▽ Editorial

Location, Location, Location: Continuous Peripheral Nerve Blocks and Stimulating Catheters

Continuous peripheral nerve blocks offer the potential benefits of extended site-specific postoperative analgesia, few side effects, improved patient satisfaction, and accelerated functional recovery after extremity surgery.[1] Continuous peripheral nerve blocks provide superior analgesia compared with intravenous patient-controlled analgesia and a lower incidence of side effects compared with either intravenous patient-controlled analgesia or continuous lumbar epidural analgesia.[2-5] Prospective, randomized clinical studies have demonstrated the effectiveness of ambulatory continuous peripheral blocks after painful orthopedic procedures.[6,7] A major concern with the use of continuous peripheral nerve block is placement of the catheter close enough to the nerve to allow effective analgesia with the small amounts of dilute local anesthetic solutions utilized for the "secondary analgesic block" after the initial primary anesthetic block has resolved. Large case series have demonstrated failed secondary block in up to 10% of patients, despite receiving a large bolus of concentrated local anesthetic.[8,9] Recent studies using injected contrast media exiting at the catheter tip have demonstrated that despite the ease of "successful insertion," the direction of continuous femoral catheters is unpredictable.[9,10] Given the expected increase in the clinical use of continuous peripheral blocks, a reliable method to immediately verify correct peripheral catheter position is needed to prevent secondary analgesic block failures. Otherwise, patients will be subject to a technique with possible risks, but no benefit.

Traditionally, correct catheter placement has been confirmed by testing for a clinical effect of satisfactory analgesia and or by sensory modality testing within the desired sensory distribution. Many continuous studies have initiated primary block via the stimulating needle, followed simply by blind insertion of the peripheral catheter 5 to 15 cm beyond the needle tip. Communication with colleagues who have significant experience in placing peripheral catheters reveals up to 40% secondary analgesic block failure rate (via the peripheral catheter infusion). My personal experience with placing continuous peripheral catheters confirms this impression. In order to avoid secondary block failure, the primary block can be injected through the peripheral catheter. Lack of satisfactory anesthesia after injection of local anesthetic would then indicate an improperly positioned catheter prior to initiating continuous perineural analgesia. However, even this approach may require several attempts to localize the peripheral nerve and then correctly place the catheter, as well as injection of an additional bolus of local anesthetic.

In this issue of *Regional Anesthesia and Pain Medicine*, Pham-Dang et al.[11] report an observational study of 130 patients designed to evaluate the effectiveness of stimulating catheters used to immediately verify and confirm correct catheter placement. In their study, once the stimulating needle localized the peripheral

See Pham-Dang et al. page 83

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nerve, the stimulating catheter was threaded 3 to 5 cm beyond the needle tip without stimulation. The catheter was then connected to the peripheral nerve stimulator to confirm and verify adequate perineural position. There was no attempt to stimulate via the catheter as it was being threaded beyond the needle tip, thus there was no “real-time” assessment during advancement of the stimulating catheter. Their results indicate that only 82 of 130 stimulating catheters achieved the desired perineural position with the initial attempt, thus predicting a 37% secondary block failure rate. If the stimulating catheter did not elicit the desired motor response at ≥ 5 mA, it was removed and a second or third attempt was made. When excluding sciatic nerve stimulation via the catheter (40 intersternocleidomastoid, 24 axillary, and 47 femoral), (66 of 111), 60% achieved the desired perineural position with the first attempt, and the success rate increased to (99 of 111) 89% after a second attempt. Ultimately, 98% (127 of 130) of all stimulating catheters were correctly positioned.

Preceding Pham-Dang et al’s study, an alternative method for using a stimulating catheter was reported, whereby the desired motor response is observed *during* catheter advancement. By utilizing a stimulating catheter in this “real-time” manner, acceptable advancement of the catheter should not result in decrease of the desired motor response.[12,13] If the desired motor response decreases or disappears during catheter advancement, then either the needle or the catheter is manipulated until a maximal motor response is observed. This method may have a potential advantage, as real-time observation of motor responses allows the operator to ideally place the catheter on a specific nerve trunk or distal nerve during advancement.

