



Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: [www.jcvaonline.com](http://www.jcvaonline.com)

## Editorial

## Enhanced Recovery After Surgery for Cardiac Surgery: Will We Have the Techniques Needed to Reduce Opioid Use and Still Provide Appropriate Analgesia?



SEVERAL STUDIES evaluating opioid-sparing techniques in cardiac surgery patients to provide quicker emergence from anesthesia with rapid extubation and superior analgesia have been published recently. These enhanced recovery techniques are being used in an attempt to reduce overall cost, improve satisfaction, and reduce morbidity. In many of these studies, a multimodal analgesic technique was used with the incorporation of regional anesthesia. These techniques classically have involved local anesthetic (LA) infiltration; neuraxial techniques using thoracic epidural anesthesia (TEA); intrathecal morphine injection; and, as recently reported in this journal, the use of continuous ropivacaine infusion into the sternotomy wound using a multiorifice catheter with an elastomeric pump.<sup>1</sup> Other regional techniques used to provide analgesia to the chest wall could reduce pain and opioid requirements, in turn allowing for better chest wall mechanics, reduced atelectasis, and improved pulmonary function.<sup>2</sup> Mitnacht et al.<sup>3</sup> described the types of chest wall pain that occur after cardiac surgery, the innervation of the chest wall that elicits the pain, and the regional techniques appropriate to block the nerves damaged by the incision and surgical approach. These blocks are used to provide pain relief and to avoid or reduce the use of opioids and their unwanted side effects, such as respiratory depression, delirium, and gastrointestinal dysfunction.

If multimodal analgesic medications are used, why do we need regional anesthesia? Why not use a combination of drugs to reduce the overall use of opioids? Ketamine can be a useful part of a multimodal pain management strategy<sup>4</sup> but carries the risk of delirium and hallucinations and is known to increase sympathetic outflow in patients at risk for perioperative cardiac ischemia. Dexmedetomidine also can be used as an adjuvant to reduce opioid use. However, the associated bradycardia, hypotension, and sedation can be problematic after cardiac surgery. The addition of a nonsteroidal anti-inflammatory agent as an adjunct is associated with bleeding and renal

dysfunction. Clearly, multimodal drug combinations for analgesia after cardiac surgery have many limitations. The addition of regional techniques or neuraxial anesthesia negates the reliance on these other agents.

Neuraxial techniques may be used for analgesia and reduce the need for opioids. These techniques, especially TEA, are considered the gold standard for pain relief after cardiac surgery. A study examining the use of TEA for enabling ultrafast-track anesthesia in off-pump coronary artery bypass demonstrated that although immediate extubation in the operating room can be achieved using either opioid-based analgesia or TEA, TEA provided significantly lower pain scores after surgery compared with patient controlled analgesia (PCA) using morphine.<sup>5</sup> One potential disadvantage of TEA is the risk of epidural hematoma, which potentially has devastating implications. This risk can be as high as 0.35% and is increased by systemic heparinization. Arterial or venous epidural puncture also could occur during placement. This could delay surgery because of the risk of bleeding with heparinization. Postoperative coagulopathy can place the patient at risk for bleeding on removal of the catheter or even make removal contraindicated until the coagulopathy is corrected. Estimates of the risk of spinal injury from epidural hematoma have been calculated to range from 1:150,000 to 1:1,500.<sup>6</sup> Other side effects with TEA could occur if opioids are used in combination with LAs. These include pruritus (0%-100%), nausea and vomiting (30%), and urinary retention (0%-80%). Hypotension also is relatively common (50%-90%) when epidural LA is used.<sup>7</sup> Arterial or venous epidural puncture also could occur during placement. This could delay surgery because of the risk of bleeding with heparinization. TEA is not without risk, which probably is why peripheral nerve block techniques are being considered as a method to provide safe and effective analgesia to minimize or eliminate the use of opioids.

DOI of original article: <http://dx.doi.org/10.1053/j.jvca.2018.09.017>.<https://doi.org/10.1053/j.jvca.2018.10.022>

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Intrathecal morphine injection is another neuraxial technique that has been well studied in cardiac surgery. Early studies found superior analgesia and decreased need for antihypertensive medications in the immediate postoperative period with no difference in the 20 hour time to extubation. As fast-track surgery emerged, studies using varying doses of intrathecal morphine with standardized or unstandardized intraoperative management demonstrated conflicting results. Higher doses of morphine seemed to be associated with better analgesia but hindered early extubation, whereas lower doses amenable to early extubation may or may not have any benefit in terms of analgesia. The best combination of patient selection, dosing, and intraoperative management has yet to be established.<sup>7</sup> Even though studies have shown low-dose intrathecal morphine alone to be unreliable as an adjunct to reduce oral or parenteral opioid use, several studies have shown that in patients with preserved left ventricular function, the combination of intrathecal clonidine with morphine may preserve the ability to fast-track with both providing analgesia and blunting the stress response to surgery.<sup>8–10</sup> However, the potential for bleeding and hemodynamic alterations remains.

The practice of continuous LA infusion into the wound has been shown to be beneficial in some studies<sup>11</sup> and of no benefit in others.<sup>1</sup> However, the results of some of these studies are suspect because variations in catheter placement, along with dosing techniques and catheter position, may be the reason for the differences in results observed. In addition, the pump continuously infuses LA agents and depending on the concentration used, fairly high serum levels can be noted with effective analgesia.<sup>11</sup> Lower concentrations of LAs may not provide adequate analgesia when infused at the rate provided by the elastomeric pumps.

When all this is taken into consideration, regional nerve blocks of the chest wall may be the best method to provide analgesia and lower opioid use with fewer complications. The use of ultrasound to place these blocks under direct visualization adds to the safety profile of these procedures. Many studies have evaluated paravertebral blocks for chest wall analgesia after cardiac surgery. Investigators have determined a decreased risk of neurologic damage using paravertebral catheters compared with thoracic epidural catheters, particularly if the patient is anticoagulated. Other studies have demonstrated continuous paravertebral blocks provided as good or better analgesia after minimally invasive cardiac bypass grafting using minithoracotomy.<sup>12</sup> Other studies also have shown a beneficial analgesic effect with paravertebral block after cardiac surgery, establishing the concept that peripheral nerve blocks pose less risk of neurologic injury and provide comparable analgesic effects as TEA. Regional anesthetic blocks of the chest wall have been shown to reduce sternotomy pain and opioid use. A study of patients randomly assigned to receive parasternal blocks with levobupivacaine versus placebo showed significantly decreased opioid use in the block group and better oxygenation at time of extubation, whereas the placebo group required opioids to manage breakthrough pain.<sup>13</sup>

It appears that peripheral nerve blocks may be the best adjunct for pain relief after cardiac surgery, reducing the need for opioids and enhancing recovery in patients to reduce morbidity and length of stay. Other regional techniques, such as neuraxial blocks and continuous infusion of LAs, have either more severe complication rates or failure of effect that may not make them the ideal technique for enhanced recovery after surgery protocols. Future comparator studies between the different regional techniques will be key in assessing which technique is the best and most reproducible to provide analgesia and improve chest wall mechanics for the enhanced recovery of cardiac surgery patients.

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