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Original Research Article

A Comparative Study between Co-Induction Using Propofol with Ketamine and Propofol with Midazolam in Reducing the Dose of Propofol in General Anaesthesia: A Prospective Comparative Study

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Abstract

Background: Propofol is widely used as an induction agent in general anaesthesia due to its rapid onset and smooth recovery profile. However, it is associated with dose-dependent adverse effects such as hypotension and respiratory depression. The concept of co-induction involves the administration of a small dose of another agent prior to the primary induction drug to reduce the required dose and minimize adverse effects. Ketamine and midazolam are commonly used co-induction agents because of their synergistic effects with propofol. Ketamine provides analgesia and sympathetic stimulation, whereas midazolam offers anxiolysis and sedation. This study was conducted to compare the effectiveness of ketamine and midazolam as co-induction agents in reducing the induction dose of propofol and to evaluate their hemodynamic effects.

Aim: To compare the effectiveness of ketamine and midazolam as co-induction agents with propofol in reducing the required induction dose of propofol during general anaesthesia.

Materials and Methods: This prospective comparative study was conducted at Sri Siddhartha Medical College and Hospital, Tumkur, a tertiary care teaching institution, over a 24-month period. A total of 60 patients, aged 18–60 years, of either gender, scheduled for various elective surgical procedures under general anaesthesia. Patients were randomly divided into two groups of 30 each. Patients in Group KP received intravenous ketamine at a dose of 0.3 mg/kg as a co-induction agent prior to propofol administration, whereas patients in Group MP received intravenous midazolam at a dose of 0.03 mg/kg as the co-induction agent before the administration of propofol. After administration of the co-induction agent, propofol was given intravenously until loss of verbal response and eyelash reflex, and the total dose required for induction was recorded. Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were monitored at baseline, after co-induction, during induction, and after intubation. Statistical analysis was performed using appropriate tests, and $p < 0.05$ was considered statistically significant.

Results: The mean induction dose of propofol required in Group KP (ketamine-propofol) was significantly lower compared with Group MP (midazolam-propofol). Both co-induction agents effectively reduced the dose of propofol required for induction. However, patients receiving ketamine demonstrated better hemodynamic stability, with smaller reductions in blood pressure and heart rate compared to the midazolam group. The incidence of hypotension was higher in the midazolam group, whereas ketamine maintained more stable cardiovascular parameters during induction and intubation.

Conclusion: Co-induction with ketamine or midazolam effectively reduces the required dose of propofol for induction of general anaesthesia. However, ketamine provides superior hemodynamic stability compared to midazolam. Therefore, ketamine may be considered a preferred co-induction agent in patients where cardiovascular stability is essential.

Keywords: Propofol; Ketamine; Midazolam; Co-induction; General Anaesthesia; Hemodynamic Stability.

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Introduction

General anaesthesia requires a balanced combination of hypnosis, analgesia, and muscle relaxation to facilitate surgical procedures while ensuring patient safety and comfort. Intravenous induction agents are commonly used to rapidly induce anaesthesia before airway instrumentation and maintenance of anaesthesia. Among these agents, propofol has become one of the most widely used drugs for induction of general anaesthesia due to its rapid onset, smooth induction, short duration of action, and favourable recovery profile. However, propofol is associated with dose-dependent adverse effects such as hypotension, respiratory depression, and decreased systemic vascular resistance, which may lead to significant hemodynamic instability during induction, particularly in patients with limited cardiovascular reserve. Therefore, strategies to reduce the required dose of propofol while maintaining adequate anaesthetic depth have gained increasing attention in clinical anaesthetic practice. [1]

The concept of co-induction has been introduced as an effective method to reduce the total dose of induction agents. Co-induction refers to the administration of a small dose of another sedative or analgesic agent prior to the primary induction drug to achieve synergistic pharmacological effects. This technique allows for lower doses of the main induction agent, thereby minimizing adverse effects while preserving adequate anaesthetic conditions. The use of co-induction agents has been shown to improve hemodynamic stability, reduce drug-related complications, and provide better induction conditions. [2]

