

การพบการคงอยู่ของภาวะหลอดเลือดดำเวนาคาวาซ้ายระหว่างการใส่สายสวนหลอดเลือดดำส่วนกลาง ในผู้ป่วยไตวายเฉียบพลันที่ได้รับการบำบัดทดแทนไตแบบต่อเนื่อง

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บทคัดย่อ

Persistent Left Superior Vena Cava (PLSVC) เป็นความผิดปกติทางกายวิภาคของระบบหลอดเลือดดำที่พบได้ไม่บ่อย โดยมีความชุกประมาณร้อยละ 0.3-0.5 ของประชากรทั่วไป และพบได้สูงขึ้นในผู้ป่วยโรคหัวใจพิการแต่กำเนิด ภาวะนี้มักไม่มีอาการทางคลินิก และมักถูกตรวจพบโดยบังเอิญจากการตรวจรังสีวินิจฉัยหรือหัตถการที่เกี่ยวข้องกับระบบหัวใจและหลอดเลือด อย่างไรก็ตาม PLSVC อาจเป็นอุปสรรค หรือก่อให้เกิดภาวะแทรกซ้อนในหัตถการบางชนิด เช่น การใส่สาย central venous catheter การฝังเครื่องกระตุ้นหัวใจถาวร หรือการผ่าตัดหัวใจ บทความนี้ทำการรายงานกรณีศึกษา และบททบทวนวรรณกรรมเกี่ยวกับผู้ป่วยที่มีประวัติติดเชื้อไscrub typhus) ร่วมกับภาวะเลือดออกในปอด และภาวะไตวายเฉียบพลัน ต้องได้รับการใส่สาย double lumen catheter และบำบัดทดแทนไตแบบต่อเนื่อง (continuous renal replacement therapy: CRRT) ระหว่างการใส่สายตรวจพบโดยบังเอิญว่าผู้ป่วยมี PLSVC ซึ่งเป็นความผิดปกติที่พบได้ไม่บ่อย รายงานนี้สะท้อนถึงความสำคัญของการตระหนักถึงภาวะ PLSVC ในผู้ป่วยวิกฤต เนื่องจากอาจส่งผลกระทบต่อวางแผนการรักษา การทำหัตถการ และการป้องกันภาวะแทรกซ้อนที่อาจเกิดขึ้น

คำสำคัญ: การคงอยู่ของภาวะหลอดเลือดดำเวนาคาวาซ้าย; ไตวายเฉียบพลัน; ฟอกเลือดแบบต่อเนื่อง

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Persistent left superior vena cava detected during central venous catheterization for continuous renal replacement therapy in acute kidney injury: A case report

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Abstract

Persistent left superior vena cava (PLSVC) is an uncommon anatomical anomaly of the venous system with a prevalence of approximately 0.3%-0.5% in the general population and a higher incidence in patients with congenital heart disease. This condition is usually asymptomatic and often discovered incidentally during imaging studies or cardiovascular procedures. However, PLSVC may pose challenges or lead to complications in certain interventions, such as central venous catheter insertion, permanent pacemaker implantation, or cardiac surgery. This case report and review of the literature concerns a patient with a history of scrub typhus complicated by pulmonary hemorrhage and acute kidney injury, who required insertion of a double-lumen catheter and continuous renal replacement therapy. During catheter placement, a PLSVC was incidentally identified, highlighting a rare but clinically relevant finding. This report underscores the importance of PLSVC awareness in critically ill patients, as its presence may have implications for treatment planning, procedural safety, and the prevention of potential complications.

Keywords: persistent left superior vena cava; acute kidney injury; continuous renal replacement therapy

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Introduction

Persistent left superior vena cava (PLSVC) is the most common congenital anomaly of the thoracic venous system, frequently detected incidentally during imaging or cardiovascular procedures. Although usually asymptomatic, its presence becomes clinically important during central venous catheterization or other invasive cardiovascular interventions, where unusual venous anatomy may lead to technical difficulties or unexpected catheter pathways^{1,2}. PLSVC has a prevalence of approximately 0.3%-0.5% in the general population but may occur in up to 10% of patients with congenital heart disease^{1,3,4}.

PLSVC develops due to incomplete regression of the left anterior cardinal vein during embryologic development (Figure 1). Typically, PLSVC originates from the confluence of the left internal jugular vein and the left subclavian vein, runs along the aortic arch, and drains into the coronary sinus (CS) before reaching the right atrium (RA). In approximately 10%-20% of cases, PLSVC drains directly into the left atrium (LA), resulting in a right-to-left shunt (Figure 2), which may cause cyanosis and paradoxical embolism^{1,5,6}.

