

# Use of bispectral index monitoring to compare awareness during general anaesthesia: a comparison between isoflurane and sevoflurane

Archana Tripathi<sup>1</sup>, Amit Yadav<sup>2\*</sup>, Mukesh Somvanshi<sup>3</sup>

<sup>1</sup>Professor, <sup>2</sup>Postgraduate Student, <sup>3</sup>Associate Professor, Department of Anaesthesiology and Critical Care, Government Medical College and AG Hospitals, Kota-324001, Rajasthan, INDIA.

Email: [archutripathi@ymail.com](mailto:archutripathi@ymail.com), [dr.amit.yadav.4k4@gmail.com](mailto:dr.amit.yadav.4k4@gmail.com), [mukeshsomvanshi81@gmail.com](mailto:mukeshsomvanshi81@gmail.com)

## Abstract

**Background:** The present study was carried out to evaluate and monitor the awareness (depth of anaesthesia) during surgery at 1 MAC of isoflurane and sevoflurane with the help of BIS monitor and to assess which one is better in decreasing awareness with good haemodynamic stability during anaesthesia in patients undergoing various surgical procedures. **Method:** Fifty ASA physical status I-II patients, aged between 20 and 60 years of either sex were randomly divided to receive isoflurane (group I) or sevoflurane (group S) during maintenance of anaesthesia. Cardiovascular parameter and Bispectral index (BIS) scores were recorded at intervals throughout the procedure. The incidence of awareness recorded by modified Brice Questionnaire in postoperative period. The perioperative complications were also recorded. **Results:** At 1MAC the BIS score for isoflurane was significantly lower than sevoflurane during the maintenance of anaesthesia ( $P < 0.05$ ). Towards the end of anaesthesia (at time of skin closure) there was no significant difference (BIS isoflurane;  $73.72 \pm 1.45$ , BIS sevoflurane;  $74.16 \pm 1.17$ ). Heart rate and mean arterial pressure were comparable in both groups. On modified Brice Questionnaire, none of the patient had evidence of intra-operative awareness. **Conclusion:** We concluded that at equipotent concentrations of isoflurane and sevoflurane, both drugs provided adequate depth of anaesthesia during maintenance of anaesthesia, however isoflurane significantly lowered BIS score as compared to sevoflurane. With regard to haemodynamic stability, both drugs isoflurane and sevoflurane were comparable.

**Keywords:** Bispectral index, Isoflurane, Sevoflurane.

## \*Address for Correspondence:

Dr. Amit Yadav, Postgraduate Student, Department of Anaesthesiology and Critical Care, Government Medical College and AG Hospitals, Kota-324001, Rajasthan, INDIA.

Email: [dr.amit.yadav.4k4@gmail.com](mailto:dr.amit.yadav.4k4@gmail.com)

Received Date: 11/03/2015 Revised Date: 23/03/2015 Accepted Date: 26/03/2015

## Access this article online

Quick Response Code:	Website: <a href="http://www.statperson.com">www.statperson.com</a>
	DOI: 28 March 2015

## INTRODUCTION

Awareness can be defined as the subjective experience of external or internal stimuli and one's own existence in space and time at any given moment<sup>1-2</sup>. Awareness during general anaesthesia is undesired, unanticipated patient wakefulness during surgery or recall afterward.

The incidence of awareness under anaesthesia is probably underestimated because very often conscious recall is taken, as evidence. The incidence of intraoperative awareness has been reported to be 0.2-1% but it may be as high as 40% in high risk situations like trauma, caesarean sections and during cardiac surgery<sup>3-4</sup>. During the last decade, an increasing number of monitoring systems have been designed to estimate the depth of anaesthesia. One of these systems is the bispectral index (BIS) monitor. BIS offers advantage over several technologies used to monitor depth of anaesthesia. Use of the BIS monitor is thought to reduce the incidence of intra-operative awareness during anaesthesia.<sup>5-6</sup> Thus the present study was designed to compare awareness during general anaesthesia at 1MAC of isoflurane or sevoflurane by using BIS, in patients undergoing various elective surgical procedures.

