ORIGINAL ARTICLE

Comparison of propofol versus sevoflurane on thermoregulation in patients undergoing transsphenoidal pituitary surgery: A preliminary study

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ABSTRACT

Purpose: General anesthesia causes inhibition of thermoregulatory mechanisms. Propofol has been reported to cause more temperature fall, but in case of deliberate mild hypothermia, both sevoflurane and propofol were comparable. Thermoregulation is found to be disturbed in cases of pituitary tumors. We aimed to investigate which of the two agents, sevoflurane or propofol, results in better preservation of thermoregulation in patients undergoing transsphenoidal excision of pituitary tumors. **Methods:** Twenty-six patients scheduled to undergo transsphenoidal removal of pituitary adenomas were randomly allocated to receive propofol or sevoflurane anesthesia. Baseline esophageal temperature was noted. Times for temperature to fall by 1°C or 35°C and to return to baseline were also comparable (P>0.05). After that warmer was started at 43°C and time to rise to baseline was noted. Duration of surgery, total blood loss, and total fluid intake were also noted. If any, side effects such as delayed arousal and recovery from muscle relaxant were noted. **Results:** The demographics of the patients were comparable. Duration of surgery and total blood loss were comparable in the two groups. The time for temperature to fall by 1°C or 35°C and time to return to baseline was also comparable (P>0.05). No side effects related to body temperature were noted. **Conclusion:** Both propofol and sevoflurane show similar effects in maintaining thermal homeostasis in patients undergoing transsphenoidal pituitary surgery.

Key words: *General anesthesia, pituitary tumor, thermoregulation*

INTRODUCTION

In humans, maintenance of normal body temperature is essential for homeostasis of internal milieu. This thermoregulation is maintained by hypothalamus system. General anesthesia inhibits thermoregulatory mechanisms and results in hypothermia.[1] Disturbed thermoregulation has also been reported in patients with pituitary tumors.[2] During surgery of pituitary tumor removal, this thermoregulation is likely to be affected primarily due to the close proximity of hypothalamus. Hypothalamic stimulation may occur due to tumor itself, intraoperative handling/ stimulus or anesthetics induced. Anesthetic agents have differential effect on cerebral blood flow (vasodilatation versus vasoconstriction), and neuroendocrinal responses are also found to be different.[3] Propofol produces a marked and linear decrease in the vasoconstriction and shivering thresholds.[4] In contrast, volatile anesthetic agents decrease the cold-response thresholds nonlinearly.[5] Consequently, the volatile anesthetics inhibit vasoconstriction and shivering less than propofol at low concentrations, but more than propofol at typical anesthetic doses. Therefore, it is likely to have different thermoregulatory responses for different anesthetic agents. To minimize perturbations in thermoregulation in this type of surgery, we should select the anesthetics that may ensure better temperature preservation. Thus the primary aim of our study is to determine, which of the two anesthetic agents, propofol (intravenous) or sevoflurane (inhalational), is better suited for the maintenance of body temperature during transsphenoidal excision of pituitary tumors and secondary aim is to observe any immediate postoperative complications due to hypothermia, if any.

