ORIGINAL ARTICLE

THE UTILITY OF BISPECTRAL INDEX FOR TITRATION OF PROPOFOL DOSAGES AND RECOVERY FROM ANAESTHESIA

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ABSTRACT

Background: The use of clinical signs may not be reliable to measure the hypnotic component of anaesthesia. Bispectral Index monitoring provides a direct measurement of the hypnotic effect of the anaesthetic agent used and it may have certain clinical advantages over clinical signs.

Objective: This study consists of dose requirement of propofol with bispectral Index monitoring and without bispectral Index monitoring.

Material and Methods: In the present study, 100 patients were randomly divided into two groups (50 in each group), one group received Standard dose of propofol while the other received propofol infusion with BIS monitoring.

Results: Mean amount of propofol for induction used was 1.6 vs 2.24 mg/kg in bispectral index group and standard group respectively. The inference was that the induction dose of propofol by Bispectral index and by standard practice was statistically highly significant with P<0.001. Similarly mean amount of propofol for maintenance used was 5.70 vs 8.88 mg/kg/hr in bispectral index group and standard group respectively. The inference was that the maintenance dose of propofol by Bispectral index and by standard practice was statistically highly significant with P<0.001.

Conclusion: Dose requirement of propofol was less and early recovery from anesthesia with bispectral Index monitoring.

Keywords: Bispectral Index monitoring system, propofol, anaesthetic drug consumption, awareness, recovery.

INTRODUCTION

BIS monitors are noninvasive devices that reflect a signal processed EEG [1]. Since the introduction of bispectral index in 1992, it has steadily gained clinical acceptance as a reliable measure to monitor the effects of anesthesia and sedation on the brain.[2, 3] A BIS monitor provides a continuous display of the current BIS and several parameters important to BIS monitoring. The BIS value is displayed in the upper left corner of the monitor. This score ranges from 0 to 100 and is a measure of cerebral electrical activity (Figure1)[4]. A BIS value between 40 and 60 indicates an appropriate level for general anesthesia. When the patient is awake, the cerebral cortex is very active and the EEG reflects vigorous activity. The pattern of activities changes when the patient is asleep or under general anesthesia (Figure 2)[5]. Under sedation can increase patient anxiety, agitation and the possible risk that the patient will be aware of and able to recall the surgery or procedure[6]. Over sedation can adversely affect patient's vital signs and impair the ability to breathe. It can also increase the risk of complications, prolong the time of hospital stay and raise the cost of care.[1]

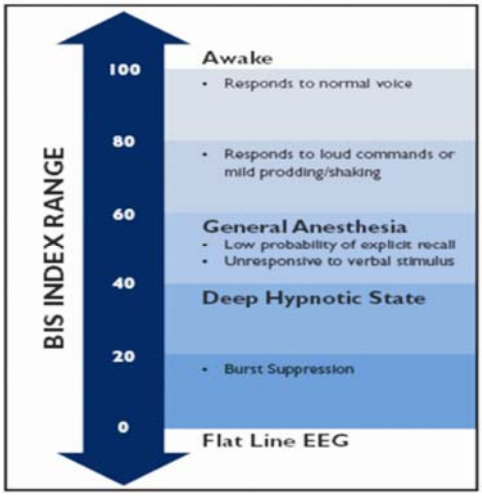

Fig 1: BIS Index range guideline

The BIS Index is a scale from 100 (Awake, Responsive to Normal voice) to 0 (Representing as isoelectric, flat line EEG)

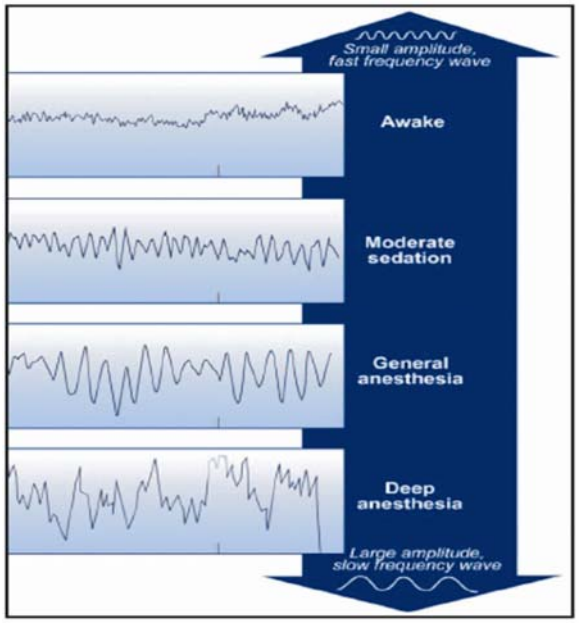

Fig 2: General Pattern of EEG changes observed during increasing doses of Anaesthesia

As anesthetic effect increases, EEG frequency typically slows resulting in transition through frequency- based classes: Beta→Alpha→Theta→Delta.

