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IMAGES IN CARDIOVASCULAR ULTRASOUND

Suprasternal optical window to Doppler the superior vena cava in neonates

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Assessment of cardiovascular status in preterm infants can be challenging. The correlation between blood pressure and systemic blood flow (SBF) is weak, and intracardiac shunts in the adapting heart confound the interpretation of echocardiographically estimated ventricular outputs. Measurement of superior vena cava (SVC) flow has been described as a novel measure of upper body SBF, ~80% of which goes to the brain, providing a useful marker of cerebral perfusion. It has been shown to have a significant correlation with left ventricular output ($r = 0.63$; $p < 0.0001$) [1]. While late intraventricular haemorrhage has been shown to be strongly associated with low SBF, early low SVC flow has also been associated with substantial mortality, morbidity and developmental impairments at 3 years [2, 3].

Evans described a Doppler echocardiographic technique to measure SVC flow velocities by imaging the heart from subcostal view [1]. The SVC flow was identified by angling the beam anteriorly until the flow into the right atria from the SVC is seen using colour Doppler. One of the problems frequently encountered with this technique is the difficulty in obtaining satisfactory views in infants with abdominal distension. Presence of abdominal tenderness/oedema in infants with conditions such as necrotising enterocolitis or abdominal masses could make this approach uncomfortable and painful for the preterm infant.

We use a different approach which obviates the above problems and is technically much easier. The infant is placed supine with the face turned to the left, facilitating easier access to the suprasternal notch. The probe is positioned in the notch to visualise the aortic arch in the first instance. It is then brought to the base of the right sternocleidomastoid muscle and rotated anticlockwise by about 20–30° and angled to bring in view the left brachiocephalic vein draining behind the arch. The left brachiocephalic vein then joins the right brachiocephalic vein to form the SVC (Fig. 1).

The angle of insonation for pulse wave Doppler from this view is virtually nonexistent, allowing for reliable and reproducible assessment of SVC flow velocity patterns. The SVC flow pattern is pulsatile with two peaks as described previously by Froysaker [4], the first associated with ventricular systole (S wave) and the other with early ventricular diastole (D wave). In addition, frequently there are short periods of reverse flow (A wave), associated with atrial systole (Fig. 2). The mean velocity of blood flow can be calculated from the integral of the Doppler tracings. Forward flow is positively integrated and any retrograde

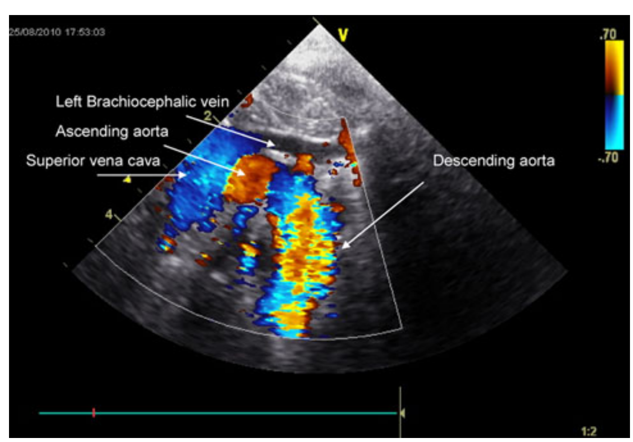

Fig. 1 Image showing relative anatomy of the aortic arch, left brachiocephalic vein and the superior vena cava

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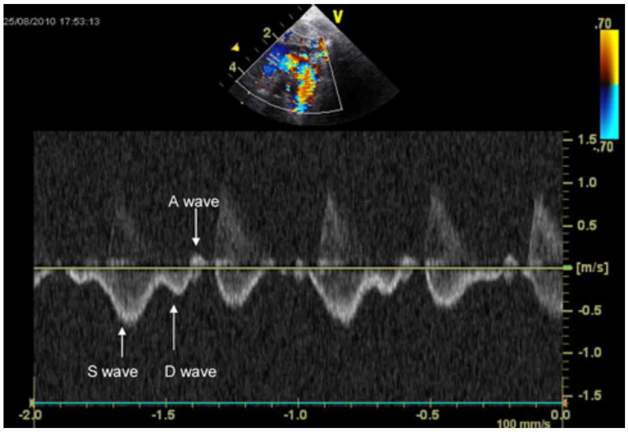

Fig. 2 Pulse wave Doppler image showing S, D and A wave traces

flow is negatively integrated using the incorporated software [5]. Superior vena cava flow measurement in this way offers a non-invasive means to assess SBF in newborn infants. Using the parasternal long-axis view, the internal diameters can be measured at the point where SVC starts to open into the right atrium [1].

While SVC flow measurement is being frequently used in haemodynamic research, this additional optical window to visualise and Doppler the SVC will go a long way to facilitate assessments without discomforting neonates.

Conflict of interest None.

References

1. Kluckow M, Evans N. Superior vena cava flow in newborn infants: a novel marker of systemic blood flow. Arch Dis Child Fetal Neonatal Ed. 2000;82:F182–7.
2. Kluckow M, Evans N. Low superior vena cava flow and intraventricular haemorrhage in preterm infants. Arch Dis Child Fetal Neonatal Ed. 2000;82:F188–94.
3. Osborn DA, Evans N, Kluckow M, Bowen JR, Rieger I. Low superior vena cava flow and effect of inotropes on neurodevelopment to 3 years in preterm infants. Pediatrics. 2007;120:372–80.
4. Froysaker T, Cappelen C. Flow pattern in central and peripheral human veins. A pilot study. Scand J Thorac Cardiovasc Surg. 1970;4:262–6.
5. Gindea AJ, Slater J, Kronzon I. Doppler echocardiographic flow velocity measurements in the superior vena cava during the Valsalva manoeuvre in normal subjects. Am J Cardiol. 1990; 65:1387–91.