Original Article

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Anaesthesia Section

Comparison of Haemodynamic Stability and Early Recovery Characteristics of Desflurane versus Sevoflurane in Robotic Prostatectomy: A Randomised Clinical Study

KIRTI GUJARKAR[1], ALKA MANDKE[2], SHARMILA RANADE[3], PRAJWAL MAHATME[4]

ABSTRACT

Introduction: An ideal anaesthetic for robotic surgery would allow for a quick induction with minimal discomfort, as well as a short operation duration, quick recovery, and minimal aftereffects. Additionally, it would enable speedy recovery.

Aim: To compare the haemodynamic stability and recovery characteristics of sevoflurane with desflurane for robotic surgery.

Materials and Methods: The present randomised clinical study was conducted for four years from January 2019 to January 2023 and included 60 patients undergoing elective robotic radical prostatectomy and randomised into the group receiving desflurane (Group D) and that receiving sevoflurane (Group S). All patients were monitored using the Bispectral index (BIS) monitor, in addition to standard monitoring. General anaesthesia was administered using midazolam, fentanyl, propofol, atracurium, and either desflurane or sevoflurane based on the assigned group. Throughout the surgery, patients' haemodynamic stability was monitored, and vital signs were recorded at induction, intubation, after assuming the Trendelenburg position, and at 30-minute intervals, until extubation. The inhalational agent was turned off at skin closure, and the time to spontaneous eye opening (T1), time to extubation (T2), and time to verbal response (T3) were noted. After the verbal response, patients were assessed based on the Modified Aldrete Score (MAS) with a threshold of ≥9. Pulse rate, blood pressure, BIS, and MAS were recorded during this time period. Data was presented as mean, frequency, and percentage. MAS comparison among the study groups was assessed using the Chi-square test. Demographic, haemodynamic, and BIS variables were compared using paired t-tests.

Results: The mean age of patients in group S was 67.67±6.07 years, while in group D, it was 65.17±6.69 years. The time required for extubation after turning off the agent was significantly shorter in group-D compared to group-S, with a mean of 16.07±13.00 minutes in group-D and 21.71±9.07 minutes in group-S (p-value=0.0001). The percentage of patients achieving MAS >9 at five minutes was significantly higher in group D. Additionally, the use of both agents was not associated with any major complications.

Conclusion: Desflurane as the inhalational agent ensures faster recovery in the early postoperative period and minimal changes in haemodynamic parameters compared to sevoflurane. However, sevoflurane has fewer complications compared to desflurane.

Keywords: Anaesthesia, Inhalational agents, Robotic surgery

INTRODUCTION

Robotic prostatectomy, often known as RP, is becoming increasingly popular as a viable alternative to open prostatectomy since it is less invasive, more effective, and more convenient. Capnoperitoneum (CP) and a Steep Trendelenburg Posture (STP), a head-down position of at least 25°-45°, are also required for the surgery [1,2]. Due to this combination, anaesthesiologists face unique problems that may involve major pathophysiological abnormalities in both the pulmonary and cardiac systems. Patients undergoing RP not only experience pulmonary dysfunction, which can be seen in the development of atelectasis and increased airway pressure, but also profound abnormalities in their haemodynamics [3,4].

Inhaled volatile agents are still the most commonly used medications for maintaining general anaesthesia. This is because they are easy to administer and provide stability during the procedure and recovery. The standardised balanced strategy consists of two parts: ensuring haemodynamic stability and promoting rapid recovery [5-7]. An ideal anaesthetic for robotic surgery would allow for quick induction with minimal discomfort, a short operation duration, rapid recovery, and minimal aftereffects. Inhaled volatile anaesthetics continue to be the preferred choice for sustaining general anaesthesia due to their ease of administration and consistent intraoperative and postoperative characteristics. Maintaining haemodynamic stability and facilitating early recovery are considered the most important aspects of a standardised balanced strategy [8,9].

Sevoflurane is a volatile anaesthetic agent that is a halogenated methyl propyl ether. It does not cause irritation or inflammation but does induce bronchodilation. It has a low blood/gas partition coefficient, leading to rapid induction. Inhalation of sevoflurane can cause dose-dependent respiratory and cardiovascular depression. Sevoflurane does not affect the sympathetic nervous system [10]. Desflurane, in addition to being an irritant to the respiratory system, is a non combustible fluorinated methyl ethyl ether with a potent odor. Induction and recovery times are quick with desflurane due to its low solubility in blood and body tissues. There is no evidence of a propensity for ventricular arrhythmia [11,12]. The purpose of this study was to compare the relative benefits of sevoflurane and desflurane during robotic surgery in terms of patient haemodynamic stability and recovery features.

