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A COMPARATIVE ANALYSIS ON PROPOFOL AND DEXMEDETOMIDINE DRUG EFFICACY AND HEMODYNAMIC STABILITY IN TOTAL INTRAVENOUS ANESTHESIA

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ABSTRACT

Background:

The advantages of total intravenous anesthesia (TIVA), including a quicker recovery, less post-operative nausea and vomiting (PONV), and better post-operative pain management, have made it an attractive substitute for inhalational anesthetic. Among TIVA drugs, dexmedetomidine and propofol are notable for their unique benefits. Propofol's quick onset, gradual emergence, low adverse effects, and anti-inflammatory qualities make it a popular drug. It provides better hemodynamic regulation and is linked to positive recovery patterns. The selective α2 adrenergic receptor agonist dexmedetomidine, on the other hand, guarantees superior sedation, low respiratory depression, intraoperative hemodynamic stability, and improved recovery. It also lessens the need for opioids and the side effects that come with them. There are still differences between the two drugs' effects on recovery outcomes, hemodynamic stability, and sedative quality, despite their encouraging qualities. In order to improve anesthetic procedures, this study compares the intraoperative hemodynamic stability, cost-efficiency, and effectiveness of propofol and dexmedetomidine in TIVA. Aim: Assessing and contrasting the hemodynamic stability and effectiveness of propofol and dexmedetomidine in patients receiving total intravenous anesthesia (TIVA) is the goal of this comparative study. The purpose of this study is to evaluate important factors such as the degree of sedation, intraoperative hemodynamic stability, recovery time following surgery, and side effects linked to each anesthetic drug.

Material and Methods:

At Peshawar General Hospital, 144 ASA I or II patients between the ages of 18 and 60 who were having elective procedures covered by TIVA participated in this prospective, randomized, double-blind trial in 2024. The propofol group (Group P, n = 72) and the dexmedetomidine group (Group D, n = 72) were assigned to the patients at random. In Group D, a loading dosage of 1 mcg/kg was administered over 8 minutes, with maintenance at 0.5–1 mcg/kg/h. In Group P, the initial propofol dose was 2 mg/kg, followed by maintenance at 100–200 mcg/kg/min. Monitoring of hemodynamic parameters (MAP, HR, and SpO2) was done at baseline, during induction, and several times during surgery. Recovery profiles, extubation durations, adverse events, total drug dosages, expenses, and sedation levels were assessed.

Results:

Two groups (Group P: Propofol, Group D: Dexmedetomidine) were randomly assigned to 144 patients, 69.4% of whom were male and 30.6% of whom were female. The groups' demographics did not differ significantly. Based on hemodynamic analysis, Group D consistently showed lower heart rates than Group P, with statistically significant differences ($p < 0.01$), suggesting improved cardiac stability. Group D had higher stability in subsequent intervals, even though systolic blood pressure was largely identical (T3, $p = 0.018$). Following induction, both groups' diastolic and mean arterial pressures were quite comparable, indicating stable profiles for both drugs. Conclusion: The hemodynamic stability and quality of recovery during TIVA were shown to differ significantly between propofol and dexmedetomidine in this study. In later phases, dexmedetomidine demonstrated exceptional effectiveness in reducing and stabilizing heart rate and preserving a steady systolic blood pressure profile. Furthermore, a greater proportion of patients received outstanding recovery ratings, indicating that dexmedetomidine has the potential to improve the quality of recovery. Overall, it was found that dexmedetomidine was a more effective drug for enhancing post-operative recovery and establishing hemodynamic stability in TIVA.

Keywords: *Dexmedetomidine, hemodynamic stability, anesthetic agents' comparison, total intravenous anesthesia, intraoperative monitoring.*

INTRODUCTION

In the recent times, total intravenous anesthesia (TIVA) has transformed into a good alternative for inhalational anesthesia due to its variety of benefits like smooth recovery from anesthesia, reduced incidence of post-operative nausea and vomiting (PNOV), and post-operative pain.(1) Though the use of TIVA can reduce the complications of inhalational anesthesia, based on the IV agents chosen, patients can still face unwanted complications.(2)Total intravenous anesthesia (TIVA) is very popular in regard to enhance the quality of anesthesia in ambulatory surgery. The most commonly used anesthetic drugs for monitoring anesthesia care are fentanyl, midazolam, and propofol. Opioids are generally linked with post-operative nausea and vomiting (PONV), and respiratory depression. Anesthesia without opioid is associated with lower post-operative rescue analgesic drug usage and lower adverse effects linked with opioids as well as there is also significantly higher patients with excellent recovery profile in OF TIVA. Propofol can be suitable for total intravenous anesthesia (TIVA) in order to maintain general anesthesia during surgical procedure in the absence of inhalational anesthetic agents. Some benefits of propofol-based TIVA involve minimum post-operative nausea and vomiting, favorable post-operative psychomotor function, and smooth emergence. Additionally, propofol inhibits the production of pro-inflammatory cytokines IL-1β, IL-6, and TNF-α mediated by pain and it also involved in the inhibition of NMDA receptor, which plays a key role in the transmission of pain. Certain clinical studies which have compared the post-operative analgesic effect of propofol-based TIVA versus inhalational anesthesia do not yield consistent outcomes. Whereas some studies have discovered greater pain control with propofol-based TIVA, Benefits of total intravenous anesthesia (TIVA) with propofol also involve decreased nausea and vomiting, minimal atmospheric pollution, and a good wake up profile with containing better analgesic properties. In animal-based studies, propofol has been indicated to decrease levels of pro-inflammatory cytokine and suppress the stimulation of N-methyl-D-aspartate (NMDA) receptors. Additionally, TIVA with propofol can decrease frequency of severe post-surgical pain. In contrast, TIVA with dexmedetomidine is offering rapid recovery, lower post-operative analgesic need, good quality of recovery, and offers good patient satisfaction with maintaining the hemodynamic parameters.(3)

