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Comparative study to evaluate the Desflurane Versus Sevoflurane in outpatientanesthesia

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Abstract

Introduction: Currently, new volatile anaesthetics such as sevoflurane and desflurane are in widespread clinical use for maintenance of general anesthesia. The advantage of these anaesthetics is their low blood solubility, which accounts for its extremely rapid onset of action and recovery from general anesthesia. Since 2001, several randomized controlled trials (RCT) have been carried out to assess the efficiency and safety of desflurane and sevoflurane anesthesia in patients. As each type of anesthesia has some advantages and/or disadvantages, and the conclusions have not been completely consistent.

AIM: Aim of present study is comparison of maintenance and emergence characteristics after

desflurane or sevoflurane in outpatient anesthesia.

MATERIALS AND METHODS: The present study was a prospective, randomized, comparative clinical study conducted in patients scheduled to undergo day care surgeries in Osmania General Hospital, and its allied hospitals, Hyderabad with 60 patients with 30 patients in Group D(Desflurane) and 30 patients in Group S(Sevoflurane) is undertaken to study recovery parameters in patients undergoing day care procedures. Pre anesthetic checkup was done one day prior to the surgery. Patients were evaluated for any systemic diseases and laboratory investigations recorded. The procedure of general anesthesia was explained to the patients and written consent was obtained. Preparation of patients included period of overnight fasting. Patients were premedicated with Tab. Alprazolam 0.5 mg at night.

RESULTS: There were 14 male and 16 female in group D and 15 male and 15 female in group S. There was no statistically significant difference P=0.796 ($p > 0.05$) between the two groups in gender distributions.There was no statistically significant difference P=0.573 ($p > 0.05$) between the two groups in ASA grade distributions. There was no statistically

significant difference P= 0.191 (p > 0.05) between the two groups in mean duration of surgery. There was no statistically significant difference P= 0.149 (p > 0.05) between the two groups in mean duration of anesthesia.There was no statistically significant difference (p > 0.05) between the two groups in mean systolic BP, diastolic BP and heart rate.Time in minutes for eye opening p<0.001 significantly shorter in Group D (Desflurane) than in Group S(Sevoflurane).Time in minutes for extubation p<0.001 significantly shorter in Group D (Desflurane) than in Group S(Sevoflurane)

CONCLUSION: Intraoperative hemodynamic parameters are similar in both desflurane and sevoflurane anesthesia.Discharge to home was assessed by the Modified Aldrete Score. There was no statistically significant difference between Desflurane and Sevoflurane. Hence Time to home readiness is similar with both agents.We concluded from the study that desflurane anesthesia produces faster emergence and early recovery from anesthesia compared to sevoflurane anesthesia in outpatient anaesthesia.

Keywords: Desflurane Sevoflurane, anesthesia

Introduction

Day‑care surgery, that is, the patient being discharged from the hospital on the same day of surgical procedure. The forthcoming era will definitely see a much larger number of patients and physicians opting for this surgical trend. The fast pace of life, adoption ofnuclear family structure, need of early return to work, and resumption of daily routine chores to maintain social and professional competitiveness, are few of the important factors which have propelled this treatment modality to newer heights.[1,2]

Moreover, the relative shortage of beds in the hospital and scarce economic resources due to ever increasing patient population has boosted the concept of small incisions and minimalinvasive surgeries, thus allowing for more surgical procedures to be performed on day‑care basis.[1‑4]Very high-risk patients and major surgical procedures can now be conducted safely because of the precision in monitoring and advanced surgical techniques.[5,6]

The advancements in anesthesia techniques and availability of newer drugs have contributed largely to the progress of day‑care surgery.[7]Anesthesia for day‑care (ambulatory anesthesia) surgeries may require administration of general, regional, and local anesthesia or monitored anesthesia care supplemented with sedation.[1]

An ideal general anaesthetic, for the ambulatory patients, should provide smooth and rapid induction, optimal operating conditions, and rapid recovery with minimal side effects like nausea, vomiting, bleeding and postoperative pain.

Inhaled anaesthetics allow rapid emergence from anaesthesia because of easy titrability with inherent neuromuscular blocking[7] effects that make them more suitable for ambulatory anaesthesia.

