Original Research Article

Emergence and Recovery Characteristics of Desflurane versus Sevoflurane in Morbidly Obese Adult Patients Undergoing Abdominal Surgery

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Abstract

Background: Early and complete recovery after general anesthesia is desirable in all patients, more so in the morbidly obese patients. All volatile anesthetics accumulate, over time, in adipose tissue. Such accumulation may delay recovery from anesthesia. The new fluorinated agents have markedly improved the quality and the time required for recovery compared with the older inhaled anesthetics. **Aim:** This study was done to compare the maintenance and recovery characteristics of Sevoflurane versus Desflurane in morbidly obese patient, **Method:** Fifty morbidly obese patients (BMI > 35kg/ meter square) requiring Abdominal surgery were randomly allocated to 2 groups (25 patients in each group)Group A received 1 MAC target concentration of Desflurane and GROUP B received 1MAC target concentration of Sevoflurane in oxygen for maintenance. $EtCO_2$ (end-tidal carbon dioxide) was maintained between 30-40mm Hg. The MAP and HR were targeted to maintain within ± 20% of the baseline values throughout intra operative period. **Results:** Early recovery parameters were achieved statistically significantly($p<0.05$) faster in Desflurane group in comparison to Sevoflurane group. Time for response to eye opening was earlier by 1.41 minutes, time for hand grip was faster by 1.61 minutes, time for tracheal extubation was significantly faster by 2.21 minutes in Desflurane group than Sevoflurane group. Time to state his/her own name and name of village were also significantly faster in Desflurane group by 2.76 minutes and 2.76 minutes respectively. Intermediate recovery (the time to discharge the patient from the PACU) was comparable between two groups. ($p>0.05$). **Conclusion:** In morbidly obese patients, using 1 MAC end-tidal concentration, we found that the time to emergence and early recovery from prolonged anaesthesia with Desflurane is shorter than with Sevoflurane anaesthesia.

Introduction

Obesity is a multi-system disorder, particularly involving the respiratory and cardiovascular systems; therefore, a multidisciplinary approach is required. Morbidly obese patients are at increased risk of aspiration and acute upper airway obstruction after tracheal extubation. An ideal general anesthetic agent should provide intra-operative hemodynamic stability and rapid recovery[1] more so in the morbidly obese patients. All volatile anesthetics accumulate over time, in adipose tissue. Such accumulation may delay recovery from anesthesia.. The impact of anesthetic stored in fat may be exaggerated in morbidly obese patients, particularly after prolonged anesthesia[2]. The new fluorinated agents have markedly improved the quality and the time required for recovery compared with the older inhaled anesthetics. Desflurane, in particular, is a new fluorinated anesthetic agent with a very low blood–gas partition coefficient (about 30% less than sevoflurane) and low oil–gas partition coefficient (about 64% less than sevoflurane) which allow for quick modification of the anesthetic plan and rapid emergence at the end of surgery[3,4], even in obese patients. Nonetheless, obesity markedly affects the cardiovascular and respiratory systems, the proportion of different tissues in body composition, and perfusion, uptake, and solubility. These changes can potentially affect not only wash-in and wash-out kinetics of the aforesaid new inhalational agents, but also recovery times in obese patients. In this study we compared the hemodynamic stability and recovery characteristics of Desflurane and Sevoflurane in morbidly obese adult patients undergoing abdominal surgery.

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Methodology

This Hospital based, comparative, randomized, Interventional clinical study was conducted after taking due permission from the institutional ethics committee and research review board. Written informed patient consent was taken.

After proper pre-anesthetic examination, 50, Morbidly obese patients (BMI > 35kg/ metre square) ASA physical status 1 & 2 requiring Abdominal surgery were randomly allocated to 2 groups (25 patients in each group) **GROUP A:** received GA with Desflurane as inhalational agent **GROUP B:** received GA with Sevoflurane as inhalational agent for maintenance of Anaesthesia

On the day of surgery, patients were taken into OT. Baseline PR, SBP, DBP, MAP, SpO_2 and ECG were recorded. Difficult airway cart was kept ready for all patients.. In both groups, all the patients were pre-medicated with Inj. midazolam 0.05 mg/kg , Inj. Glycopyrrolate 0.01 mg /kg , Metoclopramide 0.15 mg/kg and inj. Fentanyl 2µg/kg and pre-oxygenated with 100% oxygen for 3 minutes. Then, induction was done by inj. propofol 2mg/kg and Inj. Succinyl choline 2mg/kg was given to facilitate tracheal intubation. The MAP and HR were targeted to maintain within ± 20% of the baseline values throughout intraoperative period. If MAP and HR remained increased even after 5 minutes, rescue bolus dose of fentanyl 0.5ug/kg was given to control acute hemodynamic changes. Muscle relaxation was maintained by top up doses of injection vecuronium 0.1mg/kg every half hourly. GROUP A received 1MAC target concentration of

