Medical Journal of Ahl al-Bayt University, Vol.4, No.1, Aug.2025

Challenges Of Administering General and Spinal Anesthesia and Hemodynamic Changes In Hernia Repair Patients

Haider Ahmed Jalab Salem Al-Khikani
hider.ahmed.j@gmail.com
Al-Taff University College, Anesthesia and Intensive Care Technology

ABSTRACT

Introduction: Choosing the best anesthetic medication to the patient's life continues to be the top priority for the anesthesia and critical care department personnel when it comes to techniques, medications, tactics, and recommendations for choosing optimal anesthesia. The most popular and efficient kind of anesthetic for those who repair hernias is spinal anesthesia.

Subjects And Methods: an accurate and up-to-date study of the patients. Based on the types of spinal and general anesthesia, we divided the 100 patients who had herniotomy into two groups: 50 patients received spinal anesthesia, while the remaining 50 patients received general anesthetic. The patient's age, weight, pulse rate, and blood pressure change were all analyzed. The study divided patients between the ages of 20 and 90 into two groups: general anesthesia (GA) and spinal anesthesia (SA) to do thorough follow-up before, during, and after operations.

Results: We demonstrate that it is also more stable in SA, which is around 56%, compared to GA, which is roughly 40%. However, blood pressure is higher in GA, which was 32%, and in SA, which was 24%, and lower in GA, which was 28%, and in SA, it was 20%. As demonstrated in this study, the heart rate is more stable in SA (56%) compared to GA (32%), and it increases in SA (34%), while it increases in GA (60%). The impact of (SA) is more consistent, and the heart rate dropped by 10% in (SA) and around 8% in (GA).

Conclusions: This study concludes that spinal anesthesia (SA) offers greater hemodynamic stability compared to general anesthesia (GA) in patients undergoing hernia repair. Patients in the SA group demonstrated more consistent blood pressure and heart rate control during the period of perioperative. Blood pressure and heart rate fluctuations were significantly higher in the GA group, indicating a less stable cardiovascular response. Therefore, spinal anesthesia may be considered the preferred anesthetic technique for hernia repair in patients where maintaining hemodynamic stability is a clinical priority.

Keywords: blood pressure, hemodynamic stability during anesthesia, Intraoperative Hemodynamics, best anesthetic medication, Cardiovascular Response.

INTRODUCTION

The need for anesthesia during the procedure and postoperative analgesic medicine are two challenges associated with hernia treatment methods. Both spinal and general anesthesia are used during open inguinal hernia surgery [1]. Children with hypertension are known to experience end-organ damage and are at risk of developing hypertension as adults, even though little is known about the long-term effects of chronic hypertension in children [2]. In adults, hypertension is a significant risk factor for renal damage, coronary artery disease, and stroke. The American Society of Anesthesiologists standard for monitoring calls for monitoring the patient's breathing, oxygenation, circulation, and temperature. In addition to usual monitoring, pre- and post-ductal oxygen saturation must be measured using a second pulse oximeter. An aggravation of pulmonary hypertension may be indicated by the beginning of a gradient between the pre- and post-ductal oxygen saturations [3]. Propofol lowers systemic vascular resistance, preload, and myocardial contractility to lower arterial blood pressure. These effects are exacerbated by higher dosages, heart issues, and age extremes. Injection pain and few instances of thrombophlebitis Approximately (58%) of injectable propofol users report experiencing pain [4]. Even though most patients' blood pressure should return to normal a few months before surgery, mild to severe diastolic or systolic hypertension does not raise the risk of anesthesia. Moderate to small increases need not be sensitively addressed in the days before surgery. Increased operational risk is associated with higher blood pressure, which should be carefully managed prior to surgery [5]. Since Bassini's first description of inguinal hernia surgery was published in (1887), several hernia repair techniques have been documented, such as Shouldice, Darning, Modified Bassini, Lichtenstein mesh repair, and the more recent laparoscopic approach. Due to their short recovery periods and low rates of recurrence, laparoscopic and Lichtenstein mesh repairs have grown in popularity recently [6]. Ineffective endotracheal intubation and pulmonary aspiration of stomach contents are the two primary causes of maternal morbidity and death under general anesthesia. One to two hours before general anesthesia is induced, patients with additional risk factors that raise their risk of aspiration should give intravenous ranitidine (50 mg), metoclopramide (10 mg), or both. A potentially problematic airway, reflux symptoms, morbid obesity, and emergency surgery performed without a planned fasting period are some of these risk factors. Antacid prophylaxis against aspiration pneumonia should be administered to all patients (30 to 45 minutes) before induction using (30mL) of sodium citrate. (40mg) of omeprazole taken orally as a premedication [7]. Propofol's main cardiovascular effect is a decrease in arterial blood pressure because it lowers preload, cardiac contractility, and systemic vascular resistance (sympathetic vasoconstrictor activity inhibition). The stimulation required for laryngoscopy and intubation frequently reverses hypotension after induction. Other factors, including large dosages, rapid injections, and advanced age, are also associated with propofol-induced hypotension. Propofol dramatically reduces the response of normal arterial baroreflexes to hypotension [8]. In order to induce a single vital-capacity breath inhalation in (67) persons, it was shown that sevoflurane or isoflurane mixed with (67%) nitrous oxide was not suitable [9]. The hemodynamic reactions to halothane induction and maintenance of anesthesia were compared with those to sevoflurane in (68) unplanned children aged (1-3) who were having adenoidectomy [10]. Not all operations can be performed using the three anesthetic options available for open groin hernia treatment. The ideal anesthetic technique must fulfill specific requirements. It should be as easy and safe as possible, with few postoperative complications. It needs to be affordable, give the patient a speedy recovery after surgery without any negative consequences, and be painless [11]. The FFM (Fat-Free-Mass) scalar may be a preferable option for bolus dosage, according to clinical pharmacology studies conducted on obese individuals [12]. Postoperative hypotension is another risk factor for myocardial injury after Noncardiac surgery [13]. The best anesthetic for avoiding reflex bronchoconstriction during anesthesia could be propofol Compared to inhaled

