

PERIPHERALLY INSERTED CENTRAL VENOUS CATHETERS FOR OUTPATIENT INTRAVENOUS ANTIBIOTIC THERAPY

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Because of its advantages in maintaining venous access, the peripherally inserted central venous catheter was studied in an outpatient setting. One hundred forty-three patients were selected for the placement of 2.8 and 3.8 French silastic catheters by an intravenous therapy nurse in an infectious diseases practice. Placements were successful in 137 patients. Lines were used for 5–120 days (average of 29.9 days). The phlebitis that occurred in 10% of cases correlated with the experience of the person inserting the catheter and correlated inversely with the size of catheter. Only three catheters had to be removed because of phlebitis, and none of those were infected. In conclusion, peripherally inserted central venous catheters offer a useful, convenient, and safe alternative to peripheral lines in outpatient intravenous antibiotic therapy.

THE POTENTIAL BENEFITS of outpatient therapy include patient convenience and emotional well being, cost savings, and more appropriate use of hospital facilities, plus the potential for the patient to return to work or school during the course of therapy. For these reasons, there has been a consistent increase in the use of intravenous therapies outside the hospital. With increasing acceptance of outpatient intravenous antibiotic therapy as an effective and safe alternative to hospitalization, new technologies are needed to facilitate and improve therapy in this setting. This article describes our experience with a central venous catheter that can be inserted in the physician's office and maintained for extended periods of time.

A prolonged course of intravenous antibiotic therapy may be difficult to provide with peripheral venous access with stainless steel needles or short plastic catheters. They require replacement every

few days, particularly with antibiotics that cause phlebitis. Reliable vascular access is a greater problem for patients treated outside the hospital, where an intravenous site can be readily placed by a nurse on the floor or by a member of an intravenous therapy team. A subclavian or jugular catheter can be placed but with the risks of bleeding or pneumothorax and the cost of a surgical procedure and operating room. "Midline" catheters may be useful for longer than peripheral catheters, but they also have a limited life span and still run the risk of causing phlebitis above the catheter. An alternative is a peripherally inserted central (PICC) venous line. It has already been found useful in the hospital setting and in children [1–3]. The catheters are made of a soft, flexible, silicone elastomer material; they are inserted into an antecubital vein and are threaded into the superior vena cava, where they may be left for weeks.

This PICC line may be used for drawing blood as well as for the administration of antibiotics, thereby avoiding the discomfort of repeated venipunctures. In addition, a PICC line facilitates the self-administration of medications and the use of portable intravenous therapy pumps. These pumps can be programmed to administer medications on a variety of schedules, some of which

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would otherwise make outpatient intravenous therapy impractical [5]. This study was conducted to evaluate the efficacy and safety of PICC catheters in an office setting.

Patients and Methods

Between September 1989 and February 1991, 143 patients from our infectious diseases practice in Tacoma, Washington, were selected for PICC line placement [6]. Patients were selected for study if they had a serious infection that was expected to require intravenous antibiotics for 2 weeks or more. Additional considerations included vein status, the type of antibiotic to be used, the frequency of administration, the need for a pump, and the patient's ability to learn catheter care. After an informed consent for the procedure was obtained, the catheter was inserted by one of the intravenous therapy nurses in the practice. All patients were then taught about site assessment and catheter-flushing procedures.

The catheters we used were made of a patented "silastic" polymer (Per-Q-Cath; GESCO International, San Antonio, Texas). They were 58 cm in length and either 2.8 or 3.8 French in diameter. These catheters have previously been found useful in home care and can be inserted by a registered nurse [7,8].

All catheters were placed in our office by standardized techniques [9]. They were placed by nurses who had either taken a course on the placement of catheters or who were under the supervision of a nurse experienced in their placement. They were inserted in either the basilic or cephalic vein. The skin was prepared with a sequence of povidone iodine solution, alcohol, and then povidone-iodine again. A sterile drape, sterile gloves, and a mask were routinely used. The catheter, containing a guide wire, was threaded through an 18- or 16-gauge breakaway introducer needle. After the catheter was inserted, the needle was broken apart and the guide wire was removed. Catheter tip location was then checked by roentgenogram to confirm its position in the superior vena cava [10]. A lordotic view of the shoulder, with slightly increased kilovolts, helped in visualizing the radiopaque catheter. The catheter was then fixed in place with the use of a clear, occlusive dressing, and the tubing was taped securely in place to avoid accidental withdrawal. No sutures were used. All patients returned to home, work, or school. They were seen in the office at least twice weekly by a physician and nurse to monitor progress,

assess for side effects from the antibiotics, and to check the PICC line. Catheter patency was maintained by the use of a flush with 2.5 ml of saline and 25 U of heparin after each antibiotic dose. If the catheter was not to be used for 12 hours, patients were instructed to inject a 2.5-ml saline flush with 250 U of heparin at least twice daily.