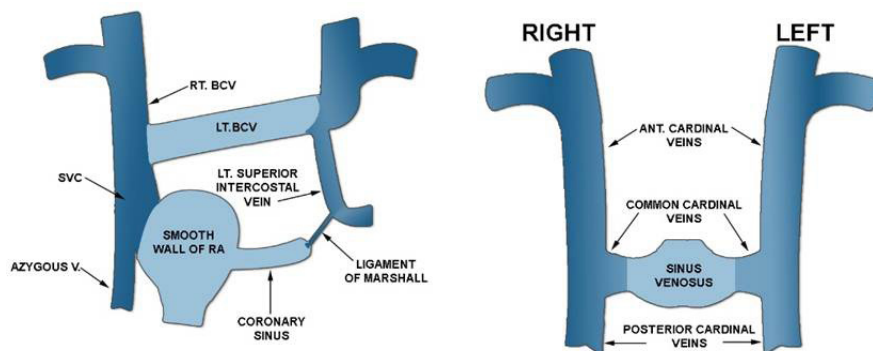


Figure 1 Embryological development of the superior vena cava. (SVC, superior vena cava; BCV, brachiocephalic vein; RA, right atrium.)

The right and left anterior cardinal veins drain blood from the cranial portion of the embryo in the early embryonic stage. These veins join the common cardinal veins before entering the sinus venosus. Normally, the left common cardinal vein and most of the left anterior cardinal vein regress, leaving only a remnant known as the ligament of Marshall. Venous return from the left side of the head and upper extremity is then redirected through the left brachiocephalic vein (BCV) to the right side. The right anterior and right common cardinal veins persist and form the normal right-sided SVC⁷.

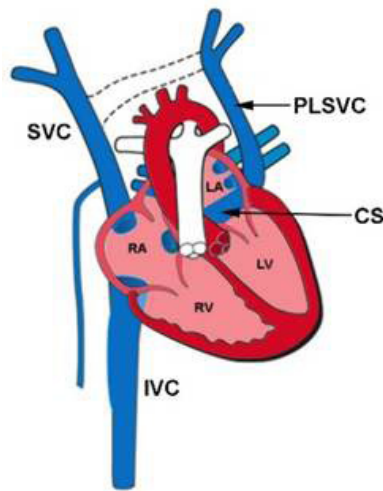


Figure 2 Schematic of a persistent left superior vena cava. (CS, coronary sinus; SVC, superior vena cava; IVC, inferior vena cava; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.) The PLSVC courses anteriorly and drains into the CS, resulting in CS dilatation. The right SVC and inferior vena cava also drain into the RA. Notably, the bridging vein or left brachiocephalic vein (depicted by dashed lines) is absent, which is a common finding in PLSVC⁸.

Most cases of PLSVC are asymptomatic. However, the anomaly becomes clinically relevant during cardiovascular interventions. A dilated CS on echocardiography is often the first clue. Agitated saline contrast injected into a left-sided vein can demonstrate early opacification of the CS. These findings inform further evaluation using advanced imaging modalities such as, transesophageal echocardiography (TEE) typically shows a dilated CS, multidetector CT, computed tomography angiography (CTA), and magnetic resonance venography (MRV) provide detailed anatomical information about the PLSVC^{1,2}. Approximately 80%-90% of PLSVCs drain into the RA via the CS without hemodynamic consequences, whereas approximately 10%-20% drain into the LA, directly or through an unroofed CS, creating a right-to-left shunt with critical clinical implications^{1,9}.

In situations where a PLSVC drains into the RA and no significant associated anomalies are detected, specific intervention is generally unnecessary. Awareness is crucial during vascular access because catheters may follow an atypical mediastinal course. In cases of left atrial drainage or significant right-to-left shunting, surgical or percutaneous closure may be considered. Long term follow up is generally unnecessary unless associated congenital anomalies are present¹⁰⁻¹².

This case report highlights the clinical relevance of PLSVC in critically ill patients requiring urgent vascular access and continuous renal replacement therapy. It emphasizes the importance of recognizing atypical catheter trajectories on chest imaging, the role of cross-sectional imaging in confirming venous anomalies when echocardiography is not

immediately available, and practical considerations for safe catheter use and timely procedural decision-making.

Case Report

A 23-year-old Thai male laborer with no underlying medical conditions presented with a 5-day history of fever, headache, myalgia, conjunctival injection, chest tightness, dyspnea, and hemoptysis following water exposure. This case report was approved by the Human Research Ethics Committee of Chumphon Khet Udomsakdi Hospital (CPH-EC-109/2568). Written informed consent was obtained from the patient for the use and publication of anonymized clinical data.

On admission, the patient was drowsy.

