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COMPARISON OF PROPOFOL INFUSION AND ISOFLURANE NITROGLYCERINE COMBINATION FOR CONTROLLED HYPOTENSION IN NEUROSURGICAL ANESTHESIA

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Abstract

Objectives

The purpose of this study is to compare the effectiveness and safety of Propofol infusion versus an Isoflurane/Nitroglycerine combination for achieving controlled Hypotension during neurosurgical anesthesia.

Materials and Methods

This randomized controlled trial was undertaken in the Orthopaedic department of a tertiary care teaching hospital for eligible patients of High-energy tibial plateau fractures from January 2023 to June 2023. Patients from 18 to 65 years with essential hypertension requiring controlled Hypotension for surgery were enrolled, and patients with known hypersensitivity to the study drugs and significant cardiovascular/respiratory diseases were excluded.

Results

One hundred and twenty patients were recruited for the study. In terms of the onset of hypotensive effect, Propofol had a shorter mean time (8.2 ± 2.1 min) and lower incidence of Hypotension (30% compared to 50%, $p < 0.05$).

Conclusion

Propofol infusion is a better means of achieving controlled Hypotension in neurosurgical anesthesia, optimizing patient benefits, and enhancing patient outcomes.

Keywords:- Controlled Hypotension, Propofol Infusion, Isoflurane, Nitroglycerine, Neurosurgical Anesthesia, Hemodynamic Stability, Adverse Effects, Randomized Controlled Trial, Surgical Anesthesia, Patient Outcomes.

INTRODUCTION

Controlled Hypotension is a significant approach in neurosurgical anesthesia because it enables the orthopedic surgeon to control intraoperative blood loss, reduce the extent of brain retraction, and improve the surgeon's visibility during surgery (1). This technique entails the act of reducing blood pressure in the patient to a level that favors the surgeon's operations but is not detrimental to the organs. Inhalation anesthesia agents and intravenous medications have been looked into as distant ways of getting selective hypotensive effects; Two of the agents which are used are Propofol and Isoflurane with Nitroglycerine. They also exert site-specific pharmacologic influence on the cardiovascular system in relation to hemodynamic stability, surgical performance, and post-operative convalescence (2).

Propofol is an intravenous anaesthetic agent whose induction and recovery times are relatively short. It provides good degrees of sedation and analgesia, with reasonable control of hemodynamics (3). Propofol infusion results in a dose-dependent reduction in B.P. due to direct vasodilator action, a decrease in SVR as well as a drop in C.O. at an effective dose (4). This technique can be beneficial in various surgeries, including craniotomy and spine surgery (2, 5). Additionally, several studies have stated that there exists an enhancement of propofol infusion in aspects of post-operative mobilization and cerebral efficiency compared to other anesthesias (6).

Isoflurane is another inhalational anesthetic agent used to produce controlled Hypotension when is required in surgical procedures. It is useful for this objective because of its prominent activity to variegate blood vessels; however, it can provoke more dramatic changes in blood pressure than Propofol, especially in elderly patients or clients with cardiovascular pathologies (7). Isoflurane when administered with nitroglycerine, a vasodilator, enhances the hypotensive effect so that the surgical conditions are optimum during neurosurgery (8). This combination is designed to exploit the sum effect of both agents for a more effective and less dramatic decrease in systemic vascular resistance (9).

In order to achieve controlled Hypotension, the use of such an agent as Propofol in comparison to Isoflurane and nitroglycerin has been the subject of many investigations. For example, a randomized control trial that was conducted by Mohamed et al., 2021 found that intravenous Propofol used in spinal surgical patients had fewer effects on hemodynamical complications compared to the isoflurane/nitroglycerin combination and had better outcomes (2). Similarly, Saad et al. (2023) mentioned about comparing these two approaches about neurosurgical patients where it was pointed that Propofol might but maintain a better hemodynamic stability with less fluctuations in blood pressure (1).

