DOI: https://doi.org/10.53350/pjmhs2023175271

ORIGINAL ARTICLE

Propofol Infusion Versus Isoflurane/Nitroglycerine Combination for Controlled Hypotensive Anesthesia in Neurosurgery

MUHAMMAD SAAD[1], HASEEBULLAH YOUSUF[1], TALHA AHMED[1], MIRWAIS KHAN[1], ADNAN NABI[1]
[1]Postgraduate trainee, Department of Anesthesia, Pain Management & Surgical Intensive Care, Jinnah Postgraduate Medical Centre, Karachi
Corresponding author: Muhammad Saad, Email: saad.guddar@gmail.com

ABSTRACT

Background: The use of hypotensive anesthesia is one of several techniques that have been used to lessen the intraoperative loss of blood and improve visibility in the operative field. A procedure that requires a clear area and little intraoperative bleeding, which can affect the surgeons' abilities, is Neurosurgery.

Objective: The current study aimed to assess how both anesthetics affected tissue perfusion, blood loss, operating field visibility, and extubation time.

Settings and Design: A prospective quasi-experiment was used in the design of this clinical trial

Practical Implication: The practical implication for choosing between propofol infusion and the isoflurane/nitroglycerine combination for controlled hypotensive anesthesia in neurosurgery includes considering several factors. Firstly, the patient's individual characteristics and medical history should be taken into account to determine the most suitable anesthesia approach. Secondly, the surgical procedure and the desired level of hypotension required should be evaluated. Thirdly, the availability and expertise of the anesthesia team in managing either method should be considered. Finally, potential side effects and complications associated with each technique should be weighed. Ultimately, a well-informed decision must be made based on these considerations to ensure the safety and efficacy of controlled hypotensive anesthesia in neurosurgery.

Patients and Methods: Sixty individuals with ASA I or II were separated into two groups; Group P received both induction and maintenance doses of propofol, while Group I received isoflurane for maintenance with nitroglycerine. Blood loss, heart rate, mean arterial pressure, and the degree of surgical field clarity were all monitored every ten minutes.

Results: As opposed to the isoflurane group, the propofol group substantial reduction in blood loss (p=0.01), improved clarity of the surgical field (p=0.002), and reduced time to extubation (p=0.001).

Conclusion: Even with the addition of the hypertension medication nitroglycerine to isoflurane, propofol for craniotomy improved surgical conditions and gave a quicker recovery than isoflurane.

Keywords: Nitroglycerin, Isoflurane, Propofol, Hypotensive Anesthesia, and Neurosurgery

INTRODUCTION

For neurosurgeons, intraoperative bleeding is a difficulty. The surgical field is more visible when blood pressure is reduced intraoperative, and this also helps to reduce venous hemorrhage from cancellous sinusoidal channels as well as bleeding from damaged arteries and arterioles. Since the 1970s, controlled hypotensive anesthesia has been recommended for use either alone or in conjunction with other methods to reduce bleeding during craniotomies[1, 2, 3]. There have been many endeavors to promote the surgical profession, such as situating patients correctly so that their abdomens are not compressed, which significantly lowers IVC pressure and lowers the likelihood of hemorrhage and congested epidural space[4]. Surgery performed quickly and efficiently by skilled hands is crucial to minimizing blood loss. It is crucial to use electrocautery and conduct thorough sub-periosteal dissection. Platelet aggregation and blood clot formation are passively induced by collagen, cellulose, and gelatin-based materials. On the other hand, the de novo formation of a fibrin clot is permitted by active hemostatic medications like thrombin or combination products. Additionally, they provide hemostasis within 10 minutes of dosing[5, 6].

Propofol is the most often used intravenous anesthetic in total intravenous anesthesia (TIVA); it negatively affects the heart's inotropic and chronotropic functions, which considerably reduce blood pressure and cardiac output (CO) due to its vasodilator effect on blood vessels[7, 8]. Isoflurane decreases blood pressure through lowering systemic vascular resistance since it is a myocardial depressant, and drop in blood pressure is associated with concentration[9].

This study compared the effectiveness of inhalational anesthesia using isoflurane and nitroglycerine during elective craniotomies for brain surgery to total intravenous anesthesia (TIVA) using propofol for controlled hypotension.

