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Review

Peripheral nerve blocks in the management of postoperative pain: challenges and opportunities

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Abstract Peripheral nerve blocks (PNBs) are increasingly used as a component of multimodal analgesia and may be administered as a single injection (sPNB) or continuous infusion via a perineural catheter (cPNB). We undertook a qualitative review focusing on sPNB and cPNB with regard to benefits, risks, and opportunities for optimizing patient care. Meta-analyses of randomized controlled trials have shown superior pain control and reductions in opioid consumption in patients receiving PNB compared with those receiving intravenous opioids in a variety of upper and lower extremity surgical procedures. cPNB has also been associated with a reduction in time to discharge readiness compared with sPNB. Risks of PNB, regardless of technique or block location, include vascular puncture and bleeding, nerve damage, and local anesthetic systemic toxicity. Site-specific complications include quadriceps weakness in patients receiving femoral nerve block, and pleural puncture or neuraxial blockade in patients receiving interscalene block. The major limitation of sPNB is the short (12-24 hours) duration of action. cPNB may be complicated by catheter obstruction, migration, and leakage of local anesthetic as well as accidental removal of catheters. Potential infectious complications of catheters, although rare, include local inflammation and infection. Other considerations for ambulatory cPNB include appropriate patient selection, education, and need for 24/7 availability of a health care provider to address any complications. The ideal PNB technique would have a duration of action that is sufficiently long to address the most intense period of postsurgical pain; should be associated

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with minimal risk of infection, neurologic complications, bleeding, and local anesthetic systemic toxicity; and should be easy to perform, convenient for patients, and easy to manage in the postoperative period.

1. Introduction

Multimodal analgesia refers to the use of combinations of analgesics acting via different mechanisms and thus taking advantage of additive or synergistic activity while minimizing adverse events with larger doses of a single analgesic [1]. Evidence-based multimodal techniques are procedure specific and may include combinations of systemic analgesics (eg, opioids, acetaminophen, nonsteroidal anti-inflammatory drugs), neuraxial analgesia (spinal, epidural, and combination spinal/epidural), local infiltration, and peripheral nerve blocks (PNBs).

The benefits of PNBs are numerous and include improvement in clinical, economic, and humanistic outcomes (Table 1). PNBs have been associated with improvement in postoperative pain control and reduction in the use of opioids in a variety of surgical procedures [2-7]. Avoidance of opioids not only minimizes the risk of adverse events but also has important public health implications given that opioids prescribed at hospital discharge, which are often in excess of the amount required to manage postoperative pain, may serve as a source for diversion [8,9]. Other benefits of PNBs include reduction in hospital resource utilization [10,11], improved postoperative recovery [10,12,13], and improvement in patient satisfaction [2].

Given the many benefits of PNBs in practice, it is not surprising that their use has expanded over the last several decades. PNBs are now a common component of analgesia for both upper extremity (eg, brachial plexus block using interscalene, supra- or infraclavicular, and axillary nerve approaches) [14] and lower extremity (eg, lumbar plexus, femoral, sciatic, and popliteal sciatic blocks, among others) procedures [15]. Technical advances include the use of ultrasound-guided needle placement and the movement from the use of single injections of local anesthetic (single-shot PNB [sPNB]) to a continuous infusion administered using a perineural catheter (continuous PNB [cPNB]). One recent study showed that the use of femoral nerve block (FNB, both cPNB and sPNB) after total knee arthroplasty (TKA) among Medicare patients increased dramatically between 2008 and 2009 [16]. As this use has expanded both within the hospital and in ambulatory settings, a greater understanding of the potential risks of these procedures and unmet needs has been achieved.

Table 1 Benefits of PNB as a component of multimodal postoperative analgesia regimen

- Improvement in postoperative pain control and reduction in the use of opioids [2-7]
- Reduction in hospital length of stay [10,11]
- Prevention of hospital readmissions [16]
- Reduction in postoperative nausea and vomiting [2]
- Faster movement to phase 2 recovery and/or postanesthesia care unit bypass [13]
- Earlier participation in physical therapy [10]
- Improved patient satisfaction [2]

The objective of this article is to review the recent literature on sPNB and cPNB as a component of multimodal postoperative analgesia, highlighting benefits, risks, and opportunities for optimizing patient care. A search of the literature was performed using PubMed, including citations published up to March 2015. Search terms included *nerve block* [MeSH term], combined with *efficacy or effectiveness*, *safety or complication or adverse event*, and *cost or economic*. From the search results and the references cited in articles identified in the search, we selected articles most relevant to our objective. The assessment of efficacy focused on systematic reviews and meta-analyses comparing sPNB and cPNB to opioid-based analgesia and to each other. Additional information on risks and complications was gathered primarily from PNB registries and retrospective database analyses, which represent the use of PNB in current clinical practice.

2. Clinical efficacy of PNB

2.1. PNB vs opioids

The efficacy of sPNB in improving short-term pain control has been shown in a number of upper and lower extremity surgical procedures. In a Cochrane review of randomized trials in patients undergoing major knee surgery, PNB used in combination with systemic analgesics (primarily opioids) was associated with significantly lower pain scores at rest from 0 to 72 hours after surgery, but no difference in pain on movement until 48 to 72 hours postoperatively, compared with systemic analgesics alone [6]. This review included a broad range of surgical procedures (TKA, anterior cruciate ligament [ACL] repair, and meniscectomy), block techniques (sPNB and cPNB), and locations (femoral, femoral/sciatic, adductor canal), many of which have been investigated in more focused systematic reviews. A meta-analysis of randomized trials comparing single-shot FNB to intravenous patient-controlled analgesia opioids showed a significant reduction in pain at rest and on movement for up to 24 and 48 hours, respectively, with significantly less opioid consumption for up to 48 hours [2]. When continuous FNB was compared with intravenous