

A new application for near-infrared spectroscopy in regional anesthesia?

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To the Editor:

Near-infrared spectroscopy (NIRS) can be used to measure the regional hemoglobin oxygen saturation of arterial, venous, and capillary blood, providing an estimate of local tissue perfusion [1]. A recent review article documented the use of NIRS for monitoring perfusion in cerebral and somatic tissue beds in a variety of settings [1]. Peripheral nerve blockade has been shown to cause vasodilatation [2, 3], and may also indirectly prevent peripheral vasoconstriction from increased adrenergic activity because of surgical stress. It is assumed that these effects result in increased regional tissue perfusion, although few objective measures are readily available to document these findings. We hypothesized that NIRS is able to capture the increase in local tissue perfusion after brachial plexus block, and conducted a pilot study to investigate this possible association.

After Institutional Review Board approval, 15 adult ASA I–III patients scheduled for elective upper extremity orthopedic surgery who consented to preoperative brachial plexus block and regional oxygen saturation (rSO₂) monitoring were enrolled. Exclusion criteria included emergent surgery, coagulopathy, previous arteriovenous fistula or graft, prior peripheral nerve injury, or peripheral neuropathy. The INVOS[®] Cerebral/Somatic Oximeter (Somanetics,

Troy, Michigan, USA) was used to monitor local tissue perfusion. Sensor pads were attached to the flexor surfaces of bilateral forearms. A brachial plexus block (interscalene, supraclavicular, infraclavicular, or axillary) was performed by an experienced anesthesiologist under ultrasound guidance. The local anesthetic used was bupivacaine 0.5% with an average volume of 30.7 ± 4.6 ml. rSO₂ values in both blocked and unblocked extremities were recorded at baseline, at block completion, and at 5, 10, 15, and 20 min intervals after block completion. Baseline rSO₂ values in the blocked extremity were compared with those in the unblocked extremity by use of the unpaired Student's *t* test. rSO₂ values for all time points in each extremity were compared with baseline values by use of repeated measures ANOVA. Statistical calculations were performed using GraphPad Prism[®] (GraphPad Software, La Jolla, CA, USA). *p* < 0.05 was considered statistically significant.

There was no statistical difference between baseline rSO₂ values in blocked and unblocked extremities. Statistically significant increases in rSO₂ values were found at 5, 10, 15, and 20 min post-block compared with baseline in the operative arm, but statistically significant increases were not observed in the unblocked extremity (Fig. 1). All patients had successful surgery utilizing the brachial plexus block as the primary anesthetic.

Our study is the first to demonstrate that NIRS can capture the increase in local tissue perfusion occurring after brachial plexus block. Significant increases in rSO₂ values were observed within 5 min of block completion, occurring before the patients' perception of sensory and motor loss. These changes are likely to result from a sympathectomy-like effect of the brachial plexus block, leading to increased diastolic flow and reduced peripheral resistance [4]. For this reason, somatic oximetry may potentially be used as an *objective* non-invasive measure to predict block success,

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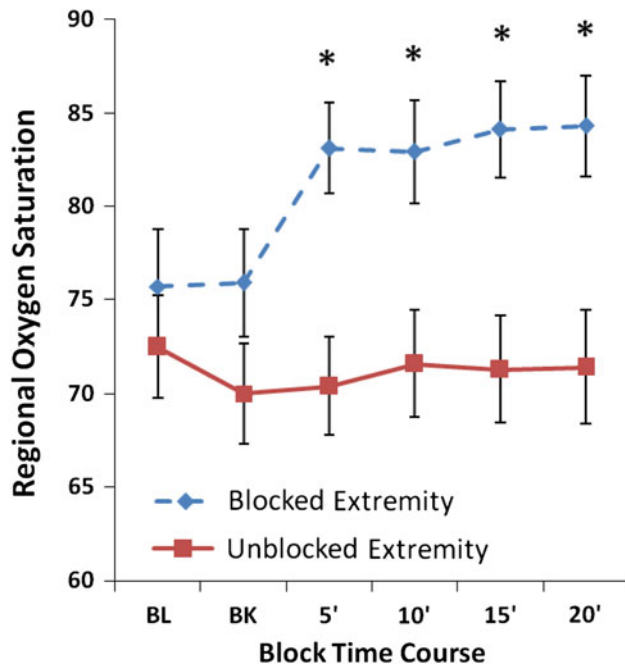


Fig. 1 Regional oxygen saturation (rSO₂) in patients receiving preoperative brachial plexus block. *Significantly ($p < 0.05$) different from baseline rSO₂ values as analyzed by repeated measures ANOVA. rSO₂ values reported as mean \pm standard error. BL, baseline; BK, block completion; 5', 5 min post-block; 10', 10 min post-block; 15', 15 min post-block; 20', 20 min post-block

although further studies are needed to investigate this possibility.

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References

1. Murkin JM, Arango M. Near-infrared spectroscopy as an index of brain and tissue oxygenation. *Br J Anaesth.* 2009;103:i3–13.
2. Laskowski IA, Muhs B, Rockman CR, Adelman MA, Ranson M, Cayne NS, Leivent JA, Maldonado TS. Regional nerve block allows for optimization of planning in the creation of arteriovenous access for hemodialysis by improving superficial venous dilatation. *Ann Vasc Surg.* 2007;21:730–3.
3. Hingorani AP, Ascher E, Gupta P, Alam S, Marks N, Schutzer RW, Mulyala M, Shiferson A, Yorkovich W, Jacob T, Salles-Cunha S. Regional anesthesia: preferred technique for venodilatation in the creation of upper extremity arteriovenous fistulae. *Vascular.* 2006;14:23–6.
4. Shemesh D, Olsha O, Orkin D, Raveh D, Goldin I, Reichenstein Y, Zigelman C. Sympathectomy-like effects of brachial plexus block in arteriovenous access surgery. *Ultrasound Med Biol.* 2006;32: 817–22.