Continuous Local Anesthetic Wound Infusion to Improve Postoperative Outcome

Back to the Periphery?

EFFECTIVE postoperative analgesia is a prerequisite to enhance the recovery process and reduce morbidity. The use of local anesthetic techniques is well documented to be effective, but single-dose techniques (infiltration, peripheral blocks, neuraxial blocks) have been of limited value in major operations because of their short duration of analgesia. Continuous administration of local anesthetics at various segments in the nociceptive pathway has therefore been introduced and where the relatively demanding continuous peripheral nerve blocks and epidural techniques have proven effective, although with a small risk of complications and relatively high costs. From a theoretical point of view, administration of local anesthetics at the wound site is the most rational approach to reduce the afferent nociceptive barrage and thereby pain and stress responses with their secondary risks of organ dysfunction and morbidity. Therefore, an improved understanding of the analgesic efficacy of continuous wound infusion of local anesthetics and its consequences on outcome is important as reported by Beaussier et al. In their double-blind randomized setup, patients undergoing colonic surgery received continuous ropivacaine at 0.2%/10 ml/h for 48 h or saline through a multiholed wound catheter placed in the preperitoneal space. The study has important clinical implications because they assessed in detail relevant outcomes such as patient-controlled analgesia—quantified opioid sparing, level of dynamic analgesia, sleep quality, and recovery of gastrointestinal function, all of which were significantly improved, and duration of hospitalization was reduced (115 vs. 147 h) as well. No wound morbidity or ropivacaine toxicity was observed.

Hitherto, no analgesic technique has fulfilled all requirements of optimal efficacy—no side effects, low costs, high patient compliance, and improvement in outcome—and consequently, multimodal analgesic techniques have been introduced with a focus on opioid sparing to improve analgesia and recovery. As documented by Beaussier et al. as well as in randomized studies with different continuous local anesthetic wound infusion techniques, the available data have almost consistently shown improved analgesia across a range of procedures and with a very low (approximately 1%) technical failure rate and zero reported toxicity. Most importantly, wound infection rates have not increased, and patient compliance is acceptable. Unfortunately, the studies previously reported in the literature have not allowed sufficient analyses on postoperative recovery of different organ functions (pulmonary, ileus, mobilization, etc.), or a potential reduction in morbidity as well as duration of hospitalization will require further studies because of a lack of well-defined discharge criteria and standardized care and rehabilitation programs according to the concept of fast-track surgery. The report by Beaussier et al. therefore represents an important example of how to optimize design for an improved assessment of local anesthetic wound infusion to enhance the postoperative recovery process.

The important question is whether we have enough evidence to more widely recommend continuous local anesthetic wound infusion techniques in our perioperative care programs. The primary risk from peripheral infusions of local anesthetics is direct tissue toxicity such as myotoxicity. Although there are supportive laboratory data, the clinical experience is that such injuries are rare. So far, the benefits clearly outweigh the risks, and the only drawback of the technique is catheter equipment costs, which amount to approximately US $250 per patient. However, this may be acceptable in certain major procedures such as abdominal surgery, provided that the significant improvements in outcome as demonstrated by Beaussier et al. can be confirmed by others. The cost of this technique may be further offset by its
simplicity. Because the equipment is basic and risk of serious complications is minimal, it is likely that these patients can be treated on the floor without involvement and subsequent cost of an acute pain service. This would not only save charges to the patient, but also allow the acute pain service to focus on patients with more complicated pain management techniques. On the other hand, continuous local anesthetic wound infusion in minor procedures such as inguinal herniorrhaphy may not be cost effective despite proven efficacy. Instead, in such minor procedures we should strive to implement effective oral multimodal nonopioid analgesia, which is more simple to manage and can be continued for a longer period where necessary than the usual wound infusion regimens with 2–3 days’ duration.\(^1\)\(^3\)

However, as is so often the case, introduction of new analgesic techniques also raises several important questions: What is the optimal concentration and volume of the local anesthetic? (no conclusive procedure-specific dose response studies available); what is the optimal site of placement of the wound catheter? Beaussier et al.\(^1\) used preperitoneal placement, which may be rational, and probably the placement should be close to the muscle-facial layer and not in the subcutaneous layer, as demonstrated in one of the few comparative studies.\(^6\) Furthermore, we should not be overoptimistic that these newer techniques alone will provide sufficient dynamic analgesia, and therefore the opioid-sparing effects should be assessed in more detail in different procedures (postoperative nausea and vomiting, sedation, sleep disturbances, etc.)\(^1\)\(^2\)\(^5\) and combined with other nonopioid analgesics. In addition to these patient-reported outcomes, it will be interesting to examine impact on patient safety from opioid sparing. The Anesthesia Patient Safety Foundation has recently released a position statement highlighting potential risks of respiratory depression with systemic and central neuraxial opioid analgesia.\(^*\) Use of continuous local anesthetic wound infusion techniques, especially with concomitant use of several nonopioid analgesics,\(^2\) may thus directly improve patient safety. Importantly, the optimal duration of wound local anesthetic infusion must be evaluated together with the effect on relevant outcomes. So far, the literature on the effect of different types of perioperative analgesia on outcome is controversial,\(^7\) most probably because the analgesic techniques have not been sufficiently incorporated into multimodal rehabilitation programs to take advantage of the provided analgesia.\(^4\) Finally, there is a need for comparative studies with other local anesthetic techniques such as epidural analgesia,\(^7\)\(^8\) predominantly to assess potential differences in technical failures, costs, and side effects. Comparison with continuous paravertebral blocks and epidural analgesia in thoracic procedures is a good example,\(^5\)\(^9\) as well as comparison with peripheral nerve blocks in major orthopedic procedures.\(^10\)\(^11\) Therefore, recent data from high-volume incisional multimodal local anesthetic infiltration/infusion\(^12\) is of major interest because of its simplicity, efficacy, and safety, but additional studies are required to assess the relative role of incisional versus intraarticular administration in major joint replacement.\(^12\) Other areas of interest could be comparison with systemic administration of local anesthetics.\(^13\)