Propofol, despite its advantages, is known to produce a marked reduction in systemic vascular resistance and myocardial depression, leading to hypotension during induction of anaesthesia. These effects may be exaggerated when large doses are required, especially in anxious or unpremedicated patients. As a result, various adjunct drugs such as benzodiazepines, opioids, and dissociative agents have been investigated as co-induction agents to decrease the propofol requirement and attenuate its cardiovascular effects. [3]

Midazolam, a short-acting benzodiazepine, is commonly used as a co-induction agent because of its sedative, anxiolytic, amnestic, and hypnotic properties. When administered prior to propofol, midazolam produces a synergistic sedative effect that allows for a reduction in the propofol dose required for induction.

This combination has been widely used in clinical practice to achieve smooth induction and reduce the risk of awareness during anaesthesia. However, midazolam may contribute to respiratory depression and hypotension when used in combination with propofol, especially in higher doses or in susceptible patients. [4] On the other hand, ketamine is a unique intravenous anaesthetic agent that produces dissociative anaesthesia characterized by profound analgesia, amnesia, and preservation of airway reflexes. Unlike most induction agents, ketamine stimulates the sympathetic nervous system, resulting in increased heart rate, blood pressure, and cardiac output. This property makes ketamine particularly useful in maintaining hemodynamic stability during anaesthesia induction. When used in low doses as a co-induction agent with propofol, ketamine can counteract the hypotensive effects of propofol while also reducing the required dose of propofol. The combination of ketamine and propofol, often referred to as “ketofol,” has been shown to provide improved hemodynamic stability and better analgesia during induction. [5]

Several studies have evaluated the effectiveness of ketamine and midazolam as co-induction agents with propofol. These studies suggest that both agents significantly reduce the propofol dose required for induction of anaesthesia. However, differences have been observed in their hemodynamic effects. While midazolam mainly enhances sedation and hypnosis, ketamine provides additional analgesic effects and sympathetic stimulation, which may help maintain cardiovascular stability during induction and intubation. [6]

In patients undergoing elective surgical procedures under general anaesthesia, maintaining stable hemodynamic parameters during induction and airway manipulation is crucial to prevent complications such as hypotension, tachycardia, or myocardial ischemia. Therefore, identifying the most effective co-induction agent that minimizes propofol requirements while preserving cardiovascular stability is of significant clinical importance. [7]

Although both ketamine and midazolam are widely used as co-induction agents with propofol, there is still ongoing debate regarding which agent provides better hemodynamic stability and more effective reduction in propofol dosage during induction. Comparative studies in this area can help guide anaesthesiologists in selecting the most appropriate co-induction agent based on patient characteristics and surgical requirements. [8]

Therefore, the present prospective comparative study was conducted to evaluate and compare the effects of ketamine (0.3 mg/kg) and midazolam (0.03 mg/kg) as co-induction agents with propofol

in patients undergoing elective surgical procedures under general anaesthesia. The study aims to determine their effectiveness in reducing the induction dose of propofol and to compare their effects on hemodynamic parameters during anaesthesia induction.

Material and Methodology

Study design: This study was designed as a prospective randomized comparative clinical study, focusing on evaluating and comparing the effects of ketamine (0.3 mg/kg) and midazolam (0.03 mg/kg) as co-induction agents with propofol in patients undergoing elective surgical procedures under general anaesthesia.

Source of data: Data were collected from 60 patients undergoing various elective surgical procedures under general anaesthesia, in the Department of Anaesthesiology and Critical Care, Sri Siddhartha Medical College and Research Institute, Tumkur, a tertiary care teaching hospital.

Sampling: Patients were randomly allocated into two groups using a computer-generated randomization sequence:

- **Group KP:** Ketamine 0.3 mg/kg as co-induction agent
- **Group MP:** Midazolam 0.03 mg/kg as co-induction agent

All patients received intravenous glycopyrrolate 0.004 mg/kg as premedication. Patients were preoxygenated with 100% oxygen for 3 minutes. The co-induction drug was prepared in a 10 ml syringe by an anaesthesiologist not involved in the study to maintain blinding. Two minutes after co-induction, propofol was administered at 30 mg every 10 seconds until loss of verbal response. Additional propofol boluses were given if required.