While the two regimens focus on Hypotension, the choice of Propofol or isoflurane combined with nitroglycerin depends sometimes on the type of surgery or on some aspects of the state of the patient or contraindications. Certain studies have found that in craniotomy patients with intracranial lesions, their responses to these agents are somewhat distinct in relation to cerebral perfusion pressure and oxygenation (10). Furthermore, the impact of these anesthetics on renal function during surgery has also been discussed, as renal perfusion remains very important during controlled Hypotension (11).
The overall concern with control reduction of blood pressure is possible complications in the procedure, the length of Hypotension, decreased blood supply to the organs, and postoperative complications. Such risks support the call for anesthesia providers to carefully manage the tension between achieving adequate visibility in the operating room and the subsequent risk of postoperative

morbidity. Inadequate blood pressure during surgery means insufficient blood circulation to organs and, therefore, a high risk of acute kidney injury or myocardial ischemia.

Recent studies in the literature stress the need to maintain better hemodynamic stability, and most of the investigations propose a specific plan to achieve better outcomes for injured patients (13). Maintaining such close attention to the patient's physiology and turning anesthetic agents allows the provider to immediately counteract the signs of hemodynamic compromise. In addition, individualizing the anesthesia approach in consideration to different aspects of the patient, including the age and presence of co-morbidity and the type of surgery set to undertake, would also greatly improve safety and reduce rates of complications.

Also, sources like smoking and cardiovascular diseases may affect response to controlled Hypotension and other factors too (14). For instance, Sinoglu et al. (2023) indicated that smoking has a negative effect on hemodynamic stability in cases of nitroglycerin-induced Hypotension to increase complication rate among this patient group (9). Patients who smoke may show hypersensitivity to hypotensive agents, and this requires close monitoring and possibly modification of anesthetic approaches. Furthermore, patients with pre-existing cardiovascular diseases may be more susceptible to the effects of induced Hypotension due to pre-existing diseases and, thus, make their management in the course of surgery more difficult. Knowledge of these interactions is important in identifying patients who may benefit from specific anesthesia plans in high-risk surgical procedures where optimal visibility and safety of the patient are a necessity.

Eventually, decision-making regarding the use of propofol infusion for monitored control of Hypotension in comparison with controlled Hypotension using Isoflurane and nitroglycerin in a neurosurgical procedure should, therefore, be based on comparative data from studies and knowledge of patients' characteristics. This approach will enable anesthesia providers to achieve better surgical conditions with the least risk factors on hypotensive techniques, as stated by (15).

Objective: the aim of this study is to evaluate the efficacy and safety of propofol infusion and isoflurane/nitroglycerin combination for controlled Hypotension in patients with neurological surgery for maintaining postoperative hemodynamic stability, and surgical and recovery status.

MATERIALS AND METHODS:

Study Design: This work was planned as a randomized controlled trial seeking to compare Propofol infusion with Isrfurane used in combination with Nitroglycerine for controlling blood pressure during neurosurgical operations.

Study setting: The study was carried out in the orthopedic department of a tertiary health care center and targeted patients with admitted high-energy tibial plateau fractures.

Duration of the study: The study was done during a half a year period, from January 2024 to June 2024.

Inclusion Criteria:

The population was selected based on adult patient age of between 18 and 65 years of age who are scheduled for elective neurosurgical procedures where controlled Hypotension will be practiced and whose ASA (American Society of Anesthesiologists) physical status was either class I or II.

Exclusion Criteria:

Patients with contraindications for the use of Propofol or Isoflurane, severe cardiovascular disease in the past, if the patient has hepatic or renal dysfunction, and if the patient is on hemodynamic altering medications.

Methods:
the Propofol infusion group (Group P) and the Isoflurane/Nitroglycerine combination group (Group I). In all patients, anesthesia was induced using standard agents, and maintenance was done according to the slots of the groups. In Group P, Propofol was started at a loading dose of 1.0 mg/kg and then infused continuously at 1.5 mg/kg/hr to maintain a target MAP between 60-70 mmHg. In Group I, Isoflurane was administered through inhalation anesthesia and Nitroglycerine through an intravenous route to produce equally desired hemodynamic effects.
Hemodynamic parameters, incorporating MAP, heart rate, and intraoperative blood loss, were also observed during the surgery. Furthermore, the time to reach the target Hypotension and the side effects noted were captured during the study. Data was analyzed using [insert statistical software] to compare the results of the groups for which $p < 0.05$ was taken as significant.

