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Abbreviation:
PICC = peripherally inserted central catheter

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Tunneled Jugular Small-Bore Central Catheters as an Alternative to Peripherally Inserted Central Catheters for Intermediate-term Venous Access in Patients with Hemodialysis and Chronic Renal Insufficiency[1]

In 34 patients with chronic renal insufficiency or failure, 43 small-bore central catheters were placed via the internal or external jugular veins: right internal jugular vein, 28; left internal jugular vein, 14; right external jugular vein, one. Central venous access was achieved in all patients (mean catheter dwell time, 28 days; range, 3–99 days), with two minor complications (arterial puncture and catheter damage during suturing). Tunneled jugular small-bore central catheters are a vein-preserving alternative to peripherally inserted central catheters in this population.

The establishment of reliable, temporary central venous access is essential for an increasing number of patients who require vesicant drugs or solutions, long-term antibiotics, or chemotherapeutic or other agents. In 1992, it was estimated that 3 million central venous catheters were placed (1). By 1996, that number was estimated at 5 million (2). Peripherally inserted central catheters (PICCs) are becoming commonplace as a means of providing such access. In patients with renal failure, however, the importance of vein preservation creates new issues not found in the average patient. As dictated by the vascular access guidelines of the Dialysis Outcomes Quality Initiative (3), arm veins should not be used whenever possible in patients with either current or pending hemodialysis in order to preserve veins for future hemodialysis access sites (3). Therefore, the standard veins used for PICCs—the brachial, basilic, and cephalic veins—should not be used in these patients. On the basis of the vascular access guidelines, we use small-bore jugular venous catheters as an alternative to PICCs for central venous access in patients undergoing hemodialysis, because jugular veins are an acceptable form of access in this population (4).

Materials and Methods

From May 1997 through July 1998, 34 patients (25 female and nine male patients; mean age, 47 years; age range, 12–81 years) with chronic or impending renal failure (creatinine level, ≥3.0 mg/dL [265 μmol/L]) were referred to the interventional radiology department for PICC placement. Forty-three small-bore catheters were placed via the internal or external jugular veins. Indications for the catheters included antibiotic or antiviral treatment (n = 31), total parenteral nutrition (n = 9), intravenous fluids (n = 2), or gamma globulin therapy (n = 1). The PICCs were either 4-F single-lumen or 5-F double-lumen central catheters (Arrow International, Reading, Pa), and they were all placed in the interventional radiology department with use of sterile technique. Conscious sedation was not used routinely.

The right internal jugular vein was our preferred access site, as it is for all nontunneled and tunneled central catheters (4). Alternate sites were chosen if the right internal jugular vein was already in use or was occluded. In one patient, both internal jugular veins were occluded so the right external jugular vein was used. The catheters were placed with a technique similar to that used for placing tunneled dialysis catheters (5).

With use of real-time ultrasonographic (US) guidance, the internal or external jugular vein was punctured just cephalad to the clavicle by using the 21-gauge needle from the PICC kit. Once venous access was obtained, a 0.018-inch wire was passed through the needle with fluoroscopic guidance. The needle was then removed. A 4- or 5-F peel-away sheath (from the PICC kit) was inserted over the wire. The wire was then removed, and we used it to measure the desired catheter length by placing the tip at the caval-atrial junction and bending it at the sheath hub.

A short subcutaneous tunnel (approximately 6 cm long) was created by using a 5.5-inch sterling silver probe (Jamner Surgical Instruments, Hawthorne, Calif)(Fig 1). According to operator preference, the tunnel was either lateral to the venotomy site or parasternal (5). Local anesthesia for the tunnel was delivered by using the 21-gauge access needle, which is long enough to anesthetize the entire tunnel. The catheter tip was passed through the eye of the probe and pulled through the tunnel. The bent wire was used to measure and cut the catheter to the appropriate length.

The catheter was passed through the sheath, which was removed. The catheter tip thus rested at the caval-atrial junction (Fig 2). The catheter was sutured to the skin by using the suture wing attached at its exit site (Fig 3). The venotomy site was closed with a single monofilament suture. A nonocclusive dressing was applied, and the catheter was flushed with 10 U heparin per cubic centimeter.

