



## Potential contamination of the surgical site caused by leakage from an interscalene catheter with the patient in a seated position: a case report

### Étude de cas: risque de contamination du site opératoire attribué à une fuite du cathéter interscalénique chez un patient en position assise

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#### Abstract

**Purpose** Continuous catheterized nerve blockade has been used for many years to provide effective analgesia postoperatively. We report a potential complication of interscalene nerve block performed with the traditional catheter-through-needle insertion technique. Specifically, leakage from the catheter insertion site posed a risk of contamination to the sterile surgical field. We also describe an alternative catheter design to overcome this leakage problem.

**Clinical features** We present a case of leakage from the catheter insertion site during the course of an interscalene nerve block with the patient in a beach chair position for shoulder arthroplasty. Using the traditional catheter-through-needle technique, an 18G 100-mm Tuohy needle was inserted between the C6 and C7 roots under ultrasound guidance. After confirming the needle tip position, 20 mL of local anesthetic (1% ropivacaine and 0.25% bupivacaine 1:1) were injected. A 20G catheter was then threaded through the Tuohy needle and carefully secured with tape and dressing. In the operating room, leakage

from the catheter insertion site started to disturb the adhesives of the surgical drapes and threatened the sterility of the surgical field. The catheter was removed prior to surgery upon the surgeon's request. Upon completion of the operation, a catheter was reinserted using an alternative catheter-over-needle method. Postoperatively, no leakage was seen at or around the catheter entry site.

**Conclusion** This case report serves as a reminder that leakage from the catheter entry site remains a troublesome and hazardous issue during continuous peripheral nerve block. Leakage from the catheter insertion site often occurs due to the loose fit of the catheter in the larger diameter hole left by the Tuohy needle. We have also shown the successful use of an alternative catheter-over-needle design to minimize the risk of leakage from the catheter entry site. This technique resulted in being particularly vital for shoulder surgery with the patient in the beach chair position.

#### Résumé

**Objectif** Le bloc nerveux continu avec cathéter est utilisé depuis de nombreuses années pour assurer une analgésie postopératoire efficace. Nous décrivons ici une complication potentielle d'un bloc nerveux interscalénique réalisé avec la technique d'insertion classique du cathéter à travers l'aiguille: une fuite au site d'insertion du cathéter a posé un risque de contamination du champ chirurgical stérile. Nous décrivons également un autre concept de cathéter pour surmonter ce problème de fuite.

**Caractéristiques cliniques** Nous présentons un cas de fuite provenant du site d'insertion d'un cathéter pour bloc nerveux interscalénique chez un patient en position semi-assise pour une arthroplastie d'épaule. En utilisant la technique traditionnelle du cathéter à travers l'aiguille,

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une aiguille Tuohy 18 G, de 100 mm a été insérée entre les racines C6 et C7 sous guidage échographique. Après confirmation de la position de l'extrémité de l'aiguille, 20 mL d'anesthésique local (ropivacaïne 1 % et bupivacaïne 0,25 % dans un rapport 1:1) ont été injectés. Ensuite, un cathéter 20 G a été enfilé à travers l'aiguille Tuohy et soigneusement fixé au moyen d'adhésifs et d'un pansement. Dans la salle d'opération, la fuite provenant du site d'insertion du cathéter a commencé à imprégner les bandes adhésives et les champs chirurgicaux, menaçant la stérilité du champ opératoire. Le cathéter a été retiré avant l'intervention, à la demande du chirurgien. Une fois l'intervention chirurgicale terminée, un cathéter a été réinséré en utilisant une autre méthode, celle du cathéter par-dessus l'aiguille. Aucune fuite n'a été observée en postopératoire au site d'entrée du cathéter ou autour.

**Conclusion** Cette étude de cas sert de rappel: une fuite au site d'entrée d'un cathéter reste un problème gênant et dangereux au cours du bloc continu d'un nerf périphérique. La fuite provenant du site d'insertion du cathéter survient souvent à cause d'une adaptation insuffisante du cathéter dans l'orifice de plus grand diamètre laissé par l'aiguille Tuohy. Nous avons également montré l'utilisation réussie d'une technique de remplacement, le cathéter par-dessus l'aiguille; ce concept a pour but de minimiser le risque de fuite à partir d'un site d'entrée. Cela s'est avéré particulièrement essentiel pour une chirurgie de l'épaule avec un patient en position semi-assise (« Beach chair »).