## MATERIAL AND METHODS

After Hospital’s ethical committee’s approval and written informed consent from the patient’s attendant, the present study was conducted on fifty patients of ASA grade I -II, aged 20-60 years of either sex, who were operated for various elective surgical procedures under general anaesthesia. Patient who have known allergy from study drugs, patients with history of DM, hypertension, ischaemic heart disease, aortic stenosis, left ventricular failure and atrio-ventricular conduction block, severe CAD, respiratory problems and patients concomitantly taking methyl dopa, beta blocking drugs, benzodiazepines, psychotropic drugs and MAO inhibitors were excluded from study. The selected patients will be randomly divided into two groups of 25 patients each to receive isoflurane (Group I) or sevoflurane (Group S) for maintenance of anaesthesia. A thorough preoperative check-up including general and systemic examination and routine laboratory investigations were done. On arrival in O.T., an intravenous cannulation was secured and all patients were premedicated with midazolam 0.02 mg/kg, glycopyrrolate 0.004mg/kg and pantazocin 0.6mg/kg. Leads II of an electrocardiogram and saturation via pulse oximetry (SpO<sub>2</sub>) were continuously monitored. An automated blood pressure cuff was applied to the right arm to check blood pressure. To ensure uniform conditions, the same monitoring equipments were used in all patients. Before anaesthetic induction, electrodes for BIS (BISTM monitor 2000, Aspect Medical System, USA) were placed on the forehead. The electrodes used were disposable BIS –QUATRO Sensor strips (Aspect Medical System, USA). After preoxygenation with 100% oxygen for three minutes, anaesthesia was induced with propofol 2.5 mg / kg and succinylcholine 1.5 mg/ kg was given to facilitate tracheal intubation. All patients were ventilated mechanically with a tidal volume of 10 ml/kg at a fixed respiratory rate 12 breath/min and anaesthesia was maintained with 1 MAC of isoflurane or sevoflurane and 66 % N<sub>2</sub>O in O<sub>2</sub>. The patients were left undisturbed for an additional 5 minutes for cardiovascular parameters and BIS recordings. After completion of surgery, residual neuromuscular blockade was reversed with standard reversal technique i.e. neostigmine 0.05 mg/ kg and glycopyrrolate 0.01 mg/kg intravenously. Haemodynamics and BIS score were monitored preoperatively just before induction and considered as basal values. BIS score along with haemodynamics were monitored intraoperatively after induction at every 5 min during surgery up to 60 min and at the time of skin closure. Postoperative haemodynamics were noted at 5, 10 and 15 min after extubation. Complications like bradycardia, tachycardia, hypertension, hypotension, and arrhythmia were recorded and managed accordingly. All

patients were interviewed for recall half an hour postextubation and on the first postoperative day by modified Brice Questionnaire. Statistical analysis was done using Chi-square test for non-continuous variables and unpaired *t*-test for continuous variables. A *p*<0.05 was considered statistically significant

## RESULTS

The two study groups were comparable with respect to the number of participants, age, weight, gender and duration of surgery [Table 1]. BIS score was observed between 40 and 60 during maintenance of anaesthesia in both groups and it was significantly lower in isoflurane group compared to sevoflurane group (*P*<0.05). However, towards the end of anaesthesia (at the time of skin closure) BIS score did not differ between isoflurane and sevoflurane groups [Table 2]. There was no significant difference in heart rate and mean arterial pressure (MAP) during the maintenance of anaesthesia between the two groups (*P*>0.05) [Fig 1, 2]. On modified Brice Questionnaire, none of the patient in either group had given evidence of having explicit memory. No complications were recorded in any group.

**Table 1:** Demographic profile and duration of surgery

Category	Group I (mean ±SD)	Group S (mean ±SD)
Number (n)	25	25
Age (years)	39.88±13.14	42.96±14.07
Weight (kg)	67.16±7.99	63.92±7.33
Sex (male/female)	4/21	10/15
Duration of surgery (min.)	73±12.07	72.6±11.28

**Table 2:** BIS Score (mean ±SD)

Time	Group I	Group S
Before induction	97.44±1.52	98.24±1.23
After induction at 0 min.	61.72±2.44	67.08±1.8
5 min.	52.28±2.52	57.37±2.19*
10 min.	7.64±1.97	53.8±1.91*
15 min.	45.32±2.07	52.28±1.94*
20 min.	44.4±1.32	50.88±1.53*
25 min.	43.8±1.44	49.8±1.19*
30 min.	42.16±0.98	49.16±1.21*
35 min.	41.12±1.53	49.04±1.51*
40 min.	41±1.87	49.52±1.26*
45 min.	40.92±2.34	50.32±1.57*
50 min.	42.76±2.33	49.84±1.31*
55 min.	43.16±1.9	50.04±1.24*
60 min.	44.68±1.37	49.64±1.31*
At the time of skin closure	73.72±1.45	74.16±1.17

