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ORIGINAL ARTICLE

Ketamine Versus Dexmedetomidine as Adjuvants to Bupivacaine in Modified Pectoralis Plane Block for Analgesia in Patients Undergoing Modified Radical Mastectomy

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ABSTRACT

Background: Effective perioperative pain management is crucial for improving postoperative recovery and reducing the use of opioids in patients undergoing modified radical mastectomy (MRM). The current study compares the analgesic impact of ketamine versus dexmedetomidine as adjuvants to bupivacaine in modified pectoralis (PECS) plane block in this category of patients**.**

Methods: In this prospective randomized double-blinded clinical trial which included sixty-eight women with breast cancer scheduled for modified radical mastectomy who were randomized into two equal groups. Group K received ultrasound-guided modified PECS block with ketamine added to bupivacaine. Group D received an ultrasound-guided modified PECS block with dexmedetomidine added to bupivacaine.

Results: Compared with Group D, VAS scores were significantly higher in Group K at 6 hours and 12 hours ($p < 0.05$). The number of patients who needed rescue analgesia (nalbuphine) was significantly higher in Group K (61.7%) than in Group D (35.3%). The time for the first rescue analgesia was significantly shorter in Group K than in Group D (18 hrs±3.30vs 12.96±2.7) ($p<0.05$). Moreover, the total nalbuphine consumption during the 24 postoperative hours was significantly higher in Group K than in Group D ($p<0.05$).

Conclusion: The findings suggest that dexmedetomidine provided superior analgesic effects compared to ketamine, as demonstrated by longer time to initial rescue analgesia, decreased requirement for rescue analgesia, and lower postoperative Visual Analog Scale (VAS) ratings at 6 and 12 hours. Additionally, the dexmedetomidine group consumed considerably less fentanyl intraoperatively. indicating better intraoperative analgesic efficacy.

Keywords: Breast cancer, Pectoralis Plane Block, Dexmedetomidine, Ketamine

INTRODUCTION

Breast cancer is the most common malignancy among women worldwide [1]. One of the basic treatment options for breast cancer is surgically excising the primary tumor together with axillary dissection. General anesthesia, with or without regional blocks, is the most often used anesthesia modality [2].

According to estimates, in the initial days after breast cancer surgery, 40% of women have moderate-to-severe discomfort [3].

In addition to affecting pulmonary and immunological functioning, acute post-operative pain delays discharge from the

recovery area following surgery, increases the risk of myocardial infarction and thrombosis, and can lead to an extended hospital stay [4]. In more than half of the patients, it also plays a significant part in the development of chronic, ongoing postoperative pain [3].

Therefore, it is crucial to provide patients having breast surgery with efficient perioperative pain treatment. Among the techniques for efficient perioperative pain management are regional blocks. They enable early mobilization and early hospital discharge and have an opioid-sparing effect. Newer techniques like fascial plane blocks and pectoral nerve blocks have been documented for perioperative analgesia in breast surgeries after the introduction of ultrasonography [2]. The use of adjuvants, such as tramadol, dexamethasone epinephrine, clonidine or dexmedetomidine, or ketamine, with the goal of synergistically improving the quality of analgesia, has been justified by the short duration of analgesia supplied by local anesthetics [5].

Ketamine and dexmedetomidine are two commonly explored adjuvants for regional anesthesia due to their unique analgesic and anesthetic properties. Ketamine, an antagonist of the N-methyl-D-aspartate (NMDA) receptor, provides analgesia through its central and peripheral actions while also exhibiting opioid-sparing effects. Additionally, ketamine has been associated with preventing central sensitization and reducing the incidence of chronic postsurgical pain [6]. Conversely, the highly selective α2-adrenergic agonist dexmedetomidine, enhances analgesia through central and peripheral mechanisms by inhibiting norepinephrine release and promoting sedation without respiratory depression. Its sympatholytic properties may also contribute to improved hemodynamic stability during surgery [7].

AIM OF THE WORK

Our aim is comparing the effect of ketamine versus dexmeditomidine as adjuvant to bupivacaine during modified pectoralis plane block in patients undergoing modified radical mastectomy.

