INTERNATIONAL JOURNAL OF MEDICAL SCIENCES; AUGUST 2026;9(3):111-161:
ISSNE: 2522-7386; DOI: HTTPS://DOI.ORG/10.32441/9.3.8

Anesthetic Techniques and Patients -Related Determinant of Perioperative Outcomes in Orthopedics Surgery: A Cross-Sectional Analytical Study

Hawrey Nouman Jalal, Department of Anesthesia, College of Health and Medical Technologies, Kirkuk, Iraq. Email: Hawreyans124@gmail.com; Mobile:+9647507703265; ORCID: https://orcid.org/0009-0009-3579-457X.
Abdulghani Mohamed Alsamarai, Department of Medical Laboratory Techniques, College of Health and Medical Techniques, Al-Qalam University, Kirkuk, Iraq.
Tikrit University College of Medicine, [TUCOM], Tikrit, Iraq.
Email: Abdulghani.Alsamarai@alqalam.edu.iq; abdulghani.Mohamed@tu.edu.iq, galsamarrai@yahoo.com; Mobile: +9647701831295,
ORCID: https://orcid.org/0000-0002-7872-6691
Mohamed Almoustafa Alsamarai, Department of Medical Laboratory Techniques, College of Health and Medical Techniques, Al-Qalam University, Kirkuk, Iraq.
Email: Mohamed.almostafa@alqalam.edu.iq; mohamedalmoustafaa@gmail.com
Mobile: +9647718814092; ORCID: https://orcid.org/0000-0002-3051-725X
Jasim Mohamed Ali Alsamarai, Computer Techniques Department, College of Engineering Techniques, Al-Qalam University. Email: jasem.it@alqalam.edu.iq. ORCID: https://orcid.org/0009-0002-0995-9333.
Mobile: +9647734377612.
Suzan Mahmoud Rashid Ahmed, Department of Anesthesia, College of Health and Medical Technologies, Kirkuk, Iraq. Email: susan.mahmouid99@gmail.com; Mobile: +9647735533023; ORCID: https://orcid.org/0009-0002-5389-5269
Honar Hussein Hassan Aziz, Department of Anesthesia, College of Health and Medical Technologies, Kirkuk, Iraq. Email: hunarhussen7082gmail.com@gmail.com; Mobile: +9647717921222; ORCID: https://orcid.org/0009-0008-8309-5282
Shadman Sarkawt Rashid Sayda, Department of Anesthesia, College of Health and Medical Technologies, Kirkuk, Iraq. Email:Sarkawtshadman08@gmail.com; Mobile:+9647706963733; ORCID: https://orcid.org/0009-0009-7335-521X.
Sumaya Jumaa Shafiq Ahmed, Department of Anesthesia, College of Health and Medical Technologies, Al-Qalam University, Kirkuk, Iraq. Email: sumayajuma303@gmail.com; Mobile: +9647503576913; ORCID: https://orcid.org/0009-0003-1708-5418.
Correspondence author: Hawrey Nouman Jalal, Department of Anesthesia, College of Health and Medical Technologies, Kirkuk, Iraq. Email: Hawreyans124@gmail.com; Mobile:+9647507703265; ORCID: https://orcid.org/0009-0009-3579-457X.

Cite article as: Jalal HN, Alsamarai AM, Alsamarai MA, Alsamarai JM, Ahmed SMR, Aziz HHH, Sayda SSR, Ahmed SJS. Anesthetic Techniques and Patients -Related

Determinant of Perioperative Outcomes in Orthopedics Surgery: Across-Sectional Analytical Study. Int J Med Sci, 2026;9(3):111-161
There is supplement file for this article
Received: 16/03/2026 Accepted: 15/07/2026 Published: 01/08/2026

Abstract
Background: Perioperative outcomes in orthopaedic surgery are influenced by multiple patient, surgical, and anaesthetic factors. This study aimed to identify predictors of preoperative anxiety, postoperative pain, side effects, analgesia needs, and mobilisation time.
Methods: A cross-sectional study of 161 orthopaedic surgical patients. Associations were examined using chi-square tests for sex, age, education, operation type, anaesthesia type, reason for anaesthesia selection, operation duration, and preoperative explanation.
Results: Preoperative anxiety (72.7%) was associated with anaesthesia type (p=0.046) and reason for selection (p=0.012). Postoperative pain (79.5%) and pain intensity were significantly associated with age, education, anaesthesia type, operation duration, and sex (pain intensity only). Regional and spinal anaesthesia produced the lowest pain rates, mildest pain, fewest side effects (8–11% vs. 84% for general), and lowest analgesia needs (33–56% vs. 79% for general). Younger age predicted more pain and delayed mobilisation; longer operation duration (>3 hours) predicted severe pain (23.5%) and delayed mobilisation. Preoperative explanation (91.3%) was confounded by procedure invasiveness. Side effects (66.5%) were predicted only by anaesthesia type and reason for selection.
Conclusion: Anaesthesia type is the strongest modifiable predictor. Regional and spinal techniques improve pain control, reduce side effects, and accelerate mobilisation. Age, operation duration, and sex also influence outcomes. These findings support preferential use of regional anaesthesia and age-tailored pain management in orthopaedic surgery.
Keywords: Orthopedic surgery, anesthesia type, postoperative pain, preoperative anxiety, postoperative pain, delayed mobilisation.

1. Introduction

Orthopedic surgery is considered one of the most demanding and evolving specialties in modern medicine, dealing with the management of disorders affecting bones, joints, ligaments, and muscles. Over the past decades, advances in surgical techniques have significantly improved patient outcomes; however, these advancements would not be possible without parallel progress in anesthesia [1]. In this context, anesthesia is not only essential for pain control but also plays a critical role in maintaining physiological stability and ensuring optimal surgical conditions.

Anesthetic management in orthopedic surgery presents unique challenges compared to other surgical fields. Many procedures, such as joint replacements and spinal surgeries, are associated with significant blood loss, prolonged operative time, and complex positioning that may affect cardiovascular and respiratory functions [2]. Therefore, anesthesiologists must adopt a comprehensive and individualized approach, starting with a detailed preoperative assessment. This assessment includes evaluating comorbid conditions such as hypertension, diabetes mellitus, and pulmonary diseases, which are commonly encountered in orthopedic patients, particularly in the elderly population [3].

Both general and regional anesthesia techniques are widely used in orthopedic procedures. In recent years, regional anesthesia, including spinal, epidural, and peripheral nerve blocks, has gained increasing popularity due to its advantages in providing superior postoperative analgesia, reducing opioid requirements, and promoting early mobilization [4]. Moreover, the use of ultrasound-guided techniques has enhanced the accuracy and safety of regional blocks, minimized complications and improved patient satisfaction.

Another critical aspect of anesthesia in orthopedic surgery is the prevention and management of perioperative complications. Patients are at increased risk of thromboembolic events, fat embolism syndrome, and hemodynamic instability [5]. Anesthesiologists play a pivotal role in intraoperative monitoring, fluid management, and maintaining adequate tissue perfusion and oxygenation. Furthermore, effective postoperative pain control is essential for improving recovery outcomes and facilitating early rehabilitation. Thus, anesthesia is an integral component of orthopedic surgery that extends beyond intraoperative care to include preoperative optimization and postoperative management. A multidisciplinary approach involving surgeons, anesthesiologists, and healthcare teams is essential to ensure patient safety and achieve the best possible outcomes.

Objectives: To:

1. Clarify the role of demographic characteristics as risk factors in orthopedics surgery.
2. Illustrate the role of clinical characteristics as risk factors for orthopedics surgery outcomes.
3. Determine the effect of anesthesia type on orthopedics surgery outcomes.
4. Determine the frequency of operation type in orthopedics surgery.
5. Outline the anesthesia type and anesthesia drugs used in orthopedics operation.
6. Examine the anesthesia selection causes in orthopedic surgery.
7. Outline is there a preoperative explanation of anesthesia used and operation type.
8. Probe the postoperative pain presence and level and it relation to demographic and clinical characteristics of patients.
9. Investigate the complication of the orthopedics operation.
10. Predict the needs of analgesia postoperatively.
11. Compute the time of mobilization following orthopedics surgery.

2. Materials3 and methods

2.1. Study design

A cross-sectional study conducted in Azadi Teaching Hospital during the period November, 2025 to 23 April 2026. Informed consent is taken from any subject included in the study. The study protocol was approved by the College of Health and Medical Techniques Ethical Committee, Al-Qalam University. All the work performed according to Declaration of Helsinki

2.2. Study population

The study included 161 patients, of them 101 [62.7%] were males and 60 [37.3%] were females. All the cases were elective orthopedics surgery. The demographic and clinical characteristics were gathered using a questionnaire which contains 4 sections. The first one consists of questions on the demographic characteristics. While, section two contains items to get information on the operation. The third part contains questions to gather preoperative information. The fourth part consists of items for collection of postoperative information.

2.3. Statistical analysis

The data arranged in excel and then transferred to SPSS statistical package [Version 20]. The frequency distribution of variables determined using the SPSS and the significance calculated using chi square. Logistic regression line analysis used to clarify the role of demographic and clinical characteristics as risk factor in orthopedics operations by application of SPSS package. AI used to guide the application of logistic regression line analysis in SPSS. P value of < 0.05 regarded as significant.

3. Results

3.1. Demographic and clinical characteristics relationships.

Preoperative Anxiety (Table 1)

There was no statistically significant association between sex and preoperative anxiety ($\chi^2 = 0.91$, $p = 0.34$). Although a higher absolute number of females reported anxiety (41/60, 68.3%) compared to males (76/101, 75.2%), the difference was not significant. This suggests that both male and female patients experience similar levels of preoperative anxiety in this sample.

Postoperative Pain – Presence (Table 1)

There was a **trend toward statistical significance** but no defini3tive association between sex and the presence of any postoperative pain (females: 52/60, 86.7%; males: 76/101, 75.2%). The p-value of 0.08 suggests a possible clinically meaningful difference that did not reach the conventional alpha of 0.05, possibly due to sample size. Females tended to report pain more frequently.

Pain Level (Table 1) – Statistically Significant Finding

Out of 161 patients, the majority experienced **moderate pain** (44.7%), followed by mild pain (26.1%). No pain was reported in 20.5%, and severe pain in only 8.7%.

Side Effects (Table 1)

No significant association between sex and presence of side effects ($\chi^2 = 1.163$, $p = 0.281$). Both sexes reported side effects at comparable rates (males 63.4%, females 71.7%).

Analgesia Needs (Table 1)

No significant association between sex and analgesia requirements ($\chi^2 = 1.54$, $p = 0.214$). Although, females reporting higher pain levels, their analgesia needs did not differ significantly from males. This may reflect prescribing practices or under-treatment of female pain, a phenomenon previously described in the literature [6].

Postoperative Movement Time (Table 1)

No significant association between sex and time to postoperative movement ($\chi^2 = 0.41$, $p = 0.82$). Recovery of mobility was similar between sexes.

The only statistically significant sex difference was in **pain level**, with females reporting more moderate-to-severe pain than males. Notably, this did not translate into increased analgesia needs or delayed mobilization, suggesting possible under-treatment or differences in pain reporting behavior.

Table.1. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs3, and postoperative movement time according to sex

Outcome	Category	Male (n=101)	Female (n=60)	Total	Chi-square	P-value
Preoperative anxiety	Yes	76	41	117	0.91	0.34
	No	25	19	44		
Postoperative pain (presence)	Yes	76	52	128	3.0119	0.08
	No	25	8	33		
Pain level (among those with pain, N=128)*	Mild	35	12	47	8.104	0.017
	Moderate	35	32	67		
	Severe	6	8	14		
Side effects	Yes	64	43	107	1.163	0.281
	No	37	17	54		
Analgesia needs	Yes	70	47	117	1.54	0.214
	No	31	13	44		
Postoperative movement time	Same day	55	31	86	0.41	0.82
	1–3 days	34	23	57		
	>3 days	12	6	18		

Interpretation of Findings in Relation to Age

Below is an interpretation of Table 2, which examine associations between age and various perioperative outcomes. Statistically significant findings ($p < 0.05$) are discussed in detail.

Preoperative Anxiety According to Age

$\chi^2 = 5.898$; $p = 0.316$ – Not significant.

No statistically significant association was found between age and preoperative anxiety. Although the highest absolute numbers of anxious patients were in the 20–30 and 31–40 age groups, this likely reflects the larger sample sizes in those groups rather than a true age effect.

Postoperative Pain (Presence) According to Age

Younger patients (especially <40 years) reported higher pain levels. Patients aged 41–70 had mostly no or mild pain.

Pain Level According to Age

$\chi^2 = 21.08$; $p = 0.021$ – Statistically significant.

Pain intensity (mild/moderate/severe) differed significantly across age groups:

- **Mild pain:** Highest proportion in the 61–70 group (4/6, 66.7%) and 41–50 group (9/13, 69.2%).
- **Moderate pain:** Most common across all groups, but notably absent in the 61–70 group (0/6).
- **Severe pain:** Highest absolute numbers in the 20–30 (n=4) and 31–40 (n=5) groups; proportionally, the 61–70 group had 2/6 (33.3%) with severe pain – a small cell size that warrants caution.

Side Effects According to Age

$\chi^2 = 7.19$; $p = 0.207$ – Not significant.

No significant association between age and presence of side effects. Although the youngest group (<20) reported a high rate (22/29, 75.9%) and the 61–70 group also had a high rate (4/6, 66.7%), the overall distribution did not reach statistical significance.

Analgesia Needs According to Age

$\chi^2 = 15.69$; $p = 0.008$ – Statistically significant.

Analgesia requirements differed significantly by age:

- Highest proportion needing analgesia: 20–30 years (52/63, 82.5%) and <20 years (20/29, 69.0%).
- Lowest proportion needing analgesia: 61–70 years (1/6, 16.7%) and 51–60 years (6/7, 85.7% – note small number).
- The 41–50 group also had relatively low needs (7/13, 53.8%).

Postoperative Movement Time According to Age

$\chi^2 = 28.215$; $p = 0.002$ – Statistically significant.

Time to postoperative mobilization (same day / 1–3 days / >3 days) varied significantly with age:

- **Same-day movement:** Highest in the youngest groups (<20: 18/29, 62.1%; 20–30: 40/63, 63.5%) and lowest in the oldest group (61–70: 2/6, 33.3%).
- **Delayed movement (>3 days):** Most common in the 31–40 group (9/43, 20.9%) and 61–70 group (2/6, 33.3%).
- The 41–50 group had no patients with >3 days delay, but the sample size is small (n=13).
- **Interpretation of Findings in Relation to Education**
- Below is an interpretation of Tables 3, which examine associations between educational level and various perioperative outcomes. Statistically significant findings ($p < 0.05$) are discussed in detail.
- **Preoperative Anxiety According to Education**
- **$\chi^2 = 5.303$; $p = 0.151$** – Not significant.
- No statistically significant association was found between education level and preoperative anxiety. Although the proportion of patients with anxiety varied across groups (Primary: 15/24, 62.5%; Secondary: 15/20, 75%; Preparatory: 28/32, 87.5%; ≥College: 59/85, 69.4%), these differences did not reach significance.

Postoperative Pain (Presence) According to Education

$\chi^2 = 9.291$; $p = 0.026$ – Statistically significant.

The presence of postoperative pain differed significantly across education levels:

- **Primary education:** 21/24 (87.5%) reported pain
- **Secondary education:** 19/20 (95.0%) – highest proportion
- **Preparatory education:** 28/32 (87.5%)
- **≥College education:** 60/85 (70.6%) – lowest proportion

Patients with **higher education (≥College) were significantly less likely to report any postoperative pain** compared to those with lower education levels.

Pain level according to education

Chi-square = 18.46; P = 0.030

Higher education level (≥ college) was associated with more "no pain" reports (25/85 = 29.4%) compared to lower education groups (e.g., primary: 3/24 = 12.5%). However, severe pain was similar across groups.

Side Effects According to Education

χ^2 = 4.22; p = 0.238 – Not significant.

No significant association between education and presence of side effects. Rates ranged from 66.7% (Primary) to 85.0% (Secondary) to 68.8% (Preparatory) to 61.2% (≥College). The lack of significance suggests that education does not influence side effect occurrence.

Analgesia Needs According to Education

χ^2 = 4.21; p = 0.24 – Not significant.

No significant association between education and analgesia requirements. Although the ≥College group had the lowest proportion needing analgesia (56/85, 65.9%) compared to Primary (19/24, 79.2%), Secondary (16/20, 80.0%), and Preparatory (26/32, 81.3%), this did not reach statistical significance.

Postoperative Movement Time According to Education

χ^2 = 10.84; p = 0.093 – Not significant (trend toward significance).

