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CASE IMAGE IN CARDIOVASCULAR ULTRASOUND

Hemodynamic vise in obstructed total anomalous pulmonary venous connection

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A 10-day-old neonate presented with respiratory distress and poor feeding from the 7th day of life. The baby was in congestive heart failure. Precordial examination revealed cardiomegaly, notably split second heart sound with a loud pulmonary component and a short mid-systolic murmur in the pulmonary area. The oxygen saturation on room air was 90% in all limbs. Cardiomegaly and pulmonary venous congestion were conspicuous on chest roentgenogram. Electrocardiography showed right ventricular hypertrophy and normal QRS axis. Two-dimensional transthoracic echocardiography showed supracardiac total anomalous pulmonary venous connection (TAPVC). The interatrial communication was not restrictive, measuring 5 mm and showed continuous laminar flow from right to left. The interventricular septum was intact, and the arterial duct was not patent. Doppler interrogation showed right ventricular systolic pressure of 50 mmHg. The suprasternal view (Fig. 1a, Supplementary video 1) revealed the entire anomalous course of pulmonary venous drainage. The vertical vein which connected to the left brachiocephalic vein had focal obstruction [pulsed-wave Doppler mean gradient 9 mmHg with aliasing (Fig. 1b), continuous wave Doppler mean gradient 15 mmHg (Fig. 1c)] at the region of the crossing left pulmonary artery anteriorly and left main-stem bronchus posteriorly, a point often referred to as the "hemodynamic vise" in this setting. Based on satisfactory echocardiographic demonstration of anatomy, the patient was taken up for surgery without the need for additional imaging by computed tomography or magnetic resonance imaging, after a Joint Cardiac Meet. The child underwent primary sutureless TAPVC repair and tanned pericardial patch closure of the ASD, and is doing well on follow-up.

Anomalous pulmonary venous connection to the left brachiocephalic vein constitutes the most common form of TAPVC and is generally non-obstructive. The vertical vein (also called the superior emissary vein) that ascends from the confluent chamber draining the pulmonary veins usually courses anterior to the left pulmonary artery [1]. On occasion, the vertical vein may pass posterior to the left pulmonary artery, which renders it susceptible to compression against the left bronchus, particularly in the presence of dilated pulmonary arteries (Fig. 1d) [2]. Such an entrapment of the vertical vein thus constitutes a dynamic and purely extrinsic obstruction to pulmonary venous return. This leads to considerable pulmonary venous congestion and relatively earlier presentation in infancy. The entire phenomenon can