METHODS

This prospective randomized double-blinded clinical trial study was conducted over the period of one year, starting from March 2024 to March 2025, after approval of the Institutional Review Board (IRB# 255/26) in Zagazig University and obtaining written informed consent after a full explanation of the regional block technique and possible complications. This study was carried out in a random sample of Sixty-eight to have modified radical mastectomy in the operating rooms of Zagazig University hospitals' anesthesia, critical care, and pain management departments. The World Medical Association's Code of Ethics for Human Studies, known as the Declaration of Helsinki, was followed when conducting.

Sample size

If total postoperative morphine consumption dose in ketamine group. Versus dexmedetomidine group was 12.5±4.1mg morphine [8] versus 14.8±2.4mg morphine [9] at power of test 80% and 95% CI, the estimated sample size was 68 cases, 34 case in each group using Open Epi program.

Inclusion criteria included female patients aged 21-64 years old, physical class I or II according to ASA, BMI ≤ 35, and slated for a unilateral radical mastectomy with modifications. Anticoagulant users and patients with a history of bleeding problems were not included. Patients who have a local infection at the site of a local anesthetic injection, those with known allergies to the medications used in the study, individuals with psychiatric disorders, and chronic analgesic users prior to surgery in supraclavicular, infraclavicular, or axillary regions.

Withdrawal criteria: Patient had the right to withdraw from the study at any time without any negative consequence on her medical or surgical treatment.

Preoperative

A history was taken, and a complete physical examination was conducted, including the airway and the site of the block. Laboratory testing was performed, including CBC, random blood glucose, coagulation profile, and liver and kidney function tests. An explanation of the visual analogue scale Delgado et al. [10] was given, and patients

were instructed to use a scale of 0 to 10 to score their pain, with 10 representing the most excruciating pain and 0 representing no discomfort at all. The patient received instructions on the preoperative fasting hours, which include two hours for clear drinks and at least six hours for meals.

Anesthetic techniques

Preoperative, 10mg of oral diazepam was administered as a premedication to all patients. An intravenous line was placed in the contralateral upper limb to the operational side as soon as the patient entered the operating room. Monitoring includes non-invasive blood pressure (NIBP) checks and electrocardiograms (ECGs), pulse oximetry (Sao2), and baseline readings (HR, O2 Saturation, mean arterial blood pressure) were recorded. fentanyl 1 µg/kg IV, propofol 2-2.5 mg/kg IV, and Cisatracurium 0.15 mg/kg IV bolus were used to induce general anesthesia. After that, the patient was mechanically ventilated and intubated, and the CO2 level was adjusted to end-tidal (35–45 mmHg). Isoflurane 1–1.2% in oxygen was used to maintain anesthesia, and 0.05 mg/kg of cisatracurium was administered as needed. 0.5µg/kg fentanyl boluses were given if the mean heart rate and blood pressure increased by more than 20% from the baseline. Hemodynamic parameters (heart rate and mean arterial blood pressure) and O2 saturation were assessed every 15 minutes.

Regional Block Technique

Computer-generated randomization tables were used to divide the patients into two equal groups: after patients generally anesthetized using ultrasound, patients in Group K received a modified PECS block, with ketamine 1mg/kg, completed to 2 ml with saline then to 30 ml with 0.25% bupivacaine. The 30 ml solution was divided into 10 mL injected between the 2 pectoralis muscles on the interfacial plane (PESCS I) and 20 mL injected between the pectoralis minor and serratus anterior muscles (PESCS II).

Group D; after patients generally anesthetized using ultrasound a modified PECS block with 1 µg/kg dexmedetomidine completed to 2 ml with saline then to 30mL with 0.25% bupivacaine. The 30 ml solution was divided into 10 mL injected between the 2 pectoralis muscles on the interfacial plane (PESCS I) and 20 mL injected between the pectoralis minor and serratus anterior muscles (PESCSII).

