



## COMPARISON OF MAINTENANCE AND RECOVERY CHARACTERISTICS WITH ISOFLURANE OR SEVOFLURANE FOR AMBULATORY ANAESTHESIA

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### ABSTRACT

**Introduction:** Surgery is increasingly performed on a day-case basis. An ideal day-care anaesthetic agent should have rapid smooth induction, provide optimum surgical conditions with rapid recovery and minimal side effects.

In recent times, inhalational agents like isoflurane and sevoflurane have shown a promising result for such type of surgeries.

**Aim & Objectives:** this randomized double blind study was designed to compare isoflurane and sevoflurane during short surgical procedure regarding Intraoperative haemodynamic stability Recovery profile and Adverse effects.

**Method:** 60 patients ASA 1 AND 2 were randomly divided into two groups including 30 patients. Group I: Patients who maintained on isoflurane anaesthesia

**Group S:** Patients who maintained on sevoflurane anaesthesia. All patients were monitored with pulseoximeter for SpO<sub>2</sub>, HR and RR. Vitals were recorded before pre-medication, The volatile agent was administered at approximately one 'minimal alveolar concentration' (MAC) for 3 min i.e. 1.2% for isoflurane and 2% for sevoflurane. Then it continued at 0.75 MAC i.e. 0.8% for isoflurane and 1.5% for sevoflurane, further increasing or decreasing by 0.5% for sevoflurane and 0.2% for isoflurane (0.5 MAC) according to the clinical assessment. At the end of surgery, administration of isoflurane or sevoflurane discontinued without tapering. The Hemodynamic parameters, Emergence time, adverse effect (PONV, pain, airway hyper reactivity) and discharge time from PACU & for home were recorded.

**Result:** The use of sevoflurane resulted in quicker emergence and faster early recovery. The mean arterial pressure was lower from baseline in both groups after induction. Isoflurane has more incidence of airway hyper reactivity though milder when compared to sevoflurane.

**Conclusion:** Sevoflurane may be a useful inhaled anesthetic for maintenance of adult ambulatory anaesthesia.

**KEYWORDS :** sevoflurane, isoflurane, surgery, day-care

### Introduction:

Day care surgery is a planned surgery wherein the patients, requiring early recovery and discharge, are admitted for short stay for surgery on a non-resident basis. Discharge time after ambulatory surgery determined by postoperative complications and in particular by the presence and severity of nausea and vomiting. Advances in anaesthetic induction agents and airway management have contributed to the success of day care surgeries. Surgery is increasingly performed on a day-case basis. An ideal day-care anaesthetic agent should have rapid smooth induction, provide optimum surgical conditions with rapid recovery and minimal side effects. One should be able to rapidly alter the effect site concentration, allowing the anaesthetic depth to be altered easily. Although no single anaesthetic agent completely satisfies all these requirements, pharmacological developments over the past decades have brought us considerably closer [Ghatge et al (2003)]. In recent times, inhalational agents like isoflurane and sevoflurane [Philip et al (1996), Robinson et al (1999)] have shown a promising result for such type of surgeries. Sevoflurane has become a popular agent for day-case surgery despite little evidence of clear advantages over current alternatives.

Isoflurane is widely used in this context and has a good track record as far as complications, patient acceptability and recovery profile are concerned [Kortilla et al (1998)]. However, newer agents are now available whose physicochemical profiles suggest the possibility of a faster recovery, and this may be advantageous in the day-case environment [Jones et al (1990)]. One of these newer agents, desflurane, has been shown to have some disadvantages: lack of acceptability during induction [Zwass et al (1992)]; an association with intra-operative complications, such as coughing [Hemelrijk et al (1991)]; and a tendency to cause postoperative nausea and vomiting (PONV).

Sevoflurane is also theoretically attractive as it too has low blood-gas partition coefficient than isoflurane and has been reported to have a good recovery profile [Smith et al (1992), Philip et al (1996)]. It also might cause faster emergence times than for propofol-based anaesthesia. Sevoflurane is a desirable anaesthetic for induction and maintenance because of its low blood-gas solubility, rapid

induction and emergence characteristics, nonirritating airway properties and stable patient hemodynamic characteristics. Rapid recovery is desirable, to ensure early efficient coughing and to decrease the rate of postoperative respiratory complications. However, it remains expensive [Ebert et al (1998)], and any real practical benefit has yet to be proven. In day-case surgery, the principal adverse effect responsible for delayed discharge is PONV [Green et al (1999), Chung et al (1993)]. Furthermore, it has recently been suggested that sevoflurane might be more emetogenic than isoflurane [Dashfield et al 1998].