Desflurane and GROUP B received 1MAC target concentration of Sevoflurane in oxygen for maintenance. Minimum fresh gas flow was 2L/min, administered via a circle breathing system with a carbon dioxide absorber.

$EtCO_2$ (end-tidal carbon dioxide) was maintained between 30-40mm Hg.

Intra abdominal pressure was maintained between 12-14 mm Hg.

Hemodynamic parameters (HR, SBP, DBP, MAP, SPO_2), BIS and $ETCO_2$ values were recorded before Induction of anaesthesia (baseline), immediately after tracheal Intubation, immediately after skin incision and then at every 10 min interval for the next 2 hours and every 15 minutes till the end of surgery.

The end tidal concentration of Desflurane or Sevoflurane was maintainted at 1 MAC until the end of surgery. Immediately after the last skin stitch volatile anaesthetic administration was discontinued, without tapering its delivery during the period approaching the end of surgery. At the end of surgery the fresh gas inflow rate was changed to 6 l/min of oxygen. Time of total discontinuation of anesthetic agent was taken as time zero for all measures of recovery profile. Intravenous ondansetron 0.1mg/kg mg was given to patients of both groups as antiemetic prophylaxis. On return of spontaneous ventilation, injection neostigmine 0.05mg/kg and injection glycopyrrolate 0.01mg/kg was administered to antagonize residual neuromuscular block.

At 1 minute interval from the discontinuation of volatile anaesthetic agent, we looked for time of Eye opening, Obeying commands, Hand grip, Tracheal extubation, Telling name and name of village.

Intermediate recovery variables were measured immediately on arrival in the PACU and then every 15, 30, 45, 60, 90, 120 minutes and/or immediately before discharge from the PACU based on modified ALDRETE score.

The Modified Aldrete Score

Respiration	2	1	0
	Able to take deep breath and cough	Dyspnea/Shallow breathing	Apnea
O2 Saturation	2	1	0
	Maintains>90% on room air	Needs O2 inhalation to maintain O2 saturation>90%	Saturation<90% even with supplemental O2
Consciousness	2	1	0
	Fully awake	Arousable on calling	Not responding
Circulation	2	1	0
	BP ±20mmHg pre op	BP ±20-50mmHg pre op	BP ±50mmHg pre op
Activity	Able to move 4 extremities voluntarily or on command	Able to move 2 extremities voluntarily or on command	Able to move 0 extremities voluntarily or on command

Maximum total score is 10; a score of ≥9 is required for discharge.

Statistical analysis

Statistical analysis was performed with the SPSS, version 21 for Windows statistical software package (SPSS inc., Chicago, IL, USA). The Categorical data was presented as numbers (percent) and were compared among groups using Chi square test. The quantitative data was presented as mean and standard deviation and were compared by students t-test. Probability was considered to be significant if less than 0.005.

Results

The Demographic data and baseline haemodynamic parameters were comparable between both the groups.

After pneumoperitoneum, the mean Heart Rate and Blood Pressure in both the groups showed rise which was managed by hyperventilation & additional doses of fentanyl so that it gradually settled around baseline in both the groups. The mean values of heart rate and BP were comparable in both groups (P>0.05) throughout the intra-operative period.

All early recovery parameters were achieved statistically significantly(p<0.05) faster in Desflurane group in comparison to Sevoflurane group. Time for response to eye opening was earlier by 1.41 minutes, time for hand grip was faster by 1.61 minutes, time for tracheal extubation was significantly faster by 2.21 minutes in Desflurane group than Sevoflurane group. Time to state his/her own name and name of village were also significantly faster in desflurane group by 2.76 minutes and 2.76 minutes respectively.

