Section: Anaesthesia

Original Research Article

COMPARISON OF HEMODYNAMIC, EMERGENCE AND RECOVERY CHARACTERISTICS OF SEVOFLURANE WITH DESFLURANE IN GENERAL ANESTHESIA

Indupalli Kiran[1], Kakani Samson Dev Sundar[2], Seshagiri Rambabu[2], Gangapuram Ramesh[3]

[1]Associate Professor, Department of Anaesthesia: Siddhartha Medical College and Government General Hospital, Vijayawada, Andhra Pradesh, India.
[2]Assistant Professor, Department of Anaesthesia: Siddhartha Medical College and Government General Hospital, Vijayawada, Andhra Pradesh, India.
[3]Post Graduate, Department of Anaesthesia: Siddhartha Medical College and Government General Hospital, Vijayawada, Andhra Pradesh, India.

Received : 16/09/2023
Received in revised form : 19/10/2023
Accepted : 30/10/2023

Keywords:
Desflurane, sevoflurane, PARS > 10 (post anaesthesia recovery score of Aldrete and Kroulik).

Corresponding Author:
Dr. Gangapuram Ramesh,
Email:
drgangapuramramesh234@gmail.com

DOI: 10.47009/jamp.2023.5.6.13

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (6); 56-61

Abstract

Background: Inhaled anaesthetics allow rapid emergence from anaesthesia because of easy titrability with inherent neuromuscular blocking effects that make them more suitable for ambulatory anaesthesia. This study was undertaken with the aim of prospectively comparing the hemodynamic, emergence and recovery characteristics of sevoflurane with those of desflurane in general anaesthesia. **Materials and Methods:** Prospective randomized controlled single blinded study in 60 ASA I and II patients undergoing elective surgical procedures less than 3 hours duration under endotracheal general anaesthesia were randomly divided into two groups. Both the groups were induced with standard intravenous induction technique. Group D was maintained with 3% desflurane and group S with 1% sevoflurane in 50% oxygen with 50% nitrous oxide. Mean arterial pressure and heart rate were noted before induction and every 5 minutes after induction. The time of discontinuation of anaesthetic agents were noted as time zero for all the subsequent measurements and recovery times were determined at 1-minute intervals to awakening were noted. **Result:** Number of additional doses of fentanyl needed was noted. time to first spontaneous motion, response to painful pinch, extubation, recall of name, hand grip, achieve a PARS> 10 were noted. Age, sex, weight and the duration of surgery were comparable in both the groups. Both desflurane and sevoflurane-maintained hemodynamics, but desflurane needed more number of additional doses of fentanyl to maintain the hemodynamic stability. This difference was found to be statistically significant. The time to first spontaneous motion, response to pain, extubation, recall of name, and hand grip were shorter in the desflurane group than the sevoflurane group. The difference was statistically significant. The time to achieve a PARS of greater than 10 was earlier in the desflurane group and it was statistically significant. **Conclusion:** Desflurane provides earlier emergence and recovery from anaesthesia compared to sevoflurane.

INTRODUCTION

The introduction of general anaesthetics into clinical practice over 150 years ago stands as one of the seminal innovations of medicine. This single discovery facilitated the development of modern surgery and spawned the speciality of anaesthesiology. General anaesthesia can broadly be defined as a drug-induced reversible depression of the central nervous system resulting in the loss of response to and perception of all external stimuli. General anaesthesia is a dynamic balance between the level of hypnosis, analgesia, and stimulation. It is usually defined as a triad of amnesia, analgesia, and muscle relaxation.

Inhalation anaesthetics are the most common drugs used for the provision of general anaesthesia. Adding only a fraction of a volatile anaesthetic to the inspired oxygen results in a state of unconsciousness and amnesia. When combined with intravenous adjuvants, opioids and benzodiazepines, a balanced anaesthetic technique is achieved that results in analgesia, further sedation or hypnosis, and amnesia. The popularity of the inhaled anaesthetics for surgical

ISSN (O): 2687-5365; ISSN (P): 2753-6556

procedures is because of their ease of administration and the ability to reliably monitor their effects with both clinical signs and end-tidal concentrations.[1,2]

Inhaled volatile anaesthetics remain the most widely used drugs for maintenance of general anaesthesia because of their predictable intraoperative and recovery characteristics. Management of haemodynamic stability and early recovery is the most important part of a standardized balanced technique.

