Hemodynamic Stability in Different Age Groups Patient under General Anesthesia with Propofol

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Abstract

Introduction: Propofol is a commonly used intravenous agent for the induction and maintenance of anesthesia. It possesses sedative and hypnotic properties, making it an effective choice for various surgical procedures. However, its administration is associated with certain risks, including hypotension and hemodynamic instability. **Aim of study:** This study aims to investigate the hemodynamic stability of patients across different age groups undergoing general anesthesia with propofol. **Method:** A descriptive observational study design was employed to assess hemodynamic stability in patients undergoing general anesthesia with propofol. A total of 50 patients were randomly sampled from Imam Al-Sadiq Hospital, Najaf Hospital, Alhusseiny Teaching Hospital (Karbala), and Al-Hilla Surgical Hospital. Hemodynamic parameters, including systolic and diastolic blood pressure, heart rate, and oxygen saturation, were measured pre and post-medication administration. **Results and Findings:** The analysis revealed a significant decrease in systolic blood pressure post-medication administration (p-value < 0.001), indicating the impact of propofol on hemodynamic stability. However, there were no significant differences in diastolic blood pressure, heart rate, or oxygen saturation pre and post-medication. The crossmatch analysis further highlighted the distribution of normal and abnormal hemodynamic signs, providing insights into the effects of propofol on specific parameters. **Conclusion:** There is non-significant difference between pre and post medication according to Diastolic, Heart Rate, SpO2 (p.value greater than 0.05) While there are significant differences according to Systolic. The significant reduction in systolic blood pressure post-medication suggests the efficacy of the intervention in lowering blood pressure levels **Recommendations:** Based on the study findings, recommendations include implementing personalized anesthesia protocols, conducting thorough preoperative assessments, and enhancing real-time hemodynamic monitoring to mitigate the risks associated with propofol-induced hypotension. Additionally, interdisciplinary collaboration and ongoing education programs can further improve patient care and safety in the perioperative setting.

Key words: Hemodynamic, Stability, General anesthesia.

Introduction

Propofol (Diprivan 1) is a phenolic derivative with sedative and hypnotic properties but is unrelated to other sedative/hypnotic agents. Formulated as an oil-in-water emulsion for intravenous use, it is highly lipophilic and rapidly crosses the blood-brain barrier resulting in a rapid onset of action. Emergence from sedation is also rapid because of a fast redistribution into peripheral tissues and metabolic clearance. The depth of sedation increases in a dose-dependent manner. Propofol is a common intravenous agent for induction and maintenance of anesthesia. The advantage of propofol is rapid recovery of consciousness when the continuous infusion is stopped. Additionally, it has antiemetic effect of reducing postoperative nausea and vomiting. On the other hand, rapid infusion of propofol is painful and may cause hypotension **(Ruey et al., 2023).**

Patient safety has always been a major concern for the physicians of both ancient and modern eras **(Golzari et al., 2023).** Propofol is a widely administered hypnotic agent that is of unique advantages yet some disadvantages **(Reich et al., 2015).** Induction of anesthesia with propofol is associated with significant blood pressure reduction and hemodynamic instability especially in patients over 50 years old. In patients with previous hypotension and those with American society of anesthesiologists' physical status (ASAPS)>II, this drop is more dramatic **(Dhungana et al., 2018).** Geriatric patients do require different medical and surgical settings **(Golzari et al., 2013).** older patients and special surgeries it is of great importance to maintain stable hemodynamics both throughout and after the surgery **(Azarfarin et al., 2013).**

Hemodynamic changes due to anesthesia in various surgeries have become a great concern in physicians of operation room and evidence show that changes in blood pressure, either increase or decrease, independently are associated with side effects and complications in patients undergoing surgery **(Felfernig et al., 2016).** All methods used in anesthesia induction are designed so that the hemodynamic stability is maintained especially in older patients that the need for surgery is increasing and complications of anesthesia are higher **(Passot et al., 2018).**

General anesthetics can be used in elderly patients, but the dose should be carefully and patiently adjusted according to the response. Elderly patients display a huge variability in sensitivity to many drugs, especially hypnotics, but generally these patients will need much lower doses than younger and middle-aged patients. It is not uncommon for the elderly to receive excessive doses of anesthetics that lead to an undesired prolongation of recovery and to hemodynamic depression. An important factor contributing to this error is the longer onset time, which may lead to an unnecessary supplementation to the induction dose **(Hadi Shalan et al., 2024).**

