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Original Article

Comparative Study of Effects of Sevoflurane versus Propofol-based Anesthesia on Intraoperative Maintenance of Hemodynamics and Recovery Characteristics in Patients Undergoing Modified Radical Mastectomy

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Abstract

Background: The need for maintenance of hemodynamic parameters and rapid emergence poses a dynamic clinical challenge for anesthesiologists. We studied and compared the effects of sevoflurane inhalational anesthesia with propofol intravenous anesthesia for maintenance of intraoperative hemodynamics, recovery characteristics, and any adverse effects in patients undergoing modified radical mastectomy.

Materials and Methods: After approval from the Institutional Ethical Committee and proper patient consent, 100 adult patients of American Society of Anesthesiologists Grade I and II were randomly allocated into two groups (50 each) using chit in box method. Group A was maintained with 1-4% sevoflurane with 60% nitrous oxide in oxygen, and Group B was maintained with injection propofol infusion 50-150 ug/kg/min with 60% nitrous oxide in oxygen to maintain a bispectral index (BIS) value of 40-60. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), SpO_2, $ETCO_2$, and BIS were recorded intraoperatively and at the end of surgery. Emergence time, extubation time, recovery time, and any adverse event were also noted. Quantitative data was analyzed using two paired and un-paired student *t*-tests. Qualitative data was analyzed using Chi-square or Fisher's exact test.

Results: HR, SBP, DBP, and MAP were more stable in sevoflurane group intraoperatively. In propofol group, HR was significantly lower (P = 0.000), and MAP, DBP, and SBP were significantly higher intraoperatively. Emergence time, extubation time, and recovery time (P =0.000) were much smaller in sevoflurane group. Shivering was reported in 12 patients in propofol group.

Conclusion: Sevoflurane anesthesia provides more stable intraoperative hemodynamics and rapid recovery as compared to propofol-infusion anesthesia.

Key words: Hemodynamics, Recovery characteristics, Sevoflurane, Propofol, Modified Radical Mastecctomy

INTRODUCTION

Breast cancer accounts for 23% of all newly occurring cancers in women worldwide and represents 13.7% of all cancer deaths. The standard conservative surgical treatment for breast cancer is modified radical mastectomy.[1] The need for maintenance of hemodynamic parameters and rapid emergence as well, represent a dynamic clinical challenge for anesthesiologists.[2-4] Various anesthetic agents and a number of alternative anesthetic techniques have been tried with varying results.[5-7] The use of intravenous anesthesia with propofol is in widespread clinical practice due to its rapidity and quality of awakening.[8-10] Sevoflurane is a new inhaled anesthetic that also permits rapid emergence due to its low blood solubility. It has been successfully used as an alternative to propofol for various day care procedures.[11,12]

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With this background, the present study was conducted to compare the effects of sevoflurane anesthesia with propofol intravenous anesthesia for maintenance of intraoperative hemodynamics and recovery characteristics in patients undergoing modified radical mastectomy.

Aims and Objectives

To assess and compare the effects of sevoflurane versus propofol-based anesthesia on intraoperative maintenance of hemodynamics and recovery characteristics and to find out and compare any adverse occurrences in patients undergoing modified radical mastectomy.

MATERIALS AND METHODS

After approval from the Institutional Ethical Committee, 100 adult patients of American Society of Anesthesiologists (ASA) Grade I or II, undergoing modified radical mastectomy were randomly allocated into two groups (50 each at alpha error 0.05 and power 80%) - Group A (sevoflurane group) and Group B (propofol group) using chit in box method. Patients included in study belonged to age group 40-60 years, weight between 45 and 65 kg and ASA Grade I or II. Patients with major organ dysfunction, ASA Grade III-V, and with anticipated difficult airway were excluded.