MATERIALS AND METHODS

The present randomised clinical trial was approved by the Institutional Research Ethics Committee (IEC No.ECR/141/Inst/MH/2013, Kokilaben Dhirubhai Ambani Hospital and Medical Research Institute, September 2018). The duration of the study was four years from January 2019 to January 2023. Written informed consent for anaesthesia during robotic prostatectomy was obtained from the

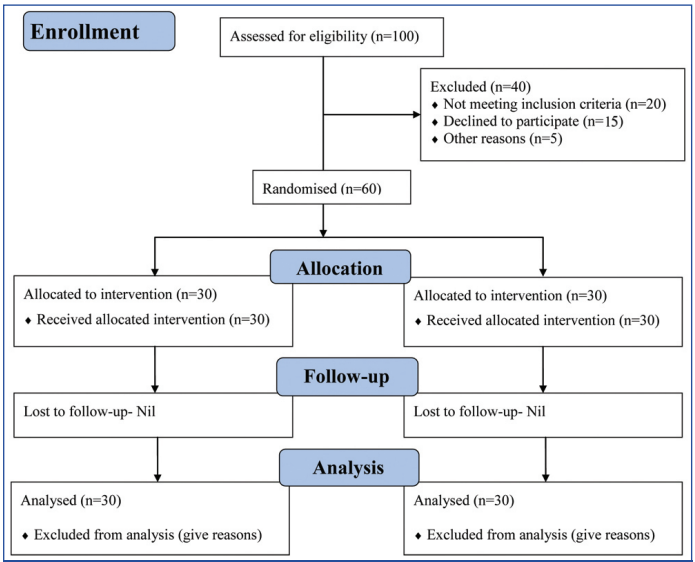
study participants, and the ethical principles for medical research involving human subjects, as per the Declaration of Helsinki, were followed throughout the study.

Inclusion criteria: Adult patients (18-60 years) undergoing elective Robotic Radical Prostatectomy and classified as Category I-II according to American Society of Anaesthesiologists (ASA) were included in the study.

Exclusion criteria: Patients with ASA Category-III-i.v., those with chronic alcohol or narcotic drug abuse within 90 days of surgery, Body Mass Index (BMI) over 30 kg/m^2, significant cardiopulmonary disease, hepatic, renal, and neurological dysfunction, intracranial pathology associated with intracranial hypertension, or suffering from glaucoma were excluded from the study

Sixty patients undergoing "Robotic Radical Prostatectomy" were included in the study. The sample size was determined based on unpublished pilot observations from routine robotic surgeries, which showed an average variation of ±20 mm Hg in blood pressure during the intraoperative period. Based on these observations, a two-sided two-sample t-test with an alpha level of 0.05 and 80% power, a study with 44 evaluable subjects would be sufficient. Accounting for a dropout rate of 10%, a final sample size of 60 patients (30 patients in each group) was considered.

The randomisation of patients into two groups was done using a computer-generated table. The patients were categorised as group S, receiving sevoflurane (1-3%) as the anaesthetic agent for maintenance of anaesthesia, and group D, receiving desflurane (3-6%) as the anaesthetic agent for maintenance of anaesthesia. Both the patient and the anaesthesiologist were not blinded regarding the agent being used. Preanaesthetic check-up was performed one day prior to the surgery [Table/Fig-1].

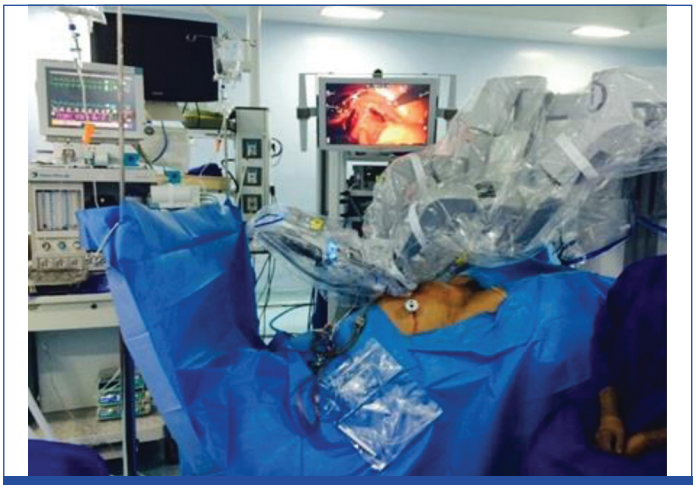


[Table/Fig-1]: CONSORT flow diagram of patient participation in the study.

