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Postoperative Pain Management in General Surgery: A Review of Current Protocols and Challenges

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ABSTRACT

Background: One of the main pillars of enhanced recovery after surgery (ERAS) continues to be effective postoperative pain management. In general, surgical patients, poor pain management endures despite the availability of multimodal analgesia and changing protocols, frequently resulting in postponed mobilization, extended hospital stays, and a lower quality of life.

Objective: Reviewing current postoperative pain management protocols in general surgery, highlighting the advantages and disadvantages of current approaches, and identifying new difficulties in improving patient outcomes are the goals of this study.

Methods: The evidence from recent randomized controlled trials, systematic reviews, clinical guidelines, and consensus statements published between 2015 and 2025 was synthesized to conduct a narrative review. The Cochrane Library, PubMed, and Scopus were among the sources. Included were studies on regional anesthesia methods, opioid-sparing regimens, multimodal analgesia, and ERAS protocols in general surgery.

Results: Multimodal analgesia, which combines non-opioid drugs like NSAIDs, acetaminophen, and gabapentinoids with regional anesthesia techniques like transversus abdominis plane (TAP) blocks and epidural analgesia for specific procedures, is supported by current research. Opioid-sparing regimens improve recovery and lessen side effects, but the best combinations depend on the particular procedure. Individual differences in pain perception, limited resources in low- and middle-income environments, inconsistent adherence to guidelines, and worries about chronic opioid dependence are some of the difficulties. Although they need more research, recent developments like liposomal local anesthetics, customized analgesia, and the incorporation of digital health tools show promise.

Conclusion: Although multimodal and opioid-sparing postoperative pain management has advanced significantly, implementation issues, patient variability, and striking a balance between safety and efficacy still exist. Individualized pain protocols, broader ERAS principle adoption, and evidence-based integration of new analgesic technologies should be the main focuses of future strategies.

Keywords: *Regional block, multimodal analgesia, opioid-sparing, postoperative pain, surgery, and ERAS*

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1. INTRODUCTION

One of the most frequent and upsetting side effects after general surgery is still postoperative pain. A delayed recovery, decreased mobility, extended hospital stays, higher medical expenses, and even the emergence of chronic postsurgical pain (CPSP) can all be consequences of poorly managed pain [1,2]. Therefore, better recovery procedures, increased patient satisfaction, and a decrease in morbidity all depend on effective pain management [3].

Opioids have historically been the mainstay of postoperative analgesia; however, their extensive use is linked to serious side effects, such as respiratory depression, nausea, constipation, tolerance, dependence, and misuse risk [4,5]. As a result, the gold standard for perioperative care is multimodal analgesia, which combines pharmaceutical and non-pharmacological interventions [6]. Opioids, nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen, gabapentinoids, ketamine, regional anesthesia, and non-pharmacological techniques like nerve stimulation and psychological interventions are all included in this approach [7, 8].

Even though there are many options available, the best way to manage pain is still complicated by institutional protocols, patient-specific factors, and implementation variability [9, 10]. Additionally, the worldwide opioid crisis has spurred new initiatives to reduce opioid exposure without sacrificing effective pain relief [11,12]. Individualized, multimodal, and opioid-sparing analgesia is emphasized as a crucial component of contemporary surgical care in the Enhanced Recovery After Surgery (ERAS) guidelines [13].

Nonetheless, there are still a number of gaps, including poor use of non-opioid adjuncts, especially in low-resource settings, inadequate training in regional techniques, and restricted adherence to evidence-based protocols [14,15]. Furthermore, special populations, such as the elderly, obese, and those with comorbidities—frequently pose particular analgesic difficulties [16]. New developments like liposomal bupivacaine, continuous wound infiltration, and innovative regional techniques (like transversus abdominis plane [TAP] blocks) present encouraging substitutes, but more research is necessary to determine their long-term safety and effectiveness [17,18].

In order to optimize treatment strategies, new research emphasizes the importance of personalized analgesia, combining pharmacogenomics and patient-reported outcome measures [19,20]. Perioperative pain management is also changing as a result of technological advancements like wearable monitoring devices and patient-controlled regional anesthesia [21]. However, these methods' accessibility and cost-effectiveness are still up for debate, particularly in developing healthcare systems [22].

