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Dislocation rates of perineural catheters: a volunteer study

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Editor's key points

- This study investigated dislocation rates of interscalene and femoral nerve catheters in volunteers under standardized study conditions via ultrasound (US).
- They found a 15% overall dislocation rate of interscalene and femoral nerve catheters with a highly significant correlation between the time and rate of catheter dislocation.
- US was a useful technique to detect the dislocation of the spread of fluid through peripheral nerve catheters.

Background. Dislocation rates of continuous peripheral nerve block are poorly described even though this technique is frequently used in clinical practice. The present study was designed to evaluate dislocation rates over time of interscalene and femoral nerve catheters under defined experimental circumstances. Ultrasound (US) monitoring was used to detect the position of the perineural catheters.

Methods. Twenty volunteers received US-guided interscalene and femoral nerve catheters. The volunteers performed standardized physical exercises in regular intervals and the position of both catheters was examined by US confirmation of the spread of fluid. The maximal time of investigation in each volunteer was 6 h. The main outcome parameters were the overall dislocation rates and the cumulative dislocation rates at a given time point.

Results. We observed an overall dislocation rate of 15% (5% for interscalene catheters, 25% for femoral nerve catheters) and a significant correlation between time and rate of dislocations (r=0.99, P=0.001). US visualization of the spread of fluid was possible in all cases.

Conclusions. This is the first dedicated evaluation of dislocation rates of peripheral nerve catheters (PNCs) via US investigation. Both movement and time are considerable factors for perineural catheter displacement. US is useful for the performance of PNCs and for the continuous detection of the spread of fluid relative to the nerve and adjacent anatomical structures. Translational research is required to confirm the study results in the clinical practice.

German Clinical Trials Register: DRKS00003494.

Keywords: anaesthetic techniques, regional, brachial plexus; anaesthetic techniques, regional, lumbar plexus; monitoring, ultrasound

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Continuous peripheral nerve block is a standard anaesthetic technique for perioperative pain therapy.[1 2] Despite the broad use of the various techniques for continuous upper and lower limb block, the dislocation rates remain unclear. There are no sufficient reports in the literature regarding this important issue.

Ultrasound (US) is a bedside diagnostic method to observe the spread of local anaesthetic (LA) around neuronal structures.[3–5] Peripheral nerve catheters (PNCs) are only irregularly visible in US,[6] but the spread of LA which is administered through a catheter can always be detected by US. Thus, it is obvious that this technique should be used for this indication.

The main objective of this prospective, open, and uncontrolled volunteer study was the evaluation of dislocation rates over time for upper and lower limb PNCs in a standardized, experimental study setting. Two PNC techniques were investigated in this study: interscalene and femoral. Both are popular regional anaesthetic techniques in clinical practice, and easily approachable by US. Additional findings were expected regarding the practicability of the detection of PNC positions via US and the mechanism of dislocation of PNC.

Methods

The study was approved by the Ethical committee of the Medical University of Vienna (EK 1121/2011) and by the Austrian Agency for Health and Food Safety (EudraCT

2011-005530-19). Trial registration was performed via the German Clinical Trials Register (DRKS00003494).

Screening visit

Twenty volunteers were included in this study. Each volunteer was scheduled to receive an interscalene and a femoral nerve catheter. Before inclusion in the study, we informed them about the nature, scope, and the procedures of the study and about the particular study-related risks.

Exclusion criteria were defined as follows:

- Anatomical abnormalities of the upper or lower limbs.
- BMI $\geq$ 30 kg m^{-2}.
- Use of non-steroidal anti-inflammatory drugs during the last 2 weeks.
- Known allergy or hypersensitivity to mepivacaine or amino-amide LAs.
- Participation in another clinical study within the last 4 weeks before study.
- Clinically relevant coagulopathy.
- Abnormalities in ECG that are considered clinically relevant like AV-block or bradycardia.
- Inability to perform the standardized physical exercises (see below).

Each enrolled healthy volunteer was scheduled to undergo a general physical examination, including an anamnesis and drawing of blood for the laboratory (red and white blood count, haemoglobin, haematocrit, platelet count, and blood coagulation parameters). In addition, an ECG, arterial pressure, and heart rate were performed (after 5 min rest in supine position). A US investigation of the interscalene portion of the brachial plexus and the femoral nerve in the inguinal area was performed to exclude anatomical variations which may interfere with successful placement of the perineural catheters. The screening visit took place within 3 weeks before the study day.

Study day

In the morning of the study day, the volunteers were admitted to the clinical research ward. One 18-G plastic cannula (Venflon™, Becton Dickinson, Helsingborg, Sweden) with a switch-valve was inserted into an antecubital vein. The US-guided performance of continuous interscalene block and continuous femoral nerve block (in direct sequence, all techniques on the left side) was performed (see below). US observations of the spread of saline were performed after each of the four cycles of physical examination.

US guided performance of continuous interscalene block

The puncture area and the US transducer were prepared in a sterile manner and a skin wheal was raised with 2 ml Mepivacaine 1% (BBraun Melsungen AG, 34209 Melsungen, Germany). We used the Polymedic® polyplex C90 K US 18G PNC set (te me na, Z.I. des Amandiers, Carrières sur Seine, France) with an 18-G facette tip cannula and a 20-G catheter with one terminal hole with a guide wire. The catheter was marked at distances of 1 cm for determination of the penetration depth.

Once the C5–7 nerve roots were identified by US (SonoSite Edge™, SonoSite, Inc., Bothell, WA, USA) with a high frequency US transducer (38 mm active area, 15 MHz frequency), the puncture was performed as previously described in an out-of-plane technique.[7] After optimal visualization of the nerve roots, the needle was introduced 2 cm cranial the US transducer to increase the subcutaneous distance from the injection site to the nerve structures. Once the tip of the needle was placed between the anterior scalene muscle and the C5–7 nerve roots, 5 ml saline was administered to confirm that the tip of the cannula was in the correct position with a subsequent saline distribution around the nerve structures. Thereafter, the catheter was advanced through the cannula 30 mm beyond the tip of the cannula and retracted under permanent slow saline administration and US guidance until the spread of the fluid was confirmed as optimal relative to the C5–7 nerve roots. The introduction length of the catheter was recorded and the catheter was fixed with sterile transparent tapes (Fig. 1). A 0.2 μm filter was connected at the proximal site of the catheter to provide sterile administration of saline throughout the duration of the study.

US guided performance of continuous femoral nerve block

Sterilization procedures and skin wheal were performed, and catheter and US equipment were used as described above. Once the femoral nerve was identified by US, the puncture was performed as described[8] with an out-of-plane needle guidance technique and a needle introduction site 2 cm caudal to the US transducer. Five millilitres of saline were administered to confirm that the tip of the cannula was in the correct position. The catheter was advanced through the cannula 30 mm beyond the tip of the cannula and retracted under permanent slow saline administration and US guidance until the

Fig 1 Method of fixation of an interscalene catheter.