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Research Article

COMPARISON OF CONVENTIONAL AND BISPECTRAL INDEX-GUIDED PROPOFOL INDUCTION DURING GENERAL ANAESTHESIA FOR ABDOMINAL SURGERIES

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Abstract

Background: Propofol is the most commonly used intravenous induction agent for general anaesthesia. Conventional weight-based dosing may lead to over- or under-dosing because of inter individual pharmacokinetic and pharmacodynamic variability, resulting in haemodynamic instability and delayed recovery. Bispectral Index (BIS) monitoring objectively assesses the depth of anaesthesia and may facilitate individualized propofol administration, thereby improving perioperative outcomes.

Aim: To compare conventional clinical endpoint-guided induction with Bispectral Index-guided induction of general anaesthesia using propofol in patients undergoing elective abdominal surgeries with respect to propofol induction dose, haemodynamic responses, intraoperative awareness, postoperative nausea and vomiting, and involuntary movements during induction.

Methodology: This prospective randomised comparative study included 60 patients undergoing elective abdominal surgery under general anaesthesia. Patients were randomly allocated into two groups (30 each). Group A received intravenous propofol 2 mg/kg until loss of verbal response, while Group B received titrated propofol until a BIS value of 40–50 was achieved. Total induction dose, heart rate, systolic and diastolic blood pressure, oxygen saturation, intraoperative awareness, postoperative nausea and vomiting, and involuntary movements were recorded and compared.

Results: The BIS-guided group required a significantly lower induction dose of propofol than the conventional group

($p<0.05$). Haemodynamic parameters were more stable in the BIS group, with smaller reductions in systolic and diastolic blood pressure following induction and intubation. Heart rate changes were also less pronounced. Oxygen saturation, intraoperative awareness, postoperative nausea and vomiting, and involuntary movements were comparable between the groups.

Conclusion: BIS-guided propofol induction reduces drug requirement and provides superior haemodynamic stability compared with conventional induction without increasing perioperative complications. BIS monitoring is an effective tool for optimising anaesthetic induction in elective abdominal surgeries.

Keywords: Propofol, Bispectral Index, General anaesthesia, Induction, Haemodynamic stability, Abdominal surgery.

INTRODUCTION

General anaesthesia aims to provide adequate hypnosis, analgesia, and muscle relaxation while maintaining haemodynamic stability and ensuring rapid postoperative recovery. Propofol is the most commonly used intravenous induction agent because of its rapid onset, short duration of action, and favourable recovery profile. However, the dose required for induction varies considerably among individuals due to differences in age, body weight, cardiovascular status, and individual pharmacological responses. Consequently, fixed-dose administration may result in inadequate anaesthesia or excessive cardiovascular depression (1,2).

Conventionally, the adequacy of anaesthetic induction is assessed using clinical signs such as loss of verbal response, loss of eyelash reflex, and haemodynamic responses. Although these endpoints are simple and widely accepted, they are subjective and may not accurately reflect the patient's depth of hypnosis. This may increase the risk of under- or over-dosing of anaesthetic agents (3,4).

The Bispectral Index (BIS) is an electroencephalogram-derived monitor that provides an objective assessment of the depth of anaesthesia on a numerical scale from 0 to 100. A BIS value between 40 and 60 is generally considered appropriate for surgical anaesthesia. BIS monitoring enables individualized titration of propofol according to the patient's hypnotic state, thereby reducing unnecessary drug administration while maintaining adequate anaesthetic depth (5–8).

Several studies have demonstrated that BIS-guided induction decreases propofol consumption, improves haemodynamic stability, facilitates early recovery, and reduces the incidence of intraoperative awareness without compromising patient safety (9,10). However, evidence regarding its routine use during induction in patients undergoing elective abdominal surgery remains limited. Therefore, the present study was undertaken to compare conventional clinical endpoint-guided induction with BIS-guided induction using propofol in elective abdominal surgeries, with emphasis on propofol requirement, haemodynamic responses, intraoperative awareness, and postoperative nausea and vomiting.

OBJECTIVES

To compare conventional clinical endpoint-guided and Bispectral Index (BIS)-guided propofol induction of general anaesthesia in patients undergoing elective abdominal surgeries with respect to propofol dose requirement, haemodynamic stability, intraoperative awareness, and postoperative nausea and vomiting

MATERIALS AND METHODS

Study Design and Setting

This prospective, double-blind, randomised controlled study was conducted over a period of one year in the Department of Anaesthesiology in a Tertiary Care Center, Tamil Nadu, India.