There was a statistical trend (p = 0.093) but no definitive association between education and time to postoperative movement. Notable patterns:

- **Same-day movement:** Highest in ≥College (47/85, 55.3%) and Preparatory (16/32, 50.0%); lowest in Primary (10/24, 41.7%).
- **Delayed movement (>3 days):** Highest in Primary (5/24, 20.8%) and ≥College (12/85, 14.1%); interestingly, the Preparatory group had zero patients with >3 days delay. The trend suggests that lower education (Primary) may be associated with slower mobilization, which could relate to higher pain levels or other socioeconomic factors affecting recovery. However, the p-value >0.05 indicates that this finding is not statistically significant in the present sample.
  - **Interpretation of Findings in Relation to Operation Type**
  - Below is an interpretation of Tables 4, which examine associations between the type of orthopedics operation and various perioperative outcomes. **Only one outcome (side effects) showed a statistically significant association (p = 0.001).** All other comparisons were non-significant (p > 0.05).
  - **Preoperative Anxiety According to Operation Type**
  - **χ^2 = 10.65; p = 0.473** – Not significant.
  - No statistically significant association was found between the type of surgery and preoperative anxiety. Although rates varied (e.g., fracture fixation: 32/45, 71.1%; knee joint replacement: 13/22, 59.1%; amputation: 5/11, 45.5%; foreign body removal: 11/15, 73.3%), these differences did not reach significance.
  - **Postoperative Pain (Presence) According to Operation Type**
  - **χ^2 = 9.75; p = 0.553** – Not significant.
  - The presence of any postoperative pain did not differ significantly across operation types. Proportions were generally high across all groups (e.g., developmental

dislocation: 13/13, 100%; knee joint endoscopy: 13/14, 92.9%; fracture fixation: 33/45, 73.3%).

Table.2. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to age

Outcome	Category	<20	20–30	31–40	41–50	51–60	61–70	Total	Chi-square	P-value
Preoperative anxiety	Yes	20	49	32	10	3	3	117	5.898	0.316
	No	9	14	11	3	4	3	44		
Postoperative pain	Yes	28	52	33	7	6	2	128	18.99	0.002
	No	1	11	10	6	1	4	33		
Pain level	No pain	1	11	10	6	1	4	33	32.398	0.006
	Mild	8	16	9	6	1	2	42*		
	Moderate	18	31	19	1	3	0	72*		
	Severe	2	5	5	0	2	0	14		
Side effects	Yes	22	45	26	5	5	4	107	7.19	0.207
	No	7	18	17	8	2	2	54		
Analgesia needs	Yes	20	52	31	7	6	1	117	15.69	0.008
	No	9	11	12	6	1	5	44		
Postoperative movement time	Same day	18	40	14	10	2	2	86	28.215	0.002
	1–3 days	9	21	20	3	2	2	57		
	>3 days	2	2	9	0	3	2	18		

Pain Level According to Operation Type

$\chi^2 = 27.81$; $p = 0.72$

Despite apparent differences (e.g., knee arthroplasty and amputation showing severe pain in 4/22 and 2/11 respectively), the p-value is high, indicating no statistically significant association between operation type and pain level.

Pain intensity (mild/moderate/severe) did not vary significantly by operation type. Notable observations include:

- **Severe pain** was most frequent in knee joint replacement (6/22, 27.3%) and knee joint endoscopy (4/14, 28.6%).
- **Mild pain** was most common in fracture fixation (18/45, 40.0%) and wound cleaning (8/17, 47.1%).
- Developmental dislocation and hip replacement had no severe pain cases, but sample sizes were small.

Side Effects According to Operation Type – Statistically Significant

$\chi^2 = 32.16$; $p = 0.001$ – Significant.

This is the only significant finding among the operation-type analyses. Side effect occurrence varied markedly across procedures:

- **Highest rates** (100%): Developmental dislocation (13/13), treatment of frozen shoulder (2/2), hip joint replacement (5/5).
- **High rates** (≥70%): Fracture fixation (31/45, 68.9% – actually 68.9% not 100%; but note: developmental dislocation 100%, hip replacement 100%, frozen shoulder 100%).
- **Lowest rate**: Amputation (1/11, 9.1%). Nerve release had 5/8 (62.5%); foreign body removal 8/15 (53.3%).

Analgesia Needs According to Operation Type

χ^2 = 9.768; p = 0.551 – Not significant.

Analgesia requirements did not differ significantly across operation types. Most groups had high proportions needing analgesics (e.g., fracture fixation 34/45, 75.6%; knee joint endoscopy 11/14, 78.6%; developmental dislocation 10/13, 76.9%; hip replacement 5/5, 100%).

Postoperative Movement Time According to Operation Type

χ^2 = 30.88; p = 0.099 – Not significant (trend toward significance).

There was a statistical trend (p = 0.099) but no definitive association between operation type and time to mobilization. Observations:

- **Same-day movement** was most common in foreign body removal (14/15, 93.3%), wound cleaning (11/17, 64.7%), and fracture fixation (27/45, 60.0%).
- **Delayed movement (>3 days)** was seen in fracture fixation (6/45, 13.3%), knee joint replacement (5/22, 22.7%), knee joint endoscopy (3/14, 21.4%), and developmental dislocation (2/13, 15.4%).
- Amputation and nerve release had no patients with >3 days delay.

Table.3. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to education

Outcome	Category	Primary (n=24)	Secondary (n=20)	Preparatory (n=32)	≥ College (n=85)	Total (N=161)	Chi-square	P-value
Preoperative anxiety	Yes	15	15	28	59	117	5.303	0.151
	No	9	5	4	26	44		
Postoperative pain	Yes	21	19	28	60	128	9.291	0.026
	No	3	1	4	25	33		
Pain level	No pain	3	1	4	25	33	18.46	0.030
	Mild	4	3	8	27	42		
	Moderate	14	14	17	27	72		
	Severe	3	2	3	6	14		
Side effects	Yes	16	17	22	52	107	4.22	0.238
	No	8	3	10	33	54		
Analgesia needs	Yes	19	16	26	56	117	4.21	0.240
	No	5	4	6	29	44		
Postoperative movement time	Same day	10	13	16	47	86	10.84	0.093
	1–3 days	9	6	16	26	57		
	>3 days	5	1	0	12	18		

Note: Pain level categories sum to 33 (no pain) + 42 (mild) + 72 (moderate) + 14 (severe) = 161 total patients.

Table.4. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to operation type

Operation Type	Total (N)	Preop Anxiety (Yes)	Postop Pain (Yes)	Pain Level (No pain / Mild / Moderate / Severe)	Side Effects (Yes)	Analgesia Needs (Yes)	Postoperative Movement Time (Same day / 1–3 days / >3 days)
Fracture fixation	45	32	33	12 / 11 / 18 / 4	31	34	27 / 12 / 6
Knee joint replacement	22	13	17	5 / 4 / 9 / 4	14	13	7 / 10 / 5
Knee joint endoscopy	14	12	13	1 / 4 / 6 / 3	10	11	6 / 5 / 3
Developmental dislocation	13	10	13	0 / 5 / 8 / 0	13	10	5 / 6 / 2
Wound cleaning	17	15	13	4 / 7 / 6 / 0	13	14	11 / 5 / 1
Amputation	11	5	7	4 / 2 / 3 / 2	1	7	5 / 6 / 0
Nerve release	8	6	6	2 / 1 / 5 / 0	5	5	3 / 5 / 0
Treatment of frozen shoulder	2	2	2	0 / 1 / 1 / 0	2	1	2 / 0 / 0
Tendon release	4	3	3	1 / 1 / 2 / 0	1	3	2 / 2 / 0
Foreign body remove	15	11	12	3 / 3 / 8 / 1	8	9	14 / 1 / 0
Hip joint replacement	5	4	5	0 / 1 / 4 / 0	5	5	1 / 3 / 1
Extra bone removing	5	4	4	1 / 2 / 2 / 0	4	5	3 / 2 / 0

Statistical test results (Chi-square, P-value) for each outcome:

- **Preoperative anxiety (Table 5):** $\chi^2 = 10.65$, P = 0.473
- **Postoperative pain (Table 5):** $\chi^2 = 9.75$, P = 0.553
- **Pain level (Table 5):** $\chi^2 = 27.81$, P = 0.72 (not significant)
- **Side effects (Table 5):** $\chi^2 = 32.16$, P = 0.001
- **Analgesia needs (Table 5):** $\chi^2 = 9.768$, P = 0.551
- **Postoperative movement time (Table 5):** $\chi^2 = 30.88$, P = 0.099

Note: Pain level categories sum to total patients per operation type (No pain + Mild + Moderate + Severe = Total). For example, fracture fixation: 12+11+18+4 = 45.

Interpretation of Findings in Relation to Operation Type

Below is an interpretation of Tables 6, which examine associations between the type of orthopedic operation and various perioperative outcomes. **Only one outcome (side effects) showed a statistically significant association (p = 0.001).** All other comparisons were non-significant (p > 0.05).

Preoperative Anxiety According to Operation Type

$\chi^2 = 10.65$; p = 0.473 – Not significant.

No statistically significant association was found between the type of surgery and preoperative anxiety. Although rates varied (e.g., fracture fixation: 32/45, 71.1%; knee joint replacement: 13/22, 59.1%; amputation: 5/11, 45.5%; foreign body removal: 11/15, 73.3%), these differences did not reach significance.

Postoperative Pain (Presence) According to Operation Type

$\chi^2 = 9.75$; $p = 0.553$ – Not significant.

The presence of any postoperative pain did not differ significantly across operation types. Proportions were generally high across all groups (e.g., developmental dislocation: 13/13, 100%; knee joint endoscopy: 13/14, 92.9%; fracture fixation: 33/45, 73.3%).

Pain Level According to Operation Type

$\chi^2 = 27.81$; $p = 0.72$

Despite apparent differences (e.g., knee arthroplasty and amputation showing severe pain in 4/22 and 2/11 respectively), the p-value is high, indicating no statistically significant association between operation type and pain level.

Pain intensity (mild/moderate/severe) did not vary significantly by operation type. Notable observations include:

- **Severe pain** was most frequent in knee joint replacement (6/22, 27.3%) and knee joint endoscopy (4/14, 28.6%).
- **Mild pain** was most common in fracture fixation (18/45, 40.0%) and wound cleaning (8/17, 47.1%).
- Developmental dislocation and hip replacement had no severe pain cases, but sample sizes were small.

Side Effects According to Operation Type – Statistically Significant

$\chi^2 = 32.16$; $p = 0.001$ – Significant.

This is the only significant finding among the operation-type analyses. Side effect occurrence varied markedly across procedures:

- **Highest rates** (100%): Developmental dislocation (13/13), treatment of frozen shoulder (2/2), hip joint replacement (5/5).
- **High rates** (≥70%): Fracture fixation (31/45, 68.9% – actually 68.9% not 100%; but note: developmental dislocation 100%, hip replacement 100%, frozen shoulder 100%).
- **Lowest rate**: Amputation (1/11, 9.1%). Nerve release had 5/8 (62.5%); foreign body removal 8/15 (53.3%).

Analgesia Needs According to Operation Type

$\chi^2 = 9.768$; $p = 0.551$ – Not significant.

Analgesia requirements did not differ significantly across operation types. Most groups had high proportions needing analgesics (e.g., fracture fixation 34/45, 75.6%; knee joint endoscopy 11/14, 78.6%; developmental dislocation 10/13, 76.9%; hip replacement 5/5, 100%).

Postoperative Movement Time According to Operation Type

$\chi^2 = 30.88$; $p = 0.099$ – Not significant (trend toward significance).

There was a statistical trend (p = 0.099) but no definitive association between operation type and time to mobilization. Observations:

- **Same-day movement** was most common in foreign body removal (14/15, 93.3%), wound cleaning (11/17, 64.7%), and fracture fixation (27/45, 60.0%).
- **Delayed movement (>3 days)** was seen in fracture fixation (6/45, 13.3%), knee joint replacement (5/22, 22.7%), knee joint endoscopy (3/14, 21.4%), and developmental dislocation (2/13, 15.4%).
- Amputation and nerve release had no patients with >3 days delay.

Table.5. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to anesthesia type

Outcome	Category	General (n=116)	Spinal (n=27)	Epidural (n=5)	Regional (n=12)	Regional + analgesia (n=1)	Total (N=161)	Chi-square	P-value
Preoperative anxiety	Yes	89	15	5	8	0	117	9.699	0.046
	No	27	12	0	4	1	44		
Postoperative pain	Yes	100	14	5	8	1	128	18.628	0.001
	No	16	13	0	4	0	33		
Pain level	No pain	16	13	0	4	0	33	37.96	<0.001
	Mild	29	7	1	5	0	42		
	Moderate	62	4	4	2	0	72		
	Severe	9	3	0	1	1	14		
Side effects	Yes	97	3	5	1	1	107	73.649	<0.001
	No	19	24	0	11	0	54		
Analgesia needs	Yes	92	15	5	4	1	117	18.164	0.001
	No	24	12	0	8	0	44		
Postoperative movement time	Same day	61	12	2	11	0	86	20.058	0.010
	1–3 days	45	9	2	1	0	57		
	>3 days	10	6	1	0	1	18		

There is a trend toward higher pain with longer operations (severe pain: 1/52 in <1h vs 2/17 in >3h), but the p-value does not reach conventional significance. Longer surgical duration is generally associated with more tissue trauma and higher pain scores, but this may be confounded by procedure type.

The table **S1** presents the association between various anesthetic agents or combinations and the presence of preoperative anxiety in 161 patients. Overall, 72.7% (117/161) of patients experienced anxiety. Single agents such as propofol (2/2, 100%) and thiopental (4/4, 100%) were associated with anxiety in all cases, whereas ketamine alone (0/1) and succinylcholine alone (0/1) showed no anxiety. Combinations including ketamine demonstrated variable anxiety rates (0–80%), with some regimens (e.g., ketamine + esmeron + sevoflurane: 2/4, 50%) falling below the overall average. Local anesthetics marcaine (11/20, 55%) and lidocaine (9/12, 75%) also had lower-than-average anxiety rates.

Based solely on the provided table, the frequency of use for each anesthetic drug (counting the total number of patients receiving that drug, alone or in combination) is as follows:

- **Propofol**: 105 patients, **Sevoflurane** (including misspellings "sevoflorine", "seveoflorine", "seveflorine"): 80 patients, **Ketamine**: 72 patients, **Atracurium**: 49 patients, **Isoflurane** ("isoflorine"): 35 patients, **Esmeron** (rocuronium): 29 patients
- **Marcaine** (bupivacaine): 26 patients, **Succinylcholine**: 20 patients, **Lidocaine**: 18 patients, and **Thiopental** (including "thiopentsl"): 13 patients. These frequencies sum to more than the total patient number (N=161) because most patients received multiple drugs. No external references are used; the calculation is derived directly from the table. S1

Table. S2. Pain level according to anesthesia drug (40 regimens)
Chi-square = 188.84; P = 0.000

This table shows strong statistical significance, meaning the choice of anaesthetic drug or combination is strongly associated with pain level. Key observations:

- **Propofol alone** (drug 1.00): 2 patients both had severe pain – this is unusual because propofol is not analgesic. Possibly these were short procedures without additional analgesia.
- **Marcaine alone** (3.00): 20 patients, mostly no pain (11) or mild (7) – excellent postoperative analgesia.
- **Lidocaine alone** (4.00): 12 patients, mostly no/mild pain – good, but one severe case.
- **Ketamine alone** (5.00): only 1 patient, no pain – ketamine provides analgesia. **Succinylcholine alone** (6.00): 1 patient, severe pain – likely due to postoperative myalgia, a known side effect.
- **Combinations containing propofol + ketamine + atracurium + sevoflurane** (9.00): 15 patients, 10 moderate, 1 severe – moderate pain levels.
- **Propofol + sevoflurane** (18.00): 10 patients, 9 moderate – less effective than adding a regional block.
- **Marcaine + lidocaine** (27.00): 5 patients, 3 moderate, 2 severe – unexpectedly high pain; possible insufficient dose or short duration.
- **Propofol + ketamine + esmeron + sevoflurane** (25.00): 9 patients, 4 no pain, 2 mild, 3 moderate – relatively good.

The table S3 presents the relationship between 40 different anesthetic regimens (single or combined drugs) and postoperative pain intensity (mild, moderate, severe) in 161 patients. Overall, mild pain was reported in 60 patients (37.3%), moderate in 85 (52.8%), and severe in 16 (9.9%). The distribution varied markedly by agent.

Key findings:

- **Single agents**: Propofol alone (row 1) was associated with severe pain in both patients (32/2, 100%), whereas thiopental alone (row 2) resulted only in mild or moderate pain (2 mild, 2 moderate). Marcaine (bupivacaine) (row 3) produced predominantly mild (12/20) and moderate (7/20) pain, with only one severe case. Lidocaine (row 4) showed similar pattern (8 mild, 3 moderate, 1 severe). Ketamine alone (row 5) yielded mild pain (1/1), and succinylcholine alone (row 6) severe pain (1/1). Sevoflurane alone (row 10) gave mild pain (1/1).

- **Combinations containing ketamine**: Most ketamine-containing regimens had zero severe pain. For example, propofol + ketamine + atracurium + isoflurane (row 7) had 4 mild, 4 moderate, 1 severe (n=9); ketamine + Esmeron + sevoflurane (row 14) had 3 mild, 1 moderate, 0 severe (n=4); propofol + ketamine + sevoflurane (row 22) 3 mild, 4 moderate, 0 severe (n=7); propofol + ketamine + esmeron + sevoflurane (row 25) 3 mild, 6 moderate, 0 severe (n=9). However, one exception was propofol + ketamine + succinylcholine + sevoflurane (row 29) with 1 mild, 2 moderate, 2 severe (n=5).
- **Combinations without ketamine**: Several propofol-based regimens without ketamine still showed moderate or severe pain. For instance, propofol + sevoflurane (row 18) had 0 mild, 10 moderate, 0 severe; propofol + succinylcholine + atracurium + isoflurane (row 11) had 2 mild, 0 moderate, 1 severe; marcaine + lidocaine (row 27) had 0 mild, 3 3moderate, 2 severe.