Procedure: The study was carried out in the Department of Anaesthesiology and Critical Care at Sri Siddhartha Medical College and Research Institute with approval from the Institutional Ethics Committee (IEC approval number: SSMC/MED/IEC-042/FEB-2024, Dated: 09/02/2024) and written informed consent from each patient.

Once sufficient preoperative fasting was confirmed, patients scheduled for elective procedures under general anaesthesia were transferred to the operating room. Ringer lactate solution was started at a rate of 4-6 ml/kg/hour after an intravenous access was acquired under aseptic precautions. Standard monitoring was established, which included an ECG, non-invasive blood pressure, pulse oximetry, and end-tidal carbon dioxide. Prior to induction, baseline heart rate, systolic and diastolic blood pressure, and mean arterial pressure were measured. Intravenous glycopyrrolate (0.004 mg/kg) was used as a premedication for all patients. Using a face mask, preoxygenation with 100% oxygen was carried out for three minutes.

Patients were divided into two groups at random. As the co-induction agent, Group MP received 0.03 mg/kg of midazolam and Group KP received 0.3 mg/kg of ketamine. The co-induction drug was prepared in a 10-ml syringe by an anaesthesiologist not involved in the study to ensure observer blinding. Propofol was administered in incremental doses of 30 mg every 10 seconds until loss of verbal response and eyelash reflex, two minutes after the co-induction agent was delivered. Additional propofol boluses were given as needed if there was an intolerance to face mask ventilation or insufficient anaesthetic depth. Intravenous succinylcholine (1.5 mg/kg) was used to assist endotracheal intubation. Atracurium, isoflurane, and oxygen and nitrous oxide in a 40:60 ratio were used to maintain anaesthesia. Hemodynamic parameters were monitored at predetermined intervals. Neostigmine and glycopyrrolate were used to reverse neuromuscular blockade at the conclusion of the procedure, and patients were extubated after making sure they had recovered sufficiently.

Inclusion Criteria

- Patients belonging to ASA physical status I, II, and III
- Age group 18–60 years
- Patients of either sex
- Patients undergoing elective surgeries under general anaesthesia

Exclusion Criteria

- Patient refusal to give consent
- Emergency surgical procedures
- History of hypersensitivity to study drugs
- Patients belonging to ASA class IV and above
- Patients with hepatic, renal, neurological, or endocrine disorders
- Pregnancy
- History of drug or alcohol abuse

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 20.0. Quantitative variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Independent sample t-test was used for comparison between groups. Repeated measures ANOVA was applied for intra-group comparison across different time intervals. Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

Results

A total of 60 patients undergoing various elective surgical procedures under general anaesthesia were

included in this prospective comparative study. The patients were randomly allocated into two equal groups of 30 patients each. Group KP received ketamine 0.3 mg/kg as the co-induction agent, while Group MP received midazolam 0.03 mg/kg prior to induction with propofol.

Table 1: Distribution of Co-Induction Agents and Gender among Study Participants (n = 60)

Variable	Group MP (Midazolam) n=30	Group KP (Ketamine) n=30	Total (n=60)
Co-induction agent	30 (50%)	30 (50%)	60 (100%)
Male	14 (46.7%)	12 (40.0%)	26 (43.3%)
Female	16 (53.3%)	18 (60.0%)	34 (56.7%)

The table presents the distribution of co-induction agents and gender among the study participants. Out of the total 60 patients, 30 (50%) received midazolam (Group MP) and 30 (50%) received ketamine (Group KP) as co-induction agents.

This equal allocation ensured a balanced comparison between the two groups and minimized the possibility of selection bias. Regarding gender distribution, in the midazolam group, 14 patients (46.7%) were males and 16 patients (53.3%) were females.

In the ketamine group, 12 patients (40.0%) were males and 18 patients (60.0%) were females. Overall, females constituted the majority of the study population (56.7%), while males accounted for 43.3%.