All the patients were premedicated with intravenous (IV) glycopyrrolate, midazolam, and fentanyl (2 ug/kg) and induced with injection propofol 1.5-2.5 mg/kg, followed by injection succinylcholine (2 mg/kg) IV. Intubation was done with an endotracheal tube of appropriate size after direct laryngoscopy. Group A was maintained with 1-4% sevoflurane with 60% N_2O in oxygen, and Group B was maintained with injection propofol infusion 50-150 ug/kg/min IV via infusion pump with 60% N_2O in oxygen to maintain bispectral index (BIS) value of 40-60 and muscle relaxation was maintained with injection atracurium. Heart rate (HR), BP, mean arterial pressure (MAP), SpO_2, $ETCO_2$, and BIS to be recorded. All inhalations and infusions to be stopped at the end of surgery.

Reversal was done with injection neostigmine and injection glycopyrrolate. HR, systolic blood pressure (SBP), diastolic blood pressure (DBP), MAP, SpO_2, $ETCO_2$, and BIS were recorded preinduction, just after induction, just after intubation, for every 5 min after intubation till 15 min and then at 15 min interval till end of surgery, at end of surgery (till last suture), and just after extubation. Shifting vitals were recorded. Duration of surgery (from skin incision to completion of surgery), emergence time (after stoppage of sevoflurane inhalation and propofol infusion to reach BIS value of 80), extubation time (end of surgery to removal of endotracheal tube), and recovery time (end of surgery till Aldrete score of 9 is achieved) were noted. Any adverse event intraoperative and post-operative and patient's satisfaction about the quality of anesthesia (any recall of events during surgery, any unpleasant memory, or discomfort) was also noted. The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA, version 19.0 for Windows). Parametric data were analyzed using paired and un-paired *t*-tests. Qualitative or categorical variables were compared using Chi-square test or Fisher's exact test. All statistical tests were two-sided and were performed at a significance level of $\alpha = 0.05$.

RESULTS

There was even distribution of age, weight, ASA grade, and duration of surgery in both the groups with $P > 0.05$ as shown in Table 1. BIS value was kept between 40 and 60 in both the groups by altering inspired concentrations of sevoflurane or infusion rate of propofol. BIS values were also comparable in both the groups at all the time points ($P > 0.05$) as shown in Figure 1. Thus, randomization was done adequately, and the desired study and control populations were achieved.

Baseline HR was comparable in both the groups as shown in Figure 2. HR changes were insignificant between the two groups at just after induction and just after intubation. HR was significantly low in Group B at 5 min ($P = 0.0137$), at 10 min ($P = 0.0019$), and from 15 to 90 min ($P = 0.0000$) compared to Group A. At the end of surgery, there was insignificant difference in HR between the two groups

Table 1: Distribution of age, weight, and duration of surgery among the two groups

Study variables	Mean±SD		*P* value
	Group A (50)	Group B (50)	
Age (in years)	49±7.5	50±7.5	0.4991
Weight (in kg)	58.2±6.5	56.9±5.6	0.2985
Duration of surgery (min)	117.8±8.3	118.5±8.7	0.6986

SD: Standard deviation

Table 2: Emergence time, extubation time, and recovery time compared between the two groups

Time (min)	Mean±SD		*P* value
	Group A (50)	Group B (50)	
Emergence time	10.3±2.2	18.7±4.2	0.0000
Extubation time	2.9±1.1	12.9±3	0.0000
Recovery time	5±1.5	18.1±4.9	0.0000

SD: Standard deviation

(P = 0.4665). Just after extubation, HR was significantly high in Group B (P = 0.0323). Shifting HR was comparable between the two groups.

Baseline SBP was comparable in both the groups as shown in Figure 3. There was insignificant change at just after induction, intubation, at 5 min and 10 min in both the groups (P - 0.6489, 0.4512, 0.1294, respectively). There was significant rise in SBP in Group B at 15 min (P = 0.0007) then at 45, 60, 90 min, and at end of surgery (P - 0.0003, 0.0007, 0.0015, 0.0002, 0.0000). Just after extubation, both groups showed a significant rise, more with Group B compared to Group A (P = 0.0000). Shifting SBP was comparable in both the groups (P = 0.4270).

