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Comparison of Guidewire Passage in the Presence of Subclavian Vein Valves During Ultrasound-Guided Catheterization: A Two-Case Series

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Abstract **Case Report**

Ultrasound-guided subclavian vein catheterization significantly improves procedural success and safety; however, intra-luminal dynamic structures such as venous valves can interfere with guidewire advancement. This case series compares two distinct clinical scenarios involving pre-procedurally identified subclavian vein valves during real-time ultrasound-guided infraclavicular catheterization. In Case 1, an 83-year-old female (150 cm, 48 kg) was scheduled for elective brain tumor resection. Pre-procedural longitudinal ultrasound identified a dynamic bicuspid valve leaflet in the right mid-subclavian vein; a precise central in-plane needle trajectory aligned with the longitudinal vessel axis and directed through the center of the valve orifice allowed smooth, unhindered guidewire advancement on the first attempt without resistance. In Case 2, a 31-year-old female (165 cm, 55 kg) presented for emergency posterior lumbar interbody fusion (PLIF) due to an L1 bursting fracture. Real-time longitudinal ultrasound similarly revealed a dynamic venous valve. Initial venipuncture performed distal to the valve yielded free blood return, but firm mechanical resistance was encountered during 0.035-inch J-tip guidewire insertion due to impaction within the valve sinus pocket. Real-time ultrasound confirmed wire buckling. Withdrawing the wire and relocating the puncture site ~ 1.0 cm proximal (cardiac side) to the valve leaflet enabled effortless guidewire passage and successful 7-Fr catheter placement. These cases demonstrate that while the presence of a subclavian vein valve does not universally obstruct guidewire passage, pre-procedural ultrasound mapping, optimal trajectory alignment through the valve orifice, or strategic re-puncture proximal to the valve when resistance occurs are essential steps to ensure safe, complication-free central venous catheterization.

Keywords: Central venous catheterization, Subclavian vein, Ultrasonography, Venous valve, Guidewire impaction.

INTRODUCTION

Central venous catheterization (CVC) is an indispensable intervention for hemodynamic monitoring, fluid resuscitation, and administration of vasoactive medications during both emergency and elective surgical procedures. The subclavian vein (SCV) route is highly favored due to lower rates of catheter-related bloodstream infections, reduced incidence of venous thrombosis, and superior patient comfort [1]. The routine implementation of real-time ultrasound (US) guidance has substantially improved success rates and minimized mechanical complications such as pneumothorax and accidental arterial puncture [1,2]. Nevertheless, clinicians frequently encounter technical challenges after obtaining free venous blood return. Difficulty in advancing the guidewire remains a primary cause of procedural delay, often resulting from posterior wall contact, venous spasm, tortuous vessel anatomy, or intra-luminal valves [3]. Anatomical studies report that venous valves are present in the subclavian vein in 50% to 80% of individuals, typically situated near the jugulo-subclavian junction or within the mid-subclavian segment [4,5]. Depending on needle orientation and the relation of the entry point to the valve leaflets, a guidewire may either pass seamlessly through the valve orifice or become lodged within the valve sinus pocket [3,6]. Forcing a wire against an obstructed valve risks vessel rupture, valve tearing, or wire deformation [3,6]. This two-case series compares a case of valve-induced guidewire impaction requiring site modification in an emergency surgery setting with a case of uncomplicated guidewire passage despite the presence of a valve during an elective neurosurgical procedure, highlighting the clinical management and technical nuances under US guidance.

CASE REPORT

The institutional ethics committee approved this report, and written informed consent was obtained from both patients (approval number: PMC 2026-08-018).

Case 1

An 83-year-old female patient (height: 150 cm, weight: 48 kg) was admitted for elective craniotomy and brain tumor resection. Due to her advanced age, potential hemodynamic fluctuations, and the necessity for central venous access during prolonged neurosurgery, central venous catheterization was planned.

In the operating room, pre-procedural ultrasound scanning of the right subclavian vein was conducted using a high-frequency linear transducer (12–15 MHz) in both transverse and longitudinal long-axis views. Longitudinal visualization demonstrated a distinct, mobile bicuspid valve leaflet oscillating rhythmically within the mid-subclavian lumen [Fig1.A]. Utilizing real-time in-plane ultrasound guidance, the needle was introduced with a trajectory aimed precisely along the central axial lumen of the vessel toward the open center of the valve orifice.