Propofol primarily decreases arterial blood pressure by reducing systemic vascular resistance, preload, and cardiac contractility. Factors contributing to propofol-induced hypotension include high doses, fast administration, and advanced age. It can impair the body's normal response to low blood pressure and rarely cause a reflex bradycardia due to a significant drop in preload. While changes in heart rate and cardiac output are typically minor in healthy individuals, they can be more pronounced in certain groups like the elderly, patients on β-blockers, or those with impaired heart function. Although myocardial oxygen consumption and coronary blood flow usually decrease together, some patients may experience an imbalance between oxygen supply and demand, indicated by increased coronary sinus lactate production **(Smith et al., 2020).**

Propofol is a potent respiratory depressant that can induce apnea even at low doses. It suppresses the body's normal response to low oxygen levels and high carbon dioxide levels. Additionally, propofol reduces cerebral blood flow and intracranial pressure, which can be beneficial during surgeries involving the brain. However, in patients with high intracranial pressure, it may decrease cerebral perfusion pressure to critical levels unless blood pressure is supported. Propofol also has anti-itch and anti-nausea properties, making it a preferred choice for outpatient anesthesia **(Dahaba et al., 2021).**

The patients lie on the couch with left. Lateral till with pillow behind their buttock, the patients received 100% oxygen for 5 min then induction done with 2mg/kg propofol as induction agent, 0.5mg/kg ketamine as analgesic, 0.6mg/kg rocuronium as muscle relaxant. The patients were intubated with proper endotracheal cuffed tube size and ventilated with 100% oxygen and maintained with 0.7% MAC isoflurane. the patients were reversed by given neostigmine 2-5mg with atropine 1mg to reversed the effect of muscle relaxant and then awake extubating done. Postoperative pain was measured on a numeric rating scale (0–10). Ketorolac 30 mg i.m. was used as bolus dose if required. Ultrasound scans of the bladder were performed hourly after surgery until spontaneous micturition or catheterization occurs. It should be noted that ultrasound bladder scans were used to diagnose urinary retention. Urinary retention was defined as a bladder volume ⩾ 500 ml together with the inability to micturate or post residual volume > 500 ml. Patients were catheterized when these criteria were met. Assessment of the Hemodynamic stability in different age groups patient under General anesthesia.

Methodology and Participants

2.1 Design of the study

A descriptive study design was used to describe the variables and the relationships that occur among them in this study. This design was implemented to achieve the objectives of the current study on hemodynamic stability in different patient age groups under GA in propofol.

2.2 Administrative and ethical permission

To conduct the study, permissions has been obtained from the college to accomplish this study. Research objectives and benefits were explained to patients personally, of health and medical techniques AL Mustaqbal University.

2.3 Sitting of the study

The study has been conducted in Imam Al-Sadiq Hospital, Najaf Hospital, Alhusseiny Teaching Hospital, (Karbala), and Al-Hilla Surgical Hospital.

2.4 Sample of the study

Random sampling (probability) of (50) samples.

2.5 Statistical data analyses

After the collection of data, they have been coded and analyzed by the application of statistical procedures and by using Statistical package of Social Science (**IBM SPSS**) program (**version 26; 2021**), and Jeffreys's Amazing Statistics Program (**JASP ver 17.1**) for Windows to analyze and assess the results of the study, which include:

2.6 Descriptive statistical data analysis approach was used for determining the following measurement:

a) Statistical tables.
b) Bar chart.
c) Percent.
d) Chi-Square (X^2).
e) Two independent T.test.

Results

This table shows there is non-significant difference according to **Sex** (p_{value} greater than **0.05**) While there are significant differences according to **Age** (P_{value} less than **0.05**).

Table (1). Demographic Characteristics

Variable	Level	Frequencies	Percent	P.Value
Sex	Male	20	40 %	0.153
	Female	30	60 %	
Age	Young	32	64 %	<0.001
	Middle Young	13	26 %	
	Elderly	5	10 %	

Table (2). Types of surgeries.

