Can J Anesth/J Can Anesth (2010) 57:143–148
DOI 10.1007/s12630-009-9234-3

CASE REPORTS/CASE SERIES

Ultrasound-guided suprascapular nerve block: a correlation with fluoroscopic and cadaveric findings

Bloc du nerf suprascapulaire par échoguidage: corrélation avec des résultats fluoroscopiques et cadavériques

Philip W. H. Peng, MBBS · Michael J. Wiley, PhD · James Liang, BSc · Geoff A. Bellingham, MD

Received: 25 August 2009 / Accepted: 12 November 2009 / Published online: 6 January 2010

Abstract

Purpose *Previous work on the ultrasound-guided injection technique and the sonoanatomy of the suprascapular region relevant to the suprascapular nerve (SSN) block suggested that the ultrasound scan showed the presence of the suprascapular notch and transverse ligament. The intended target of the ultrasound-guided injection was the notch. The objective of this case report and the subsequent cadaver dissection findings is to reassess the interpretation of the ultrasound images when locating structures for SSN block.*

Clinical features *A 45-yr-old man with chronic shoulder pain received an ultrasound-guided SSN block using the suprascapular notch as the intended target. The position of the needle was verified by fluoroscopy, which showed the tip of the needle well outside the suprascapular notch. Similar ultrasound-guided SSN blocks were performed in two cadavers. Dissections were performed which showed that the needle tips were not at the suprascapular notch but, more accurately, were close to the SSN but at the floor of the suprascapular fossa between the suprascapular and spinoglenoid notch.*

Conclusion *Our fluoroscopic and cadaver dissection findings both suggest that the ultrasound image of the SSN block shown by the well-described technique is actually targeting the nerve on the floor of the suprascapular spine between the suprascapular and spinoglenoid notches rather than the suprascapular notch itself. The structure previously identified as the transverse ligament is actually the fascia layer of the supraspinatus muscle.*

Résumé

Objectif *Des travaux précédents portant sur une technique d'injection par échoguidage et la sono-anatomie de la région suprascapulaire pertinente pour les blocs du nerf suprascapulaire (NSS) suggéraient que l'échogramme montrait la présence de l'échancrure suprascapulaire et du ligament transverse. L'échancrure était la cible de l'injection par échoguidage. L'objectif de cette présentation de cas et des résultats subséquents de dissection cadavérique était de réévaluer l'interprétation des images échoguidées lors de la localisation des structures pour la réalisation d'un bloc du NSS.*

Éléments cliniques *Un homme de 45 ans souffrant de douleur chronique à l'épaule a reçu un bloc du NSS échoguidé en utilisant l'échancrure suprascapulaire comme cible. La position de l'aiguille a été vérifiée par fluoroscopie, ce qui a montré que la pointe de l'aiguille était à l'extérieur de l'échancrure suprascapulaire. Des blocs du NSS semblables ont été réalisés par échoguidage sur deux cadavres. La dissection des cadavres a démontré que les pointes des aiguilles n'étaient pas situées au niveau de l'échancrure suprascapulaire mais, plus précisément, étaient proches du NSS mais au niveau du plancher de la*

P. W. H. Peng, MBBS (✉) · J. Liang, BSc · G. A. Bellingham, MD
Department of Anesthesia, Toronto Western Hospital, University Health Network, University of Toronto, McL 2-405, Toronto Western Hospital, 399 Bathurst Street, Toronto, Ontario M5T 2S8, Canada
e-mail: philip.peng@uhn.on.ca

G. A. Bellingham, MD
The Wasser Pain Management Centre, Mount Sinai Hospital, Toronto, Ontario, Canada

M. J. Wiley, PhD
The Division of Anatomy, Department of Surgery, University of Toronto, Toronto, Ontario, Canada

fosse suprascapulaire, entre les échancrures suprascapulaire et spino-glénoïdienne.