METHODOLOGY

From October 2022 to March 2023, this study was done at Jinnah Postgraduate Medical Centre Karachi. Before taking part in this trial, full written informed permission was obtained to all patients. 60 patients with American Society of Anesthesiologists (ASA) class I or II, of both sexes, undergoing elective craniotomy were randomly allocated to receive either propofol infusion as Group P (n=30) or isoflurane/nitroglycerine combination as Group I (n=30) in a prospective, quasi-experimental study using a non-probability consecutive sampling technique. An assistance nurse who was not involved in the administration of the anesthetic or the data collection performed the randomization using opaque sealed envelopes. OPENEPI calculator was employed to determine the sample size by taking the mean MAP in isoflurane group 15.43+ 2.03 [10] and in propofol group 10.53+ 1.11[10], with power of 80% and α error of 5%, the calculated sample size was 4 patients. We enrolled 60 patients and randomly separated them into two groups in order to account for boosting the strength and statistical validity. Exclusion criteria included anemia (hemoglobin level of 10 g/dl), hypertension, serious cardiac conditions, kidney diseases, hyperglycemia, and liver illnesses. The room used to prepare for anesthesia had the IV line placed. As soon as the patient reached the operating room, a 4-6 ml/kg/h dose of lactated Ringer solution was started. Standard monitors like non-invasive blood pressure (NIBP), ECG, pulse oximeter (SpO2), and capnography were utilized before initiating general anesthesia (GA).

Anesthetic Technique:

Group I: The anesthesia was initiated with 0.1 milligram/kg nalbuphine, 2 milligram/kg propofol and 0.5 milligram/kg atracurium before tracheal intubation was performed. To maintain MAP between 60 and 70 mmHg, anesthesia was maintained with 50% O_2/air and 1-2 MAC isoflurane, with modified isoflurane percentage based on hemodynamic monitoring. Atracurium was given in doses 0.1 milligram/kg as needed. The rate of the Nitroglycerine infusion was started at 5 mcg/min and gradually raised until the target MAP was reached.

Group P: 0.1 milligram/kg nalbuphine, 2 milligram/kg propofol and 0.5 milligram/kg atracurium were used to start the anesthesia. Tracheal intubation was then carried out. 50% O_2/air was used to maintain anesthesia. After intubation, propofol was infused at a rate of 12 mg/kg/h in first 10 minutes, followed by 10 mg/kg/h next 10 minutes, and then infused at an 8 mg/kg/h. The infusion was

controlled in response to the patient's hemodynamics and to maintain the MAP between 60 mm Hg and 70 mmHg. Atracurium increments were given 0.1 milligram/kg as necessary to keep the propofol infusion rate from going over 12 mg/kg /h, which the maximum rate is allowed.

Intraoperatively recorded variables:

1 Hemodynamics: MAP and Heart Rate (HR) at 10-minute intervals.

2 Intraoperative blood loss: The quantity of lost blood during surgery gathered and calculated.

3 The extubation time: This number represents the interval between ending the isoflurane or propofol infusion and withdrawing the endotracheal tube.

In groups I and P, the NTG and propofol infusion would be reduced if the MAP fell below 60 mmHg, respectively. If the MAP remained below 60 mmHg, adrenaline 10 mcg IV would be administered and repeated after three minutes. Atropine 10 mcg/kg would be given if the heart rate fell to less than 50 beats per minute, and the process would be repeated in three minutes if the heart rate remained low. Isoflurane, NTG infusions, and propofol infusions are halted in groups I and P, respectively, once the procedure is complete. When the train of four (TOF) count reaches two out of four, or when the patient opens their eyes and the second twitch emerges (less than 90% of receptors are blocked), the remaining atracurium is subsequently reversed with neostigmine 0.04 milligram/kg IV and glycopyrrolate 10 mcg/kg IV.

Following surgery, the following parameters were measured in the PACU: Mean arterial blood pressure, heart rate, and O_2 saturation recorded each 10 min.

The Aldrete's Modified Scoring System [8] used to assess patient recovery upon admission to the PACU and every 30 minutes thereafter. Patients released from recovery unit once they achieved score of nine or less.

Data analysis was performed using SPSS 26 (Statistical Package for the Social Sciences). For quantitative data, mean + SD was calculated; frequencies and percentages were provided for qualitative variables. The quantitative factors among two groups compared using independent t-test, while the qualitative variables compared using chi-square test. P-values lower than 0.05 were regarded as significant.

RESULTS

There was no statistically significant difference between the two groups' demographic data (Table #I).

