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Feasibility of ultrasound-guided peripheral nerve block catheters for pain control on pediatric medical missions in developing countries

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Summary

Continuous peripheral nerve blocks (CPNB) are effective for postoperative pain management in children in the hospital and at home. CPNB techniques are particularly advantageous when compared with systemic or oral opioids on medical missions to unfamiliar environments with minimal monitoring capacity. In addition, ultrasound-guidance facilitates the placement of perineural catheters in anesthetized children even in the absence of commercially packaged regional anesthesia equipment. We present a series of successful cases employing ultrasound-guided CPNB for postoperative analgesia on medical missions and discuss the impact of this technology on present and future patients in underserved countries.

Keywords

pediatric regional anesthesia; continuous peripheral nerve block; perineural catheter; patient-controlled regional analgesia; ultrasound-guided regional anesthesia; medical missions

Introduction

Continuous peripheral nerve blocks (CPNB) provide superior analgesia compared with opioids and have been used for a variety of pediatric surgical procedures in developed countries

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Conflicts of interest

Dr Edward Mariano conducts continuous peripheral nerve block workshops for Stryker Instruments (Kalamazoo, Michigan, USA). Dr Santhanam Suresh receives equipment support from SonoSite, Inc. (Bothell, WA, USA). None of the other authors has any personal financial interest in this research.

Implications statement

Continuous peripheral nerve blocks (CPNB) provide extended and specific postoperative pain relief for a variety of surgical procedures. The portability of CPNB using ultrasound guidance facilitates excellent postoperative pain control on pediatric medical missions in underserved countries.

(1-4). One of the many advantages of CPNB as an analgesic modality is its portability, which facilitates its application on medical missions for children. In addition, surface ultrasound provides the means for anesthesiologists to place perineural catheters in environments where nerve stimulators and other specialized regional anesthesia equipment are unavailable. We present a series of pediatric cases in which ultrasound guidance was used to perform CPNB for postoperative analgesia after major surgical procedures on overseas medical missions.

Case descriptions

Mission 1: Alaminos City, Philippines (February 2007)

Case 1—An 8-year-old girl (23 kg) presented for surgical excision of a lower extremity amniotic band. As the primary purpose of the medical mission was surgical correction of midline facial deformities, the anesthesiology team was prepared with local anesthetic medications for infiltrative nerve blocks of the face but lacked specific equipment for nerve blocks of the extremities (i.e. nerve stimulator and insulated needles). Coincidentally, the team pediatrician brought a portable ultrasound for transthoracic echocardiography (SonoSite Titan, Bothell, WA, USA) to be used for preoperative screening. After an uneventful intravenous induction and endotracheal intubation, the sciatic nerve was identified in the popliteal fossa using ultrasound guidance with a curvilinear probe (SonoSite Titan C-11). Using a standard 22-gauge angiocatheter attached to a syringe containing 0.25% bupivacaine *via* extension tubing, 10 ml of local anesthetic was injected incrementally around the sciatic nerve using an in-plane trans-biceps approach. The angiocatheter was then placed anterior to the nerve and secured with clear occlusive dressing.

Case 2—A 10-year-old girl (21 kg) was scheduled for extensive burn contracture release of the left upper extremity. After intravenous induction and intubation, the brachial plexus was identified by ultra-sound between the anterior and middle scalene muscles. Using a 22-gauge angiocatheter attached to a syringe containing 0.25% bupivacaine *via* extension tubing, 10 ml of local anesthetic was injected incrementally around the trunks of the brachial plexus using a posterior in-plane trans-scalene approach (Figure 1). The angiocatheter was inserted into the interscalene groove and secured with clear occlusive dressing (Figure 2).

Neither patient required intraoperative or postoperative intravenous opioids. As infusion devices were unavailable, both patients received scheduled boluses of 10 ml of 0.125% bupivacaine *via* their perineural catheters every 12 h for two postoperative days to provide analgesia. No adverse events occurred in either case.