Conclusion *Les résultats de fluoroscopie et de dissection des cadavres suggèrent que l'échogramme du bloc du NSS montré par cette technique bien décrite cible en fait le nerf sur le plancher de l'épine suprascapulaire entre les échancrures suprascapulaire et spino-glénoïdienne plutôt que l'échancrure suprascapulaire en soi. La structure qui avait été précédemment identifiées comme le ligament transverse est en fait la couche de l'aponévrose du muscle supra-épineux.*

First described by Wertheim and Rovenstein in 1941,[1] the suprascapular nerve (SSN) block has been performed by anesthesiologists, rheumatologists, and pain specialists for the management of acute and chronic pain.[2] Recently, the ultrasound-guided injection technique and the sonoanatomy of the suprascapular region relevant to the SSN block have been described.[3–5] The images shown in the ultrasound-guided SSN injection reports[3,4] were described as identifying the SSN within the suprascapular notch and covered by the superior transverse scapular ligament. However, the identity of the structures captured in the published images has not been validated.

The objective of this case report and the subsequent cadaver dissection findings is to suggest a reinterpretation of the structures in the ultrasound scanning of the SSN described in those articles.[3–5] The patient provided consent for publication of personal information contained in this report.

Case report

A 45-yr-old man with a six-month history of left shoulder pain secondary to adhesive capsulitis was referred to us for a SSN injection. He failed to respond to regular non-steroidal anti-inflammatory drugs and ultrasound therapy.

The ultrasound-guided SSN injection was performed with the patient placed in a prone position with a pillow under his chest. The spine of the scapula, the coracoid process, and the acromion were used as landmarks. Ultrasound scanning was performed with a linear ultrasound probe (7–13 MHz) placed in a coronal plane over the suprascapular fossa with a slight anterior tilt. Once the typical ultrasound image[3,4] was obtained (Fig. 1), a 22G 80 mm needle was inserted directly to reach what was considered to be the "suprascapular notch" from the medial side of the probe using an in-plane technique. A mixture of 0.25% bupivacaine 6 mL and methylprednisolone acetate (Depomedrol) 40 mg (Pharmacia & Upjohn, Kalamazoo, MI, USA) was administered. The spread of medication around the nerve was well observed under the ultrasound scan. Since all of our interventional procedures were routinely performed in the fluoroscopic suite, fluoroscopy was performed to appreciate the position of the needle tip. Unexpectedly, the needle tip appeared lateral to the suprascapular notch on the floor of the scapular spine (Fig. 2). Subsequently, the patient reported 50% relief from pain which lasted four months.

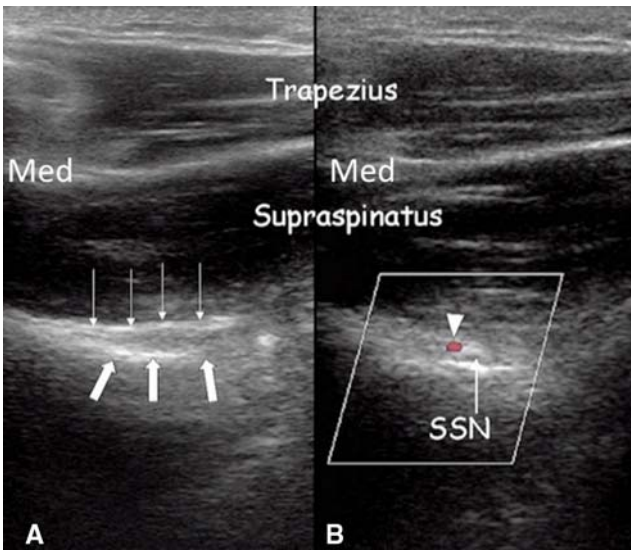

Fig. 1 Ultrasound image for a suprascapular nerve (SSN) block with interpretation as suggested by Gofeld[3] and Harmon and Hearty.[4] **a** Short axis scan of the nerve. Bold arrows = "suprascapular notch"; line arrows = "transverse scapular ligament". **b** Similar scan with colour Doppler to show the suprascapular artery (solid arrow), which was seen underneath the "transverse scapular ligament". The "suprascapular notch" is actually the floor of the scapular spine between the suprascapular notch and the spinoglenoid notch, while the "transverse ligament" is identified in this article as the fascia covering of the supraspinatus muscle. Med = medial