Rapid induction and recovery may lead to faster operating room turnover times, shorter recovery room stays, and earlier discharges to home. Over the last 15 years, there has been an explosive growth in the trend to provide cost-effective care in the practice of medicine. Ambulatory surgery is an increasingly important part of that trend. Ambulatory surgery continues to grow and thrive such that the vast majority (65–70%) of all surgical procedures is performed on an outpatient basis. Rapid recovery and shorter hospital stays are required to increase the efficiency of an ambulatory institution and save Health- care expenses. The choice of anaesthetic method plays a crucial role in determining the speed of recovery from anaesthesia. Although local and regional anaesthesia techniques are increasingly used in the ambulatory setting because they allow a more rapid recovery, general anaesthesia is still the most common anaesthetic technique. A good general anaesthetic approach should offer a smooth and quick induction, appropriate operating conditions, and a quick recovery with minimum or no adverse effects. It is also beneficial if the anaesthetic technique allows for fast tracking (i.e, transferring patients directly from the operating room to the phase II unit, thus bypassing the post anaesthesia care unit [PACU]).[3]

Because of their ease of titration and natural neuromuscular blocking effects, inhaled anaesthetics allow for faster emergence from anaesthesia, making them more appropriate for mobile anaesthesia. Because of the emergence of less soluble inhalation anaesthetics such as sevoflurane and desflurane, we reconsidered the use of volatile anaesthetics for outpatient surgical operations. Given the low blood: gas partition coefficient of sevoflurane and desflurane, awakening from anaesthesia should be faster than with standard inhalation anaesthetics. The purpose of this study was to compare the sevoflurane and desflurane in terms of hemodynamic, emergence and recovery characteristics.

MATERIALS AND METHODS

It was a prospective randomized controlled single blinded study done After institutional ethical committee approval, the study was conducted in 80 patients from June 2022 to December 2022. All were ASA I and II patients undergoing elective surgical procedures under general anaesthesia lasting for less than 3 hours but more than 1 hour duration. After getting consent, the anaesthetic technique was performed.

Inclusion criteria

Age of the patients ranged from 20 to 60 years, ASA Risk I&II undergoing elective surgical procedures under general anaesthesia lasting for less than 3 hours but more than 1 hour duration.

Exclusion criteria

Significant cardiovascular, respiratory, hepatic, renal, neurologic, psychiatric or metabolic disease. Recent anaesthetic exposure within previous seven days. History of allergic reaction to drugs, Potential susceptibility to malignant hyperthermia, Patient on chronic opioid analgesic or sedative treatment.

Preoperative Preparation: In the preoperative examination, all the patients were asked for any history of systemic illness like hypertension, diabetes, seizure disorder, bronchial asthma. History of any muscular dystrophies, neuromuscular disorders and family history of any malignant hyperthermia were noted. History of any allergic reactions to drugs and any chronic drug intake were noted. History of any previous surgeries was noted. Examination of the cardiovascular system and respiratory system were done.

Assessment of the airway and the range of neck movements were done to rule out any difficult intubation. Apart from the routine blood investigations like haemoglobin, blood sugar, blood urea and serum creatinine, electrocardiogram and chest x-ray were ordered in patients greater than 40 years of age.

Hypertensive patients were advised to continue the antihypertensives on the day of surgery. Diabetic patients were advised to skip the morning dose of insulin. The surgeons were instructed to post the diabetic case first in the list and to send the patient to the operating room with the fasting blood sugar and urine acetone values taken on the day of surgery.

On arrival to the preoperative room, all patients were premedicated with injection midazolam 0.05mg/kg and injection glycopyrrolate 10µg/kg intravenously 30minutes prior to induction.

