Knotting of a Perineural Catheter Inserted with Ultrasonography

Christina Y Duong, De QH Tran, Avinash K Sinha

ABSTRACT

Objectives: Increasingly, ultrasonography is being used to insert perineural catheters. We report the case of a knotted and retained interscalene catheter that required surgical extraction.

Case report: An interscalene catheter was inserted to provide postoperative analgesia in a patient undergoing surgical repair of a proximal humeral fracture. Using ultrasound guidance, the needle tip was advanced in real time next to the brachial plexus. Under direct vision, a bolus of local anaesthetic agents was injected and found to surround the plexic roots and trunks. Subsequently, a perineural catheter was inserted blindly past the needle tip. Postoperatively, removal of the catheter (at 24 hours) yielded unexpected resistance. An X-ray of the neck revealed the presence of a knot. The catheter was successfully removed with a surgical incision. The patient suffered no neurological sequelae.

Conclusion: In order to maximise the benefits of ultrasound guidance for perineural catheter insertion, the operator should ensure that all steps (needle insertion, local anaesthetic injection and catheter advancement) be carried out under direct vision.

Keywords: Knot, Perineural catheter, Ultrasonography.

INTRODUCTION

Knotted perineural catheters have been previously reported in the context of continuous parascalene, axillary, femoral, fascia iliaca and sciatic nerve blocks. This case report describes the knotting and retention of an interscalene catheter inserted with ultrasound guidance.

CASE REPORT

After sustaining a fall, a hypertensive 64-year-old man, weighing 84 kg and measuring 175 cm, was scheduled to undergo surgical repair of a left proximal humeral fracture. General anaesthesia and a continuous interscalene brachial plexus block were selected for intra- and postoperative management, respectively. In the induction room, 2 mg of midazolam and 10 μg of sufentanil were titrated for patient comfort. The patient was placed in a supine position with the head turned toward the nonoperative side. A standard nerve block kit (Arrow StimuCath Continuous Nerve Block Set, Arrow International, Reading, PA, USA) and a portable ultrasound machine (Sonosite Micromaxx, Bothell, WA, USA) were used. At the level of the cricoid cartilage, the brachial plexus was identified with a 6 to 13 MHz linear probe. The plexic roots and trunks were seen as a column of hypoechoic structures. After skin infiltration, using an in-plane technique and a lateral to medial direction, a 4 cm, 18-gauge Tuohy needle was advanced until its tip was located between the first 2 hypoechoic nodules. A bolus of 20 ml of lidocaine 2% was injected through the needle. Subsequently, the operator put down the ultrasound probe so a 20-gauge catheter could be threaded 8 cm past the needle tip with one hand while the other hand stabilized the needle. The advancement process presented no resistance. The patient’s neck was then rescanned and 2 ml of normal saline were injected to confirm that the catheter’s tip was situated in close proximity to the brachial plexus. There was no resistance to injection. The needle was removed and the catheter secured at 12 cm at the skin. The patient was transferred to the operating room for the induction of general anaesthesia. The surgery proceeded uneventfully and lasted 90 minutes.

Postoperatively, the patient reported no pain in the recovery room. He exhibited a satisfactory block of the shoulder and arm. The patient was discharged to the ward with a perineural infusion of ropivacaine 0.2% at 6 ml/hr. Twenty-four hours later, a decision was made to transition the patient to oral analgesics and to discontinue the nerve block. The ward nurse attempted to remove the catheter but noted unexpected resistance to traction. Our acute pain service was notified. An X-ray of the neck revealed a knot at the catheter’s distal end (Fig. 1A). The patient was brought down to the operating room: a small surgical incision was made and the catheter was removed without difficulty. The presence of a knot was confirmed (Fig. 1B). The patient recovered uneventfully and suffered no neurological sequelae.

DISCUSSION

Knotting of perineural catheters is an uncommon problem. In one large series (n = 5,964), Burgher et al3 have estimated its incidence to be 0.13%. Although knotted catheters can be removed by repositioning the patient, their extractions often require fluoroscopic guidance or surgical
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incisions.\textsuperscript{1,4,5,7} Risk factors associated with knotting have not been elucidated. Of the 13 knotted catheters reported in the literature, difficulty during the advancement process was encountered in only two patients.\textsuperscript{2,3} The postoperative duration of catheter infusion does not seem to predict knotting as the latter has been observed immediately after catheter placement.\textsuperscript{7} Finally, knotting has been associated with both styletted\textsuperscript{1} and nonstyletted catheters (Table 1).\textsuperscript{2-7}

