

Placement of tunneled cuffed vascular catheter through superior vena cava puncture



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ABSTRACT

Objective: The purpose of this study was to assess the feasibility and safety of placement of tunneled cuffed catheters through direct percutaneous puncture of the superior vena cava (SVC) in patients with occluded right and left innominate veins.

Methods: This was a retrospective review of all patients with right and left innominate vein occlusions who underwent tunneled catheter placement with direct SVC puncture between January 2012 and December 2014. Under fluoroscopic guidance with the patient in a supine position, a 5F catheter was placed at the distal end of the SVC through the femoral vein, iliac vein, or hepatic vein. This catheter was used as a fluoroscopic target for the puncture. Following the guidance of fluoroscopy, the puncture needle and sheath were placed through a transcutaneous route with the insertion site 0.5 to 1.0 cm lateral-inferior to the clavicle head of the sternocleidomastoid, with the pathway inferior (caudal) to the clavicle, which allowed access of the guidewire and placement of a tunneled central venous catheter.

Results: The procedure succeeded in all 16 patients. During follow-up (mean, 12 months; range, 3-36 months), access failure due to thrombosis was observed in one patient. The remaining continued to function well until the end of the follow-up period or until the death of the patient ($n = 3$). No pneumothorax occurred. The most common complication was mediastinal hematoma after puncture failure in five patients. The diameter of the maximum hematoma was 2.2 cm, and all resolved spontaneously.

Conclusions: In patients with central vein occlusion and exhaustion of conventional insertion sites, a tunneled central venous catheter can be safely placed through SVC puncture by the transcutaneous route. (*J Vasc Surg: Venous and Lym Dis* 2017;5:547-52.)

Although a tunneled central venous catheter (tCVC) is considered inferior to an arteriovenous fistula (AVF) and graft according to nephrology guidelines, it remains an important access for patients who require hemodialysis (HD).¹ According to the Dialysis Outcomes and Practice Patterns Study, the use of central venous catheters increased in many countries between 2002 and 2011, and the percentage of HD patients using tCVCs was as high as 27.7% in Sweden, 35% in Belgium, and 49.1% in Canada.² The reason for the prevalence of tCVCs is multifactorial. Many patients require tCVCs while waiting for AVF maturation. Repeated vascular placement of catheters (eg, in the jugular veins and subclavian veins) often causes thrombosis and obstruction, and when both innominate veins are obstructed, there is no exact method to resolve this depletion of the blood vessels.

There are limited ways, such as crossing these endovascularly and placing stents, but these occlusions are typically fibrotic and are not amenable to these techniques. Thus, there have been frequent challenges for physicians in placing tCVCs in new locations in the past. In recent years, the Hemodialysis Reliable Outflow (HeRO; Merit Medical, South Jordan, Utah) graft has become a useful way to solve these problems.³ However, its safety and efficacy remain to be investigated. In addition, the HeRO has not been introduced in many countries, including China. Here we report a retrospective case series of patients in our hospital with innominate vein occlusion who underwent tCVC placement through a direct superior vena cava (SVC) puncture. The patients were followed up clinically and evaluated.

METHODS

Participants. Between January 2012 and December 2014, a total of 16 patients presented to our hospital requiring maintenance HD with occlusion or stenosis in the right and left innominate veins. All patients received tCVC placement through a direct SVC puncture. All patients had exhausted other arteriovenous access sites and had chosen not to undergo other vascular access placement. The concrete inclusion and exclusion criteria were as follows.

We included patients who were aged >18 years, had been on maintenance HD for >3 months, had been followed up for >3 months, and met the following

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Clinical Trial registration: ChiCTR-ONN-16007790.

Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2213-333X

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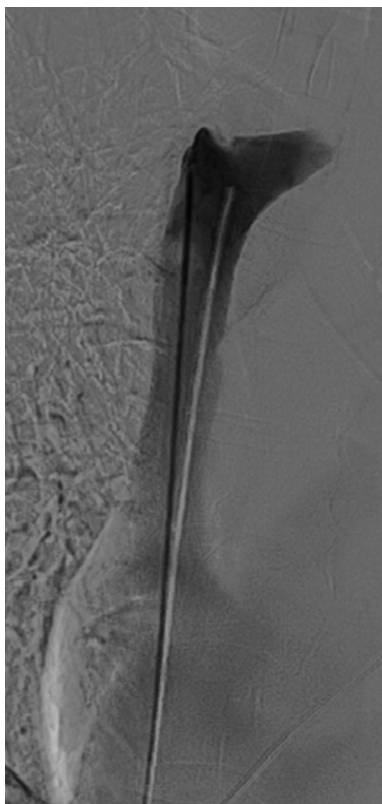


Fig 1. Fluoroscopic image of a 5F catheter placed at the distal end of the superior vena cava (SVC) through the femoral vein.

requirements of vascular conditions: the obstruction or stenosis was in the right innominate vein, with or without obstruction or stenosis of the left innominate vein, and the patient was not suitable for an AVF on the upper extremity or refused another attempt to create an AVF.

We excluded patients who were aged <18 years; had severe cardiac, hepatic, or cerebral diseases, such as coronary heart disease or acute congestive heart failure; had been on HD for <3 months; had severe infection; or could not cooperate because of mental health problems.

Surgical procedure. The insertion of tCVCs was performed under local anesthesia. Under fluoroscopic guidance with the patient in a supine position, a 5F catheter was placed at the distal end of the SVC through the femoral, iliac, or hepatic vein (Fig 1). The femoral vein was the first choice, then the iliac vein or hepatic vein, depending on each patient's vascular condition. This catheter was used as a fluoroscopic target for the puncture. Next, guided by vertical and horizontal fluoroscopy, the percutaneous cholecystostomy puncture needle and 5F sheath were placed through a transcutaneous route with the insertion site 0.5 to 1.0 cm inferolateral to the clavicle head of the sternocleidomastoid (Fig 2), with the pathway inferior (caudal) to the clavicle, which allowed guidewire access and placement

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective single-center cohort study
- **Take Home Message:** In 16 patients with brachiocephalic vein occlusions, percutaneous access to the superior vena cava was obtained for tunneled catheters. Five mediastinal hematomas resolved spontaneously; there was no pneumothorax.
- **Recommendation:** The authors suggest that percutaneous puncture of the superior vena cava may be an option for tunneled dialysis access catheter placement in patients with occluded brachiocephalic veins.

of a tCVC (Fig 3). The puncture angle was about 45 degrees cephalad to the transverse plane at the first puncture, and then the angle was adjusted according to the fluoroscopy results, with the patient in the supine posture. A 0.018-inch guidewire was inserted through the needle and guided into the vein under fluoroscopic visualization. The wire was exchanged for a stiff guidewire, and the catheter was then inserted into it.

For the first and second cases, we attempted recanalization of the occlusions but failed. So for the following cases, no attempt was made again.

The catheter tip's position was verified by fluoroscopy. Finally, the wire and catheter were successfully manipulated into the right atrium and then into the inferior vena cava.

After the procedure, 4% sodium citrate as a lock solution was used for 1 week, and then normal heparin lock solutions (1250 units/mL) were used.

Evaluation of outcomes. The outcomes investigated were the blood flow and duration of use of the tCVCs. Complications related to the surgical procedure, such as mediastinal hematoma and pneumothorax, and complications related to the prolonged use of tCVCs, including catheter-related infection and catheter dysfunction (defined as blood flow <250 mL/min), were observed and reported. Fluoroscopy revealed these hematomas during the procedure. If digital subtraction angiography demonstrated the puncture needle to have reached the distal SVC but the wire could not enter the vessel, after injection of 2 mL of contrast medium, we could see accumulation of the contrast medium. We thought that hematomas may have developed. The patients who might have had hematomas were observed carefully and followed up by computed tomography.

The protocol and informed consent were approved by the Institutional Review Board, and all subjects gave informed consent.

RESULTS

Characteristics of the patients. Among the 16 included patients, 10 were men (62.5%). The primary renal disease

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