# Evaluation of Postoperative Pain Severity and Rescue Analgesic Administration in General Surgery Patients: A Prospective Cohort Study

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## Abstract

**Aim:** This study was conducted to examine postoperative pain severity and the time-dependent pattern of rescue analgesic administration, and to identify factors associated with this pattern in elective general surgery patients.
**Methods:** This prospective descriptive cohort study included a total of 369 elective general surgery patients evaluated between February 2022 and January 2023 in a tertiary university hospital. Pain severity (Visual Analogue Scale) and rescue (additional) analgesic administration were recorded at postoperative 0-2, 3-4, 5-8, 9-12, and 13-24 hours. Demographic and clinical factors associated with pain intensity and opioid use were analyzed.
**Results:** While the number of patients requiring rescue analgesia despite routine treatment increased over time, the mean pain intensity recorded before rescue analgesic administration significantly decreased (2.39 ± 1.75 vs. 1.69 ± 2.17, $p<0.001$). Pain was lower among women at 0-2 hours and among older adults (≥65 years) and those with chronic disease at 3-4 hours. Male patients were more likely to receive opioids across the early postoperative period, and opioid use at 3-4 hours was higher in patients without chronic disease.
**Conclusions:** During the first 24 postoperative hours, pain severity decreased while rescue analgesic administration increased over time. Rescue analgesic patterns were influenced by age, sex, and chronic disease status. Although low pain scores suggest generally adequate pain management, the increasing need for rescue analgesia indicates that routine practice is open to improvement. These findings support structured pain assessment, reassessment and individualized, multimodal postoperative pain management in surgical nursing practice.
***Keywords:*** *Postoperative pain; rescue analgesia; general surgery; surgical nursing; pain management; analgesics*

## 1. Introduction

Pain is defined by the International Association for the Study of Pain as a multidimensional sensory and emotional experience associated with actual or potential tissue damage.[1] Post-surgical pain is a common acute nociceptive response to surgical trauma, and more than 80% of patients report postoperative pain, with approximately three-quarters experiencing moderate to severe levels.[2-4] When acute postoperative pain is inadequately managed, the risk of developing persistent postsurgical pain increases,[5-7] which may lead to prolonged hospitalization, delayed wound healing, reduced patient satisfaction, increased healthcare costs, and impaired physical and psychological functioning.[3,8,9]

Accurate and repeated pain assessment is essential for effective pain management.[10] Professional organizations, emphasize the importance of systematic assessment and reassessment to guide appropriate analgesic selection according to the type and severity of pain.[10,11] Furthermore, reassessment following analgesic administration is recommended to ensure both treatment adequacy and patient safety.[10,12,13]

Despite these established standards, achieving optimal pain control in clinical practice remains a complex challenge. Postoperative pain severity varies depending on the type of surgical procedure and the extent of tissue trauma.[14] Inadequate pain management practices persist, with nearly half of surgical patients reporting insufficient analgesia.[3,4,15,16] This ongoing gap highlights a critical need for time based evaluations and individualized approaches to improve clinical outcomes.

Understanding how pain severity changes over time and how routine and rescue analgesics are administered in everyday clinical

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practice is essential Nurses, as the primary providers of continuous postoperative monitoring, play a central role in pain assessment, monitoring treatment response, and timely intervention. Therefore, time dependent evaluations are important for determining the adequacy of postoperative pain control and identifying rescue analgesic administration in routine clinical settings.

The aim of this study was to examine postoperative pain severity and the time dependent pattern of rescue analgesic administration during the first 24 hours after elective general surgery, without altering routine clinical practice. The findings are intended to inform evidence based nursing practices that support structured pain assessment, reassessment and individualized, multimodal postoperative pain management. By identifying the specific timing of rescue needs, this study provides a strategic framework for nurses to optimize pain control and minimize patient discomfort in general surgery units.

## 2. Materials and Methods

*Study design*

A prospective descriptive cohort study design was employed. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was followed throughout the entire study process.

*Participants and Setting*

This study was conducted in the general surgery clinic of a tertiary university hospital. The study population included patients who underwent elective surgical procedures between February 2022 and January 2023. The sample size was calculated using G*Power 3.1.9.2 software based on a medium effect size (Cohen's d = 0.5), a significance level of α = 0.05, and a statistical power of 0.95, as recommended for observational studies. While a minimum of 249 patients was determined via power analysis, the study was completed with 369 patients who met the inclusion criteria and agreed to participate. A total of 427 patients were assessed for eligibility. Fifty-eight were excluded (refused to participate, n=12; emergency surgery, n=22; required postoperative intensive care, n=24). The final study sample included 369 eligible patients. Due to discharge before the 13-24 hour interval, the number of available observations decreased at the last time point (n=286) (Figure 1).

