Volume Assessment in Interrupted Inferior Vena Cava

Biraj Parajuli et al.

ABSTRACT

Bedside ultrasound imaging of inferior vena cava (IVC) is commonly used to guide fluid administration. Here, we present the echocardiography and angiography images of a postoperative surgical patient in whom an anomalous IVC was detected during evaluation for hemodynamic instability.

Keywords: Congenital abnormalities, Diagnostic imaging, Inferior vena cava.

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CASE DESCRIPTION

A 1-year-old male child with a preoperative diagnosis of partially anomalous pulmonary venous connection (PAPVC), large ostium secondum atrial septal defect (OS-ASD), large patent ductus arteriosus (PDA), severe pulmonary artery hypertension (PAH) and persistent left-sided superior vena cava (LSVC) underwent PDA ligation. He was extubated on the first postoperative day after an uneventful course. A few hours after extubation, he developed hemodynamic instability, and he was reintubated. Transthoracic echo examination was performed, which revealed suprasystemic pulmonary artery pressures with normal left ventricle function. The abnormal shape of the left ventricle precluded determination of volume status and prompted us to image the inferior vena cava.

Through the subxiphoid window, inferior vena cava (IVC) appeared collapsed, and the hepatic vein appeared dilated. Figure 1A, Video 1 was the image obtained in the sagittal plane in the index patient. Figure 1B illustrates the IVC in a normal subject for comparison. The markedly reduced the caliber of the vessel coursing through the liver can be appreciated in the index patient. In an emergency situation, this would have warranted fluid administration.

However, when we rotated the probe to look at the vessel in the transverse plane, no vessel could be visualized at the usual location of the IVC (Fig. 2A). A sweep performed at this level also failed to show a hepatic portion of the inferior vena cava (Video 2). The normal location of IVC is depicted in Figure 2B for comparison. From this, we inferred that the vessel with the reduced caliber seen in Figure 1 was one of the hepatic veins and that there was infra hepatic interruption of the IVC.

The preoperative angiogram was reviewed which confirmed the infrahepatic interruption of IVC. Contrast injected into the right superior vena cava (SVC) followed a pathway into the right atrium a little away from that of the catheter (Fig. 3A, Video 3). Normally, contrast follows the pathway of the catheter into the right atrium. In our case, the pathways were different which indicated that the catheter reached right SVC through the azygos vein bypassing the right atrium (Fig. 3B). In subsequent images, the catheter could also be seen reaching the persistent left superior vena cava through the azygos vein by the following pathway: azygos vein–right superior vena cava–right atrium-coronary sinus-persistent LSVC (Fig. 4A). The left SVC was also visualized by cannulation through the left internal jugular vein (Fig. 4B).

CLINICAL SIGNIFICANCE

Infrahepatic interruption of the IVC, also known as a hepatic interruption of IVC or anomalous inferior vena cava with azygos continuation1 is a rare anomaly with a prevalence of 0.6%.2 This condition arises when the pre-renal and hepatic segments of IVC fail to fuse during embryogenesis. The azygos vein is normally subcentimetric, has a paravertebral course and enters the chest through the aortic hiatus. In the case of interrupted IVC, blood from the infrarenal IVC is shunted through the azygos vein, which gets mildly dilated.3

Few of the clinical implications of infra hepatic interruption of IVC include increased risk of deep venous...
thrombosis owing to venous stasis, association with sick sinus syndrome, difficulty in femoral cannulation for cath lab procedures, technical alteration during institution of cardiopulmonary bypass by way of insertion of a larger SVC cannula and a small cannula in the hepatic venous system, and as in our case, the need for alternative method for assessing volume status.

Figs 1A and B: (A) Subxiphoid window, sagittal plane in the index patient showing collapsed vessel(\*) in place of inferior vena cava; (B) Subxiphoid window, sagittal plane in a normal subject showing a normally sized Inferior vena cava. IVC, Inferior vena cava

Figs 2A and B: (A) Subxiphoid window, transverse plane in the index patient showing the absence of any vessel at the usual location of Inferior vena cava, adjacent to the aorta; (B) Subxiphoid window, transverse plane in a normal subject showing the usual location of Inferior vena cava adjacent to the aorta. IVC, Inferior vena cava

Figs 3A and B: (A) Angiography image of contrast injected through a catheter inserted via a femoral vein into the superior vena cava. Note the pathway of contrast away from that of the catheter; (B) Anatomical correlation of angiography image. RA, Right atrium; SVC, Superior vena cava; \* - Pathway of contrast
REFERENCES