ORIGINAL RESEARCH

Comparison of desflurane and sevoflurane for maintenance of anaesthesia, emergence, recovery parameters and hemodynamic stability in patients with BMI >27.5; A prospective randomized comparative study

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ABSTRACT

Aim: The purpose of this prospective randomised study was to assess the maintenance, emergence, recovery parameters and hemodynamic stability with sevoflurane or Desflurane for any surgical procedure under general anaesthesia lasting for >120mins in Indian patients with BMI>27.5. **Material and methods:** Total of 100 Patients were divided in to 2 groups. Group I (D) – anesthesia was induced using standard induction and maintained O2 and desflurane and Group II (S) – anesthesia was induced using standard induction and maintained with O2 and sevoflurane. Patient demographics(age, sex, height, weight,BMI), medical history(ASA grading), maintenance of anaesthesia (MAC every 15minutes intraoperatively), emergence (time duration forextubation), recovery (durations for ability to follow commands and orientation to time, place and person and time to PACUdischarge) and hemodynamic stability (SBP, DBP,HR measured preoperative,intraoperatively every 15mins and postoperatively)] were recorded. **Results:** We found that there were no significant differences in MAC requirements during maintenance of anesthesia. The time to extubation, time to follow verbal commands, time to orientation to time place and person and time to PACU discharge were significantly shorter (P<0.001) with desflurane as compared to sevoflurane. Intraoperative BP and HR did differ statistically between the two groups at some time points (P<0.001) but these differences were clinically insignificant and warranted no additional intervention. **Conclusion:** Both Desflurane and Sevoflurane provide comparable clinical hemodynamic stability and maintenance of anesthesia but the emergence and recovery were significantly faster after Desflurane thus contributing to fast tracking and early discharge of patients from PACU.

Keywords: Desflurane, Sevoflurane, hemodynamic stability

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INTRODUCTION

One of the major factors that determine speed of recovery from anesthesia is the choice of anesthetic agents. An ideal general anesthetic for the patients, should provide smooth and rapid induction, optimal operating conditions, and rapid recovery with minimal side effects like nausea, vomiting, bleeding, and postoperative pain[1].

Inhaled volatile anesthetics remain the most widely used drugs for maintenance of general anesthesia because of their ease of administration and predictable intraoperative and recovery characteristics. Management of hemodynamic stability and early recovery is the most important part of a standardized balanced technique. Inhaled anesthetics allow rapid emergence from anesthesia because of easy titrability with inherent neuromuscular blocking effects that make them more suitable for anesthesia[2].

Desflurane and Sevoflurane are the two most administered inhaled anesthetics for outpatient surgeries due to their favorable pharmacokinetic profiles and low incidence of untoward effects. Given the low blood: gas partition coefficient of Sevoflurane and Desflurane, faster emergence from anesthesia is expected compared to traditional inhalation anesthetics[3,4].

The purpose of this prospective randomized study is to compare the maintenance, emergence recovery parameters and hemodynamic stability of Sevoflurane with those of Desflurane in obese patients for longer duration(>120mins) of anesthesia in India.

MATERIAL AND METHODS

This prospective, double blinded, randomized comparative study was conducted after ethical committee and scientific committee clearance and after obtaining an informed written consent from every patient at Fortis Hospital Shalimar Bagh. Total of 50 Patients with ASA grade 1-2 patient with BMI>27.5 of age >18years undergoing any surgical procedure under general anesthesia for >120mins were included in the study .

Patients with known or suspected genetic susceptibility to malignanthyperthermia ; with known sensitivity to Desflurane or Sevoflurane or to other halogenatedagents, Pregnant orlactating patients , with clinically significant cardiovascular, respiratory, hepatic, renal, neurologic, psychiatric and metabolic disease or those who had undergonea recent anaesthesia (within the previous 7days) and patients chronically receiving opioid analgesics or sedativemedication were excluded from the study.

A pre-anesthetic examination comprising history, general physical and systemic examination of all the patients was conducted. Routine investigations including haemoglobin, total leucocyte count, blood sugar, serum creatinine and urine examination was carried out. All patients were kept fasting for at least 6 hours prior to surgery.

