

Original Research Article

An analytical study of standard propofol- sufentanil target controlled infusion protocols for total intravenous anaesthesia requirements in an Indian population using bispectral index monitoring

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ABSTRACT

Background: Target controlled infusion (TCI) is an automated and regulated total intravenous anaesthesia delivering device. On the basis of western pharmacokinetic and pharmacodynamic models it delivers a calculated dosage of intravenous anaesthetic drugs to achieve an ideal anaesthetic plane. The depth of anaesthesia is judged by monitors such as bispectral index (BIS) monitors which gives a rough estimate whether the TCI is delivering more or less.

Methods: This analytical study was carried out on 100 patients between 20 to 60 years of age in a teaching hospital. Simultaneous BIS monitoring and TCI were set on these patients. If BIS values went below 45 the target concentration was decreased by 0.5µg/ml and if it was more than Injection propofol was supplemented manually and the changes were collected and analyzed.

Results: On analyses and comparison of the data with a western study it was found that the duration of surgery was similar in both studies. With the help of “t” test based on normal distribution it was found that group having BIS <45 and 45-60 were similar in both studies, but the group having BIS >60 was more statistically significant in the Indian population.

Conclusions: Depth of anaesthesia was assessed with neurological monitor, BIS, at the time of administration of Target controlled infusion (TCI) and data acquired was compared with data from a western study. The two groups had similar anaesthetic depth levels with the same infusion protocols of Target controlled infusion (TCI).

Keywords: BIS monitoring, TCI, TIVA

INTRODUCTION

The development of surgery has been attributed to the advances that have been made in the field of anaesthesia. With advances in the field not only the safety of the patients has increased exponentially but anaesthesiologists have been able to prevent awareness and recall during surgery. At the same time patients can be exposed to deeper planes of anaesthesia to bear the painful, prolonged and bloody surgeries performed at times.¹

Earlier such planes were achieved by calculations, monitoring of vital parameters and good guesswork. But with newer drugs and equipment this is done in a more scientific manner. The introduction of intravenous short acting agents total intravenous anaesthesia (TIVA) has become a reality.² Administering of such drugs has become more easy for the anaesthesiologists with the coming of microprocessor controlled infusion pumps.^{3,4} On the basis of age, gender and body weight infusion protocols have been devised to achieve a stable blood-brain concentration, hence achieving a stable plane of

anaesthesia.⁵ Most of these protocols have been devised by testing on a western population which are genetically and structurally distinct from Indian population.⁶

It remains a big challenge for every anaesthesiologist to achieve the right depth of anaesthesia.⁷ Every patient is different from the other. The distribution, metabolism and excretion of drugs would vary from person to person, so a thumb rule, i.e. drug dosage, infusion rate, plasma concentration, etc. would not be applicable to all.⁸ The latest anaesthesia depth monitors, like bispectral index, cerebral state index, narcotrend and many more, have outphased earlier means of estimating depth of anaesthesia like eye signs, sudomotor responses and monitoring of vital parameters.^{9,10} This study was conducted to gauge the efficacy of target controlled infusion of hypnotic agent in providing adequate depth of anaesthesia in an Indian population by measuring depth of anaesthesia by bispectral index monitoring.

METHODS

Approval of the institutional ethical committee was obtained and consent was taken from all the subjects considered suitable for the study. Patients coming for surgeries of more than one hour, of an age group of 20-60 years accepted in ASA I and II in preoperative assessment were included for the study.

Exclusion criteria

- Allergy to the drugs.
- Neurological diseases.
- Psychiatric diseases.
- Pregnant women.
- Immunocompromised patients.
- Cardiac diseases.
- Uncontrolled diabetes and hypertension.

Patients were familiarized with the procedure a night prior and written informed consent was taken. They were given Tab Diazepam 10mg a night prior and were advised to be fasting after 10 pm night prior to surgery. On the day of surgery the patient was connected to all routine monitors

and then the BIS forehead strip was attached, as advised by the manufacturer, to the forehead of the patient and a system check carried out.

A broad 16 G intravenous cannula was secured in a large forearm vein and three 3 way stop corks were put and connected to the syringes to the infusion pump. Premedication such as antiemetic (Injection ondansetron 4mg iv), antacid (Injection ranitidine 50mg iv) and analgesic (0.5µg/kg of Injection sufentanil) was administered bolus, intravenously. Injection propofol was started by the Marsh Model of TCI device manufactured by Braun to achieve a plasma concentration of 4µg/ml. At the same time an infusion of sufentanil was started at a rate of 0.7µg/kg/hr.^{11,12} An infusion of atracurium was also started at a rate of 0.4mg/kg/hr. On loss of consciousness the patient respiration was supported and later on intubated with non-depolarising muscle relaxant atracurium at a dosage of 0.5 mg/kg. During the surgery, the BIS levels were continuously monitored and recorded every 5 minutes.

