cause them to distend. If parasthesia is encountered, we re-
direct the needle, and we do not inject in the presence of pain
or parasthesia, or against unusually high resistance (although
this last feature is subjective, not measured).

If the definition of Bigeleisen et al. is correct, we are per-
forming intraneural injections with a mean volume of 33 ml
of local anesthetic9 on a daily basis, although we believe that
we are depositing local anesthetic outside the nerves of the
plexus, after breaching extraneural fascial layers. In a recent
case series from our institution, evidence of possible neuro-
logic injury was sought from 510 consecutive supraclavicular
blocks. Two instances of numbness in the fingers of the
operative hand were found in retrospect. Both of these had
resolved spontaneously after several weeks and were not com-
mented on at surgical follow-up.9

Given our question about their definition of intraneural
at the level of the supraclavicular brachial plexus block, we
would reserve judgment on the generalizability of the results
of Bigeleisen et al. to nerves in other anatomical sites. An
examination of the question of stimulating thresholds and
nerve injury, particularly in relation to the perineurium,
would be of great interest, although we would be wary of
conducting such a study on human subjects.

Whichever term is used for the outer border of the bra-
chial plexus, the technique of supraclavicular block that we
describe seems to be safe and reliable. We firmly believe that
neurologic complications of regional anesthesia must be the
subject of continued investigation, both in terms of quanti-
fying the incidence and understanding the means of avoid-
ance, and we congratulate Bigeleisen et al. for their contribu-
tion to our understanding of the subject.

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References
1. Bigeleisen PE, Moayeri N, Groen GJ: Extraneural versus
intraneural stimulation thresholds during ultrasound-
guided supraclavicular block. ANESTHESIOLOGY 2009; 110:
1235–43
2. 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
3. Brull R, Chan VW, McCartney CJ, Perlas A, Xu D: Ultra-
sound detects intraneural injection (letter). ANESTHESIOLOGY
2007; 106:1244
4. Borgeat A: Regional anesthesia, intraneural injection, and
nerve injury beyond the epineurium. ANESTHESIOLOGY 2006;
105:647–8
5. Hadzic A, Dilberovic F, Shah S, Kuleenovic A, Kapur E,
Zaciragic A, Cosovic E, Vuckovic I, Divanovic KA, Morn-
jakovic Z, Thys DM, Santos AC: Combination of intraneural
injection and high injection pressure leads to fascicular
injury and neurologic deficits in dogs. Reg Anesth Pain
6. Sala-Blanch X, Ribalta T, Rivas E, Carrera A, Gaspa A, Reina
MA, Hadzic A: Structural injury to the human sciatic nerve
after intraneural needle insertion. Reg Anesth Pain Med
2009; 34:201–5
7. Moayeri N, Bigeleisen PE, Groen GJ: Quantitative architec-
ture of the brachial plexus and surrounding compart-
ments, and their possible significance for plexus blocks.
ANESTHESIOLOGY 2008; 108:299–304
8. Chan VWS, Perlas A, Rawson R, Oduko ya O: Ultrasound-
guided supraclavicular brachial plexus block. Anesth
Analg 2005; 97:1514–7
Ultrasound-guided supraclavicular block: Outcome of 510

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In Reply:
We thank Drs. Morfey and Brull for their response to our recent
observations.1 They raise some important questions on the abili-
ity of minimum stimulating current to detect intraneural needle
placement and to predict neurologic injury after intraneural in-
jection. Their most important question, however, concerned
the reliability of our measurements: how sure are we that the
needle tip was outside and inside the nerve during extraneural
and intraneural measurements, respectively? Their question
concerning what would be the outer layer of the supraclavicular
brachial plexus is very reasonable. In their ultrasound-guided
supraclavicular block procedure, accompanied by figures before
and after injection, they describe that during the block this outer
layer is intentionally breached, which is often felt as a loss of
resistance or "pop."