Patients were included if they underwent elective surgery under general anesthesia and provided voluntary informed consent. Patients with chronic pain conditions were excluded to reduce variability in pain perception, and emergency surgeries were omitted due to differences in perioperative management protocols. Patients admitted to the intensive care unit postoperatively were excluded because pain monitoring and analgesic protocols differ significantly from standard postoperative care.[10,11,13] Eligible patients were evaluated preoperatively through face-to-face interviews and enrolled in the study.

*Data Collection Tools*

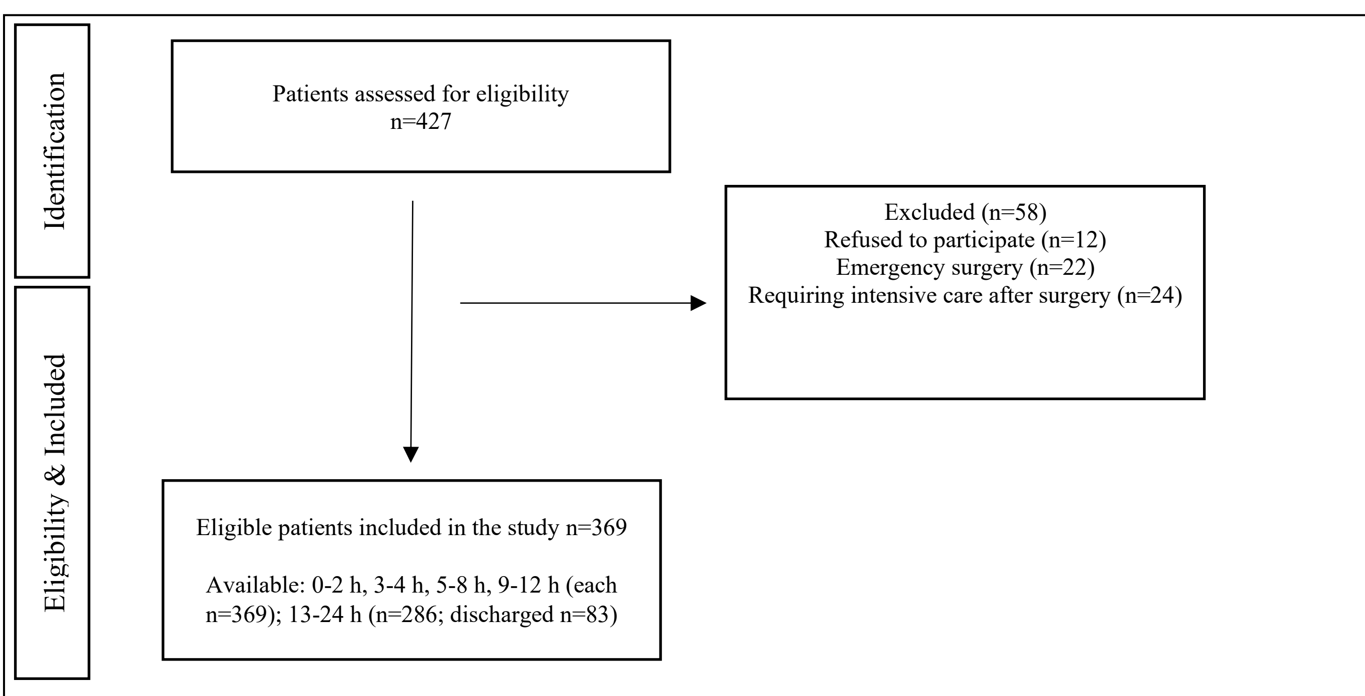
Data were collected using two structured forms:

Personal Information Form: Included age, gender, chronic disease status, and type of surgery.

Pain Assessment Form: Included postoperative pain severity and analgesic type administered at 0-2, 3-4, 5-8, 9-12, and 13-24 hours postoperatively.4,10,11,13,14,17 Pain severity was measured using the Visual Analogue Scale (VAS). The VAS, developed by Price et al. (1983),18 consists of a 10-cm horizontal line anchored by "no pain" at one end and "worst possible pain" at the other. The 0-10 cm VAS ruler validated for use in Türkiye by Aydın et al. (2011) was used in this study.[19] A score of 0 indicates no pain, while 10 represents the worst imaginable pain; higher scores reflect greater pain intensity. VAS is widely accepted as a valid and reliable tool for pain assessment in clinical practice.[20]

Figure 1

Flow chart of study



*Data Collection Procedure*

Patients were informed one day before surgery, written informed consent was obtained, and the Personal Information Form was completed. The type of surgery was categorized as metabolic and endocrine surgery, gastrointestinal surgery, and other surgeries. All procedures were performed laparoscopically, and anesthesia management was similar across patients according to the clinic's standard practice.

