



# Placement of a Subclavian Tunneled Hemodialysis Catheter with the Patient's Arm Raised May Reduce the Risk of Complications: Two Cases Report

쇄골하정맥을 통한 매립혈액투석카테터 삽입시  
상지 거상법의 유용성: 2예 보고

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The subclavian vein is an uncommon route for tunneled hemodialysis catheter (tHDC) placement because of its potency for future dialysis access. However, when favored access routes have been exhausted because of repeated catheterization or limited life expectancy, the subclavian vein can be used for urgent hemodialysis. A subclavian catheterization has a technical problem. The subclavian vein often forms a right angle with the vena cava, and advancing stiff peel-away sheath can cause a vascular injury. However, raising the patient's arm can alter the position of the guidewire and, therefore, change the angle of the vein favorable for tHDC placement. Herein, we report two patients who underwent subclavian catheterization; one experienced an injury to the superior vena cava after undergoing the conventional procedure, whereas the other patient with raised arm during the catheterization procedure had safe catheter placement.

**Index terms** Renal Dialysis; Catheters; Subclavian Vein; Hemothorax

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## INTRODUCTION

Tunneled hemodialysis catheters (tHDCs) are designed to function for several months for hemodialysis. It has in- and out-flow lumina for hemodialysis and therefore its diameter is large up to 16 French (F). A peel-away sheath placement at the cavoatrial junction can be useful for the safe and correct placement of a thick and rigid tHDC. Thus, the use of a vein that enters straight into the right atrium is preferred to the use of angular veins for the safe placement of the catheter (1). The right internal jugular vein would provide the best access route in patients with dextrocardia for that reason (2). However, repeated catheterization could result in venous stenosis and make additional cannulations impossible. Furthermore, contralateral central veins should be preserved for patients requiring later dialysis access formation. In these patients, the right subclavian vein could serve as an alternative route, although it should be used as a last resort (3). The right subclavian vein often forms a right angle with the vena cava in some patients and can result in vascular injury during the insertion of a dilator or peel-away sheath (4). Elevation of the patient's arm can change acute insertion angle to obtuse and may prevent such injuries. Herein, we report subclavian catheterization in two patients. One patient underwent catheter placement with her arm down, which was complicated by injury to the innominate vein. A second patient underwent dialysis catheter placement safely with her arm elevated.

## CASE REPORT

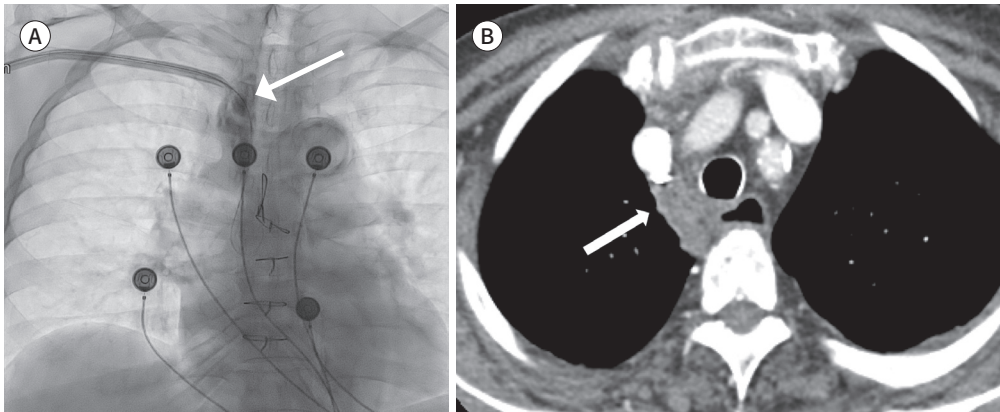
A 74-year-old female with end-stage renal disease and severe aortic stenosis presented with hypotension-associated dizziness. Her ejection fraction was 20% on echocardiography, and an emergent transcatheter aortic valve implantation (TAVI) was planned after hemodynamic stabilization. The right internal jugular vein was unable to provide catheter access because of previous catheterizations, and the left arm vein was preserved for later dialysis access. The patient was referred to angiography for the placement of a tHDC into the right subclavian vein, which was accessed using a mini access kit (Merit Medical, South Jordan, UT, USA). After a gradual dilatation to 12-F, the careful placement of a 15-F peel-away sheath into the superior vena cava (SVC) was attempted. However, the sheath could not be advanced into the innominate vein, and the extravasation of a small amount of contrast medium was observed due to vascular injury (Fig. 1). The leakage of the contrast medium did not diffuse widely, and there were no signs of a hemothorax. Due to the short length between subclavian access site and innominate vein, it was difficult to be confident in safe placement of peel-away sheath within subclavian vein. However, a tHDC (GlidePath; BD, Franklin Lakes, NJ, USA) could be successfully placed using a 0.035-inch guidewire (Radiofocus M stiff type; Terumo, Tokyo, Japan) via peel-away sheath placed in subclavian vein. On the following day, performance of CT prior to the TAVI revealed a small amount of mediastinal fluid around the SVC with no extensive hemorrhage in the thoracic cage (Fig. 1B). Four days later, during the preparation for the TAVI, the patient rapidly deteriorated and died of heart failure.