Total intravenous anesthesia (TIVA), with the mixture of propofol and remifentanil, holds an attractive benefits over conventional inhalational anesthesia regarding rapid onset, short duration of action, rapid recovery, convulsion-suppressing capacity, minimal hemodynamic variations, and enhanced post-operative cognitive dysfunction (POCD). TIVA with endotracheal intubation is recommended for patients to sustain optimal mechanical ventilation.(4) comparatively, propofol provide a deep level of sedation and high degree of respiratory compromise except when the depth of the anesthesia is monitored properly.(5)

Hemodynamic stability (Systolic BP, Diastolic BP, HR, and MAP) is an essential factor and an important target intraoperatively for hemodynamic assessment in general anesthesia.(6) It is very important to measure to maintain hemodynamic parameters at optimum level because, immediate and sufficient stabilization has an important impact on outcome.(7)

Dexmedetomidine is a highly active α2 adrenergic receptor agonist offering a worthwhile anesthetic and analgesic conserving effects. It amplify sedation and hypnosis with retaining muscle tone and minor impact on hemodynamic disturbances.(8) Having a distribution half-life of approximately 8 min and a terminal half-life of 3.5 h. At therapeutic doses, dexmedetomidine provides profound levels of sedation without affecting cardiovascular and respiratory stability.(9) It has valuable effects on decreasing the frequency of delirium in several randomized controlled trials and has obtained consideration in the adult, children and elderly populations, mainly because of its characteristic of triggering minor respiratory depression. In addition, beyond its prominent benefits, dexmedetomidine is recently examined for its capability in other clinical conditions, like neuroprotection, cardio protection and Reno protection, and the outcomes of evaluations are encouraging.(10) It exhibits several characteristics that make it an appropriate drug for use in handling individuals with difficult airways and it is also possible that when used as a sole agent or a co-agent, it is effective for conscious sedation.(11) It has been discovered that the intravenous administration of dexmedetomidine at the time of surgery results in reduced post-operative pain ratings, nausea, vomiting and decreased need of rescue analgesia. These particular characteristics of dexmedetomidine can be directed in declining the use of opioids in clinical applications with enhanced recovery profile and decrease adverse effects.(12) Some studies in the literature illustrate the efficacy of dexmedetomidine for providing intra-operative hemodynamic stability, reducing the requirements of anesthetic agents and enhanced post-operative recovery in general anesthesia.(13) The outcomes of laboratory and clinical investigations demonstrated that dexmedetomidine blunts the response of inflammation, and certain animal studies also highlighted the suppression of pro-inflammatory cytokines, it offers anxiolytic properties and reduction of norepinephrine levels and also protect cardiac muscles due to positive impact on cardiac oxygen supply and demand.(14) The authors showed that dexmedetomidine use reduces the risk of atrial fibrillation, ventricular tachycardia, and postoperative delirium.(15) Dexmedetomidine decreases the hypertensive response to tracheal intubation in CABG and certain heart related surgical procedures and offers more stability in hemodynamic profile during laceration, sternotomy as well as aortic cannulation.(16) It produces a decrease in the HR and BP linked with reduced systemic vascular resistance by triggering presynaptic Alpha2 - adrenergic receptors. (17) The sedative and analgesic characteristics of dexmedetomidine are demonstrated by its activity as a highly selective adrenoceptor agonist agent. Dexmedetomidine has been indicated to be safe in clinical setup for respiration even at excessive plasma levels. It has also been shown to decrease airway and circulatory responses during intubation and extubation.(18)

Propofol is among the most extensively used intravenous anesthetic agents for both the induction and maintenance of general anesthesia. It stimulate sedation and hypnosis by triggering the γ-amino butyric acid type A (GABAA) receptor. GABA is the primary inhibitory neurotransmitter in the central nervous system.(19) Propofol produces the most significant reduction in systemic arterial blood pressure as compared to other anesthetic agents, which additionally provide immediate anesthetic effects and minimal side effects and offer a faster recovery from anesthesia than other intravenous agents, it is also known as the agent of choice for continuous anesthetic infusion because of its quick metabolism and lower accumulative effects. After the induction of anesthesia, propofol may cause hypotension and bradycardia because of less suppression of the parasympathetic nervous system compared to sympathetic nervous system. Propofol includes anti-inflammatory and anti-oxidative properties, which covers patients towards the suppression of immune system during surgeries.(20) Besides that, this agent is very effective in oncological procedures, as it is related with anti-tumor effects and provide positive survival and recurrence-free survivals. However, in metastatic procedures choosing an appropriate anesthetic agent is a vital action in order to obtain better outcomes.(20) Propofol is frequently used for maintaining hemodynamic stability because it provides a good hemodynamic control throughout the surgical procedure. This results in reduced cardiac output in spite of a relatively unchanged heart rate.(21)The early onset of sedation with propofol compared to other anesthetic agents occurs because of high lipophilic properties of propofol due to which it distributes quickly into the central nervous system.(22)