Postoperative pain intensity was assessed using the VAS at predefined time intervals (0-2, 3-4, 5-8, 9-12, and 13-24 hours) based on measurements recorded in the clinic. Because more than one VAS measurement could be performed within the same interval as part of routine care, the mean of all VAS scores recorded within each interval was calculated and documented as the time-interval VAS. The study did not interfere with routine clinical practice; however, additional (as-needed) analgesic administrations beyond the routine regimen (defined as 'rescue analgesia' in this study) were recorded. Rescue need was defined as the patient's expressed request for analgesia. A pre-analgesic VAS score was recorded immediately before each rescue administration. Reassessment scores were then documented at 30 minutes for intravenous (IV) or 60 minutes for intramuscular (IM) delivery. As part of the standardized clinical routine of the department, paracetamol 10 mg/kg IV every 12 hours and diclofenac sodium 75 mg IM every 12 hours were administered by nurses according to the physician's order. According to the clinical protocol, if a patient reported rescue need, an additional dose of a non-opioid analgesic was administered as the first line intervention (i.e., diclofenac sodium following routine paracetamol, and vice versa). Secondly, for severe pain (VAS ≥ 7), tramadol 1 mg/kg IV was administered as the rescue opioid, once daily according to the physician's order.

**Table 1**

Sociodemographic and clinical characteristics of participants

| N=369 | n | % |
|---|---|---|
| **Age (years)** (mean ± SD: 52.40 ± 14.73) | | |
| ·<50 | 150 | 40.7 |
| ·50-64 | 133 | 36.0 |
| ·≥65 | 86 | 23.3 |
| **Gender** | | |
| ·Male | 126 | 34.1 |
| ·Female | 243 | 65.9 |
| **Chronic disease** | | |
| ·Yes | 165 | 44.7 |
| ·No | 204 | 55.3 |
| **Type of surgery** | | |
| ·Metabolic and endocrine surgery | 129 | 35.0 |
| ·Gastrointestinal surgery | 138 | 37.4 |
| ·Other surgeries | 102 | 27.6 |

*SD=Standard deviation*

*Statistical analysis*

Data were analyzed using SPSS for Windows, version 27.0. Descriptive statistics (n, %, mean ± standard deviation, and median (interquartile range) where appropriate) were used to summarize participant characteristics and study variables. Distributional assumptions were evaluated using the Kolmogorov-Smirnov test and graphical methods. Changes in pain intensity across the time intervals were evaluated using repeated-measures ANOVA when assumptions were met; otherwise, the Friedman test was applied. For comparisons between two independent groups, the independent-samples t test was used when normality assumptions were met; otherwise, the Mann-Whitney U test was applied. For comparisons among three or more independent groups, one-way ANOVA was used when assumptions were met; otherwise, the Kruskal-Wallis test was used. Associations between categorical variables were examined using Pearson's $\chi^2$ test. When multiple pairwise comparisons were required following a significant overall test, Bonferroni correction was applied to control the Type I error rate. Given the repeated testing across postoperative time intervals, p-values were interpreted cautiously. Statistical significance was set at $p < 0.05$ with a 95% confidence interval.

## 3. Results

A total of 369 patients were included (mean age 52.40±14.73 years); 65.9% were female and 44.7% had at least one chronic disease. Surgical categories were gastrointestinal (37.4%), metabolic/endocrine (35.0%), and other surgeries (27.6%) (Table 1).

Postoperative pain was assessed at 0-2, 3-4, 5-8, 9-12, and 13-24 hours. Due to discharge, analyses for the 13-24 h interval were based on available observations (N=286). Analgesic administration increased over time (12.2%, 17.6%, 31.4%, 42.8%, and 52.4%, respectively) (Table 2).

Among patients who received analgesia within the relevant interval, Pre-VAS (recorded immediately before administration) differed significantly across time intervals (Friedman $\chi^2$=31.991; p<0.001), with the 0-2 h Pre-VAS being higher than subsequent intervals (Bonferroni-adjusted post-hoc). In contrast, Post-VAS (reassessment at 30 min after IV / 60 min after IM) did not ($\chi^2$=5.210, p=0.266) (Table 2).