In this view of it, the present study was undertaken to study the hemodynamic characteristics and recovery profile of patients who received either sevoflurane or isoflurane for maintenance of anaesthesia following propofol induction undergoing short duration of ambulatory surgery.

### MATERIAL AND METHODS

#### TYPE OF STUDY:

The study was prospective, randomized clinical trial. The study was done on adult patients of American Society of Anaesthesiologist (ASA) grade I or II undergoing elective day care surgeries with an anticipated length of hospitalisation of less than 24 h post anaesthesia. The patients were randomly selected and divided into two groups of patients to receive either isoflurane or sevoflurane as a maintenance agent. The groups:

**Group I:** Patients who maintained on isoflurane anaesthesia

**Group S:** Patients who maintained on sevoflurane anaesthesia.

A pre-anaesthetic examination comprising history, general physical and systemic examination of all the patients was conducted. Premedication with oral Alprazolam 0.25-0.5 mg was given a night before surgery and in the morning on the day of surgery. All patients were kept fasting for at least 6 hours prior to surgery.

In the operating room, an intravenous (IV) line was secured on the non-dominant hand of the patient, the patients connected to non invasive sphygmomanometer, Electrocardiogram (ECG) monitor

and pulse oximeter. The baseline heart rate (HR), mean arterial pressure (MAP) and oxygen saturation (SpO<sub>2</sub>) were recorded.

A uniform premedication with Glycopyrrolate 0.2 mg, Midazolam 0.02 mg/kg and Fentanyl 1.5 microg/kg intravenous (IV) was given while pre oxygenating with 100% oxygen for 3 minutes. Induction was done with Propofol 2.5 mg/kg iv and supraglottic airway device inserted.

Anaesthesia was maintained with oxygen (40%), nitrous oxide (60%) with isoflurane or sevoflurane and patients were on spontaneous ventilation. The volatile agent was administered at approximately one 'minimal alveolar concentration' (MAC) for 3 min i.e. 1.2% for isoflurane and 2% for sevoflurane. Then it continued at 0.75 MAC i.e. 0.8% for isoflurane and 1.5% for sevoflurane, further increasing or decreasing by 0.5% for sevoflurane and 0.2% for isoflurane (0.5 MAC) according to the clinical assessment of the depth of anaesthesia and to maintain blood pressure at ±20% of base line values in response to surgical stimulation. At the end of surgery, administration of isoflurane or sevoflurane discontinued without tapering and then after 3 min nitrous oxide discontinued. The supraglottic airway device removed after eye opening and mouth opening to command.

**The followings parameters were observed:**

1. Blood pressure, Heart rate & SpO<sub>2</sub> during intraoperative period monitored continuously as part of standard monitoring during general anaesthesia.
2. Emergence: time from discontinuation of anaesthetic agent delivery (i.e. vaporizer turned off) to opening of eyes & obeys command.
3. Blood pressure, Heart rate & SpO<sub>2</sub> monitoring in PACU (0hr, 2hr, 4hr, 6hr & 24hr).
4. Pain on VRS (verbal rating score) [0= no pain, 100= most severe pain]
5. Nausea & Vomiting score
  - I. None - 0
  - II. Mild (nausea and no vomiting) - 1
  - III. Moderate (nausea and occasional vomiting) - 2
  - IV. Severe (nausea and frequent vomiting) - 3

6. Airway hyper reactivity score

Parameters/ Score	0	1	2	3	4
Cough/ Bucking	None	Occasional	Frequent	Continuous	Laryngospasm
Breath holding	None	<15 s	15-30 s	>30 s	IPPV
SPO <sub>2</sub> (for >10 s) (%)	>98	94-97	90-94	<90	<85

Mild ≤ 3, Moderate = 4-8, Severe ≥ 9

6. The Mini Mental State Examination and the digit repetition forwards and backwards administered at baseline and at 15 and 30 minutes postoperatively to assess cognitive function.

Recovery criteria (modified Aldrete score)

Oxygenation  
 SPO<sub>2</sub> more than 92% on room air - 2  
 SPO<sub>2</sub> more than 90% on room air - 1  
 SPO<sub>2</sub> less than 90% on oxygen - 0

Respiration

Breathes deeply and coughs freely - 2  
 Dyspnoeic, shallow or limited breathing - 1  
 Apnoea - 0

Circulation

B.P ± 20 mmHg of normal - 2  
 B.P ± 20 to 50 mmHg of normal - 1

B.P change more than 50 mmHg of normal - 0

Consciousness

Fully awake - 2  
 Arousable on calling - 1  
 Not responsive - 0

Activity

Moves all extremities - 2  
 Moves two extremities - 1  
 No movement - 0

7. Recovery criteria (modified Aldrete score) from PACU

1. Alert and oriented to time and place.
2. Conversant and cooperative.
3. Stable vital signs for at least 0.5 hour.
4. Able to sit up without nausea and or dizziness.
5. Pain is tolerable.
6. Aldrete score is ≥ 8.