The table S4 presents the incidence of side effects (any type, not specified) associated with 40 different anesthetic regimens in 161 patients. Overall, side effects occurred in 107 patients (66.5%). The frequency varied substantially by agent and combination.

- **Single agents**: Propofol alone (row 1) had 1/2 (50%) side effects; thiopental alone (row 2) 4/4 (100%); marcaine (row 3) 2/20 (10%); lidocaine (row 4) 1/12 (8.3%); ketamine alone (row 5) 0/1 (0%); succinylcholine alone (row 6) 1/1 (100%); sevoflurane alone (row 10) 0/1 (0%).
- **Local anesthetics (marcaine, lidocaine)** had very low side effect rates, especially marcaine (10%) and lidocaine (8.3%), and the combination marcaine+lidocaine (row 27) had 0/5 (0%).
- **Multidrug regimens containing propofol without ketamine** often had high side effect rates: e.g., propofol+atracurium+isoflurane (row 12) 3/3 (100%); propofol+atracurium+sevoflurane (row 13) 6/6 (100%); propofol+sevoflurane (row 18) 9/10 (90%).
- **Ketamine-containing regimens** showed variable rates: propofol+ketamine+atracurium+isoflurane (row 7) 9/9 (100%); propofol+ketamine+atracurium+sevoflurane (row 9) 10/15 (66.7%); propofol+ketamine+sevoflurane (row 22) 3/7 (42.9%); propofol+ketamine+esmeron+sevoflurane (row 25) 8/9 (88.9%); ketamine+Esmeron+sevoflurane (row 14) 4/4 (100%). Only one ketamine combination had zero side effects: propofol+ketamine+atracurium+esmeron+sevoflurane (row 38) 0/1, but n=1.

The table S5 reports the need for additional postoperative analgesia (yes/no) associated with 40 different anesthetic regimens in 161 patients. Overall, 117 patients (72.7%) required analgesia, while 44 (27.3%) did not. The proportion varied widely across regimens.

- Single agents: Propofol alone (row 1) required analgesia in 2/2 (100%); thiopental alone (2/2? Actually row 2: 4/4 = 100%); marcaine (bupivacaine) (row 3) 10/20 (50%); lidocaine (row 4) 5/12 (41.7%); ketamine alone (row 5) 1/1 (100%); succinylcholine alone (row 6) 1/1 (100%); sevoflurane alone (row 10) 0/1 (0%).

- Local anesthetics (marcaine, lidocaine) had the lowest analgesia requirement (50% and 41.7%, respectively), and the combination marcaine+lidocaine (row 27) had 3/5 (60%).
- Multidrug regimens without ketamine often had high analgesia needs: e.g., propofol+atracurium+isoflurane (row 12) 3/3 (100%); propofol+atracurium+sevoflurane (row 13) 6/6 (100%); propofol+sevoflurane (row 18) 8/10 (80%).
- Ketamine-containing regimens showed variable but generally lower analgesia needs than propofol-only combinations: e.g., propofol+ketamine+atracurium+isoflurane (row 7) 5/9 (55.6%); propofol+ketamine+atracurium+sevoflurane (row 9) 11/15 (73.3%); ketamine+Esmeron+sevoflurane (row 14) 1/4 (25%); propofol+ketamine+sevoflurane (row 22) 5/7 (71.4%); propofol+ketamine+esmeron+sevoflurane (row 25) 5/9 (55.6%). The lowest among ketamine groups was row 14 (25%) and row 38 (0/1, but n=1).

The table S6 presents postoperative movement time (same day, 1–3 days, or >3 days) for 40 different anesthetic regimens in 161 patients. Overall, 86 patients (53.4%) moved on the same day, 57 (35.4%) moved within 1–3 days, and 18 (11.2%) required more than 3 days to regain movement. Local anesthetics (marcaine, lidocaine) were associated with the fastest recovery: marcaine alone (row 3) had 11/20 (55%) same-day movement, 5/20 (25%) 1–3 days, and only 4/20 (20%) >3 days; lidocaine alone (row 4) had 11/12 (91.7%) same-day movement, 1/12 (8.3%) 1–3 days, and none >3 days. The combination marcaine+lidocaine (row 27) was slower: 0/5 same day, 3/5 (60%) 1–3 days, 2/5 (40%) >3 days. Single general anesthetics: Propofol alone (row 1) had 0 same day, 2/2 (100%) 1–3 days; thiopental alone (row 2) had 2/4 (50%) same day, 2/4 (50%) 1–3 days; ketamine alone (row 5) and succinylcholine alone (row 6) both required >3 days (1/1 each). Sevoflurane alone (row 10) had 1/1 (100%) 1–3 days. Ketamine-containing combinations showed rapid recovery in many cases: e.g., ketamine+Esmeron+sevoflurane (row 14) 4/4 (100%) same day; ketamine+atracurium+sevoflurane (row 15) 3/3 (100%) same day; propofol+ketamine+sevoflurane (row 22) 7/7 (100%) same day; propofol+ketamine+esmeron+sevoflurane (row 25) 7/9 (77.8%) same day. However, some ketamine regimens had delayed recovery, such as propofol+ketamine+succinylcholine+sevoflurane (row 29) with only 1/5 (20%) same day and 2/5 (40%) >3 days.

- Propofol-based multidrug regimens without ketamine had variable but often slower recovery: propofol+sevoflurane (row 18) had 4/10 (40%) same day, 5/10 (50%) 1–3 days, 1/10 (10%) >3 days; propofol+atracurium+isoflurane (row 12) 2/3 (66.7%) same day, 1/3 (33.3%) 1–3 days; propofol+atracurium+sevoflurane (row 13) 3/6 (50%) same day, 3/6 (50%) 1–3 days.

Table.6. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to causes of anesthesia selection

Outcome	Category	Operation type (n=30)	Patient illness (n=22)	Anesthetist decision (n=107)	Patient demand (n=2)	Total (N=161)	Chi-square	P-value
Preoperative anxiety	Yes	21	12	84	0	117	10.899	0.012
	No	9	10	23	2	44		
Postoperative pain	Yes	23	14	89	2	128	4.949	0.176
	No	7	8	18	0	33		
Pain level	No pain	7	8	18	0	33	11.88	0.220
	Mild	8	5	29	0	42		
	Moderate	14	6	51	1	72		
	Severe	1	3	9	1	14		
Side effects	Yes	16	10	79	2	107	10.292	0.016
	No	14	12	28	0	54		
Analgesia needs	Yes	20	18	77	2	117	2.251	0.522
	No	10	4	30	0	44		
Postoperative movement time	Same day	23	7	56	0	86	27.092	<0.001
	1–3 days	6	7	43	1	57		
	>3 days	1	8	8	1	18		

Chi-square = 19.988; P = 0.067 (borderline)

Table.7. The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to operation duration

Outcome	Category	<1 hour (n=52)	1–2 hours (n=58)	2–3 hours (n=34)	>3 hours (n=17)	Total (N=161)	Chi-square	P-value
Preoperative anxiety	Yes	40	42	25	10	117	2.13	0.546
	No	12	16	9	7	44		
Postoperative pain	Yes	41	49	26	12	128	1.92	0.590
	No	11	9	8	5	33		
Pain level	No pain	11	11	6	5	33	19.98	0.067
	Mild	19	10	8	5	42		
	Moderate	21	31	15	5	72		
	Severe	1	8	3	2	14		
Side effects	Yes	31	39	26	11	107	2.66	0.447
Analgesia needs	No	21	19	8	6	54		
	Yes	35	46	24	12	117	2.152	0.541
	No	17	12	10	5	44		
Postoperative movement time	Same day	42	26	16	2	86	33.85	<0.001
	1–3 days	8	27	11	11	57		
	>3 days	2	5	7	4	18		

Interpretation of Findings According to Preoperative Explanation

Tables 8 examine associations between whether patients received **preoperative explanation** (yes/no) about their procedure or anesthesia and various perioperative outcomes. Statistically significant findings were observed for **postoperative pain presence, pain level, and analgesia needs**. No significant associations were found for preoperative anxiety, side effects, or postoperative movement time.

Preoperative Anxiety According to Preoperative Explanation

$\chi^2 = 0.543$; p = 03.461 – Not significant.

Preoperative anxiety did not differ significantly between patients who received a preoperative explanation (108/147, 73.5% anxious) and those who did not (9/14, 64.3% anxious). Although the non-explained group had a slightly lower anxiety rate, the difference 3was not statistically significant.

Postoperative Pain (Presence) According to Preoperative Explanation – Statistically Significant

$\chi^2 = 24.408$; $p < 0.001$ – Highly significant.

The presence of postoperative pain varied dramatically:

- **Preoperative explanation received:** 124/147 (84.4%) reported pain.
- **No preoperative explanation:** 4/14 (28.6%) reported pain.

Pain Level According to Preoperative Explanation – Statistically Significant

$\chi^2 = 24.73$; p = 0.000 – Significant.

Patients who received a preoperative explanation had a higher proportion of mild/moderate pain but also more severe pain. “No” group: 10/14 (71%) no pain, but only 14 patients. Small numbers. The significant p-value indicates an association, but direction is unclear.

Pain intensity (mild/moderate/severe) differed significantly:

Side Effects According to Preoperative Explanation

$\chi^2 = 0.033$; p = 0.857 – Not significant.

Side effect occurrence did not differ: with explanation (98/147, 66.7%); without explanation (9/14, 64.3%).

Analgesia Needs According to Preoperative Explanation – Statistically Significant

$\chi^2 = 10.545$; p = 0.001 – Significant.

Analgesia requirements differed significantly:

- **With explanation:** 112/147 (76.2%) needed analgesics.
- **Without explanation:** 5/14 (35.7%) needed analgesics.

Patients who received a preoperative explanation were much more likely to require postoperative analgesics. This mirrors the finding for pain presence.

Postoperative Movement Time According to Preoperative Explanation

$\chi^2 = 2.581$; p = 0.275 – Not significant.

Time to mobilization did not differ significantly: same-day movement (with explanation 81/147, 55.1%; without 5/14, 35.7%); delayed >3 days (with 15/147, 10.2%; without 3/14, 21.4%). Although the non-explained group had a higher proportion of delayed mobilization, the difference was not statistically significant, likely due to the small sample size of the non-explained group (n=14) and confounding by procedure type.

Table.8 . The frequency of preoperative anxiety, postoperative pain, pain level, side effects, analgesia needs, and postoperative movement time according to preoperative explanation

Outcome	Category	Preoperative Explanation Yes	Preoperative Explanation No	Total	Chi-Square	P-value
Preoperative Anxiety	Present	108	9	117	0.543	0.461
	Absent	39	5	44		
Postoperative Pain	Present	124	4	128	24.408	0.000
	Absent	23	10	33		
Pain Level	No pain	23	10	33	24.73	0.000
	Mild	41	1	42		
	Moderate	70	2	72		
	Severe	13	1	14		
Side Effect	Present	98	9	107	0.033	0.857
	Absent	49	5	54		
Analgesia Needs	Present	112	5	117	10.545	0.001
	Absent	35	9	44		
Postoperative Movement	Same day	81	5	86	2.581	0.275
	1–3 days	51	6	57		
	>3 days	15	3	18		

Interpretation of Frequency Distributions (Table 9)

The following tables describe the demographic, clinical, and perioperative characteristics of the study s3ample (N = 161).

Frequency of Cases According to Sex

The sample included **101 males (62.7%)** and **60 females (37.3%)**. The male predominance is common in orthopedic trauma and joint surgery populations.

Frequency of Cases According to Age Groups

The largest age groups were **21–30 years (39.1%)** and **31–40 years (26.7%)**, together comprising nearly two-thirds of the sample. Patients aged <20 years constituted 18.0%, while those ≥51 years accounted for only 8.0% (51–60: 4.3%; 61–70: 3.7%).

Frequency of Cases According to Education

The majority of patients had ≥ **college education (52.8%)**, followed by preparatory (19.9%), primary (14.9%), and secondary (12.4%). The high proportion of college-educated individuals may reflect the catchment area or socioeconomic status of the study centre.

Frequency of Cases According to Operation Type

The most common operations were: **Fracture fixation** – 45 (28.0%), **Knee joint replacement** – 22 (13.7%), **Wound cleaning** – 17 (10.6%), **Foreign body removal** – 15 (9.3%)

Knee joint endoscopy – 14 (8.7%), **Developmental dislocation** – 13 (8.1%) and **Amputation** – 11 (6.8%)

Less frequent procedures included nerve release (5.0%), extra bone removal (3.1%), hip replacement (3.1%), tendon release (2.5%), and frozen shoulder treatment (1.2%). This wide spectrum reflects a mixed orthopedic caseload, from minor soft-tissue procedures to major joint arthroplasties and amputations.

Frequency of Cases According to Anesthesia Type

General anesthesia was used in the majority (116/161, 72.0%), followed by spinal (16.8%), local (7.5%), epidural (3.1%), and local with analgesia (0.6%). The predominance of general anesthesia is typical in orthopedic surgery, although regional techniques (spinal, epidural, local) together accounted for 28%.

Frequency of Cases According to Causes of Anesthesia Selection

The anesthetist's decision was the primary reason in **66.5%** of cases, followed by operation type (18.6%) and patient illness (13.7%). Patient demand was rare (1.2%).

Frequency of Cases According to Operation Duration

Operation durations were: **<1 hour** – 52 (32.3%), **1–2 hours** – 58 (36.0%), **2–3 hours** – 34 (21.1%), and **>3 hours** – 17 (10.6%)

Most procedures (68.3%) lasted less than 2 hours, reflecting the predominance of moderate-length operations. Only 10.6% exceeded 3 hours, which were likely complex cases.

Frequency of Cases According to Anesthesia Drugs

This table lists 40 different drug combinations (coded 1.00 to 40.00), indicating substantial heterogeneity in anesthetic protocols. The most frequent single code (3.00) occurred in 20 patients (12.4%), and several codes appeared only once. Such diversity reflects individualized anesthetic practice but complicates outcome attribution, Table S7.

Frequency of Cases According to Preoperative Explanation

Preoperative explanation was provided to **147 patients (91.3%)** – a very high rate. Only 14 (8.7%) received no documented explanation. This suggests good preoperative communication, although the quality and content of explanation were not assessed, Table 10.

Frequency of Cases According to Preoperative Anxiety

Preoperative anxiety was present in **117 patients (72.7%)**. Table 10

Frequency of Cases According to Postoperative Pain

Postoperative pain was reported by **128 patients (79.5%)**. Table 10

Frequency of Cases According to Pain Level

The predominant pain level was the moderate which from [52.3%, followed by mild level [36.7%], and severe level forms 11%. Table 10

Frequency of Cases According to Side Effects

Side effects occurred in **107 patients (66.5%)**. Table 10

Frequency of Cases According to Analgesia Needs

Analgesia was required by **117 patients (72.7%)**, identical to the anxiety prevalence. Table 10

Frequency of Cases According t3o Postoperative Movement Time
Mobilization times: **Same day** – 86 (53.4%), **1–3 days** – 57 (35.4%), and **>3 days** – 18 (11.2%), Table 10
Anxious patients had significantly higher rates of moderate/severe pain (66/117 = 56%) compared to non-anxious patients (20/44 = 45%). This is a tautological association: by definition, those reporting "yes" to postoperative pain have mild, moderate, or severe pain, while those with "no" pain have no pain. The table simply confirms internal consistency.
Unsurprisingly, patients who required rescue analgesia had higher pain levels. All severe pain patients needed analgesia. This validates the pain scoring system. Early movement (yes) was associated with more no/mild pain (55/86 = 64%) compared to delayed movement (14/57 = 25%). Delayed movement correlated with moderate/severe pain, Table.10..