Block technique

The arm was abducted to a 90-degree angle while the patient was positioned supine for the block. On the lateral aspect of the clavicle, the ultrasonography probe was positioned obliquely. Following the identification of the axillary vein and artery, high- frequency linear ultrasound probe was moved laterally until the pectoralis major, minor, and serratus anterior muscles were identified in the same view. After skin infiltration with 1–2 ml of 2% lidocaine, the needle was advanced, in the same plane as the probe, from the medial to lateral direction until the tip reached the plane in the interfacial plane (PECS I), 10 mL was injected between the two pectoralis muscles, and A 20 mL injection was made between the pectoralis minor and serratus anterior muscles (PECS I block). The needle was advanced from the medial to the lateral direction within the same plane as the probe until the tip reached the interface between the main and minor pectoralis muscles. The needle was then moved into the fascial plane between the serratus anterior and pectoralis minor muscles at the fourth rib level after the local anesthetic had been applied along this plane. The subsequent dosage was 20 millilitres of 0.25% bupivacaine for the PECS II block [11] Figure 1. To prevent the intercostal gap and minimise the risk of pneumothorax, the needle trajectory was orientated towards the superior aspect of the fourth rib, positioned beyond the needle tip. Prior to needle insertion, to avoid pleural damage, the pleura's location had to be determined. All patients were given 30mg of ketorolac 30 minutes prior to the end of surgery. Following surgery, intravenous atropine (0.01 mg/kg) and neostigmine (0.05 mg/kg) were used to reverse the muscle relaxant.

Postoperative:

After extubation, the patients were transferred to the PACU, where they were monitored and their pain was assessed. The recovery of each patient was assessed every 5 minutes using the modified Aldrete score, and they were

discharged from the PACU when their modified Aldrete score reached 9, 1g of paracetamol was given every 8 hours after surgery. Patients were given rescue analgesia in the form of 10 mg/70 kg Nalbuphine IV if the VAS was higher than 3.

Outcome measures:

Total postoperative opioid intake was the major endpoint, whereas pain scores, hemodynamic stability, analgesia duration, and adverse effect incidence were the secondary outcomes.

STATISTICAL ANALYSIS

The data was gathered and examined using the Statistical Package for the Social Sciences (SPSS) software, version 23.0. Quantitative data were displayed as mean ± SD or median and interquartile range, whereas qualitative variables were displayed as frequencies and percentages. When the data were regularly distributed, two groups were compared using parametric tests (t-test). Non-parametric testing (the Mann-Whitney U test) was used to compare two groups when the data were not normally distributed. The chi-square test (X2) or Fisher's Exact test was used to examine comparisons between a number of qualitative variables. There were two sides to every test. P value below 0.05 was considered statistically significant.

RESULTS

This study was conducted at Zagazig University Hospitals' Anesthesia, Intensive Care, and Pain Management Department. Ninety-six patients were examined for eligibility to be included in the current study. Eighteen patients did not meet the inclusion criteria, and 10 refused to participate **(Figure 2).** Sixty-eight patients were included and randomized equally into Group K and Group D, and all the patients included had completed the study.

The current study's findings revealed no statistically significant differences between the study groups regarding age, height, body weight, BMI, side of mastectomy, duration of surgery, and American Society of Anesthesiologists (ASA) class. On the other hand, intraoperative fentanyl consumption had been significantly higher in Group K than in Group D **(Table 1).**

The results of the present study showed no statistically significant differences between group K and group D regarding VAS on arrival to PAUC, 1 hour, two and twenty-four hours after surgery ($p>0.05$). However, at 6 and 12 hours, group K's VAS was substantially higher than group D's ($P<0.05$). (table 2)

In terms of rescue analgesia, group K had a considerably larger percentage of patients in need of rescue analgesia (Nalbuphine) (61.7%) compared to group D (35.3%). Group K experienced the first rescue analgesia much faster than group D (12.96±2.7 vs.18 hrs± 3.30), $p<0.05$. Additionally, group K consumed considerably more Nalbuphine overall during the 24 postoperative hours than group D ($p<0.05$) (table 3).