Catheter dressings were changed as needed, but at least weekly. A sterile preparation kit was again used with povidone-iodine and alcohol, sterile drape, gloves, and mask. A new, clear plastic dressing was again placed. If inflammation occurred along the catheter tract, the patient was started on ibuprofen, 400 mg twice a day, and was told to apply heat to the area for at least 20 minutes three times daily for the next 3 days. If the catheter clotted, the nurse used urokinase according to the manufacturer's recommendations to de clot the catheter.

TABLE 1. Patient population and catheter use

Patients	143
Male/female	76/67
Mean age (range)	42 (8-79) y
Insertions successful	137 (96%)
Catheter size	
2.8 French	33/38 (87%)
3.8 French	104/105 (99%) ^a
Duration of use -- mean (range)	29.9 (5-120) d
Total days of catheter use	4282

TABLE 2. Peripherally inserted central venous catheters

Antibiotics	No. of Cases	Diagnoses	No. of Cases
Ceftriaxone	20	Osteomyelitis	53
Tobramycin	19	Pelvic inflammatory disease	17
Cefazolin	17	Pulmonary infection	11
Vancomycin	16	Abdominal abscess	10
Oxacillin	14	Bacteremia	10
Clindamycin	12	Extremity abscess	7
Penicillin	12	Septic arthritis	6
Imipenem	12	Cellulitis	5
Piperacillin	9	Sinusitis	3
Aztreonam	9	Wound infection	3
Gentamicin	7	Aspergillosis	3
Ticarcillin-clavulanate	4	Breast abscess	3
Amphotericin B	4	Discitis	2
Nafcillin	3	Endocarditis	2
Cefotaxime	3	Retinitis	2
Amikacin	2	Otitis externa	1
Ganciclovir	2	Ophthalmitis	1
		Brain abscess	1
		Actinomycosis	1
Total	165	Total	141

Results

Catheter placement was attempted in 113 patients with successful insertion in 137 (96%) (Table 1). There were 67 female and 76 male patients with an average age of 42 years (range, 8–79). Patients tolerated well the placement of catheters in the office. The duration of use varied from 5 to 120 days, with a mean of 29.9 days. The total number of days of catheter use in this study was 1282.

The antibiotics infused through the catheters and the diagnoses treated are displayed in Table 2. Because of combined antibiotic therapy in some patients and changes in antibiotic therapy during the course of treatment in others, there are more antibiotics listed than patients. In 136 patients, the PICC line was used for the self-administration of antibiotics. Intervals between antibiotic infusions varied from 24 (17 patients), 12 (13 patients), 8 (95 patients), and 6 hours (nine patients) to 4 hours (eight patients). Continuous infusion was given in one case. In 59 cases, medication administration was facilitated by the use of an infusion pump connected to the PICC line. Types of pumps included CADD Plus (Pharmacia Deltec, St. Paul, Minnesota), Intelleject (Avion Corp., Englewood, Colorado), and Infumed 400 (Medfusion Inc., Duluth, Georgia).

Phlebitis developed in 14 patients (10%). In 11 patients, the phlebitis resolved with heat and ibuprofen therapy. In three patients, the catheter was withdrawn because of persistent or progressive phlebitis over several days. The phlebitis improved in all cases after the line was removed, and no serious problems occurred from it. No catheters were infected when cultured, and no new antibiotics were given for an infection. All cases of phlebitis resolved within a week of catheter withdrawal, and in no case did phlebitis extend to the axillary or subclavian vein. Catheters clotted in nine patients (6.6%), but all were opened again with urokinase. Table 3 displays the incidence of phle-

bitis and clotting by catheter size and the experience of the intravenous therapy nurse with the insertion technique. The incidence of phlebitis was higher with the smaller 2.8 French (18%) than with the larger 3.8 French (8%) catheter. The experience of the intravenous therapy nurse correlated inversely with the incidence of phlebitis, with a rate of 33% for the first 10 catheters a nurse placed and a rate of only 4% thereafter.

