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Pericardial Tamponade Caused by Perforation of Marshall Vein During Left Jugular Central Venous Catheterization

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Patient: Female, 62
Final Diagnosis: Persistent vein of Marshall
Symptoms: Chest discomfort
Medication: —
Clinical Procedure: —
Specialty: Cardiology

Objective: Congenital defects/diseases

Background: The persistence of a vein of Marshall (VoM) from the left subclavian vein to the coronary sinus is a rare cardiac anomaly known as a persistent left superior vena cava (PLVC). This anatomical variant is usually asymptomatic but can lead to serious complications during catheterization via the left subclavian or internal jugular vein, as described here. In our case, the patent vein of Marshall directly connected the coronary sinus with the left subclavian vein discovered in a cardiac arrest patient because of pericardial effusion during the insertion of a central venous catheter (CVC).

Case Report: A 62-year-old patient required a central line insertion through a left internal jugular vein. The patient immediately went into cardiac arrest after CVC insertion with a pericardial effusion. The patient was successfully resuscitated with the drainage of a pericardial effusion. A chest X-ray revealed that the central venous catheter (CVC) was located along the left border of the mediastinum rather than the right border. It was evident that the central venous catheter was inadvertently placed into the pericardial space, resulting in tamponade. This complication occurred through inadvertent access of a small persistent vein of Marshall.

Conclusions: This case illustrates the importance of knowledge of anatomical variants of the persistent vein of Marshall to prevent or correctly interpret and manage procedural complications.

MeSH Keywords: Cardiac Tamponade • Catheterization, Central Venous • Jugular Veins

Full-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/909005>



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Background

Central venous catheters are routinely used in Intensive Care Units and are often inserted via the jugular or subclavian veins. Pericardial tamponade, although rare, can occur during central venous catheterization, requiring emergent drainage. This happens in the majority of cases in the absence of abnormal venous anatomy, but cardiac catheterization from the left internal jugular vein because of anomalous venous connections can in rare cases lead to the perforation of the vein of Marshall [1–3]. The vein of Marshall is an embryonic remnant from the left superior vena cava that typically degenerates into a ligamentous structure known as Marshall's ligament. However, the vein of Marshall can sometimes persist either as a small vein, as demonstrated here, or, more often, as a larger vein (persistent left superior vena cava PLSVC), and drains in the coronary sinus [4]. In the case reported here, the perforation of a small persistent vein of Marshall was complicated by a pericardial effusion and tamponade.

Case Report

A 62-year-old woman was referred to our institution for further work-up following resuscitation for cardiac arrest. This cardiac arrest occurred at a satellite facility during the placement of a central venous catheter via left internal jugular venous access. On chest X-ray, the course of the catheter was not conventional (Figure 1), and a CT scan identified the catheter to be in the mediastinum near the pericardium, with a pericardial effusion.

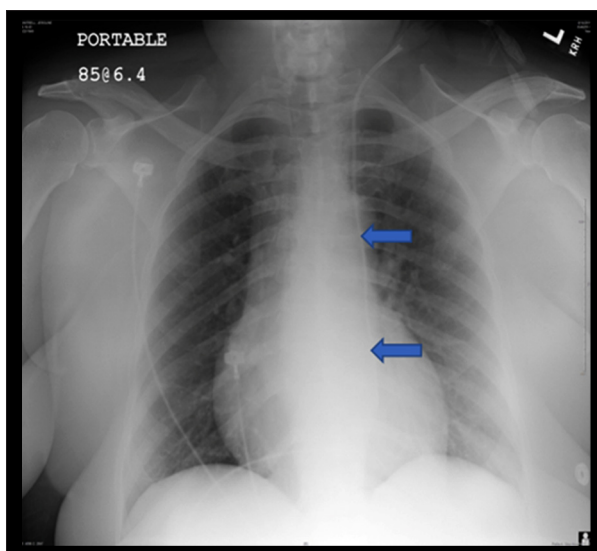


Figure 1. Chest X-ray showing the course of the central venous catheter (arrows) from the left internal jugular insertion site. The catheter remains on the left of the spine in the vein of Marshall instead of going to the right in the superior vena cava.

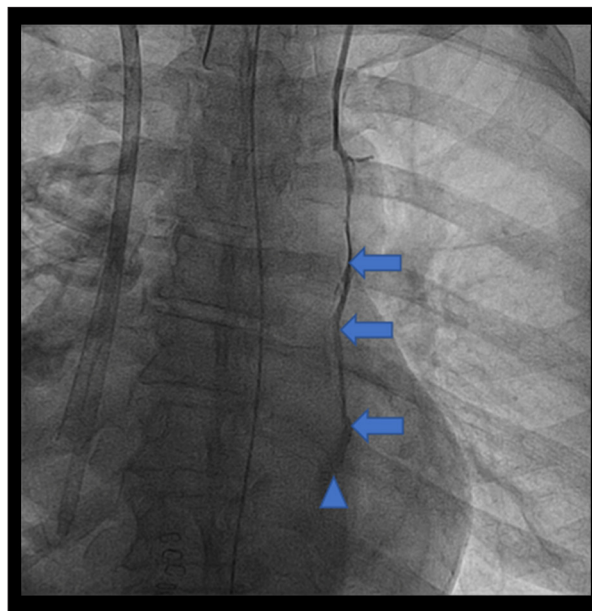


Figure 2. Contrast injection of the remnant vein of Marshall (arrows) with a multipurpose catheter showing filling into the coronary sinus (triangle).