According to the study's findings, there was no discernible difference between the two groups' times to be discharged from the PACU ($p>0.05$). (table 4)

Compared to group D, group K experienced nausea at a considerably higher rate ($p < 0.05$). Other than that, there was no statistically significant difference between groups K and D in the incidence of negative effects ($p > 0.05$) (table 5).

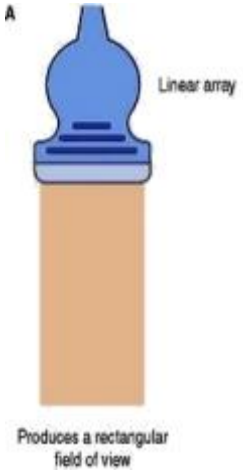

Figure 1: Linear frequency probe.

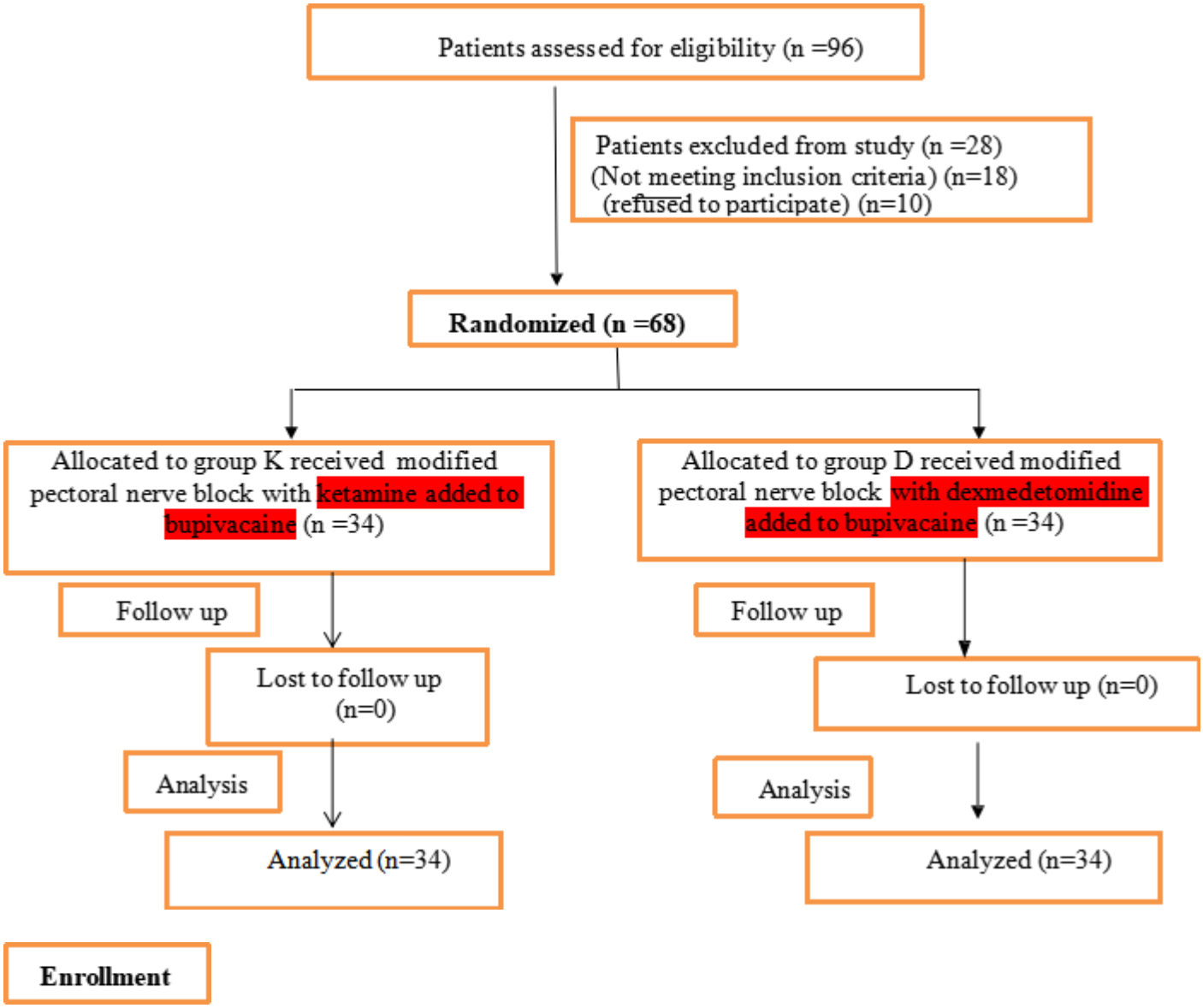

Figure 2: Study Flow Chart.