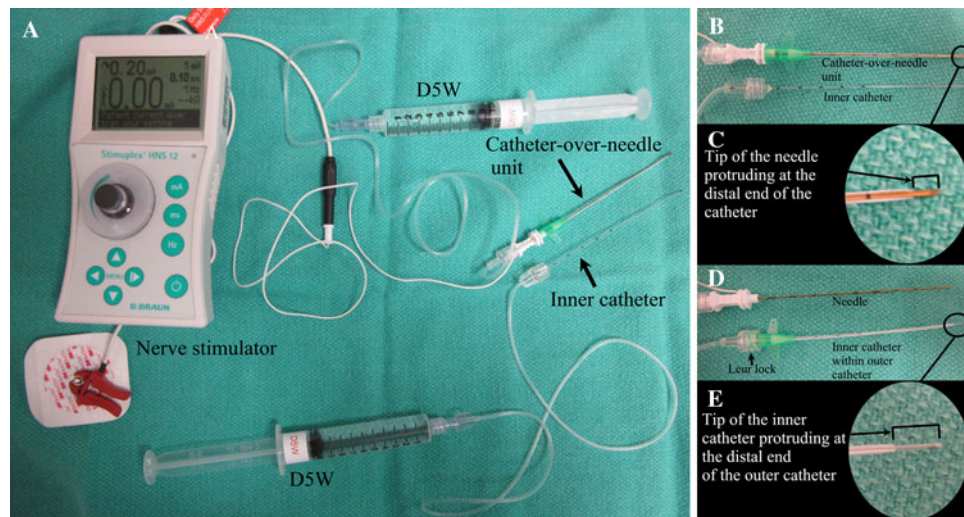
Continuous catheterized nerve blockade provides effective analgesia, reduced incidence of side effects, and improved quality of life for patients undergoing orthopedic surgery.<sup>1,2</sup> Catheter insertion usually involves feeding a catheter through a Tuohy needle towards the target nerve (i.e., catheter-through-needle technique). This technique poses several challenges, and the most important of these is avoidance of leakage at the catheter insertion site. Leakage can result when the puncture hole left after withdrawal of the needle is larger in diameter than that of the catheter. As illustrated in the following case report, this poses a risk of infection during shoulder surgery since any fluid leakage can potentially contaminate the operative field when the patient is in a seated position. We also describe the use of a non-traditional method of catheterization chosen to reduce the risk of leakage. Written consent was obtained from the patient for publication of this report.

## Case

A 62-yr-old male was scheduled for a right total shoulder arthroplasty. Apart from chronic shoulder pain, the patient's medical history was significant for moderate obstructive