So far, the promising data on continuous wound infusion of local anesthetics call for a balanced assessment of practicality versus other benefits versus side effects with other analgesic techniques and agents. This balanced approach to evaluation may become especially valuable because multiple new peripheral analgesics are being developed for postoperative analgesia. Sustained duration local anesthetics may provide up to 96 h of analgesia after a single injection and would further improve on simplicity by removing the requirement for any infusion pump equipment.\(^14\) Additional peripheral pharmacologic agents are also being examined, such as a TRPV1 (capsaicin) agonist for sustained postoperative analgesia after total knee replacement\(^15\) and possible application of peripheral tricyclic antidepressants.\(^16\) All of these represent new, exciting, and potentially valuable means to provide nonopioid analgesia directly to the periphery. However, all must be comprehensively evaluated.

In summary, the peripheral use of continuous wound infusion of local anesthetics represents an effective analgesic technique that, because of its simplicity, may find its way to be an important instrument in our analgesic armamentarium across several major surgical procedures. It is hoped that future research will document in more detail other extra-analgesic benefits on outcomes, such as reduction of postoperative organ dysfunctions and enhanced recovery when integrated into multimodal rehabilitation programs,\(^4\) patient safety, and quality of life and health economics.

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References

Glucocorticoids for Acute and Persistent Postoperative Neuropathic Pain

What Is the Evidence?

PERSISTENT neuropathic postoperative pain is a major health problem. It is highly important to find therapies that prevent or reduce chronic neuropathic postoperative pain. The current issue of Anesthesiology contains an animal study by Li et al. that examines the role of a systemic glucocorticoid (triamcinolone acetonide) on aspects of pain and inflammation using the spinal nerve ligation model. This model is traditionally considered a neuropathic pain model, but involves surgery and evokes an inflammatory response linked to pain behavior. In their study, Li et al. demonstrate that systemic injections of a glucocorticoid reduce apparent pain behavior, proinflammatory cytokines, overall neuronal firing rate, incidence of bursting activity, and abnormal sympathetic sprouting in dorsal root ganglia.

Proinflammatory cytokines secreted at or near the site of a nerve injury are involved in the development and maintenance of central sensitization and neuropathic pain. Glucocorticoids suppress proinflammatory cytokines and induce expression of antiinflammatory cytokines. They also reduce the prostaglandin synthesis by inhibiting phospholipase A2 and by blocking the expression of cyclooxygenase-2 messenger RNA.

Spinal glial activation stimulates nuclear factor κB, which induces cyclooxygenase-2, release of prostaglandins, and production of proinflammatory cytokines, excitatory amino acids, and growth factors establishing pathologic pain. By inhibiting glial activation and the activation of nuclear factor κB in animal models, glucocorticoids prevent the development of neuropathic pain behavior.

Reduced release of neuropeptides from nerve endings, inhibition of signal transmission in nociceptive C fibers and ectopic discharge from traumatized nerves, reduced mechanically induced dysesthesia after nerve injury, improved nerve recovery and regeneration, and a dose-dependent rapid inhibitory effect on the voltage-dependent calcium currents in dorsal root ganglion neurons are all documented effects of glucocorticoids that may contribute to analgesia.

Rapid antihyperalgesic effects of glucocorticoids have been demonstrated in animals and humans. Reduction in neural discharge within seconds to a few minutes due to nongenomic steroid effects on membrane receptors has been observed. These rapid nongenomic effects of glucocorticoids are due, at least in part, to decreased glutamate release and increased release of γ-aminobutyric acid and endocannabinoids. By decreasing glutamate and increasing γ-aminobutyric acid, glucocorticoids would be expected to rapidly cause a marked reduction in excitability of nerve cells. A theoretic possibility is that both nongenomic and genomic steroid actions are responsible for the analgesic and antihyperalgesic effect, where the nongenomic mechanisms lead to the rapid analgesia and antihyperalgesia (minutes) and the genomic mechanisms give a sustained analgesia and antihyperalgesia (hours to days).