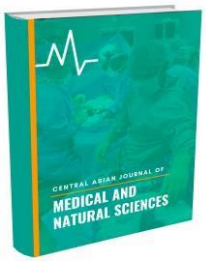

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Article

Compare the Efficacy of Thoracic Epidural Anesthesia (TEA) with General Anesthesia (GA) in Thoracic Surgical Comparative Studies to that of Total Intravenous Anesthesia

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Abstract: This study aimed to compare the efficacy of thoracic epidural anesthesia (TEA) combined with general anesthesia (GA) versus total intravenous anesthesia (TIVA) in thoracic surgical procedures, focusing on factors such as shunt fraction, hypoxic pulmonary vasoconstriction, and oxygenation levels during one-lung ventilation. A total of 150 patients with ASA physical status II-III scheduled for lung resection due to pulmonary illness were randomly assigned to two groups: Group A received TIVA with propofol and fentanyl, while Group B received TEA with low-dose isoflurane and bupivacaine. Hemodynamic parameters, oxygenation levels, and shunt fractions were measured before, during, and after surgery. Results indicated that while both anesthetic methods were safe, TEA with GA better preserved arterial oxygenation levels compared to TIVA, potentially due to differences in cardiac output changes. Patients in the TEA group also experienced shorter extubation times and lower postoperative pain scores, suggesting potential benefits for patients with preexisting cardiac issues and decreased oxygenation during one-lung ventilation.

Keywords: Thoracic Epidural Anesthesia (TEA), General Anesthesia (GA), Total Intravenous Anesthesia (TIVA), One-Lung Ventilation, Oxygenation, Shunt Fraction, Cardiac Output

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1. Introduction

Thoracic epidural anesthesia (TEA) is a method used in addition to general anesthesia (GA) and total-IV anesthesia (TIVA) or GA coupled with inhalational anesthetic drugs. The patient's hemodynamics, the risk of hypoxemia during one-lung ventilation, and hypoxic pulmonary vasoconstriction (HPV) are all affected differently by each of these approaches [1], [2]. In various studies, the effects of inhaled anesthetics on oxygenation levels and shunt % during one-lung breathing have been examined between TIVA and GA. The majority of specialists concur that volatile anesthetics inhibit HPV and may, in a dose-dependent manner, increase the risk of hypoxemia during one-lung breathing [1], [2]. However, intravenous (IV) anesthetics, like as propofol, have a minor inhibitory effect on HPV [2], [3], providing an alternative approach to managing hypoxemia in thoracic surgical scenarios.

In order to optimize outcomes during thoracic surgical procedures, it is crucial to choose an anesthetic modality that is properly tailored to each patient's requirements and surgical concerns, as shown by the varying effects of different anesthetic modalities. Anesthetic procedures need to be improved, and additional research and clinical trials are

needed to expand our understanding of these effects and enhance patient safety and perioperative care. Garutti et al. [4] discovered that when thoracic epidural anesthesia (TEA) was compared to total intravenous anesthesia (TIVA), TEAD produced greater shunt fractions and lower Pao2 values. According to a number of experimental studies, TEA has very little effects on systemic and pulmonary hemodynamics and no discernable influence on hypoxic pulmonary vasoconstriction (HPV) [5, 6].

Furthermore, a meta-analysis by Ballantyne et al. [7] found that the use of epidural local anesthetic treatment considerably improves clinical indicators of pulmonary outcomes, such as the incidence of infections, atelectasis, and other issues. Despite these findings, no thorough analysis of the optimal regimens combining TEA, GA, and TIVA in terms of intraoperative clinical significance has been done; this is particularly true with regard to HPV, hemodynamic variables, and hypoxemia. The primary objective of the research was to investigate the effects of TEA, GA, and TIVA on arterial oxygenation and shunt fraction during one-lung breathing procedures. This study aimed to clarify how different anesthetic regimens affected respiratory and circulatory parameters during one-lung breathing procedures. By analyzing the data from this study, researchers hoped to enhance patient outcomes and increase our understanding of the best ways to manage anesthesia in such circumstances. To ensure the safety and well-being of patients undergoing thoracic surgeries, as well as to improve perioperative care, research on the effects of TEA, GA, and TIVA on oxygen saturation and shunt fraction during one-lung ventilation is essential. The findings of this study might have an impact on future clinical procedures and help develop more effective anesthetic regimes for thoracic surgical procedures. Patients undergoing thoracotomies with pulmonary resections need constant monitoring and assessment of changes in hemodynamic parameters during surgical procedures in order to provide optimal patient care and surgical outcomes.