The patients were randomly allocated into two groups:

Group S- Sevoflurane 30 patients

Group D-Desflurane 30 patients

After shifting the patient inside the operating room, pre induction monitors pulse oximetry, noninvasive blood pressure and electrocardiogram were connected. After securing the intravenous line and starting a crystalloid solution, all patients were induced with injection thiopentone sodium 5mg/kg, injection fentanyl 2µg/kg and intubated with injection succinylcholine 1.5mg/kg. After intubation capnography was connected.

Group D was maintained with 3% desflurane and group S with 1% sevoflurane in 50% oxygen with 50% nitrous oxide. Neuromuscular blockade was maintained with injection vecuronium, initial bolus dose of 0.1mg/kg was given. Ventilation was controlled to maintain end- tidal carbon dioxide

ISSN (O): 2687-5365; ISSN (P): 2753-6556

between 35and40mmhg. Injection fentanyl 0.5µg/kg was repeated every 30 minutes. Injection vecuronium 0.02mg/kg was repeated every 30 minutes. Mean arterial pressure and heart rate were noted before 48 induction and every 5minutes after induction.

If there is any increase in the mean arterial pressure and heart rate more than 20% of the preinduction values, an additional dose of injection fentanyl 1µg/kg was given to maintain the hemodynamics . If there is any reduction in the mean arterial pressure more than 20% from the baseline value, it was treated with bolus of intravenous fluids and replacement of intraoperative blood loss. When the hemodynamics of the patient was unresponsive to the above measures, the patient was excluded from the study. Nitrous oxide and volatile anaesthetic were discontinued after the last skin suture. Residual neuromuscular blockade was reversed with injection neostigmine 40µg/kg and injection glycopyrrolate 10µg/kg intravenously. Trachea was extubated when regular spontaneous breathing pattern was re-established and when the patients were able to open their eyes on command.

The time of discontinuation of anaesthetic agents were noted as time zero for all the subsequent measurements and recovery times were determined at 1-minute intervals to awakening.

Number of additional doses of fentanyl needed. Time to- First spontaneous motion, Response to painful pinch, Extubation, Recall of name, Hand grip and Achieve a PARS > 10 (post anaesthesia recovery score of Aldrete and Kroulik). This PARS records vital signs with patients receiving 0- 18 points, that is 0-3 points for five physiological variables. One designated investigator administered all anaesthesia; another assessed recovery.

Consciousness
Easily arousable, alert- 3
Arousable, oriented, not alert - 2
Arousable, not oriented- 1
Not responding -0

Ventilation
Normal- 2
Not perfect, but requires no support- 1
Airway requires support -0

Circulation (mean, supine, sitting)
Arterial pressure difference
< 10 %- 2
10-20- 1
>20 %- 0

Horizontal nystagmus
Follow command, no nystagmus-2
Follow command, nystagmus-1
Fail to follow command -0

Countdown test (backward from 10 to 0)
Succeed right away-2
Succeed in 30 seconds-1
Fail in 30 seconds -0

RESULTS

Cases studied in the Desflurane group had an age of 38.93 ± 10.10 years and the Sevoflurane group had an age of 38.70 ± 9.55 years, There was no statistical significant difference between age and gender distribution.

Table 1: Demographic Distribution in present study

Age group	Desflurane Group		Sevoflurane Group	
	No	%	No	%
20-29	5	16.67%	5	16.67%
30-39	11	36.67%	11	36.67%
40-49	9	30.00%	9	30.00%
50-59	4	13.33%	4	13.33%
60-69	1	3.33%	1	3.33%
Total	30	100.00%	30	100.00%
Range	20-60 Years		20-60 Years	
Mean	38.93		38.70	
SD	10.10		9.55	
p value	0.9271 Not Significant			
Sex				
Male	15	50	15	50
Female	15	50	15	50
Total	30	100	30	100

