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Modified Transcaval Left Atrial Venoarterial Extracorporeal Membrane Oxygenation Without Preplanning Contrast CT: Step-by-Step Guide

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IMAGES IN INTERVENTION

Modified Transcaval Left Atrial Venoarterial Extracorporeal Membrane Oxygenation Without Preplanning Contrast CT

Step-by-Step Guide

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A 72-year-old woman, with right renal cell carcinoma undergoing evaluation, stage 3 chronic kidney disease, coronary artery disease, and atrial fibrillation with history of bypass surgery and left atrial appendage ligation, was emergently transferred to our facility for escalation of care. She was initially admitted to an outside hospital for heart failure (left ventricular ejection fraction = 30%) due to severe aortic stenosis with balloon valvuloplasty performed, complicated by severe aortic regurgitation (**Figure 1A**). There, the patient decompensated and was placed on vasopressors with inotropic support, and an intra-aortic balloon pump was inserted. On arrival, ultrasound scanning showed the femoral arteries were too small and with distal disease to safely accommodate 19-F cannulae. Hence, transcaval (TC) arterial access was planned.

No computed tomography (CT) scan data were available. Due to worsening renal function, urgent abdominopelvic CT without contrast was performed, which showed a feasible TC window. The aorta was anterior to the inferior vena cava due to renal cell carcinoma (**Figure 1B**), therefore we planned our crossing angle in a left anterior oblique projection. Awake TC left atrial venoarterial (LAVA) extracorporeal membrane oxygenation (ECMO) was performed with a modified TC technique, with access and process streamlined as follows:

1) A 6-F left radial artery (for snaring). A 10-F right femoral vein (RFV) (for intracardiac echocardiography [ICE]). An 8-F left femoral vein (LFV; for trans-septal crossing). An 8.5-F right internal jugular vein (for Swan-Ganz catheter).
2) Trans-septal puncture from LFV, with ICE guidance from right femoral vein. Insert a curled wire (eg, Safari wire, Boston Scientific) into the left atrium (LA) (**Figure 2A**). ICE catheter from RFV can be removed in preparation for TC crossing

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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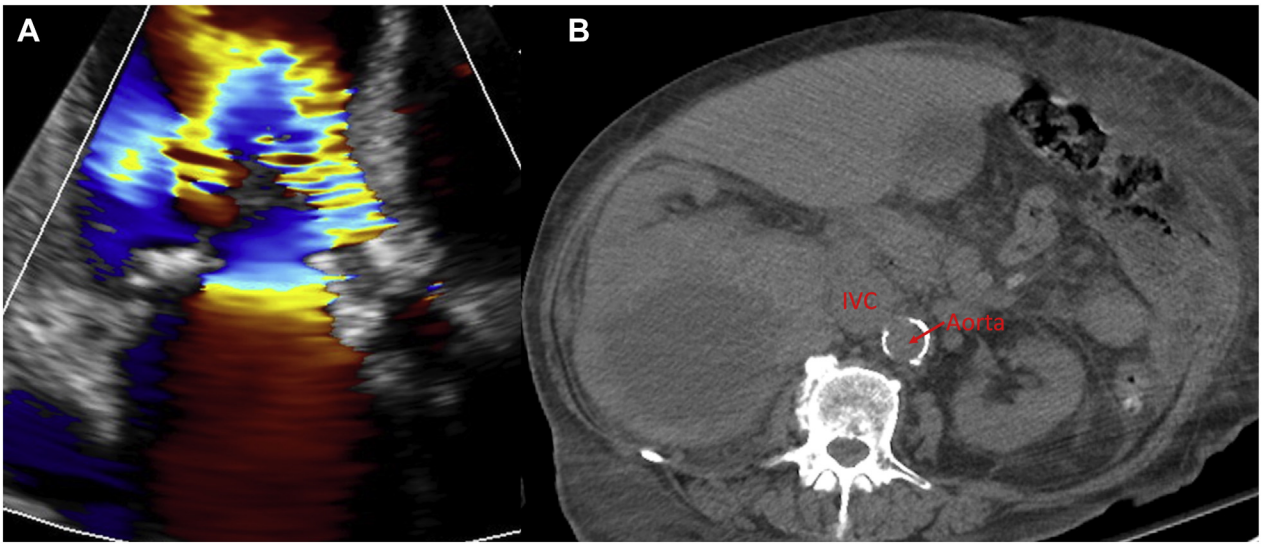
FIGURE 1 Preprocedure Workup



(A) Severe aortic insufficiency after balloon aortic valvuloplasty. **(B)** Transcaval planning. IVC = inferior vena cava.

