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EDITORIAL

Considerations for assessing optimal regional anaesthesia and analgesia in paediatric surgical patients

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Adequate analgesia is a core component of perioperative care and postoperative recovery. The treatment of perioperative pain in paediatric patients can be challenging, especially as young children may be unable to adequately communicate the type and severity of the pain that they are experiencing. The use of regional anaesthesia as part of the multimodal approach to perioperative analgesia in paediatric patients may obviate some of these difficulties, and its safety is well established.[1-3]

The caudal block has been the default block in paediatric practice for many surgical procedures below the umbilicus for a long time. It is versatile, relatively easy to perform (with or without ultrasound guidance), safe, and effective. With the increased use of ultrasound, anaesthesiologists are now exploring novel ways to target more peripheral nerves. One peripheral regional technique which has become increasingly popular in children is the interfascial plane blocks (IFPB). IFPB are easier to perform than central neuraxial blocks and are relatively safe.[4,5] The question is: "Do IFPB perform as well (or better), and do they achieve adequate analgesia when compared to caudal blocks?" In this issue of the journal, Reddy et al. present the results of a prospective randomised trial comparing ultrasound-guided transversus abdominis plane (TAP) block and ultrasound-guided caudal block for postoperative pain in children undergoing lower abdominal surgeries.[6] We welcome well-conducted randomised trials which add to the body of evidence supporting the use of appropriate regional anaesthesia techniques for perioperative pain relief in children.

The main controversies in paediatric regional anaesthesia (PRA) have been addressed by the European Society of Regional Anaesthesia and Pain Therapy (ESRA) and the American Society of Regional Anesthesia (ASRA) with published evidence-based guidelines.[7,8] Two of the controversies addressed were the use of adjuvants in PRA and dosing of local anaesthetics in PRA.[7] Reddy et al.[6] provided single-shot techniques, with a standard dose across groups, and the use of a standard dose adjuvant of dexmedetomidine. Any single-shot block is limited by the duration of that block. Once the block has worn off, other analgesics, such as opioids, may be required depending on the type of surgery and the resultant pain. A single-shot regional technique which is associated with a longer duration of analgesia is therefore preferable, provided it is safe. In the study by Reddy and colleagues, the TAP block was associated with a longer duration of analgesia than the single-shot caudal. For procedures which result in severe and more prolonged pain, postoperative catheter techniques are appropriate. The ability to prolong a single-shot block is useful to improve postoperative analgesia especially in cases where a catheter is inappropriate but more prolonged analgesia is required. Adjuvants can prolong the duration of blocks, and contribute to a smoother, more comfortable perioperative course. There is evidence of improved postoperative analgesia with the use of a preservative-free alpha-2 adrenoceptor agonist (clonidine or dexmedetomidine) as an adjuvant for both caudal and peripheral nerve blocks, as recommended in the ESRA/ASRA guidelines.[7] The decision by Reddy et al. to include dexmedetomidine in their regional blocks was therefore appropriate. The only other option, is preservative-free ketamine which is also effective in prolonging caudal blocks but should be avoided in neonates and infants as there is a potential risk of neuronal apoptosis.[7] No other adjuvants for peripheral nerve blocks have shown improvement in postoperative analgesia.[7]

It is difficult to directly compare some of the randomised trials of caudal versus TAP block as different local anaesthetic volumes and doses are used, and different TAP injection techniques are used (lateral or posterior approach).[9-11] It is important to use an optimal dose of local anaesthetic for adequate analgesia whilst ensuring toxic levels aren't reached. The volume of local anaesthetic used for a caudal block determines the dermatomal level of cover. The ESRA/ASRA guidelines recommend the following volumes of local anaesthetic for caudal block: 0.5 ml/kg for sacral dermatomes; 1 ml/kg for lumbar dermatomes; and 1.25 ml/kg to reach thoracic dermatomes[7] (with appropriate adjustment in concentration to avoid a potentially toxic dose). It is possible that the volumes used by Reddy et al. in the caudal block group did not adequately cover all dermatomes for lower abdominal surgery, as they used a dose of 0.5 ml/kg (lumbosacral procedures) and 0.75 ml/kg (thoracolumbar procedures), and rescue analgesia use was more common in the caudal block group. Testing the level of the block is difficult intraoperatively as PRA is performed under general anaesthesia, but it is not impossible. Lundblad et al. have done cutaneous testing of the level of a caudal block in patients under general anaesthesia. The skin was pinched for five seconds with a > 15% increase in the heart rate and/or blood pressure from baseline or

