caused by the suppression of thromboxane A2 and the suppression of cyclooxygenase. The antiaggregant effects of sevoflurane are reversible [9]. However, desflurane does not have an effect on the platelet response induced by ADP activation [10].

Since the surgical view is of great importance in endoscopic sinus surgery, which is one of the frequently used operations in the ear nose and throat practice, studies have been performed on this subject. In these studies, intravenous propofol anesthesia was compared with the conventional inhalation anesthetics, and it was reported that propofol caused a lower amount of bleeding [11]; however, later studies [12,13] that compared the intravenous propofol anesthesia with the inhalation anesthetics (isoflurane 0.4–1.0 vol%) showed that propofol did not provide a significant reduction in the amount of bleeding [14].

In maxillofacial surgery, in which the surgical view is again of great importance, desflurane and sevoflurane were compared by Rossi et al. [15], and the amount of bleeding was measured in two groups with similar hemodynamic status. They reported that desflurane provides a better surgical view, by causing a lower amount of bleeding. In the above mentioned study, the effect of desflurane on the amount of bleeding was attributed to its vasoactive effects on blood vessels.

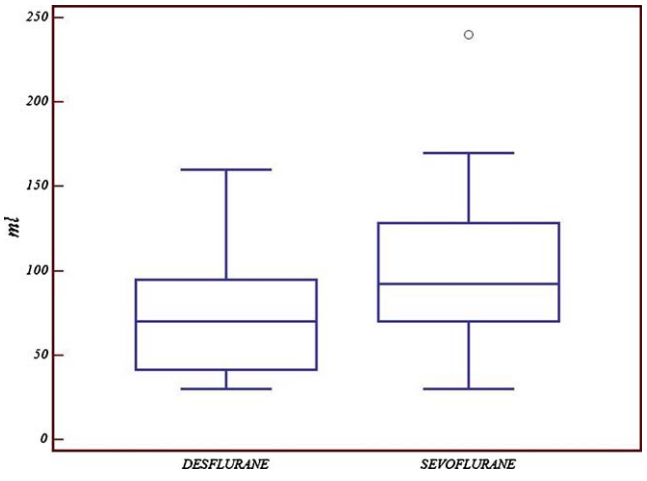

Fig. 1. The amount of bleeding in the desflurane and sevoflurane groups.

Table 1
Data regarding the amount of bleeding, age, body mass index and operation duration of patients in the desflurane and sevoflurane groups.

	Mean	SD	Median	Minimum	Maximum	*P* value
Amount of bleeding (ml)						
Desflurane	73.350	33.71	70.000	30.000	160.000	0.03
Sevoflurane	103.150	50.79	92.500	30.000	240.000	
Age (years)						
Desflurane	7.800	3.57	7.000	3.000	16.000	0.20
Sevoflurane	7.250	3.65	6.500	2.000	17.000	
BMI (kg/m^2)						
Desflurane	16.775	8.44	18.600	0.000	30.000	0.49
Sevoflurane	14.050	7.52	16.900	0.000	21.400	
Operation duration (min.)						
Desflurane	29.750	4.25	29.500	20.000	35.000	0.07
Sevoflurane	27.600	3.05	27.000	22.000	35.000	

Both groups include 20 patients each.

Elevation in catecholamine levels leads to an increase in the sympathetic tonus by means of precapillary and arteriolar vasoconstriction. However, venous dilatation increases the venous capacitance and leads to congestion in venous plexus, which results in venous hemorrhage.

In their study performed with desflurane and isoflurane, O'Riordan et al. [16] intraoperatively measured the hepatic and intestinal blood flow during major surgery, by Laser Doppler Flowmetry (LDF). They identified that desflurane provides more blood flow as compared to sevoflurane. Although the effects of both agents on systemic hemodynamics are similar, the amount of intestinal blood flow changes and this has been attributed to their local mechanisms.

In the present study conducted in two groups with similar age, gender, height, weight and operation duration, we concluded that desflurane caused a lower amount of bleeding. In conclusion, desflurane, which is one of the volatile anesthetics, causes a lower amount of intraoperative bleeding than sevoflurane in tonsillectomy and adenoidectomy operations.

Conflict of interest

None funding source.

Financial disclosures

None.

