Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 04, 2024

To Study the Clinical Effectiveness of the Bispectral Index (BIS) in Elective Surgical Patient under General Anasethiesia - A Prospective Randomized Study

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Received: 11-01-2024 / Revised: 15-01-2024 / Accepted: 16-02-2024

ABSTRACT

BACKGROUND

This study was conducted to investigate the therapeutic efficacy of the BIS (Bispectral Index) in patients undergoing elective surgery while sedated generally.

METHODS

This was a hospital-based prospective randomised study conducted among 60 patients with American Society of Anaesthesiologists [ASA] physical status I-II who were scheduled for various types of elective surgery under general anaesthesia at ACSRGMC, Nellore, following receipt of the study participants' signed informed consent and approval from the institutional ethics committee.

RESULTS

The study found statistical significance in the differences in inspired anaesthetic concentration between the two groups, as well as induction agent levels in the various groups (BIS and routine care). Both the variance in fentanyl and sevoflurane doses as well as the difference in end-tidal sevoflurane concentration were statistically significant between the two groups. Differences in intraoperative physiological variables between the two groups studied (BIS and routine care group), and the intraoperative jerking was statistically significant. The difference in the amount of time needed for phonation was statistically significant in study group differences in anaesthesia management time variables (BIS and routine care). In fact, there was a significant statistical difference between the research groups' perceptions of pain and nausea (the normal care group and the BIS group). The time needed for PACU discharge in the two groups was statistically significant, as evidenced by differences in recovery times, discharge criteria scores, and time to discharge by study group (BIS Group and regular care group). In the pre-operative RR, there was a significant statistical difference between these groups studied (BIS and RC). Between the BIS and RC groups, there were statistically significant variations in SAT at the

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various stages of the processes. Significant statistical differences were noted in awareness measurement within the RC and BIS groups.

CONCLUSION

Compared to normal therapy, the likelihood of awareness was lower with BIS-guided anaesthesia (BIS maintained at 40–60). Moreover, BIS monitoring shortens the time needed for PACU discharge and reduces the requirement for inhaled anaesthetics.

KEYWORDS

Bispectral Index (BIS), Elective Surgical, General Anaesthesia.

INTRODUCTION

The profundity of anaesthesia in individuals receiving inhaled GA can be measured using end-tidal (exhalation) anaesthetic gas concentrations. Clinical observation is not a reliable measure of anaesthetic depth. In order to provide a measure of consciousness, the method known as electroencephalography (EEG) was created to track and analyse electrical activity in the brain. The majority of EEG equipment acquires and interprets raw data from sensors attached to the patient's forehead. The anaesthetist can measure the depth of consciousness by looking at the numerical output on a monitor. The Bispectral index is another one of those EEG devices (BIS) (Todd,[1] 1998, O'Connor,[2] 2001, Kalkman,[3] 2002).

Aims and Objectives

- The aim of this study is to evaluate the therapeutic efficacy of BIS monitoring in lowering consciousness in adult patients undergoing general anesthesia, as well as its impact on hemodynamic parameters, medication consumption, recovery durations, and end-tidal volatile anesthetic concentrations.
- To assess whether introducing BIS into clinical practice for anaesthetic management minimizes the risk of intraoperative awareness and recollection in surgical patients receiving general anaesthesia.
- To investigate if BIS monitoring for patients receiving general anaesthesia reduces medication consumption, recovery time, and end-tidal inhalational anaesthetic concentration.
- To determine whether BIS monitoring poses any risk or harm to patients having general anaesthesia.
- To make a comparison between the BIS and RC groups.

METHODS

This was a hospital-based prospective randomized study conducted among 60 patients with American Society of Anaesthesiologists [ASA] physical status I-II who were scheduled for various types of elective surgery under general anaesthesia at ACSRGMC, Nellore, following receipt of the study participants' signed informed consent and approval from the institutional ethics committee.

Inclusion Criteria

- Aged between 18 and 60 years
- Surgeries under general anaesthesia
- Different types of elective surgery
- General anaesthesia

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Exclusion Criteria

- Other fever causes with normal platelets and when NS1 antigen and IgM dengue antibodies are negative, such as malaria, brucella, leptospira, enteric fever, drug-induced fever, viral fever, and rickettsial fever.
- Prior history of respiratory, hepatic, renal, hematological, and neurological problems, as well as heart failure and arrhythmias.
- Age < 16 years.