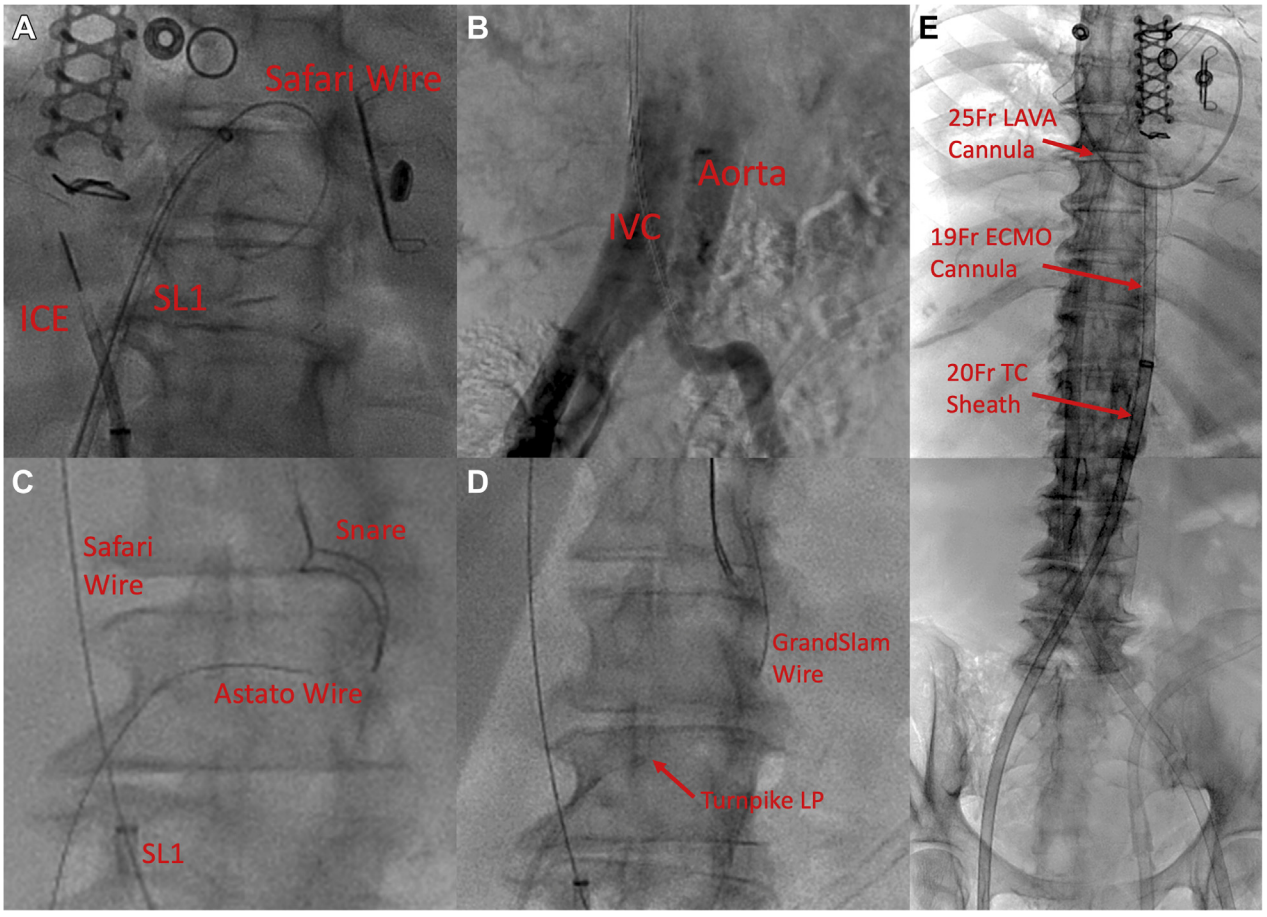
(crossing from the LFV is less desirable to enhance the angle of pushability of TC sheath).

