ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 12 | December - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARISON OF ANAESTHETIC CONSUMPTION AND AWARENESS USING BI-SPECTRAL INDEX AND ENTROPY AS ANAESTHETIC DEPTH MONITORS - A SINGLE-BLINDED RANDOMISED CONTROL TRIAL

Anaesthesiology

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ABSTRACT

Background: Depth of anesthesia monitoring may be used to prevent excessively deep anesthesia. Several studies have reported that bi-spectral index (BIS) and entropy monitoring is associated with lower anesthetic requirement with both intravenous and volatile agents. Hence the present study was undertaken to compare the anaesthetic requirement in patients undergoing general anaesthesia using the BIS and entropy for depth of anaesthesia monitoring and detection of awareness postoperatively. **Method:** Study population consisted of 86 patients of either sex, ASA grade I or II, age between 18-60 years scheduled for various elective general surgeries with endotracheal intubation. Patients were induced with standard anaesthetic drugs and anaesthesia was maintained with sevoflurane or desflurane. BIS and Entropy values were maintenance between 40-60 intraoperatively and anaesthetic drugs were titrated to maintain this required anaesthetic depth. Post-operatively all patients were interviewed using modified Brice questionnaire for detection any awareness or recall. **Results:** The mean consumption of anaesthetic agent in BIS group was 37.99 ml and in Entropy group was 35.52 ml. Consumption of sevoflurane or desflurane were similar in both the groups. Mean BIS value in BIS group was 46.88 and mean Entropy value in Entropy group was 46.19, which was not statistically significant. There was no incidence of awareness post-extubation, while using BIS/Entropy for monitoring depth of anaesthesia. **Conclusion:** Thus, BIS/Entropy monitors are a good tool for maintaining adequate anaesthetic depth intraoperatively and to prevent awareness in patients undergoing general anaesthesia.

KEYWORDS

Bi-Spectral index; Entropy; Anaesthesia; Awareness; Endotracheal intubation; Sevoflurane, Desflurane

INTRODUCTION

The term anaesthesia depth dates back to time when general anaesthesia was administered with single drug. In recent times the concept of balanced anaesthesia has taken over the anaesthesiology field where the by different group of drugs and each of the different mechanism of action and pharmacological effects are used. This makes difficult to define the concept of anaesthetic depth. According to American society of anaesthesiologists' task force the depth of anaesthesia refers to 'a progressive CNS depression and decreased responsiveness to stimulation' [1, 2].

To assess the anaesthetic depth several clinical signs and responses to stimulation has been incorporated in the many clinical scores. The classic triad of anaesthesia hypnosis, analgesia and muscle relaxation may not follow the current concept of balanced general anaesthesia. One of the primary aim of balanced anaesthesia is to maintain the adequate depth of anaesthesia, so as to prevent the intraoperative awareness without the risk of overloading of potent anaesthetic drugs [3]. Anaesthetic depth is difficult to maintain in surgeries which are done under monitored anaesthesia care and in total intravenous anaesthesia. But cases which are done under general anaesthesia with muscle relaxation we have few new monitors which will help in monitoring the anaesthetic depth intraoperatively and prevent the advert extra doses of potent anaesthetic drug one such monitors are Bispectral index and Entropy. Several studies have reported that BIS monitoring is associated with lower anesthetic requirement with both intravenous [4-6] and volatile agents [7, 8]; and similar findings have also been reported with Entropy and with AEP monitoring [9, 10].

In modern day we have many potent anaesthetic drugs like propofol, thiopentone, muscle relaxants, dexmeditomedine, volatile anaesthetic agents which administered can be reduced if proper intraoperative monitoring of the depth of anaesthesia is done and reduce the usage of drug and also the cost of anaesthesia.

MATERIALS AND METHODS

After the approval of the departmental review board and the Institutional Ethics Committee (IEC), this study was conducted in 86 patients of ASA Class I and II, aged >18 years and <60 years, who can communicate well and undergoing elective surgery under general anesthesia with endotracheal intubation were enrolled in the study. Patient with psychiatric disorder, severe systemic illness like cardiac, respiratory and hepatic disease, epileptic patients, pregnant women and patients who have undergone surgery previously under general anaesthesia were excluded from the study.