sevoflurane, children at risk experienced fewer adverse respiratory events when IV propofol was used to induce anesthesia in a randomized study [21]. Primary objective of the study Because patients undergoing hernia surgery under spinal and general anesthesia were unable to achieve circulatory stability, we devised clear techniques to avoid this problem and eliminate all issues that the second important goal decrease morbidity and death and Unwanted complications from anesthesia such as high and low blood pressure and heart rate. Sevoflurane mildly depresses myocardial contractility. Systemic vascular resistance and arterial blood pressure decline slightly less than with isoflurane or desflurane. Because sevoflurane causes little, if any, rise in heart rate, cardiac output is not maintained as well as with isoflurane or desflurane. Sevoflurane may prolong the Interval, the clinical significance of which is unknown [8]. Benzodiazepines given alone decrease arterial blood pressure, cardiac output, and peripheral vascular resistance slightly and sometimes increase heart rate and propofol is a decrease in arterial blood pressure due to a drop in systemic vascular resistance, Hypotension following induction is usually reversed by the stimulation accompanying laryngoscopy and intubation [4]. opioids have minimal direct effects on the heart. Meperidine tends to increase heart rate (it is structurally like atropine and was originally synthesized as an atropine replacement), whereas larger doses of morphine, fentanyl, sufentanil, remifentanil, and alfentanil are associated with a vague nerve–mediated bradycardia. Opioids do not depress cardiac contractility, provided they are administered alone (which is almost never the case in surgical anesthetic settings [8]. The cardiovascular actions of succinylcholine are therefore very complex. Stimulation of nicotinic receptors in parasympathetic and sympathetic ganglia and muscarinic receptors in the sinoatrial node of the heart can increase or decrease blood pressure and heart rate. Low doses of succinylcholine can produce negative chronotropic and inotropic effects, but higher doses usually increase heart rate and contractility and elevate circulating catecholamine levels. In most patients, the hemodynamic consequences are inconsequential in comparison to the effects of the induction agent and laryngoscopy [8]. Additionally, succinylcholine is commonly used to facilitate endotracheal intubation, assist in surgical procedures, and prevent muscle movement during surgery.

Materials and Methods

One hundred patients in all had herniectomy operations in this study. They were split into two equal groups of fifty each, with one group that has spinal anesthesia and the other general anesthesia. Numerous factors, such as the patients' age, weight, blood pressure variations, and pulse rate, were assessed. The subjects, who ranged in age from twenty to ninety, were divided into two groups: one for general anesthesia (GA) and another for spinal anesthesia (SA). We created a list of variables that might be observed in the operating room and arranged them into three different time periods: before to, during, and following the surgery. Blood pressure measurements and related factors, such as cases of hypertension or hypotension, heart rate fluctuations, and mean arterial pressure (MAP), which may suggest the patient is in shock because of fluid depletion or cardiac problems, were among the data gathered. Inhaled anesthetics should be used with caution since they might cause hypotension. The amount of inhaled anesthetic needed to stop (50%) of people from moving in response to a standardized stimulus, like surgery, is known as the minimum alveolar concentration, or MAC. This metric acts as a benchmark for experimental assessments and enables comparisons of the potencies of various anesthetic drugs. By numbing the lower body, spinal anesthesia significantly reduces pain during surgery while preserving patient consciousness, making it a good substitute for general anesthesia. Spinal anesthesia can be used for the majority of procedures performed below the waist. A spinal anesthetic is administered by an anesthetist using Bupivacaine, the most commonly used and recommended drug in surgical operations. On the other hand,