Method of randomization: After enrolment, group assignments were determined by a computer-generated number sequence and were contained in sequentially numbered opaque envelopes to ensure blinding. The two groups being:

Group I (D) – anesthesia was induced using standard induction and maintained O2 and desflurane and Group II (S) – anesthesia was induced using standard induction and maintained with O2 and sevoflurane.

METHODOLOGY: PROTOCOL FOR GENERAL ANESTHESIA

In the operating room, an intravenous (IV) line was secured on the non-dominant hand of the patient, monitors were attached and baseline heart rate (HR), mean arterial pressure (MAP) and oxygen saturation (SpO2) was recorded.

All patients were preoxygenated prior to induction of anesthesia till etO2 is 90andreceived fentanyl citrate 1 mcg/ kg intravenously. Anesthesia induced with propofol 2.5 mg/kg IV. After loss of consciousness, ventilation of lungs was manually assisted. Neuromuscular blockade was achieved with atracurium (0.5mg/kg) IV and airway secured with an endotracheal tube under direct laryngeoscope.

The patients subsequently received either sevoflurane 1–2%(group 2) or desflurane 3– 6% (group1) with oxygen. The inspired concentration of the volatile anesthetic was kept at MAC 0.8-1.0.

Muscle relaxation was maintained using intermittent doses of atracurium as per individual requirements.

Continuous monitoring of SpO2, electrocardiogram (ECG), Heart Rate and end-tidal carbon dioxide (EtCO2) and non invasive blood pressure every 15mins. The primary anesthetic was discontinued at the end of the procedure and flow rates adjusted to calculated minute volume for the patient(males:105±13.1ml /kg lean body weight, females:98.7±13.3ml/kg LBW). The neuromuscular block was reversed with Inj. myopyrrolate intravenously and patient were extubated when patient met the clinical criteria of extubation.

In the post anesthesia care unit (PACU), all the patients were kept in propped up position. Oxygen was administered via Hudson mask. Parameters were recorded according to study protocol attached.

Patients were observed for nausea / vomiting, drowsiness, respiratory distress and pain postoperatively and managed accordingly.

Double blinding was done by keeping the patient and the observer blinded towards the details of comparison group. Observer was a trained post operative care nurse who was instructed to note down the data in study pro-forma without any knowledge of the group assignments.

Patient demographics(age, sex, height, weight,BMI), medical history(ASA grading), maintenance of anaesthesia (MAC every 15minutes intraoperatively), emergence (time duration forextubation), recovery (durations for ability to follow commands and orientation to time place and person and time to PACUdischarge) and hemodynamic stability (SBP, DBP,HR measured preoperative, intraoperatively every 15mins and postoperatively) were recorded.

RESULTS

100 patients were divided into two groups. Each group had 50 patients and there was no difference observed in number of patients in the two groups. There was total 89% females and 11% males. It was observed that the mean age for group 1 was 41.38 ± 11.72 years while for group 2 mean age was 43.80 ± 7.44 years. Mean height of group was 160.39 ± 8.42 cm and for group 2 was 157.93 ± 7.21 cm. Mean weight for group 1 and group 2 was 86.48 ± 23.94 kg and 82.21 ± 11.57 kg respectively. Mean BMI for group 1 and group 2 was 33.94 ± 10.71 and 32.93 ± 3.89 respectively. Further, it was observed that difference in gender, mean age, mean height, mean weight and mean BMI between the two groups was statistically insignificant. ($p > 0.05$).

In group 1, 46% of the patients were ASA1 while54% were ASA2. Group 2 had 34% of the patients as ASA1 while 66% were ASA2. It was further observed that there was no significant difference in ASA grading between the two groups p=0.05).

Figure 1 shows the comparison of mean systolic

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blood pressure (SBP) at various timepoints between the two groups. It was noted that there was a significant difference in mean SBP at 30 min, 45 min, 135 min and at 270 min when compared between the two groups(p value was <0.001, 0.019, 0.039 and 0.001 respectively). **Figure 2** shows there was a significant difference in mean DBP at 30 min, 45 min, 105 min, 120min, 210min, 270min, 285min and at 300 min when compared between the two groups(p value was <0.001, 0.001, 0.012, 0.039, 0.011, 0.001, 0.001 and 0.001). **Figure 3** shows It was noted that there was a significant difference in mean HR at Preop, Induction, 15min, 30 min, 45 min, 75min, 105 min, 120min, 225min, 255min, 285min and at 300min when compared between the two groups(p value was <0.001, 0.001, 0.001, 0.028, 0.024, 0.023, 0.012, 0.027, 0.006, 0.30, 0.001 and 0.002respectively). **Table 1** shows the comparison of mean durations between the two groups. It was observed that the mean durations were quite variable for both the groups under the study. It was noted that there was a significant difference in mean durations of extubation, follow commands, orientation and PACU discharge when compared between the two groups(p value was <0.001, <0.001, <0.001 and <0.001respectively). There were no intra operative and post operative adverse events in both groups.