The availability of less soluble inhalation anaesthetics such as sevoflurane and desflurane made us rethink about the selection of volatile anaesthetics for outpatient surgical procedures. Given the low blood: gas partition coefficient of sevoflurane and desflurane, faster emergence from anaesthesia is expected compared to traditional inhalation anaesthetics.[9]

Sevoflurane, a volatile anaesthetic agent, is halogenated ether. It has rapid induction due to low blood: gas partition (blood: gas partition coefficient of 0.65 and fat: blood solubility 48 at 37°C). Desflurane is also halogenated ether. Low solubility of desflurane in blood and body tissues (blood: gas partition coefficient of 0.42 and fat: blood solubility 27 at 37°C) leads to rapid induction and recovery.[10,11]

Both sevoflurane and desflurane have shorter emergence times compared to isoflurane based anaesthesia techniques.[9]

AIM: Aim of present study is comparison of maintenance and emergence characteristics after desflurane or sevoflurane in outpatientanesthesia.

MATERIALS AND METHODS

The present study was a prospective, randomized, comparative clinical study conducted in patients scheduled to undergo day care surgeries in Osmania General Hospital, and its allied hospitals, Hyderabad with 60 patients with 30 patients in Group D(Desflurane) and 30 patients in Group S(Sevoflurane) is undertaken to study recovery parameters in patients undergoing day care procedures.

INCLUSION CRITERIA:

1. ASA grade I and II
2. 18 to 60 years of age
3. Who gave informed written consent
4. Patients scheduled to undergo day care surgeries. General anesthesia lasting from 30 min up to 90 mins.

EXCLUSION CRITERIA:

1. Patients who underwent general anesthesia in the past seven days
2. Patients with h/o neuropsychiatric disorders
3. Patients with h/o alcohol consumption.
4. Patients with clinically significant cardiovascular, respiratory, hepatic, renal, neurological, psychiatric, metabolic disease,
5. Patients with BMI > 30
6. patients unable to read and write
7. Patients with impaired hearing

METHODS:

After approval from the ethical committee of Osmania Medical College, 60 ASA I and II patients scheduled for day care surgery,under general anesthesia were chosen for the study and divided into 2 groups, group D (Desflurane) and group S (Sevoflurane) 30 patients in each group.

Pre anesthetic checkup was done one day prior to the surgery. Patients were evaluated for any systemic diseases and laboratory investigations recorded. The procedure of general anesthesia was explained to the patients and written consent was obtained. Preparation of patients included period of overnight fasting. Patients were premedicated with Tab. Alprazolam 0.5 mg at night.

On the day of surgery anesthesia machine was checked. Appropriate size endotracheal tubes, working laryngoscope with medium and large size blades, stylet, bougie and working suction apparatus were kept ready before the procedure. Emergency drug tray consisting of atropine, adrenaline, mephenteramine, ephedrine, dopamine were kept ready.

Patients shifted to operation theatre, monitors like non-invasive blood pressure (NIBP), electrocardiogram (ECG), Pulse oximeter were connected. Base vitals were recorded, IV access was obtained on the forearm with No 20G IV cannula.

Patients were premedicated with Glycopyrrolate 0.2mg IV, ondansetron 4mg IV, fentanyl 1.5 mcg/kg IV. Both the study groups received standard anesthetic technique with Thiopentone sodium 5 mg/kg titrated to loss of eyelash reflex. Endotracheal intubation was facilitated with Suxamethonium (1.5 mg/kg) and intubation done with suitable sized cuffed tube. All patients were mechanically ventilated with 33:66 O2/N2O mixtures. Respiratory rate (RR) and tidal volume (TV) were adjusted according to body weight to maintain normocapnia. During the maintenance period, ventilation was controlled to maintain normocarbia using a closed circle system with a total fresh gas flow rate of 5 L/min. with 66%N2O and 33% O2 . Atracurium is used during maintenance of anesthesia.

After oral suctioning desflurane/ sevoflurane and N2O are switched of simultaneously. At the end of anesthesia, residual neuromuscular blockade was reversed using glycopyrrolate, 0.01 mg/kg IV, and neostigmine, 0.05 mg/kg IV.