Routine investigations, including haemoglobin complete blood count, hepatic and renal function tests, chest X-ray, electrocardiogram, 2D-Echo, and Arterial Blood Gas Analysis (ABGA), were performed. Preoperative clinical assessment of each patient was conducted, and Nil By Mouth (NBM) for six hours prior to surgery was advised. Prior to surgery, starvation was confirmed, and consent was checked. Premedication with a tablet of pantoprazole 40 mg and their respective systemic disease medicine (e.g., antihypertensive) was confirmed. During the operation, monitors in the form of an ECG monitor, pulse oximeter, non invasive blood pressure monitor, and BIS strip were attached. Baseline (preoperative) pulse rate, blood pressure, SpO_2, and BIS were recorded. Intravenous (i.v.) cannulation was performed using an 18G cannula on the non dominant hand, and balanced salt solution was started. After induction, i.v. cannulation on the other hand using 18G was secured and kept accessible.

All patients were given an intravenous injection of fentanyl (1.5 mcg/kg), midazolam (0.02 mg/kg), and glycopyrrolate (0.004 mg/kg). Preoxygenation for three minutes and induction with injection Propofol (2 mg/kg) until the loss of eyelash reflex was used for all patients. The neuromuscular inhibiting agent atracurium (0.6 mg/kg) was injected. Within three minutes, the patient had a nasogastric tube and a cuffed endotracheal tube in place. The weight of the body was distributed over the shoulders by padding the eyes and resting the head on a pillow that gives way slightly between both shoulder bracings. Shoulder braces were given to the patient to prevent sliding cephalad after being in a 30-40 degree Trendelenburg position. To prevent hypothermia due to prolonged pneumoperitoneum with dry, cold gases, we tucked the arms into the sides and placed a warming over-blanket on the upper body. Sequential compression stockings were used on the lower extremities to prevent deep venous thrombosis. Once the urethra was catheterised, the patient was positioned so that the robot could be rolled between their legs. Further precautions were taken to ensure that sensitive areas like the elbow, axilla, back, and shoulder were not pressed upon.

Anaesthesia was maintained with air:oxygen (50:50) with a fresh gas flow of 1.5 liters, using sevoflurane (1-3%) or desflurane (3-6%) to maintain the depth of anaesthesia targeting BIS values between 40 and 60. All patients were maintained on an injection of atracurium infusion at 0.5 mg/kg/hr to maintain muscle relaxation throughout surgery, an injection of fentanyl infusion at 0.5 mcg/kg/hr to reduce the anaesthetic requirement throughout surgery, and an injection of ppropofol infusion at 0.6 mg/kg/hr to provide cerebral protection in the steep Trendelenburg position [Table/Fig-2].



[Table/Fig-2]: Position of patient with robot docked.

Vital parameters such as pulse rate, non invasive blood pressure, oxygen saturation, BIS, $EtCO_2$ (end-tidal carbon dioxide), and end-tidal inhalational agents were monitored for all patients throughout the surgery at intervals of 30 minutes. The patient was then ventilated using a closed circuit and a mechanical ventilator in volume control mode with a tidal volume of 8-10 mL/kg and a frequency of 12-14 bpm.

Once the Trendelenberg position was given to the patient, the ventilatory mode was changed to pressure control mode with an inspiratory pressure between 20-25 mm Hg and a frequency of 16-18, aiming to achieve the required tidal volume and maintain peak airway pressure between 25 and 28 mm Hg. A Positive End-Expiratory Pressure (PEEP) of 4-5 cm of H_2O was applied after switching to pressure control mode to prevent atelectasis. End-tidal capnometry and anaesthetic gas monitoring were then initiated. Subsequently, the patients received either sevoflurane (1-3%) or desflurane (3-6%) with 50% air in oxygen and fresh gas flows at 1.5 liters per minute. Haemodynamic stability at incision was maintained through the infusions we started and adjustments of

inhalational agents based on BIS values. The maintenance doses of the anaesthetic agents were titrated to maintain a BIS value of 40-60. All patients were ventilated to maintain an $EtCO_2$ level of 32-36 mm Hg. As the main surgical procedure ended and the robot was undocked, muscle relaxant infusion and other infusions were discontinued. At the same time, analgesia in the form of an intravenous injection of paracetamol at a dose of 15 mg/kg body weight was administered and an intravenous injection of ondansetron as an antiemetic at a dose of 0.1 mg/kg body weight.