Table 2: Baseline Clinical Characteristics of Study Participants (n = 60)

Variable	Category	Group MP (Midazolam) n=30	Group KP (Ketamine) n=30	Total n=60 (%)
Type of Surgery	General surgery	16 (53.3%)	17 (56.7%)	33 (55.0%)
	Orthopaedic	8 (26.7%)	4 (13.3%)	12 (20.0%)
	Gynaecological	0 (0.0%)	12 (40.0%)	12 (20.0%)
	Urological	6 (20.0%)	3 (10.0%)	9 (15.0%)
Personal Habits	Smoking	10 (33.3%)	3 (10.0%)	13 (21.7%)
	Betel nut chewing	6 (20.0%)	9 (30.0%)	15 (25.0%)
Comorbidities	Hypertension	9 (30.0%)	9 (30.0%)	18 (30.0%)
	Type 2 Diabetes Mellitus	8 (26.7%)	9 (30.0%)	17 (28.3%)
	COPD	4 (13.3%)	2 (6.7%)	6 (10.0%)
	Hypothyroidism	3 (10.0%)	1 (3.3%)	4 (6.7%)
	Asthma	1 (3.3%)	1 (3.3%)	2 (3.3%)
Mallampati Class	Class I	17 (56.7%)	16 (53.3%)	33 (55.0%)
	Class II	13 (43.3%)	14 (46.7%)	27 (45.0%)
Thyromental Distance	6.5 cm	20 (66.7%)	22 (73.3%)	42 (70.0%)
	7.0 cm	10 (33.3%)	8 (26.7%)	18 (30.0%)
ASA Physical Status	ASA I	14 (46.7%)	14 (46.7%)	28 (46.7%)
	ASA II	16 (53.3%)	16 (53.3%)	32 (53.3%)

The table summarizes the baseline clinical characteristics of the study participants in the midazolam and ketamine co-induction groups. Regarding the type of surgery, general surgery constituted the majority of cases (55.0%), followed by orthopaedic and gynaecological surgeries (20.0% each), while urological procedures accounted for 15.0% of cases.

Orthopaedic procedures were relatively more common in the midazolam group, whereas gynaecological surgeries were observed only in the ketamine group. In terms of personal habits, smoking was more prevalent in the midazolam group (33.3%) compared to the ketamine group (10.0%), while betel nut chewing was more common among patients receiving ketamine (30.0%) than midazolam (20.0%).

Overall, betel nut chewing (25.0%) was slightly more frequent than smoking (21.7%) in the study population.

Regarding comorbid conditions, hypertension was the most common comorbidity (30.0%) and was equally distributed between the two groups.

Type 2 diabetes mellitus was present in 28.3% of patients, with a slightly higher proportion in the ketamine group. COPD and hypothyroidism were more frequent in the midazolam group, while asthma was uncommon in both groups.

Overall, the distribution of comorbidities was comparable between the groups, indicating similar baseline clinical characteristics. Assessment of airway parameters showed that Mallampati Class I was observed in 55.0% of patients, while 45.0% belonged to Class II, with similar proportions in both groups.

Similarly, thyromental distance of 6.5 cm was noted in the majority of patients (70.0%), while 30.0% had a distance of 7.0 cm, with comparable distribution across both groups.

Table 3: Comparison of Hemodynamic Parameters between Midazolam and Ketamine Groups at Different Time Intervals

Parameter	Observation	Midazolam Group (MP)	Ketamine Group (KP)	p-value
Heart Rate	Baseline (H0)	Comparable	Comparable	1.000
	Post co-induction to early induction (H1–H4)	Lower	Higher	**<0.001**
	Mid interval (H5)	Comparable	Comparable	0.085
	Later intervals (H6–H8)	Lower	Higher	**<0.001**
Systolic Blood Pressure	Baseline (S0)	Higher	Lower	**<0.001**
	Post co-induction (S1)	Lower	Higher	**<0.001**
	Early induction (S2)	Comparable	Comparable	0.359
	Later intervals (S3–S8)	Lower	Higher	**<0.05**
Diastolic Blood Pressure	Baseline (D0)	Higher	Lower	**<0.001**
	Post co-induction (D1)	Lower	Higher	**<0.001**
	Early intervals (D2–D3)	Lower	Higher	**<0.05**
	Mid interval (D4)	Slightly higher	Slightly lower	**<0.05**
	Later intervals (D5–D8)	Lower	Higher	**<0.001**
Mean Arterial Pressure	Baseline (M0)	Higher	Lower	**<0.001**
	Post co-induction (M1)	Lower	Higher	**<0.001**
	Early intervals (M2–M3)	Slightly lower	Slightly higher	**<0.05**
	Mid interval (M4–M5)	Slightly higher	Slightly lower	**<0.05**
	Later intervals (M6–M8)	Lower	Higher	**<0.001**