2. Materials and Methods

Between September 2008 and January 2011, 150 patients with ASA physical status II–III who were scheduled for elective lung surgery at Al-Imamain Al-Kadhimain Medical City were randomly selected if they provided written consent to take part in this controlled trial in the future. Before surgery, all patients having thoracotomies underwent a thorough preoperative evaluation that covered their medical history, physical examination, lab work, electrocardiogram, chest X-ray, preoperative pulmonary function assessments, and perfusion scans. Every patient scheduled for a pulmonary resection or thoracotomy is placed in a lateral decubitus posture using one lung for breathing. The patients' compliance with the study protocol was crucial for gathering crucial data and insights for the advancement of medical knowledge in the field of pulmonary surgery.

Before the administration of anesthetic, a thorough hemodynamic surveillance was performed by placing a radial artery catheter on the opposite side of the cut. Hemoglobin levels, arterial blood gas tests, and invasive blood pressure monitoring were all done with this device. Additionally, a pulmonary artery catheter was carefully inserted into the right jugular vein to access the PCWP. This catheter was required for the collection of mixed venous blood gases, the monitoring of pulmonary artery pressure (PAP), and thermodilution techniques to determine cardiac output. The pulmonary artery catheter was accurately positioned in the pulmonary artery of the dependent lung, as shown by an examination of the preoperative chest x-ray. Heart rate (HR), systolic and diastolic arterial blood pressure, and systolic and diastolic PAP were among the vital signs that were continuously collected and monitored throughout the procedure using state-of-the-art equipment. Arterial oxygen saturation was also monitored continuously (Spo2). The levels of end-tidal isoflurane concentration, end-tidal CO_2, and inspired oxygen fraction (Fio_2) were also continually monitored and recorded using cutting-edge equipment. To provide the greatest care and

safety during the induction of anesthesia, all patients were also exposed to comprehensive monitoring, which included tidal volume assessments and measurement of ECG readings. Each participant received an oral dosage of 0.5–1.0 mg of midazolam one hour before to their scheduled arrival in the operating room.

To induce anesthesia, intravenous injections of atracurium (doses ranging from 0.5 mg/kg), fentanyl (doses ranging from 5 to 10 mcg/kg), and propofol (doses ranging from 2 to 3 mg/kg) were administered to both study groups. To maintain anesthesia throughout the surgical procedures, the patients were randomized at random to either the Total Intravenous Anesthesia (TIVA) or Thoracic Epidural Anesthesia (TEA) groups, which also contained General Anesthesia (GA). In the TIVA group, continuous intravenous propofol infusion rates of 2 to 3 mg · kg-1 · h-1 were combined with intermittent intravenous fentanyl doses of 5 to 10 mcg/kg until one hour before to the procedure's conclusion to maintain anesthesia.

For the TEA group, on the other hand, an epidural catheter was carefully positioned in the T6-7 or T7-8 interspace using the paramedian method before the beginning of anesthesia. The epidural space was located by using a 10-milliliter glass syringe that was filled with a 0.9% sodium chloride solution using the loss of resistance technique. After the catheter was positioned, a test dose of 15 mg of bupivacaine 0.5% isobaric was administered to ensure it was not placed intrathecally. Following that, an epidural catheter was used to provide the patient's first dosage of 0.5% bupivacaine. The precise dose was between 15 and 25 mg, depending on the patient's age and stature. Before the surgical incision was created, a total of 20–30 mg of bupivacaine 0.5% were administered, which consisted of the test dosage and beginning dose combined. The degree of anesthesia achieved was indicated by the absence of pinprick sensation.