Due to the unexpected location of the needle, four ultrasound-guided SSN injections were performed in two cadavers (one injection in each shoulder of the cadaver) followed by dissection to locate the position of the needle tip. The permission to perform dissection in a cadaver was granted by the Office of the Chief Coroner for the Province of Ontario. The cadavers, both male aged 89 and 93 yr old, were entirely non-embalmed. Prior to use, the cadaver specimens were kept frozen at a sub-zero temperature in the Department of Anatomy, University of Toronto, and they were thawed for 3–4 days prior to the actual study. During the course of the experiments, the cadavers were kept at room temperature in the Department of Anatomy Dissection Laboratory. No preservative agents were used.

The ultrasound scanning was performed with the cadaver in the prone position using the same technique applied to live subjects. The SSN was clearly visualized and 0.5 mL of methylene blue (2.5 $mg \cdot mL^{-1}$) was injected under real-time ultrasound-guidance. Dissection of the

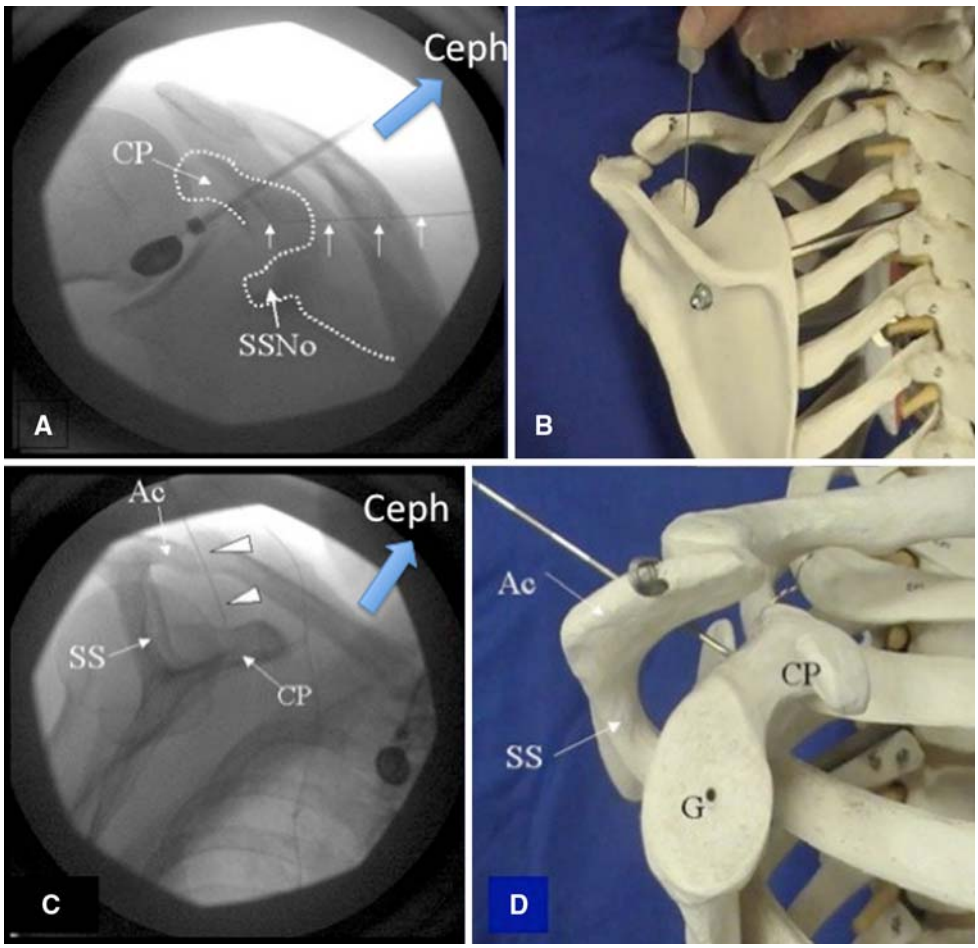

Fig. 2 **a** and **b** Fluoroscopic image of the scapula (posterio-anterior view) showing the scapular notch and the skeleton model showing the structures seen in the corresponding fluoroscopic image. The needle path is highlighted by the line arrows. **c** and **d** Lateral view of the scapula showing the needle insertion and the skeleton model showing the structures seen in the corresponding fluoroscopic image. Solid arrows show the needle path. Ceph = cephalic direction as indicated with the bold arrow; CP = coracoid process; SSNo = suprascapular notch; SS = scapular spine; Ac = acromion; G = gleonoid

