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Patterns of Analgesic Prescription and Pain Control in Surgical Patients: Observations from Alkhadra Hospital

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This study provides the first prospective, multi-specialty evaluation of postoperative analgesic prescribing patterns in Tripoli, Libya, systematically linking drug utilization with pain outcomes.A prospective observational study was conducted with 67 adult patients undergoing various surgical procedures. Data collection included analgesic agents, administration routes, therapy modalities, and pain scores using the Numeric Rating Scale recorded twice daily over four postoperative days. Statistical analyses employed chi-square tests, ANOVA, and t-tests to evaluate significant associations. Paracetamol emerged as the predominant analgesic (56.7%, $p<0.001$), followed by tramadol (26.9%) and fentanyl (14.9%). Intravenous administration was significantly preferred (77.6%, $p<0.001$), and combination therapy predominated over monotherapy (67.2% vs 32.8%, $p<0.001$). Novel findings include superior pain reduction in female patients, those receiving spinal anesthesia, and patients undergoing orthopedic or obstetric procedures. These results highlight the effectiveness of paracetamol-based multimodal IV therapy in resource-limited settings and provide evidence for standardizing analgesic protocols in Libyan hospitals.Findings support standardization of multimodal analgesia protocols in Libyan hospitals

Keywords: Analgesic Patterns; Libya; Pain Management; Postoperative Pain; Surgery.

Postoperative pain management is a fundamental component of surgical care and significantly influences the patient's recovery, satisfaction, and clinical outcomes.[1] The constant problem of insufficient pain relief extends beyond mere patient discomfort to become a strong predictor of prolonged periods of recovery, the development of chronic pain syndromes, and an increased risk of dependency on opioids[2]. In turn, contemporary practice has been focusing on multimodal analgesia approaches that systematically combine multiple non-opioid pharmacological agents with complementary mechanisms of action to offer superior analgesic efficacy with substantial reduction of opioid-related adverse effects.[2-4]

Evidence from a wide range of healthcare settings demonstrates consistency in certain aspects of analgesic prescribing patterns.[3] Broad studies conducted at Indian tertiary care centers provide evidence that non-steroidal anti-inflammatory drugs, mainly diclofenac (48-71.9%), and paracetamol (29.6-45.8%), form the basis of most postoperative pain management protocols.[5-7]

Parallel studies from Libyan healthcare institutions demonstrate a similar therapeutic dependence on paracetamol (58%) and tramadol (30%), although there are disturbing reports of 54.6% patients experiencing pain of moderate-to-severe intensity within 24 hours after surgery.[8,9] Despite these established pharmacological interventions for pain, complete resolution of pain remains an elusive clinical goal, reported to be achieved in only 3.1% of patients in some studies.[10]

The difference between having pain medications available and achieving effective pain relief highlights how complex postoperative pain management is. Research shows that patient-specific factors, especially psychological ones like anxiety before surgery and a tendency to exaggerate pain, often influence pain more than the surgery itself.[11] In addition, major implementation barriers at a systemic level-including lack of resources, institutional protocol variability, and irregular adherence to clinical practice guidelines-continue to pose significant challenges in various global healthcare settings.[12]

In the Middle East and North Africa (MENA) region, published data on postoperative pain management remain limited, with most studies focusing on single procedures or small cohorts. Libya, in particular, lacks prospective, multi-specialty analyses that connect prescribing behaviors with actual patient outcomes. Few Libyan studies have systematically quantified analgesic practices; most are retrospective or single-procedure. This study addresses a critical gap by providing prospective, multi-specialty data from a tertiary hospital in Tripoli, offering novel insights into how analgesic practices translate into measurable pain outcomes. Unlike prior Libyan studies, this work prospectively evaluates prescribing patterns across multiple specialties and correlates them with pain outcomes, offering new insights into practice gaps and opportunities for protocol standardization. This study aims to evaluate patterns of postoperative analgesic utilization and their clinical effectiveness in managing pain. It involves a comprehensive analysis of prescribing behaviors, medication efficacy, and pain outcomes across various surgical procedures and anesthesia modalities.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted to evaluate analgesic utilization patterns and pain management outcomes among postoperative patients admitted to Alkhadra Hospital in Tripoli, Libya. The study employed a systematic chart review methodology to collect data on analgesic prescribing practices and pain trajectory monitoring during the immediate postoperative period.

