

Ultrasound: Is there a place for it in pediatric anesthesia?

YES

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The twin goals of peripheral nerve blockade (PNB) in children are efficacy and safety. Ultrasonography during PNB helps achieve these goals by permitting direct visualization of the block needle, target nerve and adjacent anatomic structures. Is there evidence that the use of ultrasound leads to improved outcomes in children? Admittedly, pediatric outcome studies are few in number and size, so the level of evidence is low and large multicentered trials are needed. That being said, numerous studies support the use of ultrasound for PNB in children.

Our patients vary considerably in size and shape to the degree that reliance on landmark techniques alone results in a high incidence of failed blocks. A number of studies have shown that the rate of block failure can be reduced by the use of ultrasound. Even the "bread and butter" blocks such as an ilioinguinal nerve block for inguinal hernia repair can be performed with improved success if ultrasound guidance is used.(1)

Both block procedure and onset time can be improved. A study of three-in-one blocks demonstrated an onset time that was approximately 50% faster with ultrasound (13 min) versus conventional methods.² Marhofer et al demonstrated an onset time of 9 min following ultrasound-guided infraclavicular blocks in children with ropivacaine 0.5%.⁽³⁾ In the same paper, they also demonstrated that the duration of anesthesia and analgesia following PNB can be improved by the use of ultrasound.

Ultrasound can reduce the discomfort of regional anesthesia. For example, children with fractured limbs can undergo nerve blockade without the added pain of a nerve stimulator causing muscle contraction.⁽³⁾

Ultrasound may also reduce the complications associated with nerve blockade. Visualization of the needle and nerve may limit the incidence of nerve injury.⁽⁴⁾ There are animal studies supporting this theory⁽⁵⁾, but the rarity of this complication makes it unlikely that a clinical trial will prove this assumption. The Pediatric Regional Anesthesia Network (PRAN) is a multicenter database that may in time offer some clarity to this and other controversies concerning regional anesthesia in children.

Systemic local anesthetic toxicity can be fatal and the use of ultrasound may reduce the incidence of this dreaded complication. Firstly, ultrasound guidance reduces the minimum effective dose of local anesthetic for PNB.^(1,2) Secondly, visualization of the needle tip and adjacent vascular structures helps avoid accidental intravascular injection. Thirdly, ultrasound can differentiate an intravascular from an extravascular injection based on the pattern of local anesthetic spread.

Direct visualization of non-neural structures is another advantage of ultrasound. For example, visualization of the pleura during periclavicular blocks prevents accidental lung puncture, while the kidney can be seen and avoided during lumbar plexus block. Bowel can be seen and avoided during the performance of rectus sheath or ilioinguinal nerve blocks.

Cost is frequently raised as a reason to avoid the use of ultrasound. However, Sandhu showed that the cost of ultrasound versus nerve stimulator techniques is similar based on the assumption that the average cost per ultrasound-guided block is \$3.40 (machine, gel and noninsulated Tuohy needle) and the portable machine (Sonosite 180 model) is used for 5000 procedures.⁽⁶⁾

Labat stated in 1928 that "anatomy is the foundation on which the edifice of regional anesthesia is built".⁽⁷⁾ PNB is an exercise in applied anatomy and the use of ultrasound improves the anatomic knowledge of the user such that one's ability to subsequently perform "blind" techniques is anecdotally improved.⁽⁸⁾

In conclusion, nerve blocks work when local anesthetic is optimally distributed around nerve structures. Ultrasound permits visualization of this goal and its use during PNB in children should be encouraged.

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