Comparison of propofol and sevoflurane anesthesia by means of blood loss during endoscopic sinus surgery

Remziye Sivaci, MD, *Mustafa D. Yilmaz*, MD, *Canan Balci*, MD, *Tuna Erincler*, MD, *Halis Unlu*, MD,

ABSTRACT

Objective: The purpose of the present investigation is to examine whether induced hypotension with propofol or sevoflurane anesthesia improves the dryness of surgical field in endoscopic sinus surgery (ESS).

Methods: The study was performed between 1999 and 2002 in Celal Bayar University and Afyon Kocatepe University Hospitals, Turkey. Thirty-two patients (American Society of Anesthesiologists physical status I and III) with chronic sinusitis undergoing outpatient endoscopic sinus surgery under general anesthesia were studied to determine if anesthetic technique had an impact on estimated blood loss. The patients were allocated randomly into 2 groups. None of the patients were premedicated. Anesthesia was induced with propofol in both groups and maintained with propofol/fentanyl in the first group and sevoflurane/fentanyl in the second group. In both groups, controlled hypotension was used to improve surgical condition.

Results: There were no differences between the duration of surgery and intraoperative mean arterial blood pressure when comparing the 2 groups. The average estimated blood loss in the propofol group was 128.1 ± 37.3 ml compared with an average estimated blood loss of 296.9 ± 97.8 ml in the sevoflurane group ($p<0.01$).

Conclusion: General anesthesia based on propofol infusion may have the advantage of decreased bleeding compared with conventional inhalation agents. Therefore, making endoscopic surgery technically easier and safer by improving endoscopic visualization of the surgical field.

Saudi Med J 2004; Vol. 25 (12): 1995-1998

Endoscopic sinus surgery (ESS) in which primary objective is the removal of pathology in the ostiomeatal complex to achieve ventilation and drainage through the natural ostium of the paranasal sinuses, has gained widespread acceptance in treatment of chronic sinus diseases.[1,2] Although this surgical intervention can be performed under local anesthesia with intravenous administration of sedative-analgesic drugs, general anesthesia is often preferred by both the surgeon and the patient, since it has the advantage of improving surgeon's and patient's comfort.[3] An important factor in the management of general anesthesia is to provide a bloodless field to optimize the visibility of the surgeon. Controlled hypotension is generally used for this purpose. Different anesthetic techniques using different pharmacological agents have been used to induce controlled hypotension.[4] Recently, it has been suggested that propofol anesthesia is associated with decreased bleeding and superior operating conditions when compared with isoflurane for ESS.[5] The aim of this study was to compare intravenous anesthesia induced and maintained by propofol and fentanyl with sevoflurane inhalation anesthesia by means of blood loss during ESS.

From the Department of Anesthesiology (Sivaci, Balci), Department of Otolaryngology (Yilmaz), Kocatepe University, School of Medicine, Afyon, Department of Anesthesiology (Erincler) and the Department of Otolaryngology(Unlu), Celal Bayar University, School of Medicine, Manisa, *Turkey*.

Received 21st April 2004. Accepted for publication in final form 11th August 2004.

Address correspondence and reprint request to: Dr. Mustafa D. Yilmaz, Aku Ans Arastirma Hastanesi, (Pembe Hastane) KBB Anabilimdali, 03200 Afyon, *Turkey*. Tel. +90 (272) 2167901. Fax. +90 (272) 2172029. E-mail: denizy@aku.edu.tr