Surgery	Frequency
ankle fixation	3
Bowel obstruction	13
Femoral fracture	21
Gastrectomy	3
Cesarean section	22
Laparoscopic gallbladder	7
pelvic fracture	14
Vertebral fixation	7
Total	100

Table (3) shows the distribution of patients according to types of surgery 22% of patients were cesarean section

Table (3). Hemodynamic Signs pre and post medication

Signs	Pre	Post	P.Value
Systolic (mean±sd)	137.22±21.02	127.28±20.91	<0.001
Diastolic (mean±sd)	78.34±26.84	73.00±13.39	0.12
Heart Rate (mean±sd)	89.16±18.71	89.64±16.62	0.84
SpO2 (mean±sd)	97.34±2.18	96.82±2.61	0.79

This table shows there is non-significant difference between pre and post medication according to Diastolic, Heart Rate, SpO2 (**p_{value} greater than 0.05**) While there are significant differences according to Systolic (**P_{value} less than 0.05**).

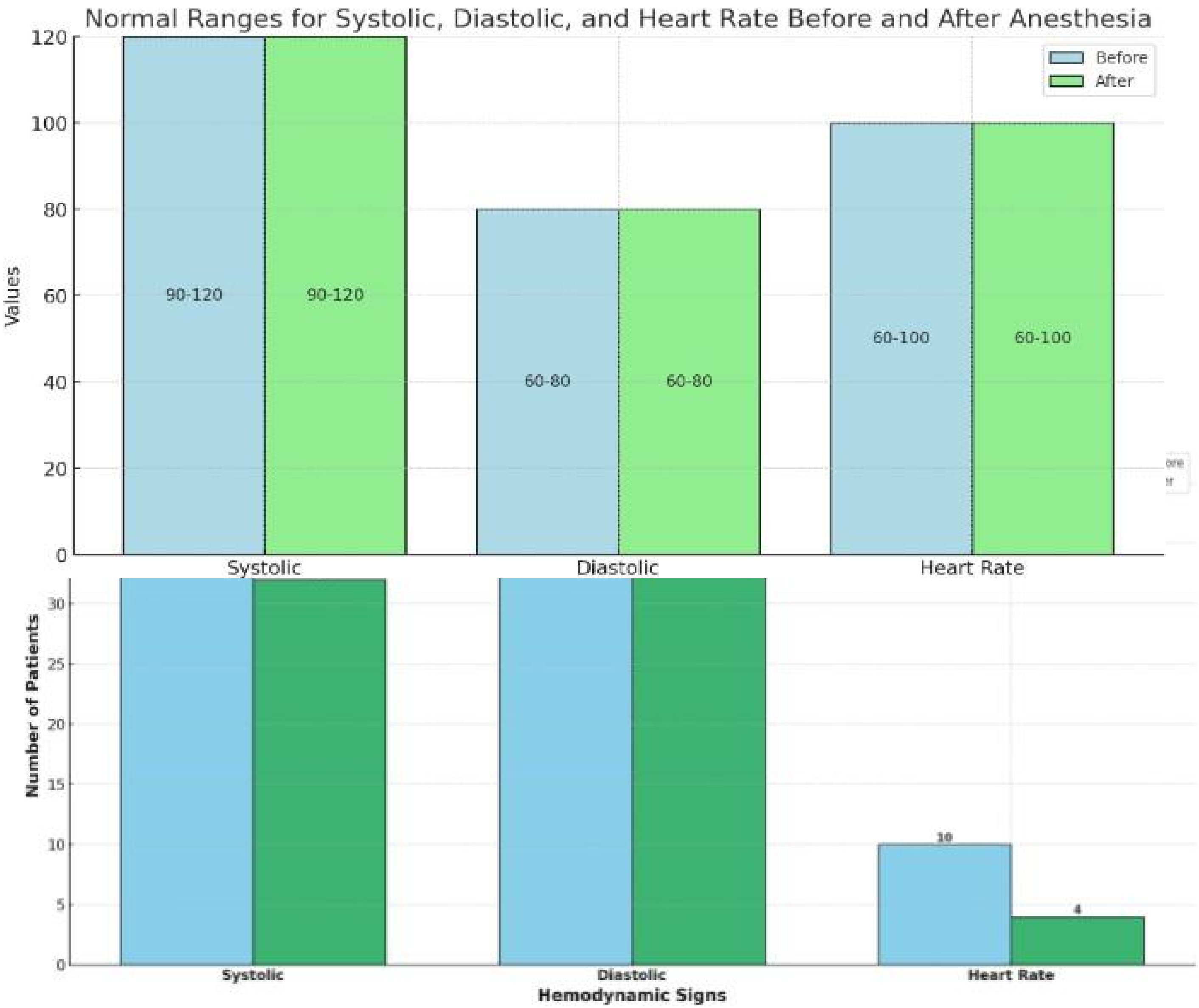
Normal Ranges for Systolic, Diastolic, and Heart Rate Before and After Anesthesia
Values
Before
After
90-120
90-120
60-80
60-80
60-100
60-100
Systolic
Diastolic
Heart Rate
Number of Patients
10
4
Systolic
Diastolic
Heart Rate
Hemodynamic Signs