The venotomy site suture was removed 14 days after initial placement. Catheter removal was accomplished by cutting the sutures and withdrawing the catheter, followed by brief manual compression.

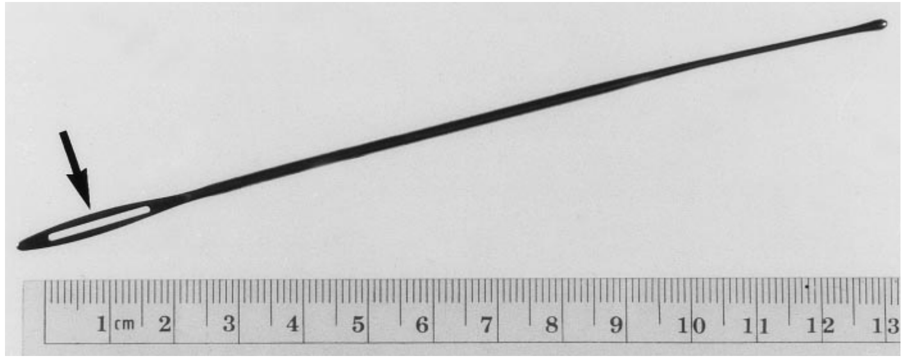

Figure 1. Silver probe used to create subcutaneous tunnel. Catheter tip was passed through the eye (arrow) and pulled through the tunnel.

Results

Forty-three catheters were placed in 34 patients. Five patients required two catheters. Three of these patients required two separate catheters at different times for different reasons. The same access site (right internal jugular vein) was used in all three of these patients. One patient had an elective exchange after 66 days, with use of the same access site (right internal jugular vein). One patient required catheter exchange because of poor function at 6 days. This catheter had been inappropriately flushed.

Two patients required three catheters. The first needed a second catheter at a different time for a different reason, but a suture was inadvertently placed through the catheter at the time of insertion. This catheter subsequently leaked into the soft tissues of the patient's neck and was exchanged for a new catheter. The same access site (right internal jugular vein) was used for the third catheter, and there were no sequelae to the leak.

The catheter in one patient with chronic pancreatitis and end-stage renal disease was removed after 14 days for presumed infection. Blood cultures were positive, but the catheter tip was not cultured. Her course of treatment (total parenteral nutrition) had been completed, but the patient was still hospitalized and the catheter was still in place. Two separate catheters were subsequently placed in this patient at different times for different reasons in the months following the episode of presumed infection. Dwell times for these two catheters were 12 and 15 days. In both instances, the patient completed her course of treatment without incident. All three catheters were placed via the left internal jugular vein.

Twenty-eight catheters were placed via the right internal jugular vein, 14 via the left internal jugular vein, and one via the right external jugular vein. Central venous access was achieved in all patients. The mean catheter dwell time was 28 days (range, 3–99 days). Twenty-seven patients completed their course of treatment. In one patient, the catheter was removed before the completion of antibiotic therapy because it was exchanged for a temporary dialysis catheter. Antibiotics were given through the dialysis catheter for the remainder of the course of treatment. Five patients died with their catheters in place. Two patients were lost to follow up.

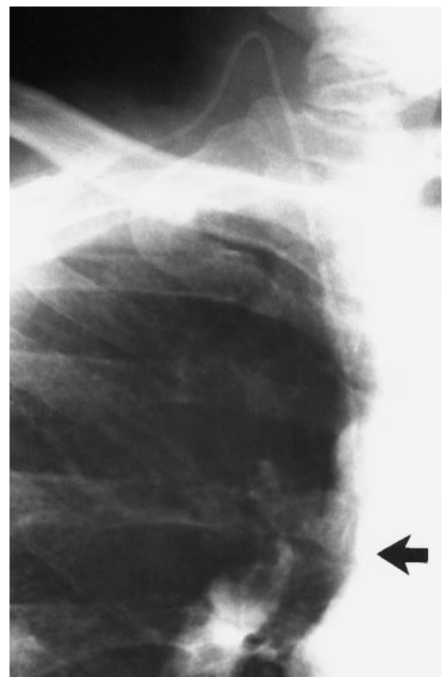

Figure 2. Anteroposterior chest radiograph obtained after tunneled placement of a small-bore central catheter in the right internal jugular vein. Catheter tip (arrow) is at the caval-atrial junction.