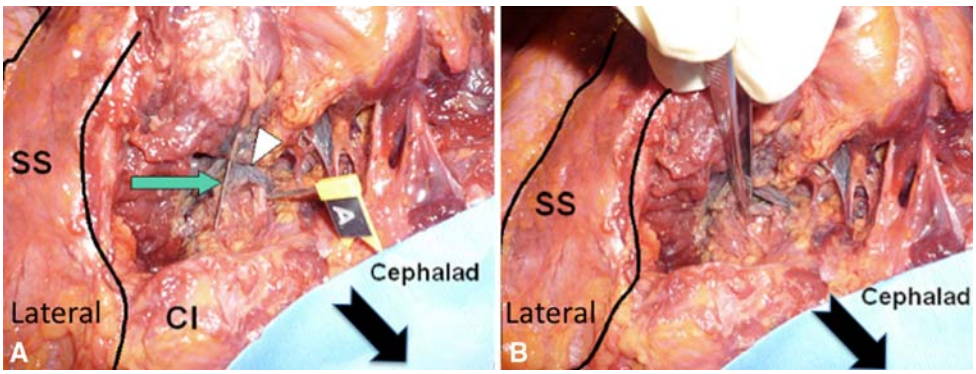

Fig. 3 Dissection showing the suprascapular structures. Only the posterolateral portion of the scapula was shown. The orientation was indicated by the bold arrow. **a** The flag, A, points to the transverse scapular ligament, and the solid triangle indicates the suprascapular vessel. The needle is indicated by the solid arrow. **b** The needle was removed, and the suprascapular nerve (SSN) is lifted up by the forceps. SS = scapular spine; Cl = clavicle

cadavers was performed with the needle kept in situ in one shoulder and with the needles removed in the other three shoulders. The needle tip or the methylene blue was on the SSN in all ultrasound-guided needle insertions (Fig. 3). The exact location of the needle was on the floor of the scapular spine between the suprascapular notch and spinoglenoid notch (Fig. 4).

Discussion

Three recently published articles described the sonoanatomy of the SSN relevant to the nerve injection.[3–5] With the ultrasound probe placed in the suprascapular fossa in the long axis of the supraspinatus muscle, they described the visualization of the suprascapular notch, the transverse

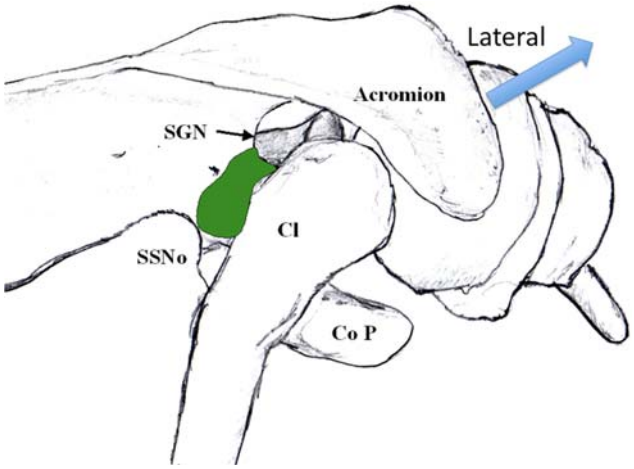

Fig. 4 Superior view of the scapula. The orientation is indicated by the bold arrow. The shaded area shows the floor of the scapular fossa which was mistaken as the suprascapular notch. This is the floor where the suprascapular nerve (SSN) courses from the suprascapular notch (SSNo) to the spinoglenoid notch (SGN). Cl = clavicle; CoP = coracoid process

scapular ligament, and the suprascapular artery and nerve. According to some authors,[3,4] the ultrasound image showed the suprascapular notch (as a curved continuous hyperechoic line), the transverse scapular ligament, and the SSN. Yücesoy *et al*.[5] commented that the vascular bundle "was clearly shown in the notch" but "under the (transverse scapular) ligament, possibly due to the tortuosity of the vessels".