compared to other induction agents, propofol, the preferred medication for general anesthesia, has a significant effect on systemic blood pressure. The main cause of this is the considerable vasodilation that occurs in the venous and arterial systems, which lowers preload and afterload. With increasing age, in individuals with reduced intravascular fluid capacity, and after fast delivery, the impact on systemic blood pressure becomes especially noticeable. The choice of the type of anesthesia depends on the patient's appropriate condition. One type is not preferred over another, and the action is based on the position taken by the anesthesiologists. We take a reading every (5 to 7) minute and (30) minutes after the operation. Everyone knows and remembers these values well as they are the foundation of clinical work the normal heart rate ranges from (60 to 100) beats per minute while the average blood pressure is typically around (120 over 80) millimeters of mercury the respiratory rate falls between (12 to 20) breaths per minute and the mean arterial pressure should be maintained between (70 to 100) millimeters of mercury as for the minimum alveolar concentration. Additionally, the inhibition of the normal baroreflex response exacerbates the hypotensive effects, resulting in a negligible rise in heart rate even in the presence of vasodilation.

Results

In study as seen the Patient Distribution Table (1) for Blood Pressure Change, Additionally, blood pressure is more constant in SA (56%) compared to GA (40%); yet, blood pressure increases more in GA (32%) and decreases more in SA (24%), whereas blood pressure decreases more in GA (28%) and decreases more in SA (20%). In terms of blood pressure, the figures demonstrate that spinal anesthesia is more stable than general anesthesia, Everyone knows and remembers these values well as they are the foundation of clinical work the normal heart rate ranges from (60–100 bpm) while the average blood pressure is typically around (120/80 mmHg) the respiratory rate falls between (12–20 bpm) and the mean arterial pressure should be maintained between (70–100 mmHg) as for the minimum alveolar concentration or MAC it refers to the alveolar concentration of an inhaled anesthetic required to prevent movement in 50% of patients in response to a standardized surgical stimulus.

Table 1. Distribution of patients according to the change in Blood Pressure

NO. OF PATIENT	INCREASE IN BLOOD PRESSURE	REMAIN	DECREASE IN BLOOD PRESSURE	TOTAL
(GA) - GROUP	16 32%	20 40%	14 28%	50 100%
(SA) - GROUP	12 24%	28 56%	10 20%	50 100%
TOTAL	28 28%	48 48%	24 24%	100 100%

Table (2) indicates that the heart rate in this study is steadier, with a percentage of (56%) in (SA) but 32% in (GA) and (34%) in (SA) but (60%) in (GA). The percentage of drop-in heart rate was (10%) in (SA) and around 8% in (GA), and the impact of (SA) is more stable. Additionally, we demonstrate that it is more consistent in SA (56%), as opposed to GA (40%).

Blood pressure increases more in GA (32%) than in SA (24%), although it decreases more in GA (28%) than in SA (20%) in the absence of treatment. Blood pressure is also more stable in SA (56%), compared to GA (40%) nonetheless, GA (32%) has higher blood pressure, and GA (28%) has higher blood pressure. Therefore, spinal anesthesia is superior and more stable considering the data and statistics provided here.

NO. OF PATIENT	INCREASE IN HEART RATE	REMAIN	DECREASE IN HEART RATE	TOTAL
(GA) - GROUP	30 60%	16 32%	4 8%	50 100%
(SA) - GROUP	17 34%	28 56%	5 10%	50 100%
TOTAL	47 47%	44 44%	9 9%	100 100%

Table 2. Distribution of patients according to the change in Heart Rate

The graph illustrates the relationship between age and mean arterial pressure during general anesthesia both before and during the procedure as age increases there is a subtle variation in MAP values but no consistent trend is observed across all age groups the MAP before general anesthesia appears to be slightly higher than during anesthesia in most age categories indicating a common anesthetic effect of lowering blood pressure across patients regardless of age however the changes are not uniform and seem to fluctuate with individual differences rather than age alone this suggests that while age may have some influence on hemodynamic responses to anesthesia other factors like patient condition anesthetic dose and surgical stress likely play a more significant role in determining MAP levels during general anesthesia