3) Simultaneous aortogram and venogram (Figure 2B).
4) Snaring setup from the left radial artery with a 6-F JR4 guiding and gooseneck snare. Transcaval crossing setup from RFV with a Turnpike LP (Teleflex) (Figure 2C), in 27° left projection (normally 15° left anterior oblique is the default crossing projection.
5) Unable to snare the Astato wire (Asahi Intecc Medical) inside the aorta after crossing. Turnpike LP was advanced into the aorta. Astato wire removed. Blood was drawn from the Turnpike LP to ensure it was arterial. Turnpike LP was also connected to pressure to ensure pulsatile waveform confirming true lumen. Grand Slam wire (Asahi Intecc Medical) was then advanced up the descending aorta via the Turnpike LP with fluoroscopic guidance (Figure 2D).
6) Transcaval access upsizing and wire exchange in standard fashion.[1] A 20-F × 33-cm Gore DrySeal sheath (W. L. Gore) was advanced up the TC access from the RFV via a Lunderquist wire (Cook Medical). A 19-F ECMO cannula was introduced into the sheath.
7) A 24-F LAVA cannula sent from the LFV access along the Safari wire in the LA (Figure 2E). Septostomy can be performed via the wire with peripheral balloon if needed. However, from our experience, this is seldom necessary. (A 5-F MP catheter was sent to the LA for detailed hemodynamic study before and after ECMO, not essential for procedure.)

Invasive hemodynamics showed marked improvement (Figure 3). Subsequently, a TAVR workup was completed, and TAVR was performed on day 4 with a 26-mm SAPIEN 3 Ultra (Figure 4). ECMO decannulation with TC hole closure was done the day after TAVR with a 12/10 Amplatzer ADO1 (Abbott) (Figure 5).

TC LAVA ECMO combines the benefit of LAVA ECMO,[2] enabling placement of larger cannulas and avoiding large-bore lower limb arterial access complications (eg, lower limb ischemia, blocked reperfusion sheath, bleeding around arterial sheath).

FIGURE 2 **Modified Transcaval LAVA ECMO Steps**



(A) ICE-guided trans-septal puncture with placement of Safari wire in the left atrium. **(B)** Simultaneous aortogram and venogram for crossing planning. **(C)** Transcaval crossing. **(D)** Astato exchanged for Grand Slam wire via Turnpike LP. **(E)** Transcaval LAVA ECMO setup. ECMO = extracorporeal membrane oxygenation; ICE = intracardiac echocardiography; IVC = inferior vena cava; LAVA = left atrial venoarterial; TC = transcaval.