Table 2: Diagnosis in present study

Cases	Desflurane		Sevoflurane	
	No	%	No	%
Carcinoma Breast	6	20.00	5	16.67
Cholelithiasis	4	13.33	8	26.67
Epigastric Hernia	3	10.00	3	10.00
Multi Nodular Goitre	3	10.00	4	13.33
Gynaecomastia	4	13.33	5	16.67
Solitory Nodular Goitre	3	10.00	1	3.33
Others:				
Bilateral Fibroadenoma	1	3.33	-	-
Bilateral gynaecomastia	1	3.33	-	-
colostomy closure	-	-	1	3.33

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Fibroadenoma	1	3.33	1	3.33
Incisional hernia	1	3.33	1	3.33
Pain Abdomen for evaluation	1	3.33	-	0.00
Right Illiac fossa mass	1	3.33	1	3.33
Umblical Hernia	1	3.33	-	-
	7	23.33	4	13.33
Total	30	100	30	100

Table 3: Variables in present study

ASA status	**Desflurane Group**	**Sevoflurane Group**
ASA 1 in number of cases (%)	16 (53.33 %)	17 (56.67 %)
ASA 2 in number of cases	14 (46.67 %)	13 (43.33 %)
P'	0.7969 Not significant	
Weight in kgs		
Range	48-60	48-58
Mean	53.90	53.73
SD	3.24	2.77
'P'	0.8311 Not significant	
Duration of Surgery		
Range	80-150	80-150
Mean	112	110
SD	17.44	15.11
'p'	0.6331 Not significant	
Additional doses of fentanyl		
Range	0-3	0-2
Mean	1.47	0.33
SD	0.90	0.55
p'	0.0001 Significant	

There was no Significant difference in the ASA status of the two groups, ('p' >0.05). The weight of the patients was comparable in both the groups. There was no significant difference statistically in surgery length between the two groups. The number of additional doses of fentanyl needed in desflurane group was 1.47 and in sevoflurane group was 0.33 this difference was statistically significant with a p value of 0.0001.

Table 4: Efficacy of the drugs in present study

Parameter	**Group D**	**Group S**
Time to spontaneous motion		
Range	3 TO 5	6 TO 9
Mean	4.00	6.97
SD	0.74	0.93
'p'	0.0001 Significant	
Time to response to pain		
Range	4 -7	7 -11
Mean	5.33	8.37
SD	0.93	0.93
'p'	0.0001 Significant	
Time to extubation		
Range	5--8	8--12
Mean	6.57	10.43
SD	0.73	1.10
'p'	0.0001 significant	
Time to recall of name (in Minutes)		
Range	6-9	10-14
Mean	7.80	12.00
SD	0.76	1.29
'p'	0.0001 significant	
Time to hand grip		
Range	8-11	12-17
Mean	9.33	14.20
SD	0.84	1.54
'p'	0.0001 significant	
Time to achieve PARS>10		
Range	9-12	14-19
Mean	10.43	16.43
SD	0.97	1.33
'p'	0.0001 significant	

PARS- post anaesthesia recovery score of Aldrete and Kroulik

Efficacy of the drugs as time to spontaneous motion, time to response to pain mean time to extubation, time to recall of name, time to hand grip and time to achieve PARS>10 was statistically significant.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 5: Changes in pulse rates beats per minutes and mean arterial pressures.

Changes in pulse rates	Desflurane group		Sevoflurane group		p Value	
Variables	Mean	SD	Mean	SD		
Baseline pulse rate	83.20	7.48	84.00	8.27	0.70	Not significant
Intra-Operative Pulse rate	82.73	7.21	79.61	7.31	0.10	Not significant
Baseline MAP	64.53	3.48	65.40	3.02	0.31	Not significant
Intra-Operative MAP	65.02	3.44	63.66	2.69	0.09	Not significant

There is no significant difference in pulse rate and mean arterial pressure.