Following free dark blood aspiration, the 0.035-inch J-tip guidewire was introduced and advanced effortlessly on the first attempt without encountering tactile resistance. Real-time ultrasound visualization confirmed that the curved wire tip passed smoothly through the center of the open valve leaflets into the central circulation. A 7-Fr triple-lumen catheter was placed over the wire and secured without difficulty.

Case 2

A 31-year-old female patient (height: 165 cm, weight: 55 kg) was admitted to the emergency department following high-energy trauma, presenting with an L1 bursting fracture. She was scheduled for emergency posterior lumbar interbody fusion (PLIF). Due to expected intraoperative hemodynamic instability and the need for continuous fluid resuscitation and vasoactive drug administration, central venous access was requested.

Pre-procedural ultrasound scanning of the right subclavian vein in the long-axis view similarly identified a dynamic, mobile bicuspid valve leaflet in the mid-subclavian vein [Fig.1.B]. Real-time in-plane venipuncture was executed distal (peripheral side) to the valve leaflet, yielding prompt blood aspiration. However, the 0.035-inch flexible J-tip guidewire met firm mechanical resistance after advancing approximately 2 cm. Real-time ultrasound confirmed that the wire tip was lodged inside the valve sinus pocket behind the leaflet, causing visible wire buckling.

Forceful manipulation was immediately avoided, and the needle and guidewire were withdrawn simultaneously. Under continuous real-time US guidance, a second puncture was performed approximately 1.0 cm proximal (cardiac side) to the valve leaflet. Free blood return was re-confirmed, and the guidewire advanced smoothly without resistance into the superior vena cava, allowing uncomplicated placement of a 7-Fr triple-lumen catheter.

Post-procedural upright chest radiographs for both patients confirmed ideal catheter tip positioning at the cavoatrial junction, with no evidence of pneumothorax, hemothorax, or vessel injury [Fig.2].

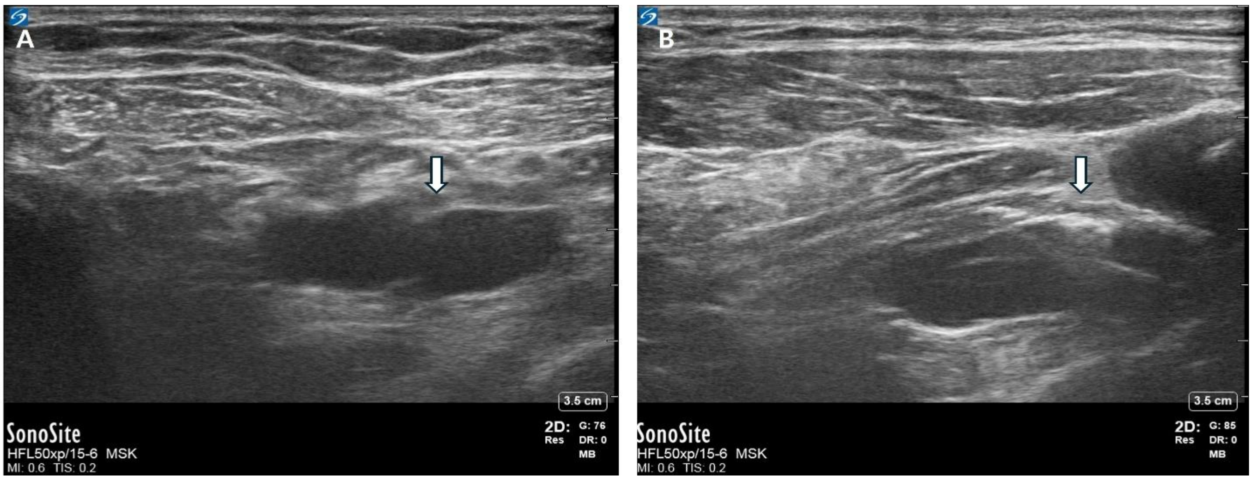

Fig. 1: pre-procedural ultrasound visualization of subclavian vein valves
A. Case 1 (83-year-old female): Longitudinal view demonstrating a dynamic valve leaflet. Central trajectory alignment permitted unhindered wire passage through the valve orifice.
B. Case 2 (31-year-old female): Longitudinal view showing a mobile bicuspid valve leaflet within the mid-subclavian vein. Initial distal puncture resulted in guidewire impaction within the valve sinus pocket.
Arrow indicates the venous valve leaflet