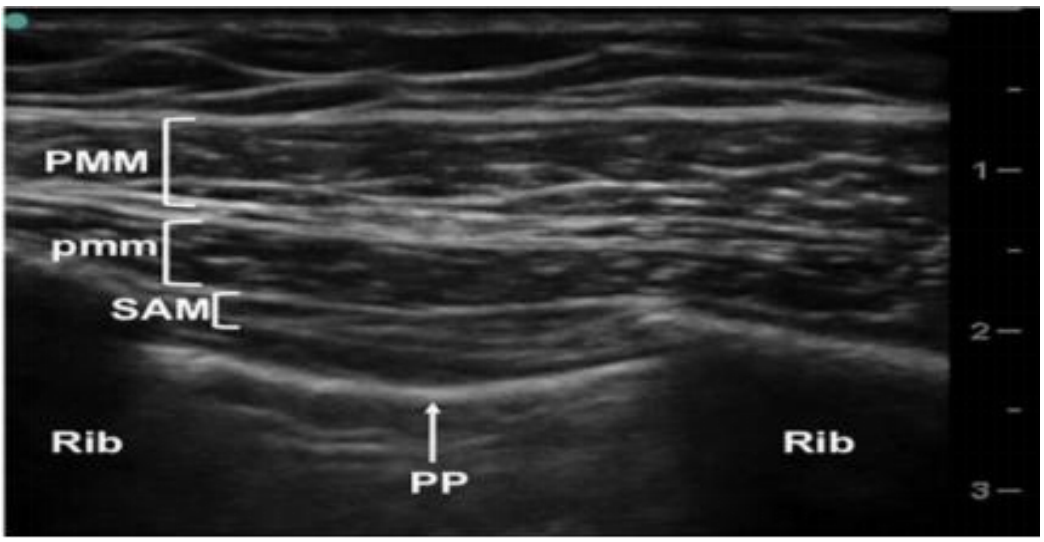

Figure 3: Ultrasound visualization for pectoral nerve block II. The pectoralis major muscle (PMM), pectoralis minor muscle (pmm), serratus anterior muscle (SAM), and the parietal pleura (PP) are identified between the ribs [30].

Table 1: Patients' characters of studied groups and intraoperative fentanyl consumption.

Variables	**Group K** n.34	**Group D** n.34	**p-value**
Age (years)	48.59±11.70	50.09±10.45	0.579
Height (cm)	160.88±6.21	162.41±4.59	0.252
Body weight (kg)	70.15±4.99	71.21±4.82	0.377
BMI (kg/m^2)	27.26±3.24	27.07±2.58	0.794
Duration of surgery (min)	137.65±29.65	134.12±33.02	0.644
Total intraoperative fentanyl (µg)	122.06±29.37	100±23.84	0.001*
	N(%)	**N(%)**	**p-value**
Side of mastectomy Left Right	 19(55.9) 15(44.1)	 16(47.0) 18 (53.0)	0.467
ASA I ASA II	16(47.0) 18(53.0)	18(53.0) 16(27.0)	0.628

Quantitively
Group K = Ketamine , **Group D =** Dexmedetomidine
Data are expressed as mean ± standard deviation (SD),
Qualitative data as number, BMI: body mass index,
ASA: American Society of Anesthesiologist ***P value < 0.05: significant.**

Table 2: Postoperative VAS in studied groups.