When pain scores were examined by clinical characteristics, significant differences were observed across age groups at 3-4 hours (p=0.025) and 5-8 hours (p=0.020). Post-hoc analyses showed higher pain in patients aged <50 years compared with those aged ≥65 years at 3-4 h, and higher pain in patients aged <50 years compared with those aged 50-64 years at 5-8 h (Bonferroni-adjusted). At 0-2 h, women reported significantly lower pain (1.91±1.63) than men (2.35±1.78) (p=0.015); no sex differences were observed at later time points (p>0.05). At 3-4 h, patients without chronic disease reported higher pain than those with chronic disease (p=0.042). Pain scores did not differ by surgery type at any time interval (p>0.05) (Table 3).

Regarding analgesic administration (Yes/No), a significant sex difference was observed at 3-4 h, with a higher administration rate in men than women (23.8% vs 14.4%, p=0.032). Analgesic administration also differed by surgery type at 3-4 h (p=0.012), with rates of 24.5% in other surgeries, 18.8% in gastrointestinal surgery, and 10.9% in metabolic and endocrine surgery. No significant differences in administration rates were found across age groups or chronic disease status at the remaining time intervals (Table 4).

Among patients who received analgesia, non-opioid analgesics predominated across all intervals. Opioid use differed by sex at 0-2 h (male: 38.9%; female: 11.1%; p=0.028) and 9-12 h (male: 5.3%; female: 0%; p=0.018). At 3-4 h, opioid use was higher in patients without chronic disease than in those with chronic disease (28.2% vs 7.7%, p=0.044). No significant differences in analgesic type (opioid/non-opioid) were observed across age groups or surgery types (p>0.05) (Table 5).

Table 2

Pre- and post-analgesic VAS scores and number of patients receiving rescue analgesia by postoperative time interval

| Postoperative time interval | Available observations (N) | Rescue analgesic administration | | Pain intensity- VAS (Patients receiving rescue analgesia)* | |
|---|---|---|---|---|---|
| | | **Yes, n (%)** | **No, n (%)** | **Pre-VAS† Mean±SD** | **Post-VAS‡Mean±SD** |
| 0-2 hours | 369 | 45 (12.2) | 324 (87.8) | 2.39±1.75 | 0.65±1.29 |
| 3-4 hours | 369 | 65 (17.6) | 304 (82.4) | 1.83±1.80 | 0.52±1.10 |
| 5-8 hours | 369 | 116 (31.4) | 253 (68.6) | 1.76±1.91 | 0.52±1.07 |
| 9-12 hours | 369 | 158 (42.8) | 211 (57.2) | 1.84±1.88 | 0.48±0.96 |
| 13-24 hours | 286 | 150 (52.4) | 136 (47.6) | 1.69±2.17 | 0.41±0.89 |
| Test statistics p | | | | $\chi^2$=31.991<br>**p<0.001[a]** | $\chi^2$=5.210<br>p=0.266 |

*N indicates available observations (13-24 h: N=286 due to discharge).*
**Pre/Post VAS values were calculated among patients who received analgesia in that interval (Yes group).*
*†Pre-VAS: recorded immediately before administration. ‡Post-VAS: reassessed 30 min after IV or 60 min after IM administration.*
*[a] Pre-VAS at 0-2 h was higher than at later intervals (Bonferroni-adjusted).*

Table 3

Comparison of VAS pain scores across postoperative time intervals by clinical characteristics

| Variable (n=369) | 0-2 hours $\bar{X} \pm SD$ | 3-4 hours $\bar{X} \pm SD$ | 5-8 hours $\bar{X} \pm SD$ | 9-12 hours $\bar{X} \pm SD$ | 13-24 hours $\bar{X} \pm SD$ (available n=286) |
|---|---|---|---|---|---|
| | **VAS** | **VAS** | **VAS** | **VAS** | **VAS** |
| **Age** | | | | | |
| ·<50 | 2.26±1.77 | 1.99±1.87 | 2.01±1.99 | 1.83±1.95 | 1.90±2.09 |
| ·50-64 | 1.96±1.61 | 1.61±1.71 | 1.46±1.89 | 1.61±1.81 | 1.43±1.81 |
| ·≥65 | 1.88±1.64 | 1.36±1.62 | 1.52±1.76 | 1.69±1.82 | 1.59±2.03 |
| ·Test statistics | χ2=3.129 | χ2=7.402 | χ2=7.836 | χ2=0.824 | χ2=2.829 |
| ·p | p=0.209 | **p=0.025a** | **p=0.020b** | p=0.662 | p=0.243 |
| **Gender** | | | | | |
| ·Male | 2.35±1.78 | 1.85±1.69 | 1.53±1.74 | 1.87±1.97 | 1.87±2.47 |
| ·Female | 1.91±1.63 | 1.62±1.81 | 1.78±1.99 | 1.63±1.81 | 1.57±0.96 |
| ·Test statistics | Z=-2.424 | Z=-1.622 | Z=-0.737 | Z=-0.952 | Z=-0.894 |
| ·p | **p=0.015** | p=0.105 | p=0.461 | p=0.351 | p=0.371 |
| **Chronic disease** | | | | | |
| ·Yes | 1.98±1.58 | 1.43±1.51 | 1.65±1.90 | 1.81±1.87 | 1.43±1.81 |
| ·No | 2.14±1.78 | 1.92±1.93 | 1.73±1.92 | 1.65±1.87 | 1.82±2.09 |
| ·Test statistics | Z=-0.622 | Z=-2.031 | Z=-0.530 | Z=-0.903 | Z=-1.363 |
| ·p | p=0.534 | **p=0.042** | p=0.596 | p=0.367 | p=0.173 |
| **Type of Surgery** | | | | | |
| ·Metabolic and endocrine surgery | 1.96±1.67 | 1.45±1.67 | 1.65±1.84 | 1.61±1.81 | 1.90±1.95 |
| ·Gastrointestinal surgery | 2.14±1.76 | 1.88±1.82 | 1.71±2.04 | 1.89±1.91 | 1.76±2.16 |
| ·Other surgeries | 2.09±1.64 | 1.77±1.79 | 1.73±1.84 | 1.62±1.88 | 1.21±1.67 |
| ·Test statistics | χ2=1.045 | χ2=4.242 | χ2=0.291 | χ2=1.926 | χ2=5.439 |
| ·p | p=0.593 | p=0.120 | p=0.864 | p=0.382 | p=0.066 |

