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Case Report

Ultrasound-guided block of the axillary nerve: a case series of potential clinical applications

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The specific blocking of the axillary nerve has never been investigated clinically. We present four cases illustrating potential applications of the axillary nerve block in the perioperative setting and discuss possible directions for future research in this area. The axillary nerve blocks were all performed using a newly developed in-plane ultrasound-guided technique. In one patient undergoing arthroscopic shoulder surgery, we used the axillary nerve block as the only analgesic combined with propofol sedation and spontaneous breathing. Chronic shoulder pain was eliminated after the axillary nerve block in two patients. The pain score after arthroscopic shoulder surgery in these two patients remained low until termination of the nerve block. In a fourth patient, severe post-operative pain after osteosynthesis of a displaced proximal humerus fracture was almost eliminated after performing an axillary nerve block. These findings warrant larger clinical trials that investigate the pain-mediating role of the axillary nerve in the perioperative setting.

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Since the 1970s, the interscalene brachial plexus block (IBPB) has been considered the gold standard in managing post-operative pain following shoulder surgery.[1–4] However, the IBPB is extensive and results in motor blockade of almost the entire upper extremity. Significant adverse effects also comprise phrenic nerve paralysis, Horner's syndrome, hoarseness and swallowing difficulties.[3,5] For these reasons, it would be desirable to have a more specific regional anaesthetic technique for treating post-operative shoulder pain. The suprascapular nerve block has been used[6] but often – and expectedly – does not provide adequate post-operative analgesia because the axillary nerve also contributes substantially to the complex innervation of the shoulder.[7] Lately, a combined axillary and suprascapular nerve block has been developed and used successfully in treating post-operative shoulder pain.[8–11] The authors used anatomical landmark techniques combined with nerve stimulation, but especially the axillary nerve block is difficult to perform using a blind technique. Recently, we have described a new ultrasound-guided method to specifically block the axillary nerve in healthy volunteers.[12] However, the potential clinical usefulness of this axillary nerve block remains as yet undetermined. To gain some clinical experience with the block – and before undertaking a larger randomised, placebo-controlled, blinded clinical trial – we investigated potential clinical applications of the block in a small group of patients. This has never been reported before. In the present study, we describe our experience with this new block in four patients.

Case series

This case series was part of a pilot study approved by the Committees on Biomedical Research Ethics of the Capital Region of Denmark (protocol nr. H-1-2011-057). After informed consent, we performed an ultrasound-guided axillary nerve block in four patients. All patients had a peripheral intravenous (iv) catheter and were monitored according to hospital standards (non-invasive blood pressure, peripheral pulse oximetry and continuous electrocardiography). We performed the block with the patients in the sitting position (Fig. 1A), using in-plane technique, an 80 mm, 22G insulated nerve

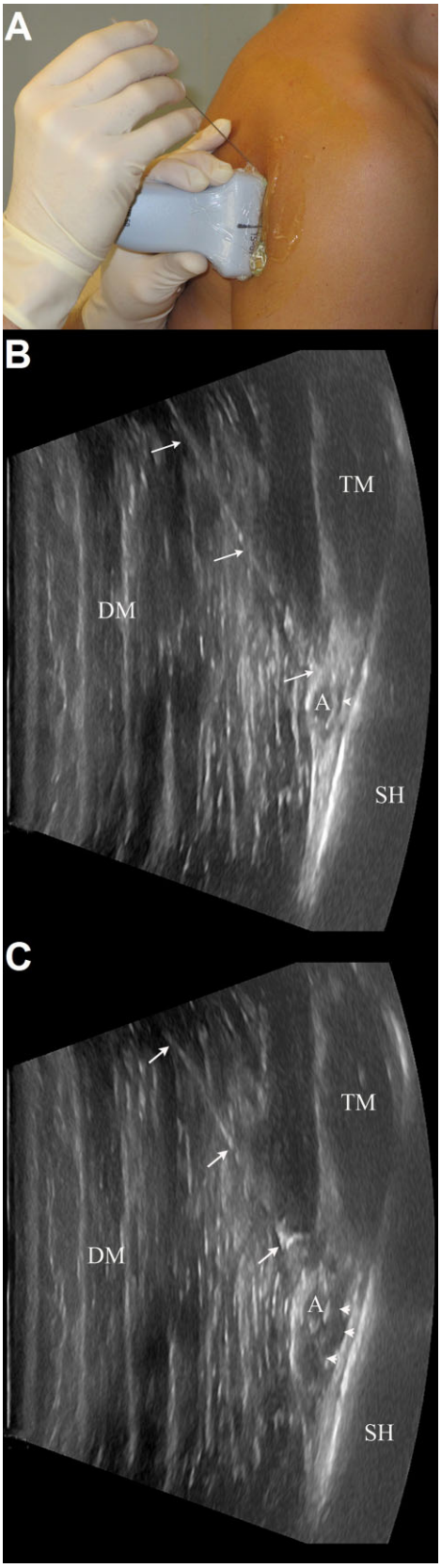

Fig. 1. Ultrasound-guided axillary nerve block. (A) Patient and transducer position. Lateral view of the shoulder region demonstrating in-plane needle insertion with the transducer parallel to the longitudinal axis of the humerus. (B) Ultrasonographic image oriented as in (A), showing the needle in-plane with the needle tip just cranial to the posterior circumflex humeral artery (PCHA). Beginning of local anaesthetic spread is observed around the PCHA (0.5–1 ml). (C) Ultrasonographic image oriented as in (A), showing local anaesthetic spread (10 ml) around the PCHA. DM, deltoid muscle; TM, teres minor muscle; SH, humeral shaft; A, artery (PCHA); large arrows, needle (in-plane); small arrows, local anaesthetic.