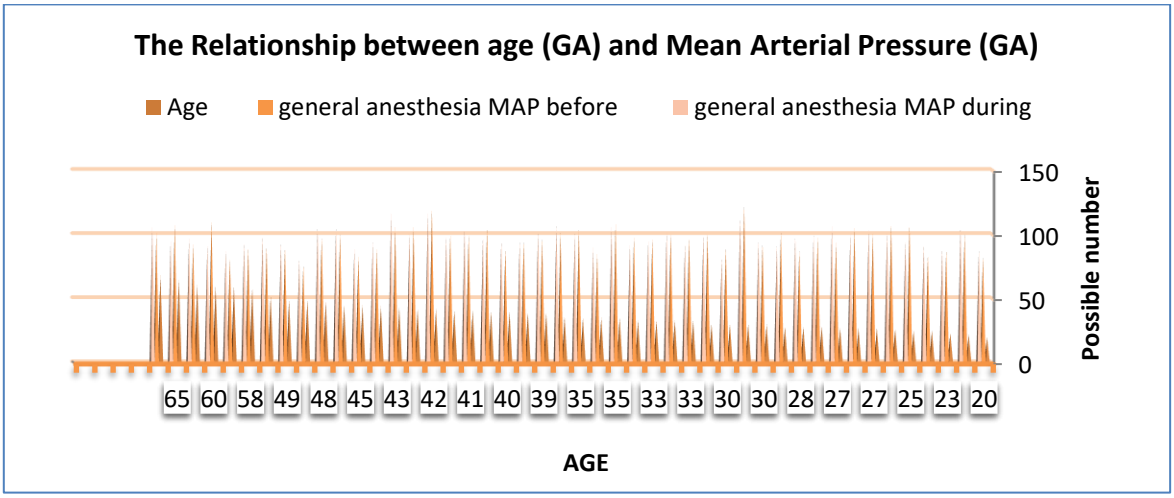

Figure 1. The relationship between age GA and Mean Arterial Pressure GA

The radar chart shows the relationship between mean arterial pressure before during and after general anesthesia across different subjects the general trend indicates that MAP values are highest before anesthesia then slightly decrease during the procedure and finally show partial recovery after anesthesia although not always returning to baseline levels this suggests that

general anesthesia tends to reduce MAP due to its vasodilatory and cardio depressant effects and while MAP often improves after the procedure it may remain lower than the preanesthetic state depending on individual physiological responses and anesthetic management.

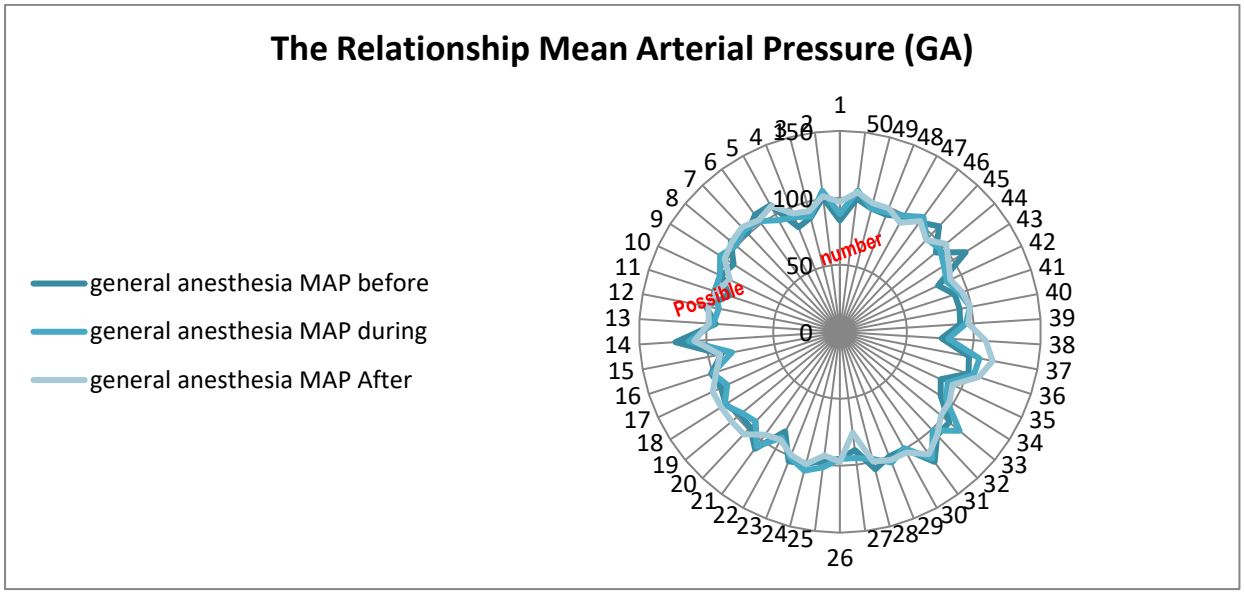

Figure 2. The Relationship Mean Arterial Pressure GA

In study The age of patients ranged from (20) to over (90) years, with average of (48) years, the age group (26-40 years) show the peak incidence of this study which was (46%) in GA and (44%) in SA, followed by age group (41-55 years) which was (24%) in the GA and (30%) in SA group age group (55 and more than55) which was (12%) in GA and (18%) in SA, while age group less (25 years) was the least number, it was (8 %) of the SA. In this study the patients were selected Male and Female and the nobler of Male is (27) in general anesthesia and (33) person in spinal anesthesia about (54%) in Male (66%) in Female.