** Values; $\bar{X}$=Mean, SD=Standard deviation*
** Mann-Whitney U was used for two-group comparisons (reported as Z), and Kruskal-Wallis for ≥3 groups (reported as $\chi^2$).*
** Analyses for 13-24 h were based on available observations (N=286) due to discharge.*
*a; 3-4 h: pain was higher in the <50 group than in the ≥65 group (Post-hoc pairwise comparisons were Bonferroni-adjusted).*
*b; 5-8 h: pain was higher in the <50 group than in the 50-64 group (Post-hoc pairwise comparisons were Bonferroni-adjusted).*

Table 4

Rescue analgesic administration by postoperative time interval and clinical characteristics

| Variable (n=369) | **0-2 hours** | | **3-4 hours** | | **5-8 hours** | | **9-12 hours** | | **13-24 hours (available n=286)** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Analgesic | | Analgesic | | Analgesic | | Analgesic | | Analgesic | |
| | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) |
| **Age** | | | | | | | | | | |
| <50 | 17 (11.3) | 133 (88.9) | 27 (18.0) | 123 (82.0) | 55 (36.7) | 95 (63.3) | 65 (43.3) | 85 (56.7) | 63 (56.8) | 48 (43.2) |
| 50-64 | 19 (14.3) | 114 (85.7) | 22 (16.5) | 111 (83.5) | 35 (26.3) | 98 (73.7) | 58 (43.6) | 75 (56.4) | 56 (52.3) | 51 (47.7) |
| ≥65 | 9 (10.5) | 77 (89.5) | 16 (18.6) | 70 (81.4) | 26 (30.2) | 60 (69.8) | 35 (40.7) | 51 (59.3) | 31 (45.6) | 37 (54.4) |
| **Test statistics** **p** | χ2=0.887 p=0.642 | | χ2=0.213 p=0.899 | | χ2=3.987 p=0.136 | | χ2=0.381 p=0.827 | | χ2=2.110 p=0.348 | |
| **Gender** | | | | | | | | | | |
| Male | 18 (14.3) | 108 (85.7) | 30 (23.8) | 96 (76.42 | 36 (28.6) | 90 (71.4) | 57 (45.2) | 69 (54.8) | 54 (50) | 54 (50) |
| Female | 27 (11.1) | 216 (88.9) | 35 (14.4) | 208 (85.6) | 80 (32.9) | 163 (67.1) | 101 (41.6) | 142 (58.4) | 96 (53.9) | 82 (46.1) |
| **Test statistics** **p** | χ2=0.781 p=0.377 | | χ2=4.618 **p=0.032** | | χ2=0.791 p=0.374 | | χ2=0.222 p=0.638 | | χ2=0.417 p=0.519 | |
| **Chronic disease** | | | | | | | | | | |
| Yes | 21 (12.7) | 144 (87.3) | 26 (15.8) | 139 (84.2) | 50 (30.3) | 115 (69.7) | 72 (43.6) | 93 (56.4) | 63 (50.8) | 61 (49.2) |
| No | 24 (11.8) | 180 (88.2) | 39 (19.1) | 165 (80.9) | 66 (32.4) | 138 (67.6) | 86 (42.2) | 118 (57.8) | 87 (53.7) | 75 (46.3) |
| **Test statistics** **p** | χ2=0.079 p=0.779 | | χ2=0.801 p=0.371 | | χ2=0.255 p=0.614 | | χ2=0.140 p=0.709 | | χ2=0.236 p=0.627 | |
| **Type of surgery** | | | | | | | | | | |
| Metabolic and endocrine surgery | 13 (10.1) | 116 (89.9) | 14 (10.9) | 115 (89.1) | 37 (28.7) | 92 (71.3) | 53 (41.1) | 76 (58.9) | 54 (58.1) | 39 (41.9) |
| Gastrointestinal surgery | 22 (15.9) | 116 (84.1) | 26 (18.8) | 112 (81.2) | 43 (31.2) | 95 (68.8) | 62 (44.9) | 76 (55.1) | 57 (51.4) | 54 (48.6) |
| Other surgeries | 10 (9.8) | 92 (90.2) | 25 (24.5) | 77 (75.5) | 36 (35.3) | 66 (64.7) | 43 (42.2) | 59 (57.8) | 39 (47.6) | 43 (52.4) |
| **Test statistics** **p** | χ2=2.894 p=0.235 | | χ2=8.818 **p=0.012** | | χ2=1.359 p=0.507 | | χ2=0.322 p=0.851 | | χ2=2.015 p=0.365 | |