Variables	**Group K** n.34	**Group D** n.34	p-value
VAS at arrival to PAUC	0(0-0)	0(0-0)	-
VAS 1hr	0(0-1)	0(0-0)	0.154
VAS 2hr	1(1-1)	0(0-1)	0.091
VAS 6hr	2(1-2)	1(1-2)	0.0001*
VAS 12hr	4(3-5)	3(3-4)	0.006*
VAS 24hr	2(2-3)	2(2-3)	0.095

Group K = Ketamine , **Group D =** Dexmedetomidine
VAS: Visual Analog Scale
Data are expressed as median (interquartile Range), *P value <0.05: significant

Table 3: Time of first rescue analgesia and "Total Nalbuphine consumption during 24hrs postoperatively of studied groups.

Variables	**Group K n.34**	**Group D n.34**	**p-value**
Number request analgesic postoperative	21(61.7%)	12(35.3%)	0.0015*
Time of first rescue anlagesia (Nalbuphine)"hrs	12.96±2.7	18± 3.30	0.0001*
TotalNalbuphine consumption (mg/24h)	9.4±4.4	6.75± 2.26	0.023*

Group K = Ketamine, **Group D =** Dexmedetomidine
Data are expressed as mean± *standard deviation or number (percent)*
χ2: Chi-square test {c} ***P value < 0.05: significant***

Table 4: Time to discharge from PACU of studied groups.

Variables	**Group K** n.34	**Group D** n.34	p-value
Time to discharge from PACU (min)	42.35±12.51	37.03±10.37	0.060

Group K = ketamine, **Group D =** Dexmedetomidine
Data are expressed as mean ± standard deviation (SD,), P value ≥ 0.05: non-significant

Table (5): Incidence of adverse effects in studied groups.

Adverse effects	**Group K n.34 N(%)**	**Group D n.34 N(%)**	**p-value**
Nausea	8(23.5)	3(8.8)	0.021*
Vomiting	3(8.8)	2(5.8)	-
Agitation	5(14.7)	3(8.8)	0.089
Bradycardia	2(5.8)	3(8.8)	0.155
Arrhythmia	3 (8.8)	2(5.8)	0.493
Pneumathoraxic (pleural injury)	0.0	0.0	-
Hematoma	0.0	0.0	-

Group K = Ketamine, **Group D =** Dexmedetomidine
Data are expressed as number (percent),
P value < 0.05: significant

DISCUSSION

For patients having a modified radical mastectomy (MRM), efficient perioperative pain management is essential to promoting overall patient satisfaction, reducing narcotic use, and improving postoperative recovery **[12].**

In the context of multimodal pain management for breast surgery, regional anesthesia procedures like the pectoralis (PECS) plane block have become more and more common. This technique effectively targets the pectoral nerves, reducing postoperative pain and opioid requirements. However, optimizing the PECS block by incorporating suitable adjuvants remains an area of ongoing research to enhance its efficacy and prolong analgesic duration **[13].**

Ketamine and dexmedetomidine are two commonly explored adjuvants for regional anesthesia due to their unique analgesic and anesthetic properties. Ketamine is an NMDA receptor antagonist that provides analgesia through its central and peripheral actions while also exhibiting opioid-sparing effects. Ketamine has also been linked to lowering the

prevalence of chronic postsurgical pain and preventing central sensitization **[14].**

However, limited data directly compare the efficacy of ketamine versus dexmedetomidine as adjuvants.

The current study's findings demonstrated that the dexmedetomidine group consumed fewer analgesics during and after surgery. The VAS was also lower in the dexmedetomidine group six- and twelve-hours following surgery. Regarding intraoperative hemodynamics and postoperative recovery, there was no appreciable difference between the two groups.

The results of the present study showed that total intraoperative fentanyl consumption was significantly higher in ketamine group compared to dexmedetomidine group.