Statistical Methods

SPSS programme 21 was used to conduct the statistical analyses. The size of the study needed to establish that monitoring using BIS diminishes intraoperative consciousness was determined using statistical power analysis.

RESULTS

Induction Agent	Routine Care Group (N=30)	BIS Group (N=30)	P-Value
Propofol mg	229.5±60.3	274.09±710.5	0.7332
Midazolam mg	1.18±0.407	1.5±0.9	0.08
Fentanyl (mcg)	77.78±40.52	115.58±94.12	0.048*
Sevoflurane Inspired Concentration	0.028±0.009 (0.011-0.04)	0.024±0.013 (0.0-0.07)	0.043*
IV Anaesthetic Agents Mean Dose (mg)	221.00±56.131	260.49±243.61	0.3916
Mean Dose of Inhaled Anaesthetic Agents	0.028±0.006 (0.012-0.04)	0.024±0.008 (0.01-0.035)	0.0324*
Sevoflurane End Tidal Concentration %	0.056±0.09 (0.008-0.9)	0.019±0.012 (0.006-0.06)	0.029*
Induction Agent Levels in the Different Groups that has been Studied (BIS and Routine Care)			
Variable	**Categories**	**Routine Care Group (N=30)**	**BIS Group (N=30)**	**P-Value**
Intraoperative Sweating	No	30 (100%)	26 (86.7%)	0.296
	Yes	0 (0%)	4 (13.3%)	
Intraoperative Lacrimation	No	25 (83.3%)	25 (83.3%)	0.686
	Yes	5 (16.7%)	5 (16.7%)	
Pupillary Dilatation	No	29 (96.7%)	26 (86.7%)	0.553
	Yes	1 (3.3%)	3 (13.3%)	
Intraoperative Coughing	No	29 (96.7%)	29 (96.7%)	0.313
	Yes	1 (3.3%)	1 (3.3%)	
Intraoperative Jerking	No	21 (70.0%)	27 (90.0%)	0.037*
	Yes	9 (30.0%)	3 (10.0%)	
Differences in Intraoperative Physiological Variables between the 2 Groups Studied (BIS and Routine Care group)				
Table 1				

There is a statistically significant difference in the inspired concentration of the anesthetic between the two experimental groups. The p-value for the BIS group was 0.043, whereas the mean value for the routine care group was 0.0282, which was later lowered to

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0.024 percent. According to the results, there was a statistically significant difference in the mean dosages of inhaled anesthetic medicines between the two groups. The normal care group had a mean value of 0.023 percent, while the BIS group had a mean value of 0.025 percent.

With a mean value of 0.018 and 0.054, respectively, and a p-value of 0.004, the end-tidal sevoflurane concentration was statistically significantly different between BIS and routine care. There was a p-value of 0.023 for the BIS group and 0.028 for the normal care group, indicating a statistically significant difference in sevoflurane dosage between the two groups. A p-value of 0.035 indicated that the mean fentanyl dosage difference between the two groups-115.56 for the BIS group and 77.76 for the normal care group-was statistically significant.

According to a chi-square test, the intraoperative jerking percentage dropped from 30.0 percent in the RC group to 10.0 percent in the BIS group, with a p-value of 0.037. Neither the two groups nor the other factors that were considered showed a statistically significant difference.