In intermediate recovery, the time to discharge the patient from the PACU was statistically comparable between two groups. (p>0.05)

Table 1: Distribution of patients according to BMI

	Mean	SD	P value
Group A (N=25)	38.06	4.96	0.913
Group B (N=25)	37.90	4.81	

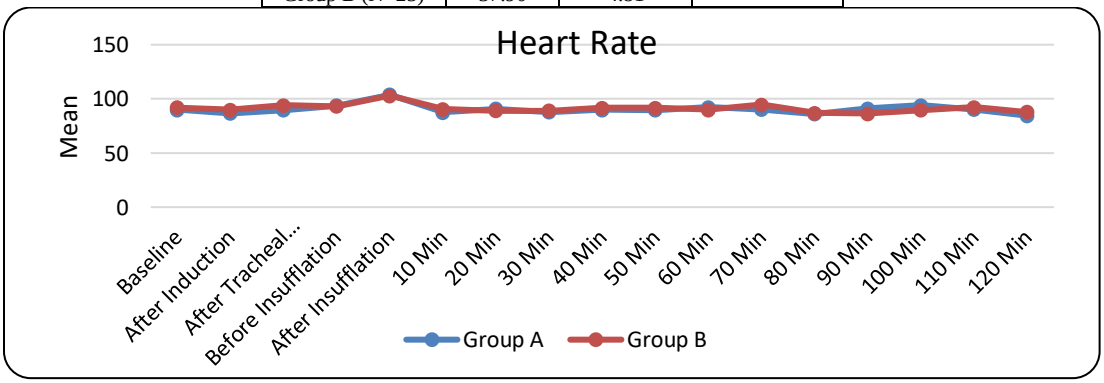

Fig 1: Trends of heart rate in both the group

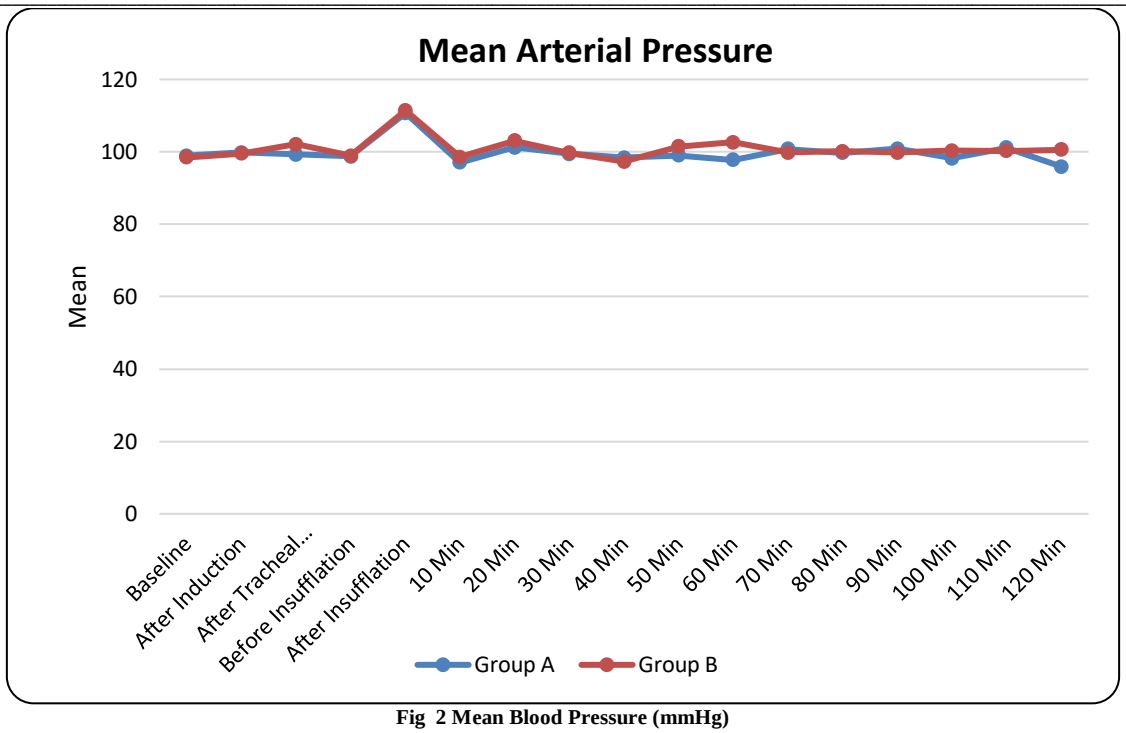

Fig 2 Mean Blood Pressure (mmHg)