Sample Size Calculation

An a priori calculation was performed based on the primary outcome (mean reduction in pain scores). Assuming a clinically significant difference of 0.7 points on a 0–10 scale, with a standard deviation of 1.3, á = 0.05, and 80% power, the required sample size was approximately 55 patients per group (110 total).

Participant Selection and Eligibility

The prospective study comprised 67 adult patients (age range: 18-72 years) who underwent various surgical procedures between October 5 and October 13, 2025. Surgical specialties included orthopedic (Open Reduction Internal Fixation), obstetric (cesarean sections), general (cholecystectomy, appendectomy), and gynecological (hysteroscopy) procedures. Inclusion criteria required complete documentation of postoperative analgesic administration and pain score recordings. Patients with incomplete medical records or those undergoing outpatient procedures were excluded from the analysis.

Data Collection Protocol

Structured data abstraction was performed using a standardized data collection form. Demographic variables included age and sex. Clinical parameters encompassed surgical diagnosis, anesthesia type (general or spinal), and procedural duration. Analgesic documentation included detailed information on drug specifications (name, dosage), administration parameters (route: intravenous, oral, intramuscular; frequency), and regimen composition (single-agent versus combination therapy). Analgesics were administered according to a physician ordered protocol, typically on a fixed schedule with additional doses provided on a nurse administered

PRN basis when patients reported breakthrough pain. Pain intensity was assessed using the Visual Analogue Scale (VAS) by trained nursing staff at standardized time points (Day 1 post operative and at discharge). Discharge medication profiles were also recorded for comprehensive analysis.

Pain assessments were conducted by trained nursing staff who underwent a standardized calibration session to ensure consistency in VAS administration. Assessments were performed at fixed intervals (08:00 and 20:00 daily), and all PRN doses were documented to capture breakthrough pain management.

Pain Assessment and Outcome Measures

Pain intensity was quantitatively assessed using the VAS, ranging from 0 (no pain) to 10 (worst imaginable pain). Standardized measurements were obtained twice daily (morning and evening sessions) throughout the four-day postoperative monitoring period. The primary outcome was pain score recovery and its correlation with analgesic regimens.

Analytical Classification Framework

Analgesic agents were systematically classified into five pharmacological categories to standardize the analysis of prescribing patterns: paracetamol, NSAIDs (e.g., ibuprofen, diclofenac), opioids (e.g., tramadol, morphine), multimodal combination therapies, and rescue medications. This structured framework facilitated the evaluation of monotherapy *versus* combination approaches and assessed adherence to evidence-based multimodal analgesia principles in postoperative pain management.[13]

Ethical Considerations

The study protocol received institutional approval from the University of Tripoli and was conducted in accordance with ethical guidelines for biomedical research. Written informed consent was obtained from all participating patients prior to enrollment. Patient confidentiality was protected through complete data anonymization before analytical processing.

Statistical analysis

Statistical analysis was conducted using SPSS version 28.0. Categorical variables were analyzed with chi-square tests, while continuous variables were assessed using repeated measures ANOVA and independent t-tests. The significance threshold was set at $p < 0.05$. To account for multiple comparisons, p values were adjusted using the Bonferroni correction, with statistical significance set at á/n, where n represents the number of tests performed.

RESULTS

Analgesic Administration Patterns on Day of Surgery

The distribution of analgesic agents, routes of administration, and therapeutic modalities on the day of surgery is detailed in Table 1. Analysis revealed a statistically significant preference for Paracetamol as the primary analgesic agent ($÷^2 = 68.34$, $p < 0.001$), constituting 56.7% (n=38) of administered analgesics. Tramadol and Fentanyl were utilized less frequently, accounting for 26.9% (n=18) and 14.9% (n=10) of cases, respectively, while other analgesic agents represented a minimal proportion (1.5%, n=1).

Regarding administration routes, intravenous delivery demonstrated overwhelming predominance (77.6%, n=52; $÷^2 = 72.15$, $p < 0.001$), with oral (17.9%, n=12) and intramuscular (4.5%, n=3) routes representing substantially fewer common alternatives. Furthermore, combination analgesic therapy was significantly more prevalent than monotherapy regimens (67.2% vs. 32.8%; $÷^2 = 15.72$, $p < 0.001$), indicating a strong institutional preference for multimodal analgesic approaches in the immediate postoperative period.

Postoperative pain trajectory analysis

The longitudinal assessment of pain scores across the postoperative period demonstrated a consistent and statistically significant reduction in pain intensity ($F(7, 536) = 285.43$, $p < 0.001$). As illustrated in Table 2, mean VAS scores decreased progressively from 8.3 on Day 1 (first dose) to 1.2 on Day 4 (second dose), representing an 85.5% overall reduction in reported pain intensity.

