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Original Article

EFFECT OF PROPOFOL AND ISOFLURANE ON HEMODYNAMIC CHANGES DURING SPINAL SURGERY UNDER GENERAL ANESTHESIA

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Abstract:

Background: *Hemodynamic stability are vital requirements of up-to-date anesthesia. Both propofol and isoflurane meet these criteria though the clinical effects like postoperative nausea vomiting after administering propofol and isoflurane have been studied in various surgeries but have not been much evaluated or studied in patients undergoing major surgical procedures like spine surgeries, There' is definite advantage of one technique over the other. Isoflurane has a low blood gas partition coefficient, which contributes to rapid induction and emergence from anaesthesia than with other volatile anesthetics in current clinical use. Propofol has been established as the intravenous agent that provides faster and smoother recovery & peri operative hemodynamic stability.*

Objective: *To compare the effects of isoflurane and propofol regarding hemodynamic status in spinal surgery under general anaesthesia.*

Methods: *After getting ethical approval, a randomized controlled trial study design was performed where patients were selected in the pre-anesthetic checkup room based on inclusion and exclusion criteria for those who were scheduled for spine surgeries under general anesthesia is admitted in the Department of Neurosurgery in East West Medical College from January 2023 – December 2024. A total number of 40 patients were selected. 20 patients were enrolled each in group A and group B by lottery method in a sealed envelope. They were divided into two groups by randomization; Group A and Group B. A written informed consent was taken from all selected patients. Patients were advised to fast for at least 8 hours before intervention. In Group A, anesthesia is maintained with propofol infusion, nitrous oxide (66%), and oxygen (33%) while in Group B, anesthesia is maintained with Isoflurane, nitrous oxide (66%), and oxygen (33%). All patients were given N2O in oxygen and 1.25% inspired concentration of Isoflurane (MAC -1.15). In Group A propofol infusion at rate of 80 µg/kg/min (fixed from the beginning). All data was collected at –Just after starting, 15 minutes, 30-minute, 1 hour, and >1 hour interval per operatively. Data was compiled, edited and plotted in tabular and figure form. P value was determined as significant when it was <0.05.*

Results: *40 patients yielded the following results. The mean age of Group A and B were 32.56±12.55 years and 34.6±12.5 years. Mean difference of heart rate was lower in Group A than that of Group B. Other parameters in both groups were confined to good and acceptable categories. But interestingly, there was a statistically significant difference found between Group A and Group B in Systolic Blood Pressure (SBP) & Diastolic Blood Pressure (DBP). The scoring was far better in Group A than Group B. Mean SBP was higher in Group B than Group A (p= >0.05). Similarly, mean DBP was also higher in Group B than Group A (p = >0.05).*

Conclusion: *Propofol is better for maintaining hemodynamic status than Isoflurane for Spine surgery under General anaesthesia.*

Keywords:
Propofol , Isoflurane, Spine surgery, Hemodynamic Changes

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Introduction:

Hemodynamic stability is the main concern of modern anesthesia. Major surgical procedures like brain and spine surgeries require Controlled hypotension where both propofol and Isoflurane meet these criteria.

In neurosurgical day-to-day cases, spine surgeries are performed where increased bleeding results in further difficulties obtaining an adequate surgical field. As a result, the operation becomes more difficult and takes longer than usual time. Controlled hypotension [1]; (mean arterial pressure between 60-70 mmHg) can provide better surgical field conditions and lessen the operation time which ultimately improves surgical comfort for surgeon and patient outcome.

To reduce bleeding, surgeons usually apply many techniques during Spine surgeries. Applying local vasopressors (Lidocaine and epinephrine) before incision, hypotensive drugs, and tight control of CO_2 are the very excellent ways to prevent hemorrhage. Thus, the operating surgeon can smoothly and comfortably complete the procedure. The anesthetic drugs can also play a significant role in reducing hemorrhage by vasodilatation and by controlling blood pressure.