Study Parameters

The study parameters included haemodynamic parameters such as pulse rate, non invasive blood pressure, BIS, $EtCO_2$, and end-tidal inhalational agents.

Emergence

The muscle relaxant was discontinued when the main surgical part was over and the robot was undocked, and volatile agent was stopped with the start of skin closure.

- Emergence time (T1): It is the time from the end of inhalational anaesthesia until eye opening.
- Extubation time (T2): It is the time from eye opening until extubation.
- Recovery time (T3): It is the time from discontinuation of anaesthesia until the patient recalls their name.
- Total anaesthetic time (T4): It is the time from the start of induction until the discontinuation of inhalational anaesthesia with high flow.

Recovery

Assessment of recovery was done by measuring the MAS at intervals of five minutes after extubation and noting the results.

STATISTICAL ANALYSIS

After data collection, the data was entered into Microsoft Excel. Data analysis was performed using Statistical Package for Social Sciences (SPSS) Software version 21.0. The data is presented using frequency and percentage tables, and the association among study groups was assessed using the Chi-square test. Demographic variables and categorical variables were compared using paired t-tests. A p-value less <0.05 was considered significant.

RESULTS

The demographic characteristics of the patients are highlighted in [Table/Fig-3].

Variables	Inhalations used (n=30)	Mean±SD	p-value
Age (years)	Desflurane	65.17±6.69	0.569
	Sevoflurane	67.67±6.07	
Weight (kg)	Desflurane	71.13±8.42	0.712
	Sevoflurane	69.37±9.12	
Height (cm)	Desflurane	164.17±7.23	0.687
	Sevoflurane	166.20±5.93	
BMI (kg/m^2)	Desflurane	26.38±2.53	0.114
	Sevoflurane	25.11±3.05	
Ejection fraction (%)	Desflurane	59±5	0.301
	Sevoflurane	60±6	

[Table/Fig-3]: Demographic characteristics of the patients between the both groups. Paired t-test was used for comparison between both the groups. p-value <0.05 was considered significant

Haemodynamic Parameters

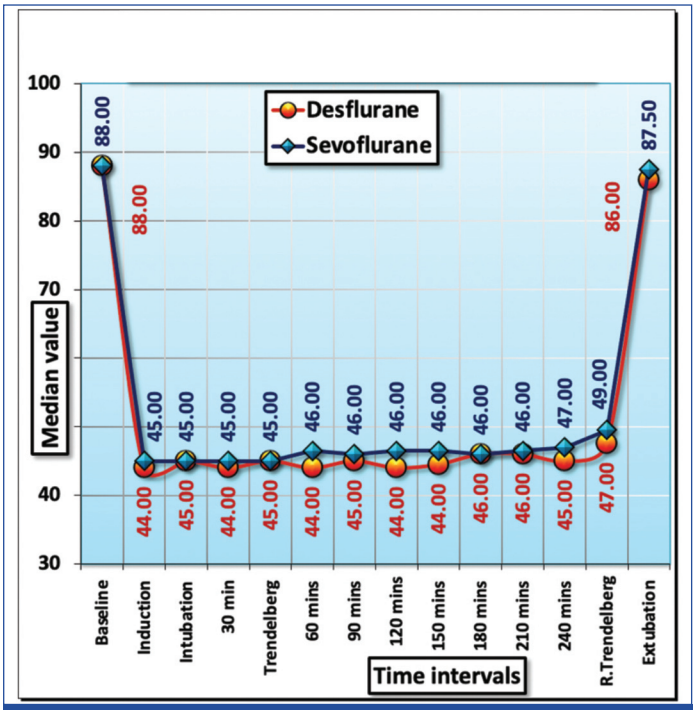
Haemodynamic stability was comparable in both groups [Table/Fig-4]. The Minimum Arterial Pressure (MAP) and Heart Rate (HR) were maintained within ±2 units of baseline throughout surgery in both groups. The time required for patients to be extubated after switching off the anaesthetic agent was significantly shorter in the group D (16.07±13.00 minutes) compared group S (21.71±9.07 minutes).

[Table/Fig-5] shows that inhalational agents were adjusted to maintain the BIS value between 40 and 60 throughout surgery. The Minimum Alveolar Concentration (MAC) value was changed to maintain the BIS value in the range of 0.5-0.6 MAC for desflurane (3-6%) and sevoflurane (1-3%) [Table/Fig-6].