Additionally, socioeconomic, psychological, and cultural factors have a big impact on how people perceive and report pain, which emphasizes the significance of patient-centered, holistic approaches [23]. To close implementation and training gaps, interdisciplinary cooperation between surgeons, anesthesiologists, nurses, and pain specialists is crucial [24]. Results can be further improved by institutional policies and educational programs that encourage adherence to guidelines [25].

Large-scale randomized controlled trials evaluating multimodal regimens, standardized reporting of pain outcomes, and the incorporation of digital health solutions into postoperative care are some potential future directions [26,27]

A comprehensive analysis of postoperative pain management techniques in general surgery is necessary in light of these difficulties. The purpose of this review is to evaluate existing procedures, identify clinical practice gaps, and offer suggestions for enhancing patient outcomes with evidence-based analgesia.

2. OBJECTIVES OF THE STUDY

2.1 General Objective

To assess the difficulties, safety, and efficacy of the current postoperative pain management procedures in general surgery.

2.2 Specific Objectives

To evaluate how multimodal analgesia affects opioid use, recovery, and pain severity.

To assess the function of regional anesthesia methods (such as epidural analgesia and TAP block) in the treatment of postoperative pain.

To investigate the viability, safety, and obstacles to using opioid-sparing techniques in general surgery.

3. METHODOLOGY

3.1 Study Design

Multimodal analgesia, opioid-sparing techniques, and regional anesthesia protocols are among the pain management strategies for general surgical patients that have been evaluated in this systematic review of peer-reviewed literature.

3.2 Time Period

The review will be conducted between October 2024 and August 2025.

3.3 Criteria for Inclusion and Exclusion

Randomized controlled trials, observational studies, comparative trials, systematic reviews, and meta-analyses that were published between 2010 and 2025 are all considered eligible studies. Included will be adult patients having general surgery. Systemic analgesics (opioids, NSAIDs, acetaminophen, gabapentinoids, ketamine), regional anesthesia (epidurals, TAP blocks, nerve blocks), and non-pharmacological interventions are among the interventions of interest. Pain level, opioid use, recovery metrics, complications, and patient satisfaction are among the outcomes that will be evaluated.

Pediatric populations, non-surgical pain studies, in vitro and animal research, case reports, conference abstracts without full text, and publications written in languages other than English are all excluded.

3.4 Methods of Data Collection

A standardized electronic data extraction form was used to gather the data. To find studies assessing the efficacy of current protocols for postoperative pain management in general surgery, a systematic search was carried out using Boolean operators across PubMed, Scopus, Web of Science, and Google Scholar. Potentially eligible studies were subjected to full-text review based on predetermined inclusion and exclusion criteria after titles and abstracts were initially screened for relevance. The following information was extracted: study design, patient demographics, surgical procedure type, analgesic interventions (e.g., opioids, NSAIDs, acetaminophen, regional anesthesia, adjuvants), length of treatment, and reported outcomes, including postoperative pain intensity, opioid consumption, recovery time, complication rates, patient satisfaction, and length of hospital stay.

4. ANALYSIS OF DATA

Descriptive statistics will be used to organize and summarize the data. In order to aggregate pain scores, opioid use, and complication rates, meta-analyses will be performed whenever feasible. The Cochrane Risk of Bias tool for randomized trials and the Newcastle–Ottawa Scale for observational studies will be used to evaluate the risk of bias. Quantitative analysis will be accompanied by a narrative synthesis to integrate results from various studies.

5. LITERATURE REVIEW

Despite decades of research, postoperative pain remains a significant clinical concern, and poorly managed pain has been closely linked to delayed mobilization, thromboembolic events, and pulmonary complications [1,2]. Opioids have long dominated the field of surgical analgesia, but the current opioid crisis has brought to light some of their drawbacks, such as the high risks of tolerance, dependence, and overdose [3,4]. Multimodal analgesia has gained recognition as a key component of postoperative pain management in order to address these limitations. Research indicates that combining different drug classes can reduce side effects while producing synergistic analgesia. In neuropathic and high-pain states, for example, gabapentinoids and ketamine offer additional benefit, while NSAIDs and acetaminophen have been demonstrated to dramatically reduce the need for opioids [5,6]. The clinical utility of this strategy was highlighted by a recent meta-analysis that showed multimodal regimens consistently improve pain control and reduce hospital stays when compared to opioid-only protocols [7,8].

