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Case study

A rare case of Double Superior Vena Cava, diagnosed after Central Line placement, in a poly-trauma patient

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ABSTRACT

Health professionals involved in invasive procedures such as central venous catheter placement should have a thorough knowledge of thoracic vascular anatomy. Various developmental anomalies of the large intra-thoracic veins can be incidentally discovered in normal adults. Amongst these congenital anomalies is a duplication of superior vena cava (SVC), which results from failure of the left superior cardinal vein to obliterate. Awareness about this anomaly and its variations is important to help overcome challenges in procedures, as well as avoid complications. In this article, we present a case of incidentally diagnosed double-SVC in an adult polytrauma patient after central line insertion in the Trauma Intensive care Unit.

Keywords: Case report, double Superior Vena Cava, persistent left superior vena cava

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INTRODUCTION

Duplication of the superior vena cava (SVC), involving a persistent left SVC, is a rare anomaly, estimated to exist in 0.3-0.5% of the general population, and 3-10% of patients with other forms of congenital heart disease[1,2]. The majority of cases are asymptomatic and diagnosed incidentally. However, this anomaly may present difficulties during cardiac pacemaker implantation, radiofrequency catheter ablation, and the internal jugular or subclavian vein catheter insertion, including diagnostic dilemmas as to perceived access or positioning of catheters[3,4,5]. Moreover, double SVC is surgically important in the presence of congenital heart disease. In this article, a case of an adult poly-trauma patient, in whom a double SVC with persistent left SVC (PLSVC) was incidentally diagnosed during central venous catheter (CVC) placement, is presented.

CASE REPRESENTATION

A 24-year-old male patient, with no past medical history, sustained multiple injuries due to a fall from an unknown height. He was hypotensive and tachycardic at the scene, and a right-sided needle decompression of the chest was performed by EMS for suspected tension pneumothorax. In the Trauma room (TRU), the patient was intubated, a right-sided chest tube was inserted, and a FAST study was performed, revealing free intra-abdominal fluid.

The patient was taken to the operative theater, where a damage control laparotomy was performed to control bleeding and contamination. A small bowel resection (distal jejunum, for mesenteric injury with bowel ischemia) without anastomosis, and liver packing (for multiple lacerations) was performed. The abdomen was kept open, and he was admitted to the trauma intensive care unit (TICU) post-operatively. He subsequently underwent a second-look laparotomy for the removal of the packs and bowel anastomosis, and the abdomen was closed.

In the TICU, Central venous access was required for inotropic support, and the right subclavian vein was cannulated with a 7.5 French triple lumen catheter under ultrasound guidance. The procedure was uneventful, and a Chest X-Ray was performed to confirm the position of the CVC (Figure 1a).

On day 17, the patient became febrile and showed laboratory signs of sepsis. Because of CVC-related sepsis as a potential cause, the decision was made to remove the right CVC and insert a new central line, this time using the left subclavian vein as access.

The left subclavian vein was cannulated with a 7.5 French triple lumen catheter under a landmark approach. The procedure was uneventful; the vein was found on the first pass, and there was no resistance to guidewire or catheter advancement. There was also good forward and backflow from the catheter. A post-procedure chest X-Ray was performed to verify the position of the CVC (Figure 1b).

Because of the uncertainty of the position of the CVC, a paired blood sample was obtained from both the most distal port of the triple lumen catheter, as well as a peripheral vein. Blood gas analysis of these samples found that both samples had identical PO2, indicating the venous location of the CVC (ie: not arterial). The waveform was also suggestive of the Central Venous position.

The initial admission CT scan of the chest done (including 3D reconstructions) were then re-reviewed, focusing on the upper thoracic venous anatomy, and it revealed the presence of a double SVC, with the left CVC in a persistent left SVC (Figures 2,3).