A few months later, a 72-year-old female with chronic kidney disease presented with vomiting due to probable gastroenteritis, with sepsis superimposed on acute kidney injury that

**Fig. 1.** Case 1.

**A.** A fluoroscopic thoracic image of a 74-year-old female during placement of a tunneled hemodialysis catheter shows the near right angle of the subclavian vein relative to the superior vena cava and a small amount of contrast medium (arrow) around the innominate vein. A hemodialysis catheter was placed over a 0.035-inch guidewire and through a subclavian peel-away sheath.

**B.** A CT image shows a small hemorrhage in the mediastinum (arrow).



required continuous renal replacement therapy. A tHDC was initially placed into the right internal jugular vein, which subsequently malfunctioned after 2 days, so a right femoral dialysis catheter was subsequently placed. One month later, the femoral catheter also malfunctioned. The patient was then referred for a jugular tHDC, but the right jugular vein became totally thrombosed. Her physician requested to save left jugular vein for an impending creation of arteriovenous fistula. After discussing appropriate vein selection, it was decided to place tHDC via right subclavian vein. The patient was placed in the supine position, and a 0.018-inch guidewire, under ultrasonography guidance, was inserted into the subclavian vein (Fig. 2A). The patient's right arm was raised without disturbing the sterile drape (Fig. 2B). This change in position altered the previous right angle of the subclavian vein to an obtuse angle relative to the SVC, and a peel-away sheath could be easily placed into the right atrium (Fig. 2C). A tHDC (GlidePath; BD) was placed successfully (Fig. 2D), and the patient recovered after hemodialysis and treatment with antibiotics.

This study was approved by the Institutional Review Board of our hospital and the requirement for informed consent was waived (IRB No. OC20ZASI0048).