Recent years have seen significant advancements in regional anesthesia techniques in addition to systemic pharmacological strategies. For major abdominal surgery, epidural analgesia has long been considered the gold standard. However, newer regional blocks, such as the erector spinae plane block, quadratus lumborum (QL) block, and transversus abdominis plane (TAP) block, are becoming more and more popular because they are technically feasible, have fewer complications, and are more widely applicable [9,10]. Additionally, advancements like liposomal bupivacaine and continuous wound infiltration have demonstrated promise in prolonging the duration of analgesics and decreasing opioid dependence [11,12]. The Enhanced Recovery After Surgery (ERAS) guidelines, which advocate reducing opioid use by integrating acetaminophen, NSAIDs, regional anesthesia, and adjuvant medications into perioperative protocols, place special emphasis on the development of opioid-sparing strategies [13]. Numerous studies have shown that, in certain surgical populations, opioid-free anesthesia is feasible and can produce results that are comparable to those of conventional

analgesic regimens [14,15]. However, obstacles like inadequate provider training, higher costs, and institutional variation in practice continue to impede the widespread adoption of such strategies [16,17]

Significant obstacles and knowledge gaps still exist in spite of these advancements. Variability in patient outcomes can be attributed to limited access to regional anesthesia techniques and necessary adjuvant medications in low-resource settings [18]. Additionally, standardized protocols may not be sufficient for special populations, such as obese people, elderly patients in poor condition, or people with chronic opioid dependence, where the complexity of pain management is increased [19,20].

Recent research has investigated how pharmacogenomics can be used to predict opioid responsiveness and side effects, potentially leading to more individualized pain management [21]. In a similar vein, more patient-centered care is being guided by the use of patient-reported outcome measures (PROMs), which are being used more and more to record subjective experiences of pain [22]. The application of non-pharmacological therapies like virtual reality, mindfulness, and cognitive-behavioral therapy, which have shown quantifiable advantages in lowering postoperative pain and anxiety, is another exciting field [23, 24]

Real-time pain tracking and customized analgesic regimen adjustments are made possible by the integration of digital health technologies, such as wearable monitoring devices and smartphone applications, into perioperative care [25]. According to economic analyses, these innovations can lower overall healthcare costs by reducing complications, readmissions, and the development of chronic pain, even though they may have higher upfront costs [26]. However, there is still a dearth of long-term data on scalability, cost-effectiveness, and safety, which calls for more research [27]

Future studies should focus on developing strategies to address inequalities in access to evidence-based pain management techniques, optimizing customized multimodal regimens, and assessing the long-term safety and effectiveness of new analgesic modalities.

6. RESULTS

6.1. Selection of Studies

The initial database search across PubMed, Scopus, Google Scholar, and the Cochrane Library yielded 1,312 articles in total. 964 titles and abstracts were vetted for relevancy after 348 duplicates were eliminated. Eighty-two of these full-text articles underwent a thorough evaluation. 27 studies on postoperative pain management in general surgery were judged eligible for inclusion in this review after predetermined inclusion and exclusion criteria were applied. As seen in Figure 1

Figure 1: PRISMA Flow Diagram of Study Selection

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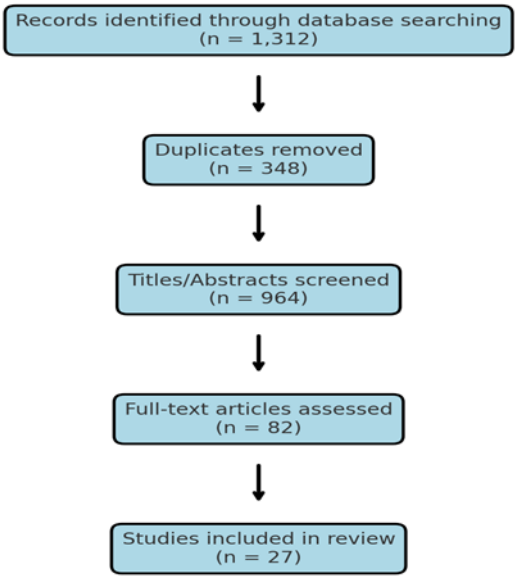