**Values are n (%). Percentages are calculated within subgroup by time interval; 13-24 h is based on available observations (n=286) due to discharge. Pearson's $\chi^2$ (or Fisher's exact when expected counts <5) was used.*

Table 5

Rescue analgesic type among patients receiving analgesia by postoperative time interval and clinical characteristics

| | 0-2 hours (available n=45) | | 3-4 hours (available n=65) | | 5-8 hours (available n=116) | | 9-12 hours (available n=158) | | 13-24 hours (available n=150) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Analgesic Type | | Analgesic Type | | Analgesic Type | | Analgesic Type | | Analgesic Type | |
| | Opioid n (%) | Non opioid n (%) | Opioid n (%) | Non opioid n (%) | Opioid n (%) | Non opioid n (%) | Opioid n (%) | Non opioid n (%) | Opioid n (%) | Non opioid n (%) |
| **Age** | | | | | | | | | | |
| <50 | 4 (23.5) | 13 (76.5) | 7 (25.9) | 20 (74.1) | 5 (9.1) | 50 (90.9) | 2 (3.1) | 63 (96.9) | 2 (3.2) | 61 (96.8) |
| 50-64 | 5 (26.3) | 14 (73.7) | 3 (13.6) | 19 (86.4) | 4 (11.4) | 31 (88.6) | 1 (1.7) | 57 (98.3) | 2 (3.6) | 54 (96.4) |
| ≥65 | 1 (11.1) | 8 (88.9) | 3 (18.8) | 13 (81.2) | 2 (7.7) | 24 (92.3) | 0 (0.0) | 35 (100) | 0 (0.0) | 31 (100) |
| Test statistics<br>p | χ2=0.844<br>p=0.656 | | χ2=0.982<br>p=0.612 | | χ2=0.226<br>p=0.893 | | χ2=1.169<br>p=0.557 | | χ2=1.090<br>p=0.580 | |
| **Gender** | | | | | | | | | | |
| Male | 7 (38.9) | 11 (61.1) | 5 (16.7) | 25 (83.3) | 4 (11.1) | 32 (88.9) | 3 (5.3) | 54 (94.7) | 3 (5.6) | 51 (94.4) |
| Female | 3 (11.1) | 24 (88.9) | 8 (22.9) | 27 (77.1) | 7 (8.8) | 73 (91.2) | 0 (0.0) | 101 (100) | 1 (1) | 95 (99) |
| Test statistics<br>p | χ2=4.821<br>**p=0.028** | | χ2=0.378<br>p=0.539 | | χ2=0.202<br>p=0.653 | | χ2=5.617<br>**p=0.018** | | χ2=2.649<br>p=0.104 | |
| **Chronic disease** | | | | | | | | | | |
| Yes | 4 (19) | 17 (81) | 2 (7.7) | 24 (92.3) | 5 (10) | 45 (90) | 0 (0.0) | 72 (100) | 3 (4.8) | 60 (95.2) |
| No | 6 (25) | 18 (75) | 11 (28.2) | 28 (71.8) | 6 (9.1) | 60 (90.9) | 3 (3.5) | 83 (96.5) | 1 (1.1) | 86 (98.9) |
| Test statistics<br>p | χ2=0.230<br>p=0.623 | | χ2=4.040<br>**p=0.044** | | χ2=0.019<br>p=0.889 | | χ2=2.555<br>p=0.110 | | χ2=1.891<br>p=0.169 | |
| **Type of surgery** | | | | | | | | | | |
| Metabolic and endocrine surgery | 0 (0.0) | 13 (100) | 3 (21.4) | 11 (78.6) | 1 (2.7) | 36 (97.3) | 0 (0.0) | 53 (100) | 1 (1.9) | 53 (98.1) |
| Gastrointestinal surgery | 7 (31.8) | 15 (68.2) | 6 (23.1) | 20 (76.9) | 7 (16.3) | 36 (83.7) | 1 (1.6) | 61 (98.4) | 3 (5.3) | 54 (94.7) |
| Other surgeries | 3 (30) | 7 (70) | 4 (16) | 21 (84) | 3 (8.3) | 33 (91.7) | 2 (4.7) | 41 (95.3) | 0 (0.0) | 39 (100) |
| Test statistics<br>p | χ2=5.236<br>p=0.073 | | χ2=0.548<br>p=0.760 | | χ2=4.004<br>p=0.135 | | χ2=2.969<br>p=0.227 | | χ2=2.759<br>p=0.252 | |