Table.9. The frequency of cases according to demographic and clinical

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Sex	Male	101	62.7	62.7	62.7
	Female	60	37.3	37.3	100.0
Age group (years)	< 20	29	18.0	18.0	18.0
	21 – 30	63	39.1	39.1	57.1
	31 – 40	43	26.7	26.7	83.9
	41 – 50	13	8.1	8.1	91.9
	51 – 60	7	4.3	4.3	96.3
	61 – 70	6	3.7	3.7	100.0
Education	Primary	24	14.9	14.9	14.9
	Secondary	20	12.4	12.4	27.3
	Preparatory	32	19.9	19.9	47.2
	≥ college	85	52.8	52.8	100.0
Operation type	Fracture fixation	45	28.0	—	—
	Knee joint replacement	22	13.7	—	—
	Knee joint endoscopy	14	8.7	—	—
	Developmental dislocation	13	8.1	—	—
	Wound cleaning	17	10.6	—	—
	Amputation	11	6.8	—	—
	Nerve release	8	5.0	—	—
	Treatment of frozen shoulder	2	1.2	—	—
	Tendon release	4	2.5	—	—
	Foreign body removal	15	9.3	—	—
	Hip joint replacement	5	3.1	—	—
	Extra bone removing	5	3.1	—	—
Anesthesia type	General	116	72.0	72.0	72.0

	Spinal	27	16.8	16.8	88.8
	Epidural	5	3.1	3.1	91.9
	Local	12	7.5	7.5	99.4
	Local with analgesia	1	0.6	0.6	100.0
Cause of anesthesia selection	Operation	30	18.6	18.6	18.6
	Patient's illness	22	13.7	13.7	32.3
	Anesthetist decision	107	66.5	66.5	98.8
	Patient demand	2	1.2	1.2	100.0
Operation duration	< 1 hour	52	32.3	—	—
	1 – 2 hours	58	36.0	—	—
	2 – 3 hours	34	21.1	—	—
	> 3 hours	17	10.6	—	—

Note: For *Operation type* and *Operation duration*, the original tables did not report Valid Percent or Cumulative Percent, so those columns are marked with "—". All percentages are based on a total of 161 cases.3

Table 10. Frequency of cases in relation to preoperative explanation, preoperative anxiety, postoperative pain, pain levels, side effects, analgesia needs, and postoperative mobilization.

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Preoperative explanation	Yes	147	91.3	91.3	91.3
	No	14	8.7	8.7	100.0
Preoperative anxiety	Yes	117	72.7	72.7	72.7
	No	44	27.3	27.3	100.0
Postoperative pain	Yes	128	79.5	79.5	79.5
	No	33	20.5	20.5	100.0
Pain level (among those with postoperative pain, n=128)	Mild	47	36.7*	—	—
	Moderate	67	52.3*	—	—
	Severe	14	11.0*	—	—
Side effects	Yes	107	66.5	66.5	66.5
	No	54	33.5	33.5	100.0
Analgesia needs	Yes	117	72.7	72.7	72.7
	No	44	27.3	27.3	100.0
Postoperative movement time	Same day	86	53.4	53.4	53.4
	1–3 days	57	35.4	35.4	88.8
	>3 days	18	11.2	11.2	100.0

Table 11. Frequency of pain levels in relation to variables

Variable	Category	No pain	Mild	Moderate	Severe	Total	Chi-square	P-value
Preoperative anxiety	**Yes**	**17**	**34**	**54**	**12**	**117**	**10.28**	**0.016**
	No	**16**	**8**	**18**	**2**	**44**		
Postoperative pain	**Yes**	**0**	**42**	**72**	**14**	**128**	**161.00**	**0.000**
	No	**33**	**0**	**0**	**0**	**33**		
Side effects	**Yes**	**8**	**29**	**60**	**10**	**107**	**35.86**	**0.000**
	No	**25**	**13**	**12**	**4**	**54**		
Analgesia needs	**Yes**	**11**	**29**	**63**	**14**	**117**	**39.23**	**0.000**
	No	**22**	**13**	**9**	**0**	**44**		
Postoperative movement time	**Same day (moved early)**	**23**	**32**	**29**	**2**	**86**	**32.42**	**0.000**
	1–3 days (delayed)	**6**	**8**	**36**	**7**	**57**		
	>3 days (unknown)	**4**	**2**	**7**	**5**	**18**		

3.2. Logistic regression line analysis.

A binary logistic regression analysis was conducted to examine the association of multiple factors with the outcome variable. The full model included sex, age, education, operation type (OpType), anesthesia type (Anesthesia type), anesthesia selection causes (AnSelection), operation duration (OpDuration), anesthetic drug type (AnDrug), preoperative explanation (PreOpExpl), and preoperative anxiety (PreopAnxiety) as predictors. As shown in the Table 11, among all predictors, **only preoperative explanation (PreOpExpl) reached statistical significance**. The variable PreOpExpl(1) demonstrated a strong negative association with the outcome (B = -6.355, Wald = 11.122, df = 1, p = 0.001). The odds ratio (Exp(B)) was 0.002 (95% CI: 0.000 to 0.073), indicating that receiving preoperative explanation was associated with a 99.8% reduction in the odds of the outcome event. Table.11.

Preoperative anxiety showed a trend toward statistical significance (B = 1.439, Wald = 3.450, df = 1, p = 0.063), with an odds ratio of 4.215 (95% CI: 0.924 to 19.232), suggesting a potential increase in outcome risk, although the confidence interval crossed 1. Similarly, anesthetic drug dosage approached significance (B = -0.068, Wald = 3.194, df = 1, p = 0.074, Exp(B) = 0.935, 95% CI: 0.868 to 1.007). Table11.

All other predictors—sex, age, education, operation type, anesthesia type, anesthesia section, and operation duration—failed to reach statistical significance (all p > 0.05). Notably, several categorical variables [particularly operation type (OpType) categories 4, 8, 11 and anesthesia type categories 1-4, and anesthesia selection causes (AnSelection) categories 1-3 exhibited extremely large standard errors and odds ratios approaching zero or infinity, with p values near 1.000, indicating potential issues of sparse data or quasi-complete separation. Table 11.

3.3. Ordinal regression analysis

Significant Predictors

Several factors were statistically significant predictors of higher postoperative pain levels. Age was a significant predictor, with the following age groups showing positive coefficients: age

group 1 (Estimate = 8.299, SE = 3.934, p = 0.035), age group 2 (Estimate = 9.211, SE = 4.133, p = 0.026), age group 3 (Estimate = 11.746, SE = 4.461, p = 0.008), and age group 5 (Estimate = 12.039, SE = 4.766, p = 0.012). Notably, age group 6 served as the reference category. Education level also significantly predicted pain, with lower education groups showing larger positive coefficients: education group 1 (Estimate = 8.427, SE = 2.355, p < 0.001), education group 2 (Estimate = 6.663, SE = 1.923, p = 0.001), and education group 3 (Estimate = 4.400, SE = 1.459, p = 0.003). The type of operation was another significant factor, with multiple operation types showing large positive estimates: operation type (OpType) 1 (Estimate = 9.475, SE = 3.306, p = 0.004), OpType 2 (Estimate = 12.160, SE = 4.185, p = 0.004), OpType 3 (Estimate = 10.385, SE = 4.593, p = 0.024), OpType 4 (Estimate = 8.381, SE = 3.587, p = 0.019), OpType 5 (Estimate = 10.214, SE = 3.451, p = 0.003), OpType 6 (Estimate = 12.118, SE = 4.114, p = 0.003), OpType 9 (Estimate = 15.084, SE = 4.334, p = 0.001), and OpType 10 (Estimate = 14.295, SE = 4.314, p = 0.001). OpType 12 served as the reference, Table 13.
An ordinal regression model was used to assess the impact of various clinical and demographic factors on postoperative pain levels, with the outcome variable pain level measured on an ordinal scale. The model included thresholds for pain level = 1.00 (Estimate = 26.028, SE = 14437.987, p = 0.999) and pain level = 2.00 (Estimate = 38.994, SE = 14437.988, p = 0.998), although these threshold estimates were not statistically significant and had extremely large standard errors, indicating poor precision in the estimation of these cut-points, Table 14.

Non-Significant Predictors

A number of predictors did not reach statistical significance at the alpha = 0.05 level. These included postoperative pain (PostOpPain) (Estimate = 2.598, SE = 1.376, p = 0.059), postoperative movement time (PostOpMov) (Estimate = 1.640, SE = 0.953, p = 0.085), and sex (sex = 1.00, Estimate = -2.047, SE = 1.222, p = 0.094). side effects (SideEffect) (Estimate = 0.492, SE = 1.731, p = 0.776), analgesia (AnalegesiaNeed) (Estimate = -1.421, SE = 1.350, p = 0.292), and preoperative anxiety (PreopAnxiety) (Estimate = 0.378, SE = 1.062, p = 0.722) also did not show significant effects, Table 15
Several other variables, including anesthesia type (AnesthesiaType), anesthesia selection causes (AnSelection), operation duration (OpDuration), anesthesia drugs (AnDrug), and preoperative explanation (PreOpExpl), exhibited extremely large standard errors and p-values close to 1, suggesting potential issues with model convergence, separation, or sparse data for these categories. For instance, anesthesia type = 2.00 had an Estimate of -34.405 with 1a SE of 14437.995 (p = 0.998), and many anesthesia drugs categories similarly showed enormous standard errors (e.g., AnDrug = 1.00, Estimate = 27.129, SE = 6929.362, p = 0.997).

Table.12. The outcomes of Binary Logistic Regression line analysis

Variables in the Equation	B	S.E.	Wald	Degree freedom	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
sex(1)	1.228	.805	2.326	1	.127	3.416	.705	16.558
Age	.199	.333	.359	1	.549	1.221	.636	2.345
Education			3.644	3	.303			
education(1)	-2.201	1.675	1.728	1	.189	.111	.004	2.948
education(2)	-3.251	2.195	2.194	1	.139	.039	.001	2.860
education(3)	-.573	.903	.402	1	.526	.564	.096	3.311
OpType			4.689	11	.945			
OpType(1)	-.693	1.393	.248	1	.619	.500	.033	7.662
OpType(2)	-2.267	1.799	1.588	1	.208	.104	.003	3.523
OpType(3)	-2.854	2.423	1.387	1	.239	.058	.000	6.651
OpType(4)	-23.320	8990.484	.000	1	.998	.000	.000	.
OpType(5)	-.463	1.470	.099	1	.753	.629	.035	11.227
OpType(6)	-.482	1.724	.078	1	.780	.618	.021	18.125
OpType(7)	-1.278	2.102	.370	1	.543	.279	.005	17.142
OpType(8)	-19.416	27346.843	.000	1	.999	.000	.000	.
OpType(9)	-4.949	4.035	1.505	1	.220	.007	.000	19.271
OpType(10)	-1.614	1.993	.656	1	.418	.199	.004	9.895
OpType(11)	-20.813	15125.558	.000	1	.999	.000	.000	.
AnesthesiaType			2.120	4	.714			
AnesthesiaType(1)	3.319	56841.587	.000	1	1.000	27.625	.000	.
AnesthesiaType(2)	4.324	56841.587	.000	1	1.000	75.511	.000	.
AnesthesiaType(3)	-11.970	58996.411	.000	1	1.000	.000	.000	.
AnesthesiaType(4)	4.964	56841.587	.000	1	1.000	143.213	.000	.
AnSelection			1.092	3	.779			
AnSelection(1)	18.875	40193.085	.000	1	1.000	1575318 02.933	.000	.
AnSelection(2)	18.632	40193.085	.000	1	1.000	1235033 69.458	.000	.
AnSelection(3)	19.542	40193.085	.000	1	1.000	3067676 78.760	.000	.
OpDuration	.338	.443	.585	1	.444	1.403	.589	3.340
AnDrug	-.068	.038	3.194	1	.074	.935	.868	1.007
PreOpExpl(1)	-6.355	1.906	11.122	1	.001	.002	.000	.073
PreopAnxiety	1.439	.775	3.450	1	.063	4.215	.924	19.232
Constant	-19.921	40192.884	.000	1	1.000	.000		

Table 13. Significant Predictors of Higher Postoperative Pain Level (Ordinal Regression)

Predictor	Category	Estimate (B)	Std. Error	p-value	Odds Ratio (OR)	95% CI for OR
Age (ref: Age=6.00)	age=1.00	8.299	3.934	0.035	4019.6	(1.80, 8.97×10^{6})
	age=2.00	9.211	4.133	0.026	10013.5	(3.03, 3.30×10^{7})
	age=3.00	11.746	4.461	0.008	126,333.5	(20.13, 7.93×10^{8})
	age=5.00	12.039	4.766	0.012	169,544.9	(14.86, 1.93×10^{9})
Education (ref: education=4.00)	education=1.00	8.427	2.355	<0.001	4565.4	(45.15, 461,535)
	education=2.00	6.663	1.923	0.001	781.5	(18.04, 33,862)
	education=3.00	4.400	1.459	0.003	81.5	(4.67, 1422)
Operation Type (ref: OpType=12.00)	OpType=1.00	9.475	3.306	0.004	13,014.9	(20.01, 8.46×10^{6})
	OpType=2.00	12.160	4.185	0.004	190,787.4	(52.20, 6.97×10^{8})
	OpType=3.00	10.385	4.593	0.024	32,258.7	(3.98, 2.62×10^{8})
	OpType=4.00	8.381	3.587	0.019	4369.5	(3.86, 4.94×10^{6})
	OpType=5.00	10.214	3.451	0.003	27,219.7	(31.37, 2.36×10^{7})
	OpType=6.00	12.118	4.114	0.003	183,441.0	(57.72, 5.83×10^{8})
	OpType=9.00	15.084	4.334	0.001	3,563,711.0	(727.17, 1.75×10^{10})
	OpType=10.00	14.295	4.314	0.001	1,617,631.0	(343.96, 7.61×10^{9})

Note: Odds ratios are exponentiated coefficients (exp(B)). Extremely wide confidence intervals reflect high uncertainty due to sparse data or model instability – interpret with caution. Non-significant predictors and those with separation issues are not shown.

Table 14. Threshold Estimates (Not Significant)

Threshold	Estimate	Std. Error	p-value	95% CI
PainLevel = 1.00	26.028	14437.987	0.999	(-28271.9, 28323.9)
PainLevel = 2.00	38.994	14437.988	0.998	(-28258.9, 28336.9)

These estimates are highly unstable; the model has difficulty distinguishing between pain levels.

Table 15. Predictors That Approached Significance (0.05 < p < 0.10)

Predictor	Category	Estimate	Std. Error	p-value
PostOpPain	Continuous	2.598	1.376	0.059
PostOpMov	Continuous	1.640	0.953	0.085
Sex	sex=1.00 (vs 2.00)	-2.047	1.222	0.094

These may be clinically relevant but were not statistically significant at α=0.05.

- **OR > 1** → higher odds of more severe pain.
- **OR < 1** → lower odds of more severe pain.
- The 95% confidence interval (CI) indicates the range within which the true OR is likely to lie.

Important caution: The extremely wide CIs (e.g., 1.80 to 8.97×10^6) mean the estimates are very imprecise. This is a sign of sparse data or model instability. Interpret the point estimates with great caution.

1. Age (reference = age group 6 – presumably oldest patients)

All younger age groups have ORs > 1, indicating **higher odds of greater postoperative pain** compared to the oldest group.

- **Age group 1** (youngest): OR = 4019.6 → odds are ~4000 times higher (but CI 1.8 to 9 million).
- **Age group 2:** OR = 10,013.5
- **Age group 3:** OR = 126,333.5
- **Age group 5:** OR = 169,544.9

Despite the huge point estimates, all are statistically significant ($p < 0.05$). The pattern suggests that younger age is strongly associated with more postoperative pain.

2. Education (reference = education group 4 – highest education)

Lower education levels have ORs > 1, meaning **less educated patients report higher pain**.

- **Education 1** (lowest): OR = 4565.4 (CI 45–461,535)
- **Education 2:** OR = 781.5
- **Education 3:** OR = 81.5

There is a clear gradient: the lower the education, the higher the odds of severe pain. All p-values < 0.01.

3. Operation Type (reference = OpType 12)

All listed operation types have ORs >> 1, indicating they are **associated with much higher pain levels** than the reference operation.

- **OpType 9** has the largest OR: 3,563,711 (CI 727 – 1.75×10^{10})
- **OpType 10:** OR = 1,617,631
- **OpType 2 and 6** also have ORs > 180,000

These enormous ORs suggest that the reference operation (OpType 12) is likely a very minor or low-pain procedure, while these other operations cause substantially more pain. Again, the wide CIs reflect low precision.

4.Discussion

4.1. Demographic characteristics and clinical association.

The majority of patients experienced moderate pain, followed by mild pain. No pain was reported in 20.5%, and severe pain in only 8.7%. This distribution indicates that postoperative pain is common but mostly mild to moderate, which aligns with large cohort studies showing that 40–630% of surgical patients report moderate pain.[7]. There was no statistically significant association between sex and preoperative anxiety. This suggests that both male and female patients experience similar levels of preoperative anxiety in this sample. Some studies have reported higher preoperative anxiety in females [8], while others found no sex differences [9], consistent with the present findings.

A significant association was found between sex and postoperative pain level. These findings indicate that females report higher levels of postoperative pain compared to males. This aligns with a substantial body of evidence showing that females experience greater postoperative pain intensity [10,11]. Biological differences in pain processing, hormonal influences, and psychosocial factors have been proposed to explain this sex difference [12]. Some studies have reported higher preoperative anxiety in younger adults [8], while others found no age-related difference [9]. The present findings suggest that age does not independently predict preoperative anxiety in this population. Younger patients reported higher pain levels. This inverse relationship between age and postoperative pain is well documented, possibly due to age-related decline in nociceptive processing or altered inflammatory response.[13]. These findings indicate that younger age is associated with a higher likelihood of reporting any postoperative pain. This aligns with literature showing that older adults often report less postoperative pain, possibly due to age-related changes in nociceptive processing or altered pain perception [13,14].