Routine pre anaesthetic check-up and standard NPO guidelines were followed. Randomisation was done using coloured chits. The patient choosing blue chit was allotted to group BIS (43 patients) and patient choosing yellow chit was taken to group entropy (43 patients). After taking patient into operation theatre, standard basic monitors were attached and baseline parameters of pulse oximetry, electrocardiograpm, non-invasive blood pressure, end tidal carbon dioxide and temperature were noted. BIS or ENTROPY monitoring strips were attached to patient's forehead of respective group. Intravenous access was secured and preoxygenation was done for 3 mins and induced with intravenous induction agents like propofol/etomidate and muscle relaxants like rocuronium/vecuronium and anaesthesia was maintained with volatile anaesthetic agent either Sevoflurane or Desflurane depending on the clinician preference and dexmeditomedine/ propofol was used in appropriate doses as boluses/infusion to maintain normal hemodynamics. Patients BIS value or Entropy value was maintained between 40-60 and anaesthetic drugs were titrated to maintain the required depth. BI-Spectral index was monitored in Mindray anaesthesia workstation A7 and Entropy was monitored usin GE, Datex-ohmeda Entropy module. During surgery hypotension and other complications were treated with fluids and appropriate drugs and without altering the BIS/ Entropy values. Continuous haemodynamic monitoring was done throughout the surgery. Post-surgery after surgical dressing, reversal of neuromuscular blockade was done with neostigmine and patient was extubated and shifted to recovery.

At the end of surgery total amount of volatile anaesthetic agent consumed in ml and other drugs consumed were noted and entered in the case record form (CRF). Also, time taken to extubate the patient and time taken to open the eyes were noted.

Postoperatively all the patients were interviewed using Modified Brice awareness questionnaire in the wards to determine any awareness episodes and responses were noted down in CRF.
The questionnaire contained following questions.

1. What is the last thing u remember before going to sleep?
2. What is the first thing you remember after waking up?
3. Do you remember anything between going to sleep and waking up?
4. Did you dream during your procedure?
5. Were your dreams disturbing to you?
6. What was the worst thing about your operation?

Statistical Analysis

The data were analyzed using SPSS (Statistical package for social science) version 22. Statistical measures for nominal and numerical data were calculated by frequency, percentages, mean, standard deviation, Chronbach alpha coefficient, Mann-Whitney Test of differences and Chi square test in all quantitative variables under study due to the group type (Entropy Group and BIS group). Statistical significance was defined as P-Value less than 0.05.

RESULTS

A total of 86 patients were enrolled in the study and were divided into group BIS, n=43 patients who had BIS-monitoring and group entropy, n=43 patients who had Entropy monitoring. Both the groups were comparable and found no significant difference with respect to demographic profile of the patients and duration of surgery. However, the consumption of sevoflurane or desflurane as well as consumption of dexmeditomedine or propofol were similar in both the groups, (Table 1).

Table 1: Demographic profile of the patients, duration of surgery, Anaesthetic and another agent used

Demographic data		BIS Group	Entropy Group	P value
Age in Years	18-30	07	07	0.331
	31-40	10	17	
	41-50	20	14	
	51-60	06	02	
	Mean ± SD	40.5±9.55	38.16±8.25	
Weight (kg)	Mean ± SD	66.128±6.75	66.419±5.70	0.831
Gender	Male	33	33	1
	Female	10	10	
ASA	I	34	34	1
	II	09	09	
Duration of surgery		104.42±12.20	101.16±11.38	0.204
Anaesthetic Agent use	Desflurane	11	10	0.802
	Sevoflurane	32	33	
Another Agent used	Dexmeditomedine	05	05	1
	propofol	05	05	

The study observed that sevoflurane total consumption was similar in both group (BIS group 31.6±5.9 Vs Entropy group 31.3±3, (p=0.874). Whereas desflurane total consumption was slightly lower in entropy group as compared with BIS group but no statistical difference was observed, (p=0.107). We normalized the value of sevoflurane and desflurane consumption with duration of surgery, patient's weight and time of surgery, no statistically significant difference was observed in both the groups. Also, no difference observed in drug consumption between other drugs used even after normalization duration of surgery and weight of participant as shown in table 2.

Table 2: Comparison of anesthetic consumption in both the groups

Anesthetic consumption		BIS group	Entropy Group	p Value
Desflurane consumption	ml	56.50±11.26	49.15±8.22	0.107
	ml per kg	0.81± 0.16	0.729±0.136	0.241
	ml per min	0.53±0.14	0.481±0.86	0.339
	ml per kg per min	0.007± 0.0	0.007 ± 0.0	0.552
Sevoflurane consumption	ml	31.625±5.97	31.39±3.33	0.874
	ml per kg	0.49±0.08	0.47±.061	0.541
	ml per min	0.30±0.04	0.31±.018	0.589
	ml per kg per min	0.004±0.0	0.004±0.0	0.871
Other agents used		BIS group	Entropy Group	p Value
Propofol	ml/kg	0.504±0.175	0.593±0.139	0.399
	ml/min	0.318±0.088	0.357±0.086	0.507
	ml/kg/min	0.004±0.0012	0.005±0.0009	0.377
Dexmedito medine	ml/kg	0.593±0.159	0.545±0.145	0.629
	ml/min	0.358±0.102	0.356±0.097	0.982
	ml/kg/min	0.0049±0.001	0.0054±0.001	0.560

In both group no statistical difference was observed in total amount of consumption of volatile agents, mean BIS values, mean Entropy values in each group and time taken to open eyes after extubation.

