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FACTORS INFLUENCING POSTSURGICAL ACUTE PAIN AND ITS PHARMACOLOGICAL MANAGEMENT AMONG PATIENT UNDERGOING ELECTIVE SURGERIES AT TERTIARY CARE HOSPITAL MARDAN

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ABSTRACT

Background: *Postsurgical acute pain is a critical factor impacting recovery, patient satisfaction, and the risk of complications in surgical patients. Effective pain management is essential for enhancing patient outcomes and reducing the likelihood of chronic pain development. However, pain perception is influenced by various factors, including demographic characteristics, type, duration and complexity of surgery, and pharmacological approach. This study aimed to identify these contributing factors and assess the effectiveness of different analgesics in managing postsurgical pain in a tertiary care setting.*

Methods: *A cross-sectional observational study was conducted on 386 patients (38.6% male, 61.4% female) who underwent elective surgeries. Data on demographics, surgical details, pain intensity, and patient satisfaction with pain management were collected. Statistical analyses, including chi-square tests, Fisher exact test and ANOVA, were performed to assess the relationships between pain intensity and various factors, with significance set at $p<0.05$.*

Results: *The significant factors influencing postoperative pain intensity included sex, body mass index, surgeon experience, duration of surgery, incision length and patient occupation. Notably, pain levels were high post-surgery, with 33.9% experiencing severe pain and 59.1% reporting moderate pain. Ketorolac was the most frequently used analgesic (60.6%), followed by tramadol (30.8%) and nalbuphine (5.9%). Compared with tramadol and nalbuphine, tramadol with adjuvants initially provided significantly better pain relief ($p<0.001$). Pain intensity decreased over time, with 63.7% of patients reporting no pain at two hours and 44.3% at four hours post-surgery. The satisfaction level was highest in patients administered tramadol combined with an adjuvant.*

Conclusion: *Effective pharmacological interventions, specifically tramadol with adjuvants and ketorolac significantly reduce postoperative pain over time. Patient*

satisfaction was highest with multimodal approaches combining tramadol and adjuvants, suggesting a preference for comprehensive pain management strategies. Further studies should explore personalized pain management approaches that consider patient demographics and surgical specifics to optimize outcomes.
Keywords: *Ketorolac, postoperative pain intensity, tramadol*

INTRODUCTION

Significant pain levels are linked to surgical operations; a recent population-based survey in China revealed that 48.7% of participants experienced moderate to severe pain on the first day after surgery (1). Postoperative pain treatment after orthopedic surgery and general surgeries such as appendectomies and laparoscopy might be difficult. A multicenter study of elective laparoscopic colorectal surgery revealed significant analgesic usage variation (2). Laparoscopic cholecystectomy, a prevalent surgical intervention for gallbladder removal, results in various forms of postoperative pain. A recent study indicated that 36% of patients experienced inadequately managed pain, whereas 29% reported chronic discomfort after 12 months (3, 4).

Research indicates that postoperative pain following hysterectomy can differ markedly depending on the surgical method utilized, with laparoscopic techniques typically linked to reduced pain levels in comparison to open abdominal hysterectomy. Nonetheless, the issue of persistent pain continues to be a significant concern, with estimates indicating that between 5% and 30% of patients may experience chronic pain after the procedure (5).

Studies have shown that laparoscopic hysterectomy is strongly associated with preoperative anxiety and postoperative discomfort. Age and gender also play a role, with women generally reporting higher pain levels than men do, and older individuals being more sensitive to pain. Surgical techniques impact postoperative pain, with less invasive methods typically resulting in lower discomfort. The surgeon's ability to manage tissue can also affect pain severity. Effective pain management is crucial, as poorly addressed pain increases the risk of chronic pain and complicates recovery, potentially leading to longer hospital stays (6). Research indicates that as many as 79% of women reported experiencing pain at the incision site following a cesarean section, with this discomfort potentially lasting for weeks or even months. A previous review indicated that surgical patients are at risk of developing chronic postsurgical pain (CPSP) following elective surgeries in the foot and ankle region. (7).