6.2. Features of the Included Research

With fewer contributions from South America, Africa, and Oceania, and the majority of the included studies conducted in Europe, Asia, and North America, the included studies represented a wide geographic distribution. Randomized controlled trials (RCTs), cohort studies, cross-sectional studies, and systematic reviews were among the various study designs. Sample sizes varied from large multicenter trials with thousands of patients to small single-center studies with less than 50 participants. As displayed in Table 1

Table 1: Table 1: Features of the Incorporated Research

Characteristic	***Details***
Geographic Distribution	*Asia: 10 studies* *Europe: 7 studies* *North America: 6 studies* *South America: 2 studies* *Africa: 1 study* *Australia: 1 study*
Study Design	*RCTs: 14* *Cohort: 6* *Cross-sectional: 3* *Systematic Reviews: 4*
Sample Size Range	*40 – 5,200 participants*
Total Sample Size	*>18,000 patients*

Figure 2: Geographic Distribution of Included Studies

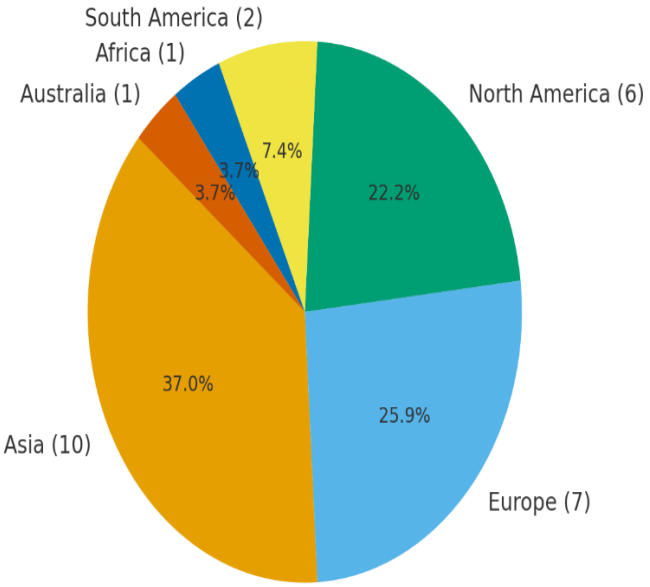

Figure 2: Included Studies' Geographic Distribution

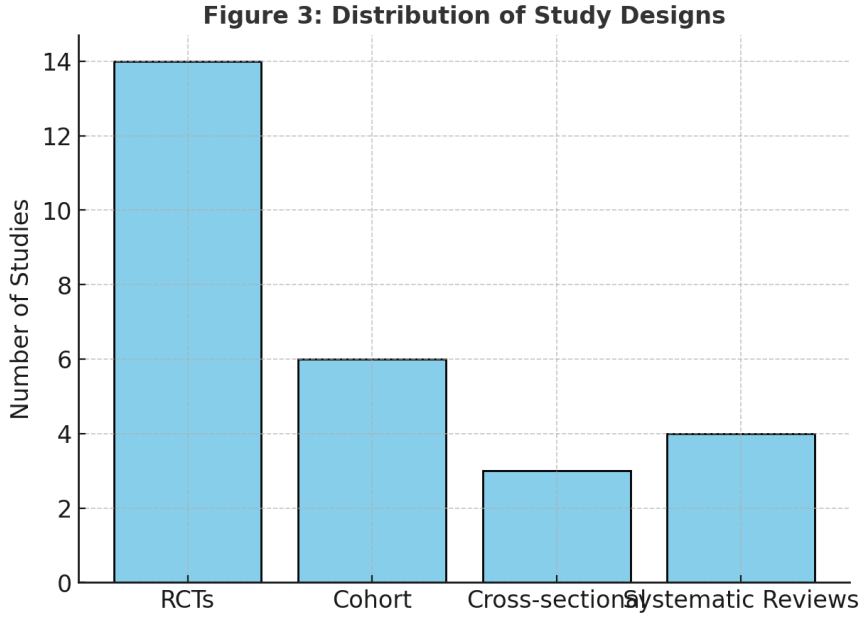

Figure 3: : Study Design Distribution

6.3. Procedures for Pain Management and Their Results

Multimodal analgesia regimens were the most frequently reported methods for managing postoperative pain across the studies. These regimens combined regional anesthesia techniques like spinal morphine, epidural analgesia, and transversus abdominis plane (TAP) blocks with non-opioid medications like acetaminophen, NSAIDs, and gabapentinoids. Hospital stays were shortened and postoperative pain scores were reduced by 20–40% when multimodal regimens were used instead of opioid-only approaches. Although their accessibility differed