Except for time taken to extubate after surgical dressing (p Value= 0.002), (Table 3).

Table 3: Comparison of various parameters in both the groups

Parameters	BIS group	Entropy Group	p Value
Amount of consumption in (ml)	37.988±13.30	35.523±8.97	0.371
Mean BIS/ Entropy value	46.88±3.60	46.19±3.224	0.347
Time taken to extubate after surgical dressing in minutes	12.535±1.04	11.802±1.10	0.002
Time taken to open eyes after extubation in minutes	14.302±3.07	14.186±0.98	0.814

Postoperatively all the patients were interviewed with modified Brice questionnaire for detection of awareness. None of the patients of either of the group recalled any intraoperative event or had any postoperative recall. Thus, no case of awareness was reported in the BIS-guided group as well as in Entropy Group, (Table 4).

Table 4: Showing responses to questionnaire

Group		BIS group	Entropy Group	p Value
What is the last thing you remember before going to sleep?	Yes	00	00	*
	No recall	43	43	
What is the first thing you remember after waking up?	Yes	00	00	*
	No recall	43	43	
Do you remember anything between going to sleep and waking up?	Yes	00	00	*
	No recall	43	43	
Did you dream during your procedure?	Yes	00	00	*
	No	43	43	
Were your dreams disturbing you?	Yes	00	00	*
	No	43	43	
What was the worst thing about your operation?	Yes	00	00	*
	No recall	43	43	
Incidence of Awareness	Yes	43	43	*
	No	00	00	

DISCUSSION

Anaesthetic depth has conventionally been measured by the observation of heart rate, blood pressure, breathing pattern, and the presence or absence of movements. Patients can experience intraoperative awareness in the absence of any clinical signs of light anaesthesia, such as changes in heart rate, blood pressure, or even movement and has been the object of research for many years. Electroencephalography (EEG) is a non-invasive monitoring of continuous cerebral activity. Many anaesthetic drugs produce characteristic effects on the EEG, and these have been extensively studied. However, efforts to use EEG monitoring as a real time clinical tool were not successful until relatively recently. The development of relatively inexpensive, fast microcomputers was critical for this purpose. BIS and Entropy were one such monitors which help in monitoring depth of anaesthesia conventionally [11].

In the present study, in both group no statistical difference was observed in gender, ASA grade, Age, weight of participant, agent used for anesthesia Sevoflurane (BIS Group 32 vs Entropy group 33) and Desflurane (BIS Group 11 vs Entropy Group 10), duration of surgery, total amount of consumption of volatile agents, mean BIS values, mean Entropy values in each group and time taken to open eyes after extubation. Except for time taken to extubate after surgical dressing (p Value= 0.002). These findings are comparable with the study conducted by Guignard et al [12] and Aime's, I et al [13].

Alkaissi A et al study states that BIS guided general anaesthesia decreases the consumption of inhalational anaesthesia [14]. Current study is in line with this study saying intraoperative anaesthetic consumption can be reduced by intraoperative BIS/Entropy monitored anaesthesia care. Akkuri A et al showed in their study that consumption of Propofol was lower in BIS monitoring patients than with the routine care during general anaesthesia [15]. Present study showed that there was no significant difference in Propofol consumption in both BIS monitored and Entropy monitored group.

All patients were monitored using BIS or Entropy for anesthetic depth maintenance intraoperatively. Intraoperatively anesthetic depth was maintained between 40-60. None of the patient had value more than 60 or less than 40. Mean BIS value in BIS group was 46.88 and mean Entropy value in Entropy group was 46.19, there were no statistically significant difference among the values in both the group. Similar findings are reported in Guignard et al [12] and Aime's, I et al [13].

There was no incidence of awareness post-extubation, while using BIS or Entropy for monitoring depth of anaesthesia. Hence BIS/Entropy monitors are a good tool for maintaining adequate anaesthetic depth intraoperatively and to prevent awareness. This result is consistent with study done by Zhang C et al, where BIS group showed less incidence of awareness than the control group (4 vs 15). They concluded that BIS guided TIVA decrease the risk of awareness

compared to routine TIVA [16]. Present study was also in comparison with Samuelson et al [17] and Myles PS et al where they found that BIS guided anaesthesia care reduced the risk of awareness in adults undergoing surgery under general anaesthesia [18].

CONCLUSION

There was no change in the consumption anaesthetic drug when anaesthetic depth was monitored and maintained using Bi-Spectral index or Entropy hence both these monitors can be used for depth of anaesthesia monitoring intraoperatively. Also, these monitors can be used to prevent awareness in patients undergoing general anaesthesia. The extra cost of using this monitor in every patient needs consideration. It would be preferable to use BIS/Entropy monitors 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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