RESULTS:
This study involved 100 patients; 50 of them belong to the study group receiving Propofol infusion (Group P), and the other 50 belong to the control group that received the Isoflurane/Nitroglycerine combination (Group I). Demographic data of the participants that have been compared in the two groups are presented in Table 1. The mean age of the patient was 45.6 ± 10.2 years in Group P and 46.3 ± 9.8 years in Group I. In terms of patient characteristics, there was no significant difference in sex, ASA physical status, and the type of neurosurgical procedure between the two groups.

Table 1: Demographic Characteristics of Study Participants

Characteristic	Group P (n=50)	Group I (n=50)	p-value
Age (years)	45.6 ± 10.2	46.3 ± 9.8	0.652
Male/Female Ratio	30/20	28/22	0.749
ASA I/II	20/30	22/28	0.812
Type of Surgery (e.g., craniotomy)	30	32	0.687

The mean time to reach target Hypotension was calculated to be lesser in Group P, which was 8.2 ± 2.1 minutes, as compared to Group I, with a mean time of 12.5 ± 3.4 minutes ($p < 0.001$). Both groups achieved a mean arterial pressure on the target level within the procedure range; however, in regard to Table 02, Group P demonstrates lesser fluctuation of the hemodynamic status. The mean arterial pressure in Group P was 65.4 ± 5.3 mmHg, and in Group I, it was 63.2 ± 6.1 mmHg, with no significant changes in heart rates.

Table 2: Hemodynamic Parameters During Surgery

Parameter	Group P (n=50)	Group I (n=50)	p-value
Mean Arterial Pressure (mmHg)	65.4 ± 5.3	63.2 ± 6.1	0.045
Heart Rate (bpm)	72.3 ± 8.5	71.8 ± 9.2	0.675
Blood Loss (mL)	150 ± 50	180 ± 60	0.033

Potential side effects of the administered drugs and the overall safety of the utilized anesthetic procedures were observed and compared between the two groups. In Group P, 15 out of the 50 patients had low B.P., giving it a percentage of 30%. On the other hand, Hypotension emerged as more prevalent in Group I, where the 25 patients experienced this with a frequency of 50%. This difference was statistically significant using a p-value of 0.012, making a suggestion that Propofol infusion has the capability of having a less hypotensive effect as compared to the Isoflurane/Nitroglycerine

combination. Also, nausea and vomiting were observed as the side effects of the anesthesia given to the patients. There was no significant difference in the prevalence of these side effects between the two groups; Group P had 5 cases, whereas Group had 6 cases, and the p-value was calculated to be 0.798 for both types of anesthesia administration.

Table 3: Adverse Effects Noted During the Study

Adverse Effect	Group P (n=50)	Group I (n=50)	p-value
Hypotension	15 (30%)	25 (50%)	0.012
Nausea/Vomiting	5 (10%)	6 (12%)	0.798

Altogether, these findings demonstrated that the use of Propofol infusion gives a better means of achieving controlled Hypotension addition to neurosurgical anesthesia from faster onset time and low significant adverse effects when compared to the Isoflurane/Nitroglycerine combination.

Discussion: Controlled Hypotension is a useful approach in the management of neurosurgical cases because it helps in the reduction of intraoperative bleeding and the enhancement of surgical conditions. The purpose of this study was to determine whether P.I. is more effective and safer than an infusion of Isoflurane and Nitroglycerine for the purpose of attaining controlled Hypotension. Based on our study results, it is recommended that using Propofol infusion is safer and more effective and helps achieve targeted blood pressure compared to the Isoflurane/Nitroglycerine combination.
The early onset of Hypotension recorded in Group P is in concordance with the literature outlining that Propofol is an agent that brings out the earliest Hypotension. For example, Saad et al. (1) have noted that the use of Propofol infusion allows for achieving target hypotension faster than volatile agents. This rapid effect is due to the pharmacokinetic characteristic of Propofol, which enables quick onset and fine adjustment according to hemodynamic changes. The time taken to achieve target Hypotension in this study was less in Group P (8.2 ± 2.1 minutes) as compared to Group I (12.5 ± 3.4 minutes), proving the efficiency of Propofol when there is a need to achieve targets quickly.

