Paradoxical Electrocardiographic Rhythm During Peripherally Inserted Central Catheter Insertion from Persistent Left Superior Vena Cava

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Abstract

Introduction: *A persistent left superior vena cava is one of the most common thoracic vascular anomalies, present in approximately 0.5% of the general population. The most common presentation is both a right and left superior vena cava, communicating through an innominate vein. In rare cases, complete absence of a right sided superior vena cava may have dispersion of pacemaker and conduction tissue leading to abnormal electrocardiography readings.*

Case Description: *This case report describes the insertion of a peripherally inserted central catheter via the right basilic vein utilising ultrasound and electrocardiographic guidance during which atypical P-waves were noted. Post procedure chest x-ray found the catheter to be positioned to the left side of the chest.*

Discussion and Evaluation: *Initial management was to assess whether the catheter was placed in the arterial system. Catheter transduction and blood gas analysis demonstrated the peripherally inserted central catheter was situated in the venous system. Computer tomography was then used to assess the patient's vasculature, demonstrating a persistent left vena cava with absence of a right vena cava.*

Conclusion: *This case describes the successful placement of a right basilic peripherally inserted central catheter in a patient with a persistent left vena cava with an absent right superior vena cave using ultrasound and electrocardiographic guidance.*

Keywords: *Persistent left superior vena cava, vena cava, peripherally inserted central catheter*

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Introduction

The insertion and use of central venous access devices (CVADs) has become the mainstay for patients requiring extended intravenous therapy in a variety of clinical settings. In particular, the insertion of peripherally inserted central catheters (PICCs) has grown substantially in recent years.[1,2] As a result, the incidental identification of venous anomalies during catheter placement has also increased.[3-6]

One of the most common vascular anomalies of the thorax is a persistent left superior vena cava (PLSVC), present in approximately 0.5% of the general population with a higher prevalence in patients with known congenital heart abnormalities.[7,8] A PLSVC occurs in multiple forms with the most common variation being the presence of both a left and right superior vena cava (SVC) with a communicating innominate vein.[9]

A more rare presentation is the absence of a right SVC where a sole SVC drains directly into the right atrium via the coronary sinus or into the left atrium resulting in a right-to-left shunt.[10]

Electrocardiography (ECG)-guided CVAD placement is frequently used to provide real-time, accurate tip confirmation during an insertion procedure. The ECG-guided method for tip location relies on the identification and changing amplitude of a patient's P wave by using the catheter as an intravascular electrode.[11] This is accomplished by either injecting a column of ionic solution such as saline into the catheter, or by inserting a metal guide wire into the catheter and attaching the system to an ECG readout device. As the catheter moves within the vessel the changing amplitude of the P-wave provides directional and positional information about the catheter tip.[12]

Under normal conditions, as a catheter travels toward the right atrium, the amplitude of the P wave increases above the isoelectric line providing an exaggerated, positive P wave deflection; however, anomalies in the thoracic vascular anatomy involving nodal conductive tissue may affect intracavitary P wave amplitude changes on CVAD insertion.[11-13] We present a case of a PICC placement in which paradoxical P wave amplitude changes were noted and attributed to atypical thoracic vasculature.

Case Presentation

A 33-year-old man with a history of recent anterior resection, stricturoplasty, and division of adhesions for recurrent small bowel obstruction secondary to Crohn's disease was referred to the Liverpool Hospital Central Venous Access Service. The patient required the placement of a double-lumen PICC for the administration of total parenteral nutrition to provide ongoing nutritional support.

The left basilic vein was chosen for cannulation after vascular assessment and the PICC was placed using maximal barrier precautions, aseptic technique, and with ultrasound and ECG guidance. During the insertion procedure, a negative P wave in relation to the isoelectric line was noted and was persistently more negative as the catheter was advanced (Figure 1). Normally, this would signal that the catheter was directing away from the SA node; however, ultrasound scanning of the left internal jugular vein found no evidence of the catheter. After manipulation of the catheter, an aberrant pathway was suspected and the PICC was removed.

A new double-lumen PICC was then placed using the right basilic vein under full barrier precautions, aseptic technique with ultrasound, and ECG guidance. A negative P wave in relation to the isoelectric line was again identified. Scanning of the patient's right internal jugular vein found no evidence of the catheter. The catheter was left in place and a chest radiograph was ordered. The postprocedure radiograph demonstrated an aberrant passage of the PICC, crossing the midline on the radiographic image and descending down the left side of the mediastinum (Figure 2)

Initially, catheter placement in the arterial system was suspected; however, pressure transduction of the catheter and blood gas analysis confirmed venous placement. Computed tomography was performed demonstrating a PLSVC with the absence of the right SVC. The left SVC was found to drain into the coronary sinus (posterior and inferior) of the heart (Figure 3).

Discussion

The finding of an absent right vena cava is uncommon, occurring in approximately 10% of patients presenting with a PLSVC.[14] The most common variation is a PLSVC accompanied by a right SVC that is bridged by an innominate vein, occurring in approximately 0.5% of the general population and up to 12% of patients with known congenital abnormalities.[14]

A PLSVC is an aberrant development of the primitive heart vessels in the first few weeks of embryonic development and is typically associated with other congenital cardiac abnormalities such as atrial and/or ventricular septal defects that may include abnormal distribution and connection of pulmonary veins.[15] The PLSVC is a result of failure of the left cardinal

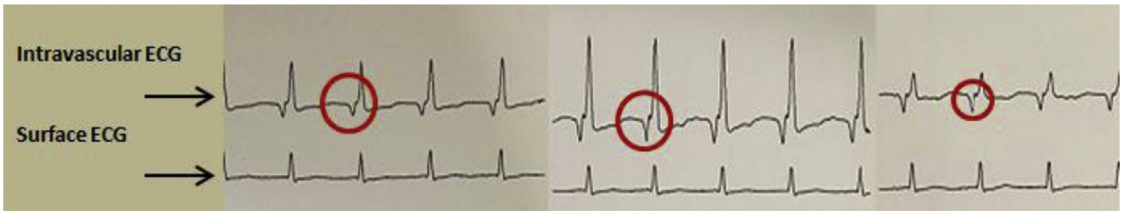

Figure 1. **Catheter insertion illustrating negative P – wave deflection on intravascular ECG trace.**