References

[1] R.T. Gi, V. Bliek, J. Borgstein, The Sluder method in the Netherlands and the incidence of postoperative haemorrhage in a pediatric hospital, Int. J. Pediatr. Otorhinolaryngol. 74 (January (1)) (2010) 56–59, Epub 2009 Nov 13.
[2] T.Q. Gallagher, L. Wilcox, E. McGuire, C.S. Derkay, Analyzing factors associated with major complications after adenotonsillectomy in 4776 patients: comparing three tonsillectomy techniques, Otolaryngol. Head Neck Surg. 142 (June (6)) (2010) 886–892.
[3] M.N. Ashbach, S.T. Ostrower, S.R. Parikh, Tonsillectomy techniques and pain: a review of randomized controlled trials and call for standardization, ORL J. Otorhinolaryngol. Relat. Spec. 69 (6) (2007) 364–370, Epub Review 2007 Nov 23.
[4] M.S. Scheller, New volatile anesthetics: desflurane and sevoflurane, Seminars in Anesthesia 11 (2) (1992) 114–122.
[5] M. Loscar, P. Conzen, Volatile anesthetics, Anaesthesist 53 (2) (2004) 183–198.
[6] N.J. O'Keeffe, T.E. Healy, The role of new anesthetic agents, Pharmacol. Ther. 84 (3) (1999) 233–248.
[7] A. Yuceaktas, A. Topal, J.B. Celik, A. Erol, S. Otelcioglu, Laparoskopik kolesistektomi girişimlerinde desfluran ve sevofluran anestezisinin hemostatik sistem üzerine olan etkilerinin tromboelostografi yöntemi ile değerlendirilmesi, Turkiye Klinikleri J. Anest. Reanim. 8 (2) (2010) 86–92.
[8] H. Hirakata, F. Ushikubi, S. Narumiya, Y. Hatano, K. Nakamura, K. Mori, The effect of inhaled anesthetics on the platelet aggregation and the ligand-binding affinity of the platelet thromboxane A2 receptor, Anesth. Analg. 81 (1) (1995) 114–118.
[9] H. Hirakata, F. Ushikubi, H. Toda, K. Nakamura, S. Sai, N. Urabe, et al., Sevoflurane inhibits human platelet aggregation and thromboxane A2 formation, possibly by suppression of cyclooxygenase activity, Anesthesiology 85 (December (6)) (1996) 1447–1453.
[10] D. Fröhlich, G. Rothe, G. Schmitz, E. Hansen, Volatile anesthetics induce changes in the expression of P-selectin and glycoprotein Ib on the surface of platelets in vitro, Eur. J. Anaesthesiol. 15 (November (6)) (1998) 641–648.
[11] K. Blackwell, D. Ross, P. Kapur, T.C. Calcaterra, Propofol maintenance of general anesthesia: a technique to limit blood loss during endoscopic sinus surgery, Am. J. Otolaryngol. 14 (1993) 262–266.
[12] J.D. Pavlin, P.S. Colley, E.A. Weymuller Jr., G. Van Norman, H.C. Gunn, M.E. Koerschgen, Propofol versus isoflurane for endoscopic sinus surgery, Am. J. Otolaryngol. 20 (March–April (2)) (1999) 96–101.
[13] P. Wormald, G. van Renen, J. Perks, J.A. Jones, C.D. Langton-Hewer, The effect of the total intravenous anesthesia compared to inhalational anesthesia on the surgical field during endoscopic sinus surgery, Am. J. Rhinol. 19 (2005) 514–520.
[14] L.H. Eberhart, B.J. Folz, H. Wulf, G. Geldner, Intravenous anesthesia provides optimal surgical conditions during microscopic and endoscopic sinus surgery, Laryngoscope 113 (2003) 1369–1373.
[15] A. Rossi, G. Falzetti, A. Donati, G. Orsetti, P. Pelaia, Desflurane versus sevoflurane to reduce blood loss in maxillofacial surgery, J. Oral Maxillofac. Surg. 68 (May (5)) (2010) 1007–1012, Epub 2010 February 13.
[16] J. O'Riordan, H.A. O'Beirne, Y. Young, M.C. Bellamy, Effects of desflurane and isoflurane on splanchnic microcirculation during major surgery, Br. J. Anaesth. 78 (January (1)) (1997) 95–96.