The times from discontinuing N2O to eye opening, tracheal extubation, obeying commands assessed at 30–60s intervals. The durations of anesthesia (from the start of induction to discontinuation of N2O) and surgery (from surgical incision to skin closure) were also recorded.
Monitoring included non-invasive blood pressure measurement, heart rate, and oxygen saturation. Haemodynamics were recorded preoperatively (baseline), intraoperatively every 15mins, post operatively for 15min (every 5mins). After extubation and full recovery, patients were transferred to the post anesthesia care unit (PACU).

Statistical Methods:
Descriptive statistical analysis has been carried out in the present study by SPSS statistics. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric

parameters. p value was determined p>0.05 is not significant, p<0.05 is significant,p<0.01 is highly significant.

RESULTS

Table-1 Comparison age distribution

		AGENT				Total	%
		Desflourane	**%**	**Sevoflourane**	**%**		
Age	**18-20**	2	40.0%	3	60.0%	5	100.0%
	21-30	12	54.5%	10	45.5%	22	100.0%
	31-40	11	57.9%	8	42.1%	19	100.0%
	41-50	5	45.5%	6	54.5%	11	100.0%
	51-60	0	.0%	3	100.0%	3	100.0%
Total		30	50.0%	30	50.0%	60	100.0%

Table - 2: Comparison of gender distribution of patients studies

		AGENT		Total
		Desflourane	Sevoflourane	
Sex	Male	14	15	29
		48.3%	51.7%	100.0%
	Female	16	15	31
		51.6%	48.4%	100.0%
Total		30	30	60
		50.0%	50.0%	100.0%

Chi square= 0.067 df=1 P value= 0.796

There were 14 male and 16 female in group D and 15 male and 15 female in group S. There was no statistically significant difference P=0.796 (p > 0.05) between the two groups in gender distributions.

Table- 3: Comparison of ASA grade distribution of patients

		AGENT		Total
		Desflourane	Sevoflourane	
ASA	I	20	22	42
		47.6%	52.4%	100.0%
	II	10	8	18
		55.6%	44.4%	100.0%
Total		30	30	60
		50.0%	50.0%	100.0%

Chi square= 0.317 df=31 P value= 0.573

There was no statistically significant difference P=0.573 (p > 0.05) between the two groups in ASA grade distributions

Table- 4 : Comparison of mean duration of surgery and anesthesia

	AGENT	N	Mean	Std. Deviation	P value
Duration of Surgery(In Mins)	Desflourane	30	58.50	9.573	0.191
	Sevoflourane	30	55.50	7.917	
Duration of Anaesthesia	Desflourane	30	74.33	9.890	0.149
	Sevoflourane	30	70.83	8.619	

There was no statistically significant difference P= 0.191 (p > 0.05) between the two groups in mean duration of surgery. There was no statistically significant difference P= 0.149 (p > 0.05) between the two groups in mean duration of anesthesia.

Table-5 : Comparison of Mean Systolic BP

	Desflourane	Sevoflourane	P value
Pre op	119.07 ± 8.09	119.77 ± 7.74	0.733
Intra op 0 MIN	126.73 ± 6.225	124.83 ± 5.621	0.22
Intra op 15 MIN	124.77 ± 5.6	120.47 ± 6.1	0.09
Intra op 30 MIN	126.23 ± 7.267	121.63 ± 6.385	0.07
Intra op 60 MIN	125.23 ± 7.709	125.5 ± 7.736	0.894
Intra op 90 MIN	133 ± 6.325	136.06 ± 7.224	0.316

There was no statistically significant difference (p > 0.05) between the two groups in mean systolic BP.

Table-6: Comparison of Mean Diastolic BP

	Desflourane	**Sevoflourane**	**P value**
Pre op	74.1 ± 6.656	70.33 ± 8.401	0.059
Intra op 0 MIN	75.27 ± 6.335	74.43 ± 6.174	0.63
Intra op 15 MIN	72.67 ± 4.816	71.4 ± 4.966	0.77

Intra op 30 MIN	74.93 ± 6.389	74.23 ± 5.752	0.91
Intra op 60 MIN	75.43 ± 6.836	71.63 ± 6.805	0.035
Intra op 90 MIN	81.75 ± 8.972	78.53 ± 7.238	0.346

There was no statistically significant difference ($p > 0.05$) between the two groups in mean diastolic BP.