Table 1: Patient demographic information

Demographic details	Isoflurane (n=30) (mean + SD)/ n (%)	Propofol (n=30)	P-value
Age (mean + SD)	28.4 + 5.2	30+ 8.2	0.3705
BMI (mean + SD)	29.3 + 4.2	29.0 + 5	0.800
Gender • Male • Female	 18 (60%) 12 (40%)	 19 (63.3%) 11 (36.6%)	0.790
ASA Status: • ASA-I • ASA-II	 21 (70%) 09 (30%)	 22 (73.3%) 08 (26.6%)	0.774

Table 2: Heart rate variations in the two groups

Heart rate (beat/minutes)	Isoflurane (mean + SD)	Propofol (mean + SD)	P-value
Pre-operative	83.91+8.91	85.49+ 9.1	0.4995
At induction	74.67+5.21	69.10 +6.90	0.000
At intubation	77.6+ 7.20	72.53 +5.39	0.003
At 10 min	76.90+ 9.97	71.10+5.20	0.006
At 20 min	75.31+7.9	71.32+5.69	0.027
At 30 min	75.71+ 6.1	70.23+5.51	0.000
At 40 min	74.12+ 5.43	70.10+5.90	0.006
At 50min	76.21+ 4.81	70.90+4.10	0.000
At 60 min	74.53+ 4.71	71.64+5.89	0.040
At 70 min	75.39+ 5.18	70.69+6.42	0.002
At 80 min	75.60+6.73	69.30+3.24	0.000
Post-extubation	77.93+ 7.10	75.1 +8.35	0.162

The baseline HRs of the two groups did not differ noticeably during induction, the two groups' HR significantly (by around 25%) reduced from baseline values before rising once more during tracheal intubation. Both groups' heart rates were nearly stable during the intraoperative time, however the heart rate decline in propofol group was lower than isoflurane group, difference was significant statistically. (Table # II) and Fig. (1).

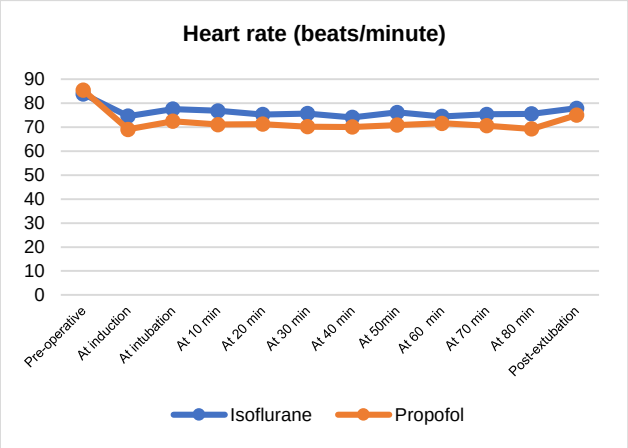

Figure 1: Comparison of heart rate between two groups

MAP not substantially different between two groups in preoperative period or when general anesthesia (GA) was induced. Compared to the isoflurane, the propofol group experienced a substantial drop in MAP following intubation. The intraoperative MAP readings did not significantly differ among two groups. (Table # III) and Fig. (2).

Table 3: Changes in Mean Arterial Pressure (MAP) between the two groups

MAP (mmHg)	Isoflurane (mean + SD)	Propofol (mean + SD)	P-value
Pre-operative	81.83+ 7.05	81.52+ 4.68	0.841
At induction	70.07+ 6.33	67.41+ 3.91	0.05
At intubation	75.30+ 4.54	70.02+ 2.19	0.000
At 10 min	70.83+ 2.65	71.38+ 2.53	0.414
At 20 min	68.33+ 2.68	69.80+ 2.91	0.046
At 30 min	67.83+ 2.98	69.69+ 4.51	0.064
At 40 min	66.63+ 2.39	68.71+ 5.32	0.055
At 50min	68.43+ 1.99	70.00+ 3.81	0.05
At 60 min	70.03+ 1.40	70.80+ 3.61	0.280
At 70 min	69.97+ 2.27	71.53+ 3.69	0.053
At 80 min	70.23+ 2.03	71.30+ 2.91	0.104
Post-extubation	79.53+ 7.23	81.07+ 3.71	0.303