- Vital signs: BT 37°C, BP 75/45 mmHg, PR 113/min, RR 30/min, and SpO₂ 94% (on endotracheal tube, FiO₂ 1.0)

- HEENT: subconjunctival hemorrhage in both eyes

- Heart: regular rhythm, no murmur

- Chest: fresh blood per endotracheal tube, fine crepitations in both lungs

- Abdomen: no hepatosplenomegaly, soft, not tender

- Extremities: no pitting edema

- Skin: no petechiae or eschar

Laboratory findings

- CBC: Hb 10.8 g/dL, Hct 32.5%, WBC 800 cells/mm³, N 65%, L 27%, Platelet 13,000 cells/mm³

- Chemistry: BUN 46 mg/dL, Cr 2.81 mg/dL, eGFR 30.3 mL/min/1.73 m², Na 138 mmol/L, K 3.9 mmol/L, Cl 101 mmol/L, HCO₃ 25 mmol/L, Ca 7.2 mg/dL, PO₄ 4.43 mg/dL, Mg 1.6 mg/dL,

AST 120 U/L, ALT 74 U/L, ALP 367 U/L, TP 4.5 g/dL, Albumin 2.4 g/dL, TB 3.58 mg/dL, DB 3.51 mg/dL, Lactate 5.4 mmol/L

- Coagulogram: PT 14.9 seconds, INR 1.34

- Urinalysis: Yellow, pH 6.0, Specific gravity 1.024, albumin1+, WBC 1-2 cell/HPF, RBC 3-5 cell/HPF, blood negative, epithelium not found

- Scrub typhus Ab IgM: weakly positive, Leptospira Ab IgM negative

- Anti HIV: negative, Urine amphetamine: positive

- ABG: pH 7.09, pCO₂ 74 mmHg, pO₂ 90 mmHg, HCO₃ 23 mmol/L, PO₂/FiO₂ ratio 90.4 mmHg

- Chest radiography: bilateral reticulonodular infiltration (Figure 3)

- CTA chest is shown Figure 4

Diagnosis: scrub typhus complicated by pulmonary hemorrhage and septic shock. The patient was intubated, resuscitated, and started on vasopressors, and a central line was inserted via the right internal jugular vein. The patient subsequently developed refractory hyperkalemia, oliguria, and fluid overload secondary to acute kidney injury, necessitating urgent initiation of renal replacement therapy in the setting of ongoing hemodynamic instability. A double-lumen hemodialysis catheter was inserted via the left internal jugular vein under ultrasound guidance using standard sterile technique, as the right internal jugular vein was already occupied for vasopressor administration. Adequate blood flow was achieved, and the catheter functioned

appropriately without immediate procedural complications. Post-procedure chest radiography revealed an unexpected left-sided catheter trajectory. Continuous renal replacement therapy was initiated concurrently with further anatomical evaluation because the catheter functioned satisfactorily and the patient remained critically ill. Cross-sectional imaging subsequently confirmed the catheter tip within a persistent left superior vena cava draining into the coronary sinus. The hemodialysis

catheter remained functional throughout continuous renal replacement therapy without evidence of catheter-related complications. The patient's hemodynamic status gradually improved, renal function recovered, and renal replacement therapy was successfully discontinued. The patient was subsequently extubated and discharged in stable condition, with no clinical evidence of embolic or vascular complications related to the anomalous venous anatomy during hospitalization.

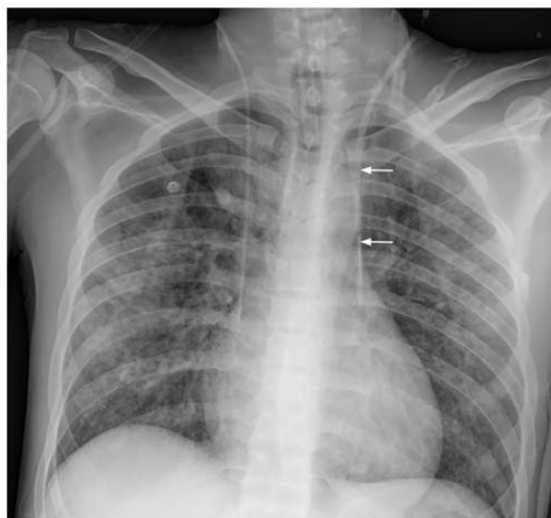


Figure 3 Chest radiography showing the atypical location of the left hemodialysis catheter along the lateral border of the left cardiac edge (arrow).



Figure 4 Computed tomography angiography (CTA) of the chest. (CT: Computed tomography.)

A: Axial CT image showing the tip of the left central venous catheter (arrow) located near the left atrial appendage. The vessel in which the catheter is located leads to the CS and drains into the RA.

B: Coronal reformatted CT image showing the left central venous catheter leading to the PLSVC (arrow) along the left edge of the mediastinum compared to the right central venous catheter along the SVC to the cavoatrial junction (asterisk).

C, D: Sagittal reformatted CT image and 3D volumetric rendering image showing the tip of the left central venous catheter leading to the PLSVC draining into the CS (arrow).