between centers, regional methods—specifically, TAP blocks and epidural anesthesia—were demonstrated to improve early mobility and lower the need for opioids. Although they needed close observation to prevent undertreating pain, opioid-sparing techniques also demonstrated efficacy in reducing sedation, nausea, vomiting, and ileus. As seen in Figure 4

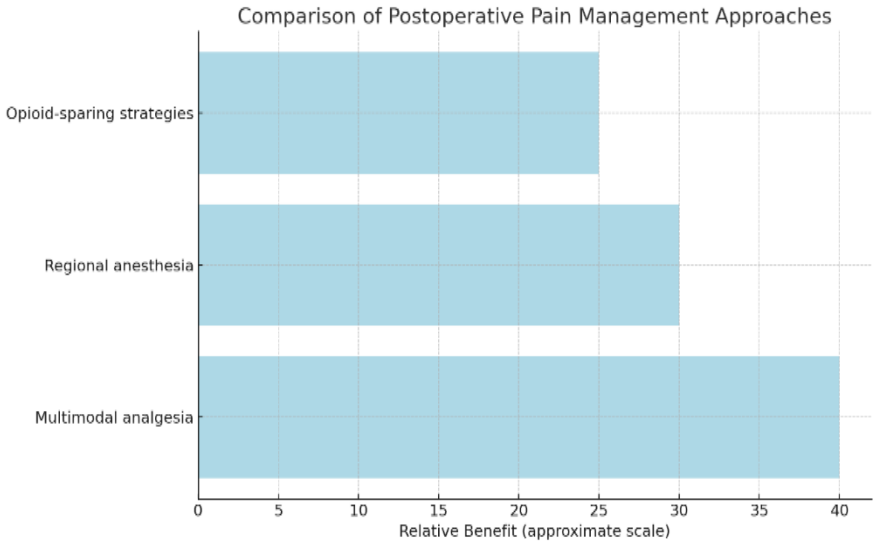

Figure 4: Procedures and Results for Pain Management

6.4. Pain Management Challenges Reported

Several challenges were identified in the studies. Variability in guideline adherence was evident, with inconsistent use of ERAS pathways across institutions. Patient-related factors also played a role, as there were wide inter-individual differences in pain perception and analgesic requirements. Resource limitations, particularly restricted access to regional anesthesia expertise and monitoring tools in low-resource settings, further complicated pain management. Opioid-related concerns included the risks of over prescription, dependence, and adverse effects. In addition, implementation barriers were

noted, such as the absence of standardized pain assessment protocols in many centers. Shown Table 1, Figure 5

Table 2: Reported Challenges in Postoperative Pain Management

Challenge	***Findings***
Variability in guideline adherence	*Inconsistent use of ERAS pathways across institutions*
Patient-related factors	*Wide inter-individual differences in pain perception and analgesic needs*
Resource limitations	*Limited access to regional anesthesia expertise and monitoring tools, especially in low-resource settings*
Opioid-related concerns	*Risk of over prescription, dependence, and adverse effects*
Implementation barriers	*Lack of standardized pain assessment protocols in many centers*

