INTRANEURAL INJECTION - CON

Michael Barrington
Anatomy of Peripheral Nerves

1. Fascicle
2. Epineurium
3. Perineurium
4. Endoneurium

Permission obtained from Mary Bryson
Subepineurial Injection in Ultrasound-Guided Interscalene Needle Tip Placement

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Introduction: The neural elements of the brachial plexus between the anterior and middle scalene muscles are readily visible by ultrasound. However, the epineurium of these nerve structures is difficult to discern on ultrasound imaging because of the proximity of the scalene muscles to the nerve elements, and this may lead to unintentional subepineurial injection (SEI). To evaluate whether typical needle tip placement under ultrasound guidance results in SEI, as opposed to extraneural injection, we undertook this cadaver study.

Materials and Methods: Six nonpreserved cadavers served as subjects for 10 injections. After imaging revealed the hypoechoic fascicles of the brachial plexus at the interscalene level, the tip of a 22-gauge, 5-cm short-bevel needle was inserted into a position adjacent to one of the fascicles by ultrasound guidance. At this point, 0.1 to 0.2 mL of india ink solution was injected. The brachial plexus at this level was then dissected and removed. The nerve elements discolored by the ink were removed, fixed, and stained for histologic analysis and were then examined for stimulation guidance alone.1 The hypoechoic nodules that are visible at this level on US imaging are believed to represent the fascicles within the plexus, and these are typically the targets adjacent to which the needle tip is placed.1,2 However, the anatomic boundaries of nerve elements at the interscalene level are somewhat obscure because of the anatomy of the brachial plexus and the surrounding structures.3 With US, the actual epineurial boundary of the nerve structures is difficult to identify with precision in this compact space.2 In this cadaver study, we attempted to evaluate whether typical needle tip placement for interscalene brachial plexus block under US guidance may result in subepineurial injection (SEI), as opposed to extraneural injection. We hypothesize that when a needle tip is placed next to a hypoechoic nodule representing a fascicle in the interscalene groove, subsequent injection may result in SEI.

METHODS

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Interscalene Subepineurial Injection
Ultrasound-guided nerve block - what is intraneurial? Anesthesiology Vol 1 January 2010
1. Fascicle
2. Artery
3. Vein
4. Adipocytes
5. Epineurium

From: Sala-Blanch et. al. Structural Injury to the Human Sciatic Nerve After Intraneural Needle Insertion
Regional Anesthesia and Pain Medicine 34(3) 2009, pp 201-205.
Figure 1. Histology of the peripheral nerve. Bundles of nerve fibers (1) can be seen within a fascicle, which is surrounded by perineurium (2). The loose, connective tissue of the epineurium (3) surrounds the fascicle. A 20-gauge plastic catheter has been inserted for comparison into the epineurium immediately adjacent to the fascicle.
From: Sala-Blanch et. al. Structural Injury to the Human Sciatic Nerve After Intraneural Needle Insertion
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Can we distinguish intrafascicular from extrafascicular injection using ultrasound?

Ultrasound imaging is low resolution technology.

Even the highest frequency probe and the most superficial nerve will NOT distinguish intrafascicular/extrafascicular injection.
Intraneural Catheterization of the Sciatic Nerve In Humans: A Pilot Study
Rodríguez, Jaime, Taboada, Manuel et al
Regional Anesthesia and Pain Medicine
Out of 55 patients recruited, 39 met the criteria for stimulation inside and outside the nerves. 29% were excluded because of patient and technical factors.
Do we have a monitor that reliably detects intraneural intrafascicular injection?

Intraneural intrafascicular injection (high pressure) is likely to result in neurological injury.
Nerve injury in pigs were assessed following direct needle nerve perforation with 24 G and 19 G needles. Large needles resulted in greater degree of myelin damage, intraneural haematoma. Regional inflammation was the comparable in both groups.
Toxicity of Local Anaesthetics
Ropivacaine-Induced Peripheral Nerve Injection Injury in the Rodent Model

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BACKGROUND: Intraneural administration of local anesthetics has been associated with nerve damage. We undertook the present study to investigate histological changes induced by ropivacaine injection into rat sciatic nerve.

METHODS: Fifty-four adult male Lewis rats were randomly distributed into 9 groups, 6 animals per group. Fifty microliters of normal saline, 10% phenol, or 0.75% ropivacaine were administered by intrafascicular injection, extrafascicular injection, or extraneural (topical) placement. At 2 weeks, animals were killed and the sciatic nerve at the injection site was evaluated with light microscopy, quantitative histomorphometry, and electron microscopy.