The higher intraoperative fentanyl consumption in the ketamine group suggests that dexmedetomidine may offer superior intraoperative analgesia. This could be attributed to dexmedetomidine's ability to enhance opioid-sparing effects by modulating nociceptive transmission at both central and peripheral levels, thereby reducing the need for additional analgesics during surgery**[15,16].**

In contrast with **Rashidi M, et al.** conducted a study on 74 patients undergoing thoracotomy who received serratus anterior plan block after surgery and divided into two groups. The (RK) group received ketamine 0.5 mg/kg and 0.4 cc/kg ropivacaine 0.25% and the (RD) group received dexmedetomidine 0.5 µg/kg and to 0.4 cc/kg ropivacaine 0.25%. They reported that those patients maintained stable hemodynamics throughout their study, with no significant differences in MAP or HR. Verbal Numeric Scale (VNS) was reduced to 1-, 12-, and 24-hours following surgery in the ketamine group compared to the dexmedetomidine group ($P < 0.05$) **[17]**. This difference is explained by different types of block used, different type of surgery and ropivacaine added is used in state of bupivacaine in our study.

our findings regarding intraoperative fentanyl consumption contrast with those of **Huang et al.** who observed that intraoperative analgesic and anesthetic requirements were significantly lower in groups receiving dexmedetomidine with esketamine **(Groups DE_1 and DE_2)** compared to dexmedetomidine alone **(Group D)** (all $P = 0.000$). Esketamine exhibited an opioid-sparing effect, though intraoperative remifentanil consumption was similar between **Groups DE_1 and DE_2** ($P > 0.05$) **[18]**.

The VAS scores of the two groups at admission to the PACU, one hour, two hours, and twenty-four hours after surgery did not significantly differ, according to the current study's postoperative pain evaluation. In contrast to ketamine, the dexmedetomidine group showed significantly lower VAS values at 6 and 12 hours postoperatively, indicating persistent analgesia. Compared to ketamine, the dexmedetomidine group's VAS scores were noticeably lower, indicating longer-lasting analgesia. Additionally, the ketamine group had a considerably larger proportion of patients in need of rescue analgesia (61.7%) than the dexmedetomidine group (35.3%). The protracted analgesic impact of dexmedetomidine was highlighted by the significantly longer time to first rescue analgesia in the group who received it.

In current study the prolonged analgesic effect of dexmedetomidine compared to ketamine may be attributed to shorter duration of ketamine effects compared to dexmedetomidine. This results in prolonged analgesia and reduces opioid requirements. Moreover, the higher percentage patients in the ketamine group who needed rescue analgesia further supports the hypothesis that dexmedetomidine provides more sustained analgesia, possibly due to its prolonged action at both central and peripheral sites **[16, 19].**

These findings are consistent with **Wu et al.** who demonstrated that the addition of dexmedetomidine to 0.375% ropivacaine in deep serratus anterior plane block (DSAP) significantly decreased acute postoperative VAS ratings at the 12-hour mark ($P < 0.05$). However, 48 hours after surgery, no discernible difference between the groups was found, suggesting a limited long-term benefit **[20]**.

While dexmedetomidine provided prolonged analgesia in our study, ketamine has also been associated with postoperative pain relief in

other studies. **López et al. [21]** discovered that ketamine decreased the severity of acute postoperative pain and the need for rescue analgesia during breast cancer surgery.

Shaker et al. conducted a randomized controlled trial on 75 women undergoing MRM, all receiving erector spinae plane blocks (ESPB) with bupivacaine. Patients were divided into three groups: ESPB alone (group A), ESPB with dexmedetomidine (group B), and ESPB with ketamine (group C). At several time intervals, groups B and C's pain scores were noticeably lower than group A's. Group B had the lowest pain scores overall. Both groups B and C required less rescue analgesia, consumed fewer opioids, and had fewer patients needing additional analgesia than group A. **Shaker et al.** concluded that adding either dexmedetomidine or ketamine to ESPB significantly improved postoperative pain control. Dexmedetomidine provided the most effective pain relief among the three groups which is line with our results **[22]**.

In a study conducted by **Gad et al.** with 50 patients included, comparing erector spinae plane (ESP) block against modified PECS block in MRM. Like our research, they found that modified PECS block was more effective than ESP block at lowering stress hormone levels and pain scores in the first 24 hours after unilateral MRM. In contrast to our trial, they supplemented the LA used in both blocks with 0.5μ/kg dexmedetomidine, this decreased the stress reaction to surgical trauma and postoperative pain. They explained that this could have negative effects on the heart and metabolism by altering the secretion of hormones like cortisol, adrenocorticotrophic hormone, and prolactin **[23]**.