When the BIS values overshoot the predetermined levels of adequate anaesthesia, i.e. BIS <45, the target plasma concentration was decreased by 0.5µg/ml till the predetermined BIS level was achieved and duration of overshoot documented. In case if the BIS level undershoots then Propofol would be supplemented and recorded accordingly.¹³ The data collected would be compared with data collected in a western study "Titration of propofol for anaesthetic induction and maintenance guided by the bispectral index: closed loop versus manual control".

RESULTS

On analysis of the sample it was found that most of the patients were of the age group of 21-30. Both genders had nearly equal representation in the sample. 93% of the sample was in ASA I category. The average duration of surgery was 129 mins and surgeries of all specialties were carried out on the sample. On comparison of the sample with the western group they were found to be nearly similar.

Table 1: Anthropometric characteristics of patients of the two groups.

Demographic parameters	Indian population	Western population	Significance
Sample size	100	81	
Gender (M/F)	42/58	32/49	NS
Age (years)	37±12	59±16	S
Height (cms)	164±8	167±14	NS
Weight (kg)	58±10	70±15	S
Duration of Anaesthesia	129±26	126±63	NS

The comparison of the two groups is shown in Table 1. Other than the age and weight of the groups all other parameters were statistically similar. The western group had heavier and older patients in their study. The maintenance phase of anaesthesia was divided into three phases, i.e. BIS <45, 60>BIS>45 and BIS >60. The percentage of time BIS values remained in the three categories was calculated and compared with the western group by large sample “t” test. The three groups were

analyzed separately using SPSS software. The mean frequencies, standard deviation and range were calculated and compared as shown in Table 2. The duration of phase BIS <45 was similar to the western group (z value of 1.66) and so was the phase 45<BIS<60 similar in the two groups (z value of 1.61). But the phase of BIS >60 was statistically different from the western group (z value of 2.13). The difference could be due to different age and weight of the two groups.

Table 2: Analysis of BIS values of the two study groups.

BIS values	Western population	Indian population	z-value	Significance
< 45	55±31	62±24	1.66	Not significant
45 - 60	41±20	46±17	1.61	Not significant
>60	4±5	5±3	2.13	Significant

DISCUSSION

Since the discovery of anaesthetic agents it has been the guesswork of doctors to administer the correct dosage of drugs and achieve the ideal plane of hypnosis. Infact the first demonstration of Ether anaesthesia by Dr. Horace Wells was a partial failure due to suboptimal administration of ether. This ideal plane was achieved by WTG Morton who was credited with the discovery of volatile anaesthetic agents.^{14,15} Intravenous agents were later on added to the practise of medicine which took the practise to a different level.¹⁶ Both suboptimal and supraoptimal doses of anaesthetic agents, as happened in famous Pearl Harbour surgical cases, is detrimental and needs to be avoided.^{17,18} At the same time it is very difficult to ascertain the correct dosage of these anaesthetic agents. Many human factors affect the concentration achieved by these agents at the effect site that is the brain. With introduction of shorter acting hypnotics such as propofol automated infusion pumps were introduced to administering tailor made anaesthesia to patients coming up for surgery.¹⁹ Most of these devices were made taking in mind Western population. This analytical study was carried out on an Asian population similar in many aspects to the western population of the article cited above. The western population showed some difference from the Asian population as it was more aged and had more weight. On a sample size of 100 patients coming for surgery in a referral hospital the study carried out extensive research on Indian population. Surgeries in various surgical fields was carried out in the sample which was equally represented by both genders. The average duration of surgery in the study group (129±26) was also very similar to the western group (126±63). The western population was significantly older and heavier in body weight than the Indian population. The depth of anaesthesia was monitored with cerebral state monitor which was a bispectral index monitor. The duration of surgeries was divided into three phases BIS >60, BIS <45

and 45 <BIS <60 as it was done in the western study. These groups were statistically compared by large sample “t” test based on normal distribution and found that the device was equally efficacious in administering anaesthesia to this Asian population. Possibly, the infusion protocols were administering lesser drugs to the Asian population as the group with BIS >60 was significantly more from the western population. Further research would be required in this direction to confirm the facts.

CONCLUSION

Most of the equipment that are made in the western countries are calibrated on the western population which are genetically and demographically different from Asian population.^{20,21} The main aim of this study was to see if these protocols were as good on this Indian population as on the western population. The two groups were very similar to each other demographically, other than the age and weight of the patients. Surgeries that were carried out were of various specialities and of required durations. Both genders were equally represented in the sample. Most of the patients were of ASA I physical status. On statistical analysis, it was concluded that the duration of two groups, i.e. BIS <45 and 60>BIS>45 were similar to the western group but the group BIS >60 was significantly more in the Indian population. Further study was required to ascertain the causes for this variation.

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