RESULTS: On cross-sectional evaluation, extrafascicular ropivacaine injection and extraneural placement of ropivacaine were both associated with damage to the perineurium, with focal demyelination surrounded by edematous endoneurium. Intrafascicular injection of ropivacaine resulted in a wedge-shaped region of demyelination and focal axonal loss with some regeneration, bordered by a region of normally myelinated axons in a background of edematous endoneurium. Extrafascicular injection resulted in more significant damage than extraneural
Epidemiology of infrequent events

Define the intervention
Intraneural defined as when the needle tip was subepineural and injection resulted in swelling and compartmentalisation of the nerve
Epidemiology of infrequent events

- Appropriate sample size
- Representative
Nerve Puncture and Apparent Intraneural Injection during Ultrasound-guided Axillary Block Does Not Invariably Result in Neurologic Injury

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Background: Nerve puncture by the block needle and intraneural injection of local anesthetic are thought to be major risk factors leading to neurologic injury after peripheral nerve blocks. In this study, the author sought to determine the needle–nerve relation and location of the injectate during ultrasound-guided axillary plexus block.

Methods: Using ultrasound-guided axillary plexus block (10-MHz linear transducer, SonoSite, Bothel, WA; 22-gauge B-bevel needle, Becton Dickinson, Franklin Parks, NJ), the incidence of apparent nerve puncture and intraneural injection of local anesthetic was prospectively studied in 26 patients. To determine the onset, success rate, and any residual neurologic deficit, qualitative sensory and quantitative motor testing were performed before and 5 and 20 min after block placement. At a follow-up visit after 6 h, patients were questioned about pain and any neurologic changes.

In the author's experience, as the needle touches the nerve, the nerve moves 1 or 2 cm before the needle pierces an anatomical structure that may be the fascia. As the needle pierces this anatomical structure/fascia, the practitioner may feel a pop, and the patient often reports a paresthesia or dysesthesia. Simultaneously, the needle seems to enter the substance of the nerve. Injection of 2–3 ml of local anesthetic usually proceeds with minimal pain and resistance. When compared with the undisturbed nerve (fig. 2A), the injected nerve seems to swell...
Initial cohort of recruited patients was 50
22 patients were excluded because of preoperative sensory and motor abnormalities
2 patients were lost to followup
21 of 26 patients had intraneural injection
72 out of 104 nerves had intraneural injection
No new neurology in the 26 patients
No Clinical or Electrophysiologic Evidence of Nerve Injury after Intraneural Injection during Sciatic Popliteal Block

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ABSTRACT

Background: Intraneural injection during nerve-stimulator–guided sciatic block at the popliteal fossa may be a common occurrence. Although intraneural injections have not resulted in clinically detectable neurologic injury in small studies in human subjects, intraneural injections result in postinjection inflammation in animal models. This study used clinical, imaging, and electrophysiologic measures to evaluate the occurrence of any subclinical injury.

What We Already Know about This Topic
• Ultrasonography indicates peripheral nerve blocks often result in intraneural needle placement, and intraneural injection results in acute inflammation in animals

What This Article Tells Us That Is New
• In 16 patients, an injection into the epineurium of the sciatic nerve at the popliteal fossa did not lead to postoperative neurologic dysfunction as assessed by serial physical examination.

Nerve stimulator-guided sciatic popliteal nerve block may result in intraneural injection.
Does this result in evidence of subclinical neurological injury?
Nerve stimulator popliteal sciatic nerve blocks frequently result in intraneural injection, and may not result in neurologic dysfunction.
Subepineural intraneural injections

Findings don’t apply to patients with co-morbidities (diabetes, neuropathy, obesity), use of other local anaesthetics in other concentrations, use of additives, or at other locations.
Surgical population - healthy patients, presenting with sports injuries, prevalence of diabetes 3 - 4%
Progress

* Larger sample sizes
* Clinical studies on typical surgical patients
* Clinical studies at other anatomical locations
* More animal experiments
* Resolve the “toxicity” of local anaesthetics
Why perform IN injection?
My practice
Conclusion

* Peripheral nerve anatomy is diverse
* Sample sizes inadequate
* Intervention, Intraneural injection needs to be defined
* Surgical population needs to be representative
* Drugs we use potentially toxic
* Needles cause intraneural trauma
Conclusion

* Intraneural injection has a potentially high risk to benefit ratio

* Why

* Culture of safety
IS THIS INTRANEURAL?