Figure 1: Comparison of SBP at different time points between two groups

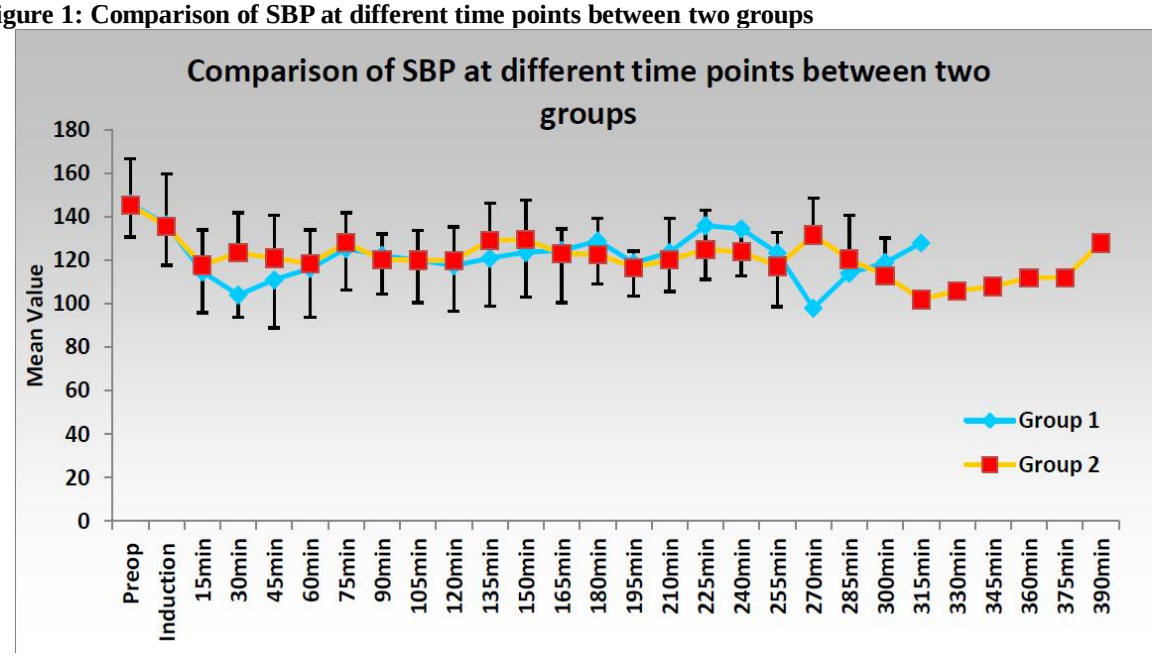

Figure 2: Comparison of DBP at different time points between two groups

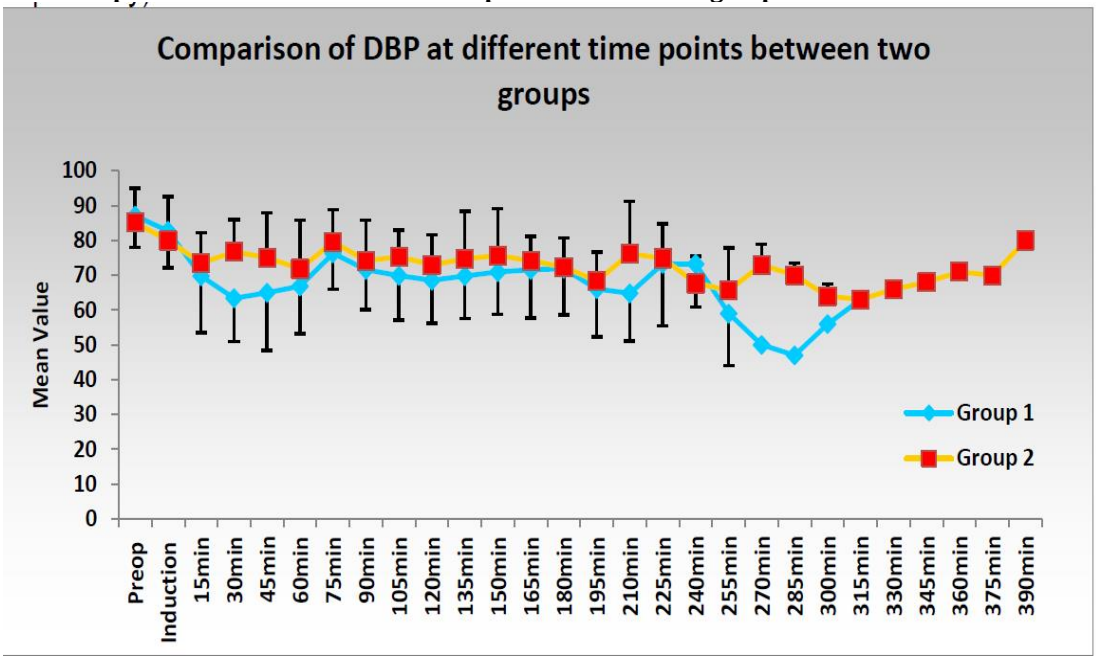

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Figure 3: Comparison of HR at different time points between two groups

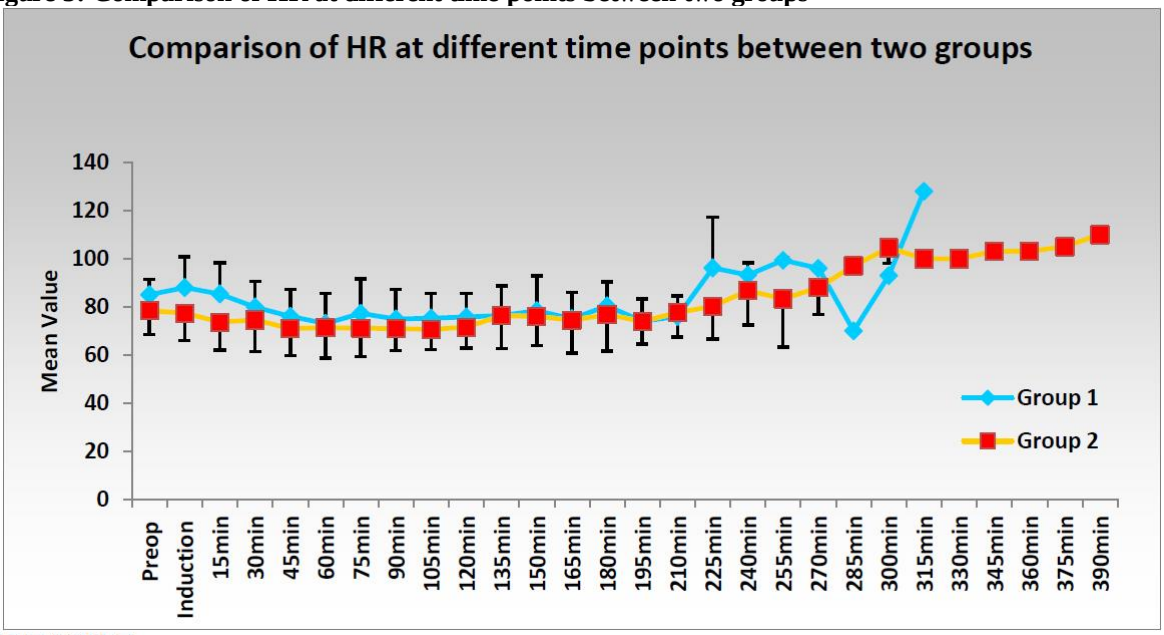

Table 1: the comparison of mean durations between the two groups

	Group 1	Group 2	p value
	Mean ± SD(Minutes)	Mean ± SD(Minutes)	
Duration extubation	7.98 ± 1.82	12.08 ± 3.56	<0.001
Duration follow commands	7.84 ± 2.65	11.86 ± 4.37	<0.001
Duration orientation	8.92 ± 4.85	14.56 ± 7.37	<0.001
Duration total anaesthesia time	198.6 ± 55.49	178.8 ± 60.91	0.092
Duration PACU discgarge	86.10 ± 9.96	112.2 ±13.29	<0.001

