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Optimizing Perioperative Analgesia in Cardiac Surgery: An Updated Mini-Review of Multimodal Strategies

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Abstract

The opioid epidemic necessitates a paradigm shift in postoperative pain management for cardiac surgery. Multimodal analgesia (MMA) within Enhanced Recovery After Surgery (ERAS) protocols reduces opioid consumption while improving patient outcomes. MMA integrates non-opioid analgesics, regional anesthesia techniques like fascial plane blocks, and systemic adjuncts to target multiple pain pathways. Recent evidence shows significant reductions in opioid use, shorter hospital stays, and decreased complications such as ileus and delirium. However, gaps persist in protocol standardization, efficacy in high-risk populations (e.g., those with endocarditis or liver disease, potentially due to altered drug metabolism), and long-term impacts on chronic pain and renal function. This mini-review consolidates recent (2022-2025) data, highlighting new evidence on fascial plane blocks and implementation challenges, and proposes directions for future research to optimize analgesia in cardiac surgery.

Background

Postoperative pain following cardiac surgery arises from sternotomy, thoracotomy, and extensive tissue manipulation. For decades, opioids have primarily addressed this pain. While effective in blunting acute discomfort, opioids lead to troubling side effects, including respiratory depression, ileus, nausea, and delayed recovery [1]. The ongoing opioid crisis heightens these risks, as excessive reliance on opioids contributes to dependency and broader societal burdens [2]. In response, MMA reduces opioid consumption while improving patient outcomes. MMA blends low-dose opioids with non-opioid medications such as acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and gabapentinoids, alongside regional techniques, to curtail opioid needs while bolstering overall pain relief [3]. This approach aligns with ERAS protocols tailored for cardiac procedures, which prioritize early mobilization, shorter intensive care unit (ICU) stays, and superior patient outcomes [4]. Where once opioid-heavy regimens prolonged intubation and hospital admissions, MMA now steers toward opioid-sparing methods that mitigate the epidemic's impact [5].

MMA Mechanisms

MMA addresses pain through multiple pathways-nociceptive, inflammatory, and neuropathic- permitting substantial opioid dose reductions and fewer adverse effects [6]. In cardiac surgery, MMA's advantages extend beyond pain control to encompass fewer opioid-linked complications, refined analgesia, and accelerated recovery [7]. Regional anesthesia plays a pivotal role, with fascial plane blocks offering a safer alternative to traditional neuraxial methods. Blocks such as parasternal, pectoralis (PECS), or serratus anterior plane (SAP) deliver precise analgesia without hemodynamic disruptions that complicate recovery, thus supporting broader opioid-sparing goals [8].

Evidence

Recent investigations illuminate MMA's potential to reduce opioid use in ERAS settings. To provide a clear overview of this supporting data, Table 1 synthesizes findings from key studies, including their sample sizes, interventions, opioid reductions, and primary outcomes. This compilation highlights the consistency of MMA's benefits across systemic, regional, and combined approaches, demonstrating its role in minimizing opioid reliance while maintaining effective pain control and enhancing recovery metrics.

Systemic Interventions

Pairings like NSAIDs with dexamethasone achieve reductions of up to 29.5 MME, underscoring their edge over acetaminophen alone [9]. A randomized trial pitting MMA- using dexamethasone, gabapentin, ibuprofen, and paracetamol- against a morphine-paracetamol regimen showed superior pain scores and far less nausea/vomiting in the MMA arm, with no compromise to renal safety [12]. Narrative reviews detail how systemic adjuncts enhance cardiothoracic care by curbing opioids and syncing with ERAS to boost recovery and satisfaction [8].

Table 1: Summary of key studies on multimodal analgesia in cardiac surgery.

Study (Year)	Sample Size	Intervention	Δ total MME	Primary Outcomes
Graham, et al. [9]	23,238	NSAIDs + dexamethasone	-29.5 MME	↓ Pain (1.0 NRS), shorter recovery
Darras, et al. [10]	2,052	Parasternal block in ERAS	-20 MME	↓ Ventilation, ileus, delirium; shorter ICU
Loria, et al. [11]	466	Gabapentin + acetaminophen/NSAIDs	-193 MME	↓ Perioperative opioid use
Rafiq, et al. [12]	151	Dexamethasone + gabapentin + ibuprofen	Marked ↓ in total MME	↑ Pain control, ↓ nausea; no renal injury
Rauseo, et al. [13]	58,998	MMA + regional blocks	-2.48 MME	↓ ICU stay, pain; no mortality Δ
Wynne, et al. [14]	Review	Multimodal analgesics	Marked ↓ in total MME	↑ Pain control