Postoperative pain management is a significant part of the surgical procedure. Recent studies highlight the importance of multimodal analgesia, which includes various classes of analgesics, such as opioids and NSAIDs, which are utilized to improve pain relief. The administration of nonsteroidal anti-inflammatory drugs (NSAIDs) alongside acetaminophen has demonstrated efficacy in enhancing pain management and decreasing the reliance on opioids across multiple surgical scenarios, such as total knee arthroplasty and lumbar discectomy (8).

Administering analgesics before surgery effectively lowers postoperative pain and reduces the need for opioids. Preoperative acetaminophen use is associated with decreased postsurgical pain and less morphine consumption (9). Tramadol is a centrally acting analgesic that works by interacting with mu-opioid receptors and inhibiting the reuptake of norepinephrine and serotonin to enhance pain relief (10). A study on tramadol versus nalbuphine in pediatric daycare surgeries reported similar side effects, while nalbuphine offered better pain relief and less need for rescue analgesics(11). Ketorolac is a nonsteroidal anti-inflammatory drug used for the short-term management of moderate to severe pain and is frequently given alongside opioids to augment the analgesic effect while minimizing the required doses of opioids (12).

This comparative study of tramadol, ketorolac, nalbuphine, and their adjuvants for postoperative pain has significant practical implications that extend beyond academic inquiry, substantially influencing clinical practice. This study's findings aimed to improve training programs for healthcare professionals on pain management guidelines. By integrating new evidence into practice, providers can tailor pain management strategies to individual needs, enhancing care quality.

Materials and methods

Study Duration and Design:

This cross-sectional observational study was conducted from September to November 2024 at the tertiary care hospital Mardan.

Sample size determination:

To ensure statistical robustness and minimize sampling error, the sample size was carefully calculated via OpenEpi, a tool designed for epidemiological research. Assuming a prevalence of postsurgical acute pain of 50% among the target population and setting a 95% confidence interval, we determined a minimum sample size of 386 participants.

Sampling Technique:

A nonprobability convenience sampling method was employed to select participants on the basis of availability during the study period. Convenience sampling was appropriate for this setting, as it enabled the researchers to enroll eligible patients who were scheduled for elective surgeries at the time of the study and who met the inclusion criteria.

Study population:

The inclusion and exclusion criteria were defined to create a homogeneous sample and minimize confounding factors. The participants included were adult patients (aged 18 years and above) with an American Society of Anesthesiologists (ASA) classification of Class I or II, indicating that they were generally healthy or had only mild systemic disease. Eligible participants were those scheduled for elective surgeries performed under general anesthesia and who received intravenous analgesia postoperatively.

The exclusion criteria were set to eliminate confounding factors, which included chronic use of opioids and NSAIDs, tricyclic antidepressants, and selective serotonin reuptake inhibitors. Patients with bleeding disorders, postoperative respiratory depression, emergency surgery or admission to the ICU postoperatively, procedures performed under regional anesthesia, a history of hypersensitivity to analgesic drugs, and refusal to participate were excluded.

Ethical considerations:

Prior to data collection, ethical approval was obtained from the hospital's Ethics Review Committee. The study was conducted in strict adherence to ethical guidelines, including the Declaration of Helsinki, to protect patient rights and welfare. Informed consent was obtained from each participant following a thorough explanation of the study's objectives, methodology, potential risks, and anticipated benefits. The consent forms included information about data confidentiality, the voluntary nature of participation, and the right to withdraw at any point without consequences. Patients were assured that the data would be anonymized to protect their privacy, and all records were securely stored in compliance with hospital policy and data protection regulations.

Data collection procedure:

Data were systematically collected from participants through direct observation, structured patient interviews, and examinations of medical records. The primary setting for data collection was the post-anesthesia care unit (PACU), where patients were closely monitored during the immediate postoperative period. Trained research staff completed standardized questionnaires that included both closed-ended and Likert-type questions to ensure consistency in the responses.

Data were recorded for elective surgeries across multiple specialties, including neurosurgery, ENT, gynecology, general surgery, orthopedics, and urology. This breadth ensures that findings are generalizable across a range of surgical disciplines.