Moreover, general anesthesia allows for achieving hypotensive anesthesia. Controlled hypotension is required in Spine surgeries for better visualization and to minimize operative time and blood loss. Various agents like beta-blockers, combined alpha and beta blockers, alpha2 agonists, and vasodilators, have been used to achieve controlled hypotension [2]; Isoflurane-based inhalational anesthetic technique for achieving controlled hypotension has gained wide popularity. In Western countries, Total intravenous anesthesia (TIVA) using propofol and remifentanil is a common practice [3].

General anesthesia is routinely provided by the use of an intravenous sedative-hypnotic as an induction agent followed by inhalational agents for maintenance of anesthesia. The widespread availability of non-pungent and rapidly acting volatile anesthetic agents is in increasing use for induction and maintenance of general anesthesia The use of appropriate anesthetic agents that provide fast and smooth induction, allows fast changes in intensity while maintaining anesthesia and early recovery. So based on these characteristics, for fast induction and early recovery, newer inhalation agents based on low blood/gas partition coefficients are being used as alternatives to propofol in various anesthetic procedures. Chemically Isoflurane is a clear, colorless, stable liquid containing no additives or chemical stabilizers. It has a mildly pungent, musty, ethereal odor. The minimum alveolar concentration (MAC) for isoflurane (1.15%) is one-and-one-half times that for halothane (0.75%) and two-thirds that for enflurane (1.7%). The blood/gas partition coefficient (1.4) for isoflurane is lower than the coefficients for all other potent inhaled agents. Isoflurane has the largest circulatory margin of safety of all potent halogenated agents; it produces the least myocardial depression at a given multiple of MAC [4].

Total intravenous anesthesia (TIVA) with propofol and opioids effectively obtunds the adrenergic response to surgical stress with a concomitant reduction in plasma catecholamine concentrations. Propofol is very popularly used in general anaesthesia which decreases systemic blood pressure by inhibiting of vasoconstrictor activity of the sympathetic nervous system. 20-30% of blood pressure is reduced in comparison to pre-induction BP by propofol in the maintenance phase. Propofol has been established as the intravenous agent that provides faster and smoother recovery & Per operative Hemodynamic stability.

So the present study has been conducted to compare Propofol with Isoflurane for maintaining anesthesia concerning intraoperative hemodynamic characteristics in patients undergoing Spine surgeries under General anaesthesia.

Methods:

Study design: Randomized controlled trial.

Period of study: January 2023 – December 2024.

Sample size: 40 patients were selected as per inclusion and exclusion criteria who were scheduled for Spine surgery under General anesthesia.

Study population: Patients admitted for Spine surgeries under General anesthesia in Department of Anaesthesia, and Intensive Care Medicine, and Department of Neuro-Surgery at East West Medical College Hospital. Patient was grouped as follows:

Group A: Patient receiving Propofol

Group B: Patient receiving Isoflurane

Here Group A was considered as a controlled group and Group B was considered as experimental group.

Inclusion Criteria

- Age ranges between 18 – 60 years of both sexes.
- American Society of Anaesthesia (ASA) grade I & II
- The patient is scheduled for elective Spine surgeries.
- Who gives informed written consent
- Mallampati class I & II

Exclusion Criteria:

- Acute neurological disease/raised ICP.
- Refusal to give consent.
- Renal or Hepatic impairment.
- American Society of Anaesthesia (ASA) grade III and above.
- Pregnant and lactating mother.
- Patients with a history of bleeding disorders.
- Hypersensitivity to halogenated agents.

Sampling Methods

Randomization by unmarked envelope where the name of the single group was written in a single envelope. Double blinding was done where both patient and interventionist did not know about the proposed procedure.

Procedures of collecting data

All the data were collected with structured questionnaires (Data Collection Sheet) and face to face interviews and by observation.