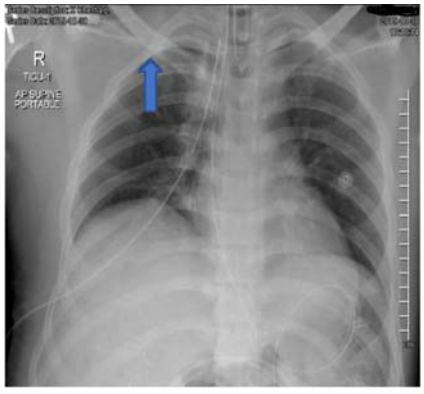

Figure 1a. Portable chest radiograph showing a central line inserted in the right subclavian vein (blue arrow) with final position in the (normal right-sided) SVC.

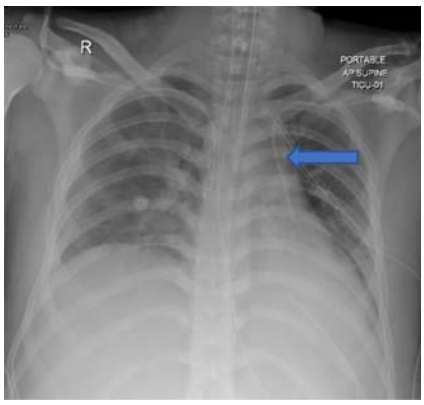

Figure 1b. Portable chest radiograph showing a central line inserted in the left subclavian vein, with the catheter located in a left para-mediastinal position.

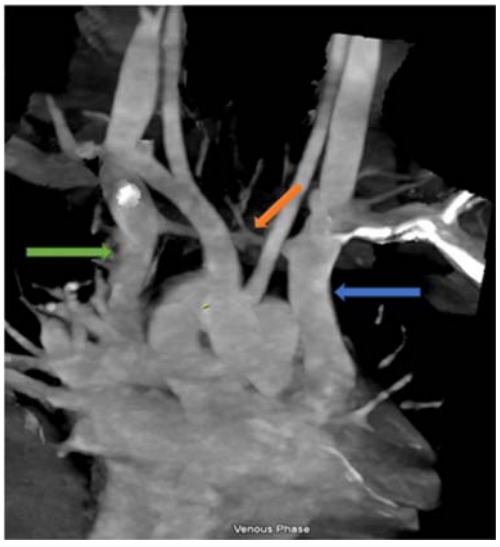

Figure 2. CT MIP (maximum intensity projection) image demonstrating the right SVC (green arrow), the left brachiocephalic vein (orange arrow), and the left SVC (blue arrow).

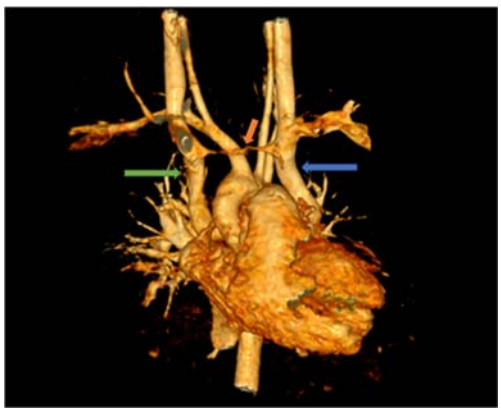

Figure 3. 3D VRT (Volume rendering) image demonstrating the right SVC (green arrow), the left brachiocephalic vein (orange arrow), and the left SVC (blue arrow).

The vascular surgeon and radiologist were consulted. Double SVC was confirmed by both, and no other cardiac or extra-cardiac anomalies were identified by the radiologist.

It was decided not to remove the CVC, and continue to use it (for inotropes and TPN) given its position in a left SVC that was draining into the right venous return system. The CVC was removed after 8 days post-insertion. No complications occurred during the removal of the CVC.

Throughout the remainder of his TICU stay, the patient developed complications of abdominal and pelvic collections, as well as a wound infection. These were managed with antibiotics, drainage, and a Vacuum-Assisted Wound Closure dressing. He was transferred to the Trauma ward in stable condition and eventually discharged home. The patient has been seen in outpatient follow-up for 8 months and is asymptomatic from a cardiovascular point of view and free from complications from the CVC insertion.

