Recovery profile of patients undergoing nasal surgical procedures: a comparison between sevoflurane and propofol

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Abstract

Objectives To compare the recovery profile of sevoflurane and propofol in nasal surgical procedures.

Design A prospective, double blind, randomized study

Setting King Abdul Aziz University Hospital, Riyadh, Saudi Arabia, a tertiary care teaching hospital, attached with King Saud University, Riyadh Saudi Arabia.

Patients 60 ASA I–II patients age between 18–35 years, and weighing 50–80 kg, scheduled for nasal surgical procedures.

Methods Patients were assigned randomly to one of the two groups, the Sevoflurane Group-S (n = 30) & the Propofol Group-P (n = 30). Anesthetic induction was carried out using propofol 2.0mg/kg in both the groups. Cis-atracurium 0.15mg/kg was given for intubation. Airway was protected with a throat pack around the endo-tracheal tube. Fentanyl 1microgram/kg was given as bolus followed by infusion at a rate of 1 microgram/ kg/ hour. Anesthesia was maintained with sevoflurane 2% in Group-S, and propofol infusion at a rate of 200 microgram/kg/min. in Group-P. 50% oxygen

in nitrous oxide was given in both the groups. At the end of surgery, patients were extubated after reversal of the neuromuscular block. Immediate recovery was assessed by recording the time to breathe spontaneously, time to extubation, and time of spontaneous eyes movements from the time of giving reversal. Ketoprofen 1.5mg/kg intramuscularly was given to all patients before transfer to (PACU). In PACU, sedation score was assessed for 45 min. Intermediate recovery was assessed by TDT and DSST at 15, 30 and 45 min. Time taken to state name and father's name was recorded.

Results Patients in Group-S breathed significantly earlier than those in Group-P. Group-P showed significantly better performance with TDT at 45 min and with DSST at 30 and 45 min.

Conclusions We conclude that both sevoflurane and propofol provide early and comparable post anesthesia recovery for patients undergoing nasal surgical procedures.

Keywords Propofol · Sevoflurane · Recovery profile · Emergence · Anesthesia · Nasal Surgery

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Introduction

Recovery from anesthesia is described as early, intermediate and late. Early recovery also known as emergence and is the time at which the patient awakens from anesthesia and obeys simple commands. Intermediate recovery is the recovery of cognitive and psychomotor function sufficient to permit discharge. Late recovery is complete return to the preoperative state and resumption of normal activities [1]. Nasal surgery carries the risk of potential complications at emergence from anesthesia. Protection of the airway from aspiration of blood warrants for the early return of active protective airway reflexes [2]. Upper airway muscle

activity depends upon combination of centrally and peripherally mediated reflexes. The central reflexes have drive from the brainstem while peripheral in the upper airways. Anesthesia depresses both central and peripheral reflexes, resulting in depression of protective arousal responses [3]. One of the anesthetic objectives for nasal surgery is the early postoperative recovery of these reflexes.

Recovery from anesthesia depends upon the pharmacological properties of different anesthetic agents. Sevoflurane is a relatively short acting inhalational agent with a blood: gas partition coefficient of 0.64, which results in rapid recovery from anesthesia with sevoflurane [4]. Propofol is a phenol derivative and is extremely popular intravenous anesthetic for its predictable recovery. Recovery is not only rapid after a single bolus dose, but also after repeated doses or a titrated continuous infusion [5].

As both the agents have potential for rapid recovery, the objective of this randomized, prospective, double blind study was to compare the recovery profile of these agents for nasal surgical procedures.

Patients and methods

After permission from the institutional ethical committee and written informed consent, 60 patients of American Society of Anesthesiology physical status I & II, age between 18–35 years, and weighing 50–80 kg, were enrolled onto the study. Patients were assigned randomly to one of two groups (numbers out of an envelope), the sevoflurane Group-S ($n = 30$) & the propofol Group-P ($n = 30$). All patients were scheduled to undergo elective nasal surgical procedures. Patients with history of mental illness, hypersensitivity to opioids or any anesthetics, substance abuse, antihistaminic use or treatment with psychoactive medication and those with history of bronchial asthma were not included in the study.