The aim of this study is to compare the efficacy and hemodynamic stability of Propofol and dexmedetomedine in the framework of Total Intravenous Anesthesia (TIVA). By evaluating the effects of these two agents on the quality of sedation, recovery profiles, agent cost effectiveness, and cardiovascular parameters, as well as the collection of data on intraoperative hemodynamic parameters including mean arterial pressure, systolic and diastolic blood pressure, heart rate, and any adverse events experienced during anesthesia with both drugs this study seeks to provide a valuable knowledge about the ideal choice of anesthetic agent, contributing to safer and more effective anesthesia practices.

Rationale

The previous study have widely compared dexmedetomidine with an opioid fentanyl in total intravenous anesthesia during laparoscopic cholecystectomy during which both drugs were associated with adequate analgesia. In the study, dexmedetomidine demonstrated prolonged recovery times in comparison to fentanyl, however dexmedetomidine showed reduced postoperative pain and low incidence of PONV. It did not compared dexmedetomidine with propofol in TIVA, additionally, the study focused on laparoscopic cholecystectomy, leaving general surgery with TIVA unexplored. Addressing these gaps, aim of our study is to compare the efficacy and hemodynamic stability of dexmedetomidine and propofol in TIVA setup.

REVIEW OF LITERATURE

The increasing focus on upgrading anesthetic techniques has resulted in vast research about the anesthetic agents that establish the patient safety, hemodynamic stability, and efficacy at the time surgical procedure. Within the intravenous anesthetic agents, Propofol and Dexmedetomidine have become crucial drugs, every one of these agents offer an exclusive pharmacokinetic and pharmacodynamic properties and clinical applications. This review explores the comparative efficacy of the mentioned agents, specifically in field of Total Intravenous Anesthesia (TIVA), which is extensively famous method for modern anesthetic approach.

Sevoflurane with dexmedetomidine, and the propofol with remifentanil in total intravenous anesthesia(TIVA) used to compare the emergence delirium in pediatrics who were selected for strabismus procedures. Study included eighty four children with age of 3 to 11 years, all of them were selected randomly. The anesthetic techniques that were used in the study had proven that, the both techniques minimized the occurrence of emergence delirium. This study also concluded that dexmedetomidine and sevoflurane combination resulted in reduced heart rate and mean arterial pressure (MAP), and had increased recovery time and high incidence of postoperative nausea and vomiting, but propofol based TIVA was associated with lower PONV and short time of recovery, and also mentioned that dexmedetomedine was involved in the higher cardiovascular adverse events.(23) During comparing dexmedetomidine and propofol effects on postoperative outcomes and hemodynamic variables in individuals undergoing elective cardiac surgery in which sixty patients were randomly selected for procedure and given either propofol or dexmedetomidine and the vital parameters were monitored appropriately which included Heart rate, vasopressor needs, mean arterial pressure, ICU stay, postoperative ventilation, and postoperative delirium. They concluded that in comparison to propofol, dexmedetomidine maintained better hemodynamic stability along with lower heart rate and mean arterial pressure with dexmedetomidine. ICU stay was much shorter with dexmedetomidine which indicate improve hemodynamic stability.(15). The study in which they evaluated the sedative property, respiratory effects, and hemodynamic stability of dexmedetomidine and propofol in children population assigned for the magnetic resonance imaging procedures. In the study 60 children were randomly selected into two groups, 30 in D (Dexmedetomidine) group received and 30 children were placed in P (Propofol) group, the D group received 1mcg/kg initial loading dose of dexmedetomidine proceeded with continuous infusion of 0.5 mcg/kg, and the P group received 3mg/kg/h initial loading dose and proceeded by continuous infusion of 100 mcg/kg/min. They defined inadequate sedation as difficulty in termination of procedure due to movement of child during MRI. All vital parameters such as HR, MAP, SpO_2, respiratory rate documented. The observed desaturation in four children in propofol group. The conclusion of the study showed that propofol provide faster induction and recovery, and cause hypotension and desaturation, so dexmedetomidine can be a good alternative sedative drug compared to propofol.(9) Examination of propofol and dexmedetomidine was done during the cerebral angiography in individuals with subarachnoid hemorrhage. Evaluation randomly included sixty adults suffered from good-grade subarachnoid hemorrhage, they received either dexmedetomidine or propofol as anesthetic agents. It is demonstrated that, propofol drug caused faster sedation (in 2.3 minutes), while dexmedetomidine took (15.4 minutes) for the onset of sedation. Use of propofol caused more respiratory complications and movement of patient during the procedure which consequently needed the repetition imaging sequences, while in dexmedetomidine there was less complications and less respiratory events. The procedure time and the recovery time was same in both drugs. The study further concluded that dexmedetomidine is the appropriate drug for cerebral angiography patients with subarachnoid hemorrhage in comparison to propofol for sedation, and provide better hemodynamic stability.(5)