Overall, younger patients (especially <40 years) tend to report higher pain intensities (moderate to severe) compared to older patients. This is consistent with studies showing that advanced age is associated with lower postoperative pain scores [15]. Possible mechanisms include reduced inflammatory response, altered central pain processing, or differing pain expectations [16]. No significant association between age and presence of side effects. This suggests that age is not a major determinant of side effect occurrence in this sample, though some studies have reported increased side effect risk in older adults due to polypharmacy and altered pharmacokinetics [17].

Younger age is associated with greater analgesia requirements, which parallels the findings for pain presence and pain level. This may reflect both higher pain intensity in younger patients and differences in pain reporting or analgesic prescribing patterns [18]. Older patients may under-report pain or receive different analgesic regimens [19].

Younger patients mobilize earlier after surgery, while older patients show a trend toward delayed mobilization. This is consistent with known age-related declines in physiological reserve, increased comorbidities, and slower recovery of physical function [20]. However, the 31–40 group's higher rate of >3-day delay is unexpected and may be due to surgical type or other confounders not accounted for. Table S8.

Age is a significant factor influencing postoperative pain (presence and intensity), analgesia requirements, and recovery of mobility. Younger patients experience more pain and require more analgesics but mobilize earlier. Older patients have less pain and fewer analgesia needs but slower mobilization. These findings support age-adapted perioperative pain management strategies [21].

No statistically significant association was found between education level and preoperative anxiety. Some studies suggest that lower education may be associated with higher preoperative anxiety due to less understanding of medical procedures [22], while others report no independent effect [8]. The present findings indicate that education level does not significantly predict preoperative anxiety in this sample.

Patients with higher education (≥College) were significantly less likely to report any postoperative pain compared to those with lower education levels. This finding is consistent with literature showing that higher socioeconomic status and education are associated with lower pain reporting, possibly due to better coping strategies, higher pain self-efficacy, or different expectations regarding postoperative recovery [23,24]. Alternatively, lower education groups may have less access to effective pain management education preoperatively [25]. Higher education (≥College) is associated with milder pain intensity, while lower education groups report more moderate-to-severe pain. This aligns with previous research demonstrating that lower educational attainment is a risk factor for higher postoperative pain scores [26]. Possible explanations include differences in pain catastrophizing, health literacy, and ability to communicate pain effectively to healthcare providers [27]. Education may influence pain expression, coping strategies, and willingness to report pain.[28] No significant association between education and presence of side effects. The lack of significance suggests that education does not influence side effect occurrence, which is plausible as side effects are largely pharmacologically determined rather than behaviorally mediated [27].

No significant association between education and analgesia requirements. The lack of significance despite apparent differences may be due to sample size or confounding factors (e.g., pain level itself, which did differ). Interestingly, despite reporting less severe pain, the ≥College group still required analgesia at a rate not significantly different from others, suggesting that pain management decisions may be influenced by factors other than patient education [29].

There was a statistical trend ($p = 0.093$) but no definitive association between education and time to postoperative movement. Delayed movement (>3 days) was highest in primary (5/24, 20.8%) and ≥College (12/85, 14.1%); interestingly, the Preparatory group had zero patients with >3 days delay. The trend suggests that lower education (Primary) may be associated with slower mobilization, which could relate to higher pain levels or other socioeconomic factors affecting recovery [15]. However, the p-value >0.05 indicates that this finding is not statistically significant in the present sample. Table S9.

Table S10 shows that education level is a significant factor influencing postoperative pain outcomes. Patients with higher education (≥College) report less frequent pain and lower pain intensity compared to those with lower education. However, education did not significantly affect anxiety, side effects, analgesia needs, or mobilization time (though a trend was observed for the latter). These findings highlight the importance of considering health literacy and socioeconomic factors in perioperative pain management [21]. Targeted educational interventions for patients with lower education may improve pain outcomes [30]. No statistically significant association was found between the type of surgery and preoperative anxiety. The lack of association suggests that anxiety is common across many orthopedic procedures, and operation type alone does not predict preoperative anxiety levels. Some studies have reported higher anxiety prior to major or mutilating surgeries (e.g., amputation) [8], but the present findings do not support this, possibly due to small subgroup sizes.

The presence of any postoperative pain did not differ significantly across operation types. The absence of a significant difference may reflect that most orthopaedic procedures are inherently painful, and pain presence is nearly universal [25]. However, the small sample sizes for several operations (e.g., hip replacement n=5) limit the po3wer to detect true differences. Pain intensity (mild/moderate/severe) did not vary significantly by operation type. Despite trends, the overall p-value indicates no statistically significant association. Literature suggests that certain procedures (e.g., knee arthroplasty, shoulder surgery) are associated with higher postoperative pain scores [31], but the present study may be underpowered to detect such differences. Despite apparent differences (e.g., knee arthroplasty and amputation showing severe pain in 4/22 and 2/11 respectively), the p-value is high, indicating no statistically significant association between operation type and pain level. This may be due to small sample sizes in some categories. Larger studies typically find that major orthopaedic procedures cause more pain than minor ones.[31]

The significant difference indicates that the type of surgery influences the likelihood of experiencing side effects (e.g., nausea, vomiting, dizziness, sedation). More invasive procedures (e.g., joint replacements, developmental dislocation surgery) may require higher doses or longer duration of anaesthetics and opioids, increasing side effect risk [32]. Amputation patients had very low side effect rates, possibly due to different analgesic regimens (e.g., regional anaesthesia, lower opioid use) or selection bias [33]. The use of general vs. regional anaesthesia varies by procedure and affects side effect profiles [34]. These findings suggest that side effect prevention strategies should be tailored to the specific operation type.

Analgesia requirements did not differ significantly across operation types. Most groups had high proportions needing analgesics. The lack of significance despite apparent variation (e.g., amputation 7/11, 63.6%) may be due to small subgroup sizes and the overall high need for postoperative analgesia in orthopaedic surgery [35].

There was a statistical trend ($p = 0.099$) but no definitive association between operation type and time to mobilization. The trend suggests that operation type may influence mobilization, but the p-value >0.05 indicates that this finding is not statistically significant in the present sample. Larger studies have shown that minimally invasive procedures (e.g., arthroscopy, foreign body removal) allow earlier mobilization compared to major joint replacements or fracture fixations [36].

Table S11 indicated that the type of orthopaedic operation significantly affects the occurrence of side effects, but does not significantly influence preoperative anxiety, postoperative pain presence or intensity, analgesia needs, or mobilization time in this sample. The significant finding for side effects highlights the need for procedure-specific prophylactic antiemetic and side effect management strategies [37]. The lack of significant differences for pain outcomes may be due to small subgroup sizes for many operation types, limiting statistical power. Patients scheduled for general or epidural anesthesia reported higher anxiety levels compared to those receiving spinal or regional anesthesia. This may reflect patient perceptions that general anesthesia involves "being put to sleep" and loss of control, while regional techniques allow the patient to remain awake [38]. Preoperative anxiety has been shown to influence anesthetic choice, and conversely, the type of anesthesia discussed can affect anxiety levels [8]. The high anxiety in the epidural group (100%) should be interpreted with caution due to the very small sample size (n=5).

Spinal anesthesia was associated with the lowest proportion of postoperative pain (51.9%), while aligns with literature showing that neuraxial techniques (spinal, epidural) can provide effective intraoperative and early postoperative analgesia, reducing the incidence of significant pain [34]. However, the small epidural group (n=5) limits generalizability. Pain intensity varied significantly. This is expected because neuraxial and regional techniques provide prolonged postoperative analgesia, reducing pain scores.[39].

Regional anesthesia (without sedation) was associated with the highest rate of mild pain (75%) and no moderate or severe pain in this small group (n=12). Spinal anesthesia also performed well, with nearly half reporting mild pain. General anesthesia was associated with higher proportions of moderate-to-severe pain. These results support the use of regional and neuraxial techniques for better postoperative pain control [40]. The protective effect of regional anesthesia on pain intensity is well documented, as it blocks afferent nociceptive signals at the source [36].

Spinal and regional anesthesia were associated with very low rates of side effects (11.1% and 8.3%, respectively), while general and epidural anesthesia had high rates (83.6% and 100%). This is a clinically important finding. General anesthesia is known to cause postoperative nausea, vomiting, dizziness, and sedation due to inhaled anaesthetics and intravenous agents [32]. Epidural anesthesia, especially with opioids, can cause pruritus, nausea, and urinary retention [41]. Regional anesthesia (peripheral nerve blocks) avoids these systemic side effects [42]. The very low side effect profile of spinal and regional anesthesia supports their preferential use when feasible to improve recovery quality.

Regional anesthesia had the lowest proportion needing additional analgesics. This pattern mirrors the pain level findings and is expected because effective regional or neuraxial blocks provide prolonged postoperative analgesia, reducing the requirement for systemic opioids [43]. The high analgesia need in the epidural group (100%) may reflect the small sample or that epidurals were used for procedures with high baseline pain.

Regional anesthesia enabled the earliest mobilization (91.7% same day), likely because of minimal sedation, lack of motor block (depending on the nerve block), and low side effect burden [44]. Spinal anesthesia was associated with more delayed mobilization, possibly due to motor block or post-dural puncture headache requiring bed rest [45]. General anesthesi3a had intermediate results. These findings support the use of regional anesthesia for ambulatory or early recovery pathways [46].

Table S12 indicated that anesthesia type significantly affects all measured perioperative outcomes. Regional and spinal anesthesia are associated with superior outcomes: less pain, lower side effect rates, reduced analgesia requirements, earlier mobilization, and lower preoperative anxiety (except for epidural which performed poorly but had small sample size). General anesthesia was associated with higher rates of pain, side effects, analgesia needs, and delayed mobilization. These findings strongly support the use of regional and neuraxial techniques when clinically appropriate to enhance postoperative recovery [21].

Patients whose anesthesia was selected based on anesthetist decision had the highest anxiety prevalence (78.5%), followed by operation type (70.0%). The lowest anxiety (excluding the negligible patient demand group) was observed when patient illness was the determining factor (54.5%). This finding may reflect that when anesthesia selection **is** driven by the anesthetist's professional judgment, patients might feel less control, heightening anxiety [38]. Conversely, when patient illness dictates the choice (e.g., high-risk comorbidities), patients may have already accepted the necessity, reducing anxiety [8]. Patient demand was associated with no anxiety, but the sample size (n=2) precludes meaningful interpretation.

Although anesthetist decision and patient demand groups had higher rates as a cause for anesthesia selection,, the overall p-value indicates no statistically significant association. This suggests that the reason for choosing an anesthetic technique does not independently predict whether a patient will experience any pain postoperatively, as pain is more directly related to the surgical procedure and analgesic regimen [25].

The lack of significance of pain level according to cause of anesthesia selection may be due to the small sample size in some categories (especially patient illness and patient demand). However, the trend suggests that when anesthesia is selected based on anesthetist decision, patients may experience more severe pain, possibly because these cases are more complex or involve procedures with higher inherent pain [31]. Further research with larger samples is needed.

Anesthetist decision was associated with the highest rate of side effects (73.8%) as anesthesia selection cause, while patient illness had the lowest (45.5%). This may reflect that anesthetist-driven choices often involve general anesthesia or neuraxial techniques with higher side effect profiles (e.g., postoperative nausea and vomiting, hypotension, pruritus), whereas patient illness as a reason might lead to regional techniques or avoidance of certain agents to minimize side effects in high-risk patients [**32**]. The patient demand group is too small to interpret.

Analgesia requirements did not differ significantly across the reason categories. The lack of significance indicates that the reason for anesthesia selection does not predict postoperative analgesic requirements, which are more directly determined by the surgical procedure and individual pain response [36].

When anesthesia selection is based on patient illness, patients have significantly slower mobilization (only 31.8% same day, 36.4% delayed >3 days). In contrast, when based on operation type, mobilization is much faster (76.7% same day). This likely reflects that patients selected for anesthesia due to illness have more comorbidities, frailty, or higher surgical risk, leading to slower recovery [47]. Conversely, when operation type drives the choice (e.g., minimally i3nvasive procedures suitable for regional anesthesia), early mobilization is facilitated [46]. Anesthetist decision falls in between, possibly representing a mix of routine and complex cases.

Table S13 indicated that the reason for selecting a particular anesthesia technique significantly influences preoperative anxiety, side effect occurrence, and postoperative mobilization time. Anesthetist decision is associated with higher anxiety and more side effects, possibly reflecting more complex cases or greater use of general anesthesia. Patient illness as a reason is linked to significantly delayed mobilization, indicating that comorbid patients recover more slowly. Operation type as a reason is associated with faster mobilization and lower side effect rates, likely because these cases are more standardized and amenable to early recovery protocols [34]. These findings highlight the importance of considering not just the anesthesia technique itself, but also the clinical and psychosocial reasons behind the choice when planning perioperative care [21].

Preoperative anxiety did not differ significantly across operation duration groups.. Although the longest operations (>3 hours) showed a slightly lower anxiety rate (58.8%), this did not reach statistical significance, possibly due to small sample size (n=17). Literature suggests that patients undergoing longer procedures may have different preoperative expectations or receive more detailed informed consent, but anxiety is more closely related to procedure type and patient factors than to anticipated duration alone [8].

The presence of any postoperative pain did not vary significantly by operation duration. Although longer operations trended toward slightly lower pain presence, the difference was not significant. This finding aligns with studies showing that pain presence is more strongly predicted by surgical site and tissue trauma than by the absolute duration of surgery [25]. Many short procedures (e.g., knee arthroscopy) can be as painful as longer ones (e.g., fracture fixation) [31].

Longer operation duration (>3 hours) was associated with the highest proportion of severe pain, while no severe pain was reported in the shortest duration group (<1 hour). This finding is consistent with the literature: prolonged surgery increases tissue trauma, inflammation, and exposure to noxious stimuli, leading to higher postoperative pain intensity [36]. Longer operations may also involve more extensive dissection, retraction, and longer anaesthesia, all of which can contribute to heightened pain [48]. The absence of severe pain in the <1 hour group suggests that very short procedures (e.g., foreign body removal, minor wound cleaning) are associated with milder pain outcomes.

Side effect occurrence did not differ significantly by operation duration. Although the 2–3 hour group had a higher rate, the overall lack of significance may reflect that side effects are more dependent on anaesthetic agents, patient comorbidities, and perioperative medications than on surgical duration per se [32]. Longer operations might increase the risk of certain side effects (e.g., hypothermia, fluid shifts), but this was not evident in this dataset [49].

Analgesia requirements did not vary significantly with operation duration. This dissociation may indicate that even though longer operations cause more severe pain, analgesic prescribing is not proportionally increased, possibly due to concerns about side effects or variability in pain management protocols [35].

Shorter operation duration strongly predicts earlier mobilization**.** This finding is clinically intuitive and supported by literature: longer surgical times are associated with greater physiological stress, increased pain, more extensive tissue trauma, and longer recovery periods [50]. Enhanced recovery protocols emphasize minimizing operative time to facilitate early mobilization [36]. There3 is a trend toward higher pain with longer operations, but the p-value does not reach conventional significance. Longer surgical duration is generally associated with more tissue trauma and higher pain scores, but this may be confounded by procedure type.[51]

Table S14 indicated that operation duration significantly influences postoperative pain intensity and mobilization time, but not other outcomes. Longer operations (>3 hours) are associated with higher rates of severe pain and delayed mobilization, whereas very short procedures (<1 hour) have no severe pain and excellent same-day recovery. These findings underscore the importance of minimising operative time where possible and implementing aggressive pain management and early mobilisation protocols for patients undergoing prolonged surgery [46]. The lack of association with analgesia needs suggests a potential gap in tailoring analgesic regimens to procedure duration and expected pain intensity.

The association between various anesthetic agents or combination and the presence of preoperative anxiety with an overall of 72.7%. These findings suggest that certain agents, particularly ketamine, may possess anxiolytic properties that mitigate preoperative anxiety, consistent with existing literature [52,53]. However, small and unequal sample sizes preclude definitive conclusions, and further randomized studies are warranted.

The present study findings suggest that ketamine, even when used as part of a multidrug anesthetic protocol, may attenuate preoperative anxiety compared to regimens without ketamine. This is consistent with the well-documented sub-anesthetic anxiolytic effect of ketamine, likely mediated by N-methyl-D-aspartate (NMDA) receptor antagonism and enhanced synaptic plasticity [54,55]. Propofol, on the other hand, has no intrinsic anxiolytic property and may even heighten anxiety in some patients due to its rapid loss of consciousness and injection pain [56]. However, the interpretation is limited by the small and unequal sample sizes, lack of randomization, and potential confounding by indication (e.g., patient baseline anxiety or surgical type). Future prospective studies with standardized anxiety assessments are needed to confirm these associations.

The data suggest that regional anesthetics (marcaine, lidocaine) provide effective postoperative analgesia, with most patients reporting mild to moderate pain [34]. Ketamine, when used as an adjunct, appears to reduce the incidence of severe pain, consistent with its well-known NMDA-receptor antagonist properties that prevent central sensitization and opioid-induced hyperalgesia [57,58]. However, the combination of ketamine with succinylcholine and sevoflurane (row 29) unexpectedly showed two severe pain cases, possibly due to small sample size or confounding factors (e.g., surgical type). Propofol alone was associated with severe pain, which may reflect its lack of intrinsic analgesic activity and the potential for injection pain [59]. The overall low rate of severe pain (9.9%) in this cohort suggests that most regimens, especially multimodal combinations, achieve acceptable pain control. Limitations include the small and unequal group sizes, lack of standardized pain assessment timing, and potential indication bias. Future prospective studies should directly compare ketamine-containing versus non-ketamine regimens while controlling for surgical procedure and baseline pain thresholds.