Two minor complications occurred: arterial puncture with the 21-gauge needle and catheter damage from suturing that necessitated catheter exchange. Late complications included one catheter infection (0.17 per 100 catheter days) and one

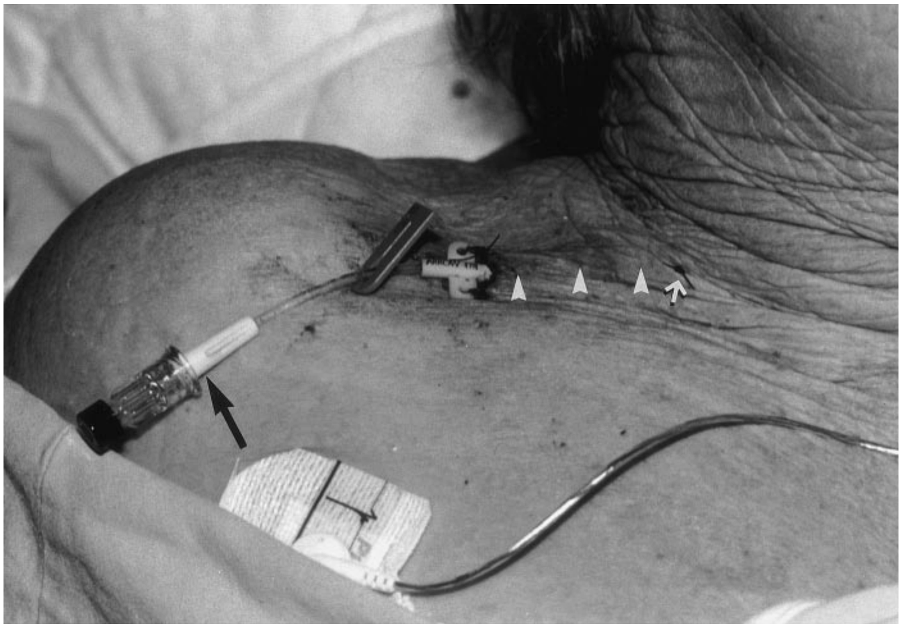

Figure 3. Photograph depicts the catheter on the chest wall. The short tunnel (arrowheads) keeps the catheter hub (black arrow) away from the neck, where it can be concealed under clothing. White arrow indicates suture at venotomy site.

episode of catheter thrombosis (0.17 per 100 catheter days).

Discussion

PICCs have been proved a safe and cost-effective method of providing central venous access in both the in- and outpatient settings (6–12). Although exact data are unclear, it is estimated that 495,000 small-bore central catheters were placed in 1997 (13). At our institution alone in 1997, more than 650 PICCs were placed in the interventional radiology department, and a similar number were placed by our hospital's home health care nurses.

Patients with chronic or impending renal failure may require central venous access for problems unrelated to kidney failure. In this patient population, the importance of central and peripheral venous preservation necessitates a standard of care different from that for other patients. This difference is addressed in the clinical practice guidelines of the Dialysis Outcomes Quality Initiative (3) sponsored and published by the National Kidney Foundation. The clinical recommendations encompass four areas of dialysis, including vascular access for hemodialysis. The importance of peripheral vein preservation for future arteriovenous fistula access is discussed in guideline 7 (3, page 30), which emphasizes "the need to preserve veins to avoid loss of potential access sites in the arms and to maximize chances for successful [arteriovenous] fistula placement and maturation." It states that "arm veins suitable for placement of vascular access should be preserved, regardless of arm dominance" and that "arm veins, particularly the cephalic veins of the nondominant arm should not be used for venipuncture or intravenous catheters." Guideline 7c also instructs against the use of subclavian vein catheterization for temporary access in patients with chronic renal failure owing to the known risk of central venous stenosis (3,14–16). These statements apply to patients with developing end-stage renal disease (creatinine level, ≥3.0 mg/dL [265 μmol/L) or conditions likely to lead to end-stage renal disease (3).