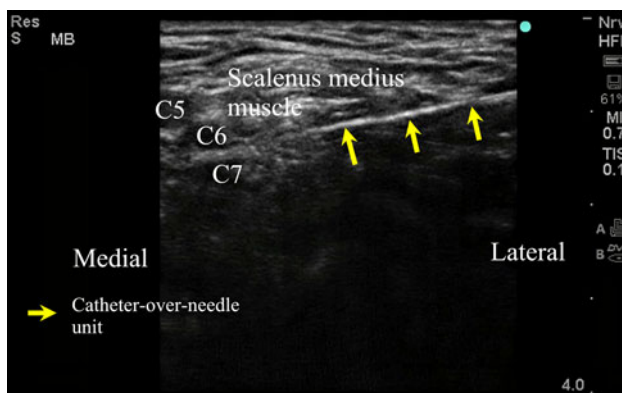
sleep apnea that required a 5-cm H<sub>2</sub>O positive airway pressure (CPAP) while sleeping. Following application of routine monitors in the area of the block procedure, an interscalene catheter was inserted preoperatively under ultrasound guidance with a 13-6 MHz high-frequency linear transducer (HFL 38, M-Turbo; SonoSite, Bothell, WA, USA). Nerve stimulation was also used to monitor needle placement. After a local anesthetic wheal was raised, an 18G 100-mm Tuohy needle (Contiplex® Tuohy set, B.Braun, Melsungen AG, Germany) was inserted between the C6 and C7 roots until the needle tip was positioned just lateral to the anterior scalene muscle, 5 cm from the insertion point. Once the needle tip position was confirmed by visualizing the spread of 3 mL of 5% dextrose in water (D5W), 20 mL of local anesthetic (1% ropivacaïne and 0.25% bupivacaïne 1:1) were used to hydrodissect the space between the sheath and the roots. Ten centimeters of a 20G catheter were fed through an 18G Tuohy needle until 5 cm of the catheter protruded from the needle tip. After removal of the Tuohy needle, the catheter was secured to the patient's skin at the 13-cm mark. Attempts were made to identify the catheter tip under ultrasound visualization, but it was difficult despite being able to visualize the spread within the sheath surrounding the roots. The catheter was secured with Epi-Guard™ (1 x REF: 8170 LiNA Medical ApS, Copenhagen MedLab, Denmark) and Tegaderm™ (3 M Health Care, St Paul, MN, USA). The procedure from skin puncture with the Tuohy needle to the application of the final piece of Tegaderm™ was performed within 15 minutes. After the tapes were applied, a pocket of accumulated fluid was detected around the catheter insertion site, a common occurrence with this technique.

The patient was transferred to the operating room. Following application of routine monitors, uneventful induction of general anesthesia, and tracheal intubation, leakage from the catheter insertion site became gradually more noticeable after the patient was placed in the beach chair position. The fluid also started to disturb the adhesives of the surgical drapes and began leaking into the potential operative site. The dressing was removed and new dressings were reapplied after the area was wiped; however, the surgeon, concerned about the continual slow leakage, requested that the catheter be removed to avoid potential contamination of the sterile surgical field. The surgery lasted three hours and anesthesia proceeded uneventfully. When the patient was wide awake in the postanesthesia care unit, he agreed to have the interscalene catheter reinserted using an alternative catheter-over-needle technique. A 21G x 95-mm catheter-over-needle unit (MultiSet UPK NanoLine 21156-40E, Pajunk, Germany; 21G refers to needle size) (Fig. 1) was directed towards the interscalene groove between the C6 and C7 roots (Fig. 2). Hydrodissection with D5W enabled the needle/catheter unit (Fig. 1B) to traverse between the roots

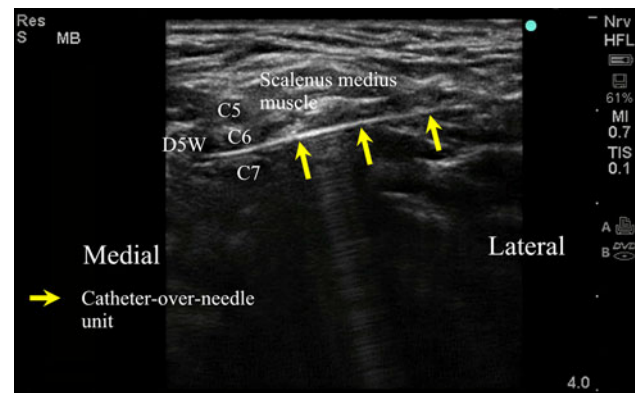


**Fig. 1** A) A photograph of the catheter-over-needle unit (MultiSet UPK NanoLine, Pajunk, Germany). B) The catheter-over-needle unit prior to withdrawal of the needle. C) A zoomed-in photograph showing the 21G needle housed within the 18G outer catheter and the needle tip protruding from the catheter. D) The catheter unit

containing the 20G inner catheter within the outer catheter secured in place by the Luer lock (bottom) following withdrawal of the needle. E) A zoomed-in photograph showing the protruding tip of the inner catheter beyond the outer catheter



**Fig. 2** An ultrasound image showing the catheter-over-needle unit approaching the roots between C6 and C7 in an in-plane approach using the high-frequency linear array transducer