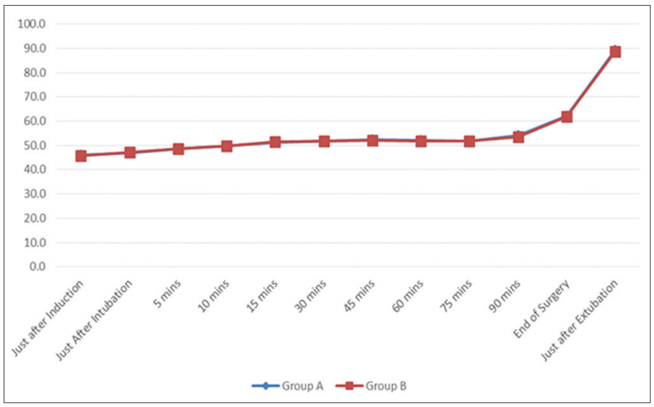

Figure 1: Trend of systolic bispectral index

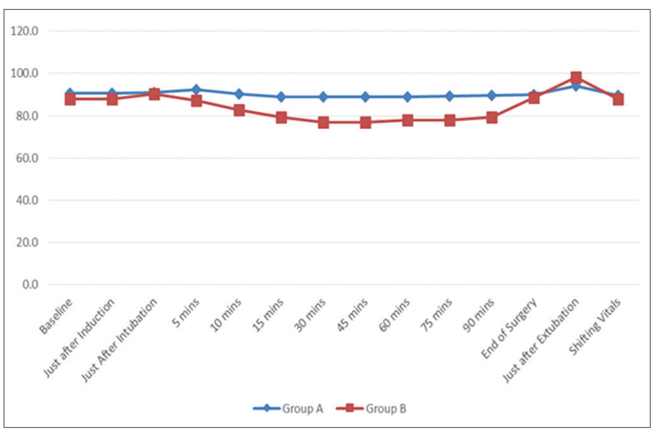

Figure 2: Trend of heart rate

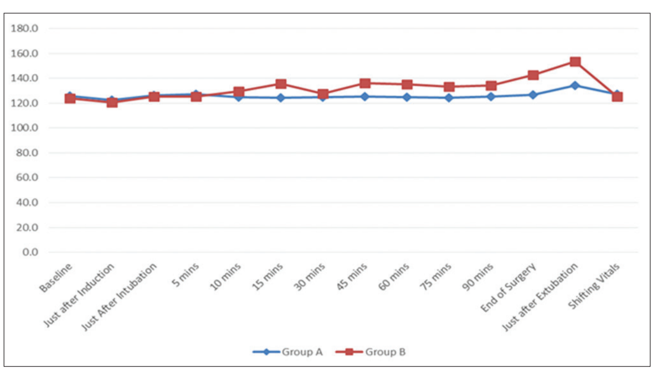

Figure 3: Trend of systolic blood pressure

Baseline values of DBP and at just after induction, just after intubation, and at 5 min were comparable in both the groups as shown in Figure 4 (P = 0.1452, 0.9163, 0.3937, respectively). There was a significant rise in Group B compared to Group A and from baseline at all time points except at 30 and 75 min. Shifting DBP was comparable in both the groups (P = 0.9628).

Baseline MAP, at just after induction, just after intubation, and at 5 min were comparable among the two groups as shown in Figure 5, followed by a significant rise at all the time points in Group B compared to Group A except at 30 and 75 min. MAP at the time of shifting showed insignificant difference among the two groups (P = 0.7255).

Group A had a shorter emergence time, extubation time, and recovery time compared to Group B with a statistically significant P = 0.0000 as shown in Table 2.

Group A had no adverse event intraoperatively or post-operatively. In Group B, 12 patients suffered from shivering