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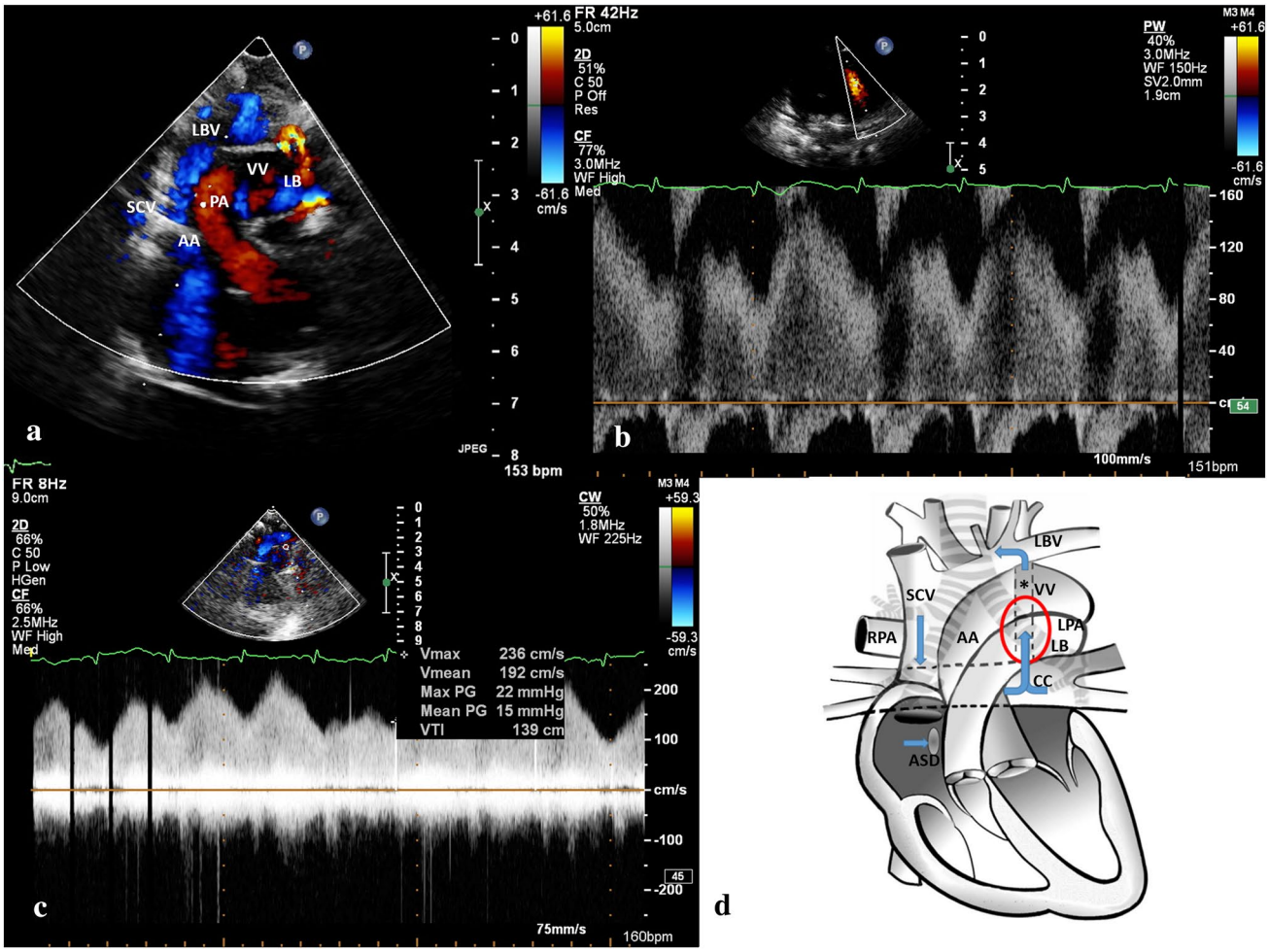

Fig. 1 Panel 1a is the transthoracic 2D echocardiographic color Doppler image from the suprasternal window showing the vertical vein draining to the left brachiocephalic vein and thereby to the superior caval vein. The turbulence in the vertical vein is evident at the region of the "hemodynamic vise" due to its compression by the proximal left pulmonary artery against the left main-stem bronchus. Panel 1b is the pulsed-wave Doppler from the suprasternal window at the level of the "hemodynamic vise" showing focal gradients with aliasing. Panel 1c is the continuous wave Doppler along the line of the vertical vein showing features of obstruction with mean gradient of 15 mmHg. Panel 1d is the diagrammatic sketch explaining the formation of the "hemodynamic vise". The asterisk in the sketch represents the sampling site of the Doppler gradients delineated in panels 1b and c. *AA* ascending aorta, *ASD* atrial septal defect, *CC* common chamber, *LB* left main bronchus, *LBV* left brachiocephalic vein, *LPA* left pulmonary artery, *PA* main pulmonary artery, *RPA* right pulmonary artery, *SCV* superior caval vein, *VV* vertical vein

be very well demonstrated on echocardiography from the suprasternal window, without the need for computed tomography or magnetic resonance imaging.

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Compliance with ethical standards

Conflict of interest Arun Gopalakrishnan, Kavassery Mahadevan Krishnamoorthy, and Ajitkumar Valaparambil declare that they have no conflict of interest.

Human rights statements and informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later revisions. Informed consent was obtained from the patient for being included in the study. No patient identity particulars have been disclosed.

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