**Fig. 3** An ultrasound image showing hydrodissection using D5W via the catheter-through-needle unit, adopting an in-plane approach with the high-frequency linear transducer. This technique allows the unit to traverse between the C6 and C7 roots

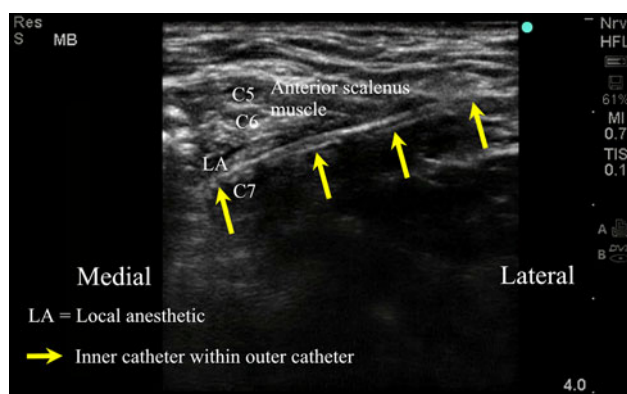
immediately lateral to the anterior scalene muscle without piercing through into the muscle (Fig. 3). Five millilitres of local anesthetic were injected to hydrodissect the space between the sheath and the roots following negative aspiration of blood or fluid. The needle was removed, and a flexible 20G x 75-mm inner catheter was inserted through the 18G outer catheter and locked in place with the Luer lock (Fig. 1D). A further 5-mL local anesthetic bolus was given via the catheter, and both the catheter tip and local anesthetic spread were visualized under ultrasound (Fig. 4). After the bolus, no leakage was observed at the site of catheter insertion. Epi-Guard and Tegaderm were used to secure the catheter, and no leakage was observed beneath the dressing or at the needle entry site. The time from skin puncture to the application of the final piece of Tegaderm was less than six

minutes. A good sensory block was achieved in the C5, C6, and C7 distribution. The local anesthetic infusion continued for two days, and the patient remained comfortable with a visual analogue scale score < 3 throughout this recovery period without requirement for opioids or other co-analgesics. The catheter was removed without any evidence of kinking or leakage, and the dressing remained dry and intact at 72 hr postoperatively.

## Discussion

This case report serves to remind anesthesiologists that leakage from the catheter entry site remains a troublesome





**Fig. 4** An ultrasound image showing the two hyperechoic lines of the 20G inner catheter within the 18G outer catheter (see Fig. 1D). The spread of local anesthetic within the neural sheath is also shown

and potentially hazardous issue during continuous peripheral nerve block. As illustrated by this case, leakage continued and worsened despite efforts to dry the area and reapply dressings when the patient was in a seated position. Consequently, removal of the catheter was required. In cases like these, leakage is due to the loose fit of the catheter within the puncture hole left by the larger diameter Tuohy needle and results in backflow of local anesthetic along the outer wall of the catheter and onto the skin. Indeed, the surgeon expressed that leakage was a common occurrence and should be addressed.

In this case, we have shown the successful use of an alternative catheter-over-needle design to minimize the risk of leakage from the catheter entry site. This approach turned out to be particularly vital for shoulder surgery with the patient in the beach chair position. The advantage of this catheter design is that the catheter is left in a puncture hole created by a needle whose diameter is smaller than the catheter. This results in a “tight fit” between the catheter and the skin and prevents leakage.<sup>3</sup> It ensures a dry skin area, which enables the dressing to adhere securely to the skin, prevents dislodgement, and reduces the likelihood of the catheter slipping out.

