

References

1. Koff MD, Cohen JA, McIntyre JJ, Carr CF, Sites BD: Severe brachial plexopathy after an ultrasound-guided single-injection nerve block for total shoulder arthroplasty in a patient with multiple sclerosis. *ANESTHESIOLOGY* 2008; 108:325-8
2. Hebl JR: Ultrasound-guided regional anesthesia and the prevention of neurologic injury. *ANESTHESIOLOGY* 2008; 108:186-8
3. Hogan Q: Finding nerves is not simple. *Reg Anesth Pain Med* 2003; 28:367-70
4. Peer S: High resolution sonography of the peripheral nervous system: General considerations and technical concepts, *High Resolution Sonography of the Peripheral Nervous System*. Edited by Peer S, Bodner G. Berlin, Springer-Verlag, 2003, pp 1-12
5. Bigeleisen PE: Nerve puncture and apparent intraneural injection during ultrasound-guided axillary block does not invariably result in neurologic injury. *ANESTHESIOLOGY* 2006; 105:779-83
6. Moayeri N, Bigeleisen PE, Groen GJ: Quantitative architecture of the bra-

chial plexus and surrounding compartments, and their possible significance for plexus blocks. *ANESTHESIOLOGY* 2008; 108:299-304

7. Chan VWS, Brull R, McCartney CJL, Xu D, Abbas S, Shannon P: An ultrasonographic and histological study of intraneural injection and electrical stimulation in pigs. *Anesth Analg* 2007; 104:1281-4
8. Bonnel F: Microscopic anatomy of the adult human brachial plexus: An anatomical and histological basis for microsurgery. *Microsurgery* 1984; 5:107-18
9. Winnie A: Interscalene brachial plexus block. *Anesth Analg* 1970; 49:44-66
10. Yang WT, Chui PT, Metreweli C: Anatomy of the normal brachial plexus revealed by sonography and the role of sonographic guidance in anesthesia of the brachial plexus. *Am J Roentgenol* 1998; 171:1631-6
11. Borgeat A, Ekatoarmis G, Kalberer F, Benz C: Acute and nonacute complications associated with interscalene block and shoulder surgery. *ANESTHESIOLOGY* 2001; 95:875-80

(Accepted for publication June 3, 2008.)

Anesthesiology 2008; 109:753

Copyright © 2008, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

In Reply:—We deeply appreciate the interest that our case report has generated. We did not anticipate, however, that the use of ultrasound would have been at the center of the discussion. Our case report stands out independently from the actual mechanism of nerve localization.¹ The academic purpose of reporting this unfortunate clinical experience is to educate anesthesiologists about the possible existence of a peripheral neuropathy in the setting of a presumed isolated central nervous system disease.²⁻⁵

With respect to ultrasound and neural imaging, referring to Dr. Rosenblatt's letter, we completely agree that the sonographic anatomy of the brachial plexus is complex and that there are distinct limitations regarding the ability to resolve intimate tissue layers. We commend Dr. Swenson's extensive experience with successful and safe ultrasound-guided peripheral nerve blocks. At Dartmouth-Hitchcock Medical Center (Lebanon, New Hampshire), we also have a long safety record in performing ultrasound-guided peripheral nerve blocks. Since 2002, we have tracked more than 5,000 ultrasound-guided peripheral nerve blocks in an institutional review board-approved regional anesthesia database. This case report represents the first serious adverse event.

We agree with Dr. Baumgarten; this is why the case report mentioned the importance of discussing individual patient risk to offer an informed consent for this patient and all patients, despite the fact that we are unable to predict outcome with absolute certainty. We would like to clarify several aspects of the described procedure. Most importantly, standard safety precautions were maintained in terms of light sedation, monitoring patient response, and assessment of resistance to injection as mentioned by Dr. Baumgarten. We typically inject (even when using the in-plane approach) 1-2 ml of local anesthetic to help identify the needle tip as it is being advanced. When the needle tip is deemed to be in the correct location, we then inject another 1-2 ml of local anesthetic. If the local anesthetic seems malpositioned (e.g., within the sternocleidomastoid muscle), we then alter the needle location and retest. We consider this to be a common and standard ultrasound practice. It should be emphasized that all parties involved at our hospital agree with Drs. Chelly and Borgeat *et al.* in that this catastrophic injury involving the entire brachial plexus would be near impossible to achieve with a root-level block. This is why it is critically important to consider the contribution of the underlying peripheral neuropathy, which may have predisposed this patient to the development of brachial neuritis. Although we cannot prove that our patient had preexisting peripheral neuropathy, this concept is important in the anesthetic care of the patient with multiple sclerosis, as discussed in the letter of Dr. Borgeat *et al.* Other causes of postoperative nerve injury to consider when evaluating a patient include intraoperative surgical stretch injury; positioning injury, as mentioned in our case

report and by Dr. Borgeat *et al.*; and, as suggested by Dr. Sia, Dr. Hebl's concept of the "double-crush" phenomena.⁶

We must clarify, as mentioned by Dr. Orebaugh, that two of the three "repositions" were the result of the situation mentioned in the previous paragraph: The needle tip was malpositioned in the sternocleidomastoid muscle. Therefore, the text should have stated three "attempts" rather than three "repositions." All clinicians reading this report can sympathize with the false-positive rate of nerve stimulation in which a great motor response occurs, but a suboptimal block results. This most likely occurs secondary to fascial or tissue planes that are being tented but not punctured by the needle tip. This is why many practitioners argue the need to dynamically assess the spread of local anesthetic and make necessary adjustments, as mentioned by Dr. Orebaugh. As such, we strongly recommend that future research should be directed toward defining the morphologic appearance of "successful and safe" versus "dangerous or ineffective" spreads of local anesthetic.

Ultrasound-guided regional anesthesia is an evolving technique that has received significant attention during the past decade. In the absence of evidence-based medicine, opinions regarding "best practice" should not distract us from dealing with issues such as considering the risk-benefit of a regional technique in a patient with a complex neurologic disease that may not be completely described in current anesthesia textbooks and the published literature.

Matthew Koff, M.D., M.S.,* Brian Sites, M.D., James R. Hebl, M.D.
*Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire.
matthew.koff@hitchcock.org

References

1. Koff MD, Cohen JA, McIntyre JJ, Carr CF, Sites BD: Severe brachial plexopathy after an ultrasound-guided single-injection nerve block for total shoulder arthroplasty in a patient with multiple sclerosis. *ANESTHESIOLOGY* 2008; 108:325-8
2. Zephir H, Stojkovic T, Latour P, Lacour A, de Seze J, Outtertyck O, Muraige CA, Monpeurt C, Chatelet P, Ovelacq E, Vermersch P: Relapsing demyelinating disease affecting both the central and peripheral nervous systems. *J Neurol Neurosurg Psychiatry* 2008; 79:1032-9
3. Pogorzelski R, Baniukiewicz E, Drozdowski W: Subclinical lesions of peripheral nervous system in multiple sclerosis patients. *Neurol Neurochir Pol* 2004; 38:257-64
4. Poser CM: The peripheral nervous system in multiple sclerosis: A review and pathogenetic hypothesis. *J Neurol Sci* 1987; 79:83-90
5. Sarova-Pinhas I, Achiron A, Gilad R, Lampl Y: Peripheral neuropathy in multiple sclerosis: A clinical and electrophysiologic study. *Acta Neurol Scand* 1995; 91:234-8
6. Hebl JR, Horlocker TT, Schroeder DR: Neuraxial anesthesia and analgesia in patients with preexisting central nervous system disorders. *Anesth Analg* 2006; 103:223-8

(Accepted for publication June 3, 2008.)