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Dr Basir is a consultant for Abbott Vascular, Abiomed, Cardiovascular Systems, Chiesi, Saranas, and Zoll. Dr B. O'Neill is a consultant to and receives research support from Edwards Lifesciences. Dr Frisoli is a proctor for Edwards Lifesciences, Abbott, Boston Scientific, and Medtronic. Dr Wang is a consultant to Edwards Lifesciences, Abbott, Neochord, and Boston Scientific; and receives institutional research grant support from Boston Scientific. Dr W. O'Neill has served as a consultant for Abiomed, Edwards Lifesciences, Medtronic, Boston Scientific, Abbott Vascular, and St. Jude Medical; and serves on the board of directors of Neovasc Inc. Dr Villablanca is a consultant for Edwards Lifesciences and Teleflex. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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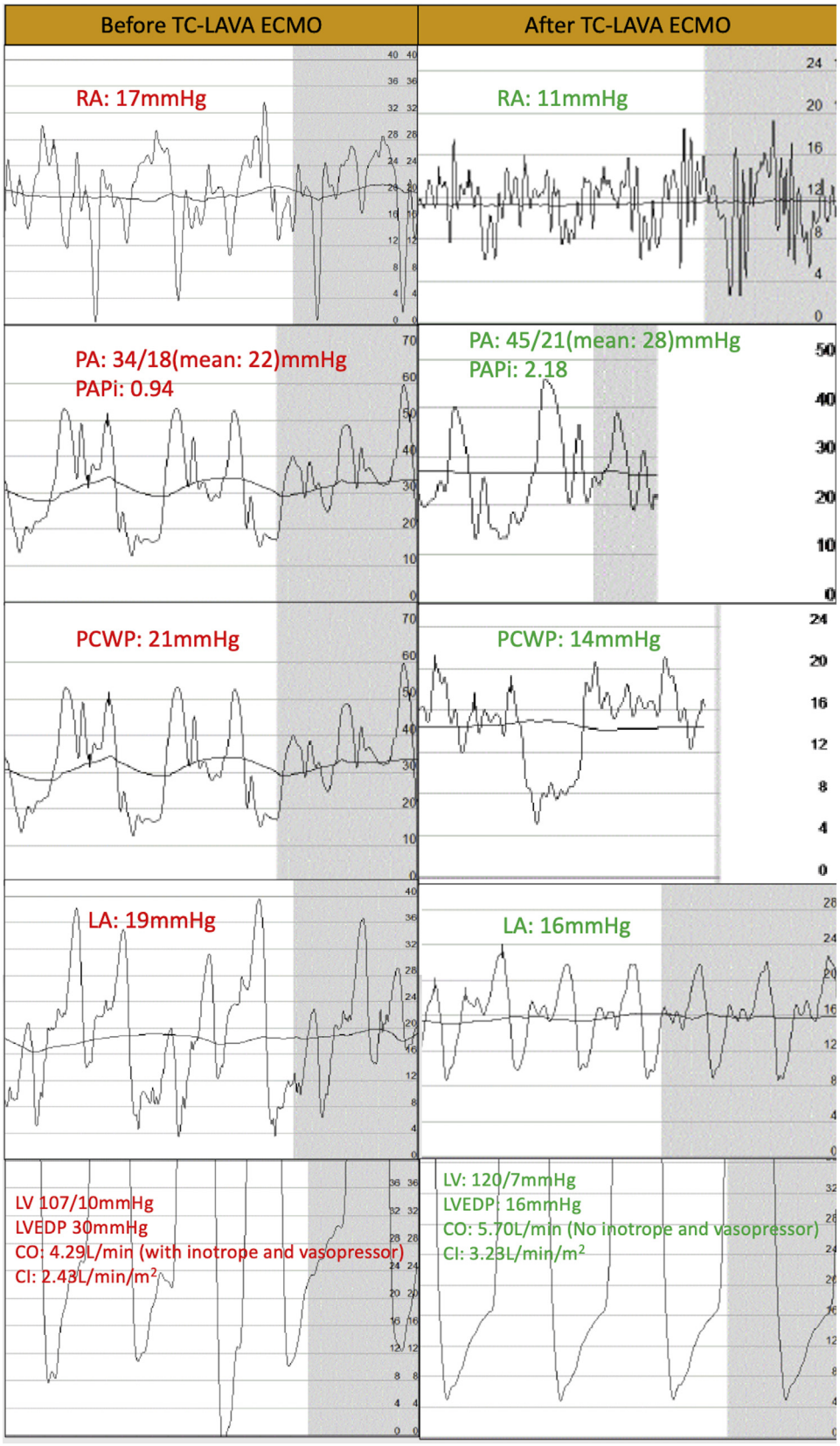
FIGURE 3 **Invasive Hemodynamics Before and After TC LAVA ECMO**



CI = cardiac index; CO = cardiac output; LA = left atrium; LV = left ventricle; LVEDP = left ventricular end-diastolic pressure; PA = pulmonary artery; PAi = pulmonary artery index; PCWP = pulmonary capillary wedge pressure; RA = right atrium; other abbreviations as in Figure 2.