Methods. The study was performed between 1999 and 2002 in Celal Bayar University and Afyon Kocatepe University Hospitals, Turkey. The study group was comprised of 32 patients with chronic sinusitis and nasal polyposis aged between 12-58 years. Informed consent was obtained from all patients. All patients in American Society of Anesthesiologists I-III physical status were monitored (Datex Ohmeda, Finland) with non-invasive blood pressure, pulse oximetry and electrocardiography, followed by infusion of 500 ml/hour ringer lactate. Patients were randomly assigned into 2 groups to receive propofol or sevoflurane for anesthesia. Before assignment, patients were grouped into 4 balanced blocks according to the severity of their disease. The severity of the disease was graded based on computed tomographic scan appearance of paranasal sinuses according to the classification of Lund–Mackay.[6] During randomization it is ensured that approximately equal number of patients with the same disease category were assigned to each treatment group. The first group (propofol group) comprised of 16 subjects. Anesthesia was induced by intravenous 2.5 mg/kg propofol, 0.5 mg/kg rocuronium bromur and 3 µgr/kg fentanyl followed by maintenance of anesthesia with 40/60% O_2-air mixture. Twelve mg/kg/hour propofol infusion was continued for the first 30 minutes, 9 mg/kg/hour for the second 30 minutes and 6mg/kg/hour until 10 minutes to the end stage of total intravenous anesthesia (TIVA) by a computer controlled infusion pump (LC 5000, Abbot). The second group (sevoflurane) comprise of 16 subjects. Anesthesia was induced by 2.5 mg/kg propofol 0.5 mg/kg rocuronium bromur and 3 µgr/kg fentanyl followed by maintenance with 33/66% O_2-N_2O mixture and 2-2.5% sevoflurane. All patients also received intravenous bolus 2 µgr/kg fentanyl and 0.2 mg/kg rocuronium bromide at 30 minutes periods during procedure. Patients were mechanically ventilated to maintain an end-tidal CO_2 of 35-45 mm Hg. Mean arterial pressure (MAP) and heart rate (HR) were recorded initially at 15-minute intervals following intubations and at the end of the surgery. For the assessment of blood loss during the surgery, the blood aspirated from the surgical area was collected by means of heparin (10000 IU/ml) measured. Additionally, nasal tamponades soaked with blood were counted. Each tamponade used was assumed to contain approximately 4 ml of blood. The patients were positioned to 20 degree reverse Trendelenburg position to minimize venous bleeding. As no premedication was given, the mucosa of uncinate process and anterior attachment of the middle turbinate were infiltrated by 2% lidocaine with one is to 100000 epinephrine. Surgery was performed by 2 surgeons who were blinded to the anesthetic being administered.

Statistical Package for Social Sciences 10.0 was used for the statistical analysis. Mann-Whitney U-test was used for the comparison of age height and gender parameter of 2 groups. Paired t-test was used to compare HR and MAP of the patients in both groups. Mann-Whitney U-test was used for the comparison of blood loss in 2 groups. Values are noted as average standard deviation and $p<0.05$ was accepted statistically.

Results. No significant difference was detected between 2 groups in regard to age, height, and the time period of surgery ($p<0.05$). The average blood loss was calculated as 128.1±37.3 ml in the propofol group and 296.9±97.8 ml in the sevoflurane group (**Table 1**); which indicates that blood loss was

Table 1 - Demographic data, duration of operation time and blood loss.

Demographic data	First group (N=16)	Second group (N=16)
Age (year)	31.7 ± 10.1	33.1 ± 13.6
Weight (kg)	67.6 ± 15.3	70.2 ± 14.9
Height (cm)	165.3 ± 11.4	166.3 ± 8.2
Duration of operation time (minute)	62.5 ± 19.2	67.8 ± 19.1
Blood loss	128.1 ± 37.3	296.9 ± 97.8*

*p<0,05 Mann-Whitney U test.
Value expressed as mean ± standard deviation.