Statistical analysis:

Data analysis was performed via SPSS software (version 26). Descriptive statistics were calculated to summarize patient demographics, surgical characteristics, pain intensity, and pain management interventions. These results provided a foundational understanding of the sample composition, including mean values and standard deviations for continuous variables such as age, and weight, as well as frequency distributions for categorical variables such as sex, body mass index, duration of surgery, type of surgery, incision length and pain intensity levels. The chi-square test was used to assess the associations between pain intensity and the contributing factors of pain. Fisher exact test was applied to analyze pain intensity at different postoperative intervals (2 hours, and 4 hours post-surgery). ANOVA and Post hoc analyses (e.g., Tukey's test) were used to compare pain intensity across different medications used for postoperative pain management (ketorolac, tramadol, nalbuphine, and tramadol with adjuvant).

Results

Table 1 presents the descriptive statistics for the patient demographic and surgical characteristics. The mean age of the patients was 39.24 years (±16.722). The average patient weight was 70.21 kg (±17.00), ranging from a minimum of 30 kg to a maximum of 105 kg. The mean length of the surgical incision was 8.53 cm (±4.44), with incisions ranging from 0--17 cm. In terms of surgical characteristics, the duration for the 188 patients was 60–90 minutes; for 134 patients, it was <60 minutes; and for 64 patients, it was 90–120 minutes, as shown in Figure 1.

Figure 1: Duration of surgery for the included participants

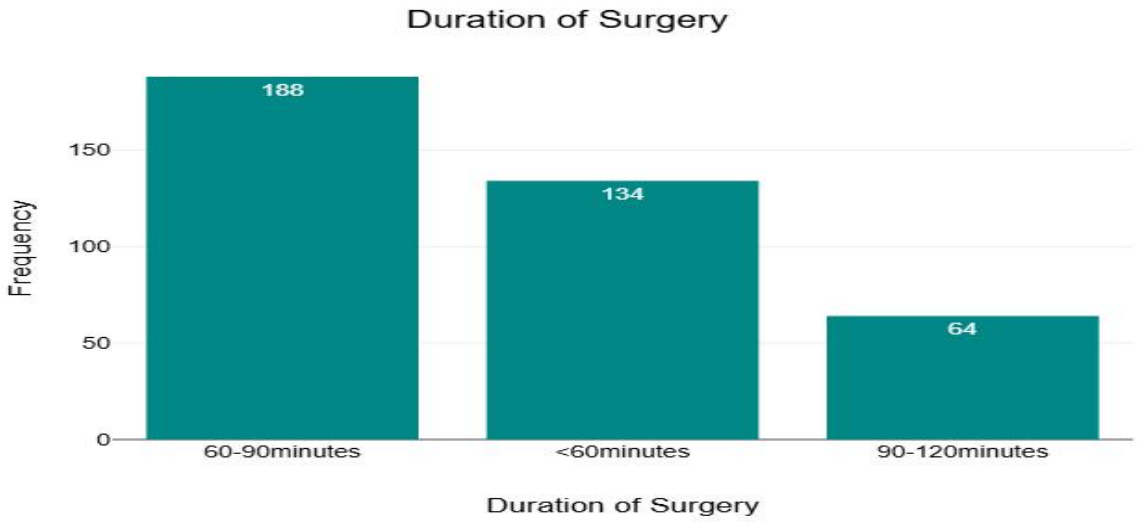

Table 1: Descriptive Statistics of Patient Demographics and Surgical Characteristics

Variable	Mean±SD	Minimuim	Maximum
Patient Age	39.24±16.722	18	92
Weight (kg)	70.21±17.006	30	105
Length of Incision (cm)	8.53±4.44	0	17
Abbreviation: SD; Standard Deviation, KG; Kilogram, CM; Centimetre.			

Table 2 shows the frequency and percentage distributions of patient demographics, body mass index, surgical approach, pain intensity, and pharmacological management after surgery. Among the 386 patients, 61.4% were female (n=237), whereas 38.6% were male (n=149). Most surgeries were invasive, 97.7% (n=377), with only 2.3% (n=9) being minimally invasive.

In terms of body mass index, 5.2% of patients were underweight (BMI < 18.5), 31.1% had a normal BMI (18.5–24.9), 29.3% were overweight (BMI 25–29.9), and 34.5% were obese (BMI ≥ 30).