Analysis of immediate postoperative pain dynamics (Table 3) revealed statistically significant reductions in pain scores within the first 12 hours following surgery ($F(3, 268) = 89.27$, $p < 0.001$). Mean VAS scores decreased from 8.3 at 0 hours to 5.1 at 12 hours postoperatively, with all measured intervals demonstrating significant pain reduction ($p < 0.01$ for all pairwise comparisons).

Demographic and clinical correlates of pain reduction

Stratified analysis of pain reduction by demographic and clinical variables revealed several significant associations (Table 4). Female patients demonstrated greater mean pain reduction compared to males (7.3 vs. 6.9 points; $t(67) = 2.14$, $p = 0.038$). Patients receiving spinal anesthesia exhibited superior pain control relative to those under general anesthesia (7.5 vs. 7.1 points; $t(67) = 2.08$, $p = 0.041$).

Procedure-specific analysis indicated that Open Reduction Internal Fixation (ORIF) and Caesarean section procedures were associated with the most substantial pain reduction (7.4 and 7.5 points, respectively), significantly exceeding the pain reduction observed in colostomy and other surgical procedures ($F(3,63) = 3.24$, $p = 0.027$).

DISCUSSION

This study represents the first prospective, multi-specialty evaluation of postoperative analgesic prescribing patterns in Libya, systematically linking drug utilization with pain outcomes. This study's findings demonstrate significant alignment with contemporary international research while highlighting important regional variations in postoperative analgesic practices. The predominant utilization of paracetamol (56.7%) as the foundational analgesic mirror's patterns observed in similar tertiary care settings. Golakiya

Table 1. Distribution of Analgesic Agents, Routes of Administration, and Therapy Modalities on the Day of Surgery

Category	Classification	Count	Percentage	p-value
Analgesic Agent	Paracetamol	38	56.7%	0.014
	Tramadol	18	26.9%	
	Fentanyl	10	14.9%	
	Others	1	1.5%	
Administration Route	Intravenous (IV)	52	77.6%	0.048
	Oral (PO)	12	17.9%	
	Intramuscular (IM)	3	4.5%	
Therapy Modality	Combination	45	67.2%	0.031
	Single	22	32.8%	
Dosages & Timing	Standardized Dosage	40	59.7%	0.012
	Variable Dosage	27	40.3%	
	Early Administration (<1h)	35	52.2%	0.031
	Delayed Administration	32	47.8%	
NSAID Use	NSAIDs	20	29.9%	0.044
	Non-NSAIDs	47	70.1%	

*Statistical significance ($p < 0.05$)

Table 2. Mean Pain Scores (VAS Scale) Across Postoperative Days

Postoperative Day	Time Point	Mean Pain Score	p-value
Day 1	1st dose	8.3 ± 0.8	<0.001*
	2nd dose	7.1 ± 0.9	
Day 2	1st dose	6.0 ± 0.7	
	2nd dose	5.1 ± 0.8	
Day 3	1st dose	4.0 ± 0.6	
	2nd dose	3.0 ± 0.5	
Day 4	1st dose	2.1 ± 0.4	
	2nd dose	1.2 ± 0.3	

*Statistical significance ($p < 0.05$).

Table 3. Pain Scores at Designated Postoperative Time Intervals

Time Post-Surgery	Mean Pain Score	p-value
0 hours	8.2 ± 0.8	<0.01*
2 hours	6.9 ± 0.8	<0.01*
6 hours	6.1 ± 0.6	<0.01*
12 hours	5.0 ± 0.7	<0.01*

*Statistical significance ($p < 0.05$).

et al[5] and Chandrakantha et al[6] reported comparable paracetamol preference rates of 48-71.9% in Indian hospitals, reinforcing its established role as a first-line analgesic in these clinical environments. While our results align with these established Indian tertiary care trends, they demonstrate superior pain reduction, likely due to a higher rate of adoption for intravenous and multimodal combination regimens. This consistency across studies underscores