Table 2: Comparison of early recovery parameters (min.) between both the groups

	Group A		Group B		'p' value
	Mean	SD	Mean	SD	
Time of Eye Opening	4.43	1.06	5.84	1.45	0.0003
Hand Grip	4.63	1.00	6.24	1.45	p<0.001
Tracheal Extubation	5.07	0.92	7.28	1.38	p<0.001
Telling Name	5.34	0.91	8.10	1.42	p<0.001
Telling Name of Village	5.52	0.89	8.28	1.44	p<0.001

Table 3: Comparison of intermediate recovery parameters by modified Aldrete score between both the groups

	Group A (N=25)		Group B (N=25)		P value
	Mean	SD	Mean	SD	
Arrival to PACU	6.32	0.49	6.36	0.49	0.770
15 Min	6.72	0.46	6.68	0.48	0.763
30 Min	7.16	0.58	7.20	0.58	0.803
45 Min	7.64	0.57	7.68	0.56	0.802
60 Min	8.16	0.65	8.20	0.65	0.824
90 Min	8.84	0.37	8.80	0.41	0.719
120 Min	8.92	0.28	8.88	0.33	0.645
Immediately before discharge from PACU	9.60	0.50	9.52	0.51	0.578

Discussion

During the study, 50 patients were enrolled and randomly allocated in two groups (Desflurane n= 25) and (Sevoflurane n=25) group. Both groups were comparable regarding demographic data in terms of age, sex, weight, height, BMI and baseline variables. so as to ensure that there was no any confounding bias.

All volatile anesthetics accumulate, over time, in adipose tissue. Such accumulation may delay recovery from anesthesia. The impact of anesthetic stored in fat may be the result of a return of the anesthetic in blood perfusing the fat or of a transfer from fat to adjacent highly perfused tissues (e.g., omental /mesenteric fat to intestine and liver)[5]. The effect of these factors might be exaggerated in morbidly obese patients, particularly after prolonged anesthesia.

After pneumoperitoneum, the mean Heart Rate and Blood Pressure in both groups showed a rise which was managed by hyperventilation & additional doses of fentanyl so that it gradually settled around baseline in both the groups. We found that the heart rate was comparable in both the groups throughout the study period.

In studies conducted by **Vrishali Ankalwar et al**[6] and **Gergin S et al**[7], they also found no significant difference in HR and BP between Desflurane and Sevoflurane.

In our study, early recovery parameters like time of eye opening, time of hand grip, time of tracheal extubation, time of telling name and name of village was significantly faster in Desflurane group compared to Sevoflurane group (P <0.005.

Eger EI, Bowland T et al[8] also observed earlier recovery after Desflurane anesthesia in their study comparing recovery characteristics of Desflurane and Sevoflurane in healthy male volunteers of normal weight.

The lower fat/blood partition coefficient of Desflurane, 27 vs. 48 for Sevoflurane, should favor its early elimination from the body resulting in early recovery. They postulated that delayed recovery after Sevoflurane could also be attributed to additional factors such as effects of its degradation products after prolonged anaesthesia.

Our results are consistent with the prediction that lower solubility produces a statistically significant recovery. Morbid obese patients may be at risk for airway complications, sleep apnea, and hypoxia during the early recovery period[9,10].

A more rapid recovery in morbidly obese patients may be associated with earlier maintenance of a patent airway, better protection against aspiration, and better oxygenation **Eger EI II, Weiskopf RB et al**[11]. Rapid recovery may allow a more rapid return to a preoperative/baseline cardiovascular function and an earlier departure from the operation theatre **(Widmark C et al**[12] and **Gergin S et al**[7]**. Fletcher JE et al**[13] also studied that use of Desflurane is associated with a more rapid initial awakening, less depression of cognitive function and less impairment of psychomotor performance.

Ankalwar V et al[14] and **Jindal R et al**[15] also showed faster early recovery with desflurane .

In our study, intermediate recovery was assessed by Modified Aldrete Score and the time to discharge the patient from the PACU was comparable in both the groups. Similarly**, Kaur A et al**[16] and **Vallejo MC et al**[17]also observed Modified Aldrete Score as criteria for intermediate recovery and found similar findings.

No complications such as nausea, vomiting was seen in both the groups. One patient in Desflurane group had larygnospasm. It was in contrast with the study done by **Ankalwar V et al[14]** and **Strum et al**[18]. This could be attributed to the fact that the patients were pre-medicated with metoclopramide and fentanyl and ondensatron was also given just before discontinuation of anaesthesia.