8. Home readiness criteria

1. Stable vital signs for at least 1 hour.
2. Pain controllable by oral analgesics.
3. Nausea or emesis mild if present.
4. Able to walk without dizziness, and able to retain oral fluids.

A study population of 30 patients for each group was determined to have 90% power at α = 0.05 (two-tailed) to detect a difference of 10% in the time to early recovery with sevoflurane group compared to isoflurane group.

Data were expressed as mean ± SD. After the study, analysis of the data was done by Chi-square test and t-test for parametric data and Mann-Whitney for non parametric data. P value <0.05 was considered as statistically significant.

**RESULTS**

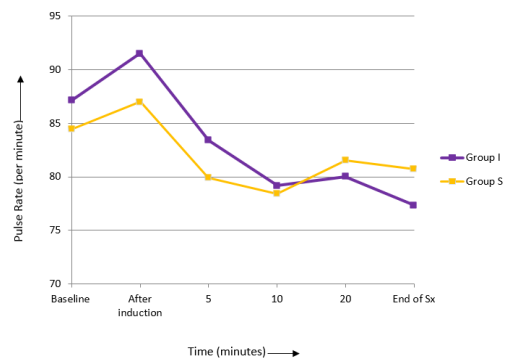
The two groups were similar with respect to age, weight, gender and physical status.

There were no dropouts in this study so all 60 patients completed the study (30 in each group) and subjected to statistical analysis. Depending on the results of randomization process, patients received Isoflurane or Sevoflurane as maintenance anaesthesia.

**Table 4: Duration of surgeries in both groups**

	Group	Mean	SD	SEM	P value
Duration of Sx (minutes)	I	42.33	8.380	1.530	0.816
	S	41.83	8.146	1.487	

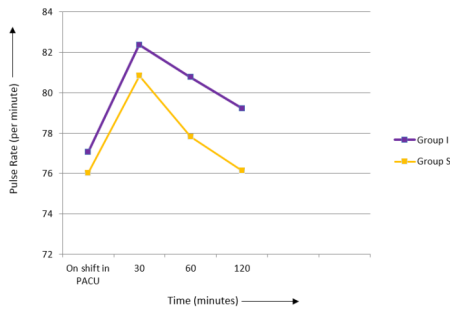
**Above table shows that there is no statistically difference (p= 0.816) in terms of duration of surgeries in both group.**



**Figure 3 : Intra operative Pulse Rate**

the baseline and intraoperative pulse rate of patients in both groups were comparable. There is slight increase in pulse rate after

induction in both the groups but the difference in rise of pulse rate is not statistically significant ( $p=0.063$ ).

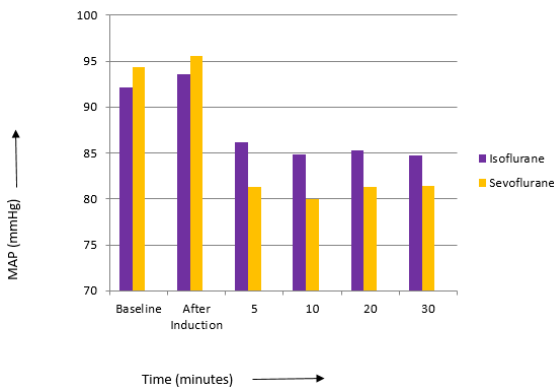


the comparison of pulse rate in the post operative period in the respective groups also did not reveal any statistically significant change from the baseline values. ( $P>0.05$ )

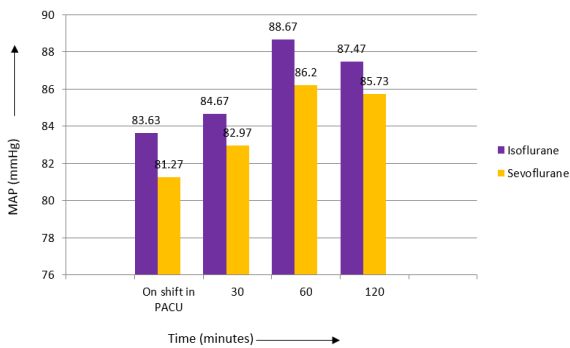
The mean blood pressure between the two groups were compared by two independent t test. There is no statistically difference ( $p>0.05$ ) between the baseline mean arterial pressures in both group I and group S showed that baseline mean arterial pressures were comparable in both the groups.