DISCUSSION

General anaesthesia is popular among the surgeons, anaesthesiologists, and patients and still remains the mainstay of anaesthesia in many centres. With the introduction of less soluble volatile anaesthetics which promote early recovery and also maintains hemodynamics and provide amnesia makes general anaesthesia the technique of choice for many patients. Inhalational anaesthetics date back to the dawn of anaesthesia.[4]

Inhalation anaesthetics are the most common drugs used for the provision of general anaesthesia. Adding only a fraction of a volatile anaesthetic to the inspired oxygen results in a state of unconsciousness and amnesia. When combined with intravenous adjuvants, opioids and benzodiazepines, a balanced anaesthetic technique is achieved that results in analgesia, further sedation or hypnosis, and amnesia. The popularity of the inhaled anaesthetics for surgical procedures is because of their ease of administration and the ability to reliably monitor their effects with both clinical signs and end-tidal concentrations.[5]

Inhaled volatile anaesthetics remain the most widely used drugs for maintenance of general anaesthesia because of their predictable intraoperative and recovery characteristics. Management of haemodynamic stability and early recovery is the most important part of a standardized balanced technique. Rapid induction and recovery may lead to faster operating room turnover times, shorter recovery room stays, and earlier discharges to home. It is preferable to recover from anaesthetic more quickly. In this study, the hemodynamic, emergence, and recovery features of sevoflurane and desflurane in general anaesthesia were evaluated.[6]

Over the last 15 years, there has been an explosive growth in the trend to provide cost-effective care in the practice of medicine. Ambulatory surgery is an increasingly important part of that trend. Ambulatory surgery continues to grow and thrive such that the vast majority (65–70%) of all surgical procedures is performed on an outpatient basis. Rapid recovery and shorter hospital stays are required to increase ambulatory facility efficiency and minimise health care expenditures.[7]

The choice of anaesthetic technique is a major factor in determining the rate of recovery from anaesthesia. Although local and regional anaesthesia techniques are increasingly used in the ambulatory setting because they allow a more rapid recovery, general anaesthesia is still the most common anaesthetic technique.[6]

An ideal general anaesthetic technique should offer a smooth and rapid induction, ideal working conditions, and rapid recovery with low or no adverse effects. It is also beneficial if the anaesthetic technique allows for fast tracking (i.e, transferring patients directly from the operating room to the phase II unit, thus bypassing the post anaesthesia care unit [PACU]).

Because of their ease of titration and natural neuromuscular blocking effects, inhaled anaesthetics allow for faster emergence from anaesthesia, making them more appropriate for mobile anaesthesia. The availability of less soluble inhalation anaesthetics such as sevoflurane and desflurane prompted us to reconsider the use of volatile anaesthetics in outpatient surgical operations. Because sevoflurane and desflurane have a lower blood:gas partition coefficient than standard inhalation anaesthetics, rapid recovery from anaesthesia is most likely expected.

The time to spontaneous motion, eye opening, response to pain were shorter in the desflurane group. The time to extubation, recall of name, and hand grip were also shorter in the desflurane group compared to sevoflurane group. Post anaesthesia recovery score of greater than 10 was achieved earlier in the desflurane group. In the desflurane group, patient moved their limbs in a mean time of 4minutes after the discontinuation of the anaesthetics whereas it took a mean of 6.97 minutes in the sevoflurane group. The time to response to pain was achieved in a mean time of 5.33 minutes in the desflurane group whereas in the sevoflurane group it took a mean of 8.37 minutes. The patients in the desflurane group were extubated earlier than those in the sevoflurane group. The patients in the desflurane group were able to recall their names in a mean time of 7.80 minutes whereas those in the sevoflurane group took 12.00 minutes. The time to hand grip was achieved earlier in the desflurane group. The post anaesthesia recovery score of greater than 10 (PARS>10) was achieved in a mean of 10.43 minutes in desflurane group which was earlier than sevoflurane. The study by Nathanson et al. suggested that sevoflurane and desflurane provided similar intraoperative conditions during the maintenance period. Although early recovery was more rapid after desflurane, there was no difference in later recovery end-points. Randomised, double-blind study of Tarazi et al. showed that both sevoflurane and desflurane were acceptable inhalational anaesthetics for outpatient tubal ligation surgery. In this study there was no

ISSN (O): 2687-5365; ISSN (P): 2753-6556

significant difference in the recovery times between the two groups after 30minutes.