Mission 2: Guayaquil, Ecuador (October 2007)

On a pediatric orthopedic surgery mission, ultra-sound-guided CPNB techniques were employed for postoperative pain management after a variety of surgical procedures (Table 1). Patients underwent inhalational induction followed by intravenous catheterization and laryngeal mask insertion. After locating the peripheral nerve with ultrasound, a bolus of 1.5% mepivacaine $0.5 \text{ ml} \cdot \text{kg}^{-1}$ was injected around the nerve circumferentially followed by perineural catheter placement. Continuous infusions of 0.2% ropivacaine were delivered *via* portable infusion devices (Stryker Pain Pump, Kalamazoo, MI, USA) at rates $2\text{--}4 \text{ ml} \cdot \text{h}^{-1}$ until the afternoon of postoperative day 1. Hospital policy did not allow local anesthetic infusions on the ward, so patients with perineural catheters were required to stay in the postanesthesia care unit overnight with catheter removal prior to transfer. None of the patients who received CPNB for analgesia required supplemental perioperative intravenous opioids, and there were no complications related to the perineural local anesthetic administration.

Discussion

Perineural catheters have been shown to provide pain relief which is specific to the site of surgery with minimal side effects for hospitalized and ambulatory pediatric patients (2-4). The portability and opioid-sparing benefit of CPNB are particularly advantageous on medical missions to countries where the availability of opioids is limited.

On medical missions to more rural locations, ultrasound can prove particularly useful since teams often do not transport specific 'regional anesthesia' equipment. Under ultrasound guidance, nerve blocks and CPNB placement may be performed efficiently without a nerve stimulator, insulated needles, and catheters specifically designed for peri-neural infusion. For higher-risk procedures such as interscalene block, ultrasound provides additional safety measures by facilitating nerve identification and confirmation of local anesthetic spread when performing CPNB in anesthetized children (5,6).

However, there are important limitations such as the necessity of an adequate and compatible power supply to operate ultrasound equipment. Local anesthetic medications appropriate for peripheral nerve blockade must be available. In the medical missions described in this report, team members are responsible for transporting their own supplies. The sponsoring entities facilitate safe passage of medical supplies and equipment through customs and to the mission sites. To date, our group has only participated in medical missions to locations with electricity. Furthermore, sonography is routinely practiced for obstetrics, gynecology, general surgery, and emergency medicine even in the smaller provincial hospitals we have visited. Ultrasound-guided CPNB can therefore be an additional application of existing equipment, which requires no further capital investment.

The risks involved in the introduction of this technique on medical missions are not yet fully known. Certainly, lack of familiarity with CPNB by local hospital staff (e.g. mistaking an interscalene perineural catheter for an intravenous catheter) may lead to disastrous consequences. The use of angio-catheters for CPNB as described in the first two cases should be the exception and is not preferred over equipment designed for perineural infusion. An educational program to train local physicians and nurses on CPNB is a long-term process. Perhaps a collaborative relationship may be established with hospitals visited to promote subsequent medical missions or opportunities for local physicians to train abroad.

Conclusions

Ultrasound-guided CPNB may be particularly useful as the sole analgesic technique on pediatric medical missions in underserved countries. In addition to the obvious benefits to the children cared for on these missions, further advances in pain management for future patients may result from teaching these techniques to local physicians. A robust regional anesthesia overseas teaching program may facilitate better management of pediatric postoperative pain in developing countries while avoiding the common side effects and complications associated with systemic opioids.

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Figure 1. Placement of an ultrasound-guided interscalene brachial plexus catheter using a 22-gauge angiocatheter. Local anesthetic solution is injected between the anterior and middle scalene muscle through the angiocatheter needle under direct visualization.

Figure 2.

A 10-year-old girl scheduled for extensive burn contracture release who has undergone placement of an ultrasound-guided interscalene brachial plexus catheter using a standard 22-gauge angiocatheter. The angiocatheter has been secured with clear occlusive dressing and will be used to provide postoperative analgesia.

Table 1

Continuous peripheral nerve block (CPNB) techniques utilized on pediatric orthopedic surgery mission to Guayaquil, Ecuador

Age (years)	Gender	Surgical procedure	Perineural catheter
1.5	F	Left ankle posterior release	Popliteal sciatic
13	F	Left knee arthrotomy, removal of implants and loose body	Femoral
9	M	Right tibial osteotomy revision	Femoral Subgluteal sciatic
10	M	Right midfoot osteotomy and left ankle posterior release	Bilateral popliteal sciatic
6	F	Right congenital vertical talus release	Popliteal sciatic
11	F	Right ankle posterior release and midfoot osteotomy	Subgluteal sciatic
11	F	Right ankle posterior release and midfoot osteotomy	Popliteal sciatic