Variable	Routine Care Group (N=30)	BIS Group (N=30)	P-Value
Time of surgery (minutes)	73.9±85.6	116.3±106.3	0.094
Length of procedure (minutes)	76.6±84.3	124.2±124.4	0.207
Duration of eye opening from stoppage of inhalational agents (minutes)	7.87±5.83	5.89±3.462	0.1152
Time taken for responding to commands(minutes)	10.04±5.325	8.17±4.506	0.1474
Time taken for opening eye (either for command or spontaneous) (minutes)	10.82±5.956	8.23±4.834	0.07
Time taken for first movement response (minutes)	7.68±6.04	5.33±3.877	0.08
Time taken for phonation (minutes)	12.90±4.21	10.7±2.13	0.012*
Time taken for extubation (minutes)	8.65±4.778	7.21±4.101	0.216
Study Group Differences in Anaesthesia Management Time Variables (BIS and Routine Care)			
Variables	**Categories**	**Routine Care Group (N=30)**	**BIS Group (N=30)**	**P-Value**
Nausea (Y/N)	No nausea	30(100%)	30(100%)	-----
Pain score	No Pain	20(66.7%)	20(66.7%)	0.011*
0 denotes no pain	Mild	8(26.7%)	0(0%)	
1-3 denotes Mild pain	Moderate	2(6.6%)	10(33.3%)	
4-6 denotes Moderate pain	Severe	0(0%)	0(0%)	
7-8 denotes Severe pain	Very Severe	0(0%)	0(0%)	
9 denotes Very Severe pain	Worse	0	0	
10 denotes Worse pain Possible	Possible	0	0	
Variations in Pain and Nausea between Study Groups (Routine Care Group and BIS Group)				
Table 2				

With a p-value of 0.026 for the Mann-Whitney test, the mean time for phonation between the two research groups is 10.21 minutes for the BIS group and 12.80 minutes for the routine care group. This difference in mean time was statistically significant. None of the categories had any statistically significant differences.

At the significance level of 0.05, there was indeed a significant statistical disparity in pain perception in both the research groups. While there was no pain in the BIS group, there appeared to be 25% minor discomfort in the RC group. The reason for this was that the BIS group had mild discomfort that was less than anticipated, whereas the routine care group had

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mild pain that was more than anticipated. On the other hand, 33.3% of participants in the BIS group and 6.6% of participants in the routine care group reported having significant discomfort. Although 33.3 percent of the BIS group had moderate pain, this was because the routine care group reported less pain and the BIS group reported more moderate pain than anticipated.

At the significance level of 0.05, there was a statistically significant difference in the duration of hospital stay for both groups' discharge from the PACU. With a p-value of 0.007, the RC group's average time to be discharged from the PACU was 12.37 minutes, while the BIS group's average was 9.24 minutes.

There were no statistically significant differences among the other factors under examination.

Variables	**RC Group (N=30)**	**BIS Group (N=30)**	**P-Value**
SAT (SPO2)%	98.53±1.03	98.8±1.36	0.3896
ET CO2 (mmHg)	33.87±4.32	33.85±3.67	0.9693
HR (beat /min)	78.79±12.35	77.27±13.26	0.6476
SBP (mmHg)	112.65±19.14	116.94±21.84	0.4217
DBP (mmHg)	69.7±16.13	70.4±13.35	0.8553
MAP (mmHg)	83.37±14.76	84.89±14.83	0.6922
Pre-Operative HR (beat/min)	81.05±15.868	88.14±21.29	0.1490
Pre-Operative Systolic BP (mmHg)	142.11±27.609	142.7±28.134	0.9349
Pre-Operative Diastolic BP (mmHg)	87.26±20.36	86.4±16.233	0.976
Pre-Operative O2SATURATION%	98.46±2.012	99.4±1.836	0.7987
Pre-Operative Respiration Rate (breath/min)	13.89±2.074	15.10±2.015	0.026*
Pre-Operative TEMPERATURE(°C)	36.64±0.202	36.64±0.28	0.9502
Post-Operative Heart Rate(beat/min)	78.58±17.948	89.67±26.192	0.9502
Post Operation Systolic BP (mmHg)	132.73±25.51	135.35±20.72	0.6640
Post Operation Diastolic BP (mmHg)	86.43±17.29	84.59±16.97	0.6789
Post Operative O2SATURATION (%)	99.08±1.64	99.12±1.32	0.9175
Post Operative Respiratory Rate (breath/min)	14.59±1.96	15.31±1.72	0.1359
Post Operative Temperature (°C)	36.14±1.38	36.39±0.46	0.3504
Differences in Anaesthesia Management Parameters among the Groups Studied (SAT, Co2, Heart Rate, Systolic BP, Diastolic BP, MAP, and Parameters Pre- and Post-Operatively) (RC and BIS)			
Parameters at Specific Time Points-Minutes	**RC Group (N=30)**	**BIS Group (N=30)**	**P-Value**
SAT_35 (%)	98.15±1.231	98.93±0.956	0.008*
SAT_40 %	98.08±1.160	98.84±1.390	0.025*
SAT_45 %	97.91±1.931	99.13±0.916	0.0028*
SAT_50 %	98.28±1.182	98.97±1.783	0.0082*
SBP_50 (mmHg)	108.93±27.93	128.39±24.94	0.006*
SBP_55 (mmHg)	104.28±20.531	121.96±27.18	0.0061*
SBP_60 (mmHg)	100.42±28.168	125.93±32.011	0.002*
DBP_50 (mmHg)	59.89±16.483	75.32±15.93	0.0005*
DBP_55 (mmHg)	61.29±16.032	72.85±16.329	0.006*
MAP_50 (mmHg)	75.99 ±17.63	92.62±19.67	0.0010*
Differences in Anaesthesia Management Parameters (Saturation, CO2, Heart Rate, Systolic BP, Diastolic BP, and Mean Pressure) between RC and BIS Study Groups over Time			