(Δ total MME = change in total perioperative morphine milligram equivalents)

Regional Anesthesia

Parasternal plane blocks (PPB) in an ERAS program achieve a 94% opioid-free rate in the ICU, compared to just 19.9% in controls, with median ICU opioid use falling from 31 to 11 MME [10]. Techniques like PECS and SAP blocks facilitate rapid extubation and diminished opioid demands [15]. Ultrasound guidance propels a move toward opioid-free anesthesia, trimming complications and aligning with ERAS principles [16].

Combination Approaches

An ERAS rollout featuring gabapentin, lidocaine, and acetaminophen/NSAIDs produces a 57% drop in total opioid use (from 452 to 259 MME), though patients with a history of intravenous drug use see no such benefit, hinting at tolerance as a limiting factor [11]. A 2025 meta-analysis of opioid-sparing approaches in cardiac procedures confirms reduced opioid intake without sacrificing pain management [13]. A systematic review from 2025 assesses multimodal analgesics' impact on post-cardiac surgery pain in adults, finding marked enhancements in pain control and opioid sparing [14].

Challenges

Even with these advances, notable gaps linger in the literature. Protocols lack standardization, as they differ widely in their choice of agents and fascial plane blocks, complicating broader application [9,10]. MMA shows limited efficacy in high-risk groups, such as intravenous drug users, where tolerance undermines its effectiveness [11]. Insufficient data exist on endocarditis patients, where opioid-sparing benefits vary considerably; hypotheses suggest that infection-related inflammation alters pain pathways or increases opioid tolerance due to prior intravenous drug use in many cases, potentially reducing MMA benefits; preliminary data from ERAS studies often exclude these patients due to infection risks, guiding future research toward tailored regimens that account for antimicrobial interactions [9,11]. Similarly, scant evidence addresses liver disease patients, where altered drug metabolism (e.g., impaired clearance of acetaminophen or opioids) hypothesizes reduced MMA efficacy or heightened hepatotoxicity risks; preliminary reviews recommend multimodal strategies with regional techniques to minimize systemic drug loads, but dedicated trials are needed to test liver-safe combinations [9,11]. On the safety side, NSAIDs cause minor, non-significant creatinine elevations, but extended data on renal health in patients with cardiac comorbidities remain lacking [9,12]. Chronic pain, which affects 20–50% of patients after surgery [15], receives scant attention, with most research focused on acute phases rather than MMA's potential to prevent long-term issues [8]. Barriers to rollout, such as the resources required for fascial plane blocks, are seldom explored [16], while analyses parsing minimally invasive versus open surgeries lack consistency [10,15]. Finally, evaluations of cost-effectiveness and adaptability across varied healthcare environments are overdue; a 2023 registry-based study showed that a perioperative pain management bundle reduced hospital costs by €1,138 per patient through shorter stays and fewer complications, suggesting similar savings may apply in cardiac surgery with further study [18].

Future Directions

Research should prioritize multicenter randomized trials to standardize MMA protocols, embedding fascial plane blocks within ERAS while tracking long-term outcomes like chronic pain [4]. Trials centered on high-risk subgroups- particularly endocarditis and liver disease patients- will refine personalized tactics [11]. A preliminary MMA framework includes core drugs (acetaminophen, NSAIDs, gabapentin) and fascial plane blocks (parasternal for sternotomy, PECS for broader coverage), adjusted for comorbidities and surgical type [9-10]. Emerging adjuncts like liposomal bupivacaine and pharmacogenomics-based dosing hold promise [19]. Training in ultrasound-guided blocks and shared registries will accelerate uptake and close evidence gaps [16,20].

Conclusion

Multimodal analgesia transforms postoperative care in cardiac surgery, aligning with ERAS principles to

reduce opioid reliance while preserving pain control and recovery quality. Despite robust evidence of benefit, heterogeneity in protocols, underrepresentation of high-risk populations and limited long-term outcomes research remain barriers to full adoption. Standardized frameworks integrating fascial plane blocks, validated through multicenter trials and real-world registries, will define the next-generation ERAS standard and improve outcomes across diverse healthcare systems. This mini-review consolidates recent (2022-2025) evidence, emphasizing novel insights into fascial plane blocks and addressing implementation barriers.