Study Population

Sixty adult patients aged 30–60 years with American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective abdominal surgery under general anaesthesia, were enrolled after obtaining written informed consent.

The sample size was calculated using an alpha error of 0.05, power of 95%, and an effect size of 0.87. A minimum of 30 patients per group was required, giving a total sample size of 60.Patients were randomly allocated into two equal groups (n = 30 each) using computer-generated random numbers. Observations were recorded by an anaesthesiologist blinded to the group allocation to minimise observer bias.

Inclusion Criteria

- Age 30–60 years.
- ASA physical status I or II.
- Patients undergoing elective abdominal surgery under general anaesthesia.

Exclusion Criteria

- Refusal to participate.
- Known allergy to propofol.
- Left ventricular ejection fraction <30%.
- Significant valvular heart disease.
- Chronic alcohol or drug abuse.
- Body mass index >30 kg/m².

Anaesthetic Technique

All patients fasted for 6 hours for solids and 2 hours for clear fluids. Standard monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO2), and Bispectral Index (BIS) monitoring, was instituted, and baseline values were recorded.

Premedication consisted of intravenous glycopyrrolate 0.2 mg and midazolam 1 mg. Following preoxygenation with 100% oxygen for 3 minutes, intravenous fentanyl 2 µg/kg was administered.

- **Group A (Conventional Group):** Propofol 2 mg/kg was administered intravenously until loss of verbal response.
- **Group B (BIS Group):** Propofol was administered in incremental doses until a BIS value of 40–50 was achieved and maintained for 1 minute.

After induction, tracheal intubation was facilitated with atracurium 0.5 mg/kg. Anaesthesia was maintained using oxygen and nitrous oxide (33:67), sevoflurane, and atracurium 0.1 mg/kg every 15 minutes until completion of surgery.

Outcome Measures

The following variables were recorded:

- Demographic characteristics (age, sex, weight, height, and BMI).
- Total induction dose of propofol.
- Haemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, and SpO2 at baseline, loss of consciousness, intubation, every minute for the first 10 minutes after intubation, and every 30 minutes until the end of surgery.
- Incidence of involuntary movements during induction.
- Incidence of postoperative nausea and vomiting (PONV) within 24 hours.
- Incidence of intraoperative awareness assessed postoperatively using the Modified Brice Questionnaire.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 16.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as

mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Comparisons between groups were performed using the independent Student's *t*-test for continuous variables and the Chi-square test for categorical variables. A p value <0.05 was considered statistically significant.

Ethical Consideration: The study was commenced after the approval from Institutional Ethics Committee, Informed consent was obtained from all participants. Strict confidentiality was maintained while analyzing and presenting the data.

RESULTS

Table 1. Baseline Demographic Characteristics of the Study Participants

Variable	BIS Group (n=30)	Conventional Group (n=30)	P value
Age (years)	40.87 ± 11.73	42.43 ± 12.27	0.615
Male/Female	23/7	22/8	0.766
Height (cm)	161.37 ± 8.86	158.77 ± 8.03	0.239
Weight (kg)	61.77 ± 7.05	62.27 ± 7.23	0.787
BMI (kg/m²)	23.77 ± 2.33	24.80 ± 2.46	0.100

Table 2. Comparison of Mean Propofol Induction Dose

Parameter	BIS	Conventional	P value
Propofol dose (mg)	108.5 ±11.4	114.3 ±9.4	0.035*

***p value <0.05 significant using Student T test**

Table 3. Comparison of Heart Rate During Peri-intubation Period

Time	BIS	Conventional	P value
Baseline	80.4±9.6	76.5±10.0	0.129
Intubation	86.3±8.5	88.2±13.2	0.517
1 min	84.9±7.9	91.4±13.2	0.024*
5 min	82.1±10.2	88.1±9.5	0.023*
10 min	80.9±9.2	85.3±11.8	0.116

***p value <0.05 significant using Student T test**

Table 4. Comparison of Systolic Blood Pressure

Time	BIS	Conventional	P value
Baseline	129.1±7.0	126.2±9.1	0.167
Loss of consciousness	122.2±7.0	111.2±9.0	<0.001*
Intubation	128.6±8.0	114.8±12.1	<0.001*
5 min	117.0±7.3	94.6±5.4	<0.001*
10 min	116.8±7.2	97.7±8.0	<0.001*