The study conducted at the department of Anesthesia, Andhra Medical College, Visakhapatnam in 2022. This study focuses on the comparison of respiratory effects and hemodynamic stability of propofol combined with dexmedetomidine, propofol combined with fentanyl, and propofol without combination (alone) for the insertion of LMA (Laryngeal Mask Airway). In the study the heart rate, mean arterial pressure, saturation of oxygen, and respiratory rate were the principle parameters to be evaluated. Study patients were divided into three groups randomly: propofol with fentanyl, propofol with dexmedetomidine, and propofol. Age and weight of the patients were not significantly different. The finding of the study indicated that dexmedetomidine and propofol group preoperatively had maximum MAP during the insertion of LMA, and was decreased with dexmedetomidine in comparison with fentanyl and propofol group. The study concluded that dexmedetomidine with propofol provided good hemodynamic stability.(18) Both propofol and dexmedetomidine have been examined in different ways in order to provide best anesthesia practice and prove the drug as agent of choice for anesthesia in this regard a study performed in which they evaluated the hemodynamic parameters as well as stress induced hormones with propofol and dexmedetomidine in individuals assigned for laparoscopic cholecystectomy procedure. Seventy patients were randomly scheduled for elective LC into two groups, the 1st group was given propofol 75 mcg/kg/min and the 2nd received dexmedetomidine 0.5 mcg/kg/h for the maintenance of anesthesia. Parameters like MAP, HR, blood glucose, and serum adrenaline values were continuously monitored peri-operatively. In the results, they concluded that dexmedetomidine offers very minor fluctuation in hemodynamic parameters, but serum adrenaline and glucose were high. Propofol was associated with lowering the stress hormones in LC procedures, so they suggested that propofol could preferred for decreasing stress responses.(14) Effort on studying the effect of dexmedetomidine and target control infusion of propofol for sedation during fiberoptic intubation for patients with difficult airways. The comparison of study involved forty patients randomly selected and divided them into two groups, the dexmedetomidine group was given 1 mcg/kg over ten minutes or the target-controlled propofol infusion group. Their study was focused on the comparison of these two drugs through which they positively concluded that the dexmedetomidine founded to be very effective in intubation and also offers more stable hemodynamic parameters as well as providing a preserved airways during procedure.(11) In clinical practice pain assessment is a vital part of the procedure in this regard different studies are done, in one of these studies the dexmedetomidine combination with fentanyl (DF) group, and ketamine combination with fentanyl (KF) group were compared in the context of hemodynamic stability and recovery during the conscious sedation in dilatation and curettage procedures. After the selection of 50 patients, the DF group was given 1 mcg/kg/10 min dexmedetomidine, and the KF group received 0.5 mcg/kg/h propofol. From results of the study, it is demonstrated that, dexmedetomidine given better hemodynamic profile with contrast to propofol, and was effective in maintaining effective analgesic and sedative effects. The study further revealed that, with maintenance of vital parameters, dexmedetomidine offers best recovery profile compared to ketamine.(24)Evaluation of the effects of dexmedetomidine, propofol, and midazolam sedation and anti-hypertensive requirements in patients with eclampsia who needed post-operative ventilation after the C-section procedure. 90 patients with eclampsia were selected randomly into three separate groups, all groups were given magnesium sulfate in order to avoid seizure. The main assessments were hemodynamic stability, sedation duration, antihypertensive need, stay in the ICU, and the use of analgesic. Like in the majority studies, this study also demonstrated that heart rate and mean arterial pressure were low in the (Dexmedetomidine group) and the need of antihypertensive drugs ratio was also very low in this group, which was only 36.6%, and the duration of ICU stay was also less in this group compared to other groups and need for analgesic was also very low, (Propofol group) was the highest in ratio which was 70%, and (Midazolam group) was at the middle and was 50%.(25) In the randomized double blinded clinical examination revealed that, in the procedures of laparoscopic cholecystectomy 60 patients were examined with the ages of 18 to 65 years by using dexmedetomedine in order to evaluate the hemodynamic stability of dexmedetomidine. Two groups were made and 30 patients were recruited in each group. D group received dexmedetomidine infusion 0.2 mcg/kg h, and S group was given 0.9% saline at 0.2 mcg/kg/h as control group. In the study result, MAP and HR in D group was very low after intubation and during pneumoperitoneum phase in contrast to S control group, further more it concluded that dexmedetomidine enhanced the intra and postoperative hemodynamic stability during surgery without disturbing the recovery phase.(26) Clinical investigation of the effects of ketamine and dexmedetomidine in total intravenous anesthesia in patients with laparoscopic cholecystectomy procedures, adults patients were examined separately in three groups of ninety individuals. TIVA was used by giving remifentanil as analgesic, propofol as sedative, and rocuronium as muscular blockade with the guidance of BIS. Groups were named as KETA for ketamine, 10 mcg/kg/h added to TIVA, DEX for dexmedetomidine, 0.5 mcg/kg/h added. Control group was given the infusion of normal saline, the post-operative analgesia was given through IV patient-controlled analgesia PCA with morphine 1mg 5 min time. Pain scores, VSA (visual analogue scale), hemodynamic parameters were documented. Conclusion of the study suggested that, adding dexmedetomidine or ketamine to total intravenous anesthesia overcome the postoperative pain as well as decrease morphine uses.(27) To compare the outcomes of TIVA by using propofol or dexmedetomidine with versus sevoflurane for maintaining anesthesia in children with the procedure of bone marrow aspiration BMA a study conducted in which they selected 60 patients aged, 3 to 12 years into three groups randomly. S group was named for sevoflurane induction and fentanyl for maintenance, P for propofol induction and fentanyl maintenance, and D for dexmedetomidine induction and fentanyl maintenance. Results of the study indicated that hemodynamic stability was lower in all groups, P group had faster recovery time, and D group had high sedation score among all three groups.(8) Another work on a prospective randomized study in which dexmedetomidine and propofol efficacy was compared by using infusions of these drugs for hypotensive anesthesia, the study was conducted in a tertiary care hospital. In study a total of 80 adults were recruited for evaluation and divided them into two separate groups, group P, and group D, 40 individuals in each were examined in general anesthesia during functional endoscopic sinus surgery FESS. After the administration of 100-200 mcg/kg/min propofol to P group, and 1 mcg/kg dexmedetomidine as initial loading dose and 0.4-0.8 mcg/kg/hour over ten minutes to D group, study conclude that, in contrast to P group (Propofol) the D group (Dexmedetomidine) showed considerably low heart rate and mean arterial pressure during the procedure. Study further stated that, in P group, blood loss was high in comparison to D group. In this evaluation, certain variables were monitored such as quality of surgical field (by using Fromme-boezaart scale), blood loss intra-operatively, hemodynamic parameters, and recovery time. Furthermore it is concluded that, both groups are effective in hypotensive anesthesia in (FESS) procedures, but dexmedetomidine is associated the good hemodynamic control and less blood loss, for this reason dexmedetomidine is a good option for hypotensive anesthesia.