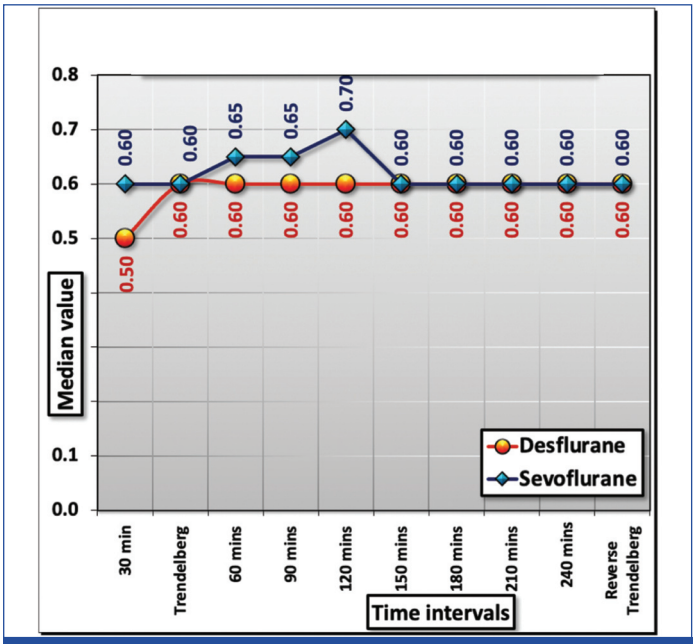
Time interval	Inhalations used	Heart rate Mean±SD	p-value	Systolic BP Mean±SD	p-value	Diastolic BP Mean±SD	p-value	MAP Mean±SD	p-value
Baseline^	Desflurane	80.57±16.82	0.882	136.37±28.10	0.901	76.47±10.97	0.410	89.97±13.99	0.868
	Sevoflurane	79.30±14.41		137.27±27.42		75.43±8.40		90.50±10.60	
Induction	Desflurane	82.57±14.12	0.613	110.03±20.81	1.000	68.13±13.95	0.926	77.77±14.33	0.494
	Sevoflurane	80.67±14.81		109.60±17.28		65.03±11.90		75.40±12.24	
Intubation	Desflurane	80.23±16.40	0.863	120.73±25.37	0.289	72.73±12.45	1.384	81.83±16.88	0.046
	Sevoflurane	80.93±14.89		127.10±20.44		77.80±13.05		90.13±14.54	
30 min^	Desflurane	75.30±13.98	0.482	111.83±19.90	0.141	71.57±12.83	0.501	84.20±15.50	0.912
	Sevoflurane	77.37±14.38		119.23±18.44		73.17±11.89		83.80±12.32	
Trendelenburg	Desflurane	74.23±13.62	0.753	124.00±21.31	0.109	82.17±11.50	0.03*	93.13±12.67	0.01
	Sevoflurane	73.17±12.50		114.60±23.40		74.43±14.07		84.03±15.83	
60 mins^	Desflurane	74.87±14.32	0.711	125.13±17.55	0.119	79.63±10.27	1.509	91.60±9.85	<0.05
	Sevoflurane	73.23±8.65		117.20±21.09		75.30±11.91		84.57±12.39	
90 mins	Desflurane	73.57±11.84	0.260	119.93±13.58	0.256	75.70±8.86	1.845	86.90±9.25	0.05048
	Sevoflurane	70.03±12.24		115.23±17.89		71.13±10.25		81.33±12.14	
120 mins	Desflurane	74.17±12.62	0.056	118.80±17.25	0.059	74.83±9.95	0.016*	85.47±9.98	0.052
	Sevoflurane	68.50±9.72		111.37±18.86		69.67±9.90		79.77±12.14	
150 mins^	Desflurane	73.03±13.26	0.492	112.70±13.91	0.045*	70.70±8.04	1.773	81.57±8.77	0.037
	Sevoflurane	69.97±11.13		105.93±15.23		66.57±9.92		76.23±10.57	
180 mins	Desflurane	73.86±13.58	0.473	116.41±12.25	0.078	70.69±10.25	0.716	81.90±10.09	0.228
	Sevoflurane	71.57±10.71		111.10±18.32		68.93±8.55		78.73±9.85	
210 mins	Desflurane	75.28±13.59	0.305	121.24±18.14	0.007*	72.40±15.50	1.467	83.60±13.21	0.074
	Sevoflurane	70.89±11.49		109.39±14.01		66.86±11.94		77.68±10.36	

