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A BIS-guided comparative study between Desflurane and Sevoflurane in patients undergoing laparoscopic surgeries under General Anaesthesia

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Abstract

Background: Inhalational anaesthetic agents like Desflurane and Sevoflurane are beneficial for early recovery after surgery, particularly in ambulatory procedures. The primary aim of this study was to compare the early recovery profiles of desflurane and sevoflurane in patients undergoing laparoscopic surgeries using a BIS monitor to assess the depth of anesthesia. **Material and Methods:** ASA I, II patients of 18-65 yrs. age undergoing laparoscopic surgeries were randomly allocated to received esflurane (n = 30) or sevoflurane (n = 30), using Bispectral Index System (BIS) to determine the depth of anesthesia. The study was conducted in Alluri Sitarama Raju Academy of Medical Sciences (ASRAM) over a period of one year, from February 2022 to January 2023. An in dependent adjudicator, who was blinded to the agent used, recorded the events during the recovery phase. The time required for spontaneous eye opening, response to painful stimuli, extubation, recall of name, and achievement of a modified Aldrete score of 9 were recorded. **Results:** The time required for an eye-opening and extubation was significantly shorter in the Desflurane group as compared to the Sevoflurane group [3.2 min ±0.71 versus6.13 min ±0.81, P = 0.001 and 5.7 min ± 0.81 versus9.3 min±1.2, P = 0.001]. A significantly higher mean modified Aldrete score was seen at extubation [9.6 min±0.81 vs 15.5 min ±1.54, P < 0.001] in the Desflurane group, which also achieved a modified Aldrete score of ≥9 significantly sooner [9.6 min ±0.81 vs 15.5 min ±1.54, P < 0.001] than the Sevoflurane group. The frequency of adverse effects was not significantly different in either of the groups. **Conclusion:** The usage of a BIS monitor reduces the incidence of intraoperative awareness, and also reduces the inhalational agent consumption by proper titration while maintaining BIS values of 40-60. Desflurane anesthesia enhances rapid emergence and recovery than sevoflurane anesthesia and facilitates early ambulation and discharge in laparoscopic surgeries.

Key Words: Bispectral Index, Desflurane, Sevoflurane, Laparoscopic Surgeries, Ambulatory Surgeries

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Introduction

Ambulatory surgeries contribute to a large proportion of all surgeries carried out nowadays because of the addition of rapid onset, short-acting anaesthetic agents with faster metabolism and availability of new minimally invasive surgical techniques [1].

These surgeries enable the patients to resume oral intake within a few hours of surgery, reduced medical costs, less postoperative pulmonary and cardio-vascular complications, and early ambulation at discharge.

Newer inhalational agents like Desflurane and Sevoflurane havelow blood gas partition coefficients (0.42 and 0.69 respectively) that facilitate erapid induction of anesthesia, precise control of end-tidal concentrations during maintenance of anaesthesia, and early recovery making them suitable for ambulatory anesthesia[2].

The measurement of anesthesia depth[3] is an unsolved problem because there is not yet a proper definition of the depth of anesthesia. Commonly used parameters like hemodynamic changes during anesthesia, skin incision response, or clinical signs like diaphoresis, and lacrimation do not correlate directly to the consciousness level and their limitations have been well documented.

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Hence a monitor that measures the physiological changes associated with an unconscious state during anesthesia would be an improvement over the conventional clinical methods. Such systems include Bispectral analysis of electroencephalogram and Entropy. The Bispectral index is used to interpret partial EEG recordings to predict the level of sedation and loss of consciousness in patients undergoing general anaesthesia[4].

Aim and Objectives

In this study, we aimed to compare the efficacy and recovery profiles of desflurane and sevoflurane in ambulatory surgeries and titration of inhalational agents to maintain adequate depth of anesthesia and early recovery by using the Bispectral index to prevent awareness and over-dosage of drugs[5].

Material and Method

Study Design and Area:a comparative clinical study conducted at Alluri Sitarama Raju Academy of Medical Sciences (ASRAM) in Eluru District, Andhra Pradesh

Study Population: The study population consisted of 60 ASA I & II patients, aged between 18 and 65 years posted for laparoscopic surgeries selected randomly.

They were allocated randomly into two groups of 30 each, by computer-generated randomization method. Group D (Desflurane 3-6%) and Group S (Sevoflurane 1-2%).

Exclusion criteria included ASA III & IV patients, patients who had a history of drug allergy or abuse, malignant hyperthermia, psychiatric disorders, and patient refusal.

The study was undertaken after obtaining ethical committee clearance as well as informed consent from all patients. All patients were examined on the day before surgery, & pre-anesthetic counselling was done.

Inside the operation theatre, the standard basic anestheticmonitors[6]- Pulse oximeter, Non-invasive blood pressure monitor (NIBP), and Electrocardiogram (ECG) were attached. A Bispectral index strip (BIS) was attached to the patient's forehead. Baseline Heart rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean arterial pressure, and BIS values were recorded before induction of anesthesia.