The table compares hemodynamic parameters between the midazolam (MP) and ketamine (KP) co-induction groups at different time intervals during induction and early maintenance of anaesthesia.

At baseline, both groups had comparable heart rates, while systolic, diastolic, and mean arterial pressures were slightly higher in the midazolam group. Following co-induction and induction, the ketamine group consistently demonstrated higher heart rate values, particularly from H1–H4 and H6–H8, reflecting the sympathomimetic effect of ketamine, while the difference was not significant at H5. With respect to systolic blood pressure, the ketamine group maintained significantly higher values following co-induction and at most subsequent intervals (S3–S8), indicating better preservation of systolic pressure during induction. Diastolic blood pressure also followed a similar pattern, with ketamine maintaining significantly higher values during most intervals, except at D4, where midazolam showed slightly higher readings. A comparable trend was observed for mean arterial pressure (MAP). Although MAP was initially higher in the midazolam group at baseline, the ketamine group demonstrated significantly higher MAP after co-induction and during later intervals (M6–M8), indicating improved maintenance of arterial pressure.

Discussion

The present prospective comparative study evaluated the effectiveness of ketamine (0.3 mg/kg) and midazolam (0.03 mg/kg) as co-induction agents with propofol in 60 patients undergoing elective surgical procedures under general anaesthesia. The study primarily assessed the reduction in the propofol induction dose and the hemodynamic responses following co-induction. The findings demonstrated that both ketamine and midazolam significantly reduced the required dose of propofol, while ketamine provided better hemodynamic stability compared with midazolam.

Propofol is widely used as an induction agent because of its rapid onset, short duration of action, and smooth recovery characteristics. However, it is associated with dose-dependent hypotension and myocardial depression, which may compromise cardiovascular stability during induction of anaesthesia. [9] Therefore, the use of co-induction

agents has become an effective strategy to reduce the total propofol requirement and minimize its adverse cardiovascular effects.

In the present study, the induction dose of propofol was significantly reduced in both groups following co-induction with either ketamine or midazolam. This finding supports the concept that co-induction enhances the hypnotic and sedative effects of propofol, thereby reducing the dose required to achieve adequate anaesthetic depth. Similar findings were reported in several previous studies which demonstrated that administration of small doses of sedative or analgesic agents before propofol significantly decreases its induction requirement.10

The present study observed that ketamine provided greater cardiovascular stability compared with midazolam, as reflected by higher heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure during induction and early anaesthesia. These findings can be attributed to the sympathomimetic properties of ketamine, which stimulate the sympathetic nervous system and increase heart rate and blood pressure, thereby counteracting the hypotensive effects of propofol.

A similar observation was reported by Yadav et al. [9], who compared ketamine and midazolam as co-induction agents with propofol and found that although both drugs reduced the propofol requirement, ketamine maintained better mean arterial pressure and produced less decrease in hemodynamic parameters compared with midazolam.

Another study comparing ketamine and midazolam as co-induction agents concluded that ketamine resulted in better hemodynamic stability and a reduced requirement of propofol during induction when compared to midazolam. [11,12] These findings are consistent with the results of the present study, where ketamine maintained more stable cardiovascular parameters during the induction phase.

