

Ultrasound-guided cannulation of the femoral vein for acute hemodialysis access with silicone catheters

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ABSTRACT: The percutaneous femoral approach for temporary central venous hemodialysis access is a mandatory part of patient management in many clinical settings. It is usually achieved with a blind, external landmark-guided technique.

The aim of this study is to evaluate whether an ultrasound technique can improve on the external landmark method. From 1990 to January 2000, cannulation of the femoral vein was performed on 230 patients (125 male, 105 female, mean age 72 years, range 52-95 years) for temporary vascular access for hemodialysis (172 patients with acute renal failure and 58 patients in end-stage renal disease), using landmark localization with semi-rigid, uncuffed catheters. Between January 2000 and February 2001, ultrasound-guided cannulation of the femoral vein was utilized in 38 patients (20 male, 13 female, mean age 71, range 55-93 years) for temporary vascular access for hemodialysis (28 patients with acute renal failure and 10 patients in end-stage-renal failure). Uncuffed, dual-lumen silicone catheters were used.

Cannulation of the femoral vein was achieved in 100% of cases using ultrasound, and in 87% using the landmark-guided technique. Using ultrasound, puncture of the femoral artery occurred in 2.6% of patients, and hematoma in 0%. Using the "blind" technique, puncture of the femoral artery occurred in 11.2% of patients, and hematoma in 3.9%.

The average catheter dwell time, in accordance with NKF-DOQI guidelines, was 5 days (range 2 - 14 days) for semi-rigid catheters and 45 days (range 5-120 days) for silastic catheters. The number of complications rose significantly in the patients with semi-rigid catheters. In this group, local exit infection occurred in 105 persons (45% of cases), total catheter thrombosis in 46 (20%), bacteriemia in 28 (12%), and phlebitis of the leg in 6 (2.6%). In the group with silicone catheters local exit infection occurred in 4 patients (10% of cases), total catheter thrombosis in 1 (2.6%), bacteriemia in 2 (5.2%) and phlebitis in 0 (0%). The result of the study suggests that ultrasound-guided cannulation of the femoral vein is superior to traditional techniques relying on anatomic landmark; it reduces the numbers of unsuccessful attempts and the possible acute complications of the procedure.

We believe that femoral cannulation with modern flexible silicone catheters can be considered as a reliable temporary access, even for extended periods. (The Journal of Vascular Access 2001; 2: 56-59)

KEY WORDS: *Femoral vein, Ultrasound-guided cannulation, Silicone catheter, Hemodialysis*

INTRODUCTION

Typical catheter insertion sites for acute hemodialysis vascular access include femoral, subclavian, and internal jugular vein (1) (Tab. I).

Because of its superficial position, just medial to the femoral artery in the groin, the femoral vein is easier to cannulate, especially in case of pulmonary

edema and respiratory failure. Potential complications are less serious (artery laceration, hematoma and blood loss) than those associated with subclavian and internal jugular catheter insertion. Catheters are characteristically inserted blindly using anatomic landmarks.

Occasionally, however, there are technical difficulties, probably because external landmarks do not

correlate exactly to the location of veins in obese patients or those with low blood pressure. For young and inexperienced operators, the blind external landmark-guided technique may be more difficult and associated with insertion complications. Therefore, we now routinely use ultrasound-guided cannulation for femoral dialysis catheter insertion.

MATERIALS AND METHODS

In our division, from 1990 to January 2000 cannulation of the femoral vein was done in 230 patients (125 male, 105 female, mean age 72 years, range 52-95 years) for hemodialysis temporary vascular access (172 patients with acute renal failure and 58 patients in end-stage renal disease).

We used landmark insertion technique by manual localization of the femoral artery in the femoral triangle inferior to the inguinal ligament. We inserted an 18 G needle medial to the artery according to the Seldinger technique, utilizing semi-rigid uncuffed catheters (single or double-lumen polyurethane catheter for temporary hemodialysis).

Between January 2000 and February 2001 we carried out ultrasound-guided cannulation of the femoral vein in 38 patients (20 male, 13 female, mean age 71, range 55-93 years) for hemodialysis temporary vascular access (28 patients with acute renal failure and 10 patients in end-stage-renal failure). We used uncuffed, dual-lumen silicone catheters (Medcomp, USA) ranging in length from 20 to 24 cm. These modern catheters are made in silastic which is a more flexible and biocompatible material. They are therefore less traumatic and reduce the risk of infection and vein thrombosis.

Ultrasound methodology

Ultrasound-guided cannulation was done by localization of the femoral vein with the aid of an ultrasound device (Site-Rite, Dymax Corp) with 7.5 MHz transducer covered by a sterile sheath, in the femoral triangle inferior to the inguinal ligament medial to the artery. This device created a two-dimensional display image. This image allowed identification of the femoral artery and vein by their position, compressibility of the vein with pressure and increase in vein size with Valsalva (5).

The percutaneous puncture, usually of the right femoral vein, was done with the patient supine, the leg revolved externally and bent at the knee. After appropriate disinfection and local anesthesia, a 21 gauge introducer needle attached to a syringe is directed under ultrasound-guidance toward the

femoral vein. Gentle aspiration is maintained until the vein is entered, usually at a depth of 2-3 cm. The syringe is detached, before a micro guide-wire, followed by a micro 4 F dilatator, are inserted. After dilation, the catheter is inserted by the Seldinger technique over a guide-wire.