In general a BIS score of 90-100 reflects awake state, 80 reflects some sedation, 60 reflects a moderate hypnotic level and less than 40 reflects unconscious patient with moderate to deep hypnotic effect.[7]

Our aim and objective in this review focused on whether the incorporation of BIS in to the standard practice of managing anaesthesia can reduce consumption of anaesthetic agents' recovery time, incidence of recall awareness and total cost of anaesthesia management in surgical patients.

MATERIALS AND METHODS

This was a randomized, prospective parallel group study. Simple randomized sampling was done by computer system. 100 patients were studied.

Inclusion criteria:

American society of anaesthesiologists grade I/II patients[8], aged 20-40 years, weighing 40-60 kg, scheduled for short surgical procedures of duration 30 minute to 1 hour

Exclusion criteria:

Patients with unstable cardiac conditions, severe liver disease, pregnancy or known allergy to propofol or its emulsion, patients on regular sedatives or narcotic medications were excluded

Allocation:

After obtaining institutional ethical committee and review board's approval and written informed consent, patients were allocated to one of the following two groups:

Group S (standard): standard dose of propofol infusion.
Group B (BIS): with the usage of BIS, dose of propofol infusion.

Study consisted of continuous recording of BIS with EEG activity during induction and maintenance of propofol anaesthesia. On the previous day of surgery, detailed history was taken and they were examined thoroughly. They were fasted for minimum of 6hrs. On the day of surgery, in pre-operative room all patients were monitored with electro cardiograph, non invasive blood pressure and pulse oximeter. Each patient were shown a picture or randomly assigned digit on paper for the purpose of post-operative recall. All patients pre medicated with glycopyrrolate 4 μg/kg IM and diclofenac sodium 1.5mg/kg IM, Ranitidine 1mg/kg IV, ondansetron 0.08mg/kg IV half an hour before surgery. Ringer lactate solution 10cc/kg of body weight was infused intravenously. Patient shifted to operation theatre. Midazolam 0.5mg/kg IV was given in both groups. BIS monitor with Quartro sensor was applied on patient's forehead. The EEG was recorded continuously beginning before the induction of anaesthesia until patients were awake and responding to verbal commands at the conclusion of surgery. Electro cardiograph, non invasive blood pressure and pulse oximeter were monitored with multipara monitor (BPL Multipara monitor MPM 5553 Accura).

Anesthesia was induced with propofol 1.5mg/kg IV maintained with propofol infusion 4-6 μg/kg/hr IV (SP 102 syringe infusion pump). Oxygen was given with ventimask throughout the operation.

A continuous EEG recording was obtained during induction and maintenance of propofol anaesthesia. Anaesthesia was maintained by titration of propofol to keep BIS between 45 to 60 and in last 15 minutes of the procedure between 60 to 70.

BIS was monitored every 30 seconds for initial 15 minutes of the procedure then every minute till the procedure was completed. Pulse, BP and S_pO_2 were monitored at regular intervals. Picture recall was tested and patients were assessed by following verbal command and open their eyes upon arrival in post anaesthesia care unit. Digital EEG recordings with BIS numerical values were obtained with BIS monitor (Aspect medical systems, INC @2003) with small amplitude of 20 to 200 μvolts/mm and variable frequency of 0 to 50 Hz. The BIS index value is derived from the preceding 15 to 30 seconds of EEG data. Statistical analysis was done with Z test and t test with P value<0.001 highly significant.

RESULTS

All the data is expressed as mean and standard deviation. The data were tested by Z test and chi-square test as appropriate. All statistical analysis was conducted using SPSS 15.0 version and the value of P<0.05 was considered significant and value of P<0.0001 was considered highly significant. The two groups were comparable in patient characterstics with respect to age, gender, ASA (American society of anaesthesiologists) physical status and mean weight (P>0.05)[Table 1].

Table 1: Demographic details of the patient included in the study

Details	Group S (n=50)	Group B (n=50)
Age(years)	29.34±5.24	30.04±5.41
Weight(kg)	48.76±5.48	50.94±5.04
Gender(M:F)	32 M :18 F	28 M : 22 F
Duration of surgery(min)	44.04±8.76	47±8.04
ASA class I/II	28 / 22	30 / 20

ASA- American Society of Anaesthesiologists; the results are expressed as Mean ± SD of 50 patients in each group P>0.05

Table 2: Comparison of Induction, Maintenance and total consumption of Propofol (P<0.001)

Dose	Group BIS	Group standard
Induction dose	1.60± 0.28 mg/kg	2.24±0.51 mg/kg
Maintenance dose	5.7±1.29 mg/kg/hr	8.88±2.1 mg/kg/hr
TotalConsumption	7.28±1.38 mg/kg	10.86± 2.03 mg/kg

The results are expressed as Mean±SD, P<0.001 compared with group S (n=50 patients).