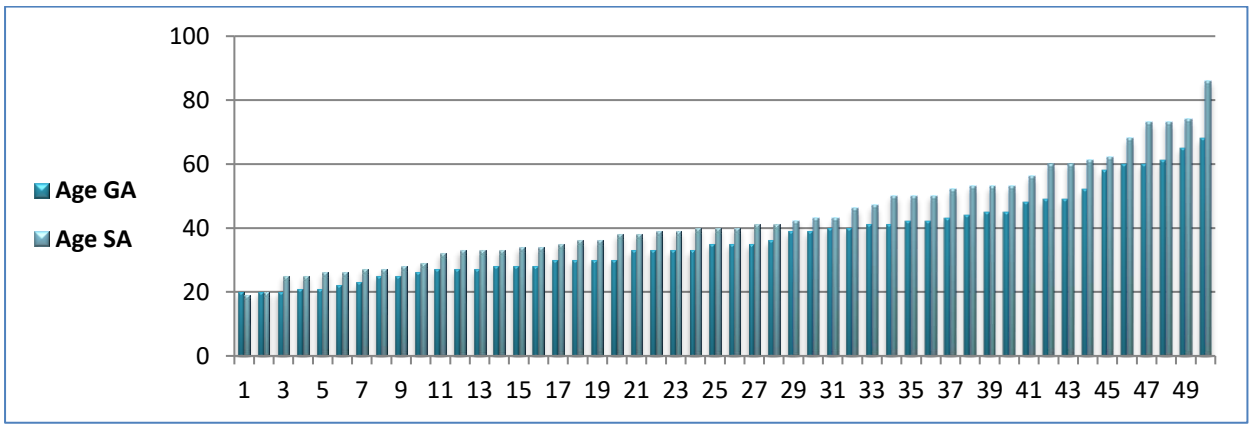

Figure 3. The Relationship Age (GA) vs (SA)

Discussion

According to Courtney J. Balentine, inguinal hernia repair is the most common general surgical surgery carried out in the US. About 15% to 20% of these procedures are performed under general anesthesia, whereas 80% are performed under local anesthesia. We expected that as people aged, the benefits of local anesthetic versus general anesthesia for inguinal hernia

surgery would grow [15]. According to Bay-Nielsen, regional anesthesia has the highest morbidity whereas local infiltration has the lowest. The elective groin hernia repair operation had a 30-day mortality rate of 0.12%. Patients who died within a week of the procedure were disproportionately more likely to have used regional anesthetics [16]. Bay-Nielsen's data further support the preference for local anesthesia by demonstrating that regional anesthesia carries a higher morbidity burden, while local infiltration anesthesia results in the lowest. The reported 30-day mortality rate of 0.12% in elective groin hernia repairs is low but clinically significant, particularly since those who died within one week postoperatively were more likely to have received regional anesthesia. This indicates the need for careful patient selection and individualized anesthetic planning based on preoperative risk factors. This comprehensive text presents a medically rich and evidence-based discussion on the comparative effects of different anesthetic techniques—specifically general, spinal, regional, and local anesthesia—on patient outcomes during and after inguinal hernia repair, with a focus on hemodynamic stability and perioperative morbidity and mortality. Salutations, Rodgers, Anthony Neuraxial blocking reduces serious issues, such as postoperative mortality. More research is needed to determine the extent of some of these advantages and whether they are solely attributable to the avoidance of general anesthesia, all-cause mortality, DVT, pulmonary embolism, myocardial infarction, transfusion needs, pneumonia, other infections, respiratory depression, and renal failure [17]. Rodgers et al. highlight the protective role of neuraxial blockades, such as spinal or epidural anesthesia, in reducing severe postoperative complications including mortality. However, while observational studies support these benefits, causality remains uncertain and further randomized controlled trials are necessary to determine whether these outcomes are directly due to the avoidance of general anesthesia or other perioperative factors. These complications include DVT, pulmonary embolism, myocardial infarction, transfusion needs, pneumonia, infection, respiratory depression, and renal failure—many of which are exacerbated by hemodynamic instability. Inguinal hernia repair is indeed the most frequently performed general surgical procedure in the United States, and anesthesia choice plays a crucial role in patient safety and surgical outcome. According to Courtney J. Balentine, approximately 80% of these procedures are performed under local anesthesia, while 15%–20% utilize general anesthesia. This demographic distribution likely reflects the growing recognition of the relative safety and efficacy of local and spinal techniques, especially in elderly and comorbid populations. The hypothesis that the benefits of local over general anesthesia increase with age is pharmacologically and physiologically plausible due to the altered pharmacokinetics and pharmacodynamics in aging individuals, as well as a higher risk of cardiovascular instability under general anesthesia. In the 5–10-minute post-induction period, severe hypotension following anesthesia induction occurs more frequently than at previous times, according to David L. Reich. Conclusion: It is advisable to consider alternatives to propofol for inducing anesthesia in individuals over 50 with (ASA physical status ≥III). Within (0–10 minutes) following the induction of anesthesia, 9% of patients in routine clinical practice exhibited clinically severe hypotension [18]. David L. Reich's observations on post-induction hypotension provide crucial insight into intraoperative hemodynamic risk, particularly in older adults (age >50) with higher ASA scores (≥III). The recommendation to consider alternatives to propofol is evidence-based, as propofol is known for its vasodilatory and myocardial depressant effects. The occurrence of clinically significant hypotension in 9% of patients within 0–10 minutes of induction underscores the importance of vigilant monitoring and hemodynamic support during this critical phase. The effects of spinal and general anesthesia on patients' hemodynamic stability were investigated by the study's authors, Al-Khikani et al.