During the pre-operative anesthetic evaluation, all patients were explained about the Trieger dot test (TDT) and digit symbol substitution test (DSST) for psychomotor and cognitive functions. All patients completed first series of these tests before surgery, serving as baseline values. All patients received 0.1mg/kg of midazolam orally with a sip of water as pre-medication 90 min before surgery.

In the operating room, all standard monitoring (electrocardiography using Lead-II, non-invasive blood pressure at interval of 2.5 min, pulse oximetry) carried out by using Datex – Ohmeda S/5 anesthesia monitor. A 20 gauge intravenous canula was inserted and compound Ringer lactate solution was started through it.

All the patients, in both the groups were pre-oxygenated with oxygen via facemask at a flow rate of six litre/min for three min by using Bain breathing system. All patients received a bolus dose of fentanyl 1 microgram/kg followed by the infusion using Terumo Syringe pump TE-311 at a rate

of 1 microgram/kg/hour. Induction of anesthesia was carried out by using 2.0 mg/kg of propofol. Cis-atracurium 0.15 mg/kg was given to facilitate endotracheal intubation and to maintain muscle relaxation for intermittent positive pressure ventilation (IPPV) during surgery. The trachea was intubated when there was no twitch on train of four (TOF) stimulation of ulnar nerve. In the females, we used 7.5 mm and in males 8.0 mm, RAE cuffed endo-tracheal tube (ETT). Position of the ETT was confirmed clinically with bilateral air entry on chest auscultation and by appearance of capnograph on End-tidal carbon dioxide (ETCO₂) monitor. A throat pack was placed around the ETT to protect the airways. Intermittent positive pressure ventilation was instituted and parameters were set according to the body weight of the patient to maintain an ETCO₂ between 33–38 mmHg.

In Group-P, the anesthesia was maintained with infusion of propofol 200 microgram/kg/min., started immediately after the bolus induction dose and in Group-S with sevoflurane 2%, started immediately after induction. In both groups, the muscle relaxant was repeated in a dose of 1/4th of the initial intubating dose, when second twitch appeared on TOF.

At the end of surgery, the anesthetics were terminated without tapering in both groups. Residual neuromuscular block was reversed with 2.5 mg neostigmine and one mg atropine, when there were four twitches on TOF stimulation. The trachea was extubated on establishment of spontaneous breathing pattern and when patients were able to open their eyes on command. Time intervals, such as start of anesthesia, start of surgery, end of surgery and termination of anesthetics, and time of giving reversal were recorded. Observations such as time to breathe spontaneously, time to extubation, and time of spontaneous eyes movements from the time of giving reversal, were assessed in the operating room by a blinded observer. Ketoprofen 1.5 mg/kg intramuscularly was given to all patients before transfer to post anesthesia care unit PACU.

In the (PACU), the observations for recovery of patients were recorded by a blinded nurse. For the depth of sedation, we used a five point scale of observer's assessment for post anesthesia recovery score (PARS), in the PACU for 45 min. (score 1 = asleep, 2 = asleep but difficult to arouse, 3 = asleep but easy to arouse, 4 = awake but calm and 5 = awake but anxious). Intermediate recovery was assessed by using TDT for psychomotor functions and DSST for cognitive functions. In the TDT, the subjects were presented with a figure composed of 41 dots and were asked to connect them with a pencil mark in 40s or less. A score was assigned according to the number of dots omitted. In the DSST, the subjects were asked to integrate visual scanning speed with number substitution for 110 given symbols. The test was scored according to the number of correct entries obtained in 90s. All patients completed series of these tests at 15, 30, and 45 min. after surgery. We also recorded the time taken by the patients to state their names and their father's name.