240 mins	Desflurane	75.29±14.62	0.504	114.41±15.52	0.871	67.71±12.10	0.183	80.00±11.42	0.561
	Sevoflurane	72.30±13.29		113.65±13.81		67.09±9.31		78.09±9.20	
Reverse trendelenburg	Desflurane	75.70±13.42	0.565	110.83±15.38	0.415	69.17±12.40	0.747	77.93±11.63	0.933
	Sevoflurane	73.30±13.29		108.35±13.01		67.15±8.30		75.74±10.30	
Extubation	Desflurane	89.30±17.06	0.118	139.97±17.93	0.064	67.03±9.80	1.278	78.17±9.66	0.236
	Sevoflurane	82.93±13.82		130.87±19.42		81.17±13.08		93.93±15.55	

[Table/Fig-4]: Comparative assessment of haemodynamic parameters.
Paired t-test; p-value <0.05 considered Significant



[Table/Fig-5]: BIS at various time intervals.



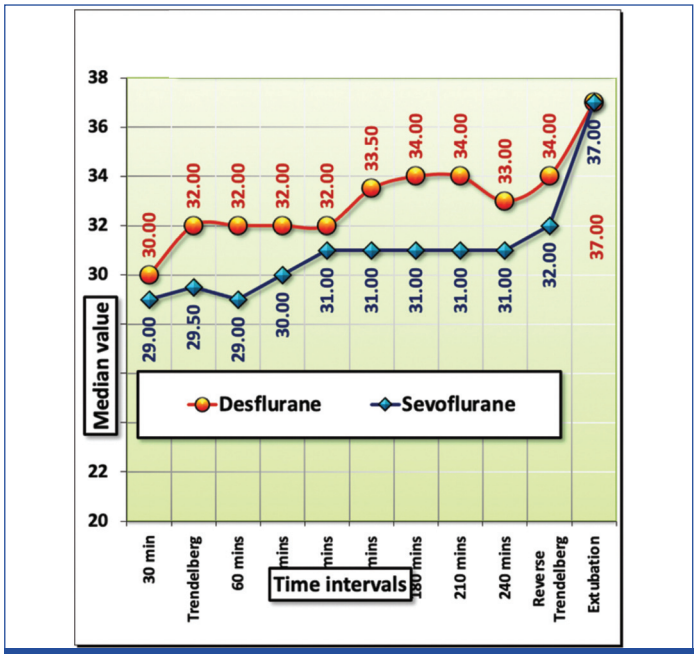
[Table/Fig-6]: MAC at various time intervals.

[Table/Fig-7] shows that $EtCO_2$ levels were higher in the desflurane group throughout surgery compared to the sevoflurane group.

Recovery Parameters

The mean time for spontaneous eye opening (T1) was shorter in the desflurane group (13.10±11.88 minutes) compared to the sevoflurane group (19.11±8.52 minutes) (p-value-0.001).

The mean time for extubation (T2) was shorter in the desflurane group (16.07±13.00 minutes) compared to the sevoflurane group (21.71±9.07 minutes) (p-value-0.0001).



[Table/Fig-7]: Comparison of $EtCO_2$ at various time intervals.

The mean time for verbal response (T3) was shorter in the desflurane group (18.43±12.94 min) compared to the sevoflurane group (24.68±9.46 min) (p-value-0.00014).

The mean MAS was slightly higher in the desflurane group (9.83) compared to the sevoflurane group (9.77), although the difference was not statistically significant [Table/Fig-8].

Variables	Inhalations used	N	Mean±SD	Median	p-value
T1 (mins)	Desflurane	30	13.10±11.88	8.50	0.001*
	Sevoflurane	30	19.11±8.52	16.50	
T2 (mins)	Desflurane	30	16.07±13.00	11.50	0.0001*
	Sevoflurane	30	21.71±9.07	18.00	
T3 (mins)	Desflurane	30	18.43±12.94	13.50	0.00014
	Sevoflurane	30	24.68±9.46	20.50	
T4 (mins)	Desflurane	30	262.67±27.54	270.00	0.667
	Sevoflurane	30	259.33±21.32	270.00	
MAS	Desflurane	30	9.83±0.38	10.00	0.858
	Sevoflurane	30	9.77±0.63	10.00	

[Table/Fig-8]: Comparison of recovery parameters in both the groups.
Paired t-test, p-value <0.05 was considered significant

Comparison of Modified Aldrete Score (MAS)

Comparison of MAS [Table/Fig-9] showed that the percentage of patients with a MAS ≥9 was higher in the desflurane group (100%) compared to the sevoflurane group (90%).