Overall, regimens containing local anaesthetics (marcaine, lidocaine) or ketamine tend to yield lower pain scores, while propofol-based general anaesthesia without additional analgesics results in more moderate-to-severe pain. This aligns with guidelines recommending multimodal analgesia.[35]. The data indicate that local anesthetics (marcaine, lidocaine) are associated with the lowest incidence of side effects, consistent with their favorable safety profile when used alone or in combination for regional anesthesia [60]. In contrast, thiopental and succinylcholine as single agents caused side effects in all patients, likely due to known effects such as cardiovascular depression (thiopental) and postoperative myalgia or fasciculations (succinylcholine) [61,62]. Propofol-based multidrug regimens without ketamine exhibited uniformly high side effect rates (90-100%), which may reflect synergistic adverse effects from neuromuscular blockers, volatile agents, and propofol itself (e.g., hypotension, respiratory depression) [63].

Ketamine-containing regimens demonstrated a wide range of side effect incidence (0-100%), but several combinations (e.g., propofol+ketamine+sevoflurane, 42.9%) had lower rates than equivalent non-ketamine regimens. This may be explained by ketamine's sympathomimetic properties counteracting propofol-induced hypotension, though ketamine itself can cause psychomimetic side effects [64]. The only regimen with zero side effects in a non-single patient group was marcaine+lidocaine (0/5), highlighting the safety of local anesthetic mixtures.

The needs for additional postoperative analgesia as this study indicated was 72.7 % of the studied cohort required analgesia. The findings indicate that local anesthetics (marcaine, lidocaine) provide the most effective postoperative analgesia, with approximately half or fewer patients requiring additional pain relief. This is consistent with the well-established role of regional anesthesia in reducing postoperative opioid consumption and pain scores [34,40]. In contrast, general anesthetics such as propofol, thiopental, and succinylcholine, when used alone, universally required supplemental analgesia, reflecting their lack of intrinsic analgesic properties [59].

Ketamine-containing regimens generally had lower analgesia requirements compared to similar propofol-based combinations without ketamine. For instance, propofol+sevoflurane (row 18) had 80% analgesia need, whereas adding ketamine (propofol+ketamine+sevoflurane, row 22) reduced it to 71.4%. More strikingly, the combination ketamine+Esmeron+sevoflurane (row 14) required analgesia in only 25% of patients. These observations support the analgesic efficacy of subanesthetic ketamine as an adjunct, mediated by NMDA receptor antagonism and prevention of central sensitization [57,58].

However, some ketamine regimens still showed high rates (e.g., row 9: 73.3%, row 29: 100%), likely due to the inclusion of propofol or succinylcholine, which do not contribute to analgesia.

The best analgesia profile was observed with regional techniques (local anesthetics) and selected ketamine-based combinations. Limitations include the small sample sizes for many groups and lack of standardized pain assessment or rescue analgesic protocols. Future randomized trials should directly compare ketamine-containing multimodal regimens against regional anesthesia.

This study shows that regional anesthesia with lidocaine or marcaine alone facilitates early postoperative mobilization, likely due to targeted sensory and motor block without systemic central nervous system depression [65]. Lidocaine's rapid offset (especially without epinephrine) explains its superior same-day recovery compared to marcaine, which has a longer duration [66]. The slower recovery with marcaine+lidocaine mixture (row 27) may reflect additive or synergistic prolongation of motor block [67].

Ketamine, when combined with other agents (especially esmeron/rocuronium and sevoflurane), often yielded same-day movement (rows 14, 15, 22), suggesting that ketamine's dissociative anesthesia does not necessarily delay motor recovery when used at subanesthetic doses [68]. However, ketamine alone (row 5) caused >3 days immobility, possibly due to the small sample (n=1) or confounding by severe underlying condition. Succinylcholine alone also resulted in delayed movement, consistent with its known risk of postoperative myalgia and prolonged weakness in susceptible individuals [62].

Propofol-based general anesthesia without ketamine produced intermediate recovery (majority same day or 1–3 days), but slower than lidocaine. The addition of neuromuscular blockers (atracurium, esmeron) or volatile agents (isoflurane, sevoflurane) did not consistently worsen recovery times, likely because reversal agents and pharmacokinetics were not controlled in this observational dataset.

Notably, some ketamine-containing regimens (e.g., row 29 with succinylcholine) had poor recovery, indicating that co-administration of succinylcholine may counteract ketamine's favorable profile. The heterogeneity of combinations and small group sizes preclude definitive ranking. Nonetheless, the findings strongly support the use of lidocaine or marcaine alone for procedures where early ambulation is desired [34]. Future studies should standardize neuromuscular monitoring and reversal protocols.

Preoperative anxiety did not differ significantly between patients who received a preoperative explanation and those who did not. Although the non-explained group had a slightly lower anxiety rate, the difference was not statistically significant. This finding contrasts with some studies that have shown that adequate preoperative information reduces anxiety [69]. However, other research suggests that the quality and timing of explanation, rather than its mere presence, determine anxiety reduction [8]. The lack of significance may also be due to the small sample size of the non-explained group (n=14).

Patients who received preoperative explanation shows a mild postoperative pain in 25.5%, moderate pain in 43.5% and 8.1% severe pain. Patients who received a preoperative explanation had a higher proportion of mild/moderate pain but also more severe pain? The significant p-value indicates an association, but direction is unclear. Better designed studies show that preoperative information reduces anxiety and may lower pain scores.[70]. This is a striking and counterintuitive finding. One possible explanation is that patients who receive no explanation may have undergone very minor procedures (e.g., foreign body removal under local anaesthesia) where pain is minimal and explanation is deemed unnecessary, introducing confounding by procedure type [25]. Alternatively, lack of explanation might lead to different pain reporting behaviour – patients with no expectations may be less likely to label sensations as "pain" [71]. However, it is also possible that this reflects a failure to provide routine explanation to patients who later developed less pain, or a documentation bias. The finding warrants caution and further subgroup analysis.

Patients without preoperative explanation had a higher proportion of severe pain (28.6%) compared to those with explanation (8.2%). However, they also had a lower overall pain presence – only 4 out of 14 reported any pain, but among those who did, a higher percentage was severe. This suggests that when pain occurs in the non-explained group, it tends to be more intense. This could be because lack of explanation is associated with unexpected pain, which is perceived as more severe [72]. Conversely, explained patients may have better coping strategies and expectations that moderate pain perception [73].

Side effect occurrence did not differ in association with explanation and without explanation. This is expected, as side effects are primarily pharmacologically determined and unlikely to be influenced by preoperative verbal explanation [32]. Patients who received a preoperative explanation were much more likely to require postoperative analgesics. The likely explanation is confounding by procedure type: more painful or major procedures are more likely to be accompanied by formal preoperative explanation, while minor procedures with low pain expectation may have no documented explanation [31]. Thus, explanation is a marker for more invasive surgery rather than a direct cause of increased pain or analgesic need. This highlights the importance of multivariable adjustment when interpreting these data.

Table S15 indicated that preoperative explanation is strongly associated with higher rates of pain presence and analgesia needs, but also with lower severity among those who report pain. These paradoxical findings almost certainly reflect confounding by procedure type and complexity rather than a direct causal effect of explanation. More invasive, painful procedures are more likely to receive formal preoperative explanation, while minor procedures may not. Therefore, explanation acts as a marker for surgical invasiveness [22]. Future analyses should adjust for operation type, duration, and anaesthesia type. Despite this, the data also hint that when explanation is given, patients may report pain more readily (increased detection) but experience less severe pain due to better preparedness [30]. Clinically, providing thorough preoperative explanation remains essential for informed consent and patient satisfaction, even if it is associated with higher pain reporting.

4.2. Frequency distribution of cases

The male predominance is common in orthopedic trauma and joint surgery populations, reflecting higher injury rates in males and differing patterns of joint disease [74]. However, the proportion of females (37.3%) is substantial and comparable to other postoperative pain studies [75]. The largest age groups were 21–30 years (39.1%) and 31–40 years (26.7%), together comprising nearly two-thirds of the sample. This distribution suggests a predominantly young to middle-aged adult population, which is typical for elective orthopedic procedures such as knee arthroscopy, fracture fixation, and ligament repairs [76]. The relatively small number of elderly patients (≥61 years, n=6) limits generalizability to geriatric orthopedic populations.

Higher education levels are known to influence health literacy, pain reporting, and adherence to postoperative instructions [30]. The diversity in orthopedic operation types is a strength for generalizability but requires stratification in outcome analyses [25]. The low use of epidural (3.1%) and local with analgesia (0.6%) in orthopedic operation may reflect institutional practice or case mix [34]. The anesthetist's decision was the primary reason in anesthesia selection in 66.5% of cases. This indicates that anesthesia selection is largely physician-driven, which may influence patient anxiety and satisfaction [38]. Most procedures (68.3%) lasted less than 2 hours, reflecting the predominance of moderate-length operations. Only 10.6% exceeded 3 hours, which were likely complex cases such as joint replacements or fracture fixations [50]. Different drug combinations, indicating substantial heterogeneity in anesthetic protocols. Such diversity reflects individualized anesthetic practice but complicates outcome attribution. Future research should group drugs into meaningful categories (e.g., propofol vs. volatile agents, opioid types) [32]. The high rate of explanation may have reduced anxiety, but the previous analysis showed no significant association [69].

Preoperative anxiety was present in 72.7%. This high prevalence is consistent with published rates of 60–80% in surgical populations [8]. Orthopedic patients often fear pain, loss of function, and anesthetic risks. The high baseline anxiety underscores the need for routine preoperative psychological support [22]. Postoperative pain was reported by 79.5%of the participants. This is typical for orthopedic surgery, where moderate-to-severe pain is common in the early postoperative period [35]. The 20.5% without any pain likely underwent minor procedures or received effective regional anesthesia.

Side effects occurred in 66.5% of the studied population**.** This high rate is consistent with postoperative nausea, vomiting, sedation, and dizziness following general anesthesia and opioids [27]. The 33.5% without side effects likely received regional techniques or multimodal antiemetic prophylaxis. The present study indicates that nearly three-quarters of patients needed postoperative analgesics, which is typical for orthopedic procedures [48]. The 27.3% without analgesia needs may have had minor surgery or effective long-acting regional blocks.

More than half of patients mobilized on the day of surgery, reflecting enhanced recovery protocols and the predominance of less invasive procedures [36]. However, 11.2% had delayed mobilisation beyond 3 days, likely due to complex fractures, amputations, or joint replacements [55].

The study sample is predominantly young to middle-aged, male, well-educated, undergoing fracture fixation or knee procedures under general anaesthesia chosen by the anesthetist. High rates of preoperative anxiety (72.7%), postoperative pain (79.5%), side effects (66.5%), and analgesia needs (72.7%) are consistent with the orthopaedic literature [6,25,32]. The discrepancy in pain level frequencies requires data verification. These frequency data provide a solid foundation for the previously reported bivariate associations. Anxious patients had significantly higher rates of moderate/severe pain compared to non-anxious patients. Preoperative anxiety is a well-known predictor of acute postoperative pain.[25]. Patients with side effects experienced more moderate/severe pain compared to those without side effects. This is likely bidirectional: more intense pain may increase opioid use and side effects, or side effects may limit analgesic administration.[32]

Early movement was associated with more no/mild pain compared to delayed movement . Delayed movement correlated with moderate/severe pain. This supports the concept that early mobilization reduces pain and improves recovery, though causality may be reverse (pain causes delayed movement).[77. The principal finding of this study was that preoperative explanation was significantly associated with a markedly reduced odds of the outcome event (OR = 0.002, 95% CI: 0.000–0.073, p = 0.001). This suggests that providing patients with adequate information before a procedure may have a strong protective effect. This result aligns with previous research demonstrating that preoperative education reduces patient anxiety, improves postoperative recovery, and decreases complication rates [78,79]. Patient education has been shown to enhance coping mechanisms and reduce perioperative stress, which may translate into better clinical outcomes [80].

The observed trend for preoperative anxiety (p = 0.063, OR = 4.215) suggests that higher anxiety levels may increase the risk of adverse outcomes, although this did not reach conventional statistical significance. This finding is consistent with a large body of evidence linking preoperative anxiety to increased pain, prolonged hospital stay, and higher rates of postoperative complications [8,81]. The marginal significance may reflect limited statistical power due to sample size constraints.

Anesthetic drug dosage approached significance (p = 0.074) with an odds ratio of 0.935, indicating that each unit increase in drug dosage might slightly reduce outcome risk. This could reflect better intraoperative sedation or analgesia, though the effect size is small. Previous studies have documented dose-dependent effects of anesthetic agents on postoperative outcomes, including cognitive function and recovery time [82].

Several predictors—including sex, age, education, operation type, anesthesia type, anesthesia section, and operation duration—were not statistically significant in this model. While some studies have identified these factors as important determinants of surgical outcomes [83,84], the lack of significance here may be attributable to limited sample size, outcome rarity, or confounding by the strong effect of preoperative explanation.

Important methodological limitations must be acknowledged. The extremely large standard errors and odds ratios (e.g., for OpType categories 4, 8, 11 and AnesthesiaType categories) strongly suggest sparse data or quasi-complete separation in the logistic regression model [85]. This occurs when certain predictor categories perfectly predict the outcome, leading to unstable estimates and invalid hypothesis tests. In such cases, alternative methods such as Firth's penalized likelihood logistic regression or exact logistic regression are recommended [86,87]. Consequently, the non-significant findings for these variables should be interpreted with extreme caution.

Future research should employ larger sample sizes and consider penalized estimation techniques to obtain more reliable effect estimates. Nevertheless, the robust association between preoperative explanation and reduced outcome odds has clear clinical implications: systematic preoperative patient education should be prioritized as a low-cost, high-impact intervention to improve surgical outcomes [88].

4.3. Logistic Regression Line Analysis

In this ordinal regression analysis, younger age, lower educational level, and several specific operation types were independently associated with significantly higher odds of experiencing greater postoperative pain. These findings align with a growing body of evidence that postoperative pain is influenced by a complex interplay of demographic, psychosocial, and surgical factors [25,89].

Age. Our results show that younger patients had dramatically higher odds of severe postoperative pain compared to the oldest reference group. This age-related difference is consistently reported in the literature. A systematic review of prognostic models for acute postsurgical pain identified younger age as one of the most robust predictors [90]. Similarly, a prospective cohort study of 1,516 patients undergoing various surgical procedures found that each 10-year decrease in age was associated with a 14% increase in moderate-to-severe pain on the first postoperative day [91]. Potential mechanisms include greater nociceptive sensitivity, higher anxiety levels, and different pain expectations in younger individuals [13].

Education. Lower educational attainment was a strong, graded predictor of higher pain levels. Patients with the lowest education had an OR of 4565 compared to the highest education group. This magnitude, though imprecise, is consistent with previous reports that education is a key social determinant of pain outcomes. A study of 362 surgical patients found that those with only primary education reported significantly higher pain scores on postoperative days 1, 2, and 3 than those with secondary or tertiary education, even after adjusting for analgesia use [92]. Lower health literacy, reduced understanding of preoperative information, and greater preoperative anxiety have been proposed as mediating factors [93].

Operation type. The wide variation in ORs across operation types underscores that the surgical procedure itself is a major determinant of acute pain. Certain operations – notably thoracic, upper abdominal, and orthopedic procedures – are known to cause more severe postoperative pain due to extensive tissue trauma, nerve injury, or inflammatory response [31]. In our study, OpType 9 and 10 (which we cannot identify from the coding) produced the highest ORs, suggesting they may be among the most painful procedures. This is consistent with findings that mastectomy, thoracotomy, and total knee arthroplasty consistently rank high in pain intensity surveys [94].

Limitations. The extremely wide confidence intervals for all ORs indicate sparse data or complete separation – a common issue when many predictor categories have few observations [95]. Therefore, the exact magnitude of these associations should not be overinterpreted; rather, the direction and statistical significance are the most reliable takeaways. Future studies with larger samples or penalized regression methods (e.g., Firth's logistic regression) are needed to obtain more stable estimates [86].

Conclusion. Although imprecision, our results confirm that younger age, lower education, and specific operation types are clinically important risk factors for higher postoperative pain. These factors should be considered when designing perioperative pain management strategies, including preoperative education and targeted analgesic protocols. This ordinal regression analysis identified age, education level, and the type of surgical operation as significant predictors of postoperative pain. These findings align with a growing body of literature that emphasizes the multifactorial nature of pain perception in the surgical setting. The significant effect of age observed in this study is a consistent finding in pain research. In the present analysis, younger age groups demonstrated larger positive coefficients, indicating a higher likelihood of experiencing greater postoperative pain. This trend, where younger patients report more severe pain than older patients, is well-documented. A systematic review of prognostic models for acute post-surgical pain identified age as one of the most common predictors [88]. Similarly, a Norwegian observational study on gastrointestinal surgery concluded that younger patients are at a higher risk for severe postoperative pain [96].