Making repairs to a hernia Potential problems might occur since spinal anesthesia has been shown to be more stable than general anesthesia; nevertheless, the cardiovascular system is unaffected, and the benefit has to be enhanced by precise and correct work rather than dependence. It's critical to identify and correct deviations from the expected course of blood circulation. While spinal anesthesia was more stable, general anesthesia was linked to a significant rise in heart rate. Similarly, mean arterial pressure (MAP) increased significantly during general anesthesia in contrast to the more stable values associated with spinal anesthesia. Furthermore, blood pressure (PB) remained steadier under spinal anesthesia but rose noticeably during general anesthesia. Hemodynamic stability is necessary to keep the heart's oxygen supply and demand in a healthy balance. This can be done using a number of drugs and techniques, including fentanyl mixed with isoflurane, sevoflurane, or propofol. Volatile anesthetics provide cardio protective effects in a number of ways [13]. The scientific principles and training techniques align with the latest American Heart Association guidelines for CPR and emergency cardiovascular care [19]. Al-Khikani et al.'s study comparing spinal and general anesthesia offers significant clinical insight. Their findings show that spinal anesthesia results in more stable heart rate, blood pressure, and mean arterial pressure (MAP), while general anesthesia causes a significant rise in heart rate and fluctuations in blood pressure and MAP, align with the known pharmacological profiles of these modalities. General anesthesia agents, especially volatile anesthetics—tend to induce vasodilation and myocardial depression, leading to variability in hemodynamic parameters. Conversely, spinal anesthesia, while associated with an initial sympathetic block, often maintains a more predictable and stable hemodynamic profile, particularly when titrated carefully and supported pharmacologically. The American Heart Association's Basic Life Support (BLS) course is highly recommended for healthcare professionals and other staff members who require instruction in performing cardiopulmonary resuscitation (CPR) and other vital cardiovascular life support treatments in a range of settings [14]. A considerable percentage of individuals undergoing general anesthesia frequently have intraoperative hypotension (IH) [20]. The occurrence of IH is linked to serious postoperative outcomes, such as cardiac damage, renal failure, and an increased risk of mortality [15]. Perioperative angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers affect the renin-angiotensin system, which can cause refractory hypotension after anesthesia [22]. A synthetic vasopressin analogue called TERLIPRESSIN (1mg) has been used to treat refractory hypotension in patients who have taken angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers [23]. Vasopressin can be used to treat hypotension caused by severe catecholamine deficiency and allergies after pheochromocytoma excision [24]. Moreover, the text highlights the importance of adherence to American Heart Association (AHA) guidelines in managing intraoperative emergencies. BLS training for healthcare personnel ensures prompt and effective response to anesthesia-related cardiovascular collapse, reinforcing the value of protocol-driven perioperative care. Finally, intraoperative hypotension (IH) is flagged as a major concern under general anesthesia, given its association with adverse outcomes such as cardiac injury, renal dysfunction, and increased mortality. The role of ACE inhibitors and ARBs in exacerbating hypotension due to their effects on the renin-angiotensin-aldosterone system is well established. The administration of vasopressin analogues like terlipressin in refractory hypotension provides an important therapeutic alternative, especially in patients with catecholamine-resistant states or post-pheochromocytoma resection. The findings presented in the results section offer empirical support for the conclusions discussed earlier. Specifically, the data confirms that spinal anesthesia (SA) provides greater hemodynamic stability compared