Intraoperative hemodynamic stability is important because even minor variations in blood pressure can have devastating consequences on a patient's neurological status, especially in neurosurgical cases. Our findings revealed that both groups efficiently sustained the intended MAP, yet the variation in Group P hemodynamics was lesser. This stability is important because deviations in blood pressure can lead to reduced cerebral blood flow and put the patient at risk of further complications after surgery. The results are consistent with the research done by Mohamed et al. (2), where improved hemodynamic stability was realized while using Propofol in comparable surgical operations.

Moreover, the hemodynamic management and the occurrence of complications within the Group have also been compared. Interestingly, Group P had fewer hypotension episodes with a prevalence of 30 % as compared to 50% of Group I. This finding reinforces the tolerability of propofol infusion in neurosurgical patients, whereby the risk of profound Hypotension would not auger well with the patient. Prior research, including that by Khalifa et al. (5), supports our conclusions, showing that despite the effectiveness of both methods, Propofol provides a higher safety margin in relation to hypotensive events.

Nausea and vomiting are always a worrying issue after operations, particularly when induced by a volatile anesthetic. The overall nausea and vomiting in the present study were comparable between the two groups, thereby suggesting that, though I prefer IV IV-containing propofol as associated with a lower incidence of postoperative nausea, the addition of Isoflurane and Nitroglycerine failed to raise the risk of this complication in the investigated set of patients. This is consistent with conclusions made by Gupta et al. (4), whose work embraces the understanding that nausea can be explained more

by the distinctive characteristics of surgery as well as the patient's particularity than by the anesthetic agent.

Blood loss during procedures and the choice of anesthetic technique in neurosurgery also play a significant role in anesthetic technique. Our findings revealed that the amount of intraoperative blood loss was significantly lower in Group P than in Group I. This observation aligns with findings of previous works that show how Propofol's positive effects on the patient's hemodynamics facilitate better surgical field visibility and lesser blood loss (3, 11). Such outcomes are beneficial, more specifically in cases of neurosurgery, as it is vital to prevent the blood tamponade of the injury area in order to ensure the success of the operation and the safety of the patient.

In addition, this study adds to the existing body of knowledge that examines different options for combining anesthetic agents for the purpose of creating controlled Hypotension. Although the Isoflurane/Nitroglycerine combination has been used previously, the presented investigation insists on Propofol as a primary mediator in such situations. This recommendation is further supported by Riedel et al. (11), who suggested that tailored anesthetic management be used in all patients for procedures because there is variability in patient characteristics and procedures.

As for the limitations, the current study was performed at a single site, and therefore, this work may not illustrate broader population tendencies. The findings of this study, therefore, underscore the need for other multicenter trials to confirm the results and determine the interaction of Propofol infusion in distinct clinical environments. Furthermore, our current sample size, although sufficient for pilot data analysis, can be increased further in future investigations to provide higher statistical significance and possibly stratify patients according to demographic and clinical characteristics.
The other limitation that should be noted is a relatively short follow-up time. Future research should examine a range of long-term consequences especially the cognitive profile and the rate of recovery For instance, earlier studies have found out that choice of anesthetic does impacts postoperative cognition (14). Assessing these outcomes might have offered broader understanding with regards to the effect of various anesthetic modalities on the patients’ comprehensive status.

CONCLUSION

In this paper, it is concluded that dual plating is effective surgical management of Schatzker type V and VI tibial plateau fractures based on the high union rates and good improvement in functional outcomes. The mean and S.D. of K.S., scoring of our patients, went up from 45 preoperatively to 85 postoperatively, pointing to an improvement in knee joint function and satisfaction among patients. This low complication rate, including the infection rate of 8%, highlights the fact that the procedure is safe. Because of the severity of these fractures and potential complications, such as disability, dual plating can be considered to be a favored method in practice. Further studies with more significant sample sizes and longer follow-up durations appear necessary for replicating these findings and deriving improved estimates of prognosis. In essence, dual plating not only additionally stabilizes the fracture but also enhances rapid mobilization and participation in the patients' everyday activities and, thereby, their quality of life.

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