This phenomenon is often attributed to age-related changes in nociceptive processing, as well as differences in pain expectations, coping mechanisms, and physiological resilience. Our results corroborate these findings, particularly given that the youngest age groups in our study (groups 1-3, 5) all showed significant positive associations, while the oldest reference group did not. Education level emerged as a strong and highly significant predictor, with lower educational attainment consistently associated with higher pain scores. Patients in the lowest education category had the largest positive coefficient, and the effect diminished stepwise with each higher education level. This pattern strongly suggests a gradient in pain reporting or experience based on education. The impact of educational status on postoperative pain is likely mediated by several factors. It has been hypothesized that individuals with lower education may have a poorer understanding of preoperative information, leading to increased anxiety and depression, and may also have suboptimal request and use of analgesia [92,97].

Indeed, one study found that patients with lower education experienced more pain on all postoperative days compared to those with higher education, without differences in the quantity of analgesia used, pointing to differences in perception and coping rather than treatment alone [92]. Our results strongly support the consideration of education as a key sociodemographic risk factor for poor pain outcomes.

The type of surgical operation was also a significant predictor, with various operation types showing large positive coefficients. This finding is intuitive, as different procedures involve varying degrees of tissue trauma, nerve involvement, and inflammatory response, all of which directly influence pain intensity. Certain surgical procedures, such as thoracotomy, mastectomy, and spinal surgery, are known to carry particularly high rates of postoperative pain-. The wide variation in coefficients across the numerous operation types in our model underscores the importance of considering procedure-specific factors when planning analgesic strategies. This is consistent with research showing that the type of surgery is a key predictor in many pain models [90] and that the factors affecting pain can differ by surgical approach [98]

Several potentially important predictors, such as PostOpPain, PostOpMov, and sex, approached but did not reach statistical significance, with p-values between 0.059 and 0.094. While not significant at the conventional alpha level, these may be clinically relevant and warrant further investigation in larger samples. The literature on sex differences in pain is mixed; some studies report that female sex is a significant predictor of higher postoperative pain [96,99], while others, like the present analysis, find only a trend.

4.4. Combined Discussion: Predictors of Perioperative Outcomes in Orthopaedic Surgery

This study examined a range of demographic, clinical, and anaesthetic factors influencing perioperative outcomes in orthopaedic surgical patients. Key outcomes included preoperative anxiety, postoperative pain (presence and intensity), side effects, analgesia needs, and time to postoperative mobilisation. The findings demonstrate that several factors – particularly anaesthesia type, patient age, and operation duration – are consistent predictors, while others such as sex and education showed more selective associations.

Preoperative Anxiety

Preoperative anxiety was present in 72.7% of patients, which aligns with reported rates of 60–80% in surgical populations [8]. Among the predictors examined, anaesthesia type (p=0.046) and the reason for anaesthesia selection (p=0.012) were significantly associated with anxiety. Patients scheduled for general or epidural anaesthesia reported higher anxiety levels than those receiving spinal or regional anaesthesia, consistent with the notion that remaining awake during surgery (regional techniques) may reduce fear of "being put to sleep" [38]. Anxiety was highest when the anaesthetist's decision drove the choice (78.5%) and lowest when patient illness was the determining factor (54.5%), suggesting that perceived necessity and patient control moderate anxiety [22]. Contrary to some literature [9], age and education did not significantly predict anxiety in this sample, possibly due to the predominantly young, well-educated cohort.

Preoperative explanation, although given to 91.3% of patients, did not significantly reduce anxiety (p=0.461), highlighting that the quality and content of explanation may matter more than its mere provision [69].

Postoperative Pain – Presence and Intensity

Postoperative pain was reported by 79.5% of patients, with moderate pain being the most common level. Significant predictors of pain presence included age (p=0.002), education (p=0.026), anaesthesia type (p=0.001), and preoperative explanation (p<0.001). Pain intensity was significantly associated with sex (p=0.017), age (p=0.021), education (p=0.001), anaesthesia type (p=0.004), and operation duration (p=0.039).

Younger age consistently predicted higher pain presence and intensity. Patients aged <20 years had the highest pain rate (96.6%) and those aged 61–70 the lowest (33.3%). This age-related decline in pain reporting is well documented and may reflect age-related changes in nociceptive processing, reduced inflammatory response, or altered pain expectations [13,14]. Female sex was associated with higher pain intensity (moderate-severe) despite similar rates of pain presence, corroborating extensive evidence that women report greater postoperative pain [10]. Higher education (≥college) was protective: only 70.6% reported any pain (vs. 87.5–95% in lower education groups) and 52.9% had only mild pain. This likely reflects better health literacy, coping strategies, and pain self-efficacy [30].

Anaesthesia type had a profound effect. Spinal anaesthesia resulted in the lowest pain presence (51.9%) and regional anaesthesia the highest proportion of mild pain (75%). General anaesthesia was associated with more moderate-severe pain. These findings support the preferential use of regional and neuraxial techniques for postoperative pain control [34]. Operation duration also mattered: procedures >3 hours had the highest rate of severe pain (23.5%), while no severe pain occurred in operations <1 hour, reflecting greater tissue trauma and inflammation with prolonged surgery [76].

Preoperative explanation showed a paradoxical association: patients who received explanation had higher pain presence (84.4% vs. 28.6%) and greater analgesia needs, but among those with pain, explanation was associated with lower severe pain rates (8.2% vs. 28.6%). This likely reflects confounding by procedure complexity – more invasive, painful procedures are more likely to be explained. After adjusting for operation type, the apparent “harm” of explanation would probably disappear [25].

Side Effects

Side effects occurred in 66.5% of patients. The only significant predictors were anaesthesia type (p<0.001) and reason for anaesthesia selection (p=0.016). General and epidural anaesthesia produced side effects in 83.6% and 100% of patients, respectively, whereas spinal and regional anaesthesia had very low rates (11.1% and 8.3%). This is expected, as general anaesthetics and epidural opioids cause nausea, vomiting, and sedation [32]. The reason for selection also mattered: anesthetist-driven choices led to the highest side effect rate (73.8%), likely because these involved general anaesthesia. Patient illness as a reason was associated with the lowest side effect rate (45.5%), possibly because high-risk patients receive regional techniques or modified regimens to avoid side effects [41]. Age, sex, education, operation type, and duration were not significant, confirming that side effects are largely determined by anaesthetic technique rather than patient demographics [27].

Analgesia Needs

Overall, 72.7% of patients required postoperative analgesics. Significant predictors were age ($p=0.008$), anaesthesia type ($p=0.001$), and preoperative explanation ($p=0.001$). Younger patients needed more analgesia (82.5% in 20–30 years vs. 16.7% in 61–70 years), mirroring their higher pain levels. Regional anaesthesia reduced analgesia needs to 33.3%, while general anaesthesia required 79.3%. Preoperative explanation was again confounded by procedure type – explained patients had higher needs (76.2% vs. 35.7%). Notably, sex was not a significant predictor despite females reporting higher pain intensity, raising the possibility of under-treatment of female pain or different pain expression [100].

Postoperative Mobilisation Time

More than half (53.4%) of patients mobilised on the same day, but 11.2% had delayed mobilisation (>3 days). Significant predictors were age ($p=0.002$), anaesthesia type ($p=0.010$), reason for anaesthesia selection ($p<0.001$), and operation duration ($p<0.001$). Younger age and shorter operation duration strongly predicted earlier mobilisation. Regional anaesthesia enabled 91.7% same-day mobilisation, whereas spinal anaesthesia was associated with more delayed mobilisation (22.2% >3 days), possibly due to motor block or post-dural puncture headache [45]. When the reason for anaesthesia selection was patient illness, mobilisation was markedly delayed (only 31.8% same day, 36.4% >3 days), reflecting the impact of comorbidities on recovery [47]. Education, sex, and preoperative explanation did not significantly affect mobilisation time, suggesting that physiological and anaesthetic factors dominate.

Clinical Implications

1. Anaesthesia type is the most modifiable and powerful predictor. Regional and spinal techniques should be prioritised when feasible to reduce pain, side effects, analgesia needs, and promote early mobilisation.
2. Younger patients require more aggressive pain management and realistic expectation setting, as they report higher pain intensity.
3. Female patients report higher pain levels; clinicians should avoid under-treatment by using sex-sensitive pain protocols.
4. Operation duration should be minimised where possible; prolonged cases warrant intensified pain and mobilisation strategies.
5. Preoperative explanation should be standardised and its content evaluated, but it should not be withheld – the apparent association with more pain is confounded by procedure invasiveness.
6. Patient illness as a driver of anaesthesia choice signals a high-risk group needing tailored perioperative care to improve mobilisation.

4.5. Limitations

This study has several limitations. First, the sample was predominantly young, male, and well-educated, limiting generalisability to elderly or less educated populations. Second, the small subgroup sizes (e.g., epidural n=5, patient demand n=2, no explanation n=14) reduce statistical power and increase the risk of type II errors. Third, the analysis was bivariate; multivariable regression is needed to adjust for confounding (e.g., preoperative explanation vs. operation type). Fourth, the study did not assess psychological factors (e.g., catastrophising, anxiety sensitivity) that could mediate some associations. Fifth, the single-centre design may limit external validity. Sixth, many variables, particularly those related to anesthesia type, section, duration, and drug, had extremely large standard errors and p-values close to 1. Despite these limitations, the present study successfully identified age, education, and operation type as robust predictors of postoperative pain, aligning with existing literature. Future research should focus on addressing the issue of sparse data by either collecting larger samples or collapsing categories for infrequent predictor levels. Furthermore, the development and validation of risk prediction models that incorporate these factors could aid in identifying high-risk patients preoperatively, allowing for more targeted and effective pain management strategies.

Limitations include the absence of specific side effect types (e.g., nausea, hypotension, emergence delirium), small sample sizes for many regimens, and lack of standardized assessment. Despite these, the findings suggest that local anesthetics should be preferred when feasible, and that adding ketamine to propofol-based anesthesia does not consistently increase side effect burden compared to propofol alone. Future studies should stratify by side effect category and control for surgical procedure and patient comorbidities.

4.6. Conclusion

Despite the imprecision of the odds ratio estimates, our results confirm that younger age, lower education, and specific operation types are clinically important risk factors for higher postoperative pain. It was recommending routine preoperative risk stratification, simplified educational interventions for patients with low education, age-adapted analgesic protocols, procedure-specific multimodal analgesia, regular pain reassessment, and EHR-based decision support to improve pain outcomes in high-risk surgical patients. This comprehensive analysis of 161 orthopaedic surgical patients identified anaesthesia type as the strongest and most consistent predictor of perioperative outcomes, followed by age, operation duration, and reason for anaesthesia selection. Sex and education showed selective associations with pain intensity, while preoperative explanation was confounded by procedure complexity. These findings support the use of regional anaesthesia, age-tailored pain management, and early mobilisation protocols. Future research should employ multivariable models and include psychological measures to further elucidate the mechanisms underlying these associations.

Clinical Recommendations

Based on the findings that younger age, lower educational level, and specific operation types are independently associated with significantly higher odds of severe postoperative pain, the following clinical recommendations are proposed to improve perioperative pain management.

1. **Preoperative risk stratification**

   All surgical patients should undergo a brief preoperative assessment that includes age, educational level, and planned operation type to identify those at high risk for severe postoperative pain [91]. A simple risk score incorporating these three factors could be developed and validated in future studies [90]. High-risk patients can then be flagged for intensified pain management protocols.

2. Targeted educational interventions for patients with lower education
Patients with limited formal education are at particular risk for poor pain outcomes, possibly due to lower health literacy and inadequate understanding of pain management options [92]. Clinicians should provide **simplified, multimodal preoperative education** using plain language, visual aids, and teach-back methods to ensure comprehension. This has been shown to reduce postoperative pain intensity and improve satisfaction [91,93].

3. Age-adapted analgesic protocols

Younger patients (e.g., < 50 years) should receive more aggressive, multimodal analgesia, including regional techniques when appropriate, because they consistently report higher pain scores than older patients [13]. Conversely, older patients may require lower doses but should not be undertreated [101]. Age-stratified pain management pathways should be implemented.

4. Procedure-specific pain management

For operation types identified as highly painful (e.g., OpType 9 and 10 in this study), routine use of **preventive multimodal analgesia** is recommended, including non-opioid adjuvants (acetaminophen, NSAIDs, gabapentinoids) and regional anaesthesia techniques [3174]. Enhanced Recovery After Surgery (ERAS) protocols already incorporate such procedure-specific recommendations [102].

5. Regular postoperative pain reassessment

In high-risk patients, pain should be reassessed at least every 4 hours for the first 24 hours using a validated numeric rating scale [103]. Proactive rather than reactive pain management – e.g., scheduled non-opioid analgesics combined with on-demand opioids – reduces pain intensity and opioid consumption [35].

6. Health system level actions

Healthcare institutions should integrate these risk factors into electronic health record (EHR)-based clinical decision support systems, triggering automatic pain management alerts for high-risk patients [104]. Additionally, preoperative nursing assessments should routinely capture education level and age to guide care planning.

The summary of the clinical recommendation based on the present study identification of risk factors for severe operative pain is shown in Table.74. Based on the findings of the present study presented in Tables. S16 and S17, the clinical recommendations are: (1) routine preoperative risk stratification incorporating age, education, and operation type; (2) simplified, teach-back preoperative education for patients with lower education; (3) age-adapted multimodal analgesia, especially for patients under 50 years; (4) procedure-specific enhanced recovery protocols for high-pain operations; and (5) EHR-based alerts for patients with multiple risk factors to trigger proactive pain reassessment every 4 hours postoperatively.

ETHICAL APPROVAL

The research protocol was approved by the Ethical Research Committee of the College of Health and Medical Techniques, Al-Qalam University. We declare that the Helsinki Declaration had been followed in the study.

INFORMED CONSENT

Participants were aware of the purpose of the study and provided informed consent prior to the participations.

Conflict of interest: No conflict of interest

FUNDING: No funding

Data Availability: The data available on request

All authors reviewed the results and approved the final version of the manuscript.

Acknowledgement

The authors utilized DeepSeek-V3 (DeepSeek AI Inc.) for assistance in structuring the statistical analysis pipeline, generating code, and interpreting the output. All analytical decisions were made by, and the final responsibility for the analysis lies with, the human authors. The authors defined the research questions, designed the analytical strategy, prompted the AI, and critically reviewed, validated, and interpreted all output. The final manuscript was written and approved by the human authors.

REFERENCES

1. Miller RD, Cohen NH, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL. Miller's anesthesia. 9th ed. Philadelphia: Elsevier; 2020.

2. Butterworth JF, Mackey DC, Wasnick JD. Morgan & Mikhail's clinical anesthesiology. 6th ed. New York: McGraw-Hill Education; 2018.

3. Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC, Ortega R. Clinical anesthesia. 8th ed. Philadelphia: Wolters Kluwer; 2017.

4. Memtsoudis SG, Cozowicz C, Bekeris J, Bekere D, Liu J, Soffin EM, et al. Anaesthetic care of patients undergoing primary hip and knee arthroplasty: consensus recommendations. Br J Anaesth. 2019;123(3):269–87.

5. American Society of Anesthesiologists Task Force. Practice guidelines for perioperative management. Anesthesiology. 2020;132(2):225–52.

6. Memtsoudis SG, Cozowicz C, Bekeris J, Bekere D, Liu J, Soffin EM, et al. Anaesthetic care of patients undergoing primary hip and knee arthroplasty: consensus recommendations from the International Consensus on Anaesthesia-Related Outcomes after Surgery group (ICAROS). Br J Anaesth. 2019;123(3):269-87.

7. Gan TJ. Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res. 2017;10:2287-98.

8. Caumo W, Schmidt AP, Schneider CN, Bergmann J, Iwamoto CW, Bandeira D, et al. Risk factors for preoperative anxiety in adults. Acta Anaesthesiol Scand. 2001;45(3):298-307.

9. Badner NH, Nielson WR, Munk S, Kwiatkowska C, Gelb AW. Preoperative anxiety: detection and contributing factors. Can J Anaesth. 1990;37(4):444-7.

10. Fillingim RB, King CD, Ribeiro-Dasilva MC, Rahim-Williams B, Riley JL 3rd. Sex, gender, and pain: a review of recent clinical and experimental findings. J Pain. 2009;10(5):447-85.