Concerning the type of surgical area, most surgeries involved the abdomen (56.7%, n=219), followed by the lower limb (22.3%, n=86), head and neck (18.7%, n=72), thorax (1.6%, n=6), and upper limb (0.8%, n=3). Surgeon experience varied, with 40.4% (n=156) of surgeries performed by associate professors with 9--12 years of experience, 37.6% (n=145) by assistant professors with 7--9 years, 14.2% (n=55) by senior registrars with 4--6 years, and 7.8% (n=30) by professors with 12--15 years.

Postoperative pain intensity was primarily moderate (59.1%, n=228), with 33.9% (n=131) experiencing severe pain and 7% (n=27) reporting mild pain. Ketorolac was the most commonly administered medication for postoperative pain (60.6%, n=234), followed by tramadol (30.8%, n=119), nalbuphine (5.9%, n=23), and a combination of tramadol with an adjuvant (2.5%, n=10).

Table 2: Frequency distributions of patient characteristics, surgical details and pain intensity

Variable	Parameters	Frequency	Percentage
Gender	Male	149	38.6%
	Female	237	61.4%
BMI	Underweight	20	5.2%
	Normal	120	31.1%
	Overweight	113	29.3%
	Obese	133	34.5%
Surgical Technique	Minimally Invasive	9	2.3%
	Invasive	377	97.7%
Type of Operated Area	Head and Neck	72	18.7%
	Thorax	6	1.6%
	Abdomen	219	56.7%
	Lower limb	86	22.3%
	Upper Limb	3	0.8%
Level of Surgeon Experience	4-6 Years (Senior Registrar)	55	14.2%
	7-9 Years (Assistant Professor)	145	37.6%
	9-12 Years (Associate Professor)	156	40.4%
	12-15 Years (Professor)	30	7.8%
Pain Intensity After Surgery	Mild	27	7%
	Moderate	228	59.1%
	Severe	131	33.9%
Medicine for Post-Operative Pain	Ketorolac	234	60.6%
	Tramadol	119	30.8%
	Nalbuphine	23	5.9%
	Tramadol+Adjuvant	10	2.5%

Table 3 shows the distributions of various factors contributing to postoperative pain intensity (mild, moderate, severe), along with the chi-square (χ^2) values and associated p values, indicating statistical significance. Gender was a significant factor affecting pain intensity, with males (n=20, mild; n=81, moderate; n=48, severe) and females (n=7, mild; n=147, moderate; n=83, severe) showing a chi-square value of 15.45 ($p < 0.001$). These findings suggest a significant association between sex and postoperative pain levels. Duration of surgery was a significant factor affecting pain intensity, showing a chi-square value of 22.741 ($p < 0.001$). The incision length was also associated with postsurgical pain showing a a chi-square value of 10.370 ($p < 0.001$). The analysis revealed a significant relationship between BMI and postsurgical pain intensity. Among all the classes, the Obese class had the greatest number of patients who experienced moderate pain (88) and severe pain (42), whereas mild pain was reported by only 3 individuals, indicating that a higher BMI is associated with intense postsurgical pain. The surgical technique (minimally invasive vs. invasive) did not significantly influence pain intensity, as indicated by a chi-square value of 0.857 and a p-value of 0.652, with no significant difference in pain level based on the type of surgical approach. The type of operation was significantly associated with pain intensity, with head and neck surgeries (n=14, mild; n=29, moderate; n=29, severe), thorax surgeries (n=0, mild; n=4, moderate; n=2, severe), abdomen surgeries (n=9, mild; n=155, moderate; n=55, severe), lower limb surgeries (n=4, mild; n=38, moderate; n=44, severe), and

upper limb surgeries (n=0, mild; n=2, moderate; n=1, severe), yielding a chi-square value of 45.96 ($p < 0.001$). These findings indicate that the type of operation significantly impacts pain levels. The level of surgeon experience also significantly affected pain intensity, with different experience levels associated with varying pain intensities (4--6 years: n=0, mild; n=16, moderate; n=39, severe; 7--9 years: n=9, mild; n=85, moderate; n=51, severe; 9--12 years: n=17, mild; n=107, moderate; n=32, severe; 12--15 years: n=1, mild; n=20, moderate; n=9, severe), as indicated by a chi-square value of 49.64 ($p < 0.001$). Patient occupation was strongly associated with pain intensity, as demonstrated by a chi-square value of 64.89 ($p < 0.001$). Certain occupations, such as housewives (n=2, mild; n=104, moderate; n=62, severe), students (n=15, mild; n=53, moderate; n=29, severe), and teachers (n=0, mild; n=20, moderate; n=17, severe), experienced differing levels of postoperative pain, indicating that occupation may influence pain perception or reporting. Overall, sex, type of operation, level of experience, and occupation were significant factors associated with postoperative pain intensity, as reflected by their low p values ($p < 0.001$), whereas surgical technique was not significantly associated with pain level. Moreover, BMI was significantly associated with pain intensity.