**Values are n (%). Analyses include only patients who received analgesia (Yes group); percentages are calculated within each subgroup for the relevant time interval. Pearson's $\chi^2$ was used; Fisher's exact test was used when expected cell counts were <5.*

## 4. Discussion

Postoperative pain remains one of the most frequent challenges in surgical care. Pain assessment records, including pain characteristics and analgesic use, are fundamental to effective pain management.[2,21] Inadequate pain assessment is a major barrier to achieving sufficient pain control.[22]

In the present study, pain severity decreased over time, while the need for rescue analgesia administration became more frequent in later intervals. Although this situation might appear unusual at first glance, patients' requests for analgesia despite reporting low pain scores (VAS < 3) could be attributed to anticipatory anxiety regarding the potential intensification of pain. Also this pattern aligns with the expected postoperative course as healing progresses and inflammatory responses subside. Similarly, Bozer and Erden (2024) reported decreasing pain severity over time.[23] However, evidence is mixed: a large multicenter study found that many patients experienced moderate-to-severe pain during the first postoperative day,[24] and Lindberg et al. (2020) reported higher pain severity than observed here.[25] Differences across studies may relate to patient and surgical characteristics and to the gap between patient-reported pain and routine clinical documentation. Overall, rising rescue analgesic administration alongside declining pain scores is compatible with acceptable pain control in the studied routine. This pattern may be further influenced by factors such as increased patient mobilization, the diminishing effect of routine analgesics toward the end of the dosing interval, and individual variations in pain thresholds. Notably, while pre-analgesic pain scores varied, post-analgesic VAS scores remained consistently low and stable across all intervals. This stability demonstrates the efficacy of the rescue analgesic protocol in consistently reducing pain to a manageable level regardless of the initial intensity.

In this context, ERAS (Enhanced Recovery After Surgery) pathways emphasize multimodal, opioid-sparing analgesia. They recommend scheduled acetaminophen (paracetamol) and NSAIDs (non steroidal anti inflammatory drugs) when not contraindicated, reserving opioids as rescue therapy for insufficiently controlled pain.[26,27] Although pain control in our cohort appears acceptable, routine dosing at longer fixed intervals may be further optimized by closer alignment with ERAS oriented scheduled non-opioid regimens, potentially reducing rescue analgesic administration.[26] ERAS oriented guidance also highlights perioperative implementation of multimodal analgesia, including pre- and intraoperative components, to support consistent pain control and recovery.[27]

Gender related differences were most apparent early after surgery. Women reported lower pain than men at the earliest interval, while later differences were less consistent. Non-opioid agents predominated overall, whereas opioid administration was more pronounced among men at specific intervals. Prior studies are inconsistent: some report higher pain severity and analgesic use in women,[28,29] while others report no association between sex and pain severity or analgesic use.[30] These findings suggest that sex differences may be time-dependent and influenced by clinical analgesic selection rather than reflecting a uniform difference across the entire postoperative period.

Chronic disease status was associated with pain at a specific interval, with higher pain reported by patients without chronic disease. Opioid administration among analgesia recipients also differed by chronic disease status at a particular interval. Patients with chronic conditions may have more experience coping with pain and may develop higher pain tolerance.[25] Nevertheless, findings vary: Bozer and Erden (2024) reported higher pain among patients with chronic diseases, whereas Zhang et al. (2024) found no association.[23,30] Such variability may reflect differences in the types and severity of chronic conditions, pain coping, and clinicians' analgesic selection. Therefore, postoperative pain management should be individualized beyond pain intensity alone. This approach is particularly important in the early postoperative hours when the influence of chronic conditions on pain perception is most prominent.