Complications

The overall incidence of complications during recovery, such as bronchospasm, secretions, and coughing, was low in both groups. However, the proportion of study participants who did not have any complications was higher in the sevoflurane group (96.7%) compared to the desflurane group (86.7%). Although the desflurane group had a higher incidence of complications, this difference was

MAS		Inhalations used		p-value*
		Desflurane	Sevoflurane	
8	No.	0	3	0.058
	%	0.0%	10.0%	
9	No.	5	1	
	%	16.7%	3.3%	
10	No.	25	26	
	%	83.3%	86.7%	
Total	No.	30	30	
	%	100.0%	100.0%	

[Table/Fig-9]: Comparison of MAS score between both the groups.
Chi-square test, p-value <0.05 was considered significant

not statistically significant. Among the participants who experienced complications after desflurane administration, three had high levels of secretions and one had bronchospasm, while only one participant in the sevoflurane group had cough during recovery [Table/Fig-10,11].

Complication	Group		Total
	Desflurane	Sevoflurane	
Yes (n)	4 (13.3%)	1 (3.3%)	5 (8.3%)
No (n)	26 (86.7%)	29 (96.7%)	55 (91.7%)
Total (n)	30 (100%)	30 (100%)	60 (100%)

[Table/Fig-10]: Complications in both the groups.

Complications		Desflurane	Sevoflurane	
Secretions	No.	3	0	3
	%	10.0%	0.0%	5.0%
Bronchospasm	No.	1	0	1
	%	3.3%	0.0%	1.7%
Coughing	No.	0	1	1
	%	0.0%	3.3%	1.7%
No complication	No.	26	29	55
	%	86.7%	96.7%	91.7%
Total	No.	30	30	60
	%	100.0%	100.0%	100.0%

[Table/Fig-11]: Type of complications in both the group.

DISCUSSION

According to the present study, desflurane and sevoflurane had equivalent effects on the patients' haemodynamic stability. However, the emergence time in elderly patients was significantly shorter with desflurane compared to sevoflurane. This study focused on elderly patients undergoing robotic prostatectomy, as they make up the majority of patients in this procedure. Similar characteristics were found between desflurane and sevoflurane anaesthesia in geriatric patients regarding haemodynamic stability, early postoperative cognitive function, and recovery. However, a study by Cobanoglu H et al., concluded differently, stating that desflurane and sevoflurane anaesthesia in geriatric patients had similar characteristics [13].

In the present study, intraoperative haemodynamic parameters, including HR, SBP, DBP, and MAP, differed between the two groups at certain time intervals during anaesthesia, but they were maintained within 20% of baseline values in both groups. Similar findings were noted in studies conducted by Kaur A et al., Kavya M, and Wilhelm W et al., [12,14,15]. Kaur A et al., found that intraoperative haemodynamic parameters did not differ between the two groups and were successfully maintained within 20% of baseline values with both anaesthetics [12]. Nathason MH et al., also observed lower heart rate values in the sevoflurane group during the induction-to-incision period [16].

In the present study, the concentration of the inhalational drug was adjusted to maintain the BIS value between 40 and 60, ensuring that the patients remained on the same plane of anaesthesia and prevented awareness. By changing the doses of the inhalational agents based on the BIS value, the appropriate level of anaesthesia could be achieved. However, contrary to the findings of this study, studies by La Colla L et al., and Vallejo MC et al., used MAC equivalents for the two inhalational drugs [17,18]. Using MAC as a guide for titrating volatile anaesthetics can result in underdosing or overdosing of the medication. There are several confounding factors that can affect the MAC in individual patients. Instead of using MAC equivalent dosages, the authors of this study opted to use the BIS as a quantitative assessment of the sedative and hypnotic effects of inhaled anaesthetics, ensuring that adequate anaesthesia was achieved.

BIS readings between 40 and 60 are well correlated with clinical endpoints such as drowsiness and loss of consciousness, and they are relatively independent of the drug used. Using BIS not only speeds up recovery but also reduces associated costs and improves quality of life. A study by Punjasawadwong Y et al., had similar findings, concluding that maintaining a BIS within the recommended range (40 to 60) optimises anaesthesia delivery and postoperative recovery from deep anaesthesia [19].