On comparison of mean arterial pressure just after induction, we found that MAP in I group  $93.57 \pm 8.541$  mmHg and in S group  $95.60 \pm 5.500$  mmHg were higher than the baseline value but the difference in rise of MAP is statistically insignificant ( $p=0.277$ ).

At 5 minutes when we compared mean arterial pressures, we found that mean arterial pressure decreased in both the groups but in group S ( $81.33 \pm 5.074$  mmHg) fall was significant more than I group ( $86.13 \pm 6.601$  mmHg) which is statistically significant with p value 0.003. There was significant difference in both the groups in term of fall of mean arterial pressure upto 30 minutes.



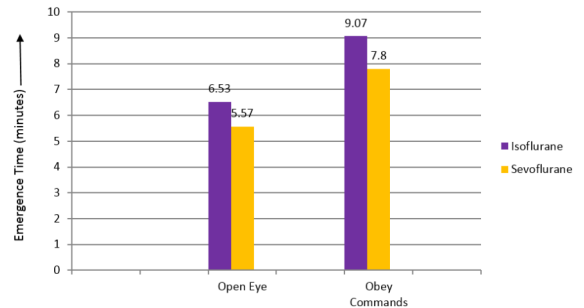
**Figure 5. Intra operative Mean Arterial Pressure**



**Figure 6. Post operative Mean Arterial Pressure**

Above table shows that there was no statistically significant difference in mean arterial pressure between both the groups post operatively ( $p.0.05$ ).

The mean emergence time to open eye was statistically shorter in the S group ( $5.57 \pm 1.357$  minutes) than in group I ( $6.53 \pm 1.795$  minutes). The mean time to obey command ( $7.80 \pm 1.518$  minutes versus  $9.07 \pm 1.799$  minutes) were also statistically shorter in the Group S than in the Group I with p value 0.005. Analysed by two independent t test



**Figure 7. Emergence Time**

**Table 10: Incidence of PONV at different time intervals**

PONV	Group	Mean Rank	Sum of Ranks	Mann Whitney U	Significance (p value)
On shift in PACU	I	31.90	957.00	408.00	0.459
	S	29.10	873.00		
At 30 min.	I	31.00	930.00	435.00	0.643
	S	30.00	900.00		
At 60 min.	I	30.50	915.00	450.00	1.000
	S	30.50	915.00		

We evaluated the incidence of PONV in both groups using Mann-Whitney U test on shift in PACU, at 30 minutes and at 60 minutes which came as insignificant ( $p>0.05$ ) in all categories

**Table 11. Time of requirement of first post operative analgesia**

	Group	Mean	SD	SEM	P value
Time to first analgesia (minutes)	I	47.07	9.443	1.724	0.918
	S	47.33	10.551	1.926	

The time of requirement of first post operative analgesia was similar in both groups; in Group I was  $47.07 \pm 9.443$  minutes while in Group S it was  $47.33 \pm 10.551$  minutes (calculated by two independent t test,  $P$  value=0.918)

**Table 12. Mini Mental State Examination**

MMSE at 15 minutes	Group		Total	Pearson Chi-Square value	P value
	I	S			
Not	18	19	37	0.071	0.791
Yes	12	11	23		

Above table shows, 18 patients in Group I and 19 patients in Group S could not perform Mini Mental State Examination (forward & backward counting) after 15 minutes after surgery, however, after 30 minutes all patients in each group could perform this test.(analysed by Chi square test with  $p>0.05$ )

**Table 13. Modified Aldret Score in PACU**

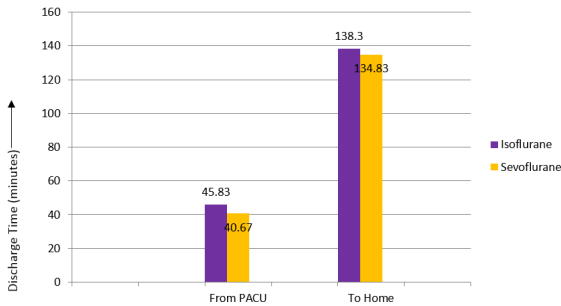
Modified Aldret score	Group	Mean Rank	Sum of Ranks	Mann Whitney U	Significance (p value)
Baseline	I	30.50	915.00	450.000	1.000
	S	30.50	915.00		
At 15 min.	I	23.38	701.50	236.500	0.001
	S	37.62	1128.50		
At 30 min.	I	30.70	921.00	444.000	0.899
	S	30.30	909.00		

Table shows that patients in group S achieved significant better modified aldre score as compared with group I after 15 minutes whereas there is no significant difference between the two groups after 30 minutes.