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*Statistically Significant

Table 4

In the pre-operative RR, there was a significant statistical difference between these groups studied (BIS and RC) at the significance level of 0.05. The pre-operative RR per minute was 15.13, SD=2.013, with a p-value of 0.033 in the BIS group, and the pre-operative respiratory rate for the R C group was 13.93, SD=2.071, with a p-value of 0.033. Because both groups' pre-operative RR values were within the normal range, this difference has little clinical significance. There were no statistically significant differences in saturation, ET CO2, heart rate, systolic BP, diastolic BP, mean pressure, or other operational parameters between the BIS group and the routine care group.

Significant variations in SAT between the BIS and RC groups at different stages of the procedures that were statistically significant: 35 minutes (RC mean = 98.32 percent, BIS mean = 99.08 percent), 40 minutes (RC mean = 98.21 percent, BIS mean = 98.96 percent), 45 minutes (RC mean = 98.11 percent, BIS mean = 99.05 percent), 50 minutes (R C mean = 98.32, BIS mean = 99.10), 50 minutes (RC mean = 98.32, BIS mean = 99.10) However, because all of the readings are within the normal limits, this information has little diagnostic value. At the following time intervals during operation, there are statistically significant differences in SBP between the two research groups: In 50 minutes, the R-C mean was 109 mmHg, while the BIS mean was 128.45 mmHg. In 55 minutes, the R-C mean was 103.75 mmHg, and the BIS mean was 122.25 mmHg.

In 60 minutes, the R-C mean was 100.08 mmHg, and the BIS mean was 126.29 mmHg. However, because all of the readings are within the normal limits, this information has little diagnostic value. Between the two research groups, there are statistically significant differences in SBP at the following periods during Operation: At 50 minutes, the R-C mean was 109 mmHg, and the BIS mean was 128.45 mmHg; at 55 minutes, the R-C mean was 103.75 mmHg, and the BIS mean was 122.25 mmHg; at 60 minutes, the R-C mean was 100.08 mmHg, and the BIS mean was 126.29 mmHg.

At the following time points, there seem to be differences between the groups in diastolic BP throughout the procedure within the two study groups (BIS and RC): 50 minutes (routine care mean = 60.18 mmHg, BIS mean = 75), 55 minutes (R C mean = 61.33 mmHg, BIS mean = 72.67 mmHg), 55 minutes (R C mean = 62.33 mmHg, BIS mean = 72.68 mmHg), 55 minutes (there were statistically substantial variations between study groups at the 90-minute time point (in mean arterial pressure during procedure (R C mean = 76.56 mmHg, BIS mean = 92.56 mmHg). Lastly, for any other criteria or time points, there was no statistically significant difference between the two study teams.