Furthermore, BIS-guided anaesthesia has been shown to significantly reduce the incidence of intraoperative recall in high-risk surgical patients who are at risk of being awake during the procedure. BIS was found to reduce recovery times, such as time for eye opening, response to verbal command, extubation, and orientation. The use of BIS monitoring also reduces the amount of anaesthesia required for maintenance, regardless of whether intravenous or inhalational drugs are used [20]. Recovery from general anaesthesia should be as fast and thorough as possible for all patients. The process can be divided into three stages: early recovery, intermediate recovery, and late recovery. In elderly patients, recovery may be slower due to their slower metabolic rates. Prolonged exposure to volatile anaesthetics during these lengthy procedures can result in slower recovery for geriatric patients [20-22]. The present study findings regarding recovery characteristics align well with previous studies [12-15,22,23]. For example, Kaur A et al., concluded that desflurane anaesthesia is associated with faster emergence and recovery in morbidly obese patients [12]. Gangakhedkar GR and Monteiro JN observed that the early recovery profile of desflurane is superior to that of sevoflurane in patients undergoing laparoscopic cholecystectomy [23].

The present study found that patients in the desflurane group consistently opened their eyes spontaneously faster than those in the sevoflurane group. The mean time for eye opening (T1) was 13.10±11.88 minutes in the desflurane group compared to 19.11±8.52 minutes in the sevoflurane group, and the difference was statistically significant. The mean time for verbal response (T3) was 18.43 minutes in the desflurane group compared to 24.68 minutes in the sevoflurane group, indicating a significant difference between the two groups. These findings were consistent with a study by La Colla L et al., which reported faster recovery times in the desflurane group compared to the sevoflurane group [17]. Jindal R et al., also found significantly shorter recovery times in patients receiving desflurane compared to sevoflurane when studying maintenance and recovery characteristics [24]. Present findings align with these studies.

The mean time for spontaneous eye opening in the desflurane group was shorter than in the sevoflurane group. Similarly, the mean time for verbal response was shorter in the desflurane group compared to the sevoflurane group. These findings were supported by a study conducted by Kaur A et al., on morbidly obese patients undergoing bariatric surgery [12]. In that study, patients were observed after extubation to determine the time it took for them to reach a MAS of nine or higher. The results showed that more patients in the desflurane group achieved a MAS of nine or higher within five minutes of extubation compared to the sevoflurane group. Another study by Jindal R et al., demonstrated that the mean time to reach

a MAS of nine was significantly shorter in the desflurane group compared to the sevoflurane group [24].

During the procedure, only 5 out of 60 patients (8.3% of the total population) experienced complications related to the anaesthetic agents. It was found that a higher number of patients receiving desflurane had complications compared to those receiving sevoflurane, but this difference was not statistically significant. Eshima R also found that respiratory complications during maintenance anaesthesia using a laryngeal mask airway were minor and had a similar incidence for both desflurane and sevoflurane [25]. However, White PF et al., concluded that the risk of coughing during the perioperative phase was significantly higher in patients given desflurane [26]. These episodes of coughing were short-lived, did not cause laryngospasm or significant drops in oxygen saturation, and did not disrupt the surgical procedures. There was also no noticeable change in the frequency of postoperative sore throats.

Limitation(s)

First limitation of the present study was the small number of patients, which may affect the generalisability of the findings. Present research focused on the effects of desflurane and sevoflurane on haemodynamic stability and early recovery profiles, so late recovery period (psychomotor and qualitative recovery) or the potential for earlier discharge or economic benefits associated with faster early recovery using desflurane cannot be commented. These questions are beyond the scope of our expertise. Another limitation was the lack of blinding for both the researchers and participants regarding the administration of the study medications and the progress of early recovery. However, all patients underwent the same surgical procedures performed by the same surgeon and anaesthesiologist following the same guidelines for anaesthesia administration. The use of BIS data to titrate the volatile anaesthetic concentration minimised investigator bias. Recovery was evaluated using objective endpoints as a standard.

CONCLUSION(S)

The present study found a comparable difference in haemodynamic stability between desflurane and sevoflurane during anaesthesia for robotic prostatectomy. Desflurane led to faster recovery in the early postoperative period and minimal changes in haemodynamic parameters compared to sevoflurane. However, sevoflurane had fewer complications than desflurane. Future studies should explore the comparative assessment of other inhalational agents with a larger sample size and different types of robotic surgeries.

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PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Anaesthesia, Datta Meghe Medical College, Nagpur, Maharashtra, India.
2. Consultant, Department of Anaesthesia, Kokilaben Hospital, Mumbai, Maharashtra, India.
3. Consultant, Department of Anaesthesia, Kokilaben Hospital, Mumbai, Maharashtra, India.
4. Consultant, Department of Anaesthesia, Kingway Hospital, Nagpur, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Kirti Gujarkar,
Associate Professor, Department of Anaesthesia, Datta Meghe Medical College, Nagpur-440016, Maharashtra, India.
E-mail: kirti2686@yahoo.com

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