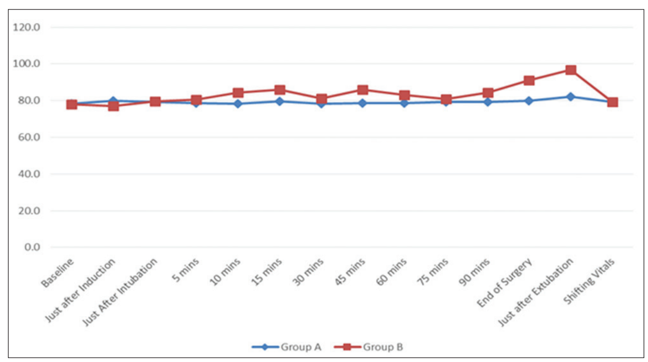

Figure 4: Trend of diastolic blood pressure

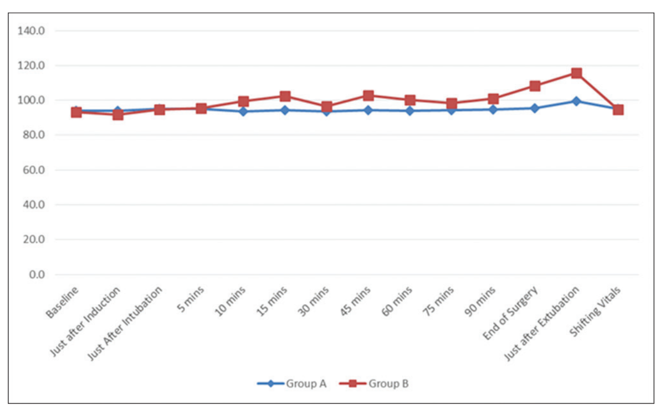

Figure 5: Trend of mean arterial pressure

postoperatively. None of the patient reported of any recall of events and were satisfied with the quality of anesthesia.

DISCUSSION

The present study investigated the hemodynamic responses and recovery profile of inhalational anesthesia with sevoflurane and intravenous anesthesia with propofol in patients undergoing modified radical mastectomy.

The doses of sevoflurane and propofol infusion were titrated according to the BIS monitoring for keeping an adequate depth of anesthesia. Comparison between the two groups revealed that baseline HR, SBP, DBP, and MAP differences were statistically insignificant among the two groups with $P > 0.05$ equating the two groups to compare these parameters at other time points.

HR was more stable in Group A, whereas in Group B, HR varied from baseline values and was significantly low below baseline values at most time points except for a significant rise just after extubation.

SBP was more stable and was comparable to baseline values in Group A at all the time points except for a significant fall just after induction and significant rise just after extubation as shown in Figure 3, whereas in Group B, SBP varies from baseline values with a significant fall just after induction to return to baseline values followed by a significant rise at most time points.

DBP was also more stable in group A and was comparable to baseline values at all the time points except for a significant rise just after extubation as shown in Figure 4, whereas in group B, DBP varied throughout the surgery to maintain a BIS value of 40-60 and was significantly high ($P > 0.05$) at various time points.

MAP was also more stable in Group A, and the difference in MAP throughout the procedure was insignificant except for a significant rise just after extubation as shown in Figure 5. In group B, MAP varied throughout surgery and was significantly high above the baseline at 10 min, 15 min, 45, 60, and 90 min, at the end of surgery and just after extubation.

Our results suggest that sevoflurane provided better intraoperative hemodynamic stability than propofol, and it was similar to the results found by Bharti *et al.*,[2] who concluded that sevoflurane shows an advantage over propofol in respect of intraoperative cardiovascular stability without increasing recovery time.

Our emergence time, extubation time, and recovery time were more rapid in the sevoflurane group compared to propofol group with a statistically significant $P = 0.000$. Our results are similar as found by Liao *et al.*,[13] who found more stable hemodynamics and faster recovery with sevoflurane volatile induction and maintenance compared with propofol-remifentanil TIVA in pediatric patients. Jellish *et al.*[14] also found emergence times with sevoflurane significantly shorter than propofol.

Shivering was reported in 12 patients in propofol group in the post-operative period and was controlled with intravenous tramadol. Vasodilatory effects of propofol may be the cause for this shivering, but it needs further studies to rule out post-operative shivering effects of propofol. None of the patients complained of recall of events postoperatively and were satisfied with the quality of anesthesia.

CONCLUSION

Inhalational anesthesia with sevoflurane provides better hemodynamic stability and early recovery compared to intravenous anesthesia with propofol infusion. Sevoflurane provides a suitable alternative to propofol for anesthesia.

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