Based on the understanding of the anatomy of the scapula and our findings from the fluoroscopy image and cadaveric dissection, we would like to revisit the orientation of the ultrasound probe described by those authors as well as the interpretation of the findings of ultrasound images. Gofled[3] and Harmon[4] described the orientation of the probe as being "parallel to the scapular spine". However, the scapular spine forms an angle ($39.5^{\circ} \pm 5.8^{\circ}$) to the axis of the scapula blade.[6] As shown in Harmon's article,[4] the final ultrasound probe position should be more in the coronal plane than in the transverse plane, because the structures in the suprascapular fossa are all obscured by the scapular spine in the transverse plane.

With the probe position in the coronal plane with a slight anterior tilt, it would be very difficult, though not impossible, to visualize the transverse scapular ligament which bridges over the notch. This is because the coracoid process forms the lateral border of the notch, projects anterosuperiorly, and then curves in an anterolateral direction. To visualize the transverse scapular ligament, the probe would have to be almost in a straight coronal position. Yücesoy *et al*.[5] had nicely demonstrated the image of the suprascapular notch and the transverse ligament. However, a slight deviation of the probe orientation from that position would result in scanning the floor of the suprascapular fossa. When the floor of the suprascapular fossa is scanned instead, a concave hyperechoic line appears, which can be misinterpreted as the suprascapular notch.[3,4] The suprascapular artery is a small artery that enters the suprascapular fossa after coursing over the transverse scapular ligament and runs along the floor of the suprascapular spine adjacent to the nerve. Consequently, if the ultrasound scan demonstrates the transverse scapular ligament, the suprascapular artery should be separated from the SSN by the ligament (Fig. 5). A slight deviation of the

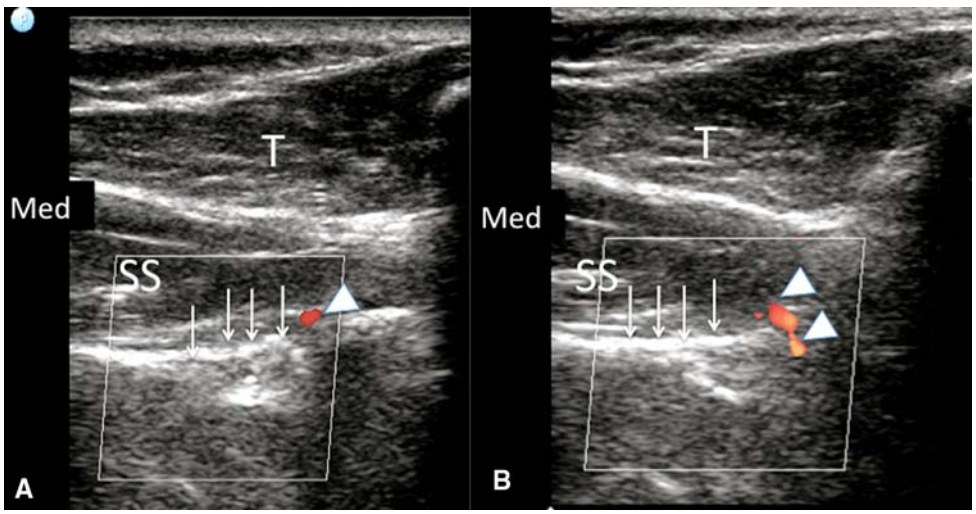

Fig. 5 Ultrasound images of the suprascapular notch and the suprascapular artery (solid arrow). **a** The ultrasound probe was positioned in the perfect plane so that the suprascapular artery is located just above the transverse ligament (line arrows). **b** With a slight posterior tilt of the ultrasound probe while preserving the image of the notch, the suprascapular artery is seen approaching the floor of the suprascapular fossa creating an image that appears as though the artery is progressing "inside the notch". T = trapezius muscle; SS = supraspinatus muscle; Med = medial