RESULTS

Successful and complicated cannulation

Cannulation of the femoral vein was achieved in all patients (100%) using ultrasound and (87%) using the landmark guided technique. The vein was entered on the first attempt in 94% of patients using ultrasound and 57% using landmark technique. Us-

TABLE I - CAUSES OF ACUTE HEMODIALYSIS

Acute renal failure
End-stage renal failure requiring immediate hemodialysis
Temporary shift from DP to HD
Hyperpotassiemia
Thrombosis of A-V fistula
Serious disorders of fluid and electrolytes
Acute intoxication by drugs or poisons
CVVHD and other continuous replacement therapies

TABLE II - RESULTS OF ULTRASOUND-GUIDED VERSUS LANDMARK-GUIDED TECHNIQUE

	No.	Success rate %	Artery puncture	Hematoma
Ultrasound	38	100	1 (2.6%)	0(0%)
Landmark	230	87	25 (11.2%)	9(3.9%)

TABLE III - ADVANTAGE OF SILICONE CATHETERS VERSUS SEMI-RIGID CATHETERS

	Average dwell time	Immobilization	Hospitalization	Tolerance
Semirigid catheter	5	yes	yes	no good
Silicone catheter	45	no	no	good

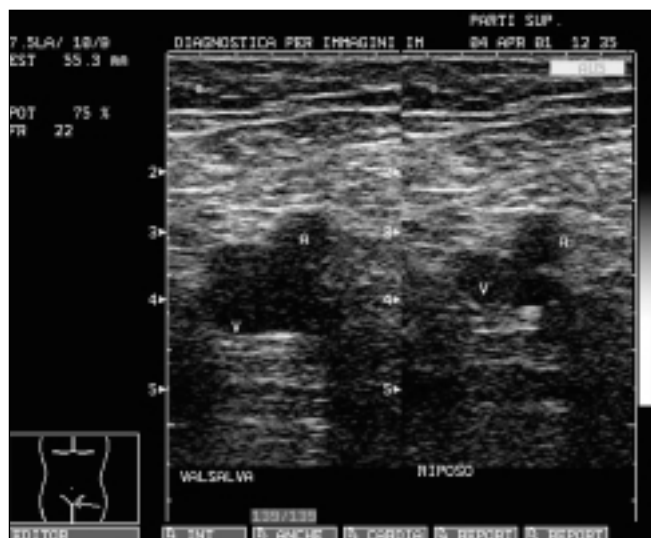


Fig. 1 and Fig. 2 - Ultrasound images of femoral vein (V) and artery (A) showing the increase in femoral vein diameter upon performing the Valsalva maneuver: before and during Valsalva.



Fig. 3 - Images of Site Rite; Dymax Corp.

ing ultrasound, puncture of the femoral artery occurred in 2.6% of patients and hematoma occurred in 0%, thanks to the use of a fine 21 G introducer needle. Using the external landmark technique, puncture of the femoral artery oc-

curred in 11.2% of patients and hematoma in 3.91% with a 18 G introducer needle (Tab. II).

Duration and tolerance of cannulation

The average catheter dwell time, in accordance with the NKF-DOQI guidelines, was 5 days (range 2-14 days) for semi-rigid catheter and 45 days (range 5-120 days) for silastic catheter.

All patients received dialysis therapy in the hospital, but the patients with silicone catheter were not immobilized. Tolerance was good and most of the dialysis sessions were performed on an out-patient basis (Tab. III).

Complication

The number of complications rose significantly in the patients with semi-rigid catheters. In this group local exit infection occurred in 105 persons (45% of cases), total catheter thrombosis in 46 (20%), bacteriemia in 28 (12%), and phlebitis of the leg in 6 (2.6%).

In the group with silicone catheters local exit infection occurred in 4 patients (10% of cases), total catheter thrombosis in 1 (2.6%), bacteriemia in 2 (5.2%) and phlebitis in 0 (0%) (Tab. IV).

TABLE IV - COMPLICATIONS OF SEMI-RIGID CATHETERS VERSUS SILICONE CATHETERS

	Exit infection	Thrombosis	Bacteremia	Phlebitis
Semi-rigid catheter	105 (45%)	46 (20%)	28 (12%)	6 (2.6%)
Silicone catheter	4 (10%)	1 (2.6%)	2 (5.2%)	0 (0%)

DISCUSSION

Central venous access is an essential part of hemodialytic patient management and is usually achieved with a blind, external landmark-guided technique. Sometimes there are technical difficulties whenever external landmarks do not correlate exactly to the location of vessels, or in patients who have coagulopathies, obesity, oedema and distorted or thrombosed veins. Indications for central venous cannulation in our patients were consistent with those in the literature (1-4, 6, 7). All patients had to obtain an immediate temporary access since no other possibility was available. The choice of the femoral route was due not only to previous use of the central thoracic veins (thrombosis, stenosis, pacemaker) or physical problems (respiratory distress or acute pulmonary oedema), but also to preserve the upper central veins in the chronic dialysis patients for future vascular access sites (2).

A significant improvement in the femoral venipuncture success could be demonstrated by applying real-time ultrasound-guidance. This procedure causes fewer complications because of the smaller number of needle passes, and reduces patient discomfort. Use of ultrasound guidance increased the success

rate from 87% to 100%.

In conclusion, from our experience we believe that real-time ultrasound guidance for femoral catheter insertion is superior to traditional techniques relying on anatomic landmarks and should be adopted as the standard of care. Ultrasound-guided cannulation of the femoral vein reduces the numbers of unsuccessful attempts and minimizes complications such as arterial puncture or hematoma.

In our opinion, the modern flexible silicone catheters could be left *in situ* for a longer time compared to DOQI guidelines (5 days) (10) and to Weyde's opinion (14 days) (1).

From our data it can be concluded that a femoral silicone catheter left in place for up to 45 days at least is a safe and reliable temporary vascular access for hemodialysis.

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