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METHODS

After institutional approval and obtaining of an informed consent, 26 patients of 18-50 years scheduled to undergo transsphenoidal excision of nonfunctioning pituitary tumors were prospectively enrolled. We excluded patients with symptomatic ischemic heart disease, thyroid, diabetes, hepatic or renal disease, or coagulopathy. All patients were premedicated with glycopyrrolate 0.2 mg 1 h before surgery. In the operation theater, the patients were randomized to receive either propofol anesthesia or the sevoflurane anesthesia using computer-generated random numbers. Intraoperative monitoring included electrocardiogram, arterial catheter, noninvasive blood pressure cuff, pulse oximetry, and capnogram was done. Bispectral index (BIS) monitoring was also applied and the value was kept between 50 and 60. Anesthesia was induced with propofol 2-2.5 mg/kg, fentanyl 2 μg/kg, and rocuronium 1 mg/kg. The trachea was intubated, and the lungs were mechanically ventilated. Endtidal carbon dioxide ($EtCO_2$) concentration was kept between 35 and 37 mmHg. Anesthesia was maintained with propofol 3-5 mg/kg/h and nitrous oxide 60% in oxygen in the propofol group and sevoflurane 1-1.5 endtidal concentration in the sevoflurane group, supplemented with doses of fentanyl 1 μg/kg and vecuronium. After induction of anesthesia, esophageal temperature probe was inserted gently through oral cavity up to the distal third of esophagus. Ambient temperatures of holding area and operation theatre were kept around 24°C. All the patients were covered with air warming sheath attached with air warmer. Temperatures were recorded every 5 min for first 15 min, every 15 min for next 60 min and at 30 min interval thereafter. The baseline temperature was noted. Time for fall in temperature (1°C from baseline or up to 35°C whichever earlier) (time 1) was noted. Forced air warming was started at 43°C and time for rise in temperature (up to baseline or 36°C) (time 2) was noted. The duration of surgery, total blood loss, and total fluid were also noted. All fluids administered were prewarmed at 37°C. Hemodynamic parameters were noted. Anesthetics were discontinued at the last suture and nitrous oxide discontinued. At the end of surgery, gentle tracheal and oral suctioning was done. Neuromuscular block was reversed with neostigmine and glycopyrrolate. Trachea was extubated and the patients were shifted to intensive care unit for supportive care. Extubation time was also noted. Extubation time should be defined as the time of discontinuation of anesthetics to extubation. Intraoperative and immediate postoperative complications, such as delayed awakening, shivering, and so forth, were noted.

Statistical analysis

Statistical analysis was done using software STATA 9.0 (College Station, TX, USA). Data are presented as mean±standard deviation (SD) for parametric and as percentage for nonparametric variables. The two groups were compared using unpaired independent *t* test. The value of $P<0.05$ was considered significant.

RESULTS

Twenty-five patients completed the study and one patient in propofol group was excluded due to failure of forced air warmer during intraoperative period. Out of 26 patients, 11 patients (42%) were hypothermic (baseline temperature of 35.7°C). Demographic details are tabulated in Table 1. The groups were comparable in respect of age, weight, height, total blood loss, and fluid given. The duration of surgery was also comparable in both the groups (group A, 61.2 (15.1) min and group B, 64.4 (18.5) min). There were no differences in heart rate and mean arterial pressure between the two groups. Temperature changes during the intraoperative period in the two groups are graphically represented [Figure 1]. In this study, we found that both, fall in temperature (time 1) and rise in temperature (time 2) during sevoflurane-based anesthesia was not different as compared with the propofol group. However, compared with sevoflurane (131.5 min), the patients in propofol group showed a rapid gain in temperature gain (131.5 min versus 122.4 min, respectively) [Table 2].

DISCUSSION

Our study revealed that 42% patients were hypothermic prior to induction of general anesthesia. This could be

Table 1: Demographic profile and baseline characteristics

	Group A (*n*=12)	Group B (*n*=13)	*P* value
Age (year)	45.7 (10)	42.3 (7.7)	0.45
Weight (kg)	66.4 (9.7)	68.6 (14.5)	0.66
Height (cm)	160.5 (7.1)	156.5 (7.4)	0.18
Total fluid (mL)	1775 (441.3)	1593 (381.8)	0.28
Blood loss (mL)	195.8 (54.2)	223.5 (92.7)	0.38
Duration of surgery (min)	141.9 (20.0)	134.5 (18.4)	0.26
Baseline temperature (°C)	36.3 (0.16)	36.2 (0.18)	0.19

n=Number of patients; Values expressed as n (%)

Table 2: Time to change in temperature in the two study groups and time to extubation

	Group A (*n*=12)	Group B (*n*=13)	*P* value
Time 1	34.5 (20.9)	31.8 (15.1)	0.75
Time 2	131.5 (36.4)	122.4 (40.1)	0.61
Extubation time (min)	4.1 (1.2)	4.7 (1.5)	0.29

n=Number of patients; Values expressed as n (%); Time 1: Time to fall in temperature (1°C from baseline or up to 35°C); Time 2: Time to rise in temperature up to baseline or 36°C