Table 3: Analysis of Factors Contributing to Pain Intensity After Surgery

Factors Contributing to Pain		Pain Intensity After Surgery			Chi Value	P - Value
		Mild	Moderate	Severe		
Gender	Male	20	81	48	15.45	.000
	Female	7	147	83		
BMI	Underweight	6	8	6	22.83	.001
	Normal	10	68	42		
	Overweight	8	64	41		
	Obese	3	88	42		
Surgical Technique	Minimal Invasive	1	4	4	.857	.652
	Invasive	26	224	127		
Type of Operated Area	Head & Neck	14	29	29	`45.96	.000
	Thorax	0	4	2		
	Abdomen	9	155	55		
	Lower Limb	4	38	44		
	Upper Limb	0	2	1		
Level of experience	4-6 Years Senior registrar	0	16	39	49.64	.000
	7-9 Assistant Professor	9	85	51		
	9-12years Associate Professor	17	107	32		
	12-15Years Professor	1	20	9		
Duration of Surgery	Less than 60mints	24	65	46	22.741	.000
	60-90mints	15	99	74		
	90-120mints	4	19	40		
Incision length	0-5cm	14	62	35	10.370	.035
	6-11cm	10	55	67		
	12-17cm	19	66	58		
Patient Occupation	Army Officer & Army Retired	0	2	0	64.890	.000
	Doctor	0	2	0		
	Driver	0	4	0		
	Farmer	7	13	5		
	Housewife	2	104	62		
	Labor	3	12	13		

	LHV	0	3	1		
	Nurse	0	5	0		
	Shopkeeper	0	8	4		
	Teacher	0	20	17		
	Student	15	53	29		
	Officer	0	1	0		

Table 4 shows that among 234 patients who received Ketorolac 151 experienced no pain, tramadol was given to 119 patients and 87 experienced no pain, nalbuphine was given to 23 and all patients experienced mild to moderate pain, tramadol with adjuvant was given to 10 patients and 8 experienced no pain, on applying Fishers exact test a significant association ($p<0.05$) found between medicines used for postoperative pain and pain intensity after 2 hours, which reveal that percentage of patients receiving tramadol with adjuvants experienced no pain in majority than other medicines.

Table 4: Postoperative Pain intensity after 2 hours

Medicine for Postoperative Pain	**Pain Intensity After 2hours**				**Fisher Value**	**P - Value**
	No Pain	Mild	Moderate	Total		
Ketorolac	151	68	15	234	56.081	.000
Tramadol	87	24	08	119		
Nalbuphine	0	13	10	23		
Tramadol with adjuvants	08	1	1	10		
Total	246	106	34	386		

Table 5 shows that among 234 patients who received Ketorolac 109 experienced no pain, tramadol was given to 119 patients and 43 experienced no pain, nalbuphine was given to 23 and maximum patients experienced no to mild pain, tramadol with adjuvant was given to 10 patients and 8 experienced no pain, on applying Fishers exact test a significant association ($p<0.05$) found between medicines used for postoperative pain and pain intensity after 4 hours, which also reveal that percentage of patients receiving tramadol with adjuvants experienced no pain in majority than other medicines.

Table 5 Pain Intensity After 4hours

Medicine for Postoperative Pain	**Pain Intensity After 4hours**				**Fisher Value**	**P - Value**
	No Pain	Mild	Moderate	Total		
Ketorolac	109	100	25	234	12.620	.039
Tramadol	43	54	22	119		
Nalbuphine	11	12	0	23		

Tramadol with adjuvants	8	1	1	10		
Total	171	167	48	386		

The sum of squares "Between Groups" was equal to 44.149 with mean squares of 14.716 and "Within Groups" sum of squares was 1016.362 with a mean square of 2.661 on 382 degrees of freedom, which depicts the variation in the satisfaction within each group. The overall sum of squares in satisfaction scores was equal to 1060.510, further ANOVA test reveals that the mean satisfaction scores between different groups were statistically significantly different ($F = 5.531$, $p = 0.001$) (Table 6). Posthoc analysis further reveals a significant difference ($p<0.05$) between Ketorolac and tramadol, and also between tramadol and tramadol with adjuvants showing the highest mean score (8.30) recorded of Tramadol with adjuvant, suggesting that treatment satisfaction was higher in patients using Tramadol with Adjuvants (Table 7 & 6).