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KEY WORDS aortic insufficiency, cardiogenic shock, ECMO, LAVA-ECMO, TAVI, TAVR, transcaval

FIGURE 4 Trace Aortic Insufficiency After Transcatheter Aortic Valve Replacement

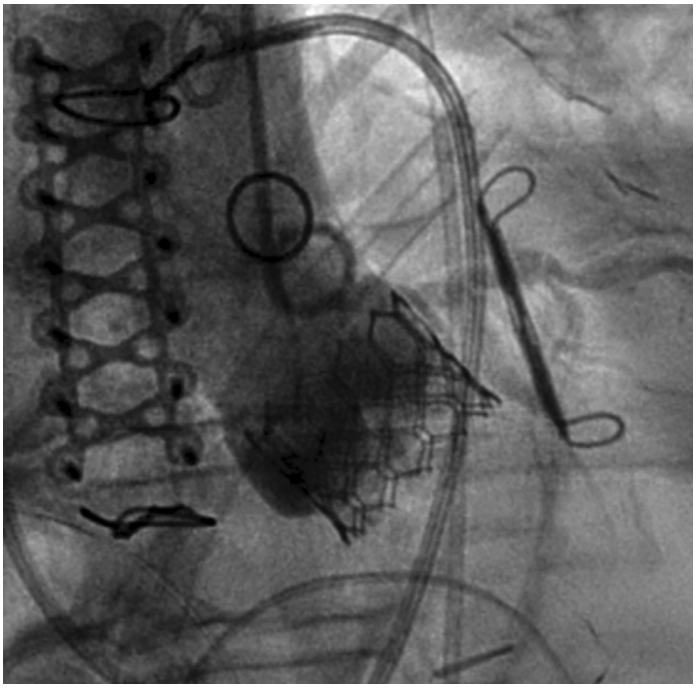
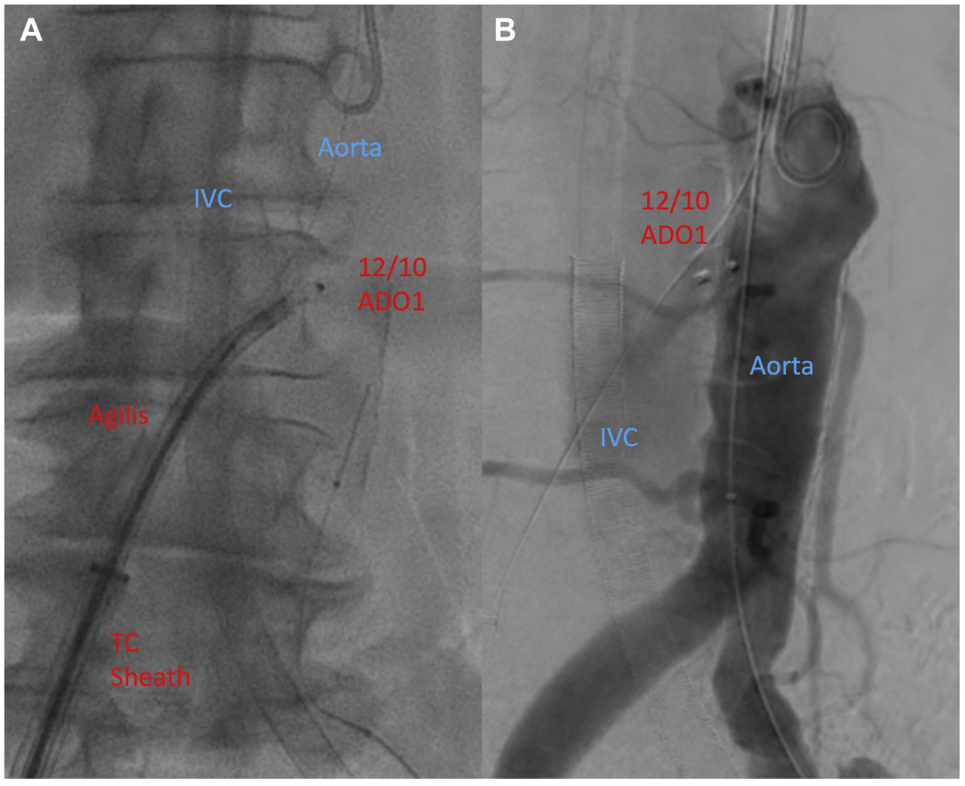


FIGURE 5 Transcaval Closure



(A) ADO1 deployment. **(B)** Aortogram demonstrating Type 1 closure. Abbreviations as in Figure 2.