The results of the present study agreed with **Kumar et al.** They discovered that, in the first 24 hours following surgery, the PECS group's duration for the first rescue analgesia was noticeably longer than that of the GA group **[24]**.

In current study, total nalbuphine consumption over 24 hours was significantly higher in the ketamine group than in the dexmedetomidine group, reinforcing the superior analgesic efficacy of dexmedetomidine.

Conversely, **Ather et al. [25]** discovered that postoperative analgesia was higher in patients in the ketamine group, as evidenced by a lower demand for postoperative rescue analgesics and a lower Numerical Rating Scale (NRS) pain score ($P < 0.001$). Group K experienced sensory block and motor block for a longer period of time than the other two groups ($P < 0.001$). Determining that for postoperative analgesia in patients with femur fractures who underwent subarachnoid block, intravenous ketamine was a better option than dexmedetomidine.

In current study, the time to discharge from the ketamine and dexmedetomidine groups' PACUs did not differ substantially (Group K: 42.35±12.51 min; Group D: 37.03 ± 10.37 min; $P > 0.05$). This suggests that both adjuvants offer comparable recovery profiles, with neither agent significantly prolonging PACU stay.

Our findings align with those of **Gao et al. [26]** who reported no significant differences in PACU stay duration among their study groups (Group C: 37 min [30–45], Group K1: 40 min [30–50], Group K2: 33 min [25–53], $P = 0.099$). Their study, which evaluated different doses of S-ketamine, similarly concluded that ketamine did not adversely affect early recovery times.

While other side effects such vomiting, agitation, and arrhythmias were similar between groups, in the current study, nausea was significantly more common in the ketamine group.

Ketamine's interaction with NMDA receptors in the central nervous system can contribute to vestibular disturbances and emesis. In contrast, dexmedetomidine, with its sedative and sympatholytic properties, may exert an antiemetic effect by reducing catecholamine release and stabilizing autonomic function **[27, 28]**.

Our findings are in contrast with those of **Huang et al.** who discovered that nausea and vomiting following surgery (PONV) and agitation were comparable among groups receiving dexmedetomidine-esketamine, suggesting good tolerability of this multimodal approach **[18]**.

Wu et al. discovered that, at 24- and 48-hours following surgery, compared to the ropivacaine-only group (30.6), the dexmedetomidine group (16.2 and 13.5) had a decreased incidence of PONV ($p = 0.147$, $p = 0.331$), despite the fact that they did not differ statistically significantly **[20]**.

Also, **Hassn et al.** revealed that there was significant reduction of the incidence of PONV in the (PECS group using bupivacaine+ dexmedetomidine) in comparison to the control (placebo) group which agreed with the results of the current study **[29]**.

Bakeer et al. also reported that the incidence of nausea, vomiting, hypotension, and bradycardia was similar between their ketamine and control groups, suggesting a comparable safety profile when ketamine is used as an adjuvant **[30]**.

Shaker et al (2024) also reported a lower incidence of PONV in dexmedetomidine group compared to ketamine and control groups with no difference recorded in the incidences of bradycardia, hypotension, or pruritus [22].

Limitation:

long-term follow-up was not conducted to assess potential differences in chronic pain outcomes. Future studies could explore the long-term benefits of dexmedetomidine versus ketamine in regional anesthesia for oncologic surgeries and investigate the optimal dosing strategies for maximizing analgesic efficacy while minimizing adverse effects.

CONCLUSION

The findings suggest that dexmedetomidine provided superior analgesic effects compared to ketamine, as indicated by longer time to initial rescue analgesia, decreased requirement for rescue analgesia, and reduced VAS scores six and twelve hours after surgery. Better intraoperative analgesic efficacy was also shown by the significantly decreased intraoperative fentanyl consumption in the dexmedetomidine group.

CONFLICT OF INTEREST: The authors declare no conflict of interest.

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