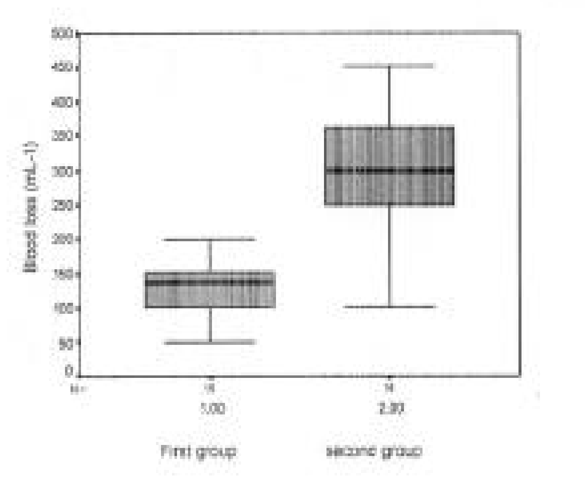

Figure 1 - Measured blood loss in the first and second groups.

significantly less in the propofol group ($p<0.05$; **Figure 1**).

There was no statistically significant differences in measured HR's and MAP's during surgery between 2 groups ($p>0.05$; **Table 2**).

Discussion. Controlled hypotension is a technique, which is used to diminish blood loss through diminishing blood pressure during different types of surgery.[4] Bleeding is very important during ESS as it impairs the vision of the surgeon and lengthens the operation time. Endoscopic sinus surgery can be both performed by local or general anesthesia. Surgeon and anesthesiologists must decide together concerning the type of anesthesia. It has been reported that estimated blood loss is less in local anesthesia in ESS.[7] Additionally, recovery is rapid at the end of the operation and hospital stay is shorter.[8] During general anesthesia, however, we see more bleeding in surgical field, that worsens operating conditions and increase operation time, due to vasodilator effects of volatile anesthetics. But general anesthesia is the choice in most instance for the patient's and surgeon's comfort.[9] The choice of agents and methods is important for general anesthesia. Controlled hypotension may be obtained through different methods. Vasodilators such as sodium nitroprusside, nicardipine, nitroglycerin, [beta]-adrenergic antagonists (esmolol), and high doses of inhalation anesthetics such as isoflurane have been studied in this context.[10,11] However, each technique has its own disadvantages. These comprise reflex tachycardia, rebound hypertension, tachyphylaxis, and cyanide intoxication during administration of sodium nitroprusside, or the possibility for myocardial depression in patients receiving esmolol. Additionally, intraoperative blood pressure and bleeding on the surgical site are not necessarily correlated. There is good evidence that decreasing MAP below 70 mm Hg can even increase intraoperative bleeding due to local vasodilation.[12] Another problem during controlled hypotension is ischemic organ deficiency. During hypotensive period, vital organs must be protected against hypoperfusion. Ischemic organ deficiencies may be the cause of mortality and morbidity.[13] If volatile anesthetics are preferred for controlled hypotension, high concentrations of them must be used; leading to a longer recovery time and hospital stay. For controlled hypotension, the most frequently used volatile anesthetic is isoflurane.[5] If compared with other volatile anesthetics, isoflurane has a longer recovery time as sevoflurane and desflurane but its vasodilator effect is stronger. Sevoflurane is suitable for controlled hypotension due to its rapid action at the beginning and short recovery. Its effect upon sympathetic tonus, baroreflex sensitivity and heart rate is minimal.[14,15] Cardiovascular depression, which may be observed during sevoflurane anesthesia is very small.[16]

Recently, an ultra short acting intravenous anesthetic propofol (2-6-diisopropylphenol) became popular due to its very short recovery time and less side effects.[17,18] It has been reported that controlled hypotension may be achieved with propofol (a non-barbiturate hypnotic) plus opioid combinations, without any antihypertensive agent.[6] Propofol causes hypotension, bradycardia and systemic venous and arterial vasodilatation and decrease cardiac output. Its myocardial depressive effect is also reported.[18] Its effect on hemodynamic status is partially due to its inhibitory action upon sympathetic nervous system. Due to its rapid elimination, recovery and hospital stay are not changed, with perfect adjustment of its doses blood pressure can be well controlled.[9,19]

In the present study, propofol and fentanyl combination (TIVA) was compared with sevoflurane inhalation anesthesia and significantly less amount of blood loss in propofol anesthesia during ESS was found. The advantages of propofol on blood loss during otorhinolaryngological surgery

Table 2 - Hemodynamic parameters in the first and second groups (mean±SD).