Variable/Category		**Pure Awareness**		**P-Value**
		No	Yes	
Gender	Male (n=42)	39(92.9%)	3(7.1%)	0.578
	Female (n=18)	16(88.9%)	2(11.1%)	
Surgical Time	0-30 minutes (n=10)	10(100%)	0(0%)	0.7040
	31-60 minutes (n=23)	20(87%)	3(13%)	
	61-90 minutes (n=10)	9(90%)	1(10%)	
	more than 90 minutes (n=17)	15(88.2%)	2(11.8%)	
Age Categories	less than 20 (n=7)	5(71.4%)	2(28.6%)	0.235
	20-29 (n=7)	7(100%)	0(0%)	
	30-39 (n=14)	12(85.7%)	2(14.3%)	
	40-49 (n=6)	6(100%)	0(0%)	

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	50-59 (n=15)	15(100%)	0(0%)	
	60-69 (n=7)	7(100%)	0(0%)	
	70 or more (n=2)	2(100%)	0(0%)	

Shows the Percentages, Frequency and P-Values of the Chi-Square Test of Association between Awareness Measurement and Surgery Duration, Gender, Surgical Time, and Age Groups

Parameters		**Group**		**P-Value**
		Routine Care (N=30) F (%)	**BIS (N=30) F (%)**	
Incidence of Awareness	No (n=54)	24 (80%)	30 (100%)	0.048
	Yes (n=6)	6(20%)	0 (0%)	

Shows the Relationship within Awareness and Study Population (RC and BIS)

Table 5

Significant statistical differences were noted in awareness measurement within the RC and BIS groups at a significance level of 0.05 (p-value=0.0350.05). Compared to the BIS group (16.7%), the routine care group had a higher level of awareness (0%).

The routine care group's saturation levels surpass the SAT levels of the BIS groups following a 60-minute operation. In these intervals (35, 40, 45, and 50), the differences were substantial in favour of the BIS group. This result has no clinical significance; all the values in both groups are within the normal range.

ET CO2 values do not show much difference within the study population. The HR values do not differ across the study groups during the operation, except for a small difference at the end (100 minutes and after), which is not significant. Each of the two comparable points had no significant differences.

The BIS group only benefited significantly from the differences at minutes 50, 55, and 60. Throughout the procedure, the research groups' SBP differences remained constant. Since all of the numbers in both groups fall within the normal range, this result has no clinical importance.

The variations in diastolic BP levels within the study groups, with the BIS group having diastolic BP greater than the regular care group's at the 50-55-minute mark. Only at the intervals (50, 55) were the differences significant in favour of the BIS group. This result has no clinical significance all the values in both groups were within the normal range

The mean arterial pressure differences between the study populations. The BIS group had only marginal significance. This result has no clinical significance; all the values in both groups were within the normal range.

DISCUSSION

Intra-Operative Awareness can be reduced with BIS-Guided Anaesthesia

It has been discovered that BIS-guided anaesthesia lowers the possibility of intra-operative consciousness in surgical patients. The incidence of perioperative consciousness varied statistically significantly between patients who received BIS monitoring during the procedure and those who received standard care throughout. Usage of BIS-monitored anaesthesia resulted in a 13.8 percent reduction in consciousness. These findings are consistent with those of Ekman et al.[4] (2004) and Myles et al.[5] (2004).

The incidence of awareness following general anesthesia was reduced by over 80% when BIS was used in place of standard monitoring in two sizable prospective trials. (Ekman et al., 2004; Myles et al., 2004).

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The results of this study are in contrast to those of Mozafari et al. (2014),[6] who, when comparing patients undergoing abdominal surgery under general anaesthesia to those monitored using conventional anaesthetic delivery methods, found no evidence that BIS monitoring decreased awareness.

This work suggests that studying the anaesthetic method is necessary to comprehend the cause of consciousness during anaesthesia. Compared to the BIS group, the RC group got less fentanyl, which reduces pain and controls movement, and less propofol, which causes hypnosis. This could assist to explain why patients in the normal care group in the current study were found to be more conscious than those in the BIS group.

This suggests that a mild anaesthetic may be administered to the patient. Too little anaesthesia might make patients recall things that happened in the OT, such as conversations or incidents. It's unclear why this is happening. On the other hand, titrating the dose of anaesthetic drugs and preventing intraoperative consciousness depend on the depth of anaesthetic monitoring. One of the first multicenter RCTs to assess the predictive effectiveness of unilateral BIS as a general anaesthesia awareness monitor was the "B-Aware" research. Of the patients in the BIS monitoring group, two (0.17 percent) exhibited intraoperative consciousness, whereas 11 (0.91%) in the usual care group did. The authors discovered that BIS monitoring might reliably prevent intraoperative consciousness.