Dose of propofol for inducing anaesthesia were less in group B (1.60± 0.28 mg/kg) compared with group S (2.24± 0.51 mg/kg) (P<0.001) [Table2]. Similarly propofol dosages for maintenance of anaesthesia were less in group B (5.70±1.29 mg/kg/hr) compared with group S (8.88±2.10 mg/kg/hr) (P<0.001) [Table2]. The overall total propofol consumption were significantly higher in Group S (10.86±2.03 mg/kg) than in Group B (7.28±1.38 mg/kg) P<0.001 Table2. Higher percentage of patient recovered early with usage of bispectral index monitoring compare to standard practice. (86% vs 60% respectively) (P<0.001) [Table3].

Table 3: Percentage of recovery from anaesthesia (P<0.001)

Recovery after 5min	Group BIS	Groups	Total
Yes	43 (86%)	30(60%)	73
No	7	20	27
Total	50	50	100

P<0.001 compared with group S (n=50 patients)

DISCUSSION

The increasing preference for bispectral index monitoring in routine clinical practice is focused not only at achieving adequate anaesthesia but also obtaining satisfactory recovery as well. The resulting decreased propofol consumption provides ideal and smooth outcome of the patient.

In standard group where BIS was not used, patients were consistently administered more propofol throughout the surgical procedure (2.24± 0.51 vs 1.60± 0.28 mg/kg Induction dose) [table 2]. Similarly maintenance dose was also required more in standard group as compare to BIS group (8.88±2.10 vs 5.70±1.29 mg/kg/hr) [table 2]. On the other hand, titration of propofol based on the BIS resulted in reduced propofol infusion rate, reduced total amount of propofol (7.28±1.38 vs 10.86±2.03 mg/kg) [table 2] and therefore it led to faster wake up and improved recovery from anesthesia(86% vs 60%) [table 3], which are in concordance with the reports published by several other authors.[9, 10, 11, 12] Clinical utility trial Results show that BIS may also be used to measure the pharmacodynamic effect of propofol and facilitate its titration to improve recovery from anaesthesia.[13]

Several important study design issues should be considered when evaluating the results from this trial. Gurses E, Sungurtekin H[14] et al divided 3 groups. Group 1 propofol (2 mg/kg) for induction. Group 2 and 3, propofol infusion until loss of response to verbal commands and until BIS value then he concluded that with BIS monitoring propofol induction dose requirement is reduced. On arrival to the PACU, a significantly higher percentage of BIS patients were already alert and fully oriented [9]. As nearly 80% of patients were awake and oriented at 5 min. [3]

J Liu, H singh [15] et al studied electroencephalographic bispectral index correlates with intra operative recall and depth of propofol-induced sedation. They have used OAA/S scale(observers assessment of alertness/sedation) at 5 and 10 min interval for depth of alertness and sedation.OAA/S scale with 1=No response to tectile stimulation and 5=Awake.

Similarly patients in the BIS group emerged from anesthesia faster than the standard practice group was proposed by Gan et al.[9] The BIS group also demonstrated greater predictability of rapid emergence.[16]The amount of propofol used was significantly less in BIS group compared with SP group (1253 mg for SP group vs 964 mg for BIS group).[17, 18] BIS monitoring may facilitate cost effective anesthetic care.

BIS algorithm underwent several developments but the anaesthesiologists should be aware of situations that cause false BIS readings to avoid complications, may it be secondary to anaesthetic overdose or underdosing, which might cause intraoperative awakening and recall[19]. Electric device interference and high electromyographic activity could create subtle artifact

signal pollution without their necessarily being displayed as artifact [20]. This would be misinterpreted by the BIS algorithm as EEG activity and assigned a spuriously increased BIS value. Numerous clinical conditions that have a direct effect on EEG cerebral function could also directly influence the BIS value.[21, 22] Addition of routine BIS monitoring to standard anesthetic care resulted in reduced use of propofol and faster recovery compared with standard clinical practice and this may result in potential economic benefits.[9, 23, 24] BIS device is increasingly becoming a standard of care in preventing patient recall during surgery[7, 19, 25]

In conclusion, these results demonstrate the safety and efficacy of BIS monitoring as a pharmacodynamic measure of patient response to propofol during induction and maintenance of anesthesia. BIS is better for the total dosage as well as for recovery point of view.

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