By allowing the operator to visualise the nerve, needle and local anaesthetic spread, ultrasound guidance has been shown to improve the success and onset time for single shot nerve blocks of the upper\textsuperscript{8,9} and lower\textsuperscript{10} limbs. This has led many authors to advocate using ultrasonography for continuous nerve blocks as well.\textsuperscript{11,12} One commonly used method, described by Swenson et al\textsuperscript{13} consists in visualising the target nerve in short axis. Under direct vision, the needle is advanced toward the latter. A bolus of local anaesthetic agents is then injected. The operator subsequently advances a catheter blindly past the needle tip. The final position of the catheter tip can be located by injecting a small amount of saline or air.\textsuperscript{12} In our patient, as per Swenson et al report,\textsuperscript{13} the interscalene catheter was secured at 12 cm at the skin. Furthermore, the final position of the catheter tip was also verified with the injection of normal saline. Although the nerve, needle advancement, initial bolus and final position of the catheter were visualised in real time with ultrasonography, the threading of the catheter beyond the needle was performed in a blind fashion. This decision was dictated by the fact that, without an assistant, it was difficult to advance the catheter while holding the ultrasound probe, as two hands were required to feed the catheter through the needle. We speculate that, during this crucial step, coiling and preorganisation of the knot occurred. The attempt at removal subsequently consolidated the latter. Although the

\begin{table}[h]
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\begin{tabular}{|c|c|c|c|c|}
\hline
\textbf{Block} & \textbf{Distance inserted beyond the needle tip (cm)} & \textbf{Size of catheter (gauge)} & \textbf{Duration of infusion (days)} & \textbf{Method of removal} & \textbf{Comments} \\
\hline
\textbf{Femoral\textsuperscript{2}} & 10 & 20 & 2 & Fluoroscopic guidance & \textbf{Slight difficulty with catheter advancement} \\
\textbf{Femoral\textsuperscript{2}} & 10 & 20 & 3 & Fluoroscopic guidance & Catheter secured at 14 cm at the skin \\
\textbf{Femoral\textsuperscript{3}} & 10 & 20 & 3 & Fluoroscopic guidance & Catheter secured at 20 cm at the skin \\
\textbf{Femoral\textsuperscript{3}} & 10 & 20 & 4 & Fluoroscopic guidance & \\
\textbf{Femoral\textsuperscript{3}} & 8 & 20 & 3 & Fluoroscopic guidance & \\
\textbf{Femoral\textsuperscript{4}} & ? & 20 & 3 & Surgical incision & \\
\textbf{Femoral\textsuperscript{5}} & ? & 20 & 2 & Surgical incision & \\
\textbf{Fascia iliaca\textsuperscript{3}} & 10 & 20 & 2 & Patient repositioning & Knotting was detected during the insertion of the catheter \\
\textbf{Fascia iliaca\textsuperscript{3}} & 10 & 20 & 2 & Patient repositioning & Catheter secured at 14 cm at the skin slight difficulty with catheter advancement \\
\textbf{Transgluteal sciatic\textsuperscript{2}} & ? & 20 & 0 & Surgical incision & Stimulating catheter contained a stylet \\
\textbf{Axillary\textsuperscript{3}} & >8 & 20 & 5 & Fluoroscopic guidance & \\
\textbf{Axillary\textsuperscript{2}} & ? & 20 & 3 & Manual traction & \\
\textbf{Parascalene\textsuperscript{1}} & 4 & 19 & 4 & Surgical incision & \\
\hline
\end{tabular}
\caption{Overview of reported cases of knotted perineural catheters}
\end{table}
relationship between coiling and knotting remains speculative, a series of 81 similar catheters (Arrow StimuCath Continuous Nerve Block Set, Arrow International, Reading, PA, USA) revealed that coiling occurred more frequently when catheters were advanced more than 3 cm beyond the needle tip.\textsuperscript{14} Interestingly, in the majority of patients with knotted catheters for which the distance threaded was provided, a minimal length of 8 cm was inserted beyond the needle tip (Table 1). In three patients who received femoral or axillary catheters, although the length introduced was not recorded, the authors chose to leave the catheters at 14 to 20 cm at the skin.\textsuperscript{2,4,5} Since, the axillary brachial plexus and femoral nerves are superficial structures, this corresponds to a substantial length of insertion.

Following this case report, we still routinely employ ultrasonography to insert perineural catheters but have altered our practice to decrease the formation of knots. All catheter insertions are now carried out with real-time ultrasonographic guidance: an assistant holds the probe while the operator feeds the catheter through the needle. Whenever possible, we choose to scan the nerve in its long axis. Using an in-plane technique, this allows the catheter to be advanced alongside the nerve.\textsuperscript{15} We commonly use this method to insert posterior popliteal sciatic catheters. When the neural structure is scanned along its short axis and the needle approaches the nerve from the side (for instance in the case of infraclavicular and supraclavicular blocks), we are careful not to advance the catheter more than 3 cm past the needle tip.

**SUMMARY**

Ultrasonography has been shown to improve the success rate of single shot nerve blocks. It can also be used to insert perineural catheters. In order to maximise the benefits of ultrasound guidance, the operator should ensure that all steps (needle advancement, local anaesthetic injection and catheter insertion) be carried out under direct vision.

**REFERENCES**


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