Statistical Analysis

We used student t-test for independent group to compare Group-S with Group-P with respect to all numerical parameters. We assumed there is a statistically significant difference if $p < 0.025$ (we used two tailed). We also used chi-square test to compare gender, age and weight. Data are presented as mean and standard deviation (SD) in the tables or standard error of mean (SEM) in the figures. Statistical analysis was performed using statistics programmes for social science (SPSS) computer software version 12.0 (SPSS, inc. Chicago) for windows

Results

The two groups were similar with respect to age, weight, duration of anesthesia, and duration of surgery (Table 1). At the end of surgery, the time to breathe spontaneously was earlier and statistically significant in Group-S ($p < 0.002$) compared to Group-P. There was no statistically significant difference between the two groups in the time taken for extubation and time to spontaneous eyes opening (Table 2).

In the PACU, the PARS was assessed at 0 min, 15 min, 30 min and at 45 min. The recovery was found to be early in Group-S compared to Group-P, but the difference was not statistically significant ($p > 0.0025$) Fig. 1. The difference between the two groups for the time to state the name and father's name was not found statistically significant in the two groups with a p-value of 0.256 for Group-S and 0.229 Group-P (Table 2). There was no statistically significant difference in TDT at 15 and 30 min in both the groups. However, at 45 min, patients in Group-P showed statistically significant difference compared to Group-S ($p < 0.0001$) Fig. 2. The DSST was found to be statistically significant in Group-P at 30 and 45 min with a ($p < 0.0001$), but at 15 min, there was no significant statistical difference between the two groups Fig. 3.

Discussion

The mixed results of our study are interesting. Patients in Group-S breathed earlier than those in Group-P. On the other hand Group-P patients showed better recovery of cognitive and psychomotor functions.

Sevoflurane, like other inhalational anesthetics, is eliminated mainly via respiratory system and has rapid emergence time when compared with other inhalational agents [6, 7]. After discontinuation, faster recovery from sevoflurane anesthesia mainly occurs due to fall in its concentration in the brain tissue secondary to its low blood gas partition coefficient [8].

Among intra-venous induction agents, propofol has shown a rapid recovery from anesthesia [9]. Propofol is metabolized in liver but there are also extra hepatic sites as it

Fig. 1 Comparison of PARS (post anesthesia recovery score). There is no significant difference at 0, 15, 30 and 45 min. between the two groups

Fig. 2 Comparison of PARS (post anesthesia recovery score). There was no statistically significant difference in TDT at 15 and 30 min in both the groups. However, at 45 min, patients in Group-P showed statistically significant difference compared to Group-S

Fig. 3 Comparison of PARS (post anesthesia recovery score). The DSST was found to be statistically significant in Group-P at 30 and 45 min with a ($p < 0.0001$), but at 15 min, there was no significant statistical difference between the two groups

has metabolic clearance, which exceeds hepatic blood flow [10]. Following termination of infusion, propofol concentration in the central compartment declines both from metabolic elimination and from continuing redistribution. The capacity of peripheral compartments is large, resulting in continuous redistribution. The net result is a rapid decline in propofol concentration to levels below those required for hypnosis (or deep sedation), permitting rapid awakening [11].

Table 1 Patients characteristics with duration of surgery and anesthesia; values are mean(SD) or no. of patients(% of total group)

	Propofol Group P	Sevoflurane Group-S
Number of Patients	30	30
Gender (male/ female)	21/9	20/10
Age (yr)	26.70 (12.98)	23.97 (7.65)
Weight (kg)	68.07 (8.60)	65.00 (9.92)
ASA I	18 (60%)	16 (53.53%)
ASA II	12 (40%)	14 (46.66%)
Duration Of Surgery (min)	75.83 (26.37)	80.67 (27.84)
Duration of Anesthesia (min)	97.10 (27.87)	99.50 (30.68)

Table 2 Recovery Times (min.) after giving reversal. PARS=Post Anesthesia Recovery score. Values are mean (SD)

