1- **Title**: Novel use of ultrasound guidance in wide awake local anesthesia technique for clavicle surgery

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3- **Running title**: Ultrasound-guided WALANT clavicle

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Dear editor,

Clavicle fixation is becoming more common but only few comparative studies have been conducted to determine the optimal approach in regional anesthesia as a sole technique for such surgery. Combined interscalene and intermediate cervical plexus block would seem the most effective technique [1]. However, this approach can be associated with undesirable effects and may be contraindicated in patients with impaired pulmonary function [2].

Wide awake local anesthesia technique with no tourniquet (WALANT) was recently reported as an alternative landmark-based technique in clavicle fractures [3]. This technique consists of injecting diluted and buffered local anesthesia with epinephrine under clavicle periosteum. We describe the use of ultrasound guidance to perform this technique in two patients undergoing clavicle surgery. Written informed consent was obtained from the patients.

A 17 years old patient was admitted for a displaced segmental fracture of the midshaft clavicle. The patient was placed in a semi-fowler position with the head turned away from the operative side. The anesthetic solution prepared was a mixture of lidocaine 0.5% containing bupivacaine 0.05%, epinephrine 1/200000 and 8.4% sodium bicarbonate (1 ml per 10 ml of lidocaine). We used a linear ultrasound probe (13-6 MHz) to scan above and below the clavicle to identify relevant nearby structures particularly pleura, brachial plexus and the subclavian vessels. After subcutaneous injection of 10 ml over the incision line, ultrasound-guided WALANT was performed by administering 40 ml of
the prepared solution at four intervals along the clavicle. Probe was placed perpendicular to the long axis of the clavicle so as to view the clavicle in cross section (Fig. 1A). A conventional needle (21G×38 mm) was inserted vertically out-of-plane until the needle tip contacts the clavicle, local anesthetic was injected, needle was next withdrawn to skin level and redirected cranially and caudally until bone contact to anesthetize the borders of the clavicle. Ultrasound guidance allowed for visualization of the adequate spread around the cortical line of the clavicle. A thickening of the hyperechoic and thin cortical line with subsequent lower echogenicity and fuzzy edges was also observed (Fig. 1B), and confirmed the spread of anesthetic solution under the periosteum (Video 1). Additionally, 5 ml were injected into the fracture site under ultrasound control using in-plane technique. Surgical incision occurred after 30 minutes in order to obtain maximal vasoconstriction and optimal sensory anesthesia of the clavicle area. There was neither motor nor sensory block of the upper limb, proving there was no spread of local anesthetic solution to the brachial plexus. The procedure of 70 minutes was performed successfully without sedation and a clavicle plate was fixed using screws. Stability of the fixation was evaluated through active shoulder movements. No surgical drain was necessary. Intravenous acetaminophen 1 g and ketoprofen 100 mg were given. No supplemental analgesics were used and patient was discharged at 24 h.

The second case involved a 45 years old man, operated three months ago for acromioclavicular dislocation treated with tension band wiring and medial malleolus fracture fixed by Kirschner wires (K-wires). He was scheduled to remove the hardware. After skin infiltration, we performed an ultrasound-guided WALANT at the lateral portion of the clavicle and the acromioclavicular junction, using the technique described previously (Fig.1C). We administered a total of 50 ml of local anesthetic solution prepared as above, including 10 ml injected in the medial malleolus. The same ultrasonographic image
was observed after subperiosteal injection which insisted on entry points of the K-wires (Fig. 1D). The surgery lasted for 25 minutes with no additional analgesic requirement. No adverse effects were observed. The patient reported no pain in the immediate postoperative period, required no rescue analgesia and was discharged home the same day with oral medication.

Although benefits of ultrasound guidance in WALANT have been reported for hand surgery [4], our cases are the first to examine its clinical utility for clavicle procedures. Ahmad and al. have expanded the use of WALANT to the clavicle surgery and reported 16 patients who successfully underwent clavicle fixation [3]. However, two patients with a displaced segmental fracture experienced a mild pain during fixation. Anesthesia was then completed by injecting intraoperatively supplemental WALANT solution. No complications were observed in this first case series, suggesting that this approach may be an effective alternative. However, special precaution must be taken when injecting blindly near lung, brachial plexus and subclavian vessels. This encouraged us to perform this technique under ultrasound guidance. Advantages over the landmark technique include the ability to visualize the correct spread of local anesthetic around the clavicle, and to avoid the inadvertent puncture of adjacent structures. Remarkably, subperiosteal diffusion results in a typical thickening and echotexture modification of the cortical line. Ultrasound control also allows depositing local anesthetic around the fixation devices and into the fracture site, thus furthermore avoiding intraoperative complementary injections.

In addition to its technical simplicity, WALANT might reduce the risk of nerve damage and phrenic nerve palsy associated with regional techniques commonly used for awake clavicle repair [2]. Although WALANT is performed anatomically away from the phrenic nerve, suggesting theoretically the absence of its involvement, we did not assess the diaphragmatic function by ultrasound to validate
this effect. Moreover, WALANT avoids motor blockade of the upper limb allowing the patient to dress by himself immediately after surgery, making it suitable for outpatient surgery. Active patient movements also assist the surgeon in checking the fixation stability. However, there are some concerns including delayed onset of blockade and patient’s discomfort due to prolonged surgery [3].

We present two cases describing the advantages of ultrasound guidance in WALANT for clavicle surgery, with a novel ultrasonographic image of subperiosteal injection. The absence of the upper limb motor blockade and the effective postoperative analgesia facilitated early recovery. This alternative could constitute a diaphragm sparing option in patients with respiratory impairment but probably also in more common cases. Further investigation is required to establish the efficiency and safety of this novel technique.
References


Fig. 1: Ultrasound-guided WALANT. A needle was inserted to contact the clavicle. After confirming proper position of the needle, local anesthetic was injected via real-time ultrasound guidance. (A) Sagittal cross section sonogram of the clavicle and (B) the modifications after subperiosteal injection showing a thickened and less echoic cortical line with fuzzy edges. (C) Patient position and needle insertion for the out-of-plane technique performed at the lateral portion of the clavicle. All needle redirections are done through the same insertion site. (D) Image showing the K-wire at his entry point as a hyperechoic structure with a comet-tail artifact (white arrow) and the hyperechoic tension band.

**Video 1.** Ultrasonographic video of subperiosteal spread of the local anesthetic after out-of-plane WALANT injection. Note the thickening and echotexture modification of the clavicular cortical line.