Jindal R et al. found that the late recovery profiles and incidences of postoperative side effects were similar after desflurane and sevoflurane. It was also showed that regardless of the duration of anaesthesia, elimination was faster and recovery was quicker for the inhaled anaesthetic desflurane than for the inhaled anaesthetic sevoflurane.

Both the desflurane and sevoflurane maintained the hemodynamic within 20% of the baseline values, but desflurane required more number of additional doses of fentanyl than sevoflurane. In the desflurane group, hemodynamic could not be maintained with the additional doses of fentanyl in 3 patients and they were excluded from the study, were as in the sevoflurane group, only 1 patient was excluded from the study. Hypotension was easily managed with fluids and blood replacement and none of the patients were excluded in both the groups.

Kaur A et al,[9] showed desflurane and sevoflurane produce similar hemodynamic changes but the immediate and intermediate recovery was significantly faster after desflurane thus contributing to fast tracking and early discharge of patients.

S Gergin, B Cevik et al,[10] in their study concluded that desflurane, like sevoflurane, maintains haemodynamic stability during intraoperative period.In our study also,both the desflurane andsevoflurane maintained the hemodynamics within 20% of the baseline values. Hypotension was easily managed with fluids and blood replacement and none of the patients were excluded in both the groups. There was no significant difference in total dose of fentanyl /vecuroniumused between two groups.

CONCLUSION

In conclusion, desflurane provides earlier emergence and recovery from anaesthesia compared to sevoflurane. Both desflurane and sevoflurane maintained haemodynamic stability, but to maintain the hemodynamics desflurane needed more number of additional doses of fentanyl.

REFERENCES

1. Dalal KS, Choudhary MV, Palsania AJ, Toal PV. Desflurane for ambulatory anaesthesia: A comparison with sevoflurane for recovery profile and airway responses. Indian J Anaesth2017; 61:315-20.
2. Patel M, Parmar N. Comparison of hemodynamic parameters and recovery characteristics between sevoflurane and desflurane in patients undergoing day care gynaecological laparoscopic surgery. Int J Med Sci Public Health2016;5:1412- 1416.
3. JalanErgönenç, TolgaErgönenç, Kadirİdin, UğurUzun, Ali Dirik, GökhanGedikli, and GülşenBican ; The recovery time of sevoflurane and desflurane and the effects of anaesthesia on mental and psychomotor functions and pain ; Anaesthesia Essays and Research. 2014 Sep-Dec; 8(3):367–371.
4. Miller AL, Theodore D, Widrich J. Inhalational Anesthetic. [Updated 2023 May 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK554540/
5. Philip, J. (2011). InhalationAnesthetics. In C. Vacanti, S. Segal, P. Sikka, & R. Urman (Eds.), Essential Clinical Anesthesia (pp. 213-226). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511842306.033
6. Lee JH. Anesthesia for ambulatory surgery. Korean J Anesthesiol. 2017 Aug;70(4):398-406.
7. Siddique SM, Tipton K, Leas B, Greysen SR, Mull NK, Lane-Fall M, McShea K, Tsou AY. Interventions to Reduce Hospital Length of Stay in High-risk Populations: A Systematic Review. JAMA Netw Open. 2021 Sep 1;4(9):e2125846.
8. 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 Jan;55(1):36-42.
9. 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 Jan;29(1):36-40. doi: 10.4103/0970-9185.105792. PMID: 23493107; PMCID: PMC3590538.
10. Edmond I. Eger, MD; Terri Bowland, BS; PompiliuIonescu, MD; Michael J. Laster, DVM; Zexu Fang, MD; et al, Recovery and Kinetic Characteristics of Desflurane and Sevoflurane in Volunteers after 8-h Exposure, including Kinetics of Degradation Products,Anesthesiology 9 1997, Vol.87, 517-526.

ISSN (O): 2687-5365; ISSN (P): 2753-6556