Hemodynamic parameters	**Baseline value**	**After induction**	**15 minutes**	**30 minutes**	**45 minutes**	**60 minutes**	**End of surgery**
Heart rate (beats/minute)							
Group I	72 ±3 .7	65 ± 3.7	66 ± 3.3	67 ± 41	75 ± 3.3	76 ± 40	72 ± 3.3
Group II	75 ± 5.7	76 ± 5.3	79 ± 4.3	71 ± 3.3	78 ± 2.7	79 ± 5.0	73 ± 5.3
MAP (mm Hg)							
Group I	86 ± 5.3	81 ± 3.7	84 ± 5.7	82 ± 4.7	83 ± 5.7	84 ± 8.7	85 ± 4.7
Group II	84 ± 3.3	83 ± 5.7	83 ± 3.7	79 ± 4.0	82 ± 6.7	80 ± 6.3	80 ± 4.7

p value of >0.05 , MAP - mean arterial pressure have been reported previously. However, there is not much study comparing inhalation anesthetics with propofol. Two studies were found in medical literature showing the beneficial effect of propofol over isoflurane[5,9] but no data exists concerning the comparison of propofol and sevoflurane. In both studies with isoflurane no significant differences in amount of blood loss were detected; however, assessed operative conditions on average were found better. In our study, however, significantly less amount of blood loss was observed with propofol in contrast to studies carried out with isoflurane. This difference between our study and the previous studies may be due to our measurement method of blood loss or direct vasodilatation effects of isoflurane.

In our opinion, the reason of less blood loss observed with propofol is due to its following effects. Peripheral circulatory effects of propofol are mediated by cerebral depression of sympathetic tone in blood vessels, whereas, sevoflurane causes direct relaxation of smooth muscle in vessel walls both inside and outside of the skull.[20,21] Secondly, propofol preferentially minimizes bleeding, which is arteriolar in nature and therefore relatively rapid and difficult to control.[22]

Harke at al[23] reported that bleeding in ESS is associated with weight of the patients. There were no significant differences between 2 groups with respect to height, weight and gender in our study. The HRs and MAPs of patients in both groups were similar and there were no statistically significant differences between the 2 groups. The levels of these parameters were tried to be kept similar in both groups in order not to influence the amount of blood loss.

As a conclusion, propofol anesthesia causes less amount of bleeding and better operating conditions compared with sevoflurane for ESS. Total intravenous anesthesia, also provides easier controlled hypotension, has less side effects and shorter recovery time. For these reasons we suggest utilization of propofol anesthesia in all endoscopic and microscopic surgeries.