(28) Effects of intravenous propofol and dexmedetomidine is also compared in moderate sedation during the spinal anesthetic procedure in which 120 adult individuals were scheduled for spinal anesthesia and all were randomly selected into three different groups, onset of sedation, level of sedation, intensity of pain, hemodynamic fluctuations, recovery times, and satisfaction of patients were continuously assessed in the study. D group received dexmedetomidine, P group received propofol, and group C was given normal saline as control. Propofol was associated with faster recovery and onset of sedation, while dexmedetomidine showed good intra-operative sedation, long analgesia after procedure with high patient satisfaction. Study further concluded that propofol was associated with significantly low HR and blood pressure during the spinal procedure, and dexmedetomidine was associated with stable cardiovascular profile and good sedation as well as patient satisfaction.(22) Certain investigations are founded on the evaluation of hemodynamic profile of dexmedetomidine in cardiac procedures. In this context investigation on a dexmedetomidine in pediatrics cardiac procedures for the examination of hemodynamic profiles in dexmedetomidine. A meta-analysis showed that dexmedetomidine effectively stabilize mean arterial pressure, systolic, and diastolic pressure and keep the heart rate low intra and post-operatively. Furthermore, this agent is satisfactory in minimizing the frequency of junctional ectopic tachycardia in contrast to placebo. In the conclusion of the study it is stated that hemodynamic profile is better preserved in pediatric population during cardiac surgeries, and offers very less adverse effects.(29) Comparing three drugs in upper gastrointestinal endoscopic procedures in order to evaluate the effects of these three drugs during anesthesia for the mentioned procedures in which it is concluded that the satisfaction of endoscopic operator was high (almost 60%) with dexmedetomidine due to its better hemodynamic profile and faster recovery (7.7 minutes) in comparison to propofol and midazolam, recovery time of propofol was (12.7 minutes), and (18.3 minutes) with midazolam. Study indicated that dexmedetomidine was the effective drug among the three for sedation and recovery in (UGIE) surgeries.(30) To study the effects of dexmedetomidine and propofol was performed for non-invasive ventilation after thoracic procedure. In this study all vital parameters such as HR, CO, systolic and diastolic blood pressure, and mean arterial pressure were evaluated, and the results of all parameters were similar in both agents, except diastolic pressure which was higher in propofol group. This study stated that there were no differences in other parameters such as SV (stroke volume) or systemic vascular resistance (SVR), and both propofol and dexmedetomidine were the same in the context of hemodynamic stability during short term sedation.(10) Propofol-based TIVA and volatile anesthesia also studied in patients with digestive tract cancer procedures. Patients were separated into two groups, the main evaluations were post-operative complication, overall survival or recurrence free survival after three years of surgery, study stated that there was no differences in both groups regarding these evaluations. The factors like cancer stage, age of patient, and comorbidities influenced the survival but method of anesthesia did not influenced, because in this regard, both anesthetic methods were same. So, the study indicated that selection of anesthetic technique did not affect the long term outcomes for individuals with GIT cancer.(20)Another study on the comparison of dexmedetomidine and propofol was performed in a tertiary care hospital to measure the hemodynamic profile and recovery profile of both agents in patients elected for laparoscopic procedure with pneumoperitoneum. Patients were randomly recruited for study to receive either propofol or dexmedetomidine with appropriated doses of 1 mcg/kg/hour dexmedetomidine or 100 mcg/kg/minute propofol. Result of the study demonstrated that hemodynamic profile is better maintained with dexmedetomidine, and showed reduced stress response to pneumoperitoneum, but the propofol group offered faster recovery.(17) A study focus on two drug such as propofol and etomidate and the related postoperative cognitive dysfunction in elderly patients after the total intravenous anesthesia. The study examined the drugs in TIVA in which the incidence of POCD occurred more consistently in patients with older age during the endotracheal intubation, and they mentioned that the modulation of anesthetic compatibility can minimize the severity of postoperative cognitive dysfunction. They assigned 63 elderly patients into two groups, one was called the controlled group (propofol) and received 1-2 mg/kg propofol, and the other group was called etomidate and propofol combination group and received 1-2 mg/kg propofol and 0.3 mg/kg etomidate. Study revealed that the combination of propofol and etomidate can be very protective in order conserve the cognitive function of elderly patients in TIVA with tracheal intubation.(4) For the comparison of volatile anesthesia and anesthesia with propofol for post-operative delirium in on-pump cardiac valve procedure, a study in which 684 patients were scheduled, among them 18.7% was given volatile anesthesia and 22.4% received total intravenous anesthesia. Results indicated that no significant differences occurred in the incidence of delirium in both groups, and there was no secondary outcomes such as morbidity or mortality or ICU stay occurred in both groups. So, volatile method is not associated with post-operative delirium reduction in contrast to TIVA with propofol.(31) In the regard of comparison of TIVA versus inhalational anesthesia, a comparative study was conducted in order to compare the outcomes of both anesthetic techniques, adult patients were recruited for transabdominal robot-assisted laparoscopic procedures which included, gynecological procedures, urological procedures, or gastroenterological procedures. Assessment of the effect of each anesthetic technique on patients was the primary outcome. Collection of data and analysis of data was done by standard manner. The study did not provided any suitable findings for meta-analysis because of insufficient comparable data, study showed that further examination may be needed to provide a good conclusion of these anesthetic techniques for the mentioned surgical procedures.(32) In the context of comparing inhalational and intravenous agents, work done on inhalational sevoflurane and TIVA with propofol for the purpose post-operative pin assessment in patients undergoing hepatectomy. This procedure is associated with severe pain. It is demonstrated that during the study, postoperative acute pain score was the same in both groups, and TIVA with propofol group was associated with low pain score as well as coughing at three months post-surgery, and offered good quality of recovery with minor chances of constipation and nausea. Evaluation further indicated that after hepatectomy, post-operative acute pain control was not improved with propofol-based TIVA in comparison to inhalational anesthesia.(1)