Studies evaluating the ketamine–propofol combination (commonly referred to as “ketofol”) have also demonstrated improved hemodynamic stability compared with propofol alone. In a randomized study conducted among patients undergoing laparoscopic surgery, the ketamine–propofol combination showed better maintenance of systolic blood pressure, diastolic blood pressure, and mean arterial pressure compared with propofol alone. [13,14] This further supports the concept that ketamine counteracts the hypotensive effect of propofol. The mechanism behind this beneficial effect lies in the pharmacological properties of ketamine. Ketamine produces dissociative anaesthesia and stimulates the sympathetic nervous system by increasing catecholamine release. This leads to an increase in heart rate, blood pressure, and cardiac output, which helps maintain cardiovascular stability during induction. In contrast, midazolam is a benzodiazepine that primarily produces sedation and anxiolysis but may contribute to hypotension and respiratory depression when combined with propofol.

The present study also demonstrated that heart rate remained significantly higher in the ketamine group at several time intervals following induction, which reflects the sympathomimetic action of ketamine. While this effect may be beneficial in preventing hypotension, it may not be desirable in patients with ischemic heart disease or tachyarrhythmias. Therefore, the choice of co-induction agent should be individualized based on the patient’s cardiovascular status.

Previous investigators have also reported similar hemodynamic trends. Studies comparing ketamine–propofol with midazolam–propofol combinations have shown that midazolam may lead to a greater decrease in mean arterial pressure, whereas ketamine maintains arterial pressure within a more stable range. [15-17] These findings align closely with the results of the present study.

In addition to hemodynamic benefits, ketamine has several other advantages as a co-induction agent. It provides analgesic properties, reduces propofol-induced injection pain, and preserves airway reflexes. Moreover, the combination of ketamine with propofol balances the sedative effects of propofol with the cardiovascular stimulation produced by ketamine, thereby providing a more stable induction profile.

However, ketamine may also produce adverse effects such as tachycardia, increased salivation, and emergence reactions, although these are generally less pronounced when used in low doses as a co-induction agent. On the other hand, midazolam offers advantages such as anxiolysis, amnesia, and smoother recovery, making it useful in certain clinical situations.

Overall, the findings of the present study are consistent with previous research indicating that both ketamine and midazolam effectively reduce the propofol induction dose, but ketamine offers superior hemodynamic stability due to its sympathetic stimulation. These findings are clinically relevant because maintaining stable cardiovascular parameters during induction is crucial, particularly in patients with compromised cardiovascular reserve.

Limitations of Study

The present study has certain limitations. The sample size was relatively small and the study was

conducted in a single centre. Additionally, the study did not evaluate recovery characteristics or postoperative complications associated with the co-induction agents. Further multicentric studies with larger sample sizes are required to validate these findings.

Conclusion

The present study demonstrates that co-induction with ketamine or midazolam significantly reduces the dose of propofol required for induction of general anaesthesia. However, ketamine provides superior hemodynamic stability compared with midazolam, as evidenced by better maintenance of heart rate and blood pressure during induction and early anaesthesia. Therefore, ketamine may be considered a preferred co-induction agent, particularly in patients where cardiovascular stability is essential.