Age was associated with pain intensity at selected intervals, with younger patients reporting higher pain than older adults. Age-related changes in pain threshold and processing have been described and may involve inflammatory and nociceptive pathways.[31,32] Some studies report greater pain or analgesic needs in younger patients,[29,30] whereas others report no association.[33,34] Our findings suggest that age effects may be more evident at specific postoperative phases rather than consistently across all intervals. These phase specific differences likely reflect the dynamic physiological and inflammatory responses observed during the early recovery period.

Although pain severity did not clearly differ by surgical category, rescue analgesic administration was more evident in the gastrointestinal surgery group at certain intervals. This may indicate that abdominal procedures can generate higher early analgesic demand even when routine care is maintained. This interpretation is consistent with reports that clinically meaningful pain remains common after colorectal/abdominal surgery within contemporary perioperative pathways.[25] The finding that pain severity remained similar across groups despite the higher analgesic demand in the gastrointestinal category suggests that the timely administration of rescue analgesia was effective in normalizing pain trajectories. Additionally, the standardized laparoscopic approach and uniform anesthetic management likely contributed to maintaining these consistent pain scores across different procedural categories.

Non-opioid analgesics predominated, while opioid use remained limited. Conservative opioid use may stem from inadequate knowledge, reluctance to prescribe adequate doses, access barriers, and concerns about respiratory depression or dependence.[10,12,35] Cooley et al. (2022) reported that nurses may hesitate to administer opioids due to side-effect concerns.[36] Yin et al. (2015) also reported persistent knowledge gaps regarding opioid use.[37] Exaggerated fears of respiratory depression and addiction and difficulty distinguishing tolerance from dependence may further contribute to suboptimal pain management.[38] These barriers highlight the need for ongoing education and clear, evidence-based protocols to optimize postoperative pain control.

*Limitations*

This study has several limitations. The single-center nature of the research and the diversity of surgical procedures may limit the generalizability of the findings. Individual differences in pain thresholds and tolerance were not directly evaluated. Additionally, pain was evaluated only within the first 24 postoperative hours; therefore, longer-term pain outcomes and the risk of persistent postoperative pain could not be assessed. Due to discharge, the number of available observations decreased in the 13-24 h interval, and findings for this interval should be interpreted with caution. The inclusion of different surgical categories may have contributed to variability in pain experiences and analgesic needs. Because pain is subjective, unmeasured psychological, cultural, and emotional factors may have influenced patient-reported VAS scores. In addition, analgesic administration was based on routine clinical practice and patient-reported additional need, which may have introduced variation in the timing and type of as-needed analgesic use. Additionally, the sample size for subgroup analyses regarding analgesic type (opioid vs. non-opioid) was limited in some categories, which may reduce the statistical power of these specific comparisons.

## 5. Conclusion

This study shows that postoperative pain intensity decreased over time, while the frequency of rescue analgesic administration increased at later postoperative intervals. Pain severity and analgesic patterns differed across patient characteristics, including sex, age, and chronic disease status. A key contribution of this study is the structured, time-interval-based assessment of postoperative pain and analgesic administration within the first 24 hours, coupled with systematic reassessment after analgesic use in line with recommended practice.[10,11] Recording pain using patient self-report consistent with the IASP definition supported documentation of subjective pain experiences.[1] Overall, the findings highlight the value of routine, structured pain monitoring and reassessment to guide both scheduled analgesia and patient-driven, as-needed analgesic administration, and they underscore the importance of continuing education for surgical nurses to strengthen pain assessment and analgesic decision-making. Moreover, aligning routine postoperative analgesia more closely with ERAS-oriented, scheduled multimodal non-opioid regimens may help further standardize pain control and reduce the need for rescue analgesic administration.

### Statement of ethics

Approval for the study was obtained from the Non-Interventional Clinical Research Ethics Committee of a tertiary university (Date/No: 04.02.2022/119-55), followed by institutional permission from University Hospital, where the research was conducted. The study was carried out in accordance with the ethical principles of the Declaration of Helsinki (2008). Prior to data collection, all participants were informed about the study's purpose and procedures, and written informed consent was obtained from each individual.

### genAI

The authors declare that artificial intelligence (AI) tools were used for language translation purposes. No AI tools were used in the creation of the scientific content of this article.

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### Conflict of interest statement

The authors declare that they have no conflict of interest.

### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

### Author Contributions

All authors contributed equally to the article. All authors read and approved of the final manuscript.

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