Acute Budd–Chiari syndrome during veno-venous extracorporeal membrane oxygenation diagnosed using transthoracic echocardiography

Editor—There has been a recent focus on the role of veno-venous extracorporeal membrane oxygenation (ECMO) in the management of adult patients with severe respiratory failure. Transfer to an ECMO-capable centre improves survival without severe neurological disability compared with standard management. However, ECMO is invasive and not without hazards including the cannula and circuit-related complications.

A 42-yr-old man was transferred to our institution with community-acquired pneumonia and acute respiratory distress syndrome, causing severe respiratory failure refractory to conventional treatment. He failed to improve with high-frequency oscillation and the prone position; thus, ECMO was initiated. Femoral-jugular cannulation was performed under ultrasound guidance and image intensifier control. The drainage cannula was positioned in the inferior vena cava (IVC) with the tip at the T11/12 level. Over the following 6 h, the patient developed acutely deranged liver function tests with a marked elevation in bilirubin (53 μmol litre⁻¹) and alanine transaminase (311 IU litre⁻¹) concentrations. Biliary ultrasound was unremarkable and a transthoracic echocardiogram (TTE) demonstrated no signs of acute cor

Fig 1 Two-dimensional transthoracic echocardiography images demonstrating ECMO cannula placement within the IVC at the insertion of the hepatic vein (a); with colour Doppler demonstrating turbulent flow (a); withdrawal of the cannula using echocardiography guidance (c) and final position (d).
pulmonale. However, TTE revealed the tip of the drainage cannula to be close to the insertion of the hepatic veins, causing narrowing of the orifice with high-velocity blood flow \((1.5 \text{ m s}^{-1})\) (Fig. 1a and b). As a result, the cannula was withdrawn 2–3 cm under real-time TTE guidance. Echo images demonstrated an increase in lumen size by visual estimate and a reduction in blood flow velocities and turbulence on two-dimensional, spectral, and colour flow imaging (Fig. 1c and d). Within 12 h, a significant improvement in liver function tests was noted; bilirubin concentration normalized within 24 h; similarly, alanine transaminase halved in the initial 24 h and then returned to baseline within a few days.

The obstruction of venous drainage of the liver (the Budd–Chiari syndrome) occurring acutely leads to jaundice, hepatomegaly, ascites, elevated liver enzymes, and encephalopathy. The Budd–Chiari syndrome may be idiopathic, due to thrombosis of the hepatic veins in thrombogenic states or extrinsic compression, for example, due to neoplasia. We are not aware that the Budd–Chiari syndrome due to ECMO cannula obstruction has been described previously. In this case, prompt clinical recognition and echocardiographic confirmation enabled immediate withdrawal of the cannula before significant or irreversible hepatic impairment occurred. Venous drainage of the liver is by the hepatic veins which enter the IVC at the T8 level, inferior to the caval opening of the diaphragm. As the cannula tip had apparently been placed at the T11/12 level, possible explanations include a parallax error during positioning, cannula movement during supine to semi-recumbent positioning, or anatomical variation.

Optimal cannula positioning is crucial during ECMO, although this is not addressed in expert guidelines.\(^5\) Traditionally, chest radiography has been used to assess cannula positioning; however, the difficulty in detecting cannula malposition on chest radiography has been highlighted.\(^4,\,\,6\) Moreover, literature suggests that there is benefit in using echocardiography to assess cannula placement.\(^4\) In a recent study, 12% of the patients evaluated using TTE for the cannula position were found to have malpositioning, despite being reported ‘normal’ on chest radiography.\(^5\) TTE provides real-time guidance of cannula placement and surveillance of cannula migration while minimizing radiation exposure. Transoesophageal echocardiography has been described to guide positioning of the Avalon Elite (Avalon Laboratories, CA, USA) ECMO cannula.\(^6\)

Awareness of the potential for hepatic vein obstruction and the timely recognition of abnormal cannula positioning are critical when utilizing ECMO. Given the difficulty in confirming correct cannula placement clinically, or with plain radiography, additional real-time TTE may be considered a useful adjunct to cannula placement.

**Declaration of interest**

None declared.

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