References

1. Gan TJ (2017) Poorly controlled postoperative pain: Prevalence, consequences, and prevention. J Pain Res 10: 2287-2298.
2. Volkow ND, Jones EB, Einstein EB, Wargo EM (2019) Prevention and treatment of opioid misuse and addiction: A review. JAMA Psychiatry 76: 208-216.
3. Buvanendran A, Kroin JS (2009) Multimodal analgesia for controlling acute postoperative pain. Curr Opin Anaesthesiol 22: 588-593.
4. Engelman DT, Ben Ali W, Williams JB, Perrault LP, Reddy VS, et al. (2019) Guidelines for perioperative care in cardiac surgery: Enhanced recovery after surgery society recommendations. JAMA Surg 154: 755-766.
5. Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, et al. (2016) 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 17: 131-157.
6. Kehlet H, Dahl JB (1993) The value of "multimodal" or "balanced analgesia" in postoperative pain treatment. Anesth Analg 77: 1048-1056.
7. American Society of Anesthesiologists Task Force on Acute Pain Management. (2012) 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 116: 248-273.
8. Capuano P, Sepolvere G, Toscano A, Scimia P, Silvetti S, et al. (2024) Fascial plane blocks for cardiothoracic surgery: a narrative review. J Anesth Analg Crit Care 4: 20.
9. Graham LA, Illarmo S, Wren SM, Mudumbai SC, Odden MC (2025) Optimal multimodal analgesia combinations to reduce pain and opioid use following non-cardiac surgery: An instrumental variable analysis. Reg Anesth Pain Med 50: 106720.
10. Darras M, Schneider C, Marguerite S, Saadé S, Maechel AL, et al. (2024) Multimodal analgesia with parasternal plane block protocol within an enhanced recovery after cardiac surgery program decreases opioid use. JTCVS Open 22: 25-35.
11. Loria CM, Zborek K, Millward JB, Anderson MP, Richardson CM, et al. (2022) Enhanced recovery after cardiac surgery protocol reduces perioperative opioid use. JTCVS Open 12: 280-296.
12. Rafiq S, Steinbrüchel DA, Wanscher MJ, Andersen LW, Navne A, et al. (2014) Multimodal analgesia versus traditional opiate based analgesia after cardiac surgery, a randomized controlled trial. J Cardiothorac Surg 9: 52.
13. Rauseo M, Mirabella L, Carrideo AA, Padovano FP, Cantatore LP, et al. (2025) Opioid-sparing Anesthesia in Cardiac Surgery: A Meta-analysis. J Cardiothorac Vasc Anesth 39: 3140-3153.
14. Wynne R, Jedwab RM, Gjeilo KH, Fredericks S, Magboo R, et al. (2025) A systematic review of multimodal analgesic effectiveness on acute postoperative pain after adult cardiac surgery. J Adv Nurs 81: 2757-2792.
15. Jiang T, Ting A, Leclerc M, Calkins K, Huang J (2021) Regional anesthesia in cardiac surgery: A review of the literature. Cureus 13: e18808.
16. Chakravarthy M (2018) Regional analgesia in cardiothoracic surgery: A changing paradigm toward opioid-free anesthesia? Ann Card Anaesth 21: 225-227.
17. Møller MH, Claudius C, Junttila E, Haney M, Oscarsson-Tibblin A, et al. (2016) Scandinavian SSAI clinical practice guideline on choice of first-line vasopressor for patients with acute circulatory failure. Acta Anaesthesiol Scand 60: 1347-1366.
18. Bojic S, Ladjevic N, Palibrk I, Soldatovic I, Likic-Ladjevic I, et al. (2023) Cost-effectiveness of the perioperative pain management bundle a registry-based study. Front Public Health 11: 1157484.
19. Malik O, Kaye AD, Kaye A, Belani K, Urman RD (2017) Emerging roles of liposomal bupivacaine in anesthesia practice. J Anaesthesiol Clin Pharmacol 33: 151-156.
20. Williams JB, McConnell G, Allender JE, Grayburn PA, Mack MC, et al. (2021) One-year results from the STS/ACC Transcatheter Valve Therapy Registry. JAMA Cardiol 6: 219-227.

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