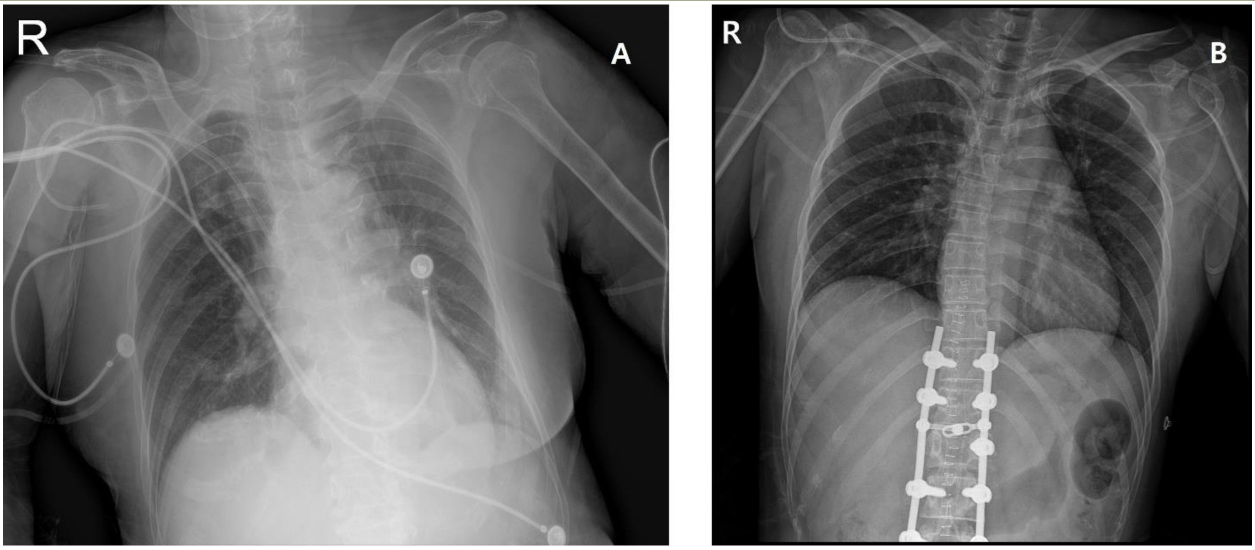

Fig.2 post-procedural chest radiography
A. Case 1 patient: Correct placement of the central venous catheter tip at the cavoatrial junction.
B. Case 2 patient: Correct placement of the central venous catheter tip without procedure-related mechanical complications.

DISCUSSION

Venous valves in the subclavian vein serve to prevent retrograde blood flow during variations in intrathoracic pressure [4,5]. However, during central line placement, these structures act as potential mechanical obstacles depending on the precise site and angle of venipuncture relative to the valve leaflets [3,6].

These two cases present contrasting clinical backgrounds—an elective geriatric neurosurgical case (Case 1) and an emergency spine trauma case (Case 2)—yet both encountered similar anatomical challenges in the form of a dynamic subclavian valve.

In Case 1, despite the patient's advanced age (83 years) and potentially fragile vessel histology, meticulous pre-procedural planning and precise alignment of the needle trajectory enabled the guidewire to navigate directly through the center of the valve orifice without resistance. This demonstrates that visual confirmation of a valve on ultrasound does not automatically mandate abandoning the site.

In contrast, in Case 2, entering distal to the valve directed the guidewire tip directly into the valve sinus pocket behind the leaflet, causing impaction and wire buckling. Emergency settings often heighten time pressure, but applying force against resistance can lead to severe vascular injury, valve tearing, or wire shearing. Immediate ultrasound re-evaluation confirmed the mechanism of failure, and relocating the puncture site ~ 1.0 cm proximal (cardiac side) to the valve successfully bypassed the barrier.

Comparing these outcomes yields three practical clinical insights. First, pre-procedural ultrasound scanning should routinely include a longitudinal evaluation to map intra-luminal valves [2,6]. Second, if resistance occurs despite clear blood return, immediate ultrasound inspection should be used to verify wire position rather than applying force [3,6]. Third, when valve impaction occurs, relocating the puncture site proximal (medial/cardiac side) to the valve leaflet bypasses the anatomical barrier entirely, providing a reliable corrective strategy [6].

CONCLUSION

Subclavian vein valves represent dynamic intra-luminal structures that may or may not impede guidewire advancement during ultrasound-guided catheterization. While successful passage through the valve orifice is possible with optimal alignment, encountering resistance warrants immediate ultrasound reassessment and relocation of the puncture site proximal to the valve to ensure safe and successful central line placement.

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