The dosage interval for the medication administered during the surgery was set at eighty minutes. Remarkably, while epinephrine may alter the shunt fraction during one-lung breathing, it was not added to the local anesthetics. Throughout the process, medication was administered under careful monitoring and tailored to each patient's specific needs. The dosage and timing of the anesthesia's administration were crucial considerations to optimize both its safety and effectiveness. The careful titration of the medication ensured that the patients received the appropriate dosage of anesthesia for the procedure. The medical staff adjusted the dosage based on each patient's unique needs in an effort to reduce risks and side effects while still providing the necessary level of anesthetic. Epinephrine was intentionally excluded from the combination in order to maintain the integrity of the anesthetic delivery technique. Generally speaking, the anesthetic regimen that was followed throughout the procedure was well-planned and executed to ensure the patients' comfort and welfare.

To keep the patient unconscious, isoflurane was administered at an end-tidal concentration of 0.3% to 0.5%. To produce relaxation, a single intravenous dose of atracurium, ranging from 0.5 mg/kg, was administered to both experimental groups. To ensure that the blood temperature remained constant between 0.5°C and 35.5°C, tight controls were used. Administration of vasoactive medications was strictly prohibited; failure to comply would have resulted in exclusion from the research. Colloids and crystalloids were given to both groups to carefully maintain a constant fluid balance and volume status. Central venous pressure and pulmonary wedge pressure, for example, were continuously monitored to ensure that they did not deviate from baseline by more than 10%. Furthermore, any variations in these values subsequent to the patient's positioning were contrasted with previous measurements, which functioned as the reference point for comparison. When hemoglobin levels dropped below 9 g/dL, erythrocyte transfusions were started immediately to maintain a hemoglobin concentration of 10 g/dL. A twin lumen catheter was carefully placed into the patient's left side after anesthesia. The correct tube placement was verified by listening with a stethoscope.

To help the patient's respiratory system, intermittent positive pressure lung ventilation was used. Throughout the constantly monitored breathing process, a tidal volume of 8 mL per kilogram of the patient's weight and a controlled FiO2 of 1.0 were maintained. In order to keep the arterial carbon dioxide partial pressure (Paco2) between 35 and 40 mm Hg, the pace was changed. We deliberately delayed utilizing PEEP or C.P.A.P. breathing until the fourth stage of our plan sequence was complete. Our carefully planned strategy included seven distinct stages, all of which involved data collection, comprehensive hemodynamic assessments, and periodic gas analysis of blood samples from both venous and arterial origin.

The patients were first given room air to breathe while lying on their backs in the theater. At this time, no anesthesia had been given, and all required arrangements had been made. About 20 minutes after the anesthetic was administered, the second part of the procedure began, with the patients still in the supine position with their chests closed. In this stage, the patients were positioned on their sides, and around twenty minutes after the chest was surgically opened, the two-lung ventilation technique was carried out. While the patients were still in the lateral decubitus position, the fourth part of the experimental procedure included beginning one-lung breathing and collapsing the nondependent lung. All of these precautions were carefully taken before any major pulmonary arteries were ligated in order to maintain the integrity of the experimental setting. It is noteworthy that throughout stages two through four of the data collection process, no surgical operations were performed. Resuming two-lung breathing while the patients were in the lateral decubitus position was the next phase in the experimental procedure. The patients next had another two-lung breathing session, but this time they were in a supine position to allow for more detailed data gathering and observation. After the endotracheal tube was withdrawn, the patients were placed on their backs and fitted with masks to receive oxygen at a rate of two liters per minute, marking the conclusion of the experiment's final stages.