Intravenous line access was obtained with an 18/20 G cannula and crystalloid solution was started. All the patients were pre-medicated with Inj. Midazolam 0.05mg/kg IV, Inj. Glycopyrrolate 10µg/kg IV and Inj. Fentanyl 2µg/kg IV after pre-oxygenation with 100% O2 for 3-5 min. Anesthesia was with Inj Propofol 2 mg/kg IV, and neuromuscular blockade with Inj. Vecuronium 0.1mg/kg IV. The airway was secured with an appropriate size Endo Tracheal Tube after direct laryngoscopy and connected to the mechanical ventilator.

The Heart rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean arterial pressure (MAP), and BIS values seen at induction were recorded. Group D was maintained with Desflurane 3–6% and Group S with Sevoflurane 1–2% with 50% air in oxygen with the fresh gas flows at 2L/min. Ventilation was controlled to maintain End-tidal carbon dioxide ($EtCO_2$) between 30and 40mm Hg. The maintenance dose of the anaesthetic agents was titrated to maintain a Bispectral index [BIS] value of 40–60.[7]

Intra-operatively MAP was maintained within 20% of baseline values. Muscle relaxation was maintained using intermittent doses of Vecuronium 0.02mg/kg at appropriate intervals. Analgesia was provided with IV paracetamol 15 mg/kg BW 90 min, after intubation, and Inj. Ondansetron 0.1 mg/kg BW was given at the end of the surgery. The primary anesthetic was discontinued after the last skin suture. The Port site was infiltrated with 0.25% bupivacaine. A coinvestigator, who was not a part of the team that administered anesthesia, was called in after the agent was turned off so that he/she was blinded to the agent that was being used for the maintenance of anesthesia.

The neuro-muscular blockade was reversed with Inj. Neostigmine 0.05-0.07 mg/kg IV with Inj. Glycopyrrolate 0.01 mg/kg IV and the patient was extubated when regular spontaneous breathing pattern was re-established and when they can open their eyes on command.

The hemodynamic parameters (HR, SBP, DBP, MAP), and BIS values were recorded intraoperatively at induction, intubation, 1 min after intubation, and every 5min for the first 30 min after intubation, every 10 min till the end of surgery and at skin closure, dressing, reversal, and extubation. After extubation HR, MAP, and BIS values were recorded at 1, 3, 5 min, and every 5 min until the patient achieved a Modified Aldrete score of 9.

Recovery times were written down from the time of discontinuation of the inhalational agent. They include Times to spontaneous movement, responseo painful stimuli, extubation, recall of name, hand grip, achieving Modified Aldrete Score[8] of >9, and any untoward events, like nausea, vomiting, cough, and bronchospasm were also recorded. Patients were shifted to PACU after achieving a modified Aldrete score of 9 and nursed in a propped-up position.

Statistical Analysis

The information collected regarding all the cases was recorded in a Master sheet. Data analysis was done with the help of a computer using MS Excel, SPSS 22.0 (Trail version). Using this software, frequencies, percentage,

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range, mean, and standard deviation. Chi-test, ANOVA-test, and p-values were calculated. A p-value<0.05 is shown to have a significant relationship.

Results

In this study, on analyzing the demographic profile, the distribution of age and weight, and ASA physical status of the patients were comparable in Group D & Group S. (Table 1)

Table 1

Parameters	**Mean+/- SD**		**p Value**
	GROUP D	**GROUP S**	
Age	46.9±11.4	50.9±13.8	>0.05
Gender (M/F)	15/15	14/16	> 0.05
ASA (I/II)	20/10	22/8	> 0.05
Weight(kg)	59.1±5.61	61.5±5.07	>0.05
Duration of surgery	**87.0±9.0**	**89.7±5.9**	>0.05
BIS values at extubation	92.2±3.9	73.3±3.3	<0.05

There was no significant difference in the duration of surgery between the 2 groups.

There was a highly significant change in the BIS Values at the time of induction in Group D (49.8±2.5) compared to Group S (67.4±2.1) & also at the time of extubation. BIS values were significantly higher in Group D (92.2±3.9) compared to Group S (73.3±3.3). These differences were statistically significant between the 2 groups (p<0.01). The time to the spontaneous movement (min) in Group D was 3.2±0.71 in comparison to Group S which was 6.13±0.81 which was statistically significant. The time to respond to pain (min) was 4.5±0.89 in Group D and in Group S was 7.5 ± 1.01. The time to extubation (min) was 5.7 ± 0.81 in Group D in comparison to Group S which came to be 9.3±1.2 which was statistically significant (p < 0.001) (Table 2)

Table 2

Recovery Times	**Mean+/- SD**		**p Value**
	GROUP D	**GROUP S**	
Time to Spontaneous movement (Min)	3.2±0.71	6.13±0.81	0.001
Time to Response to Pain (Min)	4.5±0.89	7.5 ± 1.01	0.001
Time to Extubation (Min)	5.7 ± 0.81	9.3±1.2	0.001