The rationale for these guidelines is that venipuncture, peripheral venous catheters, and central venous catheters can cause venous injury and stenosis. Although traditional PICCs are safe, with low rates of infection, complications such as phlebitis and thrombophlebitis have been reported in 4%–36% of patients (7,10,12,17,18). These complications make successful future arteriovenous fistula construction (the preferred form of vascular access for hemodialysis) less likely. The policy of peripheral vein preservation results in healthy and untouched peripheral arm veins that maximize the chance for successful arteriovenous fistula placement and maturation. It also makes the use of jugular veins a logical choice for these patients when they require temporary central venous access.

The risks of placement of internal jugular catheters by interventional radiologists with US and fluoroscopic guidance have been shown to be low (5), and such placement may result in less venous trauma (19) and subsequent stenosis than may occur with nonguided techniques. These studies involved use of larger 12.5–13.5-F hemodialysis catheters. In a recent study (20), 72 patients underwent venography after the catheter was removed from the subclavian vein, brachiocephalic vein, and superior vena cava after treatment with 12.5-F internal jugular hemodialysis catheters. Major abnormalities (stenosis, thrombosis) were found in only 4.2% of patients with permanent abnormalities, or in only 2.8% of patients. We assume 4- or 5-F small-bore PICCs will have at least similar and probably lower rates of jugular venous damage and stenosis. In our cases, no symptomatic central venous thrombosis or stenosis was observed, although we did not look for asymptomatic thromboses. This is a small series, and the overall complication rates of small-bore tunneled internal jugular catheters will need to be determined in larger studies.

The use of internal jugular or subclavian veins for larger hemodialysis catheters has been compared in multiple studies, and the internal jugular approach is far superior (15,21). In these studies, the rate of central venous thrombosis or stenosis with the internal jugular approach is estimated to be in the range of 0.8%–10.0% compared with rates as high as 50% for the subclavian venous approach (14–16).

The decision to perform subcutaneous tunneling of the distal catheter was primarily for patient comfort and social acceptance. It has been our experience that patients are less satisfied with jugular catheters that are not tunneled. The idea of a vascular access device extending from the neck is unsettling to many patients. Since most catheters are placed in the outpatient setting, we believe patients will be more comfortable and less socially conscious with the catheter covered under clothing. In our study, patients with previously placed nontunneled jugular catheters were especially agreeable to use of the tunneled catheter.

Findings in studies have suggested a higher rate of catheter-related sepsis with internal jugular catheters than with subclavian venous catheters. The authors of a recent study in critically ill patients concluded that infections related to internal jugular catheters could be reduced by using subcutaneous tunneling (22). In other studies, however, no advantage was found for subcutaneous tunneling (23). It is not clear if tunneling will reduce the risk of infections in patients with internal jugular small-bore central catheters, but that was not the purpose of our use of tunneling. The infection rate in this small series is similar to that observed with other tunneled catheters. It is clear that the use of subclavian veins is unwarranted. We did not charge for placement of the jugular small-bore catheter as we would for a tunneled catheter placed by an interventional radiologist but rather as we would for placement of a traditional PICC.

As stipulated in the dialysis guidelines, the policy of venous preservation should be foremost in the treatment of any patient with current or pending hemodialysis. This policy impedes the use of traditional PICCs and makes use of an internal jugular small-bore central catheter a logical choice in patients with end-stage renal disease. It would also seem appropriate that nurses who place PICCs refer these patients to radiologists trained in imaging-guided placement. This is the case in our hospital. The tunneled jugular small-bore central catheter may also be useful in other patients, such as those with subclavian venous stenosis or occlusion, in whom placement of a Hickman catheter or other long-term catheter may not be necessary.

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