After each hemodynamic data collection, the following parameters were measured: heart rate (HR), mean pulmonary arterial pressure (MAP), cardiac output (CO), pulmonary capillary wedge pressure, and central venous pressure. The thermodilution technique was used to determine the average of three successive measurements made from a single subject at each stage of the cardiac output. The mixed venous and arterial blood samples were immediately assessed at the time of each hemodynamic data collection. The length of time after the procedure that elapsed between being extubated and ceasing the propofol infusion or breathing anesthetic after the sixth measurement was recorded. This was the period that was marked as the extubation, meaning that the endotracheal tube was taken out. It's a vital indicator for monitoring the healing process and figuring out whether the patient is prepared to breathe on their own after surgery. In order to manage postoperative pain, a very regulated approach was used, with patients only receiving IV tramadol when requested.

Table 1. Basic Patient Characteristics

	Group A (n=75)	**Group B (n=75)**	**P Value**
Age (year)	61	59	0.58
Weight (kg)	72	72	0.63
Height (cm)	172	171	0.99
Sex (M/F)	18/7	16/9	0.54
Resection (left/right)	10/15	10/15	≥0.99
Pao2 (mm Hg)	76.5	77.2	0.71
Hb (mg/dL)	11.9	11.6	0.76

values given as the range's median. P values show intergroup relationships. Hemoglobin is abbreviated as Hb.

The TIVA group received 100 mg bolus doses within a 10-minute lockout period in order to achieve this. In contrast, the TEA group received 6–10 mL/h of bupivacaine 0.25% epidural via a thoracic epidural catheter. Every hour, pain levels were meticulously documented using a 100 mm visual analog scale, which goes from 0 (no pain) to 100 mm (the greatest degree of suffering). On the day of the surgery, this assessment was done as soon as the patient arrived at the intensive care unit (ICU) and continued for the next three days. The frequency of respiratory infections, in particular pneumonia, which was determined using the criteria of the Centers for Disease Control, was one of the other variables contributing to the ICU stay. Verifying pneumonia required a chest x-ray with a pulmonary infiltrate as a crucial signal.

Numerous hemodynamic parameters were measured and recorded, including pulmonary and systemic vascular resistance (SVR) and arteriovenous oxygen difference ($C(a-v)O_2$), using well-established mathematical methods. These calculations were made using industry-standard formulas that are often used in clinical settings to assess the body's ability to transport oxygen and maintain blood vessel health.

3. Results

Following a thorough examination of 150 patients, the study revealed that the patients' fundamental characteristics were same across all groups, as Table 1 illustrates. When general anesthesia was administered (Step 1), hemodynamic and oxygenation parameters were examined, and Table 2 demonstrates that there were no significant variations between the groups. After anesthesia was administered and both lungs were ventilated in supine and lateral decubitus positions (Steps 2-3), group A had a significant decrease in cardiac output (CO), whereas group B did not experience any such changes. Mean arterial pressure was the sole measure that significantly decreased in both groups after the patient's anesthesia, as shown by Table 2.

However, there were no differences seen between the groups. When two-lung breathing started, both groups' partial pressure of arterial oxygen (Pao2) considerably ($P < 0.05$) declined; however, group B's Pao2 values were consistently higher than group A's, with statistical significance ($P < 0.05$). Nevertheless, there were no incidences of hypoxemia (defined as Pao2 < 75 mm Hg) reported in any group. Additionally, the shunt fraction increased similarly in both groups. The study's findings shed light on the intricate dynamics of patients' responses to various anesthetic methods and ventilatory settings, underscoring the need of monitoring hemodynamic and oxygenation parameters over the course of anesthesia administration. The results of this research provide valuable guidance on how to improve clinical practices and patient outcomes in the perioperative setting, adding to the body of knowledge previously available on breathing strategies and anesthetic management.

Following the surgery, the only patient metrics linked to hemodynamics and oxygenation that showed substantial improvements were MAP and SVR (Table 2). No changes in patient data were seen in either group after the tube was withdrawn. Group B had an extubation 16 minutes earlier than group A (43 minutes) in our design investigation. Group B's pain score was lower than group A's. No observational problems, such as bleeding, infections, or postspinal headaches, were seen with the group B surgery. Group B's ICU admission and length of stay were significantly less than those of group 1 ($P = 0.04$). Pneumonia was contracted by 28% of patients in group A and 12% of patients in group 2 throughout their stays in the critical care unit ($P = 0.16$; Power 29%).

