Alternative exit sites for central venous access: Back tunneling to the scapular region and distal tunneling to the patellar region

Matthew D Ostroff and Mauro Pittiruti

Abstract
Uncooperative elderly patients with cognitive disorder are often confused and/or agitated. Risk of involuntary venous access device dislodgment is high in these patients. This is equally likely with peripherally inserted central catheters and centrally inserted central catheters but less common with femorally inserted central catheters. Solutions to this problem include strict continuous patient observation, using sutures or subcutaneous anchored securement, wrapping the arm to “hide” the line, or using soft mittens to occupy the hands. However, some patients are able to disrupt the dressing, dislodge the catheter, and often pull the catheter out completely. In some cases, the patient may also overcome the resistance offered by the stitches or by the subcutaneous anchored securement device. In a recent paper on the impact of subcutaneously anchored securement in preventing dislodgment, the only demonstrated failures occurred in non-compliant elderly patients. Creation of an alternative exit site is an emerging trend in patients with cognitive impairment at high risk for catheter dislodgement. Subcutaneous tunneling from traditional insertion sites such as the jugular, axillary, or femoral veins allows placement of the exit site in a region inaccessible to the patient. The following two case reports demonstrate the technique for tunneling a femorally inserted central catheter downward to the patellar region and for tunneling a centrally inserted central catheter to the scapular region. Internal review board approval was not deemed necessary as subcutaneous tunneling is not a new technique. In our experience, such maneuvers can be successfully performed at the bedside.

Keywords
Central venous access, centrally inserted central catheter, femorally inserted central catheter, tunneling, tunneled catheter

Introduction
Uncooperative elderly patients with cognitive disorder are often confused and/or agitated. Risk of involuntary venous access device dislodgment is high in these patients. This is equally likely with peripherally inserted central catheters (PICCs) and centrally inserted central catheters (CICCs) but less common with femorally inserted central catheters (FICCs). Solutions to this problem include strict continuous patient observation, using sutures or subcutaneous anchored securement, wrapping the arm to “hide” the line, or using soft mittens to occupy the hands. However, some patients are able to disrupt the dressing, dislodge the catheter, and often pull the catheter out completely. In some cases, the patient may also overcome the resistance offered by the stitches or by the subcutaneous anchored securement device. In a recent paper on the impact of subcutaneously anchored securement in preventing dislodgment, the only demonstrated failures occurred in non-compliant elderly patients.1

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Creation of an alternative exit site is an emerging trend in patients with cognitive impairment at high risk for catheter dislodgement. Subcutaneous tunneling from traditional insertion sites such as the jugular, axillary, or femoral veins allows placement of the exit site in a region inaccessible to the patient. The following two case reports demonstrate the technique for tunneling a FICC downward to the patellar region and for tunneling a CICC to the scapular region. Internal review board approval was not deemed necessary as subcutaneous tunneling is not a new technique. In our experience, such maneuvers can be successfully performed at the bedside.

**Case reports**

**Case 1: CICC tunneled to the back**

An 82-year-old woman with cognitive disorder who required 6 weeks of intravenous antibiotics was referred to us. She had previously pulled out several peripheral short cannulas and one PICC. With her hands, she was able to reach her upper chest and both arms. After a bilateral rapid central vein assessment, the woman’s right internal jugular vein was judged appropriate for cannulation in terms of caliber and position. The decision was made to tunnel a 4.5-Fr antimicrobial PICC (Chloragard®; Teleflex) to the scapular region, so that the patient would be unable to reach the exit site (Figure 1).

After administration of local anesthetic, ultrasound-guided puncture of the internal jugular with a 21-g needle was performed, visualizing the vein in short axis. In this particular case, we adopted the out-of-plane approach, since the vein was quite large and not collapsed during breathing; though, we think that an in-plane approach is usually safer for the internal jugular vein. A guidewire was inserted into the needle, and local anesthetic was applied to the intended tunnel track from the scapular region to the jugular vein. A double tunneling technique was used because of the distance from the insertion site. A 1-cm incision was created both in the trapezius region and in the scapular region; catheter length was determined using traditional topographic measurements (as landmark for the cavo–atrial junction, we chose the third intercostal space on the right parasternal line) obviously adding the length of the double tunnel to the estimated intravascular length. The distal end of the catheter was attached to a metallic tunneler and threaded from the novel exit site to the intermediate incision and finally to the puncture site, according to the technique of double anterograde tunneling. A micro-introducer-dilator was inserted over the guidewire into the jugular vein. The guidewire and the dilator were removed, and the catheter threaded into the veins via the micro-introducer (modified Seldinger technique). The final location of the tip was assessed by intracavitary electrocardiogram (IC-ECG). The catheter was secured with a skin-adhesive sutureless device (StatLock®; BD). The puncture site, the intermediate incision, and the final exit site were all sealed with cyanoacrylate glue and covered with transparent semipermeable membranes. The patient was discharged to a long care acute facility, completing the intended 4-week course of antibiotics without complications. During the whole clinical course, the exit site on the back was well tolerated and did not interfere with the supine position in the hospital bed.

**Case 2: FICC tunneled to the patellar region**

A 35-year-old man with Down syndrome was referred to our vascular access unit. He required medium- to long-term central venous access for antibiotic treatment of a...
pulmonary infection, hydration, and supportive therapies. Over the previous few weeks, the patient had involuntarily pulled one PICC out of his right arm and one CICC placed in the left axillary vein. After an ultrasound scan of the common and superficial femoral veins on both sides, we decided to insert a FICC via the right femoral vein, tunneled downward to the lower third of the thigh (Figure 2).