Removal of the catheter under observation with transesophageal echocardiography increased the pericardial effusion with hypotension, suggestive of pericardial tamponade. The patient was finally successfully stabilized by surgical drainage via a pericardial window and 250 cc of blood was removed.

When attempting to explore further the venous system anatomy utilized for access, we found a direct venous connection between the subclavian vein and the coronary sinus (CS), with what appeared to be a very well-developed vein of Marshall (Figure 2). We were able to demonstrate this connection by the advancement of a Terumo Glidewire into the right heart through the anomalous vein via the coronary sinus (Figure 3). The initial cardiac arrest was likely precipitated by pericardial tamponade initially caused by inadvertent advancement of the catheter into the vein of Marshall, which perforated before the junction with the coronary sinus.

Discussion

A rare but potentially fatal complication of central venous catheter placement is the occurrence of pericardial effusion with potential cardiac tamponade with a highly variable incidence ranging from 0.0001% to 0.14% [5]. This complication is often due to an incorrect catheter tip position, most commonly due to a perforation of the right atrium and ventricle. Veins such as the coronary sinus can also be perforated and lead to cardiac effusion in the absence of any structural abnormality in the cardiovascular system. More rarely, cardiac effusions

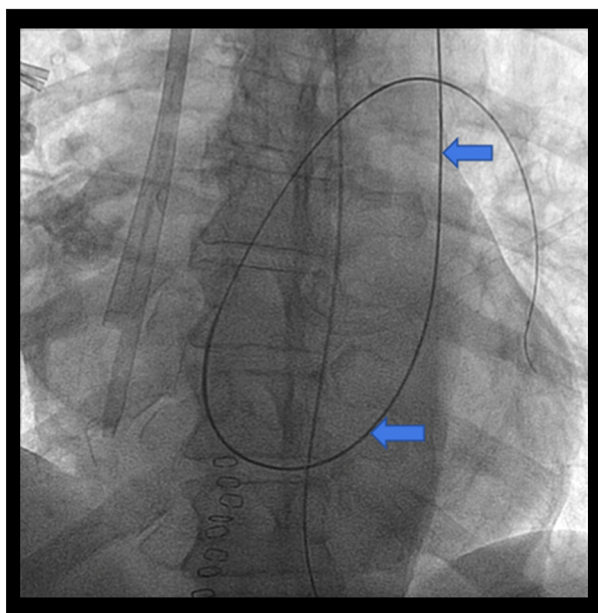


Figure 3. Wire placement demonstrating connection (arrows) from the left subclavian vein through the remnant vein of Marshall in continuity with the coronary sinus.

occur in the presence of venous anatomical variations, which is well known by intensivists, invasive cardiologists, and cardiac electrophysiologists, as they create a challenge for catheter placement or lead placement [6].

If not known prior to the placement of a central line, such venous anatomical variations can be recognized during the venous access. On chest X-rays, the expected normal course of any catheter is along the right border of the mediastinum. A course outside this pattern during central venous access raises the suspicion of either intraarterial insertion, extravasation, or insertion into tributaries of a brachiocephalic vein [7–9]. It can also be related to anomalous development of the thoracic venous

system itself. Embryos have a pair of symmetrical anterior cardinal veins draining into common cardinal veins. At about the 8th week of embryonic development, the brachiocephalic vein develops, connecting the right and left anterior cardinal veins. Part of the common cardinal vein along with anterior cardinal vein develops into the superior vena cava (SVC). The right SVC persists, but the distal lumen of the left SVC obliterates and becomes a ligamentous structure known as Marshall's ligament. The proximal portion of the left SVC persists as a very small vein running posteroinferiorly along the left atrial wall and drains into the coronary sinus, guarded by the valve of Vieussens. In the case of a persistent left superior vena cava (PLSVC), this whole channel remains patent with a few variants of this condition [4]. The vein of Marshall (VoM) is more commonly known in the realm of electrophysiology as it is believed to contain nerves that may be responsible for triggers of atrial fibrillation [10].

Non-recognition of venous abnormalities can lead to unexpected cannulation of a vein such as the vein of Marshall, complicated by significant pericardial effusion and tamponade. In such cases, the cannulation of right central veins would probably have prevented such a complication. However, our review of the literature did not show more complications in left subclavian or internal jugular central venous access versus similar accesses on the right side, even though there are no specific reports focused on pericardial effusion [11–13].

Conclusions

We managed a rare case of cardiac tamponade during a left central catheterization through the perforation of an asymptomatic and isolated persistent vein of Marshall. This rare abnormality should be suspected during a left central venous access when the catheter has an abnormal course that does not follow the classic course along the right superior vena cava.

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