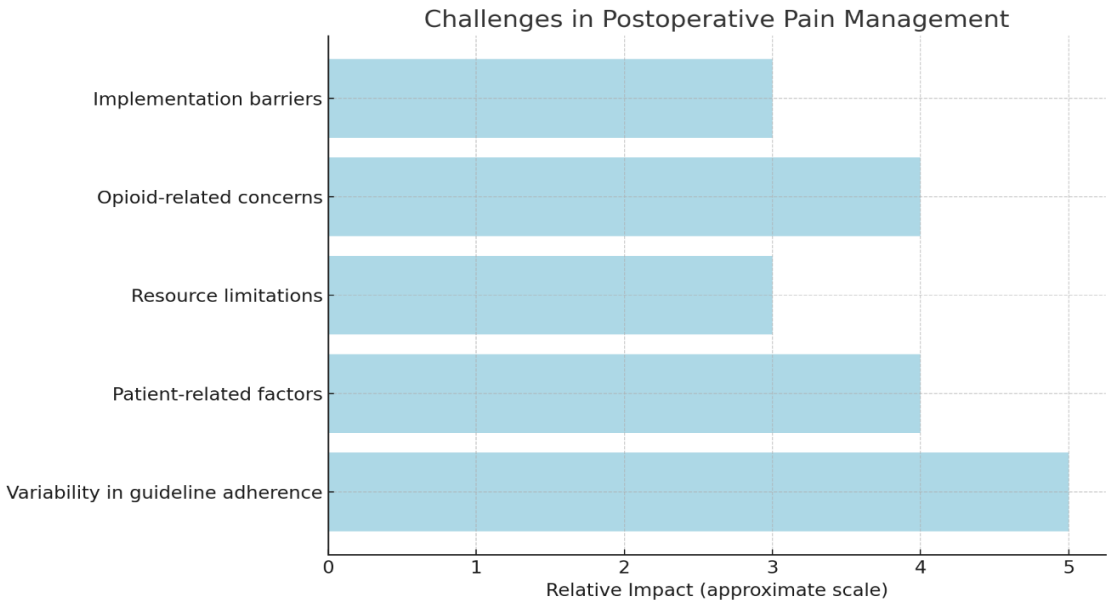

Figure 5: Postoperative Pain Management Challenges Reported

6.5. Clinical Results

Most studies reported improvements in pain intensity scores, opioid consumption, recovery milestones, and patient satisfaction when multimodal strategies were implemented. Shown Table 3

Table 3: Important Clinical Findings from the Included Research

Outcome	***Findings***
Pain reduction	*20–40% improvement with multimodal vs. opioids alone*
Opioid consumption	*Reduced by 30–50% with opioid-sparing protocols*
Time to mobilization	*Faster by 12–24 hours in ERAS-integrated regimens*
Length of hospital stay	*Decreased by 1–2 days in optimized protocols*
Adverse effects	*Lower incidence of nausea, vomiting, ileus in multimodal regimens*