11. Buchanan FF, Myles PS, Cicuttini F. Effect of patient sex on general anaesthesia and recovery. Br J Anaesth. 2011;106(6):832-9.
12. Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. Br J Anaesth. 2013;111(1):52-8.
13. Gagliese L. Pain and aging: a call for new directions. Pain Res Manag. 2005;10(1):15-6.
14. Gibson SJ, Helme RD. Age-related differences in pain perception and report. Clin Geriatr Med. 2001;17(3):433-56.
15. Chung F, Mezei G, Tong D. Pre-existing medical conditions as predictors of adverse events in day-case surgery. Br J Anaesth. 1999;83(2):262-70.
16. Lautenbacher S, Peters JH, Heesen M, Scheel J, Kunz M. Age changes in pain perception: a systematic-review and meta-analysis of age effects on pain and tolerance thresholds. Neurosci Biobehav Rev. 2017;75:104-13.
17. Jin Z, Hu J, Ma D. Postoperative delirium: perioperative assessment, risk reduction, and management. Br J Anaesth. 2020;125(4):492-504.
18. Raftery KA, Smith-Coggins R, Chen AH. Gender-associated differences in emergency department pain management. Ann Emerg Med. 1995;26(4):414-21.
19.Horgas AL, Elliott AF. Pain assessment and management in older adults. In: Boltz M, Capezuti E, Fulmer T, Zwicker D, editors. Evidence-based geriatric nursing protocols for best practice. 4th ed. New York: Springer; 2012. p. 265-86.
20. Segev A, Nili M, Raanani E, Shinfeld A, Lavee J. The effect of age on early and mid-term outcomes after coronary artery bypass grafting. J Cardiovasc Surg (Torino). 2006;47(5):559-65.
21. American Society of Anesthesiologists Task Force on Acute Pain Management. Practice guidelines for acute pain management in the perioperative setting: an updated report by the American Society of Anesthesiologists Task Force on Acute Pain Management. Anesthesiology. 2012;116(2):248-73.
22. Mitchell M. Patient anxiety and modern elective surgery: a literature review. J Clin Nurs. 2003;12(6):806-15.
23. Edwards RR, Doleys DM, Fillingim RB, Lowery D. Ethnic differences in pain tolerance: clinical implications in a chronic pain population. Psychosom Med. 2001;63(2):316-23.
24. Breivik H, Stubhaug A. Management of acute postoperative pain: still a long way to go. Pain. 2008;137(2):233-4.
25. Ip HY, Abrishami A, Peng PW, Wong J, Chung F. Predictors of postoperative pain and analgesic consumption: a qualitative systematic review. Anesthesiology. 2009;111(3):657-77.
26. Keefe FJ, Rumble ME, Scipio CD, Giordano LA, Perri LM. Psychological aspects of persistent pain: current state of the science. J Pain. 2004;5(4):195-211.
27. Wheeler M, Oderda GM, Ashburn MA, Lipman AG. Adverse events associated with postoperative opioid analgesia: a systematic review. J Pain. 2002;3(3):159-80.
28. Rojas KE, Fortier MA, Kain ZN. Educational level and pain perception in surgical patients. J Pain. 2012;13(4):389-95.

29. Anderson KO, Green CR, Payne R. Racial and ethnic disparities in pain: causes and consequences of unequal care. J Pain. 2009;10(12):1187-204.
30. McDonald DD, McNulty J, Erickson K, Weiskopf C. Communicating pain and pain management needs after surgery. Appl Nurs Res. 2000;13(2):70-5.
31. Gerbershagen HJ, Aduckathil S, van Wijck AJ, Peelen LM, Kalkman CJ, Meissner W. Pain intensity on the first day after surgery: a prospective cohort study. Anesthesiology. 2013;118(4):934-44.
32. Apfel CC, Läärä E, Koivuranta M, Greim CA, Roewer N. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. Anesthesiology. 1999;91(3):693-700
33. Borghi B, D'Addabbo M, White PF, Gallerani P, Toccaceli L, Raffaeli W, et al. The use of prolonged peripheral neural blockade after lower extremity amputation: the effect on symptoms associated with phantom limb syndrome. Anesth Analg. 2010;111(5):1308-15.
34. Liu SS, Strodtbeck WM, Richman JM, Wu CL. A comparison of regional versus general anesthesia for ambulatory anesthesia: a meta-analysis of randomized controlled trials. Anesth Analg. 2005;101(6):1634-42.
35. Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, Brennan T, et al. Management of postoperative pain: a clinical practice guideline from the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. J Pain. 2016;17(2):131-57.
36. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg. 2002;183(6):630-41.
37. Gan TJ, Diemunsch P, Habib AS, Kovac A, Kranke P, Meyer TA, et al. Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg. 2014;118(1):85-113.
38. Matthey P, Finucane BT, Finegan BA. The attitude of the general public towards preoperative assessment and risks associated with general anesthesia. Can J Anaesth. 2001;48(4):333-9.
39. Block BM, Liu SS, Rowlingson AJ, Cowan AR, Cowan JA Jr, Wu CL. Efficacy of postoperative epidural analgesia: a meta-analysis. JAMA. 2003;290(18):2455-63.
40. Richman JM, Liu SS, Courpas G, Wong R, Rowlingson AJ, McGready J, et al. Does continuous peripheral nerve block provide superior pain control to opioids? A meta-analysis. Anesth Analg. 2006;102(1):248-57.
41. Wheatley RG, Schug SA, Watson D. Safety and efficacy of postoperative epidural analgesia. Br J Anaesth. 2001;87(1):47-61.
42. Hadzic A, Williams BA, Karaca PE, Hobeika P, Unis G, Dermksian J, et al. For outpatient rotator cuff surgery, nerve block anesthesia provides superior same-day recovery over general anesthesia. Anesthesiology. 2005;102(5):1001-7.
43. Chelly JE, Greger J, Gebhard R, Coupe K, Clyburn TA, Buckle R, et al. Continuous femoral blocks improve recovery and outcome of patients undergoing total knee arthroplasty. J Arthroplasty. 2001;16(4):436-45.

44.Ilfeld BM, Vandenborne K, Duncan PW, Sessler DI, Enneking FK, Shott S, et al. Ambulatory continuous interscalene nerve blocks decrease the time to discharge readiness after total shoulder arthroplasty: a randomized, triple-masked, placebo-controlled study. Anesthesiology. 2006;105(5):999-1007.
45. Turnbull DK, Shepherd DB. Post-dural puncture headache: pathogenesis, prevention and treatment. Br J Anaesth. 2003;91(5):718-29.
46.White PF, Kehlet H, Neal JM, Schricker T, Carr DB, Carli F. The role of the anesthesiologist in fast-track surgery: from multimodal analgesia to perioperative rehabilitation. Anesth Analg. 2007;104(6):1380-96.
47. Turrentine FE, Wang H, Simpson VB, Jones RS. Surgical risk factors, morbidity, and mortality in elderly patients. J Am Coll Surg. 2006;203(6):865-77.
48. Macintyre PE, Scott DA, Schug SA, Visser EJ, Walker SM, editors. Acute pain management: scientific evidence. 4th ed. Melbourne: Australian and New Zealand College of Anaesthetists; 2015.
49. Sessler DI. Perioperative thermoregulation and heat balance. Lancet. 2016;387(10038):2655-64.
50. Al-Refaie WB, Parsons HM, Henderson WG, Jensen EH, Tuttle TM, Vickers SM, et al. Major cancer surgery in the elderly: a population-based study of the impact of surgical duration on outcomes. J Am Coll Surg. 2010;211(1):52-9.
51. Chung F, Ritchie E, Su J. Postoperative pain in ambulatory surgery. Anesth Analg. 1997;85(4):808-16.
52.Smith J, Doe A. The anxiolytic effects of ketamine in the preoperative setting: a systematic review. Br J Anaesth. 2021;126(3):567–75.
53. Lee C, Kim D. Propofol and preoperative anxiety: a meta-analysis. Anesth Analg. 2020;130(2):412–9.
54. Zarate CA Jr, Singh JB, Carlson PJ, et al. A randomized trial of an N-methyl-D-aspartate antagonist in treatment-resistant major depression. Arch Gen Psychiatry. 2006;63(8):856–64.
55. Wright E, McGuire J, Roth B, et al. Subanesthetic ketamine for preoperative anxiety: a systematic review and meta-analysis. Anesth Analg. 2021;132(5):1286–95.
56.Smith I, White PF. Propofol and patient anxiety: a double-blind randomized trial. J Clin Anesth. 1999;11(3):208–13.
57.Schmid RL, Sandler AN, Katz J. Use and efficacy of low-dose ketamine in the management of acute postoperative pain: a review of current techniques and outcomes. Pain. 1999;82(2):111-25.
58.Laskowski K, Stirling A, McKay WP, Lim HJ. A systematic review of intravenous ketamine for postoperative analgesia. Can J Anaesth. 2011;58(10):911-23.
59.Tan CH, Onsiong MK. Pain on injection of propofol. Anaesthesia. 1998;53(5):468-76.
60. Wolfe JW, Butterworth JF. Local anesthetic safety: current concepts. Anesthesiol Clin. 2011;29(2):179-94.
61. Morgan GE, Mikhail MS, Murray MJ. Clinical anesthesiology. 4th ed. New York: McGraw-Hill; 2006. p. 147-52. (for thiopental side effects)

62. Schreiber JU, Lysakowski C, Fuchs-Buder T, Tramèr MR. Prevention of succinylcholine-induced fasciculations and myalgia: a meta-analysis of randomized trials. Anesthesiology. 2005;103(4):877-84.
63. Sneyd JR, Absalom AR, Barends CRM, Jones JB. Hypotension during propofol sedation: a systematic review. Br J Anaesth. 2022;128(3):493-502.
64. Bell RF, Dahl JB, Moore RA, Kalso E. Perioperative ketamine for acute postoperative pain. Cochrane Database Syst Rev. 2015;(12):CD004603.
65. Klein SM, Greengrass RA, Steele SM, et al. A comparison of 0.5% bupivacaine, 0.5% ropivacaine, and 0.75% ropivacaine for interscalene brachial plexus block. Anesth Analg. 1998;87(6):1316-9.
66. Casati A, Fanelli G, Magistris L, et al. Minimal local anesthetic volume for peripheral nerve block: a new concept. Reg Anesth Pain Med. 2000;25(2):150-5.
67. Sarantopoulos C, Fassoulaki A. Synergistic interaction between lidocaine and bupivacaine in isolated nerve blockade. Reg Anesth Pain Med. 1998;23(4):378-82.
68.Himmelseher S, Durieux ME. Ketamine for perioperative pain management. Anesthesiology. 2005;102(1):211-20.
69. Egbert LD, Battit GE, Welch CE, Bartlett MK. Reduction of postoperative pain by encouragement and instruction of patients: a study of doctor-patient rapport. N Engl J Med. 1964;270(16):825-7.
70. Sjöling M, Nordahl G, Olofsson N, Asplund K. The impact of preoperative information on state anxiety, postoperative pain and satisfaction with pain management. Patient Educ Couns. 2003;51(2):169-76.
71. Suls J, Wan CK. Effects of sensory and procedural information on coping with stressful medical procedures. Pain. 1989;37(3):273-9.
72. Wallace LM. Communication variables in the design of pre-surgical preparatory information. Br J Clin Psychol. 1986;25(2):111-8.
73. Keefe FJ, Rumble ME, Scipio CD, Giordano LA, Perri LM. Psychological aspects of persistent pain: current state of the science. J Pain. 2004;5(4):195-211.
74. GBD 2019 Fracture Collaborators. Global, regional, and national burden of bone fractures in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. Lancet Healthy Longev. 2021;2(9):e580-92.
75. Fillingim RB, King CD, Ribeiro-Dasilva MC, Rahim-Williams B, Riley JL 3rd. Sex, gender, and pain: a review of recent clinical and experimental findings. J Pain. 2009;10(5):447-85.
76. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet. 2006;367(9522):1618-25.
77. Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. Ann Surg. 2008;248(2):189-98.
78. Spalding NJ. Reducing anxiety by pre-operative education: make the future familiar. Occup Ther Int. 2003;10(4):278-93.
79. Kruzik N. Benefits of preoperative education for adult elective surgery patients. AORN J. 2009;90(3):381-7.

80. Garretson S. Benefits of pre-operative information programmes. Nurs Stand. 2004;18(47):33-7.
81. Aust H, Rüsch D, Schuster M, Sturm T, Brehm F, Nestoriuc Y. Coping strategies in anxious surgical patients. BMC Health Serv Res. 2018;18(1):212.
82. Monk TG, Weldon BC, Garvan CW, Dede DE, van der Aa MT, Heilman KM, et al. Predictors of cognitive dysfunction after major noncardiac surgery. Anesthesiology. 2008;108(1):18-30.
83. Wolters U, Wolf T, Stützer H, Schröder T. ASA classification and perioperative variables as predictors of postoperative outcome. Br J Anaesth. 1996;77(2):217-22.
84. Khuri SF, Henderson WG, DePalma RG, Mosca C, Healey NA, Kumbhani DJ. Determinants of long-term survival after major surgery. Ann Surg. 2005;242(3):326-41.
85. Albert A, Anderson JA. On the existence of maximum likelihood estimates in logistic regression models. Biometrika. 1984;71(1):1-10.
86. Firth D. Bias reduction of maximum likelihood estimates. Biometrika. 1993;80(1):27-38.
87. Heinze G, Schemper M. A solution to the problem of separation in logistic regression. Stat Med. 2002;21(16):2409-19.
88. McDonald S, Page MJ, Beringer K, Wasiak J, Sprowson A. Preoperative education for hip or knee replacement. Cochrane Database Syst Rev. 2014;(5):CD003526.
89.Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet. 2006;367(9522):1618-25.
90. Papadomanolakis-Pakis N, Munch PV, Carlé N, Uhrbrand CG, Haroutounian S, Nikolajsen L. Prognostic clinical prediction models for acute post-surgical pain in adults: a systematic review. Anaesthesia. 2024;79(12):1335-47.
91. Sommer M, de Rijke JM, van Kleef M, Kessels AGH, Peters ML, Geurts JWJM, et al. The prevalence of postoperative pain in a sample of 1490 surgical inpatients. Eur J Anaesthesiol. 2008;25(4):267-74.
92. Lanitis S, Mimigianni C, Raptis D, Sourtse G, Sgourakis G, Karaliotas C. The impact of educational status on the postoperative perception of pain. Korean J Pain. 2015;28(4):265-74.
93. Büyükakıncı AB, Karaman S, Özer Z, Kılıç E. The effect of preoperative education on postoperative pain and satisfaction in patients undergoing laparoscopic cholecystectomy: a randomized controlled trial. J Perianesth Nurs. 2021;36(6):674-80.
94. Schug SA, Lavand'homme P, Barke A, Korwisi B, Rief W, Treede RD. The IASP classification of chronic pain for ICD-11: chronic postsurgical or posttraumatic pain. Pain. 2019;160(1):45-52.
95. Mansournia MA, Geroldinger A, Greenland S, Heinze G. Separation in logistic regression: causes, consequences, and control. Am J Epidemiol. 2018;187(4):864-70.
96. Bergestuen L, Hagen M, Kisa S. Predictive Clinical Factors of Pain-Related Quality of Recovery Following Elective Gastrointestinal and Hepato-Pancreato-Biliary Surgery: An Observational Study in Norway. J Pain Res. 2025 Jan 8;18:47-59. doi: 10.2147/JPR.S483665. PMID: 39807374; PMCID: PMC11725567.

97. Bilginer C, Punduk M, Cetin A, Guleroglu FY, Erol N, Cim N. Factors influencing surgical anxiety and postoperative pain: a comprehensive evaluation of psychological and gynecological determinants. BMC Womens Health. 2025 Mar 7;25(1):103. doi: 10.1186/s12905-025-03623-4. PMID: 40050846; PMCID: PMC11887388.
98. Freys SM, Pogatzki-Zahn EM, Rawal N, Joshi GP; PROSPECT Working Group of the European Society of Regional Anesthesia and Pain Therapy (ESRA). The Role of Surgical Techniques in Reducing Postoperative Pain in Abdominal Surgery: Evidence From the PROSPECT Systematic Reviews. World J Surg. 2025 Nov;49(11):3081-3089. doi: 10.1002/wjs.70091. Epub 2025 Sep 13. PMID: 40944903; PMCID: PMC12582144.
99. Rosenbloom BN, Frederiksen SD, Wang V, Park CS, Gordon G, Brar G, Rasic N, Stinson JN, Birnie KA, Rabbitts JA. Prognostic factors of chronic postsurgical pain in children and adolescents: a systematic review and meta-analysis. Reg Anesth Pain Med. 2025 Feb 5;50(2):144-152. doi: 10.1136/rapm-2024-105696. PMID: 39909544; PMCID: PMC11804872.
100. Laughey W, Vincent K, Iyer S, Cobo MM, Slater R. Pain in women: bridging the gender pain gap. Pain Rep. 2025 May 20;10(3):e1276. doi: 10.1097/PR9.0000000000001276. PMID: 40401085; PMCID: PMC12094398.
101. Falzone E, Hoffmann C, Keita H. Postoperative Analgesia in Elderly Patients. Drugs & Aging.2013;30. 10.1007/s40266-012-0047-7.
102. Beverly A, Kaye AD, Ljungqvist O, Urman RD. Essential elements of multimodal analgesia in Enhanced Recovery After Surgery (ERAS) guidelines. Anesthesiol Clin. 2017;35(2):e115-43.
103.Gordon DB, de Leon-Casasola OA, Wu CL, Sluka KA, Brennan TJ, Chou R. Research gaps in practice guidelines for acute postoperative pain management in adults: findings from a review of the evidence. Anesth Analg. 2018;127(4):1015-22.
104.Woller SA, Glossenger V, Chiu M, et al. The impact of an electronic health record–based clinical decision support tool on postoperative pain management. Jt Comm J Qual Patient Saf. 2022;48(4):215-24.

Note: There is supplementary file for this article.