stimulation needle (B. Braun Melsungen AG, Melsungen, Germany) and a high-frequency linear ultrasound transducer (38 × /13-6 MHz, S-ICU™ Ultrasound System, Sonosite, Inc., Bothell, WA, USA; or GE Logiq e, GE Healthcare Diagnostic Imaging, Waukesha, WI, USA). With the needle tip positioned in the neurovascular space just cranial to the posterior circumflex humeral artery (PCHA), below the deltoid muscle, caudad to the teres minor muscle and above the triceps muscle (Fig. 1B and C), we injected ropivacaine (Naropin® 7.5 mg/ml, Astra Zeneca A/S, Albertslund, Denmark) 15 ml. For further details regarding the anatomy and the block technique, we refer to Rothe et al.[12]

Case 1: axillary nerve block and propofol sedation for arthroscopic subacromial decompression

A 39-year-old male [American Society of Anesthesiologists Classification 1 (ASA 1); weight 84 kg, height 175 cm, body mass index (BMI) 27.4 kg/m^2] presented with a subacromial impingement syndrome of the right shoulder. The baseline visual analoque scale (VAS; 0–10) pain score was 5 (rest) and declined to 0 within minutes after performing the axillary nerve block. The patient was taken to the operation theatre, positioned in a beach chair and sedated with propofol, while breathing spontaneously with nasal oxygen supplementation (3 l O_2/min). The duration of the arthroscopic procedure was 27 min. Because of bursitis, the surgeon resected the subacromial bursa and performed an acromioplasty to create more space. In the recovery room, the patient reported a VAS score of 2 (rest) and was able to move the forearm and hand freely. The patient was discharged after 2 h in the recovery room, and the VAS score remained 2 until 11 h after performing the nerve block. The VAS score subsequently increased to 7, indicating block termination.

Case 2: axillary nerve block for treating post-operative shoulder pain after arthroscopic shoulder surgery including shoulder mobilisation (brisement)

A 45-year-old male (ASA 1; weight 105 kg, height 189 cm, BMI 29.4 kg/m^2) presented with chronic, unilateral shoulder pain. The baseline pain scores were: VAS 8 (activity) and VAS 2 (rest), respectively. The VAS scores 15 min after performing the axillary nerve block were 0 (rest and activity). The patient was taken to the operation theatre, positioned in a beach chair, and anaesthetised with propofol and remifentanil, and the trachea intubated without use of neuromuscular blocking agents. The duration of the arthroscopic procedure was 33 min. Because of biceps and supraspinatus tendon degeneration and limited range of movement, the surgeon performed shoulder mobilisation (brisement), biceps tendon tenotomi and a partial synovectomi. In the recovery room, the patient was connected to a patient-controlled iv pump (morphine 2 mg/ml, bolus 1 ml, lockout time 10 min). The patient was able to move the hand and forearm freely and was discharged 4 h post-operatively. The total patient-controlled iv morphine administered until discharge was 12 mg. The VAS scores were 1–2 (rest and activity) until discharge and remained at this level until termination of the block 14 h after performing the block. The VAS scores after termination of the block were 1–2 (rest) and 5 (activity), respectively. The patient had previously had an IBPB and reported that he preferred the axillary nerve block because he could move the forearm and hand freely.

Case 3: axillary nerve block for treating post-operative shoulder pain after arthroscopic shoulder surgery

A 44-year-old female (ASA 1; weight 83 kg, height 180 cm, BMI 25.6 kg/m^2) presented with severe, persisting shoulder pain 9 months after a fracture of the major tubercle of the humerus. The baseline pain scores were VAS 10 (activity) and VAS 6 (rest). The VAS scores 15 min after performing the axillary nerve block were 0 (rest and activity). The patient was taken to the operation theatre, positioned in a beach chair, and anaesthetised with propofol and remifentanil, and the trachea intubated without use of neuromuscular blocking agents. The duration of the arthroscopic procedure was 20 min, and the surgeon performed a subacromial decompression. The patient did not require any analgesics post-operatively and was able to move the hand and forearm freely. The VAS scores remained 0 (rest and activity) until discharge 1 h after arrival in the recovery room and 0 (rest and activity) until termination of the axillary nerve block 15 h after performing the block. The VAS scores after termination of the block were 0 (rest) and 3–4 (activity), respectively.