Procedures of data analysis and interpretation

Statistical analyses were carried out by using the Statistical Package for Social Sciences version 17.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean values were calculated for continuous variables. A comparison of numerical variables between the study was done using Student's t-test. For comparing categorical data, the Chi-square ($\div^2$) test with Yates correction was performed. P values less than 0.05 were considered statistically significant.

Results:

Table I depicts the basic difference between the essential profiles of the patients enrolled in Group A and Group B. The difference between the variables showed no significant difference (P=>0.05).

Table II shows the intergroup comparison of heart rate at different intervals. All the values in the rest of the periods were higher in Group B patients when compared to Group A. The mean difference at 30 min, 1 hr and >1hr interval showed statistically significant difference (P=<0.05).

Table III shows the intergroup comparison of SBP at different intervals. All the values in the rest of the periods were higher in Group B patients when compared to Group A. The mean difference at 30 min, 1 hr and >1hr interval showed statistically significant difference (P=<0.05).

Table IV shows the intergroup comparison of DBP at different intervals. All the values in the rest of the periods were higher in Group B patients when compared to Group A. The mean difference at 30 min, 1 hr and >1hr interval showed statistically significant difference (P=<0.05).

Table-I

Demographic variables of respondents (n=40; 20 in each group)

Variables	Group A (n=20)	Group B (n=20)	P-value
Age (years)			
Mean±SD	32.56±12.55	34.6±12.5	>0.08^{NS}
Range	18 – 52	18 – 56	
Sex			
Male	11	15	>0.07^{NS}
Female	9	5	

Statistics calculated by chi square test & student's t test
NS: Not significant
S: Significant

Table V shows the intergroup comparison of MAP at different intervals. All the values in the rest of the periods were higher in Group I patients when compared to Group P. The mean difference at 30 min, 1 hr and >1hr interval showed statistically significant difference (P=<0.05).

Table-II

Comparison of mean heart rate status between the groups (n=40; 20 in each group)

Time Interval	Group A	Group B	p-value
0 min	86±3.14	83.00±3.14	0.07
15 min	82±3.14	80.00±3.14	0.09
30 min	76±3.14	82.00±3.14	0.00*S
1 hr	82.20±3.17	90.00±3.14	0.00* S
>1 hr	88±3.14	92.00±3.14	0.00* S

*p-values less than 0.05 were taken as significant

Table-III

Comparison of mean Systolic Blood Pressure (SBP) status between the groups (n=40; 20 in each group)

Time Interval	Group A	Group B	p-value
0 min	120.00±3.14	122.00±3.14	0.09
15 min	118.00±3.14	120.00±3.14	0.07
30 min	114.00±3.14	120.53±4.05	0.03* S
1 hr	118.00±3.14	130.53±4.05	0.02* S
>1 hr	126.67±2.77	129.27±3.52	0.04* S

*p-values less than 0.05 were taken as significant

Table-IV

Comparison of mean Diastolic Blood Pressure (DBP) between the groups (n=40; 20 in each group)

Time Interval	Group A	Group B	p-value
0 min	80.00±3.14	82.00±3.14	0.07
15 min	78.00±3.14	80.00±3.14	0.05
30 min	74.00±3.14	80.53±4.05	0.00* S
1 hr	78.00±3.14	90.53±4.05	0.03* S
>1 hr	86.67±2.77	89.27±3.52	0.09* S

*p-values less than 0.05 were taken as significant

Table-V

Comparison of mean Mean Arterial Pressure (MAP) between the groups (n=40; 20 in each group)

Time Interval	Group A	Group B	p-value
0 min	72.00±3.14	74.00±3.14	0.09
15 min	70.00±3.14	72.00±3.14	0.07
30 min	62.00±3.14	68.53±4.05	0.00* S
1 hr	66.00±3.14	68.53±4.05	0.00* S
>1 hr	74.67±2.77	77.27±3.52	0.04* S

*p-values less than 0.05 were taken as significant

Discussion:

Spine surgery is a classy surgery that deals with minute operative field surrounded by vital structures. A little bleeding can cause grave harm that can manifest various complications. To make the surgical field less bloody the hemodynamic status is a burning concern. Wise full use of anesthetic agents that can provide a better hemodynamic status by controlled hypotension is very much beneficial to get a clean field. Interestingly, different types of agents and techniques have been used so far to get better results in this regard. Among them, propofol and Isoflurane have proved their efficacy. But there are very few papers not only in our country but also the anesthesiologist scientific world regarding the comparative study of the efficacy of the mentioned two anesthetic agents.