Table (3) Crossmatch of Hemodynamic signs pre and post medication

Signs	Pre		Post		
			Normal	Abnormal	Total
Systolic	*Normal*	N	4	7	11
		%	36.364 %	63.636 %	100.000 %
	Abnormal	N	7	32	39
		%	17.949 %	82.051 %	100.000 %
	Total	N	11	39	50
		%	%	22.000 %	78.000 %
Diastolic	*Normal*	N	5	4	9
		%	55.556 %	44.444 %	100.000 %
	Abnormal	N	8	33	41
		%	19.512 %	80.488 %	100.000 %
	Total	N	13	37	50
		%	26.000 %	74.000 %	100.000 %
Heart Rate	*Normal*	N	36	4	40
		%	90.000 %	10.000 %	100.000 %
	Abnormal	N	6	4	10
		%	60.000 %	40.000 %	100.000 %
	Total	N	42	8	50
		%	84.000 %	16.000 %	100.000 %

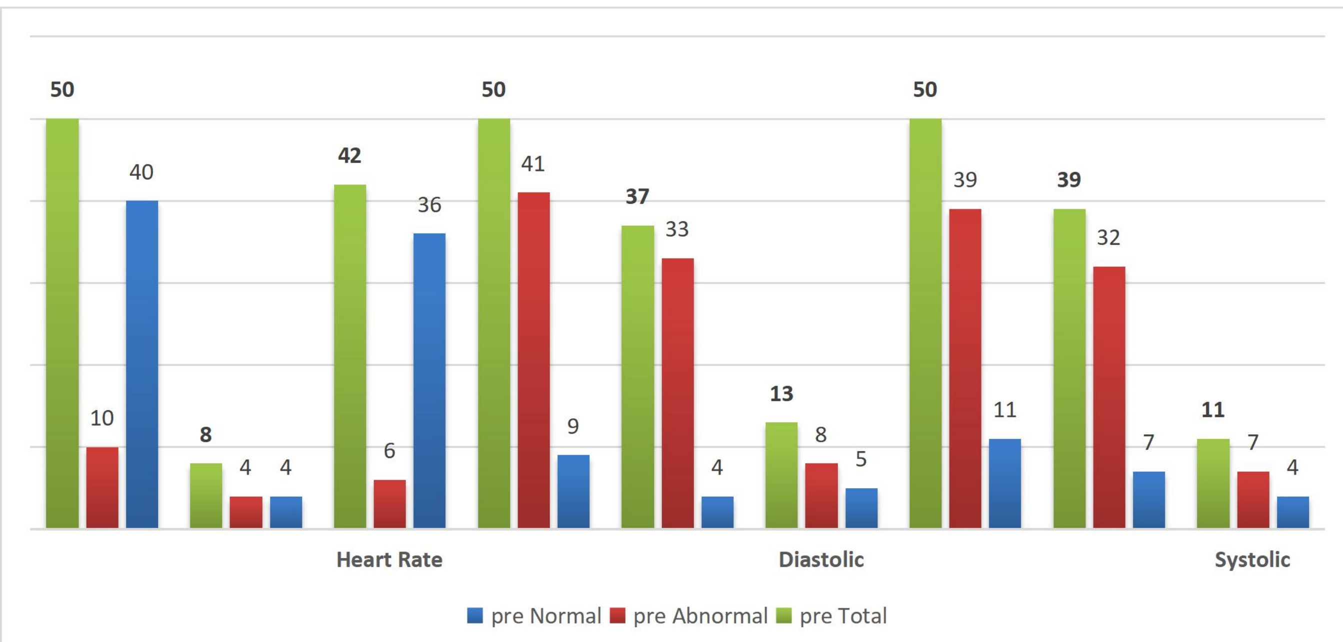

Figure (3).Number of Patients with Normal Hemodynamic Signs Pre Medication

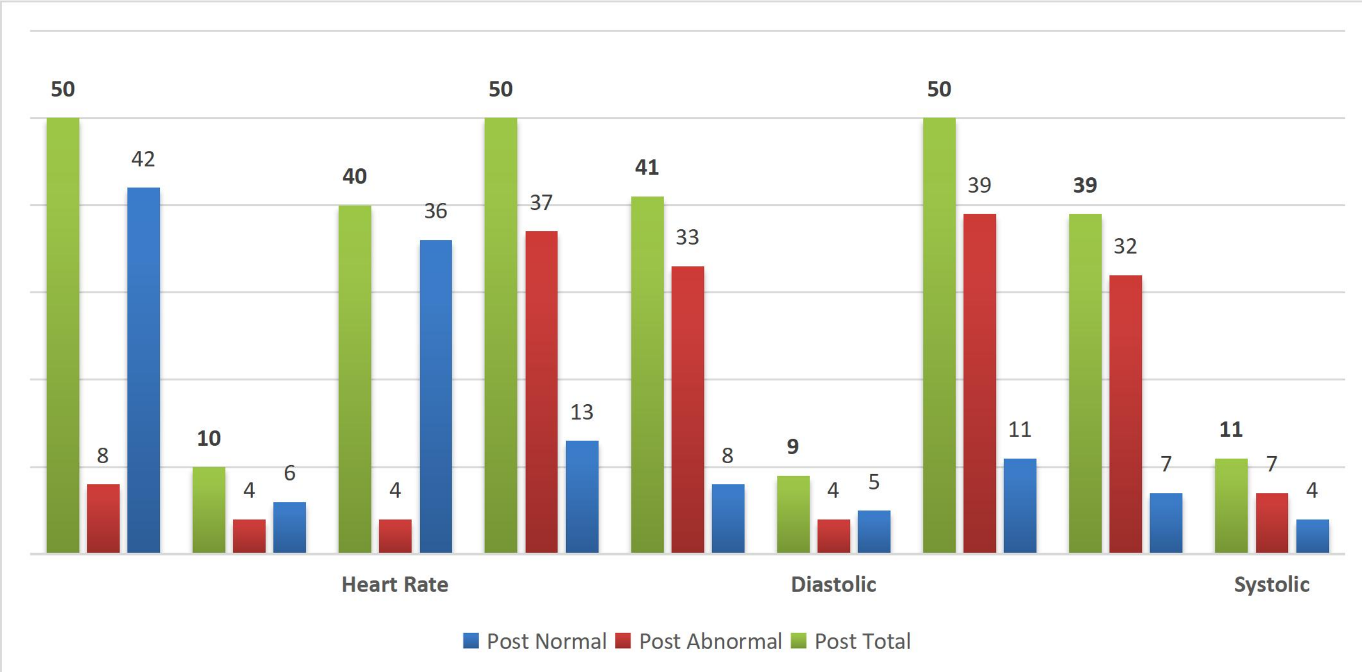

Figure (4). Number of Patients with Abnormal Hemodynamic Signs Post Medication

Discussion

The research presents a thorough exploration of hemodynamic stability across diverse age groups of patients undergoing general anesthesia, with a particular focus on the administration of Propofol. It eloquently discusses the merits of Propofol, highlighting its swift recovery and antiemetic properties, while also acknowledging its limitations. The discourse underscores the critical importance of maintaining steady hemodynamics throughout surgical procedures, especially among elderly patients who are more susceptible to adverse outcomes.

General anesthesia is a cornerstone of modern surgery, enabling the safe and effective performance of procedures that would otherwise be intolerable for patients. This review provides a comprehensive overview of the principles of general anesthesia, focusing on its primary goal: rendering a patient unconscious and insensible to painful stimuli while maintaining control over autonomic reflexes. Each class presents unique advantages and limitations in fulfilling the primary objectives of general anesthesia, and a thorough understanding of their mechanisms, applications, and potential side effects can enhance intraoperative decision -making. A surgeon's awareness of these principles is not only beneficial but often crucial for anticipating challenges and collaborating effectively with the anesthesiology team. Beyond the selection and administration of medications, familiarity with the fundamental equipment and protocols used during anesthesia can further improve outcomes. General anesthesia involves the use of specialized equipment, such as ventilators, anesthetic machines, and airway management tools, all of which play a critical role in patient safety and surgical success (**Karunarathna et al., 2024**).

The demographic profile of the study participants reveals interesting insights. The distribution of participants by sex indicates that 60% were female, while 40% were male. Despite this difference in distribution, the statistical analysis indicates a non-significant difference (p-value = 0.153), suggesting that sex may not be a significant factor influencing the outcomes under investigation.