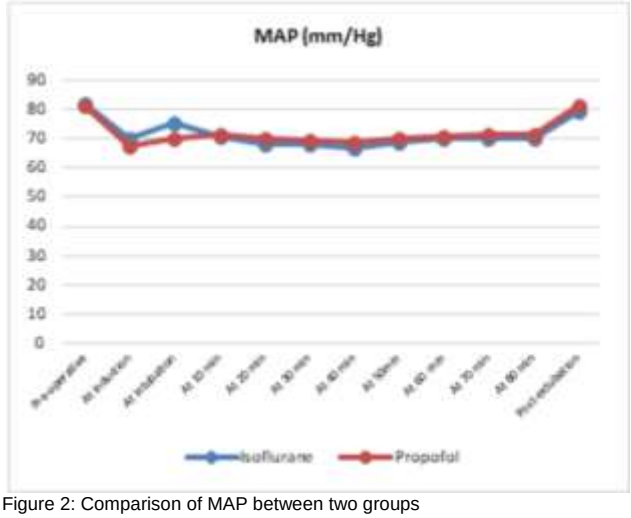

Figure 2: Comparison of MAP between two groups

According to (Table # IV), blood loss was much less in the group receiving propofol compare to group receiving isoflurane.

Table 4: Comparison of blood loss in both groups

Blood loss (ml)	Isoflurane (mean + SD)	Propofol (mean + SD)	P-value
Blood loss	689.8 +289.9	369.41 + 132	0.000

Time to extubation prolong in the group receiving isoflurane, difference statistically significant between the groups (Table # V).

Table 5: Comparison of the two groups' extubation times

Extubation time (minutes)	Isoflurane (mean + SD)	Propofol (mean + SD)	P-value
Extubation time	15.34+ 2.03	10.49+ 1.09	< 0.001

DISCUSSION

A perfect surgical operation is made possible by the anesthesiologist and neurosurgeon working together to precisely visualize the surgical field. The time of the procedure, patient morbidity, and overall surgical expense are all greatly decreased when intraoperative blood loss is kept to a minimal[11, 12]. Propofol, the most used intravenous anesthetic in total intravenous anesthesia (TIVA), considerably reduces BP secondary to blood vessel-dilating properties. Due to its negative chronotropic and inotropic effects, it also lowers cardiac output (CO)[13]. Isoflurane decreases blood pressure through reducing systemic vascular resistance since it is a myocardial depressant, drop in blood pressure is associated with its dose. Propofol was found to have a better surgical field than isoflurane in the current trial by affecting heart rate, which also resulted in less blood loss. In a research Marzaban et al[14] comparing propofol and isoflurane for FESS, propofol caused lower loss of blood than isoflurane (p=0.003). Propofol/remifentanyl combination in lumbar spine fixation proved superior to isoflurane and improved surgical vision, according to a different study from Salama HF et al[15]. Propofol for endoscopic sinus surgery did not significantly outperform isoflurane, according to Haghbin MA and Ankichetty PS research[16], either in terms of blood lost or clarity of surgical field. In our study, time to extubation was considerably shorter for the propofol compared to isoflurane group (p=0.001). The study confirms Khalid A et al's findings[18] that propofol, as opposed to isoflurane, allows for a speedier recovery following laparoscopic cholecystectomy. Propofol/remifentanyl for septorhinoplasty showed a shorter recovery time than isoflurane/remifentanyl by Haki KB et al. On the other hand, no discernible difference in the length of recovery among propofol vs isoflurane group in LD Mishra et al.'s study[20].

CONCLUSION

Even when antihypertensive (Nitroglycerine) was added to isoflurane, propofol for neurosurgery improved operative conditions and provided faster recovery than isoflurane.