***p value <0.05 significant using Student T test**

Table 5. Comparison of Diastolic Blood Pressure

Time	BIS	Conventional	P value
Baseline	84.7±9.7	82.2±10.4	0.329
Loss of consciousness	74.5±8.6	67.1±7.5	0.001
Intubation	81.6±10.2	67.9±8.9	0.001
5 min	72.4±6.1	60.1±6.3	0.001
10 min	71.7±5.8	62.1±4.9	0.001

***p value <0.05 significant using Student T test**

Table 6. Comparison of Oxygen Saturation

Time	BIS	Conventional	P value
Baseline	99.0±0.7	99.0±0.8	0.869
Loss of consciousness	99.0±0.8	99.0±0.8	0.872
Intubation	98.9±0.7	98.9±0.8	1.000
10 min	98.8±0.7	98.8±0.8	1.000

***p value <0.05 significant using Student T test**

Table 7. Comparison of Postoperative Outcomes

Outcome	BIS	Conventional	P value
PONV	3 (10.0%)	2 (6.7%)	0.502
Intraoperative awareness	0	1 (3.3%)	0.505

PONV-Post Operative Nausea and Vomiting

p value not significant using Chi square test

The baseline demographic characteristics were comparable between the BIS-guided and conventional groups. There were no statistically significant differences in age (p=0.615), sex distribution (p=0.766), height (p=0.239), weight (p=0.787), or body mass index (p=0.100). These findings indicate that both groups were well matched at baseline, ensuring comparability of the study population before intervention **(Table 1).**

The mean induction dose of propofol was significantly lower in the BIS-guided group (108.5 ± 11.4 mg) than in the conventional group (114.3 ± 9.4 mg) (p=0.035). This finding indicates that BIS monitoring enabled individualized titration of propofol, thereby reducing overall drug requirement without compromising the adequacy of induction **(Table 2).**

Baseline heart rate was comparable between the two groups. Following intubation, patients in the BIS-guided group demonstrated significantly lower heart rates during the first eight minutes compared with the conventional group (p<0.05), indicating better attenuation of the sympathetic response. Heart rate values became comparable thereafter during the remainder of surgery **(Table 3).**

Systolic blood pressure was maintained significantly better in the BIS-guided group from loss of consciousness until 10 minutes after intubation (p<0.001), whereas the conventional group experienced a greater fall in systolic blood pressure during this period. No significant differences were observed during the later intraoperative period, suggesting superior haemodynamic stability with BIS-guided induction **(Table 4).**

Diastolic blood pressure showed a significantly greater reduction in the conventional group during induction and the first 10 minutes after intubation (p=0.001). In contrast, BIS-guided induction maintained diastolic blood pressure closer to baseline values, reflecting improved cardiovascular stability during the induction period **(Table 5).**

Peripheral oxygen saturation remained consistently above 98% in both groups throughout the perioperative period. No statistically significant differences were observed at any time point (all p>0.05), indicating that oxygenation was adequately maintained irrespective of the induction technique used **(Table 6).**

The incidence of postoperative nausea and vomiting, intraoperative awareness, and

involuntary movements was low and comparable between the two groups. No statistically significant differences were observed in postoperative nausea and vomiting (p=0.502) or intraoperative awareness (p=0.505), and no patient experienced involuntary movements during induction **(Table 7).**