DISCUSSION

We conducted this study to assess and compare maintenance of anaesthesia, emergence, recovery parameters and haemodynamic stability in Indian obese surgical population because it was felt by us that there was insufficient data in the Indian obese population even though Indians form almost 17.74% of world population and India is rapidly becoming the world capital for obesity and its related comorbidities.[5]

Our study was conducted in surgical population of patients with BMI>27.5 andtentative duration of anaesthesia >120mins. The demographics and anthropometrics were similar in the two groups(group 1-desflurane and group 2 sevoflurane) as also the duration of anaesthesia (p value>0.05).

Recovery and emergence characteristics are of utmost importance in the obese as they are at increased risk of respiratory complications in immediate post operative period so even a slight improvement in early and intermediate recovery is beneficial for these patients as suggested in the study done by **juvin et al** in 2000 [5] and **Misal US** [6].

We observed that the difference between SBP and DBP in the two groups were not statistically significant except mean SBP at 30 min, 45 min, 135 min and at 270 min (p value was <0.001, 0.019, 0.039 and 0.001 respectively) and DBP at 30 min, 45 min, 105 min,120min, 210min, 270min, 285min and at 300 min (p value was <0.001, 0.001, 0.012, 0.039, 0.011, 0.001, 0.001 and 0.001 respectively) but here also the difference though statistically significant was not clinically significant and no intervention or correction was required at any point. There is a statistical and clinical difference in the HR between the two groups. The heart rate was higher at some points in group 1(Preop, Induction, 15min, 30 min, 45 min, 75min, 105 min, 120min, 225min, 255min) and at other point s in group 2(285min and300min)

The difference, we felt, can be attributed to variability in individual surgical and anaesthetic techniques. Though we excepted that a higher heart rate would be found in group 1 as desflurane is known to have internal sympathomimetic activity at higher concentration but the heart rate variability was in both groups thus our reasoning that could be due to individual variations seems justified.

Also study done by **kaur et al**[7] compared these agents in morbidly obese patients undergoing bariatric surgery. They found that Intraoperative MAP and HR did not differ between the two groups (P > 0.05).

Study done by **Jindal et al**[8] also found the intraoperative haemodynamics are similar with both the agents.

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Some studies found different outcomes like:

In 2016 **Vairavaranjanchandrasekaran et al**[9] published a study comparing both Desflurane and Sevoflurane maintained hemodynamic stability intraoperatively, but to maintain the hemodynamics Desflurane needed more number of additional doses of Fentanyl.Siampalioti [10] found in his study that sevoflurane provided better hemodynamic stability.

Mean durations between the two groups were evaluated. It was observed that the mean durations were quite variable for both the groups under the study. It was noted that there was a significant difference in mean durations ofextubation, follow commands, orientation andPACUdischarge when comparedbetween the two groups. The mean duration of extubation, and PACU discharge , follow verbal command was significantly shorter in group 1. (p value = <0.001).

The time to extubation and emergence was significantly shorter in desflurane group. Numerous studies carried out in varied patient populations,[11,12] have demonstrated early recovery with desflurane as compared tosevoflurane. Cohen *et al*.[13] observed desflurane providing early emergence and recovery as compared to sevoflurane in children undergoing adenoidectomy.

In children undergoing minor surgery, it was observed that the eye opening on verbal commands and tracheal extubation were earlier in desflurane group.[14]

In adult patients undergoing ambulatory surgeries, recovery endpoints such as time to eye opening on verbal commands and regaining orientation were found to be significantly faster with desflurane.[15]

Desflurane has also been demonstrated to reduce the average extubation time by 20– 25% as compared to sevoflurane.[16]The quicker emergence with desflurane has been shown to be associated with more rapid recovery of protective reflexes.[17]

In most of the studies mentioned here, the duration of anaesthesia was <1 h. In our study, the average duration of anaesthesia was about 120minutes, and the results are consistent with the study carried out by other investigators[18] with duration of anaesthesia up to 3.1 h. They observed that patients receiving desflurane exhibited a more rapid emergence, followed commands, were extubated early and gained orientation earlier than the patients receiving sevoflurane.