	Sevoflurane Group-S	Propofol Group-P	P-value
Time to spontaneous Breathing	4.93(2.02)	6.63(2.09)	<0.002
Time to extubation	7.47(2.40)	8.47(2.03)	0.0870
Time to spontaneous eye opening	11.77(5.34)	11.77(3.07)	0.999
Time to state name	33.07(12.46)	30.13(6.25)	0.256
Time to state father's name	33.23(12.43)	30.13(6.25)	0.229
PARS			
0 min	3.03(0.76)	3.27(0.69)	0.22
15 min	3.63(0.61)	3.93(0.58)	0.057
30 min	4.00(0.26)	4.27(0.58)	0.026
45 min	4.33(0.55)	4.53(0.51)	0.147

The results of previous studies in the literature showed variability in the recovery properties of sevoflurane and propofol. As far as nasal surgery is concerned, there is no study to-date in which the recovery profile of any anesthetic has been investigated, although there are studies for other ENT procedures. In patients undergoing microlaryngoscopy surgery, there was no difference in the recovery profiles of sevoflurane and propofol [12]. This may be related to the use of thiopentone sodium as an induction agent in sevoflurane group in this study, while propofol was the induction as well as maintenance agent in propofol group. The early awakening properties of sevoflurane might have been masked by

the delayed recovery properties of thiopentone sodium. Total intra-venous anesthesia (TIVA) comprising of propofol and remifentanyl demonstrated early recovery when compared with sevoflurane in outpatient otorhinolaryngeal procedures [13]. As remifentanyl has quicker recovery profile compare to fentanyl, so this might have affected their results. Recovery profile of different other anesthetics and analgesics have been assessed in otorhinolaryngeal surgery. Immediate recovery profile was better with propofol compare to isoflurane in middle ear surgery [14].

There was faster early recovery in patients for otorhinolaryngeal surgery, but the comparison was to compare remifentanyl with propofol, desflurane, sevoflurane and thiopental/alfentanil/isoflurane/nitrous oxide (control group) [15]. All the agents in the study group are known to have better recovery profiles as compare to the agents in control group. The late recovery parameters were not significantly different in the two groups. There was no difference in the recovery profile of sevoflurane and propofol in children underwent tonsillectomy [16].

Recovery profile of sevoflurane and propofol has also been compared for other surgical procedures. Results of these studies also showed variability. Some of these studies showed better early recovery with propofol, while others with sevoflurane. Yet there are few studies, which demonstrated no difference. In patients underwent minor gynecological procedures, propofol showed early awakening, better orientation and early home readiness as compare to sevoflurane [17, 18].

Studies have shown early recovery and better psychomotor functions with sevoflurane than with propofol [19–22]. Observations in these studies (emergence time from anesthesia, time to extubation of the trachea, eye opening, hand squeezing, response to commands, modified Aldrete score, cognitive functions) showed significantly better results with sevoflurane. Our results are similar with these studies in only one observation in that patients in sevoflurane group started breathing earlier than those of propofol group. These studies were done in knee arthroscopic procedures, [19] in abdominal surgery [20] and in ophthalmologic and urological procedures [21]. In most of these studies, the objective was to assess the early discharge. Recovery profile of the two agents has also been assessed in spontaneously breathing patients with better recovery with sevoflurane [22].

In patients underwent craniotomy for supratentorial intracranial surgery the authors did not find difference in the recovery profile of the two agents [23].

The data is lacking on the recovery profile of these anesthetics for nasal surgery. Our study showed mixed results. When we compare our results with previous studies, done both for otorhinolaryngeal and other surgical procedures, we find that our results match to those studies which showed better recovery profile with sevoflurane in only one observation (early return of spontaneous breathing) in Group-S. Our results also match to those studies,

which showed better recovery profile with propofol by demonstrating better psychomotor and cognitive functions in Group-P. These differences in our results comparing to the previous studies, may be due to the differences in the methodology, objectives, and duration of surgery. Another factor may be the pharmaco-kinetic properties of propofol and sevoflurane, which are such that precise differences in their recovery profiles are difficult to be really differentiated, and we could not find a significant difference in the recovery profile of the two anesthetics in all the observations made in our study.

In conclusion, both the anesthetic agents provide early and comparable post anesthesia recovery for patients undergoing nasal surgery.

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