MATERIAL AND METHODS

2.1 Study Design

This prospective, randomized study was conducted in the tertiary care hospital in 2024. After receiving ethical clearance from the hospital ethical committee of Peshawar General Hospital (PGH) Peshawar, Khyber Pakhtunkhwa, and informed consent secured from all participants. A total of 144 patients with ASA physical status grade I or II, aged 18-60 years of either gender scheduled for elective surgeries under total intravenous anesthesia (TIVA) were enrolled in the study. Individuals with known hypersensitivity to dexmedetomidine or propofol, severe hepatic or renal disease and pregnant or lactating women were excluded from the study. All assigned patients were fasting according to preoperative fasting guidelines for 8 hours for food, 4 hours for clear fluid, and were pre-medicated before the induction. Basic hemodynamic parameters, involving blood pressure, heart rate, oxygen saturation, and temperature were recorded preoperatively. Standard monitoring including electrocardiography, pulse oximetry, and non-invasive blood pressure was established in operating room. The current study was structured in a prospective, randomized double-blinded method. Patients were randomly divided into two groups using a computer-generated randomization table placed in sealed envelopes. Group P (n=72) given Propofol, and Group D (n=72) given Dexmedetomedine as unit of their anesthesia protocol. Anesthesia induction was accomplished with both drugs. Patients in Group (P) received Propofol with initial loading dose of 2mg/kg and followed by infusion for maintenance at rate of 100-200 mcg/kg/min. Patients in group (D) received dexmedetomedine with initial loading dose of 1 mcg/kg over 8 minutes, and followed by infusion of 0.5-1 mcg/kg/h till the end of procedure utilizing a specific peripheral venous access. Patients of both groups was given supplementary fentanyl doses and atracurium as needed. Supplementation of oxygen at 4 l/min and ventilation were adjusted in order to maintain normocapnia. Hemodynamic parameters such as peripheral oxygen saturation (SpO_2), end-tidal carbon dioxide, mean arterial pressure (MAP), and heart rate were recorded at baseline level during the induction and intermittently throughout the course of procedure at the interval of every 5 minutes as well as post-operatively. Recovery profile of both groups involving post-operative sedation scores and time of extubation were also examined. Certain adverse events including bradycardia, hypotension, or desaturation were documented and supervised properly. Heart rate <50 bpm considered bradycardia and was controlled by administering intravenous 0.5 mg atropine. Mean Arterial Pressure (MAP) <60 mmHg considered a significant hypotension and initially was managed by adjusting infusion dosage and furthermore infusion discontinued in case of no response, and then 3-6 mg intravenous noradrenaline was given to treat hypotension. The study of drug was discontinued 5-7 minutes before the end of the procedure. The residual effect of neuromuscular blockers reversed with IV neostigmine 0.05 mg /kg and IV glycopyrrolate 0.008 mg/kg. Extubation was done when the patient became fully awake and started breathing regularly by means of sufficient tidal volume. Time of recovery was considered the time, from the cessation of anesthesia till the patient followed the verbal commands and was recorded at interval of every 2 minutes. The onset of time of sedation was defined as the time period between the start of study drug infusion and achieving a Ramsay score 5. Duration of procedure was recorded along with the total intra-operative opioid consumption for the evaluation of analgesic-sparing effect of each drug, and the post-operative analgesic requirements are documented. Total dosage of Dexmedetomedine and Propofol calculated and compared throughout the procedure, and costs of study drug, costs associated with treating adverse events such as bradycardia or hypotension also calculated and compared.