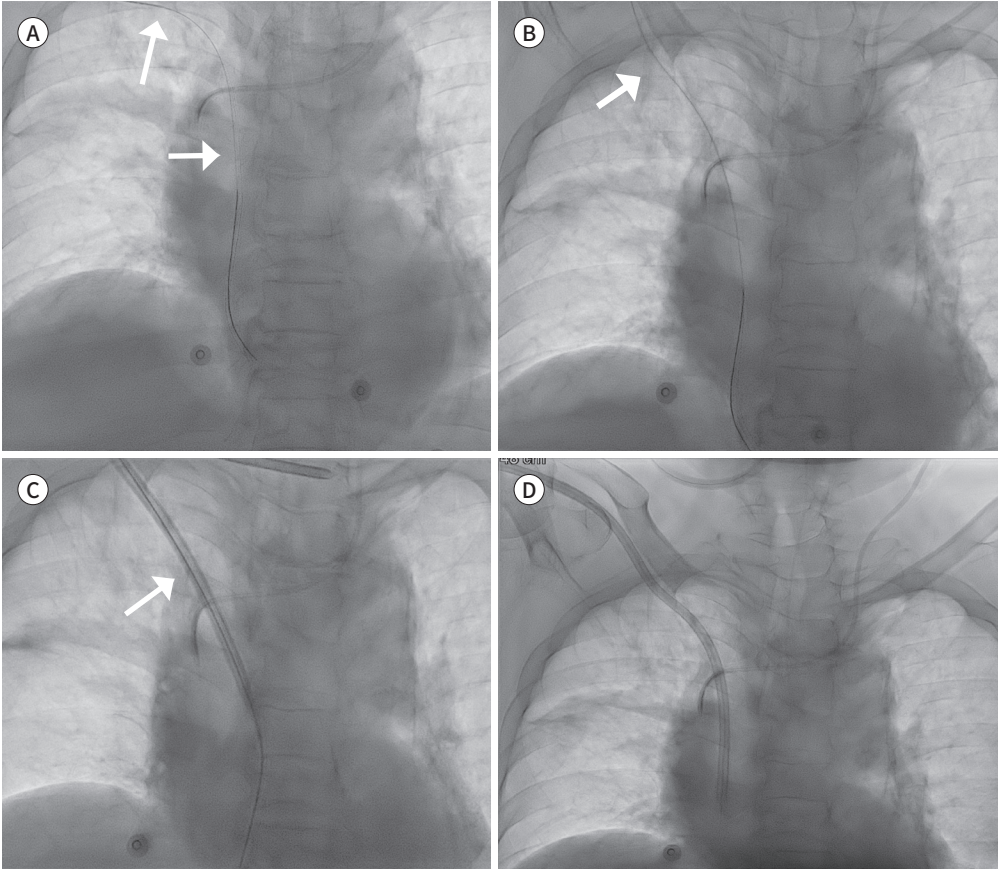
## DISCUSSION

Placement of a central venous catheter is usually very safe, and complication rates are very low (0.02%–1.50%) (4). However, a tHDC requires a large bore sheath and uses stiff dilators, which can cause devastating injuries compared to small-caliber catheters (5). Catheterization of the subclavian vein provides more patient comfort and fewer catheter-associated infections than the use of other veins, but the subclavian vein should be preserved in patients who may require future renal replacement therapy (6). In addition, due to the angle of the subclavian vein relative to the SVC, the placement of the peel-away sheath into the SVC is often difficult.

In the first case, although the peel-away sheath was carefully manipulated, the innominate vein was injured by a stiff stylet. Fortunately, the mediastinal injury was not extensive, and ow-

Fig. 2. Case 2.

- A. A fluoroscopic thoracic image of a 72-year-old female reveals the right angle of the subclavian vein into which a 0.018-inch guidewire (arrows) was inserted.
- B. A second fluoroscopic image obtained after the patient raised her right arm reveals the change in the angle (arrow) of the guidewire.
- C. A peel-away sheath (arrow) was inserted into the cavoatrial junction using a J-tip 0.038-inch guidewire.
- D. The final fluoroscopic image shows the successful placement of the tunneled hemodialysis catheter through the subclavian vein.



ing to the low pressure in the SVC, this injury did not result in serious complications (7). However, an injury to the heart or pleura might cause a larger amount of bleeding. In the second case, raising the patient's arm changed the angle of the subclavian vein relative to the SVC and enabled the safe placement of the catheter. Right subclavian vein joins right internal jugular vein to form an innominate vein at right sternoclavicular junction. In supine position, a subclavian vein runs transversely forming near right angle to an innominate vein. In arm raised position, the subclavian vein is elevated while the innominate vein is in position. Such a change can make the angle more favorable to insert a straight device. This approach is intuitive and may be helpful for some patients (especially, short or obese patients). Although a tHDC can be placed with peel-away sheath placed in subclavian vein (as first case), the risk of malposition may increase (8, 9). Subclavian tHDC placement is not a common procedure; only 4 out of 615 patients underwent catheter placement into the subclavian vein in a span of 3 years at our institution. In conclusion, raising the patient's arm may help reduce the risk of vascular and cardiac injuries and catheter malposition, at the insertion of tHDC via subclavian vein.

### Author Contributions

Conceptualization, S.D.J.; data curation, K.D., B.S.H.; formal analysis, K.D., B.S.H.; investigation, Y.J.; methodology, S.D.J.; project administration, L.J.W.; supervision, L.J.W.; validation, P.C.S.; visualization, S.D.J.; writing—original draft, Y.J.; and writing—review & editing, Y.J., S.D.J.

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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## 쇄골하정맥을 통한 매립혈액투석카테터 삽입시 상지 거상법의 유용성: 2예 보고

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매립혈액투석카테터 삽입을 위한 접근로 선택에서 쇄골하정맥은 이후에 동정맥루 접근로 형성을 위해 가능한 사용을 피하는 경로이다. 그러나 반복적 삽관으로 접근 가능한 정맥이 소진되거나 기대여명이 길지 않고 응급 투석이 필요한 경우 쇄골하정맥을 선택할 수 있다. 그러나 쇄골하정맥을 통한 혈액투석카테터 삽입에는 기술적인 어려움이 있다. 쇄골하정맥은 종종 상대정맥과 직각을 형성하여 굽은 혈관초삽입시 혈관 손상을 초래할 수 있다. 상지 거상 상태에서 혈관초를 삽입하는 방법은 각도를 완만하게 유도하여 이러한 문제를 극복하는데 도움을 줄 수 있다. 고식적양와위 자세로 시술 중 상대정맥 손상이 있었던 환자와 연달아 내원하여 상지 거상 후 안전하게 혈액투석카테터를 삽입한 환자의 각각의 증례를 통해 상지 거상법이 도움이 될 수 있음을 보고하고자 한다.

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