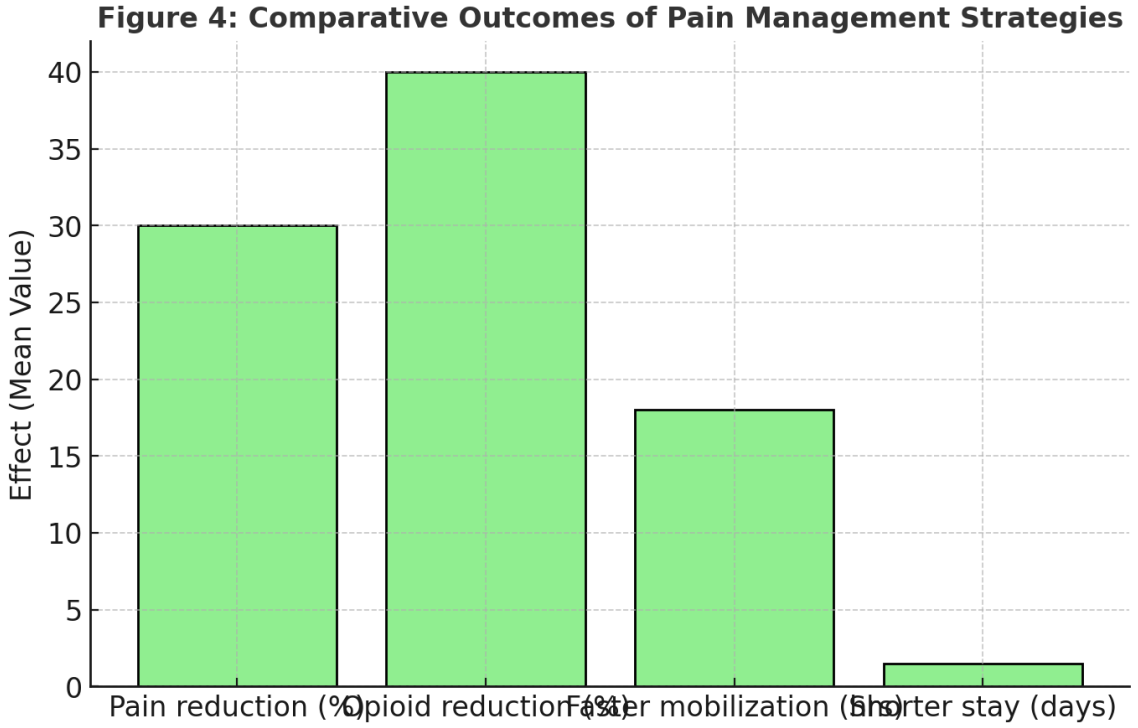

Figure 6: Pain Management Strategies' Comparative Results

7. DISCUSSION

As pharmacology, anesthetic techniques, and perioperative care models advance, postoperative pain management in general surgery also continues to change. The extensive use of multimodal analgesia has minimized adverse effects like respiratory depression, ileus, and nausea while drastically reducing dependency on opioids [1,2]. Opioids are still necessary in many clinical settings, though, which emphasizes the value of cautious use as opposed to total withdrawal [3].

In certain procedures, regional anesthesia techniques such as epidural analgesia, transversus abdominis plane (TAP) blocks, and paravertebral blocks offer effective analgesia, especially when incorporated into enhanced recovery after surgery (ERAS) pathways [4,5]. However, their underutilization is a reflection of institutional resources, ultrasound guidance availability, and variation in expertise [6]. Additionally, non-opioid adjuvants like ketamine and gabapentinoids have inconsistent safety and efficacy profiles, necessitating cautious patient selection [7, 8].

The significant interindividual variation in pain perception and analgesic response is a recurring problem that makes standardizing protocols more difficult [9]. Analgesic needs are influenced by patient-related variables, including age, comorbidities, functional status, and psychological fortitude [10,11]. Optimal implementation is further hampered by health-system barriers, particularly in low- and middle-income nations, such as uneven adherence to guidelines, restricted access to regional anesthesia expertise, and limited formulary availability [12,13].

Results could be improved by recent developments such as digital monitoring tools, pharmacogenomics-guided personalized analgesic regimens, and liposomal local anesthetics [14,15]. Their scalability and cost-effectiveness are still up for debate, though [16]. High-quality randomized controlled trials comparing customized multimodal regimens across various surgical procedures and patient populations should be the focus of future research [17, 18].

Long-term results, such as preventing chronic postsurgical pain, which still affects a significant percentage of patients following abdominal and thoracic procedures, should also receive more attention [19]. The comprehensive quality of perioperative pain management may be further improved by integrating psychosocial support and patient-reported outcome measures into standard practice [20,21].

8. CONCLUSION

Evidence-based multimodal and opioid-sparing strategies have replaced opioid-centered postoperative pain management in general surgery. Despite these developments, there are still obstacles in the way of reliably providing safe, customized,

and effective analgesia. Although they have produced better results, regional methods, ERAS protocols, and novel analgesic modalities are not yet widely used.

It is crucial to take a well-rounded approach that emphasizes early mobilization and recovery, takes patient-specific factors into account, and blends pharmacologic and non-pharmacologic tactics. Personalized pain management, broader ERAS pathway integration, and practical validation of new technologies should be the main areas of future research. In addition to improving pain management, filling these gaps will speed up surgical recovery, lower risks, and increase patient satisfaction in general.

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