The primary outcomes of the current study were the efficacy of Propofol and Dexmedetomedine in sustaining steady hemodynamic parameters, specifically MAP and HR within 20% of baseline levels during TIVA and recovery characteristics. Secondary outcomes included time of recovery, depth of sedation, assessed by using Ramsay score at pre-defined periods, and time to accomplish target sedation level. Recovery parameters involved time of emergence and time of extubation, and monitoring of PONV.

2.2 Statistical Analysis

All statistical analyses were performed using SPSS version 20. Depending on the data distribution, the Two-Way ANOVA Measure test was used to compare continuous variables, which were reported as mean ± standard deviation (SD). The Chi-square test was used to compare categorical variables between groups, and P-values were used to assess statistical significance. All of the results obtained have been examined at the 5% significance level. P-values less than 0.05 were regarded as statistically significant.

RESULTS

A total of 144 patients were included in the study, comprising of 100 males (69.4%) and 44 females (30.6%) in group P and group D. The ages ranged from 18-60 years in both groups, and the range for weight was 45-85 kg. There were no significant differences between the two groups in terms of age, sex, and weight (Table 1).

Table 1: Demographic and clinical characteristics of study participants.

		AGE			Total	P value
		18-30	30-45	45-60		
Gender	Male	6	18	76	100	0.276
	Female	3	13	28	44	0.289
Total		9	31	104	144	

Table 2: Comparison of heart rate (bpm) at various intervals among group P and Group D.

	Group P ± SD	Group D ± SD	P value
T0	81.3± 12.0	75.2±6.5	0.002
T1	76.1±11.2	70.0±6.3	0.009
T2	71.1±12.1	65.2±5.5	0.002
T3	70.1±19.5	61.2±5.4	0.002

Pre-induction value taken as baseline value.

At every time point, Group P (Propofol) continuously exhibited greater mean heart rate values than group D (Dexmedetomidine). At all times, there was a statistically significant difference in the heart rates of the two groups. This imbalance demonstrates a substantial impact of the medication on cardiac regulation. The statistical significance of these differences is indicated by the p-values (<0.01<0.01). Compared to the P group, the D group had a stronger capacity to reduce heart rate, and this effect remained constant over time (Table 2).

Table 3: Comparison of systolic blood pressure (mmHg) at various time intervals among group P and Group D.

	Group P ± SD	Group D ± SD	P value
T0	142.0±10.5	138.2±19.3	0.148
T1	127.5±17.6	127.1±10.7	0.864
T2	117.6±17.6	119.9±7.8	0.319
T3	108.7±8.5	113.1±13.2	0.018

Pre-induction value taken as baseline value.

At most time intervals, there is no significant difference between the systolic blood pressures of both groups, however, on T3, group D showed a statistically significant higher systolic blood pressure than Group P. Consequently, Dexmedetomidine (Group D) maintained a more stable systolic blood pressure profile since the results indicated that it would be beneficial for preserving SBP stability in later stages of monitoring or recovery, thus, Group D kept their systolic blood pressure profile more steady compared to Group P (Table 3).

Table 4: Comparison of diastolic blood pressure (mmHg) at various time intervals among group P and Group D.

	Group P ± SD	Group D ± SD	P value
T0	88.3±5.4	84.6±10.0	0.006
T1	81.3±4.7	79.6±8.7	0.15
T2	76.3±5.1	75.7±8.2	0.628
T3	71.6±5.7	72.2±8.0	0.609

Pre-induction value taken as baseline value.

There was a significant difference in the diastolic blood pressure between the two groups at baseline. The mean DBP was significantly higher in Group P than that of Group D. However, at the remaining time intervals, the mean diastolic blood pressure become comparable in both groups, suggesting that both groups had a similar effect on DBP and were linked to stable diastolic blood pressure profiles (Table 4).

Table 5: Comparison of mean arterial pressure (mmHg) at various time intervals among group P and Group D.

	Group P ± SD	Group D ± SD	P value
T0	106.2±6.6	102.5±11.5	0.021
T1	97.4±5.1	95.7±7.9	0.116
T2	91.1±5.3	90.2±7.1	0.401
T3	84.0±5.6	85.3±8.4	0.254

Pre-induction value taken as baseline value.

In terms of MAP, there was a statistically significant difference in the mean arterial pressure between the two groups at baseline. However, as the time went on, the differences between both groups reduced, and at the remaining time intervals, no changes were seen. This pattern suggested that both Group P and group D had a stabilized effect on mean arterial pressure (Table 5).

Table 6: Comparison of recovery profile among Group P and Group D.