Table-7: Comparison of Mean Heart rate

	Desflourane	Sevoflourane	P value
Pre op	81.87 ± 6.361	80.43 ± 5.9	0.369
Intra op 0 MIN	85.93 ± 10.235	81.07 ± 3.912	0.018
Intra op 15 MIN	83.97 ± 8.079	78.43 ± 4.408	0.002
Intra op 30 MIN	79 ± 4.799	79 ± 2.704	1
Intra op 60 MIN	80.1 ± 9.301	80.07 ± 4.127	0.986
Intra op 90 MIN	82.5 ± 10.61	83.47 ± 5.352	0.761

There was no statistically significant difference ($p > 0.05$) between the two groups in mean heart rate.

Table-8: Comparison of mean time in minutes for eye opening

	AGENT	N	Mean	Std. Deviation	P value
EYE OPENING	Desflourane	30	5.40	1.037	0.0001
	Sevoflourane	30	7.63	1.377	

Time in minutes for eye opening $p<0.001$ significantly shorter in Group D (Desflurane) than in Group S(Sevoflurane)

Table- 9: Comparison of mean time in minutes for extubation.

	AGENT	N	Mean	Std. Deviation	P value
TIME FOR EXTUBATION	Desflourane	30	6.47	1.137	0.0001
	Sevoflourane	30	9.37	1.326	

Time in minutes for extubation $p<0.001$ significantly shorter in Group D (Desflurane) than in Group S(Sevoflurane)

DISCUSSION

In the present study, found that there was no statistically significant difference between the

two treatment groups with respect to gender, age, body weight, ASA classification, duration of surgery and duration of anaesthesia. Similar findings were seen in the study done by Chudasama PA et al.[12]

The present study observed that there is no statistically significant difference in desflurane and sevoflurane in haemodynamic parameters such as HR, BP. These findings are similar in the studies done by White *et al*.,[13]observed no difference between haemodynamic parameters such as HR and BP. However desflurane has better stabilility than sevoflurane regarding hemodynamic parameters such as HR and BP in the studies done by Chudasama et al. [12]

White *et al*[13] found no difference in haemodynamics,emergence and recovery characteristics between sevoflurane and desflurane group. A similar study done by Ghouri *et al*.[14] suggested that the use of desflurane (vs. isoflurane) was associated with less depression of cognitive function during the early post‑operative period. In present study difference in Emergence and early recovery was statistically significant between desflurane and sevofluranae. Desflurane showed faster emergence and early recovery compared to sevoflurane. Karlsen found no significant differences between desflurane and sevoflurane during recovery.[15]

The study by Nathanson[16] suggested that sevoflurane and desflurane provided similar intraoperative conditions during the maintenance period. Although early recovery was faster with desflurane, there was no difference in the intermediate recovery end points. White[13] concluded that despite the faster initial recovery with desflurane, no significant differences were found between the two volatile anaesthetics in the later recovery period. Isik[17] and others also concluded that in children, early recovery was faster with desflurane compared to sevoflurane.

Eger in a study found that for a given duration of anaesthesia, elimination was faster and recovery was quicker for desflurane.[18] Other studies [19] have found that only early recovery was faster with desflurane compared to sevoflurane even when the duration of surgery exceeded 2 hours.
Gergin[20]studied the haemodynamics, emergence and recovery characteristics of sevoflurane with those of desflurane in nitrous oxide anaesthesia and concluded that the groups did not differ in these haemodynamic measures. However, a study by Elbert [21]concluded that neurocirculatory excitation seen with rapid increase in desflurane did not occur with sevoflurane. At steady state, increasing the concentration of sevoflurane was associated with lower sympathetic nerve activity and central venous pressure. Our study supported the findings in the former group.

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.[89,90] Similar results were also obtained by Welborn *et al*.[22] in theirstudies. Macario *et al*.[23] in their meta‑analysis also

reported similar observations. This faster emergence with desflurane is really important in busy pediatric ambulatory setups.