**Table.14 : Airway Hyper reactivity Score**

Airway Hyperreactivity Score	Group	Mean Rank	Sum of Ranks	Mann Whitney U	Significance (p value)
Baseline	I	30.50	915.00	450.000	1.000
	S	30.50	915.00		
After 15 min.	I	31.00	1054.50	310.500	0.024
	S	30.00	775.00		
After 30 min.	I	32.00	960.00	405.000	0.282
	S	29.00	870.00		

Above table shows Airway hyper reactivity was higher in Group I than Group S after 15 min, this difference was statistically significant, whereas there is no significant difference in airway hyperactivity between two groups after 30 minutes in post operative period.



**Figure 8. Discharge Time**

**DISCUSSION**

Day care surgery is a planned surgery wherein the patients, requiring early recovery and discharge, are admitted for short stay for surgery on a non-resident basis. Discharge times after ambulatory surgery are determined by postoperative complications and in particular by the presence and severity of nausea and vomiting. The present study "Comparision of maintenance and recovery characteristics with isoflurane or sevoflurane for ambulatory anaesthesia" was conducted in Sarojini Naidu Medical College, Agra. The study was done on 60 adult patients of American Society of Anaesthesiologist (ASA) grade I or II undergoing elective day care surgeries with an anticipated length of hospitalisation of less than 24 h post anaesthesia. The patients were randomly divided into two groups of patients to receive either <math>2.5\text{ mg/kg}</math> and supraglottic airway device inserted. Anaesthesia was maintained with oxygen, nitrous oxide with isoflurane or sevoflurane and patients were on spontaneous ventilation. At the end of surgery, administration of isoflurane or sevoflurane discontinued without tapering and then after 3 min nitrous oxide discontinued. The supraglottic airway device removed after eye opening and mouth opening to command. The Hemodynamic parameters, Emergence time, adverse effect (PONV, pain, airway hyper reactivity) and discharge time from PACU & for home were recorded. Our primary outcome variable was emergence time & discharge time from PACU & for home.

From this prospective study following conclusions were drawn.

1. Sevoflurane had shorter emergence time to eye opening ( $5.57 \pm 1.357$  minutes) and to obeys commands ( $7.80 \pm 1.518$  minutes) as compared to Isoflurane ( $6.53 \pm 1.795$  minutes and  $9.07 \pm 1.799$  minutes respectively).
2. Both the groups were similar regarding demographic data and duration of surgery.
3. The patients who received sevoflurane were discharged earlier from PACU in comparison to Isoflurane ( $40.67 \pm 8.782$  versus  $45.83 \pm 10.674$  minutes respectively).

4. There were no difference in discharge time for home in both groups. ( $134.83 \pm 9.330$  minutes for sevoflurane and  $138.30 \pm 8.471$  minutes for isoflurane)
5. No episodes of oxygen desaturation nor any differences in respiratory rate and pulse rate found in both groups.
6. We found that the mean arterial pressure remained at lower levels compared to baseline throughout the surgery in both the groups, but in none of the patients in each group the level reached below 20% from baseline. On intergroup comparison Mean arterial pressure was significantly lower in sevoflurane group. In both the groups fall in blood pressure responded to reduction in inspired concentration.
7. The airway hyper reactivity score was higher for the initial 15 minutes after removal of LMA in patients receiving isoflurane ( $p < 0.05$ ) but same after 30 minutes ( $p > 0.05$ ).
8. There is not any difference in incidence of nausea and vomiting in both groups ( $p > 0.05$ ).
9. The time of requirement of first postoperative analgesia was similar in the two groups ( $p > 0.05$ ).
10. All the patients in both groups demonstrated completely normal cognitive function at 30 minutes postoperatively as calculated by mini mental state examination.

**CONCLUSION:-**

The use of sevoflurane resulted in quicker emergence and faster early recovery with no difference in discharge time for home. The mean arterial pressure was lower from baseline in both groups after induction but significantly more lower in sevoflurane group. Isoflurane has more incidence of airway hyper reactivity though milder level for initial 15 minutes postoperative period, when compared to sevoflurane. Incidence of nausea and vomiting and requirement of postoperative analgesia are comparable in both the groups. Isoflurane is less costly in comparison to sevoflurane. All the patients in both groups demonstrate normal cognitive function after 15 minutes of post operative period. Sevoflurane may be a useful inhaled anesthetic for maintenance of adult ambulatory anaesthesia.

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