Conclusion

In conclusion, in morbidly obese patients, using 1 MAC end-tidal concentration, we found that the time to emergence and early recovery from prolonged anaesthesia with desflurane is shorter than with sevoflurane anaesthesia.

References

1. Abernethy DR, Greenblatt DJ. Drug disposition in obese humans .An update. Clin Pharmacokinet 1986; 11: 199–213
2. Eger EI, Gong D, Koblin D, Bowland T, Ionescu P, Laster MJ, et al. The effect of anesthetic duration on kinetic and recovery characteristics of desflurane versus sevoflurane, and on the kinetic characteristics of compound A, in volunteers. Anesth Analg. 1998;86:414–21.
3. Cheymol G. Effects of obesity on pharmacokinetic implications for drug therapy. Clin Pharmacokinet 2000; 39: 215–31
4. Virtanen KA, Lonnroth P, Parkkola R. Glucose uptake and perfusion in subcutaneous and visceral adipose tissue during insulin stimulation in nonobese and obese humans. J Clin Endocrinol Metab 2002; 87: 3902–10
5. Carpenter RL, Eger EI II, Johnson BH, et al. Pharmacokinetics of inhaled anesthetics in humans: measurements during and after the simultaneous administration of enflurane, halothane, isoflurane, methoxyflurane, and nitrous oxide. Anesth Analg 1986;65: 575–82.
6. Ankalwar V ,DharmaleA ,Patil V, Tirpude N; Clinical evaluation of Desflurane versus Sevoflurane in laparoscopic surgery. JMSCR 2017;5(7):24735-24740.
7. Gergin S, Cevik B, Yildirim G, Ciplakligil E, Colakoglu S.; Sevoflurane Vs Desflurane: Haemodynamic Parameters and Recovery Characteristics. The Internet Journal of Anesthesiology. 2004;9(1).
8. Eger EI, Bowland T, Ionescu P, Laster MJ, Fang Z, Gong D, et al. Recovery and kinetic characteristics of desflurane and sevoflurane in volunteers after 8-h exposure, including kinetics of degradation products. Anesthesiology. 1997;87:517–26.
9. Eger EI II. Age, minimum alveolar anesthetic concentration, and Minimum alveolar anesthetic concentration-awake. Anesth Analg 2001;93:947–53.
10. Torri G, Casati A, Albertin A, et al. Randomized comparison of isoflurane and sevoflurane for laparoscopic gastric banding in morbidly obese patients. J Clin Anesth 2001;13:565–70.
11. Eger EI II, Weiskopf RB, Eisenkraft JB. The pharmacology of Inhaled anesthetics. Sponsored by the Dannemiller Memorial Educational Foundation, Educational Grant from Baxter Healthcare Corporation. Released June 2002. Chapter 5.
12. Widmark C, Oliason J, Reftel B, et al. Spectral analysis of heart rate variability during desflurane and isoflurane anaesthesia in patients undergoing arthroscopy. Acta Anaesthesiol Scand 1998;42:204 –10. .
13. Fletcher JE, Sebel PS, Murphy MR, Smith CA, Mick SA, Flister MP. Psychomotor performance after desflurane anesthesia: A comparison with isoflurane. Anesth Analg. 1991;73:260–5.
14. Ankalwar V ,Dharmale A ,Patil V, Tirpude N; Clinical evaluation of Desflurane versus Sevoflurane in laparoscopic surgery. JMSCR 2017;5(7):24735-24740.
15. Jindal R, Kumra VP, Narani KK, Sood J. Comparison of maintenance and emergence characteristics after desflurane or sevoflurane in outpatient anaesthesia. Indian J Anaesth. 2011;55(1):36-42.
16. Kaur A, Jain AK, Sehgal R, Sood J. Hemodynamics and early recovery characteristics of desflurane versus sevoflurane in bariatric surgery. J Anaesthesiol Clin Pharmacol. 2013;29(1):36-40.
17. Vallejo MC, Sah N, Phelps AL, O'Donnell J, Romeo RC. Desflurane versus sevoflurane for laparoscopic gastroplasty in morbidly obese patients. J Clin Anesth. 2007;19(1):3-8.
18. Strum EM, Szenohradszki J, Kaufman WA, Anthone GJ, Manz IL, Lumb PD. Emergence and recovery characteristics of desflurane versus sevoflurane in morbidly obese adult surgical patients. Anesth Analg. 2004;99:1848–53.

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