Figure 1. Comparison of Heart Rate Between BIS and Conventional Groups

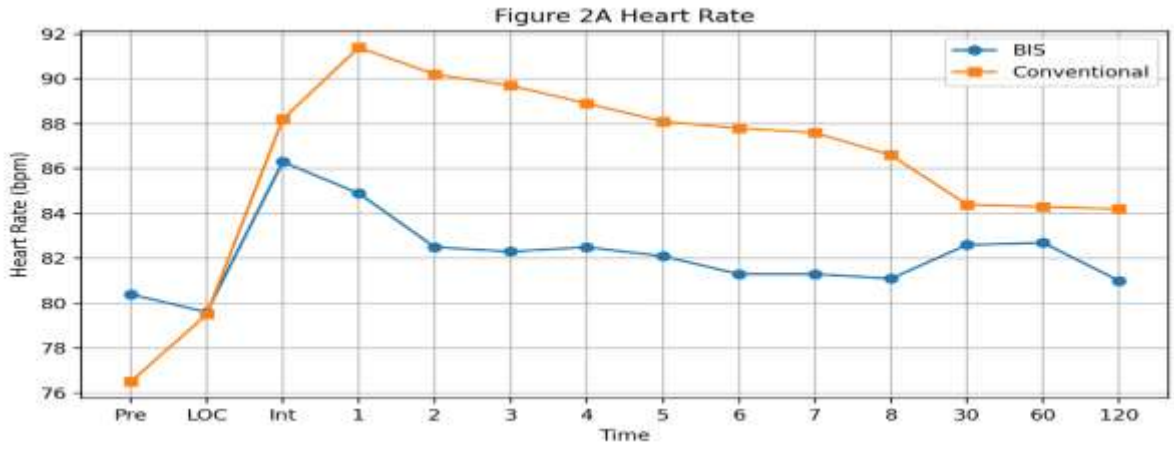

Figure 1: Line graph showing the mean heart rate changes in the BIS-guided and conventional induction groups from pre-induction to 120 minutes after induction.

The heart rate was comparable between the two groups before induction and at the time of intubation. Following intubation, the BIS-guided group demonstrated significantly lower heart rates during the first 8 minutes compared with the conventional group ($p<0.05$), indicating better attenuation of the sympathetic response. Thereafter, heart rate values were comparable throughout the remainder of surgery **(Figure 1).**

Figure 2. Comparison of Systolic Blood Pressure Between BIS and Conventional Groups

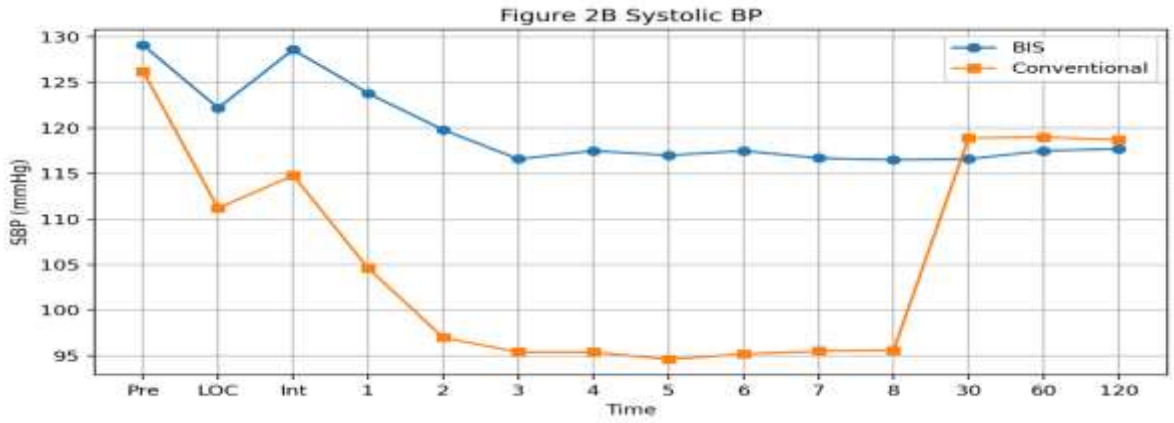

Figure 2: Line graph showing changes in mean systolic blood pressure in the BIS-guided and conventional induction groups during the peri-intubation and intraoperative periods.

Systolic blood pressure decreased significantly in the conventional group from loss of consciousness until 10 minutes following intubation ($p<0.001$). In contrast,

the BIS-guided group maintained systolic blood pressure closer to baseline values, demonstrating superior haemodynamic stability during induction. Blood pressure became comparable between the groups after 30 minutes of surgery **(Figure 2).**

Figure 3. Comparison of Diastolic Blood Pressure Between BIS and Conventional roups