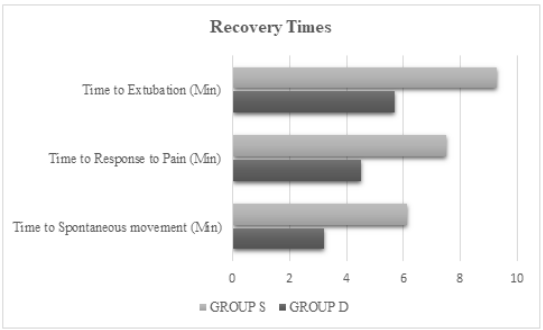

Figure 1

Patients from Group D needed 7.06 ±0.82 min for time to hand grip when compared to Group S who needed 11.23±1.25 min which was statistically significant. Patients in the desflurane group achieved MAS>9at (9.6 ±0.81 minutes) whereas the patients in the sevoflurane group were able to achieve it only after (15.5 ±1.54 minutes). This difference was statistically significant (p<0.05). (Table 3)

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Table 3

Recovery Times	Mean+/- SD		p Value
	GROUP D	GROUP S	
Time to Recall of Name (Min)	7.06 ±0.82	11.23±1.25	0.001
Time to Hand Grip (Min)	8.5 ±0.82	13.06 ±1.48	0.001
Time to Achieve MAS > 9 (Min)	9.6 ±0.81	15.5 ±1.54	0.001

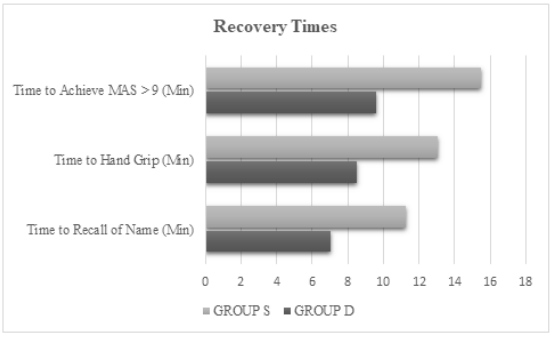

Figure 2

Discussion

Laparoscopic procedures are associated with minimum tissue damage and very little postoperative morbidity. Faster convalescence, reduced hospital stays, and faster return to normal activity are the most evident advantages of laparoscopic surgery.[9] Patients can potentially recover much earlier and be discharged from the care of the hospital. The pharmacokinetics of desflurane and sevoflurane favor better intraoperative control of anesthesia and a rapid postoperative recovery.[10,11] Theyhave significantly lower blood/gas partition coefficients than the other inhalational agents. The lower fat/bloodpartition coefficient of desflurane favours its early elimination from the body resulting in early recovery.[12] There are a few double-blind trials reported in the literature comparing desflurane and sevoflurane. Our randomized double-blinded study showed both statistically and clinicallythat the early recovery profile was better with desflurane than sevoflurane.[13]

Here in this study, we monitored the depth of anesthesia with a BIS monitor. There was a highly significant change in the BIS Values at the time of induction in Group D (49.8±2.5) compared to Group S (67.4±2.1). Also, at the time of extubation, BIS values were significantly higher in Group D (92.2±3.9)compared to Group S (73.3±3.3). These differences were statistically significant between the 2 groups ($p<0.01$)

Unlike the study conducted by Nathanson MH et al,[14] we found that the recovery times were even faster with desflurane compared to sevoflurane. This difference might be because they titrated the inhalational agents based on clinical methods rather than the depth of anesthesia monitors.

The results found by De Baerdemaeker *et al,*[15] had shown that eye-opening occurred earlier in obese patients anesthetized with desflurane as compared to sevoflurane. This difference was because, in their technique of emergence, mechanical ventilation was continued for2 min after the end of surgery and cessation of volatile anesthetic agent. If the patient was not spontaneously breathing, then 1 rescue breath would be administered every 30s. If a patient did not quickly resume spontaneous breathing, emergence would have been delayed by a decreased minute ventilation and alveolar washout of the anesthetic gas.

In contrast to the study conducted by Palak A Chudasama et al,the recovery times were faster in our study as the depth of anesthesia was titrated by a BIS monitor rather than clinical methods.[16,18]

Our study was comparable to the study conducted by Gauri R. Gangakedhkar *et al,*[12]where they compared the early recovery features of Desflurane (Group D- Desflurane 3- 6%) and sevoflurane (Group S-Sevoflurane 1-2%) in patients undergoing laparoscopic cholecystectomy using Bispectral Index system to determine the depth of anesthesia. The recovery times were comparable in both studies.[17,19,20]

Conclusion

We conclude that the usage of a BIS monitor reduces the incidence of intraoperative awareness, and also reduces the inhalational agent consumption by proper titration while maintaining BIS values of 40-60. Desflurane anesthesia enhances rapid emergence and recovery than sevoflurane anesthesia and facilitates early ambulation and discharge in laparoscopic surgeries.

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