Case 4: axillary nerve block for treating post-operative pain after osteosynthesis of a proximal humerus fracture

This 52-year-old male (ASA 1; weight 83 kg, height 186 cm, BMI 24.0 kg/m^2) presented with a displaced proximal humerus fracture after a fall. In the operation theatre, the patient was placed in the supine position, and anaesthetised with propofol and remifentanil, and the trachea intubated after administration of rocuronium 40 mg. Pre-operatively – and while anaesthetised – the anaesthesiologist on duty performed an ultrasound-guided IBPB with ropivacaine 25 ml (7.5 mg/ml) using in-plane technique. The duration of the operation was 93 min, and the surgeon performed an open reduction and internal fixation of the fracture. The patient was administered fentanyl 200 µg iv at the end of the operation. The VAS score in the recovery room was 6. During the following 60 min, alfentanil 2×0.5 mg and morphine 2×5 mg iv were administered without any effect on the pain score. We then decided to perform an ultrasound-guided axillary nerve block, and the VAS score declined almost immediately to 1–2. The patient was able to move the hand and forearm freely.

Discussion

The isolated effect of the axillary nerve block has never been tested clinically. We have recently described an ultrasound-guided technique to specifically block the axillary nerve,[12] thus providing a unique opportunity to further investigate and develop methods to treat perioperative shoulder pain. Before embarking on larger clinical trials, we performed a case series on patients that may point to relevant clinical applications of the axillary nerve block.

Case 1 suggests that the blocking of the axillary nerve is indeed a very determining factor in reducing pain during minor arthroscopic shoulder surgery. We were surprised that it was actually possible to conduct the operation in a patient using propofol sedation and having an axillary nerve block as the only analgesic. Obviously, we have tried the same procedure in other patients that had more

extensive shoulder surgery, and they complained about pain that necessitated the addition of general anaesthesia and ventilation through a laryngeal mask airway. Therefore, we do not think that the presented anaesthetic technique has the potential to become clinically useful. However, the case serves to illustrate the importance of the axillary nerve in mediating shoulder pain.

Cases 2 and 3 illustrate the marked effect of the axillary nerve block in reducing chronic shoulder pain. The reduction was substantial in case 3. Post-operatively, the same patients only had minor pain that increased markedly when the axillary nerve block ended approximately 14–15 h after performing the block. These two cases illustrate that the axillary nerve block may prove useful in managing post-operative pain after shoulder surgery either alone or in combination with a suprascapular nerve block. However, we need much more research before we can draw any conclusions. With these cases in mind, the natural next step would be a prospective, randomised, blinded, placebo-controlled trial that investigates the isolated effect of the axillary nerve block on post-operative pain after arthroscopic shoulder surgery. From there, we can go further and perform studies on the combined suprascapular and axillary nerve block and eventually compare this combined block with the gold standard, the IBPB.

Case 4 points to another potential clinical application of the axillary nerve block. The patient had substantial pain after osteosynthesis of a complicated, displaced fracture of the proximal humerus. Obviously, the pre-operative IBPB had failed, and the axillary nerve block reduced the post-operative pain substantially, illustrating the importance of the axillary nerve in mediating pain from the proximal parts of the humerus.

We have also tried the axillary nerve block in a patient with acute anterior dislocation of the shoulder. The patient went from severe to almost no pain, and the reduction was easily performed, although not entirely pain-free.

In the present case series, we used 15 ml of local anaesthetic, whereas we only used 8 ml in our volunteer study.[12] We know from magnetic resonance imaging studies that increasing the dose to 25 ml leads to local anaesthetic spread proximally along the axillary nerve without affecting other nerves of the brachial plexus (unpublished results). However, we do not actually know if the axillary nerve is located cranially or caudally to the PCHA or if there are frequent variations regarding this issue. The axillary nerve is indeed difficult to visualise on ultrasound with the presently described method. Whether a nerve stimulator should be used to avoid nerve damage is controversial. In our experience, a determining technical point to a complete axillary nerve block (both terminal branches) is to place the needle tip just cranial to the PCHA, and to inject and observe local anaesthetic spread around the PCHA in the neurovascular space (Fig. 1B and C).

We used ropivacaine, 7.5 mg/ml in the present case series. Obviously, the main objective is to do the least harm to the patient. It is most likely that ropivacaine, 5 mg/ml or even less could have been used. Great efforts should always be made at reducing both the concentration and the volume of local analgesic administered to minimise risks of toxicity and side effects. In addition, peripheral nerve blocks should be performed in awake patients whenever possible.

Many patients having an IBPB complain about the extensive motor blockade, and the side effects and potential complications associated with the IBPB are not trivial. Therefore, we hope that the present case series will lead to further studies investigating and developing more selective shoulder blocks. A technique with the possibility of introducing a catheter will be superior as compared with a technique without this possibility. Currently, we do not know if a catheter technique is feasible with our technique, and this obviously represents a limitation.

In summary, we present four cases that illustrate potential clinical applications of the axillary nerve block in the perioperative setting.

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