Discovery of left-sided superior vena cava during central venous catheterization

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Summary
We describe a 3-yr-old patient in whom a central venous catheter (CVC) was inadvertently inserted into a persistent left superior vena cava (PLSVC). This congenital anomaly was diagnosed using transthoracic echocardiography. The aetiology and the implications for the anaesthetist are discussed. (Br. J. Anaesth. 1998; 81: 260–261)

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Detailed anatomical knowledge of the great vessels of the neck and thorax is a pre-requisite for safe anaesthetic and intensive care practice. Whilst all anaesthetists are familiar with the clinical anatomy and radiological appearances in the normal patient, few are familiar with the commonest anomaly of the venous circulation—persistent left superior vena cava (PLSVC).1 2

We report a patient who underwent uneventful placement of a CVC via the left external jugular vein which produced an unusual, but previously described,3 appearance on routine post-procedural chest radiograph. Using transthoracic echocardiography the CVC was seen to lie in a hitherto undiagnosed PLSVC.

Case report
A 3-yr-old boy presented to the emergency department having suffered a non-accidental scalding injury. He suffered full thickness scalds affecting both legs, buttocks and hands. There was no other trauma.

He was admitted to the regional paediatric burns unit where, despite all appropriate measures, on the third day he developed systemic sepsis. The patient was admitted to the paediatric intensive care unit (PICU) where, despite aggressive resuscitation, his condition deteriorated. He required inotropic support of his circulation and his lungs were artificially ventilated with oxygen using high frequency oscillation. He developed a clotting defect consistent with disseminated intravascular coagulation.

On day 5, he needed additional venous access. All the channels of the multi-lumen femoral venous line were already in use. The only available site for venous access was his neck. In view of the coagulopathy and the thrombocytopenia (platelet count $17 \times 10^9$ litre$^{-1}$), central venous access was obtained aseptically via his left external jugular vein. This was accomplished uneventfully, other than for some slight resistance initially impeding full insertion of the CVC, which was presumed to represent the point at which the left internal jugular vein passes medially to join the right internal jugular vein. However, routine post-procedural chest x-ray showed that the CVC followed a left para-mediastinal course from the left neck (fig. 1).

The transduced waveform was compatible with placement of the tip in an intrathoracic vein. Blood-gas samples drawn freely from the CVC and femoral venous catheter were indistinguishable and were different from a contemporaneous femoral arterial sample. Although we had excluded extravascular and arterial placement, we were still unsure as to its precise location. We were reluctant to remove the catheter because of the coagulopathy and alternative sites were scarce. A two dimensional transthoracic echocardiogram demonstrated the CVC line in the PLSVC, with the tip lying at the coronary sinus. The heart and great vessels were otherwise structurally unremarkable and the right SVC was present. The
CVC was retracted 2.5 cm in order to avoid complications related to irritation of the coronary sinus.\textsuperscript{5} The catheter was then used uneventfully for TPN administration for the next six days. Removal was not difficult. The child made a full recovery from the episode of septic shock but did require amputation of his non-viable left hand secondary to scald-induced dry gangrene. There was no evidence of impaired venous drainage of the left upper limb.

Discussion

Persistent left superior vena cava is the commonest anomaly of the venous circulation with an incidence of 0.3\% in healthy patients and 4.3\% in those with congenital heart disease.\textsuperscript{1,2,3} It is most frequently associated with ASD, cor triatriatum and mitral atresia. John Marshall gave the first embryological explanation for PLSVC in 1850.\textsuperscript{6} The right SVC enters the right atrium on its superior aspect. The left SVC drains into the left portion of the sinus venosum or coronary sinus. The lumen of the left SVC is usually obliterated in late embryonic life because of compression between the left atrium and the hilum of the left lung. Reduction of these compressive forces—as occurs in the three anomalies with which the condition is associated—leads to persistent patency of the vessel.\textsuperscript{7}

In excess of 80\% of PLSVCs co-exist with a right SVC\textsuperscript{8} and as most central catheters are placed on the right this probably explains why the anomaly is so rarely reported. Ninety-two per cent of PLSVCs drain into the coronary sinus and thence into the right atrium.\textsuperscript{8} In this circumstance, the coronary sinus is usually large because of the increased blood flow through it. The remainder drain into the left atrium and so create a right-to-left shunt.\textsuperscript{9} This variant presents the greatest potential hazard for CVC placement, as a cannula in the PLSVC would then give rise to a danger of systemic embolization of air or thrombus.

There are seldom any clinical signs or symptoms of a PLSVC but Cha and Khoury\textsuperscript{10} claim the diagnosis is suggested by features on plain x-ray, such as widening of the aortic shadow, para-median bulging and a para-median strip or crescent along the left heart border. However, these appearances are inconsistent and were not seen in the AP mobile film taken of this patient. Rare cases of PLSVC draining into the left atrium have caused unexplained cyanosis or clubbing.\textsuperscript{11} Various problems have been encountered in patients with PLSVC. Manipulation of a CVC in or through the narrow coronary sinus may be difficult and occasionally fraught: manipulation of the coronary sinus has resulted in hypotension, angina and cardiac arrest.\textsuperscript{12} The abnormality can also make difficult an attempt to place a pulmonary artery catheter or pacemaker lead into the pulmonary artery or right ventricle respectively, because of the orientation of the coronary sinus. There may be a higher incidence of arrhythmias in these patients.\textsuperscript{13} The radiographic appearances produced by insertion of a CVC into a PLSVC may be mistaken for arterial placement, location outside the central venous circulation or an entirely extravascular site.

Diagnosis of arterial placement is made with pressure waveform and blood-gas analysis and is not difficult. In contrast, exact localization of a proven intravenous catheter requires echocardiography. We used 2-D transthoracic echocardiography (TTE) and readily identified all the relevant anatomy, but other authors\textsuperscript{14} have highlighted the superiority of contrast transoesophageal echocardiography in patients with a high transthoracic acoustic appearance and/or in mechanically ventilated patients. bedside echocardiography is safer and more convenient than line-venogram as it is non-invasive and will not cause further haemodynamic instability in a sick patient. This method also excludes the possibility of dextrocardia.

We therefore recommend echocardiographic examination of a CVC whose precise location is not obvious on routine chest x-ray. This examination allowed us to continue to safely use a CVC placed in a PLSVC and avoid the potential complications of removing the catheter or of producing damage to the coronary sinus. The possible existence of a PLSVC should be considered in a patient where particular resistance to insertion of a CVC is noted when using the left jugular route.

References

6. Marshall J. On the development of the great anterior veins in man and mammalia, including an account of certain remnants of fetal structure found in the adult, a comparative view of these great veins in the different mammalia and an analysis of their occasional peculiarities in the human subject. \textit{Philosophical Transactions of the Royal Society of London} 1850; 140: 133–154.
9. Wiles HR. Two cases of left superior vena cava draining directly to a left atrium with a normal coronary sinus. \textit{British Heart Journal} 1991; 65: 158–160.