Table 2. Hemodynamic Variables

		Before induction	Two lung ventilation /supine	Two lung ventilation /lateral position	One lung ventilation/lateral position	Two lung ventilation /lateral position	Two lung ventilation /supine	postoperative
HR (bpm)	**Group A***	78	72	72	80	75	78	86
	Group B*	83	74	72	78	71	75	72†
MAP (mm Hg)	**Group A***	93	75	85	90	90	95	99
	Group B*	88	76	82	81†	83	81	78
PCWP (mm Hg)	**Group A***	12	12	14	16	13	12	12
	Group B *	11	12	14	14	13	12	12
MPAP (mm Hg	**Group A***	17	18	18	23	23	22	20
	Group B*	18	22	20	22	20	20	18
CVP (mmHg)	**Group A***	5	6	8	11	8	7	6
	Group B*	6	8	10	10	11	9	7
	HR = heart rate, MAP =mean arterial pressure, PCWP = pulmonary capillary wedge pressure, MPAP = mean pulmonary arterial pressure; CVP = central venous pressure.							
	* P < 0.05 intragroup (Friedman Test)							
	† P < 0.05 intergroup (Mann-Whitney U Test).							

4. Discussion

Our study's key discovery was that, when TEA and GA were combined, arterial oxygenation levels during one-lung breathing were greater than when TIVA was used. Furthermore, it was noted that throughout the surgical procedure, the cardiac output of the TEA cohort did not change, unlike the TIVA group. Furthermore, the post-surgery extubation time for the TEA group was significantly shorter, in accordance with our study design. Remarkably, arterial oxygenation rose in TEA patients with the same shunt fractions seen during one-lung breathing. Group A's cardiac output rose significantly after one lung of ventilation, despite the fact that it was much lower than group B's following two-lung breathing. This increase in cardiac output even surpassed the values seen in group B during one-lung breathing. Additionally, during one-lung breathing in group A, a small but

significant association between the cardiac output and shunt fraction was discovered, with a correlation coefficient of 0.34 and a corresponding p-value of 0.02. While the partial pressure of arterial oxygen (Pao2) either decreases or remains same, an increase in the shunt percentage is often linked to a rise in (CO) levels [8]. Conversely, lower CO levels may be utilized to promote hypoxic pulmonary vasoconstriction (HPV) and decrease shunting since they are linked to lower pulmonary artery pressure (PAP). Regional atelectasis may have an effect on Pao2 in response to CO levels [8]. There have been conflicting findings from many previous clinical trials regarding oxygenation, shunt fraction, and hemodynamic parameters during one-lung breathing [2], [4] [9].

Van Keer et al. [4] and colleagues conducted an experiment with ten patients who needed thoracotomies in which anesthesia was maintained by a continuous intravenous infusion of propofol at a rate of 10 mg/kg/h. Interestingly, CO, shunt percentage, and Pao2 did not alter throughout the one-lung or two-lung breathing periods. This lack of change might be explained by variations in the techniques employed to evaluate one-lung breathing that began prior to the thoracic cavity opening. Another study by Kellow et al. [9] has also contributed to our understanding of this topic. When thoracotomy patients were ventilated with a 50% nitrous oxide in oxygen mixture without having their PaO2 levels determined, researchers observed a significant increase in both the cardiac index and the shunt fraction when they went from two-lung ventilation to a situation where the shunt fraction was limited. In a separate trial, Steegers et al. [10] continuously infused propofol intravenously at a rate ranging from 6 to 9 mg/kg/h to a group of 14 patients who needed thoracotomies. The results demonstrated that during the one-lung and two-lung breathing phases, the patients' shunt % and Pao2 levels did not vary considerably. The effects of breathing methods on shunt fraction and oxygen partial pressure were likely not the only relevant elements and parameters related to thoracic operations and anesthetic management that were investigated by Steegers et al. The outcomes of these two studies shed light on the intricate relationships that exist between breathing techniques, anesthetic drugs, and physiological characteristics in patients having thoracic procedures. These findings have important ramifications for researchers and medical practitioners who work in this field. More research in this area may look at the long-term effects of different breathing techniques and anesthetic regimes on patient outcomes and postoperative recovery in order to further enhance clinical procedures in thoracic surgery. Such research might enhance perioperative care strategies and enhance patient comfort and safety after thoracotomy procedures.