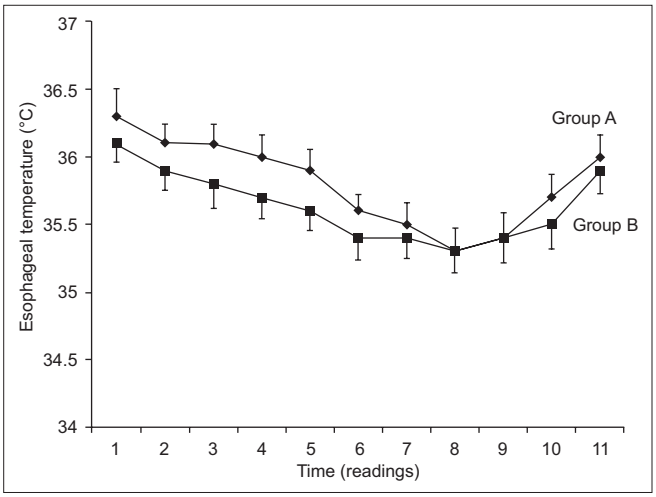

Figure 1: Trend showing changes in temperature in the two study groups during the intraoperative period

due to the altered thermoregulation in patients with pituitary tumors as demonstrated by Behr and colleagues.[2] Induction of general anesthesia causes hypothermia in a characteristic pattern, an initial rapid decrease in core temperature, mainly due to internal core to peripheral redistribution of body heat, a slower, linear decrease in core temperature and a core temperature plateau resulting from decreased cutaneous heat loss.[6-8] Almost all anesthetic agents cause a dose-dependent decrease in the thermoregulatory threshold for vasoconstriction, but the exact figure is variable. Sevoflurane and propofol both fulfill the requirements of a safe neuroanesthetic agent. In this study, we found that both, fall in temperature (time 1) and rise in temperature (time 2) during sevoflurane-based anesthesia were not different as compared with the propofol group. There were no differences in heart rate and mean arterial pressure between the two groups, and hence two anesthetic regimens had comparable effects on the cardiovascular system. The effects of sevoflurane and propofol on core body temperature during general anesthesia have been studied; however, their results remain controversial.[9,10] Although propofol has been reported to cause more fall in temperature, in cases of deliberate mild hypothermia, both sevoflurane and propofol were found to be comparable.[9,10] Ikeda and colleagues suggested that even a very brief period of vasodilatation during anesthetic induction causes substantial redistribution hypothermia.[9] The proposed mechanism of more hypothermia in propofol was systemic vasodilatation and simultaneous thermoregulatory inhibition. However, the increase in core temperature is not affected by vasodilatation by anesthetics.[11] Ali and colleagues reported that propofol in comparison to inhalational agents, is a better anesthetic agent due to the lesser pressor response after intubation, less emergence hypertension, and better cognitive function, in patients undergoing transsphenoidal pituitary surgery,[12] but for maintaining thermal balance of body, sevoflurane is not better than propofol.

Limitation

The limitation of our study is its small sample size and further studies are needed to verify this observation. Observer bias could not be eliminated in this study. Some patients were reluctant to allow themselves to undergo the inhalational induction with sevoflurane; this technique was not used in the current study, although this technique might decrease the change in core temperature after anesthesia induction. We did not note the plasma concentration of propofol, which could have influenced the temperature values. However, we tried maintaining balance between two the anesthetic agents by targeting BIS values between 50 and 60.

CONCLUSION

In this study, sevoflurane and propofol caused similar changes in the core temperature in patients undergoing transsphenoidal excision. This study has shown that intraoperative hypothermia after transsphenoidal excision of pituitary tumors developed frequently regardless of the type of anesthetics. Therefore, preventive measures for hypothermia should be considered in patients undergoing transsphenoidal excision of pituitary adenomas.

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