Our study found the difference between the demographic variables of the patients enrolled in both groups. The difference between the variables shows no significant difference (P=>0.05), which is consistent with the study titled The effect of the total intravenous anesthesia compared with inhalational anesthesia on the surgical field during Neuro surgery [5].

In another study,[6] authors compared the effect of propofol and isoflurane on hemodynamic parameters and stress response hormones during Laparoscopic Cholecystectomy surgery which is under general anesthesia, and they found heart rate and mean atrial pressure changes did not show significant differences between the two groups in all stage ($P > 0.05$), but isoflurane group tolerated lower fluctuating changes. They also found that blood glucose and serum epinephrine level rise in the isoflurane group were significantly higher than the propofol group ($P < 0.05$).In our study, intergroup comparison of heart rate at different intervals revealed all the values in the rest of the periods during operative time were higher in Group B patients when compared to Group A. The mean difference at 30 min, 1 hr and >1hr interval showed a statistically significant difference (P=<0.05) which is similar findings of other study[6].

In our study, the mean SBP are much higher in the patients using isoflurane than propofol. The mean difference at 30 min, 1 hr and >1hr interval showed statistically significant difference (P=<0.05). A randomized controlled trial study conducted[7] on effect of intravenous anesthesia with propofol *versus* isoflurane inhalation anesthesia revealed the mean of age, heart rate, systolic and diastolic blood pressure, oxygen saturation, end tidal carbon dioxide (ETCO2) before surgery were not statistically significant between two groups ($P > 0.05$). So our finding was not consistent with the study conducted by other author[7] who conducted a randomized controlled trial for the same purpose. This is possible because they were using intravenous anesthesia rather than general anesthesia. Although goal of a target systolic blood pressure was achieved in both groups. Both isoflurane- and propofol-based techniques were equally capable of producing controlled hypotension. In a study published in International Journal Of Research in Medial Science[8] showed that the highest concentration used in isoflurane group to achieve target blood pressure was an inspired concentration of 1.25%. We used the same protocol but our finding was the mean DBP is much higher among the patients of Group B than that of Group A. The DBP mean at 30 min, 1hr and >1hr time period showed statistically significant difference (P=<0.05).

In a study by two different authors[9,10] mean arterial pressure of 60–70 mmHg was aimed for surgeries, which is almost similar to our study where we found intergroup comparison of MAP at different intervals showed the values in the rest of the operating periods were higher in Group B patients when compared to Group A. The mean difference at 30 min, 1 hr and >1hr intervals showed a statistically significant difference (P=<0.05).

It was possible because we used the infusion rate based on the patient's body weight and hemodynamic response. Other factors that influence the propofol dosage requirement include age, weight, preexisting medical conditions, type of surgical procedure, and concomitant medical therapy. In our study, maintenance of target (MAP) blood pressure within the 60–70 mmHg range was more consistent with the propofol group when compared to the isoflurane group.

Conclusion:

Based on our findings, we can conclude that propofol is better than isoflurane for the maintenance of hemodynamic status during spinal surgery under general anesthesia.

Limitation of the study:

This study was conducted in two different institutes without a definitive continuation phase, there was a time-lapse for a brief period. The sample size was too small and study time was shorter.

Recommendations:

The study should be a multicenter, double-blinded study where all the hospitals of Bangladesh who has facilities for spine surgery should be covered so that we can reach a consensus regarding the better outcome of propofol use in Spine surgery.

- The study period should be long.
- The sample size should be large.

Conflict of Interest: None to disclose

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