Kim et al.[71]also found that late recovery profiles and incidences of postoperative side effects were similar after desflurane and sevoflurane. It also showed that regardless of the duration of anesthesia, elimination was faster and recovery was quicker for inhaled anesthetic desflurane than for the inhaled anesthetic sevoflurane. The study conducted by Vallejo et al.[24]showed that despite the faster initial recovery with desflurane, no significant differences were found between the two volatile anesthetics in the later recovery period.

In our study the average extubation time in desflurane was significantly shorter than sevoflurane. Time in minutes for extubation was ($p<0.001$) significantly shorter in Group D (Desflurane) than in Group S(Sevoflurane). Similar findings were found in the study conducted by Dexter et al compared statistical modelling of average and variability of time to extubation for meta-analysis comparing desflurane to sevoflurane. Desflurane reduces the average extubation time and the variability of extubation time by 20%–25% relative to sevoflurane.

In our study the mean time to eye opening following desflurane was 5.40 mins with a standerd deviation of 1.037 whereas with sevoflurane it was 7.63 mins with standerd deviation of 1.377. Mean time for obeying verbal commands for Desflurane was 7.80 with a standard deviation of 1.157 whereas with sevoflurane it was 11.33 with a standered deviation of 1.493. Gildasio et al[25] compared time to awakening and upper airway morbidity between desflurane and sevoflurane using a Laryngeal Mask Airway (LMA) and a balanced anesthetic regimen inclusive of opioids. As compared to sevoflurane, Desflurane retains faster awakening properties when used in combination with fentanyl as part of anesthetic maintenance in outpatient surgery with a LMA. The median time to eye opening following desflurane was 6.8 (5.0 - 9.8) minutes versus 11.8 (8.8 - 14.6) minutes following sevoflurane ($P < 0.001$), or a difference of 5.0 (99% CI 2.3 - 6.8) minutes. The median difference in response to verbal commands was 5.3 (99% CI 2.4 - 7.1) min.
In a study conducted by Giuseppina Magni et al compared between Sevoflurane and Desflurane Anesthesia in Patients Undergoing Craniotomy for Supratentorial Intracranial Surgery. The mean emergence time (12.2 ±4.9 min in Group S vs 10.8 ± 7.2 min in Group D; P = ns) was similar in the two groups but in the present study mean eye opening was significantly shorter. In desflurane it was 5.40 mins with a standard deviation of 1.037 and sevoflurane 7.63 mins with a standard deviation of 1.377. The mean extubation time and recovery time were longer in Group S (15.2 ± 3.0 min in Group S vs 11.3 ±3.9 min in Group D and 18.2 ±2.3 min in Group S vs 12.4 ± 7.7 min in Group D, respectively; $P < 0.001$). In the present study also mean extubation time and obeying commands were significantlybetter in desflurane than sevoflurane.

CONCLUSION

Intraoperative hemodynamic parameters are similar in both desflurane and sevoflurane anesthesia.Discharge to home was assessed by the Modified Aldrete Score. There was no

statistically significant difference between Desflurane and Sevoflurane. Hence Time to home readiness is similar with both agents.We concluded from the study that desflurane anesthesia produces faster emergence and early recovery from anesthesia compared to sevoflurane anesthesia in outpatient anaesthesia.

References:

1. Bajwa SJ, Sharma V, Sharma R, Singh AP. Anesthesia for day-care surgeries: Current perspectives. Med J DY Patil Univ 2017;10:327-33.
2. Association of Anaesthetists of Great Britain and Ireland; British Association of Day Surgery. Day case and short stay surgery: Anaesthesia 2011;66:417‑34.
3. Bajwa SS, Bajwa SK, Kaur J, Sharma V, Singh A, Singh A, *et al.* Palonosetron: A novel approach to control postoperative nausea and vomiting in day care surgery. Saudi J Anaesth 2011;5:19‑24.
4. Harsoor S. Changing concepts in anaesthesia for day care surgery. Indian J Anaesth 2010;54:485‑8.
5. 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;55:36-42.
6. Gupta A, Stierer T, Zuckerman R, Sakima N, Parker SD, Fleisher LA. Comparison of recovery profile after ambulatory anesthesia with propofol, isoflurane, sevoflurane and desflurane: A systematic review. Anesth Analg 2004;98:632-41.
7. Gangadhar S, Gopal T, Sathyabhama, Paramesh K. Rapid emergence of day‑care anaesthesia: A review. Indian J Anaesth 2012;56:336‑41.
8. Eriksson LI. The effects of residual neuromuscular blockadeand volatile anesthetics on control of ventilation. Anesth Analg 1999;89:243-51.
9. Iannuzzi E, Iannuzzi M, Viola G, Cerulli A, . cirillo V, Chiefari M **.** Desflurane and sevoflurane in elderly patients during general anesthesia: a double blind comparison. Minerva Anestesiol 2005;71:147-55
10. Eberts TJ, Schmid PG. Inhaled anesthetics. In: Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC, editors. Clinical Anesthesia. 6th ed. Philadelphia: Lippincott Williams and Wilkins; 2009. p. 413-43.
11. Morgan GE Jr, Mikhail MS, Murray MJ. Inhalational anesthetics. Clinical Anesthesiology. 4th ed. New York: McGraw-Hill; 2006. p. 155-78.
12. Chudasama PA, Mehta MV. Comparison of haemodynamic parameters and recovery characteristics between sevoflurane and desflurane in patients undergoing day-care surgical procedure. Adv Hum Biol 2018;8:140-4.
13. White PF, Tang J, Wender RH, Yumul R, Stokes OJ, Sloninsky A, *et al.* Desflurane versus sevoflurane for maintenance of outpatient anesthesia: The effect on early versus late recovery and perioperative coughing. Anesth Analg 2009;109:387‑93.
14. Ghouri AF, White PF. Effect of fentanyl and nitrous oxide on the Desflurane MAC. Anesthesiology - ASA Congress 1990;73(3A):A392.

15. Karlsen KL, Persson E, Wennberg E. Anaesthesia, recovery and postoperative nausea and vomiting after breast surgery.A comparison between desflurane, sevoflurane and isoflurane anaesthesia. Acta Anaesth Scand 2000;44:489-93.
16. Nathanson MH, Fredman B, Smith I, White PF. Sevoflurane versus desflurane for outpatient anaesthesia: A comparison of maintenance and recovery profiles. Anesth Analg 1995;81: 1186-90.
17. Isik Y, Goksu S, Kocoglu H, Oner U. Low flow Desflurane and sevoflurane anaesthesia in children. Eur J Anaesthesiol 2006;23:60-4.
18. Heavner J E, Kaye A D, Lin BK and King T. Recovery of elderly patients from two or more hours of desflurane or sevoflurane anaesthesia. Br J Anaesth (2003) ; 91 (4): 502-6
19. R.E. McKay, A. Malhotra, O.S. Cakmakkaya, K.T. Hall, W. R. McKay and C.C. Apfel. Effect of increased body mass index and anesthetics duration on recovery of protective airway reflexes after sevoflurane vs desflurane. Br J Anaesth 2010; 104; 175-82
20. S.Gergin.B. Cevik.G.B. Yildirim.E. Ciplakligil & S. Colakogul: Sevoflurane Vs Desflurane: Haemodynamic Parameters And Recovery Characteristics. *The* Internet Journal of Anesthesiology. 2005 Volume 9 Number1
21. Steward A, Allott PR, Cowles AL, Mapleson WW. Solubility coefficients for inhaled anaesthetics for water, oil and biological media. Br J Anaesth 1973;45:282‑93.
22. Welborn LG, Hannallah RS, Norden JM, Ruttimann UE, Callan CM. Comparison of emergence and recovery characteristics of sevoflurane, desflurane, and halothane in pediatric ambulatory patients. Anesth Analg 1996;83:917‑20.
23. Macario A, Dexter F, Lubarsky D. Meta‑analysis of trials comparing postoperative recovery after anesthesia with sevoflurane or desflurane. Am J Health Syst Pharm 2005;62:63
24. 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.
25. Mahmoud NA, Rose DJ, Laurence AS. Desflurane or sevoflurane for gynaecological day-case anaesthesia with spontaneous respiration? Anaesthesia 2001;56:171- 4