Pham-Dang et al’s study raises several interesting questions and a possible hypothesis. One question is why an increased current was required to elicit the desired motor response from the catheter as compared with the needle? The reported median current output needed to elicit an acceptable motor response was 3.5 times greater for the catheter as compared with the needle. The authors reported that a current output of ≤ 4.0 mA was considered acceptable via the catheter for both continuous femoral and sciatic nerve blocks. Few anesthesiologists, if any, would accept that level of current output as acceptable when performing a standard peripheral nerve block. The authors addressed the possibility of differing electrical characteristics of the catheter and the needle, which could result in different current densities at the needle tip and catheter tip. To do this, they tested 5 different needles and catheters with a multimeter and found no significant differences. The authors also addressed a more plausible hypothesis for the different current requirements, the use of the saline flush to “distend the perineural space” and facilitate catheter insertion. As little as 0.1 to 0.3 mL saline can abolish a muscle twitch when the tip of an insulated needle is within 1 cm of a nerve.[14] This is the basis for the “Raj Test” whereby physical displacement of the nerve from the needle tip (or in this instance, the tip of stimulating catheter) disperses the current density, thus requiring more current to stimulate the same nerve.[15] The clinical implication of this observation is that injection of saline via either the needle or catheter prior to stimulation may lead to incorrect interpretation of motor responses. Such false negative responses could provoke unwarranted efforts to optimize catheter placement. Previous case series in which stimulating catheters were threaded *without* the use of a saline flush have not reported such discrepancies for acceptable motor response between the needle and the catheter.[12,13]

Pham-Dang et al’s observation that stimulating nerve catheters do not appear to be useful for continuous sciatic nerve block is interesting, but caution is warranted in interpreting this result. The authors report a limited experience of only 19 patients with the new and less commonly used lateral midfemoral approach.[16] The choice of the lateral midfemoral sciatic nerve block contrasts with approaches to the other continuous blocks in this observational study. The lateral midfemoral technique approaches the sciatic nerve at a perpendicular angle, which may make catheter passage more difficult because the catheter must make a 90° turn to travel along the longitudinal axis of the sciatic nerve, and may also lead to the catheter passing distal to the sciatic perineural space. Conversely, the intersternocleidomastoid, femoral, and axillary techniques approached the target nerves along their longitudinal axis, thus potentially facilitating catheter passage. These preliminary results must also be compared with the more common approaches to continuous sciatic nerve block (classic Labat,[9] subgluteal,[17] and popliteal fossa approaches[7,17]) before any meaningful clinical conclusions can be made.

Despite the wealth of information and promising results from this study, the number of variables (a new technique, different results for several different blocks) makes it difficult to interpret their data. However, Pham-Dang et al's study is useful because it demonstrates that stimulating catheters appear to be beneficial even though further prospective, randomized studies are clearly needed to answer many of the questions it raises. For instance, does accurate catheter positioning improve the quality of analgesia provided by continuous peripheral nerve block, enhance functional recovery, or decrease overall cost due to a lower incidence of secondary block failure? Do the multiple manipulations required for optimal catheter placement increase the incidence of peripheral nerve injury?[18] Does prolonged exposure to local anesthetic have potential neurotoxic effects? Given the increased acquisition costs for the stimulating catheter set (43% higher), a prospective, randomized trial comparing standard continuous catheter placement with stimulating catheter guided placement is needed to assess the cost:benefit of potentially decreasing the secondary block failure rate. Most importantly, given the approximately 40% secondary block failure associated with standard peripheral catheter techniques, how can further studies be interpreted accurately if correct perineural catheter position is not confirmed? Comparison of different continuous peripheral nerve block techniques, analgesic regimens, or even of 2 or more studies is only possible if optimal catheter tip position is verified so as to prevent methodologic bias in interpretation of results.

As we are pushed toward more evidence-based practice, we must vigorously study the intricacies of continuous perineural analgesia. Although Pham-Dang et al's study is limited by its observational nature and the lack of rigorous comparison to a nonstimulating peripheral catheter group, they are to be commended for reporting preliminary data concerning the potential clinical and economic impact of stimulating catheters for continuous perineural analgesia.

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