	Quality of Recovery				
	Neutral	Good	Excellent	Total	P Value
Propofol	4	39	29	72	0.017
Dexmedetomidine	0	29	43	72	0.007
Total				**144**	

Regarding recovery, the analysis showed that the recovery quality of two groups differed significantly. With a higher percentage of outstanding ratings of Group D than Group P, the data showed a stronger recovery profile for Group D, which may indicate that Group D provides higher quality than Group P (Table 6).

DISCUSSION

In our study, we found there is statistically significant difference in mean arterial pressure and mean heart rate between the two groups at all time points. According to a study by Rashid et al. (25) on propofol and dexmedetomidine, mean arterial pressure was lower in propofol and lowest in dexmedetomidine when MAP was continuously monitored at various time intervals. Dexmedetomidine produced improved hemodynamic stability since its mean MAP was substantially lower. In our evaluation the HR was consistently higher in all time intervals with propofol and the arterial pressure was better maintained with dexmedetomidine. Our result exhibited significant variations between both drugs hemodynamic stability and effectiveness during total intravenous anesthesia (TIVA). Some variations were noted in the hemodynamic profile at the initial stages of interventions in both groups, at the later intervals they become comparable. Another study comparing propofol and dexmedetomidine was carried out by Gomeishi A et al. (14) who noted that the heart rate level was associated with significantly different ranges in both groups in all stages of measurement after the induction. In the study they also showed that, following the induction of anesthesia, both groups were associated with opposite trend: dexmedetomidine offered a declining trend of HR compared to propofol. In the terms of MAP, the mean MAP showed a statistically significant difference (P<0.05) in both groups, the dexmedetomidine group was comprised with a lower amount.

Impact of anesthetic drug on intraoperative hemodynamics in total intravenous anesthesia is associated with diverse clinical conditions. In a study comparing the infusion of propofol and dexmedetomidine, S. U. Hassan, N. Abbas, S. Tariq, et al. (21) revealed that the propofol group's MAP was higher at baseline than that of the dexmedetomidine group, and that the dexmedetomidine was linked to greater hemodynamic stability and a higher sedative score in pneumoperitoneum surgery. They also discovered that the propofol infusion had a quicker recovery period than the sedative effects of the dexmedetomidine infusion, requiring a longer stay in the PACU. Study of A. Koroglu et al. (9) on propofol and dexmedetomidine showed that prior to sedation, there was no statistically significant difference in MAP, HR, or RR between the two groups. During sedation, HR and MAP of both groups were considerably reduced from the baseline level. It was noted that the HR in group P was faster than in group D at same intervals. It took 50 minutes for the baseline to drop by 20%. They highlighted that propofol provided faster induction and recovery rates than dexmedetomidine. While dexmedetomidine was linked to improved MAP and RR preservation. In our study we found that the dexmedetomidine has smooth and natural like recovery which can be advantageous in different procedures, the intraoperative hemodynamics can impact the postoperative recovery. When sheikh et al. (15) (2018) compared dexmedetomidine and propofol in cardiac surgery, they found that the mean heart rates of two groups differed significantly over all time periods. Overall, during the pre-bypass period, propofol had significantly higher mean HR and MA than dexmedetomidine. Additionally, perioperative infusion of dexmedetomidine may be superior to propofol anesthesia because it produces better hemodynamic stability, lowers the risk of postoperative delirium, and results in a shorter intensive care unit stay. Furthermore, postoperative ventilation was lower with propofol than with dexmedetomidine.

J Anesth et al. (5) in their study revealed that at baseline level heart rate was comparable in the both groups. Following the administration of sedative agents, the HR decreased in both group, but the dexmedetomidine group was associated with greater drop in heart rate. The changes in the MAP pressure was same as the heart rate. They emphasized that dexmedetomidine may alone offer safe and efficient sedation without causing hemodynamic and respiratory disturbance. We found stable heart rate in both groups and noticed that MAP is better maintained with dexmedetomidine. Systolic blood pressure and diastolic blood pressure were generally preserved in both groups.

In our investigation, dexmedetomidine outperformed propofol in the context of hemodynamic stability. Throughout the operation, patients in the dexmedetomidine had more stable heart rates and mean arterial pressure, which is consistent with the recognized sympatholytic effects of medications. While being a good induction agent and maintenance drug, propofol was linked to a greater rate of bradycardia and hypotension, which is consistent with its myocardial depression and vasodilatory actions. The sedative property was better with dexmedetomidine which was consequently associated with free of analgesic need and contained opioid sparing effect throughout the procedures.

CONCLUSION

Significant differences between Propofol and Dexmedetomidine were found in our study with regard to cardiac regulation, blood pressure stability, and recovery quality. Over time, Dexmedetomidine continuously showed greater efficacy in lowering and stabilizing heart rate. Although there were some initial variances between the systolic and diastolic blood pressures, both drugs stabilized at similar intervals, with Dexmedetomidine exhibited a more consistent profile for the systolic blood pressure in the later stages. With a higher percentage of good evaluations, the Dexmedetomidine group's recovery results were noticeably better, understanding its superiority in recovery quality. Dexmedetomidine is a good choice for total intravenous anesthesia since it was generally more successful in maintaining hemodynamic stability and maximizing recovery.

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