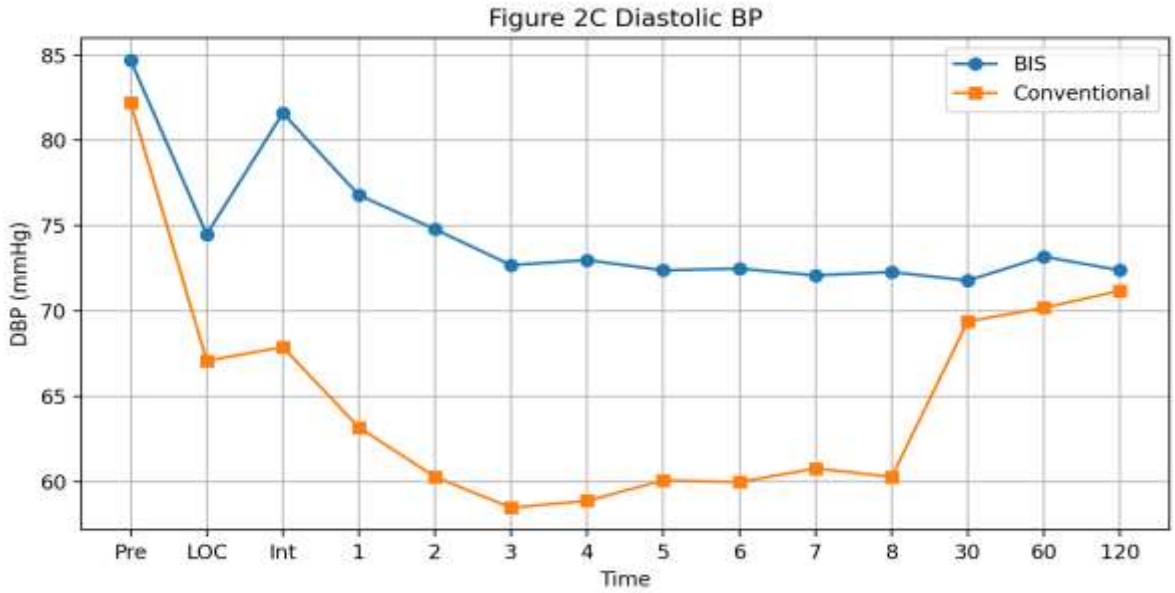

Figure 3:Line graph illustrating changes in mean diastolic blood pressure in the BIS-guided and conventional induction groups throughout the study period.

The conventional group exhibited a significantly greater reduction in diastolic blood pressure from loss of consciousness through the first 10 minutes after intubation compared with the BIS-guided group ($p<0.001$). Subsequently, no significant differences were observed during the later intraoperative period, indicating restoration of haemodynamic stability in both groups **(Figure 3).**

Figure 4. Comparison of Peripheral Oxygen Saturation (SpO2) Between BIS and Conventional Groups

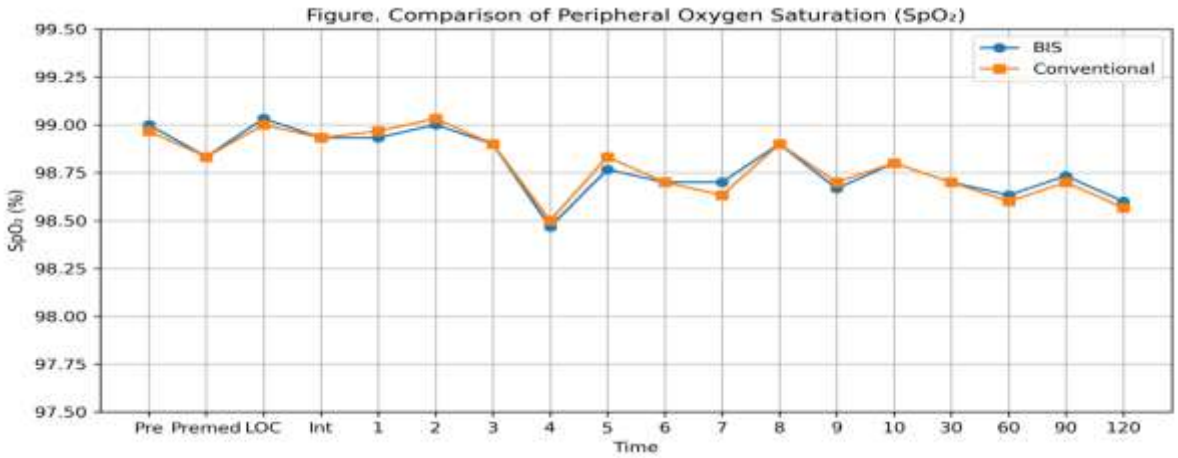

Figure 4:Line graph showing mean peripheral oxygen saturation (SpO2) in the BIS-guided and conventional induction groups during induction and surgery.