Table 6 Analysis of Pain Treatment Satisfaction Using the ANOVA Test

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min/ Max	F Value	Sig.
					Lower Bound	Upper Bound			
Ketorolac	234	7.26	1.515	.099	7.07	7.46	3/10	5.531	0.001
Tramadol	119	6.66	1.805	.165	6.34	6.99	2/9		
Nalbuphine	23	6.87	1.714	.357	6.13	7.61	3/9		
Tramadol with Adjuvant	10	8.30	1.889	.597	6.95	9.65	3/9		
Total	386	7.08	1.660	.084	6.91	7.25	2/10		

Table 7 Analysis of Pain Treatment Satisfaction Using the Post-Hoc Analysis

(I) Medicine for Postoperative Pain	(J)Medicine for Postoperative Pain	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
ketorolac	Tramadol	.597*	.184	.007	.12	1.07
	Nalbuphine	.391	.356	.691	-.53	1.31
	Tramadol with Adjuvant	-1.039	.527	.200	-2.40	.32
Tramadol	Ketorolac	-.597*	.184	.007	-1.07	-.12

	Nalbuphine	-.206	.372	.946	-1.16	.75
	Tramadol with Adjuvant	-1.636*	.537	.013	-3.02	-.25
Nalbuphine	ketorolac	-.391	.356	.691	-1.31	.53
	Tramadol	.206	.372	.946	-.75	1.16
	Tramadol with Adjuvant	-1.430	.618	.096	-3.02	.16
Tramadol with Adjuvant	Ketorolac	1.039	.527	.200	-.32	2.40
	Tramadol	1.636*	.537	.013	.25	3.02
	Nalbuphine	1.430	.618	.096	-.16	3.02
* The mean difference is significant at the 0.05 level.						

Discussion

The results from the current study are analyzed in detail, with a focus on postoperative pain management and several crucial issues in the pain experiences of surgical patients. To understand how pain is managed after surgery and what can affect patient outcomes, this study presents a complex picture from an analysis of patient demographics, surgical characteristics, postoperative pain intensity, and the effectiveness of different medications. This discussion will look at both similarities and differences in these results from recent literature by critically comparing these results.

In the present study, the patient demographics were an average age of 40 years, with a ratio of 38.6% male and 61.4% female. These findings are in agreement with earlier research, which indicated that age and sex, has a major bearing on pain perception and postoperative outcomes. As such, Yang et al. (2019) demonstrated that older patients tend to indicate higher levels of pain following surgery and that there are clear gender differences in pain perception (13). In particular, females report greater pain intensity than males do, as reported by Guimarães-Pereira et al., 2016; Buvanendran et al., 2015 (14, 15). Similarly, these findings were confirmed in the present study, which revealed slightly greater pain intensity among female patients than male patients, thus confirming that sex influences pain experience. On average, the surgical characteristics of the current study (surgical duration of 60-90 min, 6-11 cm incision length) fit those reported in the literature. According to Ferrell et al. (2019), surgeons tend to operate longer over time, which incites greater postoperative pain, especially for more invasive procedures (16). Surgeries can also be categorized into minimally invasive and invasive types, which mirror trends in surgical performance and are designed to decrease postoperative pain and fast recovery times (17, 18). Previous studies have repeatedly shown that minimally invasive surgeries (MIS) produce lower pain scores than traditional invasive surgeries do, which is due purely to smaller incisions, less tissue damage, and faster healing times, as reported by Ossendorp et al., 2013; Allain et al., 2019. As shown in the present study, patients who underwent MIS reported less pain than did those who underwent more invasive surgeries (19).