to general anesthesia (GA). As outlined in Table 1, blood pressure remained more stable in 56% of SA cases, compared to only 40% in GA cases. This aligns with prior literature cited in the discussion, particularly the observations by Al-Khikani et al., who noted that spinal anesthesia results in more consistent blood pressure levels and less hemodynamic variability than general anesthesia. Moreover, Table 2 demonstrates that heart rate stability was more prominent in SA patients (56%) versus GA patients (32%), which directly corresponds with previous research indicating that general anesthesia is associated with increased heart rate fluctuations, potentially due to systemic stress responses. These fluctuations, as noted by Reich and others, may lead to clinically significant hypotension or cardiovascular strain. Furthermore, the systolic and diastolic blood pressure variations documented in individual patient profiles reinforce the conclusion that spinal anesthesia results in fewer extreme changes. For instance, while some GA patients experienced a sharp increase from 106/61 mmHg to 154/77 mmHg post-anesthesia, SA patients typically demonstrated more moderate shifts. This observation substantiates the claim from previous studies that spinal anesthesia minimizes the likelihood of intraoperative hypotension (IH), a risk factor for postoperative cardiac and renal complications. Overall, the data confirms that spinal anesthesia offers a more favorable hemodynamic profile, aligning with findings from prior research. This consistency across literature and observed results strengthens the conclusion that SA should be the preferred technique in patients where cardiovascular stability is a clinical priority, particularly in elderly or high-risk individuals.

Conclusions

The selection of an appropriate anesthetic technique is crucial for ensuring hemodynamic stability throughout surgical procedures. General anesthesia, while effective, is often associated with significant fluctuations in heart rate, mean arterial pressure, and blood pressure. In contrast, spinal anesthesia tends to offer a more stable cardiovascular profile, reducing these fluctuations. To optimize patient outcomes, it is essential to implement effective management strategies. This includes using tailored combinations of anesthetic agents, such as fentanyl in conjunction with volatile anesthetics like isoflurane, sevoflurane, or intravenous agents like propofol. The cardio protective properties of volatile anesthetics further contribute to enhanced myocardial protection, promoting safer perioperative conditions. These considerations highlight the value of careful anesthetic planning, ensuring not only effective sedation but also improved patient safety during the perioperative period.

Ethical Approval

was granted by the Research Committee of Karbala Health Directorate under the supervision of the Center for Training and Human Development (Ref. no. 2024-03).

Acknowledgement

All thanks and appreciation to the professors at Al-Taff University College for their recognition of this amazing research, and all thanks to all the doctors and workers in the Anesthesia and Intensive Care Department at Imam Hussein and Imam Hassan Al-Mujtaba Hospitals in the city of Karbala for their efforts to complete this project towards the opportunity and provide all possible services Competing Interests All the authors declare that there are no conflicts of interest.