After administration of local anesthetic (0.75% ropivacaine), ultrasound-guided puncture of the right common femoral vein with a 21-g needle was performed (short-axis view, out-of-plane approach). A 0.018” guidewire then was placed, and local anesthetic was applied to the intended tunnel track from puncture site to the patellar: a double tunneling technique was used because of the distance from the insertion site. A 1-cm incision was created at the mid-thigh and above the patella. Catheter length was determined using traditional topographic measurements. Since the FICC was not expected to be used for hemodynamic monitoring, we decided to place its tip in the inferior vena cava, above the level of the iliac junction but also below the renal veins: we adopted the navel as surface landmark of the middle portion of the inferior vena cava. We added the length of the double tunnel to the estimated intravascular length of the catheter. As described above for the tunneled CICC, we adopted the technique of double anterograde tunneling. We inserted a 5-Fr double-lumen power-injectable polyurethane PICC (Synergy®, Healthline) into the femoral vein using the modified Seldinger technique and a micro-introducer kit. The catheter was secured with a skin-adhesive sutureless device (Grip-Lok®, Zefon International). The puncture site, the middle incision, and the exit site were all sealed with cyanoacrylate glue and then covered with transparent semi-permeable membranes. The patient remained hospitalized for 2 weeks and was later discharged to a long care acute facility, with the femoral catheter still well functioning; at a follow-up 3 months later, the FICC was still in place and used without any catheter-related complication.

Discussion

It can be challenging to reliably secure a venous access device in a patient with an altered mental status or who is non-compliant. Many of these individuals are chronically ill and have limited options for venous access. Risk of catheter dislodgement/removal is associated with critical complications such as infiltration, thrombophlebitis, thrombosis, external blood loss, and air embolism. Collaboration with a multidisciplinary team composed of the medical, nursing, and vascular access staff allows for careful planning of a safe exit site.

Specific indications for a central line are administration of irritant or vesicant solutions, need for hemodynamic monitoring, and the prospect of long-term intravenous treatment. All deep veins potentially useful for central venous access (brachial, basilic, axillary, jugular, and femoral) should be systematically explored with ultrasound. A patient’s range of motion will dictate whether a PICC, CICC, or FICC is preferable. The exit site is then selected by taking into consideration (1) the degree of contamination of the skin; (2) the ease of site care and maintenance; (3) the stability of the catheter and of the dressing; and finally, (4) a location properly out of reach of the patient’s hands.

Bedside tunneling of central venous catheters is a safe and inexpensive technique for achieving the ideal exit site. Evidence demonstrates equivalent clinical outcomes with placement of tunneled catheters in the interventional suite versus bedside. Tunneling venous catheters are proven to have lower infection rate than non-tunneled catheters. Finally, Darouiche et al. compared antimicrobial catheters to tunneled-cuffed catheters, proving that the antimicrobial catheters were less likely to become colonized.

The technique of tunneling non-cuffed PICCs was described some years ago by Pittiruti. PICC tunneling has also been described by Saijo et al. and Kim et al. The latter author found that rates of central line–associated blood stream infections (CLABSIs) were significantly lower in non-cuffed-tunneled PICCs. A “pseudo-tunneling” has also been described for PICCs: the tunnel is created using a long needle trajectory so as to puncture in Dawson’s green zone but penetrate the vein in the yellow zone. The same “pseudo-tunnel” also has been adopted for midline catheters.
and Tsetis described a two-stage tunneling technique for ports, which allows central insertion of the catheter and placement of the reservoir at the arm.

Regarding the choice of exit site, both the scapular option and the option at the thigh have already been described in the literature. Cooper et al. described the placement of the reservoir of a port over the trapezius in patients with contraindications to placement in the anterior chest area. The same technique has been discussed by Hill, who pointed out the importance of avoiding any bad curvature when connecting the catheter with the reservoir. The same author also described the use of IC-ECG for tip location during port placement in the trapezius area. Bream and Gu have also described IC-ECG during bedside placement of cuffed-tunneled catheters in three morbidly obese patients and demonstrated a safer, more accurate, and less expensive technique than radiology.

Tunneling to the scapular region offers several advantages. First, most elderly patients will not be able to reach the catheter with their hands. Second, the scapular region offers a flat surface for dressing securement and performance of care and maintenance. Third, the whole maneuver is achieved without any need for fluoroscopy, since the tip location can be verified by intracavitary ECG. The use of skin-adhesive sutureless device was carefully selected to avoid pressure to the patient’s bony prominences.

In our second case report, we tunneled an FICC downward to the knee region. Regarding FICCs, Ostroff et al. described the advantages of an exit site at mid-thigh after puncture and cannulation of the superficial femoral vein. The technique of tunneling femoral lines has been described for tunneled-cuffed devices such as Hickman®, Broviac®, and dialysis catheters. In our case report, the catheter was inserted in a large vein (common femoral vein) to minimize risk of venous thrombosis. Hou et al. suggested that FICC-related thrombosis may occur due to repeated venipunctures injuring the endothelium (early thrombosis) and excessive immobility of the limb (late thrombosis). According to some authors, FICC-related thrombosis may be more common on the left side than on the right side. However, we believe that the most important factors in preventing thrombosis after FICC insertion are the choice of a vein properly matched with the catheter size and the adoption of ultrasound-guided venipuncture. Tunneling the catheter from the common femoral vein to a region proximal to the patella may require a double tunnel. This location provides a flat surface for catheter stabilization in a clean area and a location advantageous for providing care and maintenance.

In our experience, tunneled CICCs and FICCs should be considered for patients who have acute or chronic dementia or altered mental status. For optimal outcome, puncture site and tunneling should be carefully planned after ultrasound-based evaluation of all venous options and assessment of the patient’s motility.

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