In their investigation, they omitted any baseline data, such as CO levels. Spies et al. claim that adjustments to these hemodynamic factors might result in further alterations to the pulmonary circulation [9]. Spies et al. [2] performed a study comparing 1 Minimum Alveolar Concentration (MAC) enflurane to Total Intravenous Anesthesia (TIVA) with propofol at a rate of 10 mg/kg/h in patients undergoing thoracotomy. It was observed that cardiac output (CO) and shunt fraction rose considerably when the patient was switched from two-lung to one-lung breathing, whereas Pao2 values decreased in compliance with the specified criteria. This outcome was consistent with the findings of their own inquiry. Group A, which had one lung ventilation, had far higher rises in CO and much lower PaO2 levels than group B, which received thoracic epidural anesthesia. In experimental examinations, TEA was unable to prevent Hypoxic Pulmonary Vasoconstriction (HPV), according to studies by Ishibe et al. [5], [6]. In dogs using TEA for one-lung ventilation, Ishibe et al. [5] observed elevated arterial oxygen levels and a heightened HPV response. Because of the suppression of sympathetic nerve activity and the resulting drop in mixed venous oxygen tension, CO was reduced (PvO2). Nevertheless, Brimioulle et al. [6] discovered that prior α or β-blockers had little impact and that HPV increased after epidural blocking. This implies that all effects on pulmonary circulation were due to sympathetic inhibition. However, in a group B cohort compared to a group A, Garutti et al. [4] showed lower Pao2

values (120 mm Hg) and higher shunt percentages (39.5%) among patients who had undergone thoracotomy. They concluded that in cases when one-lung ventilation was necessary, TEA was not a recommended alternative for thoracic procedures [4].

Nevertheless, their work has some significant drawbacks. It should be noted that the levels of CO and mixed venous oxygen tension—which are crucial indicators for evaluating the effects of HPV—were not really measured, as was previously indicated in a study [11]. Three different sources [4] state that the venous blood gas investigation that yielded the shunt % was carried out using a central venous catheter. TEA was provided in addition to propofol. Propofol may worsen the hypotensive effects of epidural anesthesia, according a study by Kasaba et al. [12]. We chose not to employ TEA in conjunction with propofol in our experimental environment because we anticipated hypotension, which spared us from needing vasoactive support. In a different experiment, Garutti et al. [4] only administered IV ephedrine to the TEA group when their systolic arterial pressure fell below 100 mm Hg. Another academic research [13] claims that ephedrine acts on both α and β receptors as a partial agonist. Given the finding of β-adrenergic subtype transcripts in lung and left ventricular tissues, it cannot be ruled out that the increased CO via β-receptor [14] activity and the lower oxygen levels and raised shunt fraction seen in Garutti et al.'s studies [4] are connected.

Based on our findings, Hachenberg et al. [15] evaluated ventilation-perfusion mismatch using the multiple inert gas elimination approach and demonstrated that thoracic epidural anesthesia (TEA) had no discernible impact on shunt development before or after general anesthetic administration. Thoracic surgical procedures depend on the maintenance of hypoxic pulmonary vasoconstriction (HPV) at its peak efficiency. As per an earlier study [9], preserving this mechanism is directly linked to keeping cardiac function at presurgery levels that are similar. Group B had better hemodynamic stability in terms of cardiac output (CO) than the group receiving full intravenous anesthesia (TEA), even though the TEA group's mean arterial pressure (MAP) and systemic vascular resistance (SVR) values were lower. These particular outcomes have been observed in preliminary clinical studies [16]. Following TEA administration, prior research has shown mild reductions in heart rate, blood pressure, and cardiac output [16].