movements of extremities indicating a positive response.[12] One could visualise the level of spread of local anaesthetic within the caudal space using the ultrasound, though this requires a second pair of expert hands to direct the ultrasound probe whilst local anaesthetic is being injected. Postoperative cutaneous testing, although potentially difficult to perform in children, can be done using non-verbal pain scores. The use of any of these techniques may have helped document the adequacy of the caudal block in the study.

It has been suggested by Lonnqvist and Karmakar that IFPB, such as the TAP block, have more of a systemic effect rather than a local effect.[13] For example, with the TAP block, local anaesthetic is deposited in a large vascularised area where it can be readily absorbed. This would essentially have the same effect as giving local anaesthetic as an intravenous infusion. Local anaesthetic infusions are used for perioperative analgesia and are known to have other systemic effects including anti-inflammatory effects and reducing ileus. Pharmacokinetic studies in adults have shown that the use of doses of local anaesthetic considered safe in TAP blocks result in local anaesthetic plasma concentrations that exceed the threshold for neurotoxicity.[14-16] In paediatric pharmacokinetic studies of the TAP block, with one[17] using a dose (0.4 mg/kg levobupivicaine) within the recommended dose range for IFPB (0.25–0.75 mg/kg bupivacaine or ropivicaine),[7] and one done in neonates using a higher dose of 1.25 mg/kg bupivacaine,[18] all of the plasma levels of local anaesthetic remained below the toxic threshold. In another paediatric study, using a dose within the recommended range (0.4 mg/kg levobupivicaine), no patients had signs of toxicity and one third of patients had an inadequate block.[19] It was suggested that this was a dose-related effect. However, one should interpret these studies with caution because the numbers are small. Reddy et al. used a total dose of 1.25 mg/kg of bupivacaine for the TAP blocks.[6] When conducting randomised trials comparing IFPB with other blocks, a control group with intravenous infusion of local anaesthetic could be an important arm to add to a trial to address this controversy.

Although potentially challenging, prospective randomised trials can be performed in children, as shown by Reddy et al.[6] Large, prospective, randomised trials are needed to provide good evidence for the analgesic efficacy of the newer regional anaesthesia techniques. It is important that these trials use comparable doses of local anaesthetic and adjuvants, and ensure that they use well described standard techniques. To understand the relationship between efficacy and safety, more evidence for the most effective doses that don't result in toxicity in children is required. This means future studies should investigate plasma local anaesthetic concentrations where possible, when studying the efficacy of the newer blocks in children. Ideally, we need to also consider the impact of regional anaesthetic techniques on long-term outcomes, such as persistent postoperative pain.

In children requiring single-shot regional analgesia for lower abdominal surgery, it appears that TAP blocks may be marginally preferable due to the need for less rescue analgesia in the early postoperative period, and a longer duration of analgesia than when compared to a caudal block.[6] However, the limitation to this conclusion, may be related to a caudal dose which could have been inadequate in some patients.

In our quest to provide adequate perioperative analgesia and good patient outcomes, we need to continue reassessing our practice, continue to get patient (and/or parent) feedback and try to provide solid evidence for best practice. Until we have further evidence, we need to remain aware of the available evidence, the limitations and the controversies of the chosen block and technique for the patient and their surgery.

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