One of the most interesting findings in the present study was that several factors may affect the level of postoperative pain. Consistent with previous studies, there were no sex-related differences in pain intensity, with males reporting lower pain levels than females (14, 15). High Body mass index associated with increased use of postoperative painkiller (18). These findings were confirmed in the present study, which revealed that Obese class experience severe pain. Furthermore, Surgeon experience had a particularly strong effect on postoperative pain management. Similarly, the present study demonstrated that, compared with other surgeons, senior surgeons led lower pain levels, which shows that more experienced surgeons use more

effective safe strategies and reduce postoperative pain (20). This finding highlights the need for attention to surgical proficiency when seeking to modify postoperative pain outcomes.

A second critical factor outlined in the current study was occupation as a predictor of postoperative pain levels. For example, Johnson et al. and Aladin et al. proposed that physical demand on the part of certain occupations can heighten postoperative pain experiences (21, 22). Manual labor, especially physical strain and demands, may compound the postoperative pain management problem for these people. This insight reinforces the need to develop patient-employed and physically demanding case-specific pain management strategies. Pain outcomes and recovery times might be improved by such strategies for the specific needs of those whose work involves great physical exertion. The present study concludes that a few important contributors may influence postoperative pain management, namely, sex, surgical type, incision length, duration of surgery, surgeon experience, and occupation. Consistent with the literature, these findings suggest that postoperative pain is a multifactorial phenomenon and that individualized pain management strategies are needed.

The study also showed how pain intensity trajectory over time until there was a marked drop in pain levels measuring at intervals (2 hours and 4 hours) This finding is consistent with the literature, which has reported that a usual pattern of decline in postoperative pain often resolves over time as the effects of anesthesia dissipate and pain management interventions become effective (23, 24). Prior studies of the need for early and effective pain management for better recovery (25, 26) As part of this study, the efficacy of different pain medications for reducing postoperative pain was compared. These results concord with the current literature regarding the use of nonsteroidal anti-inflammatory drugs (NSAIDs) as first-line analgesics in orthopedic setups (27, 28). Ketorolac NSAIDS are widely known for their ability to reduce inflammation and pain, for being able to do so, and for doing so while consuming fewer opioids. Opioids were also effective in postsurgical acute pain. These findings are supported by studies showing opioid efficacy variability. (20, 29). The trend of decreased pain scores over time and significant decreases in each interval observed with tramadol with adjuvants and ketorolac supports our findings, as did a meta-analysis by Cramer et al. (2018). Multimodal analgesia or the use of several types of analgesic agents to maximize pain management and the key role that multimodal analgesia played in the meta-analysis were emphasized (27). The efficacy of multimodal strategies is not only important for decreasing opioid consumption and decreasing opioid-related side effects and dependence, but we have also learned that such strategies combined result in greater pain relief. The current study findings reveal that patients were more satisfied with tramadol combined with adjuvants followed by ketorolac. The findings of this study highlight the role of multimodal analgesia in postoperative care as well as evidence-based pain management protocols designed with the administration of NSAIDs and opioids, especially tramadol use with adjuvants favored. Furthermore, the use of ketorolac as the sole analgesic and the use of opioids become even more important in combination with the use of multimodal pain management strategies aimed at reducing the use of opioids and maximizing patient outcomes. (27, 28). These results may be important in guiding the development of evidence-based pain management protocols focused on the demands of patients in overcoming their pain. Further exploration of complex postoperative pain processes continues to be focused on a continued future, and refinement of pain management strategies and improved patient outcomes can be further developed. Further investigations on the effects of occupation, surgeon experience, and other demographic variables on the level of postoperative pain are needed. This research can continue to expand from what is currently known to provide better postoperative care and maximize recovery, similar to surgical patients.

Study Limitations

This study has several limitations related to its design and correlation with medicine. First, the cross-sectional study design captures data at a single point in time, which provides limited insight into the progression and consequences of chronic pain. Additionally, the study excluded other analgesics and multimodal pain management techniques, which could provide a more comprehensive understanding of effective pain control.

Conclusion

Effective pharmacological interventions, specifically Tramadol with adjuvants, significantly reduce postoperative pain over time. Patient satisfaction was highest with multimodal approaches combining tramadol and adjuvants, suggesting a preference for comprehensive pain management strategies. Further studies should explore personalized pain management approaches that consider patient demographics and surgical specifics to optimize outcomes

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