DISCUSSIONS

One of the uncommon, yet important, complications of CVC placement is the mal-positioning of the tip of the CVC in a vessel other than the (normally right-sided) superior vena cava (SVC). Mal-positioning has been described in approximately 7% of cases of neck/thoracic CVC placement in the literature[1]. Mal-positioning of a CVC can usually be attributed to variations in thoracic venous anatomy. Although very rare, these variations include vein tributaries with low-resistance routes that lead to 'misdirection' of the catheter tip. Congenital variations are usually discovered incidentally on imaging after CVC placement[1,2]. Although these variations are usually asymptomatic, they can make the radiologic location of the CVC tip difficult to discriminate.

Among congenital variations, the most common is the presence of an isolated persistent left-sided SVC, or PLSVC[1]. Double SVC, with a normal right and abnormal PLSVC, is rarely encountered. The incidence in the general population has been documented by many authors to be less than 0.5 %[3]. The incidence may reach up to 12% in patients with other forms of congenital heart disease[2]. The true incidence of PLSVC may be underestimated because of the failure to identify the anomaly in asymptomatic patients and those with no associated cardiac abnormalities.

A PLSVC results from the failure of regression of the left anterior cardinal vein. This may occur with or without a rudimentary left innominate vein as a communication between the two SVC's. There are four variants of SVC: single right-sided SVC draining into the right atrium (normal), double SVC with right and left SVC emptying into the right atrium (as was the case in our patient), double SVC with each emptying into the ipsilateral atria, and single PLSVC emptying into the left atrium (the latter two being extremely rare but are more prone to complications). 92% of left-sided SVC's drain into the right atrium (usually via the coronary sinus), with the remainder draining directly into the left atrium. The left atrium drainage pattern represents a right–to–left shunt. They are usually asymptomatic; however, they may lead to cyanosis and right heart failure, or paradoxical systemic embolization[2–5].

In patients who have suspected anomalies (based on clinical or CXRay suspicion), diagnosis can be confirmed with CT of the chest with contrast or transthoracic echocardiography[2,4].

Double SVC (draining into the right atrium) is usually discovered incidentally and the patient will usually have no clinical signs, as was seen in our patient. Apart from causing diagnostic dilemmas during CVC insertions, double SVC may impact (challenges and complications) on procedures that require upper body central venous access, such as cardiac pacemaker implantation (temporary or permanent), implantable defibrillator placement, and radio-frequency catheter ablation. CVC insertion may result in unusual catheter positions, with subsequent inadvertent cardiac perforation. Ineffective retrograde cardioplegia may occur during cannulation of the heart for cardiopulmonary bypass, and thus may demand modification of surgical technique for cardiac surgery with extracorporeal circulation, during which the PLSVC should be cannulated separately.

Isolated left SVC has been associated with an increased risk of arrhythmias, most commonly atrial fibrillation because of abnormalities to the atrioventricular node and the bundle of His. When left SVC is encountered, there should be an investigation of other possible associated congenital defects. Cardiac anomalies include atrial and ventricular septal defects, endocardial cushion defects, tetralogy of Fallot, and Cor Triatriatum. The most frequently associated extra-cardiac anomaly is esophageal atresia[2,3]. In our patient, investigations revealed neither cardiac nor extra-cardiac anomalies.

CONCLUSIONS

Anomalies of the superior vena cava are rare, but when present, are frequently identified as incidental findings during/after CVC insertions, cross-sectional imaging, and echocardiography, and are

occasionally associated with important clinical sequelae. When encountered there should be an investigation of other possible congenital defects. A double SVC may make it difficult for the internal jugular or subclavian venous catheterization, radiofrequency ablation, pacemaker and defibrillator insertion, or coronary artery bypass graft surgery. Drainage of PLSVC into the left atrium also results in a right to left shunt. It is critical to fully characterize the pattern of cardiac venous return in any patient suspected of PLSVC before initiation of use of their central venous access device. Physicians should consider the presence of PLSVC whenever a catheter or guidewire inserted via the left subclavian vein takes an unusual left-sided downward course.

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