Declaration Interest: None

Financial Disclosure: The authors did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Elbakry AE, Ibrahim E. Propofol for spine surgery improve surgical condition and provide faster recovery compared to isoflurane even when we added antihypertensive (nitroglycerine) to isoflurane.Minerva Anestesiol 2017;83:1248–54.
2. Yuchun Y, Yuping H. Comparison of the effects of sevoflurane and propofol combined with remifentanil anesthesia in neurosurgery. Mod J Integr Tradit Chin West Med 2019;28:2940–3.
3. Wang L, Shen J, Ge L. Dexmedetomidine for craniotomy under general anesthesia: a systematic review and meta-analysis of randomized clinical trials. J Clin Anesth 2019;54:114–25.
4. Mohamed G. Tawab A, Mohamed A. Hamed and Fiki AE. Propofol infusion versus combination of isoflurane with nitroglycerine for controlled hypotensive anesthesia in spine surgery: a randomized controlled study. Med J Cairo Univ. 2021;89(1): 423-29.
5. Vimala S, Arulvelan A, Chandy Vilanilam G. Comparison of the effects of propofol and sevoflurane induced burst suppression on cerebral blood flow and oxygenation: a prospective, randomised, double-blinded study. World Neurosurg 2020;135:e427–34.
6. Prontera A, Baroni S, Marudi A. Awake craniotomy anesthetic management using dexmedetomidine, propofol, and remifentanil. Drug Des Devel Ther 2017;11:593–8.
7. Tegegne SS, Gebregzi AH, Arefayne NR. Deliberate hypotension as a mechanism to decrease intraoperative surgical site blood loss in resource-limited setting: A systematic review and guideline. Int J Sur. 2021;29:55-65.
8. Slupe AM, Kirsch JR. Effects of anesthesia on cerebral blood flow, metabolism and neuroprotection. J Cereb Blood Flow Metab. 2018;38(12):2192-08.
9. Liu J, Zhong H, DeMeo D, Do H, Kirksey M, Gonsales Della Valle A, et al. Controlled hypotension during neuraxial anesthesia is not associated with increased odds of in-hospital common severe medical complications in patients undergoing elective primary total hip arthroplasty- A retrospective case-control study. PLoS One. 2021;16(4):e0248419.
10. Mohamed A. Hamed MD, EL FIKI A. Propofol Infusion versus Combination of Isoflurane withNitroglycerine for Controlled Hypotensive Anesthesia in Spine Surgery: A Randomized Controlled Study. The Medical Journal of Cairo University, 2021; 89(March): 423-29.
11. Hur SR, Huizenga BA, Major M. Acute normovolemic hemodilution combined with hypotensive anesthesia and other techniques to avoid homologous transfusion in spinal fusion surgery. Spine (Phila Pa 1976). 1992 Aug;17(8):867-73.
12. Copley LA, Richards BS, Safavi FZ, Newton PO. Hemodilution as a method to reduce transfusion requirements in adolescent spine fusion surgery. Spine (Phila Pa 1976). 1999 Feb 1;24(3):219-22; discussion 223-4.
13. Robinson BJ, Ebert TJ, O'Brien TJ, Colinco MD, Muzi M. Mechanisms whereby propofol mediates peripheral vasodilation in humans. Sympathoinhibition or direct vascular relaxation? Anesthesiology. 1997 Jan;86(1):64-72.
14. Marzban S, Haddadi S, Mahmoudi Nia H, Heidarzadeh A, Nemati S, Naderi Nabi B. Comparison of surgical conditions during propofol or isoflurane anesthesia for endoscopic sinus surgery. Anesth Pain Med. 2013 Sep;3(2):234-8.
15. Salama HF. Remifentanyl/propofol total intravenous anesthesia versus k./isoflurane inhalation anesthesia for controlled hypotension in lumbar spine fixation surgery, Ain-Shams JAnesthesiol.2014;7:134-7.
16. Haghbin MA, Deh HH, Shabani M. Evaluating the Efficacy of Remifentanyl-Propofol versus Isoflurane in Reducing Blood Loss with Considering Depth of Anesthesia during Endoscopic Sinus Surgery). Neurosci & Medi J.2013;(4):59-62.
17. Ankichetty SP, Ponniah M, Cherian V, Thomas S, Kumar K, Jeslin L, Jeyasheela K, Malhotra N. Comparison of total intravenous anesthesia using propofol and inhalational anesthesia using isoflurane for controlled hypotension in functional endoscopic sinus surgery. J Anaesthesiol Clin Pharmacol. 2011 Jul;27(3):328-32.
18. Khalid A, Siddiqui SZ, Aftab S, Sabbar S, Haider S. Recovery profile - a comparison of isoflurane and propofol anesthesia for laparoscopic cholecystectomy. J Coll Physicians Surg Pak. 2008 Jun;18(6):329-33.
19. Haki BK, Eftekhari J, Alizade V. Comparison of hemodynamic stability, bleeding, and vomiting in Propofol-remifentanil and isoflurane-remifentanil techniques in septorhinoplasty surgery, Jentashapir J Health Res.2014;5(3).
20. Mishra L, Pradhan S, Pradhan C. Comparison of propofol based anaesthesia to conventional inhalational general anaesthesia for spine surgery. J Anaesthesiol Clin Pharmacol. 2011 Jan;27(1):59-61.