References

1. Callesen T. Inguinal hernia repair: anaesthesia, pain and convalescence. Dan Med Bull. 2003 Aug;50(3):203-18. PMID: 13677240 .
2. Chaturvedi S, Lipszyc DH, Licht C, Craig JC, Parekh R. Pharmacological interventions for hypertension in children. Cochrane Database Syst Rev. 2014 Feb 1;(2):CD008117. doi: 10.1002/14651858.CD008117.pub2. PMID: 24488616.
3. Aglio MDMS, Linda & Urman, Richard. (2017). Anesthesiology: Clinical Case Reviews. 10.1007/978-3-319-50141-3.
4. Forkin KT, Nemergut EC. Miller's anesthesia, 8th edition [Internet]. American Society of Anesthesiologists; 2016 [cited 2024 Jan 1]. Available from: https://pubHindiyah General Hospitals.asahq.org/anesthesiology/article/124/4/977/14379/Miller-s-Anesthesia-8th-Edition.
5. Wolfsthal SD. Is blood pressure control necessary before surgery? Med Clin North Am. 1993 Mar;77(2):349-63. doi: 10.1016/s0025-7125(16)30256-5. PMID: 8441300.
6. Mabula JB, Chalya PL. Surgical management of inguinal hernias at Bugando Medical Centre in northwestern Tanzania: our experiences in a resource-limited setting. BMC Res Notes. 2012 Oct 25; 5:585. doi: 10.1186/1756-0500-5-585. PMID: 23098556; PMCID: PMC3526506.
7. Aitkenhead AR, I Moppett, J Thompson. Smith and Aitkenhead's Textbook of Anaesthesia. Elsevier Health Sciences; 2013.
8. Butterworth JF. Morgan and mikhail's clinical anesthesiology. 6th ed. McGraw-Hill Education; 2018.
9. Ti LK, Pua HL, Lee TL. Single vital capacity inhalational anaesthetic induction in adults--isoflurane vs sevoflurane. Can J Anaesth. 1998 Oct;45(10):949-53. doi: 10.1007/BF03012302. PMID: 9836031.
10. Meyler L, Aronson JK. Meyler's side effects of drugs used in anesthesia. Amsterdam: Elsevier Science; 2009.
11. Kingsnorth A, Leblanc KA, Sanders DL. Management of Abdominal Hernias. Cham: International Publishing; 2018.
12. Cortínez LI, Anderson BJ, Nick, Puga V, Natalia, Hernán Auad, et al. Dexmedetomidine pharmacokinetics in the obese. European Journal of Clinical Pharmacology. 2015 Sep 25;71(12):1501–8.
13. Liem VGB, Hoeks SE, Mol KHJM, Potters JW, Grüne F, Stolker RJ, et al. Postoperative Hypotension after Noncardiac Surgery and the Association with Myocardial Injury. Anesthesiology [Internet]. 2020 May 29;133(3):510–22. Available from: https://pubs.asahq.org/anesthesiology/article/133/3/510/108232/Postoperative-Hypotension-after-Noncardiac-Surgery
14. Kaplan JA, Augustine's JGT, Manecke GR, et al, eds. Kaplan's Cardiac Anesthesia for Cardiac and Noncardiac Surgery. 7th ed. Philadelphia, PA: Elsevier; 2017:731–769. L.
15. Pardo M. Miller's Basics of Anesthesia. Elsevier Health Sciences; 2022.
16. Benes J, Simanova A, Tovarnicka T, Sevcikova S, Kletecka J, Zatloukal J, Pradl R, Chytra I, Kasal E. Continuous non-invasive monitoring improves blood pressure stability in upright position: randomized controlled trial. J Clin Monit Comput. 2015 Feb;29(1):11-7. doi: 10.1007/s10877-014-9586-2. Epub 2014 May 20. PMID: 24841333.
17. Balentine CJ, Meier J, Berger M, Reisch J, Cullum M, Lee SC, Skinner CS, Brown CJ. Using Local Anesthesia for Inguinal Hernia Repair Reduces Complications in Older

Patients. J Surg Res. 2021 Feb; 258:64-72. doi: 10.1016/j.jss.2020.08.054. Epub 2020 Sep 28. PMID: 33002663; PMCID: PMC7968932.
18. Bay-Nielsen M, Kehlet H. Anaesthesia and post-operative morbidity after elective groin hernia repair: a nation-wide study. Acta Anaesthesiol Scand. 2008 Feb;52(2):169-74. doi: 10.1111/j.1399-6576.2007.01514. x. Epub 2007 Nov 12. PMID: 17999709.
19. Rodgers A, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, Sage D, Futter M, Saville G, Clark T, MacMahon S. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. BMJ. 2000 Dec 16;321(7275):1493. doi: 10.1136/bmj.321.7275.1493. PMID: 11118174; PMCID: PMC27550.
20. Reich DL, Hossain S, Krol M, Baez B, Patel P, Bernstein A, Bodian CA. Predictors of hypotension after induction of general anesthesia. Anesth Analg. 2005 Sep;101(3):622-628. doi: 10.1213/01.ANE.0000175214.38450.91. PMID: 16115962.
21. 1.Ramgolam A, Hall GL, Zhang G, Hegarty M, Ungern-Sternberg BS von. Inhalational versus Intravenous Induction of Anesthesia in Children with a High Risk of Perioperative Respiratory Adverse EventsA Randomized Controlled Trial. Anesthesiology: The Journal of the American Society of Anesthesiologists [Internet]. 2018 Jun 1 [cited 2020 Jul 14];128(6):1065–74. Available from: https://anesthesiology.pubs.asahq.org/article.aspx?articleid=2674300
22. Bertrand M, Godet G, Meersschaert K, Brun L, Salcedo E, Coriat P. Should the Angiotensin II Antagonists be Discontinued Before Surgery? Anesthesia & Analgesia. 2001 Jan;92(1):26–30.
23. Boccara G, Ouattara A, Godet G, Dufresne E, Bertrand M, Riou B, et al. Terlipressin Versus Norepinephrine to Correct Refractory Arterial Hypotension after General Anesthesia in Patients Chronically Treated with Renin-Angiotensin System Inhibitors. Anesthesiology. 2003 Jun 1;98(6):1338–44.
24. Augoustides JG, Abrams M, Berkowitz D, Fraker D. Vasopressin for Hemodynamic Rescue in Catecholamine-resistant Vasoplegic Shock after Resection of Massive Pheochromocytoma. Anesthesiology. 2004 Oct;101(4):1022–4.