The left subclavian vein: An alternative site for percutaneous right ventricular assist device placement

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Increased single-site venovenous (VV) extracorporeal membrane oxygenation (ECMO) use promotes awake, mobilized patients. The internal jugular vein is a safe, established site for dual-lumen ECMO cannula insertion with image guidance.1 Left internal jugular (LIJ) and left subclavian veins are alternative cannulation sites when the right internal jugular (RIJ) vein is inaccessible.2,3

During the COVID-19 pandemic, patients on VV ECMO experienced refractory cor pulmonale unresponsive to medical treatment.4 The Protek Duo (TandemLife) offers percutaneous right ventricular assist device (RVAD) support. Designed for RIJ placement, it assists patients until recovery or lung transplant by draining blood from the right atrium and returning it to the PA when connected to an ECMO circuit. An oxygenator is added for gas exchange. Previously, limited options existed for percutaneous, single-site RVAD placement when the RIJ vein was inaccessible.4

We present the use of the left subclavian vein as an alternative site for percutaneous dual-lumen cannula placement, connecting the right atrium to the pulmonary artery (PA), as part of an RVAD used to bridge a patient to lung transplant (Figure 1).

MATERIALS AND METHODS

Institutional Review Board approval and written consent from patients were obtained for publication of this surgical technique (STUDY00004012, 04/02/2022).

Case Description

A 52-year-old man developed severe COVID-19–related acute respiratory distress syndrome. On day 5, he was remotely cannulated for VV ECMO using a right femoral vein multistage drainage cannula and a short single-stage, RIJ vein oxygenated return cannula, and transported to our ECMO center.

The patient’s lung injury persisted, resulting in significant parenchymal destruction and refractory hypoxemia episodes. After 6 weeks, he developed COVID-19–related group 3 pulmonary hypertension, leading to right heart failure due to extensive pulmonary vasculature scarring.

To support the failing right ventricle, the patient was transitioned to a fluoroscopically guided RIJ percutaneous RVAD with an oxygenator using a Protek Duo. After 4 months of rehabilitation, the patient met institutional lung transplant criteria. However, he developed significant skin breakdown at the RIJ site resulting in bleeding and ongoing transfusion requirements. Concurrently, he had persistent multidrug-resistant Klebsiella bacteremia. This prompted relocation of his cannula.

Surgical Technique

In the hybrid operating room, the patient was first transitioned to 2 sites: VV ECMO via the left IJ and right femoral veins. The existing RIJ vein percutaneous RVAD cannula was removed. Next, the left subclavian vein

A dual-lumen, percutaneous RVAD cannula placed via the RIJ versus left subclavian vein.

CENTRAL MESSAGE

The dual-lumen percutaneous RVAD cannula can be safely placed via the left subclavian vein under fluoroscopic guidance as an alternative to the RIJ site.

See Commentary on page XXX.
FIGURE 1. A, Dual-lumen, bicalval, VV ECMO cannula percutaneously placed in the left subclavian vein. B, Dual-lumen, right atrial to PA cannula percutaneously placed in the standard position: RIJ vein, as part of an RVAD. C, Dual-lumen, right atrial to PA cannula percutaneously placed in the left subclavian vein, as part of an RVAD.

FIGURE 2. Fluoroscopic stepwise images of left subclavian vein cannulation with a percutaneous, dual-lumen right atrial to PA cannula.
was accessed with a micropuncture needle and catheter. Under fluoroscopy, a Glidewire (Terumo) was advanced into the right lower lobe PA to provide extra purchase. This was exchanged over a catheter for an extra stiff, double-looped Lunderquist wire (Cook Medical). The site was serially dilated using the Avalon Elite Vascular access kit (Maquet GmbH) to 30F. Then a 31F, dual-lumen, right atrial to PA cannula was placed with the tip terminating in the PA (Figure 2). Flows were optimized (3.75 L/min), and subsequently oxygenation improved, with partial pressure of oxygen greater than 100 mm Hg.

On the new extracorporeal life support circuit, the patient’s hemodynamics improved, and the bleeding at the RIJ cannulation site was then surgically controlled.

**Postoperative Course**

On the new circuit, his bacteremia resolved, and the RIJ site remained hemostatic. This allowed the patient to more easily participate in rehabilitation. Previously limited to ambulating 80 feet, the patient demonstrated remarkable progress by walking more than 1000 feet. Two weeks later, he underwent a double lung transplant on mechanical circulatory support. After a sweep gas trial on postoperative day zero, the patient was decannulated from ECMO.

**CONCLUSIONS**

In cases where internal jugular site cannulation is not available, left subclavian vein cannulation with real-time fluoroscopy is a technically challenging, but safe alternative for percutaneous RVAD placement.

Illustrations were provided by Andy Matlock, Department of Surgery, Emory School of Medicine.

**References**