\**P*<0.05, Group I vs S

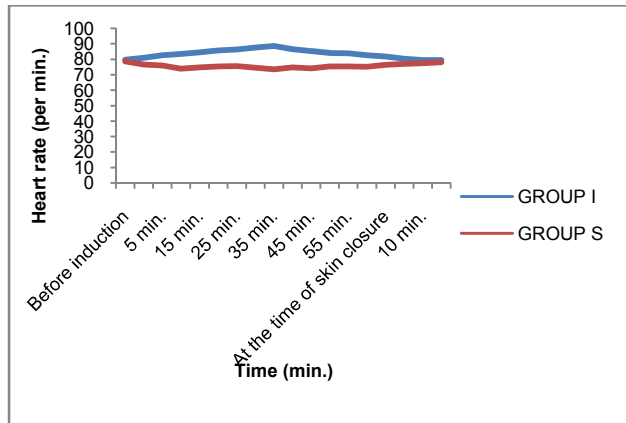


Figure 1: Heart Rate

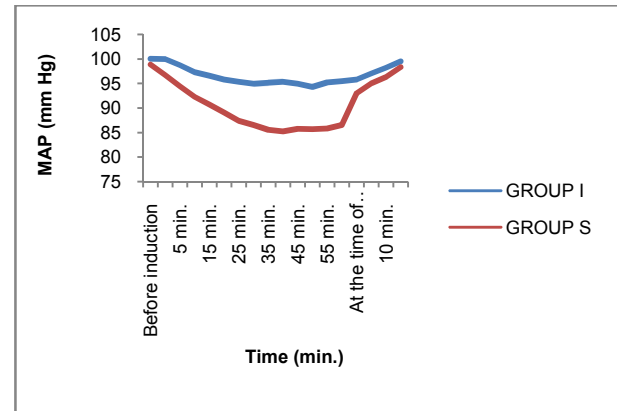


Figure 2: Mean Arterial Pressure

## DISCUSSION

One of the objectives of modern anaesthesia is to ensure adequate depth of anaesthesia to prevent awareness without inadvertently overloading the patient with potent drugs. One of the achievements of modern anaesthesia is the ability to monitor the depth of anaesthesia. The Bispectral Index (BIS) is a derived parameter from the scalp electroencephalogram used for monitoring the level of consciousness during administration of anaesthetics and hypnotics. BIS has been shown to correlate well with anaesthetic depth for a number of agents. Recovery of consciousness during general anaesthesia without any recall (in the absence of surgical stimulus) has generally been associated with BIS values 60. BIS values in a range of 40-60 have been proposed for producing adequate degree of hypnosis during anaesthesia and when appropriately used, BIS can be useful for reducing the risk of intraoperative awareness. There have been studies comparing the effects of equipotent concentrations of isoflurane and halothane<sup>7-9</sup> and sevoflurane and halothane<sup>10,11</sup> on BIS, where isoflurane and sevoflurane had a greater decrement in the BIS scores but there are very few studies comparing the effects of isoflurane and sevoflurane on EEG, which are mostly related to EEG spike activity during sevoflurane anaesthesia.<sup>12</sup> Thus we undertook this study to compare the effects of equipotent concentrations of isoflurane and sevoflurane on BIS and to evaluate and monitor the awareness (depth of anaesthesia) during general anaesthesia at 1 MAC of isoflurane and sevoflurane with the help of BIS monitor. The results of our study showed that at 1 MAC concentration of isoflurane and sevoflurane, BIS scores decreased significantly in both groups during intraoperative period and maximum fall in BIS score was noted in patients who received isoflurane anaesthesia. This observation is probably consistent with the greater metabolic suppression caused by isoflurane and also its ability to produce a higher degree of brain electrical activity suppression.<sup>13</sup> Mean BIS score at the time of

skin closure (towards the end of anaesthesia) was comparable in both groups and statistically not significant. For adequate depth of anaesthesia, a BIS score from 40 to 60 is recommended. In our study, we found that at 1 MAC concentration of isoflurane or sevoflurane, a BIS score <50 was achieved which was more than enough for adequate depth of anaesthesia. This finding is consistent with the fact that titration of the dose of anaesthetic given by monitoring BIS reduces the amount of drug administered.<sup>14, 15</sup> In present study, compared to sevoflurane anaesthesia, we found a rise in heart rate with isoflurane during maintenance of anaesthesia. The observed rise in heart rate in isoflurane group might be due to preserved baroreceptor reflex during isoflurane anaesthesia. No episode of bradycardia was recorded in any of the patient. We also found that MAP was significantly lower in sevoflurane group compared to isoflurane group. Within group comparison also revealed a significant fall in MAP in both the groups compared to baseline values. This was due to decrease in peripheral vascular resistance. However, in both the groups, none of the patient was administered vasopressor as fall in blood pressure was not more than 20% of basal values in both groups. These results suggest that patients were remained haemodynamically stable during the study period in both the groups. Frink EJ *et al*<sup>16</sup> in their comparison of sevoflurane and isoflurane, did not find any difference in arterial blood pressure from baseline values during maintenance of anaesthesia. We did not observe any complication during intraoperative as well as postoperative period. None of the patient in either group gave evidence of awareness during intraoperative period, when they were assessed in postoperative period with modified Brice Questionnaire in postoperative period.

## CONCLUSION

Thus we concluded that at equipotent concentrations of isoflurane and sevoflurane, both drugs provided adequate depth of anaesthesia during maintenance of anaesthesia,

however isoflurane significantly lowered BIS score as compared to sevoflurane. This also suggests that 1 MAC concentration of isoflurane or sevoflurane is sufficient to prevent intraoperative awareness. With regard to haemodynamic stability, both drugs isoflurane and sevoflurane were comparable. The cost of using this monitor in every patient needs consideration. It would be preferable to use BIS in high risk cases where the incidence of awareness is very high, to prevent potential complication of post traumatic stress disorder.

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Source of Support: None Declared  
Conflict of Interest: None Declared