References

1. Stammberger H. Nasal and prenasal sinus endoscopy. A Diagnostic and Surgical Approach to Recurrent Sinusitis. ***Endoscopy*** 1986; 18: 213-218.
2. Kennedy DW. Functional endoscopic sinus surgery technique. ***Arch Otorhinolaryngol*** 1985; 11: 643-649.
3. Schaefer SD. Endoscopic total sphenoethmoidectomy. ***Otolaryngol Clin North Am*** 1989; 22: 727-732.
4. Degoute CS, Dubreuil C, Ray MJ, Guitton J, Manchon M, Banssillon V et al. Effects of posture, hypotension and locally applied vasoconstrictor on the middle ear microcirculation in anaesthetized humans. ***Eur J Appl Physiol*** 1994; 64: 414-420.
5. Pavlin JD, Colley PS, Weymuller EA, Van Norman G, Gunn HC, Koerschgen ME. Propofol versus isoflurane for endoscopic sinus surgery. ***Am J Otolaryngol*** 1999; 20: 96-101.
6. Sharp HR, Rowe-Jones JM, Mackay IS. The outcome of endoscopic sinus surgery: correlation with computerized tomography score and systemic disease. ***Clin Otolaryngol*** 1999; 24: 39-42.
7. Saitoh K, Suzuki H, Hiruta A, Igarashi T, Fukuda H, Hirabayashi Y et al. Induced hypotension for endoscopic sinus surgery. ***Masui*** 2002; 51: 1100-1103.
8. Stankewitz JA. Complications of endoscopic intranasal ethmoidectomy. ***Laryngoscope*** 1987; 97: 1270-1273.
9. Eberhart LH, Folz BJ, Wulf H, Geldner G. Intravenous anaesthesia provides optimal surgical conditions during microscopic and endoscopic sinus surgery. ***Laryngoscope*** 2003; 113: 1369-1373.
10. Suttner SW, Boldt J, Schmidt CC, Piper SN, Schuster P, Kumle B. The effects of sodium nitroprusside-induced hypotension on splanchnic perfusion and hepatocellular integrity. ***Anesth Analg*** 1999; 89: 1371-1377.
11. Degoute CS, Ray MJ, Manchon M, Dubreuil C, Banssillon V. Remifentanil and controlled hypotension: comparison with nitroprusside or esmolol during tympanoplasty. ***Can J Anaesth*** 2001; 48: 20-27.
12. Lim YJ, Kim CS, Bahk JH, Ham BM, Do SH. Clinical trial of esmolol- induced controlled hypotension with or without acute normovolemic hemodilution in spinal surgery. ***Acta Anaesthesiologica Scandinavica*** 2003; 47: 74-77.
13. Iso-Lessard MR, Trepanier CA, Baribault JP, Brochu JG, Brousseau CA, Denault PH. Isoflurane-induced hypotension in orthognathic surgery. ***Anesth Analg*** 1989; 69: 379-783.
14. Han RQ, Li SR, Wang BG, Wang EZ, Liu W, Wang S, et al. The effect of isoflurane induced hypotension on intraoperative cerebral vasospasm in intracranial aneurysm surgery. ***Zhonghua Yi Xue Za Zhi*** 2004; 84: 286-289.
15. Ebert TJ, Muzi M, Lopatka CW. Neurocirculatory responses to sevoflurane in humans: A comparison to desflurane. ***Anesthesiology*** 1995; 83: 88-95.
16. Nagasaki G, Tanaka M, Nishikawa T. The recovery profile of baroreflex control of heart rate after isoflurane or sevoflurane anaesthesia in humans. ***Anesth Analg*** 2001; 93: 1127-1131.
17. Ebert TJ, Harkin CP, Muzi M. Cardiovascular responses to sevoflurane. ***Anesth Anal***g 1995; 81: 11–22.
18. Robinson BJ, Ebert TJ, O'Brien TJ, Colinco MD, Muzi M. Mechanisms whereby propofol mediates vasodilation in humans. ***Anesthesiology*** 1997; 86: 64-72.
19. Smith I, White PF, Nathanson M, Gouldson R. Propofol: An update on its clinical use. ***Anesthesiology*** 1994; 8: 105-108.
20. Heath JF. Graded Hypercapnia and Cerebral Autoregulation during Sevoflurane or Propofol anaesthesia. ***Anesthesiology*** 2000; 93: 1205-1209.
21. Kaisti KK, Metsähonkala L, Mika M, Oikonen V, Aalto S, Jääskeläinen S, et al. Effects of surgical levels of propofol and sevoflurane anaesthesia on cerebral blood flow in healthy subjects studied with positron emission tomography. ***Anesthesiology*** 2002; 96: 1358-1370.
22. Bonhomme V, Fiset P, Meuret P, Backman S, Plourde G, Paus T, et al. Propofol anaesthesia and cerebral blood flow changes elicited by vibrotactile stimulation: A positron emission tomography study. ***J Neurophysiol*** 2001; 85: 1299-1308.
23. Harke H, Gretenkort P, Schmidt K. Qualitatsvergleich von modifizierter neurolept-balanzierter und intravenöser anästhesia. ***Anästhesist*** 1995; 44: 531-537.