

The Use of Transesophageal Echocardiography for Differential Diagnosis of Poor Venous Return During Cardiopulmonary Bypass

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Transesophageal echocardiography (TEE) is now widely accepted as being useful in the management of patients undergoing cardiac surgery. There are also reports of using TEE to assist with placement of cannula for cardiopulmonary bypass (CPB) (1–3). However, there are few reports of the use of TEE for troubleshooting problems during CPB. We present a case in which intraoperative TEE assisted in the diagnosis of poor venous return during CPB.

A 64-year-old man presented for redo-sternotomy and heart transplantation. CPB was instituted after cannulation of the ascending aorta and the left femoral vein. At the time of femoral venous cannula placement, TEE was used to confirm positioning of the tip of the venous cannula at the junction of the inferior vena cava (IVC) and right atrium. After initiation of CPB, venous return flow was noted to be low and his cardiac index was $<2 \text{ L} \cdot \text{min}^{-1} \cdot \text{m}^{-2}$. Low venous return to the CPB circuit may be related to low blood volume, air in the venous return line, inappropriate cannula placement, or obstruction of the cannula. Vacuum was applied to the circuit without improvement in venous return. At this time TEE examination revealed intermittent obstruction of the venous cannula inflow by a large, redundant Eustachian valve (Figs. 1 and 2 and please see video loop available at www.anesthesia-analgesia.org). After withdrawal of the venous cannula by a few centimeters, venous return promptly improved and the cardiac index increased to $2.3 \text{ L} \cdot \text{min}^{-1} \cdot \text{m}^{-2}$.

TEE may be used for guiding CPB IVC cannula placement during direct insertion via a median sternotomy. Avoiding malposition of the venous cannula

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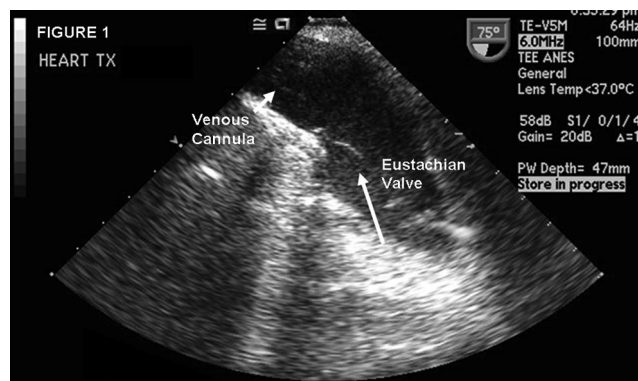


Figure 1. Transesophageal echocardiography bicaval image demonstrating the venous cannula at the junction of the right atrium and inferior vena cava. The Eustachian valve is also noted.

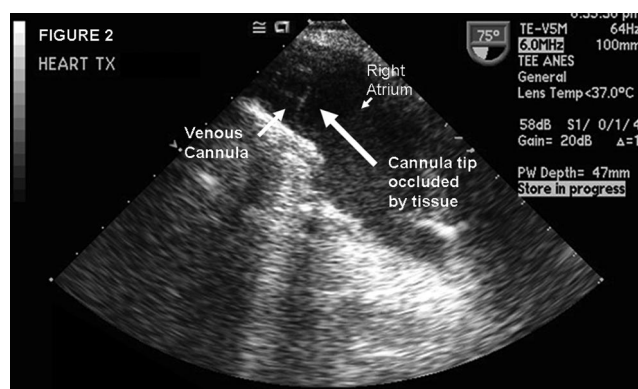


Figure 2. Similar transesophageal echocardiography image as for Figure 1 demonstrating obstruction of the venous cannula by the Eustachian valve (arrow) after initiation of cardiopulmonary bypass.

in the hepatic vein by TEE examination has been described (2). Our case demonstrates that TEE examination is also important for assisting in positioning the IVC cannula when placed via the femoral vein. In this situation, TEE first confirms placement of the guide-wire in the atrium and then the correct positioning of the subsequently placed venous cannula at the right atrium and IVC junction. In our case, the venous cannula appeared to be properly positioned on TEE examination, and obstruction to venous inflow was not evident until initiation of CPB. The Eustachian valve is a vestigial portion of the IVC which functions

during fetal life to direct IVC blood flow across the foramen ovale. Occasionally, similar vestigial structures are fenestrated and more extensive (Chiari network). Recognition of obstruction of the venous cannula by the residual Eustachian valve was facilitated by the use of intraoperative TEE, including during initiation of CPB.

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