scan position of the notch would capture the image of the suprascapular artery *posterior* to the notch where the suprascapular artery and nerve join (Fig. 5). Thus, it may explain why the suprascapular artery is closer to the floor of the suprascapular fossa and was interpreted as "within the notch" as suggested by Yücesoy *et al*.

Our fluoroscopy image and cadaveric dissection both suggest that the ultrasound image of the SSN obtained by the aforesaid authors was not at the suprascapular *notch* but was actually the short axis view of the nerve on the *floor* of the scapular spine between the suprascapular notch and the spinoglenoid notch. The hyperechoic shadow simulating the transverse scapular ligament is actually the fascia of the supraspinatus covering the suprascapular fossa. This explains why the suprascapular artery is usually observed running under the so-called "transverse scapular ligament" that is the fascia of the supraspinatus muscle covering the floor of the scapular spine.

However, despite some misinterpretations of the ultrasound image, the target site of the ultrasound-guided approach may be the optimal site for the SSN injection. With different approaches, the SSN can be targeted at either the suprascapular notch[1,7] or the suprascapular fossa.[8,9] Major disadvantages of targeting the SSN at the notch are the potential risk of pneumothorax, intravascular injection, injury, or misplacement.[10,11] The precision of the needle tip location can be improved by using imaging techniques, such as ultrasound, fluoroscopy, or computerized tomography (CT) scan guidance. However, CT scan is not widely available, and both CT scan and fluoroscopy imaging modalities expose the patient and healthcare professionals to radiation risk. Although the suprascapular notch can be revealed with ultrasound, performing needle insertion under ultrasound guidance at the notch can be very challenging.

Placing the needle into the suprascapular fossa is a popular alternative.[8,9] The technique is easy to perform and further minimizes the risk of pneumothorax because the needle is directed to the floor of the scapular spine. To ensure that the SSN is blocked, an adequate volume of solution is injected to fill the suprascapular fossa compartment. Too low a volume will result in maldistribution and too high will result in the spread of local anesthetic to the brachial plexus.[9] A recent CT scan study showed that a 10 mL injectate spread to the brachial plexus within the axilla in three out of 33 cadavers.[9] The authors suggested that 5 mL is the adequate volume for injection into the suprascapular fossa. One concern of using such a low volume is the maldistribution and potential decrease in the duration of the blockade.[12] Using an image-guided technique that allows direct visualization of the nerve can ensure the proximity of the local anesthetic to the nerve. Ultrasound-guided injection has been shown to achieve a complete block with a smaller volume of local anesthetic.[13] Directing the needle away from the suprascapular notch also minimizes complications from the "notch" approach and minimizes the risk of leakage of the local anesthetic through the notch from the suprascapular compartment. This approach is independent of the visualization of the suprascapular notch, as the notch is absent in 8% of the population.[14]

In conclusion, we present a case report and the results of cadaver dissections, which suggest a reinterpretation of the ultrasound image obtained and described in the literature. By positioning the ultrasound probe in the coronal plane over the suprascapular fossa with a slight anterior tilt, the SSN can be visualized on the floor of the scapular spine between the scapular notch and the spinoglenoid notch. The concave shape of the floor can be misinterpreted as the suprascapular notch, and the fascia of the supraspinatus muscle can be misinterpreted as the transverse scapular ligament. However, this target site may be the optimal site for SSN block, as the suprascapular fossa at this site forms a compartment, and the final needle tip position will be away from the notch with a potential decrease in the risks of pneumothorax or spread of local anesthetic towards the brachial plexus. Furthermore, the ultrasound image is easy to acquire, even in those individuals where a suprascapular notch is not present.

Financial support Institutional.

Conflicts of interest None declared.

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