Although not a novel concept, the catheter-over-needle design is rarely used for regional blocks, even though similar well-described catheter-over-needle assemblies, such as the 20G bullet-tipped needle/catheter (Arrow International, Reading, PA, USA),<sup>4</sup> Contiplex® D set (B.Braun, Melsungen AG, Germany),<sup>5</sup> and MultiSet (Pajunk, Geisingen, Germany),<sup>6</sup> have been marketed by several companies for many years. However, such assemblies were not used on their own since they are known to be susceptible to kinking and are limited by the fixed length of the catheter. Additionally, in these designs, the catheter sheath is typically made from smooth thin Teflon-like materials that facilitate easy skin puncture but render the catheter susceptible to kinking. The design of the new catheter system described here consists of two components, each made

of material with distinct properties. The outer catheter’s Teflon-like material and tapered distal end allow easy insertion into the skin. The inner catheter is made from polyamide, a soft flexible material that (Fig. 1D) provides reinforcement and kink-free flexibility to the entire unit when housed inside the outer catheter.

The introduction of ultrasound guidance has mitigated the problem of the limited length of the catheter-over-needle assembly. In the past, most catheters were placed blindly under nerve stimulation, and the optimum length of catheter required to reach the target nerve was largely unknown. To account for this, regional anesthesiologists typically inserted an excess length of catheter in an attempt to prevent dislodgement. The introduction of ultrasound has allowed better prediction of target nerve depth and visualization of catheter positioning in real time.<sup>7,8</sup> With this advancement, an appropriate length of needle/catheter set can now be selected to place the catheter tip accurately in desired proximity to a target nerve. The catheter-over-needle technique facilitates positioning the distal end of the outer catheter at the approximate position of the needle tip (Fig. 1B). As such, the catheter/needle assembly can be used in conjunction with electrical stimulation since the uninsulated needle tip protrudes from the catheter (Fig. 1C). After withdrawal of the needle, the inner catheter can be positioned to protrude variably from the distal tip of the outer catheter (Fig. 1E), allowing greater flexibility and accuracy in catheter tip placement within the perineural space and ensuring proper delivery of local anesthetic. This approach also avoids the inherent need associated with traditional catheter-through-needle designs to “over-feed” the catheter. This method of catheter insertion also seems to facilitate better visualization of the catheter tip since a layer of air is created between the two catheters when the inner catheter is placed inside the outer catheter. This results in easily visualized double hyperechoic lines on ultrasound (Fig. 4). Moreover, the catheter-over-needle design is widely used in intravenous fluid delivery systems and is therefore familiar to health care personnel in both function and handling and may be associated with a relatively short learning period.

Alternative methods for securing catheters include the application of adhesive glue<sup>9,10</sup> and tunnelling the catheter under the skin.<sup>11</sup> Dermabond® Topical Skin Adhesive (2-octyl cyanoacrylate; Ethicon, Somerville, NJ, USA) is a sterile liquid that polymerizes rapidly upon contact with the skin and forms a waterproof connection with the keratin in the epidermis. However, Dermabond® is costly, and patients can potentially suffer from severe allergic reaction<sup>12</sup> and contact dermatitis.<sup>13-15</sup> Also, removal of catheters secured by Dermabond® and tunnelling may be uncomfortable for the patient. Following this case, we have been successfully using the catheter-over-needle method preoperatively for total shoulder arthroplasty when patients

are placed in the beach chair position. This technique has earned our surgical colleagues' confidence and has been adapted into routine practice at our institution.

In summary, this case report draws attention to the issue of leakage of nerve block catheters and describes a potential solution to maintain the sterility of the surgical field in patients undergoing shoulder surgery. Our experience suggests that insertion of catheter-over-needle assemblies is both easy to perform and time efficient. More importantly, these catheters are effective in delivering local anesthetic via infusion for two days without dislodgement. In the time period following this case, we have been using the catheter-over-needle unit to perform interscalene nerve blocks, and no leakage has been detected at the catheter insertion site even when the patient is in the beach chair position. This enables our surgical colleagues to operate with the confidence that leakage from the catheter entry site will not contaminate the surgical field. Further studies are necessary to assess the qualities, effectiveness, and insertion techniques of these catheters compared with traditional catheter designs to ensure optimal drug delivery systems for optimizing perioperative analgesia while minimizing untoward effects.

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**Conflicts of interest** The Pajunk MultiSet 211156-40E is modified and re-designed by Ban Tsui. Dr. Tsui also has a patent-licensing agreement with Pajunk.

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