In one attempt at catheter insertion, the catheter was inadvertently sheared off during the process of breaking away the introducer needle. The catheter was visualized by roentgenogram and removed through a cutdown over the biceps muscle. No other complications resulted.

Patient satisfaction and compliance were excellent. Those who had previously received intravenous therapy with the use of peripheral catheters were usually quite pleased with the PICC line and thought it more convenient and less painful than peripheral sites. Some patients noted a discomfort in their shoulder, neck, or sometimes throat when the catheter was placed. The withdrawal of the catheter by a few centimeters usually relieved their symptoms. In no case did these symptoms progress, and all resolved when the catheter was withdrawn. The first 20 catheter tips were cultured in broth upon removal and were found to contain normal skin bacteria (diphtheroids and coagulase-negative staphylococci). No blood cultures were performed before the catheters were removed. Because there was no clinical indication of infection, it was presumed that these bacteria were from skin contamination as the catheter was withdrawn [10,11]. No new antibiotics were used to treat against the organisms recovered.

Discussion

Previous studies have demonstrated the effectiveness of a variety of peripherally inserted catheters [12–15]. There was, however, a significant incidence of phlebitis (14%–23%) and septic phlebitis (1%–5%) reported, depending on the catheter size and/or the insertion procedure [16]. Our experiences with the Per-Q-Cath have found that a much lower incidence of complications can be achieved. Although we cannot be certain why our results were better, they may be the result of the silicone catheter material we used or our insertion techniques. Our results compare favorably with the complication rates with subclavian catheters and are better than those with peripheral venous catheters [17,18].

TABLE 3. Complication rate of PICC lines

	Sterile phlebitis	Catheter clotted	Catheter removed early
Catheter size			
2.8 French	6/33 (18%)	5/33 (15%)	1/33 (3%)
3.8 French	8/104 (8%)	4/104 (4%)	2/104 (2%)
Nurse experience			
First 10	10/30 (33%)		3/30 (1%)
Over 10	4/107 (4%)		0

The 14 cases of sterile phlebitis were presumably the result of vein irritation with the insertion or an inflammatory reaction to the silastic catheter surface. It is interesting to note that the phlebitis usually resolved within 48-72 hours without removal of the catheter and did not impede the use of the catheter. In three patients, phlebitis worsened despite antiinflammatory agents and local heat. In these instances, the catheter was removed with prompt clearing of the phlebitis.

Our experience with the various diseases and antibiotics for which we used the PICC line suggests that it is possible to use this device in any situation in which a central venous line would otherwise be used. We have also used this catheter for the administration of hyperalimentation solutions.

The 2.8 French-size catheter was associated with more clotting problems than the 3.8 French, probably because of its smaller size. The 2.8 French also required more-frequent flushing, and it was more difficult to draw blood from it. Why the smaller catheter was associated with a higher incidence of phlebitis is uncertain, but it can be explained in part by the inexperience of the intravenous therapists who were trained first in the use of the smaller catheter. At present, almost all of our patients have a 3.8 French catheter placed for the convenience of both the patients and the nurses giving care. It is as easily inserted as the smaller catheter except in small children.

In all cases and regardless of catheter size or phlebitis, residual vein scarring was minimal. After the PICC line has been removed, we have found that the vein can usually be used again for venipuncture or even another PICC line and course of intravenous antibiotic therapy if needed. Since our initial study, we have had one patient with five different PICC lines placed in the same antecubital vein for separate courses of therapy. In two other patients, a vein was reused for a second course of therapy.

The use of intravenous therapy nurses to insert this device seems well matched to their expertise with venous access. For the three different nurses who inserted the PICC lines, there was a clear learning curve, with the incidence of phlebitis lessening as experience increased. There has been little variation in complication rates among our nurses once they had placed 20 catheters.

The problem of catheter shear points out the risk of using any catheter inserted through a breakaway

needle and underscores the importance of meticulous training in insertion procedures and proper catheter care. The manufacturer of the Per-Q-Cath has recently changed the needle so that the removal of the needle from around the catheter hub is now accomplished with greater ease and safety.

PICC lines should become an increasingly useful tool in facilitating venous access in outpatients as well as in hospitalized patients. How often they should be used in lieu of other central lines or peripheral needles or catheters remains to be determined.

In summary, our experience with a PICC catheter has been excellent. We have found it to be an important adjunct to providing intravenous antibiotics on an outpatient basis. The cost of catheter placement is easily justified by the hospital savings as well as the time and trouble that is otherwise associated with maintaining peripheral cannulas or other central venous access devices.

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