The "B-Unaware" trial compared the effectiveness of a treatment guided by end-tidal anaesthetic gas (ETAG) with a BIS-directed regimen. As a percentage of the alveolar minimum concentration (MAC), the ETAG is indicated. In the BIS-guided group, an audio alert was programmed to alert the clinician if the BIS value deviated from the 40 to 60 range, and in the ETAG-guided group, an audible alarm was programmed to alert the clinician if the ETAG concentration deviated from the 0.7 to 1.3 MAC range. Both the BIS and ETAG groups had two incidences of intraoperative awareness, according to the study. Furthermore, during the period when awareness was assessed to have occurred, the reported BIS values for most definite or possible anaesthetic awareness were less than 60. Based on these findings, the authors came to the conclusion that utilizing a BIS-guided approach vs. an ETAG-guided strategy for the express goal of reducing intraoperative consciousness provided no additional advantage.

Inhalational Anaesthetic Agent Usage

During anaesthesia, clinical indicators such as blood pressure, heart rate, and medication concentrations are used to assess the level of anaesthesia. During the course of anaesthesia titration, these metrics become unreliable for determining anaesthesia depth (Weber F. et al.[7] 2005). Routine anaesthesia practice includes monitoring the concentration of inhalational agents by evaluating the minimum alveolar concentration. This serves as a means for continuous measurement of volatile agent concentration.

The BIS index measures the effects of anaesthesia and sedation on the brain. It is an EEG parameter that is clinically validated and is numerically treated (Bauer M. et al.[8] 2004). According to the BIS maker, it is a critical tool that allows practitioners to give anaesthesia tailored to the needs of patients as well as detect and respond according to their vital signs. Maintaining an adequate depth of anaesthesia can be beneficial in general. The mean dosage of inhaled anaesthetics was found to be statistically significantly lower when comparing BIS monitoring to routine care and anaesthetic monitoring procedures. When comparing regular care and anaesthetic monitoring techniques to BIS monitoring, we found a statistically significant drop in end-tidal sevoflurane concentration. Our findings are consistent with those of Punjasawadwong et al. (2014) and Ibrahim et al.[9] (2013), who discovered that patients having laparoscopic sleeve gastrectomy require less desflurane when BIS monitoring is used

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during surgery, and who also discovered that the use of BIS-guided anesthesia can dramatically minimize the amount of anesthesia consumption.

Consumption of Anaesthetics Agents

When comparing normal group and anaesthetic monitoring techniques to BIS monitoring, we found a substantial increase in fentanyl dose. These findings contradicted those of other studies (Kreuer, et al.[10] 2003; Leslie et al.,[11] 1995, Gan et al.,[12] 1997, Song et al.,[13] 1997).

When compared to the RC group during general anaesthesia, propofol administration during induction was on the lower side when using BIS monitoring, according to Akcali et al.[20] (2008). Our findings contradict those of the Akcali et al.[14] study. The administration of propofol for inducing did not considerably vary between the RC group and the BIS group, according to our findings. Patients in the BIS group, on the other hand, needed more propofol during induction than patients in the regular group.

This study concluded that BIS monitoring increases propofol, fentanyl, and midazolam consumption; however, this finding contradicts Munoz Garcia J. et al.[15] (2009), who found that BIS monitoring reduces propofol, fentanyl, and midazolam consumption.

RC group patients received less fentanyl and propofol than cases monitored using BIS. This explained that the RC group, who were under a lighter plane of anaesthesia, were more aware in comparison with the BIS group.

Clinical Signs of Awareness and Somatic Response

A somatic reaction failure to an unpleasant stimuli is characterised by an absence of intentional movement (e.g., jerking, twisting, or twitching of the head). In our investigation, we found no differences between the BIS group and the RC group in terms of sweating, tears, pupil dilation, or coughing. Between patients receiving conventional treatment and those under BIS monitoring, there was a significant decrease in intraoperative jerking. Stated differently, BIS plays a critical role in preventing unpleasant stimuli while preserving the total absence of a somatic reaction to a nociceptive input.