In a study by Tanaka and colleagues [17], cardiac output for 13 patients undergoing thoracotomy with low-dose TEA was assessed using the suprasternal Doppler method in addition to a Swan-Ganz catheter thermodilution. They found that mean arterial pressure decreased only slightly after endotracheal intubation; in contrast, the cardiac index and pulmonary wedge pressure were very stable over the study. Conversely, Spies et al. [2] observed a noteworthy reduction in cardiac output and mean arterial pressure in thoracotomy patients who received propofol-induced anesthesia. Furthermore, because of the negative inotropic effects of propofol, Larsen et al. [18] saw considerable reductions in cardiac index. Extubation after surgery was carried out much sooner in group B than in group A according to our protocol design. Our experiment is the first of its kind to compare TEA with GA to TIVA in patients undergoing lung resections in terms of extubation time.

Boldt et al.'s [19] extubation times of 31 ± 10 minutes for thoracotomy patients treated with propofol and fentanyl are less than what we saw. Our patients received continuous propofol infusion or inhaled isoflurane within the same dosage range until Step 6 measurements were completed in order to ensure homogeneity in hemodynamic and oxygen-transport related variables. Given the higher doses of propofol needed for thoracic operations, the longer infusion period may have contributed to the prolonged extubation time in group A. Furthermore, a longer infusion interval was linked to an increase in propofol's context-sensitive half-time, according to Hughes et al. [20]. Therefore, it is conceivable that the differences in extubation times seen between the TEA and TIVA groups might be attributed to propofol's pharmacokinetic properties, which are dependent on the infusion's duration. This suggests that further study should be done to better understand how various anesthetic techniques affect how long an extubation lasts. Additionally, considering

the importance of extubation timing in postoperative care, additional research is needed to determine the optimal feasible balance between effective anesthesia and a quick recovery. These investigations may lead to modifications in anesthetic methods that enhance patient outcomes and shorten the postoperative recovery period. In the end, a complete understanding of the factors determining extubation time in different anesthetic regimes is necessary to improve perioperative care and patient safety.

It is undeniable that accumulation might introduce bias into the extubation time data. Early breathing tube removal also saves time in the critical care unit after surgery and lowers the incidence of lung infections, both of which are clinically relevant outcomes. This reduces the total cost of healthcare, especially after heart and thoracoabdominal surgery [21]. The Thoracic Epidural Anesthesia (TEA) technique may also be crucial for managing postoperative pain adequately. According to our study's findings, patients getting Total Intravenous Anesthesia (TIVA) with IV piritramide had less pain after surgery and a longer length of stay in the intensive care unit (ICU) than those receiving TEA with epidural bupivacaine. Previous clinical research have shown comparable results. A comprehensive meta-analysis further verified the hypothesis that patients' risk of pulmonary complications might be significantly decreased by utilizing epidural anesthesia for postoperative pain management. [7] As a result, it is thought to be safe to use both anesthetic techniques during surgery. The absence of harmful effects on arterial oxygen levels demonstrated the safety profile of TEA and GA. However, group A's Pao2 levels significantly decreased in comparison to group B, which may indicate a drawback for the former. This decrease in Pao2 may have resulted from group A's increased cardiac output during one-lung breathing, which group B did not experience since their cardiac output remained constant. To maintain stable hemodynamics and optimal oxygen saturation during one-lung breathing procedures, TEA may thus be beneficial to utilize in addition to GA for patients with cardiopulmonary problems.

5. Conclusion

The study concludes that both TEA combined with GA and TIVA are safe for use during thoracic surgery. However, TEA with GA offers better preservation of arterial oxygenation during one-lung ventilation and results in shorter extubation times and lower postoperative pain scores. These findings suggest that TEA combined with GA may be more beneficial for patients with existing cardiac issues and those requiring optimized oxygenation during thoracic surgical procedures.

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