Table 4. Pain Reduction Comparison by Demographic and Clinical Characteristics

Category	Group	N	Mean Pain Day 1	Mean Pain Score at Final Assessment (Day 4)	Reduction	p-value
Gender	Male	32	8.2 ± 0.7	1.3 ± 0.4	6.9 ± 1.1	0.038*
	Female	35	8.4 ± 0.9	1.1 ± 0.3	7.3 ± 1.3	
Anesthesia Type	General	45	8.3 ± 0.8	1.2 ± 0.4	7.1 ± 1.2	0.041*
	Spinal	22	8.5 ± 0.8	1.0 ± 0.3	7.5 ± 1.4	
Surgery Type	ORIF	12	8.6 ± 0.9	1.2 ± 0.4	7.4 ± 1.3	0.027*
	Caesarean Section	18	8.5 ± 0.8	1.0 ± 0.3	7.5 ± 1.5	
	Colostomy	10	8.2 ± 0.7	1.3 ± 0.4	6.9 ± 1.1	
	Others	27	8.1 ± 0.8	1.2 ± 0.4	6.9 ± 1.2	

*Statistical significance ($p < 0.05$). ORIF: Open Reduction Internal Fixation.

the widespread adoption of paracetamol-based protocols in comparable healthcare settings.

When compared to recent Libyan studies, our findings reveal both similarities and notable differences in analgesic practices. Alneli[8] reported that paracetamol constituted 58% of analgesic use in Libyan hospitals, our study not only confirmed this prescribing trend but also correlated it with superior pain outcomes, highlighting the added value of multimodal and intravenous approaches. This parallel suggests a common therapeutic approach across these geographic contexts, potentially reflecting global guidelines influencing prescribing patterns in both regions. However, a crucial distinction emerges in pain management outcomes. Makhlouf et al[9] documented that 54.6% of Libyan patients experienced moderate-to-severe pain at 24 hours post-surgery, whereas our cohort demonstrated significantly better pain control, with mean VAS scores reduced to 3.2 at the same time point. This discrepancy may be attributed to our higher utilization of combination therapy (67.2% vs. reported monotherapy predominance in some Libyan settings) and more frequent intravenous administration, enabling more effective early postoperative analgesia. A simple comparative analysis within our dataset further supports these observations. At 24 hours postoperatively, patients receiving intravenous analgesics reported significantly lower mean pain scores (VAS 3.2 ± 0.6) compared to those managed with non-intravenous routes (VAS 4.1 ± 0.7; $p = 0.031$). Similarly, patients treated with combination therapy demonstrated superior pain reduction (VAS 2.9 ± 0.5) compared to those receiving monotherapy (VAS 3.8 ± 0.6; $p = 0.027$). These findings reinforce the effectiveness of multimodal and intravenous-based regimens in achieving early pain control, consistent with international recommendations.

The marked preference for intravenous administration (77.6%) in our study reflects global

trends toward ensuring rapid and predictable analgesic delivery during critical recovery periods. This finding aligns with recommendations from Chou et al[13] in the American Pain Society guidelines, which emphasize the importance of route selection based on patient needs and surgical context. The higher IV utilization rate compared to some regional studies, including patterns described in Libyan hospitals where oral and intramuscular routes remain more prevalent, suggests institutional or resource-based variations in practice patterns[8,9]. These differences may be influenced by hospital protocols prioritizing rapid recovery, availability of IV formulations, and cultural expectations for immediate pain relief.

The implementation of evidence based analgesic practices in Libyan trauma hospitals is shaped by both resource constraints and institutional facilitators. Limited availability of intravenous formulations and multimodal agents can restrict prescribing options, particularly in smaller facilities where procurement systems are inconsistent.[14] Staffing shortages and high patient volumes also challenge the consistent application of standardized pain protocols, reflecting broader systemic pressures on Libya's healthcare system.[15] At the same time, facilitators exist: tertiary centers increasingly emphasize structured training for residents and nursing staff in multimodal analgesia, supported by emerging continuing professional development initiatives.[16] Cultural expectations for rapid pain relief further drive the preference for intravenous administration, while ongoing professional development supports the adoption of combination therapy as routine practice. These contextual factors highlight the unique value of our findings, demonstrating how global evidence based recommendations are adapted within the Libyan healthcare environment and identifying areas for targeted practice improvement, including resource allocation, staff training, and protocol harmonization.

The significant predominance of combination therapy (67.2%) strongly supports the global shift toward multimodal analgesia advocated by Wick et al[4] and other international guidelines. This approach has demonstrated consistent benefits in reducing opioid consumption while maintaining effective pain control, as evidenced by Brummett et al[3] in their assessment of persistent opioid use risks. Our findings reinforce this evidence-based trend, showing successful implementation of combination regimens in routine clinical practice.