Time to Extubation

The study's findings demonstrated that there was no difference in the BIS group's and the RC group's times to extubation. This result defies an earlier study that found a quick extubation time was associated with BIS monitoring. According to Akcali et al. (2008), the BIS group's extubation time was much shorter. Comparable results were found in other research (Boztug, et al.,[16] 2006, Burrow, et al.[17] 2001, Gan et al. 1997, Yili-Hankala, et al., 1999 and Recart et al.[18] 2003).

The Recovery Time

Punjasawadwong et al. (2014) discovered that, independent of the kind of anesthetic used, BIS-guided anesthesia shortened the duration of the early recovery period for all components, including the time for eye opening, speech response, extubation, and orientation. By using this information, anesthesiologists will be able to help patients recover from anesthesia, determine the level of anesthesia using BIS, and deliver last-minute anesthetic dosages at the conclusion of the procedure. We were able to reduce the amount of time needed to phonate the patient (4), open the patient's eyelids and extubate them by employing BIS-guided anaesthesia; however, the changes were not statistically significant.

We disagree with Kruerer et al. (2003), who reported that employing BIS monitors considerably reduced the time for eye opening, extubation, and arrival in the PACU (Post Anaesthetic Care Unit). The BIS monitoring, on the other hand, did not have any effect over

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the time it took to recover from anaesthesia as evaluated by eye opening (Sandin et al. (2009), Myles et al. (2004))

The RC group and BIS group exhibited no variation in recovery time in this study. These findings agree with those of (Loveman et al.[19] 2001), who looked at controlled remifentanil and propofol infusion in neurosurgical patients while using BIS monitoring and concluded that monitoring using BIS showed no impact on recovery time. Our findings contradict Dagtekin et al.[20] (2007), who found that BIS monitoring improves hemodynamic stability and time for recovery for neurosurgical patients using TIVA.

Time Taken for Discharge from the PACU

Those under BIS monitoring were discharged from the PACU much sooner than those in the standard care group. According to Punjasawadwong et al. (2007), BIS monitoring reduced recovery times in terms of eye opening time, verbal command reaction time, extubation time, and orientation. They also found that a shorter stay in the PACU was associated with BIS monitoring.

Despite a decrease in PACU stays, Pavlin et al.[21] (1998) found no effect of BIS-guided anaesthesia on time to discharge after ambulatory surgery. Discharge time for patients undergoing ambulatory surgery depends on various factors, such as tiredness, pain, vomiting and delay in ambulation.

The lower dosage of fentanyl usage in the RC group compared to the BIS group led to less relief of pain. The investigators suggested that the length of stay in PACU was higher in the RC group due to pain. There was no difference in the incidence of nausea between the two groups. Croci et al., who showed that anaesthesia guided by the BIS can reduce PONV. Nausea had no effect on the discharge time in the BIS group.

Hemodynamic Parameters

Significant variations in SBP, DBP, and MAP were observed between the BIS group and the conventional care group at different stages of the treatment. Our results corroborate those of Mozafari et al. (2014), who found that the type of monitoring system employed had no impact on changes in hemodynamic parameters after abdominal surgery. Our findings support those of Payne et al. (2009), who found that BIS monitoring has no effect on hemodynamic responses during surgery. Significant changes in SBP, DBP, and MAP between the BIS and usual care groups at different times of operation were not clinically important.

Gender, Surgical Time and Awareness

There was no significant relationship between the above-mentioned parameters or age in this study. These findings are consistent with those of Sebel et al.[22] (2004), who found that age and gender had no bearing on the occurrence of awareness. On the contrary, Katoh et al.[23] (2000) discovered that age had a significant impact on BIS points. When BIS values were greater, elderly patients had a larger chance of responding than younger patients. Elderly patients had a reduced chance of responding at lower BIS values. Our results, however, go counter to those of Ghoneim et al.[24] (2009), who discovered that females and younger patients were more likely to be awake. To determine the relationship between consciousness and gender, more research with a bigger sample size that includes all surgical patients undergoing various procedures under general anesthesia is required.

CONCLUSION

Compared to normal therapy, the chance of consciousness was lower with BIS-guided anesthesia (BIS maintained at 40–60). Moreover, BIS monitoring shortens the time needed for

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PACU discharge and reduces the requirement for inhaled anaesthetics.

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