However, the age distribution paints a different picture. The majority of participants (64%) belonged to the young age group, followed by 26% in the middle young group, and 10% classified as elderly. Importantly, the statistical analysis shows a significant difference in age groups (p-value < 0.001), indicating that age may play a crucial role in influencing the outcomes of interest. This finding underscores the importance of considering age-related factors in the interpretation of study results and in clinical decision-making (**Al-Jasmawi, et al., 2019**). Our findings resonate with existing literature indicating that older patients are more susceptible to the hypotensive effects of anesthetic agents, including Propofol. Studies have highlighted age-associated declines in baroreceptor sensitivity and autonomic response, contributing to an exaggerated hypotensive response to anesthesia **(Smith et al., 2010)**. However, our study further delineates these effects across a broader age spectrum, adding granularity to the understanding of age as a determinant of hemodynamic response under general anesthesia.

Contrarily, some studies have proposed minimal age-related differences in the pharmacokinetics of Propofol **(Dahaba et al., 2005).** The divergence between these findings and our own could stem from variations in study design, patient selection criteria, or methods of hemodynamic assessment. Our study contributes new insights by explicitly documenting the differential impact of Propofol on systolic blood pressure across age groups, reinforcing the need for age-specific considerations in anesthesia management.

The analysis of hemodynamic signs before and after medication administration provides insights into the effectiveness of the intervention. The mean values of systolic blood pressure decreased significantly from pre- to post-medication, with a p-value of less than 0.001. This result was in agreement with **(Felfernig et al., 2016)** who found that there were change in systolic blood pressure before and after Propofol. This suggests that the medication had a significant impact on reducing systolic blood pressure levels.

On the other hand, there were no significant differences in diastolic blood pressure, heart rate, or oxygen saturation between pre- and post-medication measurements. The p-values for these parameters were all greater than 0.05, indicating that the medication did not have a significant effect on these hemodynamic signs. However, it is important to note that even though the differences were not statistically significant, they may still have clinical relevance and should be carefully considered in the overall assessment of patient health. This result was in disagreement with **(Smith et al.,2020)** who found change in heart rate after propofol use.

For instance, in the case of systolic blood pressure, there was a higher proportion of abnormal readings post-medication compared to pre-medication (82.051% vs. 63.636%, respectively). This suggests that the medication may have adverse effects on systolic blood pressure in some individuals, warranting further investigation into potential underlying mechanisms.

Similarly, the crossmatch analysis for diastolic blood pressure and heart rate reveals important trends that may have clinical implications. While the differences were not statistically significant, the higher percentage of abnormal readings post-medication underscores the need for careful monitoring of these parameters in patients undergoing treatment.

Recommendations

Based on the findings of this study, several recommendations can be made to enhance clinical practice and patient care in the context of anesthesia:

a) Personalized Anesthesia Protocols: Anesthesiologists should adopt personalized anesthesia protocols that take into account the age of the patient. This includes careful consideration of Propofol dosing and administration speed, especially in older adults, to mitigate the risk of significant blood pressure drops.
b) Preoperative Assessment: Prior to surgery, thorough preoperative assessments should be conducted to evaluate the cardiovascular function of patients, with particular attention to identifying those at higher risk of hypotensive episodes. This will enable preemptive measures to be taken to ensure hemodynamic stability during anesthesia.
c) Real-time Hemodynamic Monitoring: Continuous monitoring of hemodynamic parameters, such as blood pressure, heart rate, and oxygen saturation, is essential, especially in older patients. This allows for prompt identification of any adverse responses to anesthesia, facilitating timely intervention to maintain hemodynamic stability.
d) Collaboration and Education: An interdisciplinary approach involving anesthesiologists, surgeons, and nursing staff is crucial for optimizing perioperative outcomes. Regular education and training sessions should be conducted to enhance awareness of age-related differences in hemodynamic responses and the importance of tailored anesthesia management.

Conclusion

There is non-significant difference between pre and post medication according to Diastolic, Heart Rate, SpO2 (p.value greater than 0.05) While there are significant differences according to Systolic. The significant reduction in systolic blood pressure post-medication suggests the efficacy of the intervention in lowering blood pressure levels. However, further research is needed to understand the potential adverse effects on other hemodynamic parameters and to optimize treatment strategies for improved patient outcomes. By implementing these recommendations, healthcare providers can improve patient safety and optimize perioperative outcomes, ultimately enhancing the quality of care delivered to patients undergoing surgery under general anesthesia.

Conflict of Interest

The authors declare no conflict of interest.

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