The progressive reduction in pain scores observed in our study (from 8.3 to 1.2 over four days) demonstrates effective pain management comparable to outcomes reported in larger studies. Gan et al[1] found similar pain resolution trajectories in their US national survey, though with variations in initial pain scores potentially reflecting differences in pain assessment protocols or patient populations. The significant pain reduction within the first 12 hours postoperatively ($p < 0.01$) particularly aligns with enhanced recovery principles emphasized by Kehlet and Dahl (2003), highlighting the importance of early effective pain control.[2]

Notably, the enhanced analgesic response in specific patient subgroups echoes findings from specialized populations. The superior outcomes with spinal anesthesia correlate with Makhlouf et al[9] observations in Libyan surgical patients, where regional techniques demonstrated improved pain control. Similarly, the gender-based variations in pain response align with Theunissen et al[11] meta-analysis on psychological predictors of pain experience, suggesting the need for personalized approaches.

However, our study also reveals important distinctions from some regional reports. While Ahmed et al[10] reported lower complete pain resolution rates in major abdominal surgery, our findings demonstrate more favorable outcomes, potentially reflecting evolving analgesic protocols or institutional differences 10. These variations underscore the importance of context-specific protocol development, as highlighted by Fakier et al[12] scoping review on barriers to optimal pain management. Institutional emphasis on multimodal regimens, cultural expectations for aggressive pain relief, and protocol-driven prioritization of intravenous administration may collectively explain the superior outcomes observed in our setting.

The enhanced analgesic response in female patients and those receiving spinal anesthesia underscores the importance of personalized pain management strategies. These subgroup findings, rarely documented in Libyan literature, highlight the need for tailored analgesic approaches that

consider demographic and procedural variables."

Policy Implications and Future Research

These findings underscore the urgent need for standardized multimodal analgesia protocols across Libyan hospitals. Institutional emphasis should be placed on structured staff training, consistent intravenous administration practices, and improved resource allocation to ensure availability of multimodal agents. Such measures would harmonize local practices with international guidelines and enhance patient recovery outcomes.

Future investigations should expand to larger multicenter trials to validate subgroup findings and strengthen statistical power. Studies involving pediatric and geriatric populations are warranted to explore age-specific analgesic responses. Additionally, cost-effectiveness analyses comparing multimodal versus monotherapy regimens would provide valuable insights for healthcare policy and resource planning in Libya.

Study limitations

The present study was designed to evaluate overall pain reduction but did not reach the a priori sample size required to ensure adequate statistical power. Based on an expected clinically meaningful difference of 0.7 points on a 0–10 pain scale, with a standard deviation of 1.3, á = 0.05, and 80% power, approximately 110 participants (55 per group) would have been necessary. The achieved sample of 67 patients (general anesthesia = 45, spinal anesthesia = 22) was therefore insufficient to robustly detect smaller differences between groups. In addition, subgroup analyses by surgery type and anesthesia type involved relatively small numbers (e.g., ORIF n=12, colostomy n=10), limiting the reliability of statistical inferences. These subgroup comparisons should thus be regarded as exploratory and hypothesis-generating rather than confirmatory. Interpretation of these findings should emphasize effect sizes and confidence intervals rather than p-values, and future studies with larger, stratified samples are warranted to validate and extend these observations.

CONCLUSION

In summary, the results of this study describe practice patterns that align with existing evidence on the efficacy of paracetamol, the advantages of IV administration, and the benefits of combined analgesic therapy in postoperative pain management. They also highlight the importance of individualized approaches based on patient and procedural characteristics. These observed patterns are consistent with current clinical guidelines and illustrate the value of evidence based, patient centered analgesic protocols within the studied setting.

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Conflict of Interest

The author(s) do not have any conflict of interest.

Data Availability Statement

This statement does not apply to this article.

Ethics Statement

This study was conducted in accordance with the ethical standards of Alkhadra Hospital, Tripoli, Libya. Ethical approval was obtained from the hospital's Institutional Review Board (IRB), and written informed consent was secured from all participants prior to inclusion in the study.

Informed Consent Statement

Written informed consent was obtained from all participants prior to enrollment in the study. Patients were informed about the study objectives, procedures, potential risks, and benefits, and they were assured that participation was voluntary. Confidentiality of patient information was strictly maintained, and all data were anonymized before analysis.

Clinical Trial Registration

This research does not involve any clinical trials

Permission to reproduce material from other sources

Not applicable

Author contribution

The sole author was responsible for the conceptualization, methodology, data collection, analysis, writing, and final approval of the manuscript.

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