We have the same experience. At this site, the nerve fas-
cicles are surrounded by epineurial layers, as shown in figure
4 of our original article. The configuration of epineurial lay-
ers may differ depending on the site of formation of the nerve
trunks and cords of the brachial plexus. In addition, as stated
in our discussion, adjacent to the epineurial layers, fascial
layers that are continuous with the prevertebral and scalenic

Fig. 1. Axial cross section of neck at T7. Arrowheads = epineurium;
arrows = fusion of epineurium and prevertebral fascia.
muscle fascias may be present. This can be better observed in an axial histologic cross-section (fig. 1) that evidently shows several layers surrounding the nerve fascicles, including an outer layer that cannot always be clearly separated from the adjacent epineurial layers. Both layers are very thin (≤ 0.2 mm). Thus, by intentionally breaching this layer, we believe that both layers are punctured, and the needle tip is inside the nerve, which we referred to as intraneurial.

However, to objectively verify this position, we adopted two additional parameters, that is, the position of the needle tip adjacent to the hyperechoic (black) round to oval-shaped nodules combined with distention of the nervous structure after small volume injection. For that reason, it might have been more appropriate to define “inside the nerve” as parafascicular (next to the nerve fascicles). The outside location was verified by indentation of a hyperechoic layer by pressure from the needle tip and by the absence of nearby black nodules. This could have been described as nonparafascicular.

Thus, we are confident that our measurements really represent intraneural and extraneural needle tip placement. In fact, the accompanying figures of Morfey and Brull show the same configuration of black, round to oval-shaped nodules. Unfortunately, the position of their needle during injection is not shown. Furthermore, they suggest that if they accept our description and conclusions, they may have performed intraneural injections of the supravaculicular fossa much of the time. Actually, figure 2 in their study can be considered as a confirming sign that shows what has actually happened during their blocks, but what always was difficult to interpret: the presence of local anesthetic fluid adjacent to nerve fascicles. Because their retrospective survey did not reveal long-term neurologic injury, it underlines our previous statement that intraneural injection does not invariably result in neurologic injury.3,4

The relative amount of connective tissue in combination with the thinness of epineurial and outer layers may further explain this phenomenon.4 Our findings may be generalizable to nerves at other anatomic sites. Recently, Robards et al.5 reported findings that are similar to those of ours for the popliteal sciatic nerve block. They observed intraneural injection in all cases with a motor response at a stimulation current of 0.2–0.4 mA. Therefore, our conclusion that stimulation thresholds more than 0.2 and less than or equal to 0.5 mA are not reliable to prevent intraneural needle tip position was verified at a second anatomical site.

In conclusion, a minimum stimulation threshold of less than or equal to 0.2 mA is reliable for parafascicular placement of the needle in ultrasound-guided supravacular block and possibly for other anatomic sites as well. Can this minimum current predict whether needle placement and local anesthetic injection will cause neurologic injury? No, it cannot. Are we convinced that our measurements inside and outside the nerve are reliable? Yes, we are convinced. Finally, are the ultrasound-guided supravacular blocks of Drs. Morfey and Brull actually intraneural? Yes, that is our opinion, when anesthetic fluid is found adjacent to nerve fascicles.

We thank Drs. Mofrey and Brull for their interesting contribution to the continuing discussion on a possible relation between intraneural injection and neurologic injury.

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References


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A Case of Accidental Hypotension Caused by Drug Leakage through the Rubber Piston in a Prefilled Inovan Injection 0.3% Syringe

To the Editor: The use of prefilled syringes is recommended as a strategy to minimize errors in intravenous drug administration during anesthesia and intensive care.1 Prefilled syringe formulations of potent cardiovascular drugs are available to provide rapid access for critically ill patients. The prefilled syringe that requires assembly is composed of two parts: A plastic syringe plunger and an airtight syringe barrel with a rubber piston at one end and the enclosed drug. The operator has to assemble the syringe by fitting the plunger to the piston at an appropriate position before fixing the syringe into the syringe pump. We encountered a rare case of accidental hypotension as a result of failed dopamine delivery caused by drug leakage from a Prefilled Inovan injection 0.3% syringe (marketed by Kyowa Hakko Kirin Co., Ltd., Tokyo, Japan; manufactured by Terumo Corp., Tokyo, Japan). This leakage was noticed approximately 4 h after the start of the syringe pump infusion and appeared to be caused by plunger/piston misassembly. We report this case briefly to draw special attention to hazardous misassembly that may occur when using a prefilled syringe requiring assembly.

The case involved an elderly patient admitted urgently to our hospital for the treatment of pneumonia and dehydration. To manage his hypotension of 60/42 mmHg, a dopa-

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