Discussion

The 23-year-old male presented with scrub typhus complicated by pulmonary hemorrhage and septic shock, later developing acute kidney injury that necessitated urgent renal replacement therapy. A PLSVC was incidentally identified during catheterization, consistent with previous reports in which an atypical left-sided catheter trajectory on chest radiography prompted the diagnosis during hemodialysis procedures.^{2,7} Recent case

literature likewise documents PLSVC initially suspected from a left mediastinal catheter silhouette after hemodialysis catheter insertion, with confirmation by echocardiography and computed tomography.^{11,12} The clinical impact of PLSVC is determined by its drainage patterns and associated anomalies. Most PLSVCs drain into the RA through the CS, generating no hemodynamic shunt but occasionally complicating device implantation or catheter manipulation^{1,7,13}.

In this case, post-procedure radiography demonstrated a catheter tracking along the left cardiac border, and computed tomographic angiography delineated the catheter within a PLSVC draining into the CS. This closely parallels experiences from dialysis-access case series in which imaging clarified safe positioning and mapped the venous route^{9,11,14,15}. A contextual nuance is the patient's critical illness. Literature on hemodialysis access suggests that temporary catheterization through a PLSVC may be feasible when drainage to the RA is adequate and no major anomalies are present, whereas variants with left-atrial drainage, small caliber, or tortuosity may underperform or require alternative access routes¹¹. Prompt identification of the anomalous course in this patient minimized unnecessary exchanges or manipulation and was consistent with procedural strategies recommended in prior reports.

This case illustrates that in critically ill patients requiring urgent vascular access, the incidental discovery of a PLSVC can directly influence procedural decision-making and the timeliness of essential therapy. The

patient's hemodynamic instability, diffuse pulmonary hemorrhage, and acute kidney injury required rapid initiation of renal replacement therapy, during which the anomalous venous course was first suggested by an unexpected left-sided catheter trajectory on chest radiography. In the absence of immediate echocardiography, a limitation common in many hospitals, computed tomography provided the anatomical clarity necessary to ensure correct catheter positioning and to avoid delays or unnecessary manipulation.¹² This experience underscores the importance of considering venous anomalies when catheter advancement deviates from the anticipated course, as timely recognition can reduce complications and preserve access to life saving interventions. Heightened diagnostic vigilance in such scenarios may therefore enhance procedural safety and support the timely delivery of critical therapy^{1,2}. To facilitate practical clinical decision-making, a simplified evaluation algorithm for an unexpected left-sided catheter trajectory is proposed (Figure 5)

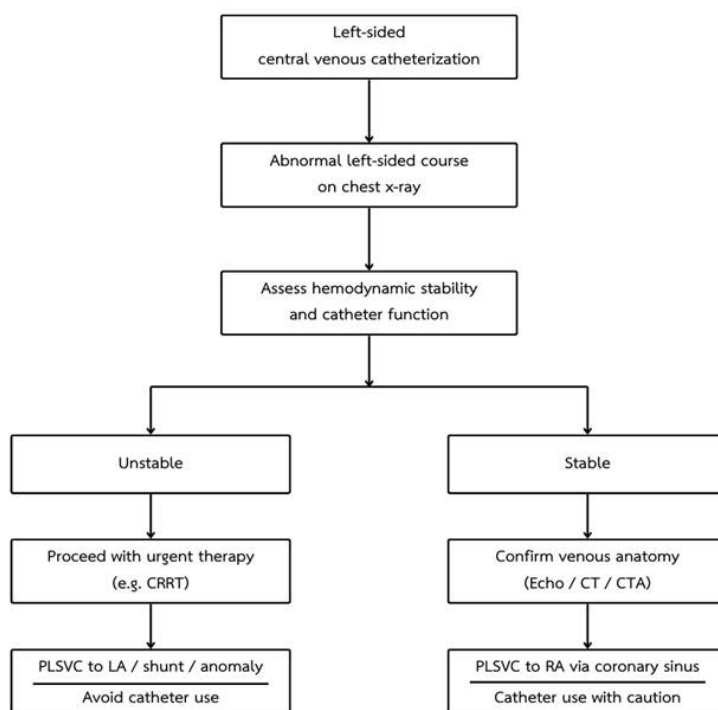


Figure 5 Clinical algorithm for abnormal left-sided catheter trajectory. (CRRT, continuous renal replacement therapy; LA, left atrium; RA, right atrium; CTA, computed tomography angiography.)

Conclusions

PLSVC is frequently asymptomatic, yet it carries important procedural implications in critically ill patients. An unexpected left-sided catheter trajectory should prompt confirmation with echocardiography or cross-sectional imaging, as early identification can prevent unnecessary catheter manipulation and procedure related complications.

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