Peripheral oxygen saturation remained consistently above 98% throughout the perioperative period in both groups. No statistically significant differences were observed at any time point (all $p>0.05$), demonstrating that adequate oxygenation was maintained irrespective of the induction technique **(Figure 4).**

DISCUSSION

The present prospective randomized controlled study compared conventional clinical endpoint-guided induction with Bispectral Index (BIS)-guided induction of general anaesthesia using propofol in patients undergoing elective abdominal surgery. The study demonstrated that BIS-guided induction significantly reduced propofol requirement while maintaining better haemodynamic stability without increasing perioperative adverse events. These findings are consistent with recent evidence supporting BIS monitoring as an effective tool for optimizing anaesthetic drug administration and improving patient safety (11,12).

The demographic characteristics, including age, sex, height, weight, and body mass index, were comparable between the BIS-guided and conventional groups, indicating successful randomization and minimizing the influence of confounding variables. Similar observations have been reported in previous clinical studies evaluating BIS-guided anaesthesia, confirming that comparable baseline characteristics strengthen the validity of outcome comparisons (13).

A significant reduction in the mean induction dose of propofol was observed in the BIS-guided group compared with the conventional group. This finding suggests that objective monitoring of hypnotic depth allows more precise titration of propofol, thereby avoiding unnecessary drug administration. Punjasawadwong et al. demonstrated in a Cochrane systematic review that BIS-guided anaesthesia significantly reduces anaesthetic consumption and facilitates faster recovery without compromising anaesthetic adequacy (14). Likewise, Bruhn et al. emphasized that EEG-based depth monitoring enables individualized anaesthetic delivery and minimizes excessive hypnotic dosing (15).

Haemodynamic stability was one of the major advantages observed in the present study. Heart rate remained significantly more stable during the first eight minutes following intubation, while systolic and diastolic blood pressures were better preserved throughout induction and the early post-intubation period in the BIS-guided group. Sessler and Riedel highlighted that individualized anaesthetic administration contributes to improved cardiovascular stability and reduces perioperative physiological stress (16). The updated American Society of Anesthesiologists Practice Guidelines also recommend appropriate depth-of-anaesthesia monitoring in selected patients to optimize anaesthetic management and minimize complications (17).

Peripheral oxygen saturation remained above 98% throughout surgery in both groups, with no statistically significant differences at any time point. This finding indicates that BIS-guided induction influences hypnotic drug titration without adversely affecting respiratory oxygenation. Similar observations have been reported in studies evaluating modern

anaesthetic monitoring techniques during general anaesthesia (18).

The incidences of postoperative nausea and vomiting, involuntary movements, and intraoperative awareness were low and comparable between the two groups. Although previous studies have reported a lower incidence of awareness and improved recovery with BIS monitoring, the differences were not statistically significant in the present study, probably because of the relatively small sample size and the low frequency of these complications (19,20).

Overall, the findings of the present study demonstrate that BIS-guided induction using propofol reduces induction dose requirements while providing superior haemodynamic stability without compromising oxygenation or increasing perioperative adverse events. These results support the routine use of BIS monitoring, particularly in patients where precise anaesthetic titration and cardiovascular stability are clinically important.

CONCLUSION

Bispectral Index (BIS)-guided induction of general anaesthesia using propofol significantly reduced the induction dose of propofol compared with conventional clinical endpoint-guided induction. BIS-guided induction also provided superior haemodynamic stability by minimizing fluctuations in heart rate, systolic blood pressure, and diastolic blood pressure during induction and the immediate post-intubation period. Peripheral oxygen saturation, postoperative nausea and vomiting, involuntary movements, and intraoperative awareness were comparable between the two groups. Overall, BIS-guided propofol induction offers a safe and effective approach for individualized anaesthetic management in patients undergoing elective abdominal surgery and may improve perioperative haemodynamic stability while reducing unnecessary anaesthetic drug administration.

Author Contributions

All authors contributed substantially to the conception and design of the study, patient recruitment, data collection, statistical analysis, interpretation of results, manuscript preparation, critical revision of the manuscript, and approval of the final version for publication.

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Nil.

Conflicts of Interest

The authors declare that there are no conflicts of interest related to this study.

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