References

1. Reves JG, Fragen RJ, Vinik HR, Greenblatt DJ. Midazolam: pharmacology and uses. Anesthesiology. 1985 Mar;62(3):310-24. PMID: 3156545.
2. Marik PE, Varon J, Kollef MH, et al. Propofol: therapeutic indications and side effects. Curr Pharm Des. 2004;10(29):3639-3649. doi:10.2174/1381612043382846
3. Short TG, Chui PT, Glass PS, Shafer SL, Campbell D, Leslie K. Propofol and midazolam act synergistically in combination. Br J Anaesth. 1991;67(5):539-545. doi:10.1093/bja/67.5.539
4. Cressey DM, Claydon P, Bhaskaran NC, Reilly CS, Clarkson PJ, Holdcroft A. Effect of midazolam pretreatment on induction dose requirements of propofol. Anaesthesia. 2001;56(2):108-113. doi:10.1046/j.1365-2044.2001.01789.x
5. Willman EV, Andolfatto G. A prospective evaluation of "ketofol" (ketamine/propofol combination) for procedural sedation and analgesia in the emergency department. Ann Emerg Med. 2007 Jan;49(1):23-30. doi: 10.1016/j.annemergmed.2006.08.002
6. Singh R, Ghazanwy M, Vajifdar H. A randomized controlled trial to compare fentanyl-propofol and ketamine-propofol combination for procedural sedation and analgesia in laparoscopic tubal ligation. Saudi J Anaesth. 2013 Jan;7(1):24-8. doi: 10.4103/1658-354X.109801
7. Furuya A, Matsukawa T, Ozaki M, Nishiyama T, Kume M, Kumazawa T. Intravenous ketamine attenuates arterial pressure changes during the induction of anaesthesia with propofol. Eur J Anaesthesiol. 2001 Feb;18(2):88-92. doi: 10.1046/j.0265-0215.2000.00784.x
8. Sabertanha A, Shakhsemampour B, Ekrami M, Allahyari E. Comparison of Infusion of Propofol and Ketamine-Propofol Mixture (Ketofol) as Anesthetic Maintenance Agents on Blood Pressure of Patients Undergoing Orthopedic Leg Surgeries. Anesth Pain Med. 2019 Nov 2;9(6):e96998. doi: 10.5812/aapm.96998
9. Yadav, R. K., Bajracharya, G. R., & Pokhrel, J. N. (2015). Ketamine as an alternative to midazolam co-induction to propofol: a comparative study. Journal of Society of Anesthesiologists of Nepal, 2(2), 62-66. Retrieved from https://jsan.org.np/jsan/index.php/jsan/article/view/68
10. Smischney NJ, Hoskote SS, Gallo de Moraes A, Racedo Africano CJ, Carrera PM, Tedja R, Pannu JK, Hassebroek EC, Reddy DR, Hinds RF, Thakur L. Ketamine/propofol admixture (ketofol) at induction in the critically ill against etomidate (KEEP PACE trial): study protocol for a randomized controlled trial. Trials. 2015 Apr 21;16:177. doi: 10.1186/s13063-015-0687-0
11. Mihalj M, Karlović Z, Vladić-Spaić D, Matić B, Mikulić I, Mikulić V, Golubović V. Effects of midazolam co-induction to general anesthesia: A randomized clinical trial. Medicine (Baltimore). 2022 Nov 11;101(45): e31400. doi: 10.1097/MD.0000000000031400
12. Prathapadas U, Gomathiamma M, Arulvelan A, Lionel KR, Hrishi AP. A Study Comparing Propofol Auto-coinduction and Standard Propofol Induction in Patients Undergoing General Anesthesia Without Midazolam Pretreatment: A Prospective Randomized Control Trial. Anesth Essays Res. 2018 Jul-Sep;12(3):690-694. doi: 10.4103/aer.AER_102_18
13. Chethana Chaparala, Anand Subramanian, Balamurugan Balasubramaniyan. Comparison of clinical effectiveness of propofol auto co-induction and midazolam propofol co-induction using the priming principle among patients undergoing surgeries. Biomedicine: 2023; 43(4): 1118-1122. DOI: https://doi.org/10.51248/.v43i4.2775
14. Khan, Khurram SaleemHayes, IvanBuggy, Donal J et al Pharmacology of anaesthetic agents I: intravenous anaesthetic agents. Continuing Education in Anaesthesia, Critical Care and Pain, Volume 14, Issue 3, 100 – 105. DOI: 10.1093/bjaceaccp/mkt039
15. Hugh C. Hemmings, Jr. and Talmage D. Egan. Pharmacology and Physiology for Anesthesia. Elsevier. 2019. DOI: 10.1016/C2014-0-04139-1
16. Smischney NJ, Seisa MO, Morrow AS, Ponce OJ, Wang Z, Alzuabi M, Heise KJ, Murad MH. Effect of Ketamine/Propofol Admixture

on Peri-Induction Hemodynamics: A Systematic Review and Meta-Analysis. Anesthesiol Res Pract. 2020 May 8;2020:9637412. doi: 10.1155/2020/9637412

17. Raman V, Segaran S, Ramyavel T, George SK, Zachariah M. Comparison of haemodynamic changes between propofol and ketofol as induction agents in patients undergoing laparoscopic surgeries under general anaesthesia. J Anaesthesiol Clin Pharmacol. 2022 Apr-Jun;38(2):215-220. doi: 10.4103/joacp.JOACP_251_20