It has been demonstrated that time for 'ready to discharge'status from PACU was significantly shorter in desflurane group as compared sevoflurane[13]. Our results were similar to the meta-analysis done by Macario *et al.*[18] in varied patient population, where recovery from anaesthesia was earlier in desflurane group.

Also study done by **kaur et al**[7] compared these agents in morbidly obese patients undergoing bariatric surgery.The time to response to painful stimuli, obeying verbal commands and spontaneous eye opening was shorter (P = 0.001) and modified Aldrete Score was higher after Desflurane anesthesia than after Sevoflurane anesthesia

(P = 0.049). DSST also returned towards normal faster after Desflurane (28.50 ± 6.30 min vs. 35.0 ± 5.62 min, P = 0.03). Hence they concluded that the immediate and intermediate recovery was significantly faster after Desflurane thus contributing to fast tracking and early discharge of patients.

Priyanka gupta et al conducted a study in AIIMS [19], New Delhi in 2015 and found that Desflurane provided earlier tracheal extubation and emergence as compared to Sevoflurane in children undergoing surgery for lumbo-sacral spinal dysraphism.

In 2016 **Vairavaranjanchandrasekaran et al**[9] published a study comparing emergence and recovery parameters in Desflurane and Sevoflurane and concludedthat Desflurane provides earlier emergence and recovery from anesthesia compared to Sevoflurane.

Joseph g. Werner et al [20] in 2015 published a study comparing the emergence and recovery of Sevoflurane and Desflurane and found that Desflurane allows for a faster emergence when compared to Sevoflurane without affecting the baseline cognitive recovery time.

In 2012 Jeong Min Kim [14] published a study titled comparison of emergence time in children undergoing minor surgery they compared the total of 499 (s=340 d=159) they concluded that emergence and recovery from anaesthesia was significantly faster in Desflurane group and wash out curves after Desflurane and Sevoflurane anaesthesia.

Emergence characteristics like time to regular breathing, time to awakening and time to extubation was faster with desflurane than sevoflurane when used for maintenance of general anesthesia. As a result of the lower solubility of desflurane in blood and lean tissues, it is expected to find faster emergence with desflurane than sevoflurane.[21,22]Similar results were also obtained by Welborn *et al*.[23] their study.

Macario *et al*.[18] in their meta-analysis also reported similar observations. This faster emergence with desflurane is really important in obese patients undergoing prolonged surgeries.

Our results were comparable to Mayer *et al*.[24] who reported faster recovery after desflurane anesthesia (36.2 ± 9.9 min) than after sevoflurane anesthesia (39.3 ± 8.1 min). They compared Aldrete score ≥9 as criteria for discharge from PACU.

Many older studies had similar results like Heavner J.E.[25] , Strum et al[26] , Innuzzi E.[27] , La colla [28], and found that desflurane had faster recovery than sevoflurane.

But contradictory results were also seen in some studies like Study done by **Jindal et al**[8] compared the emergence and recovery in a day care setting for ambulatory surgeries and demonstrated that both Sevoflurane and Desflurane provide a similar time to home readiness despite a faster early recovery with Desflurane.

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De-baerdmaeker in 2006[29] , **Romeo** in 2004 [30] and**Vallejo** in 2007 [31] did not find any difference in emergence and recovery with the two agents.

Both groups had comparable total duration of anesthesia which on average was longer than 120 minutes. (p value=0.092)

Similar studies did compare emergence after desflurane and sevoflurane maintenance after prolonged duration of surgery and found that emergence and recovery from desflurane was independent of duration of anaesthesia Mckay et al[32]

These findings were similar to other studies particularly Study by **Mckay et al[32]**in 2010 showed that emergence with Desfluraneis independent of duration of anaesthesia and BMI whereas that of sevoflurane depended on BMI and duration of anaesthesia.

CONCLUSION

Hence we conclude that both Desflurane and Sevoflurane provide comparable clinical hemodynamic stability and maintenance of anesthesia but the emergence and recovery were significantly faster after Desflurane thus contributing to fast tracking and early discharge from PACU in Indian obese patients(BMI>27.5) even with longer duration(>120min) of surgery.

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