Persistent left superior vena cava (PLSVC) is rare and asymptomatic and is usually discovered incidentally during or after insertion of a central venous catheter. There is uncertainty as to whether or not the catheter should be removed after its malposition resulting in persistent left superior vena cava. We reported an unusual case of a breast cancer patient with a persistent left superior vena cava detected after a peripherally inserted central catheter insertion. The patient had undergone a modified radical mastectomy and needed to insert a peripherally inserted central catheter for chemotherapy. After the peripherally inserted central catheter insertion, the chest X-ray and computed tomography showed that the catheter was located in the persistent left superior vena cava. After an assessment of the persistent left superior vena cava and the catheter tip position, the peripherally inserted central catheter remained in the persistent left superior vena cava for further therapy. To ensure the integrity of the catheter, special follow-ups and tip position observations were carried out. The peripherally inserted central catheter was safe until the end of chemotherapy with no complications. Although the peripherally inserted central catheter tip was located in persistent left superior vena cava, given that the persistent left superior vena cava coexisted with a right superior vena cava with the similar lumen, the peripherally inserted central catheter could be used normally under strict attention.

Keywords
Persistent left superior vena cava, peripherally inserted central catheter, malposition, nursing

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Introduction
Persistent left superior vena cava (PLSVC) is a rare diagnosis found in 0.3%–0.5% of the general population. It consists of a double superior vena cava (SVC) with a left SVC. Although PLSVC is an uncommon vascular anomaly, it is the most common congenital anomaly of the thoracic venous system. The patients are generally asymptomatic and the presence of PLSVC is typically detected during or after the insertion of a central venous catheter (CVC). Peripherally inserted central catheters (PICCs) provide medium- to long-term central venous access and are inserted through a peripheral vein (basilic vein, brachial vein, or cephalic vein). The advantages of PICCs include ease of insertion, versatility (e.g. for drug
administration or parenteral nutrition), perceived safety, and cost-effectiveness compared with other venous access. Despite these benefits, PICCs are also associated with complications such as catheter-related infection, phlebitis of the vein at the insertion site, catheter malposition, thrombus formation, and air embolism. The presence of vascular anomalies can exacerbate the complication rate, and one such anomaly is a PLSVC.

We presented a case of PLSVC that was encountered during routine PICC placement tip position check-up. Following the observation, we analyzed the conditions in which the PICCs could be retained in PLSVC for therapy using data from ultrasound and computed tomography (CT) to determine follow-up nursing measurements for PICCs with PLSVC.

**Case presentation**

A 60-year-old woman underwent a right-side modified radical mastectomy for breast cancer. A PICC was scheduled to be inserted for postoperative chemotherapy. An ultrasound scan of the upper arm veins was performed to determine a suitable insertion site and the left basilic vein was chosen. Her pre-procedure examination showed no specific finding. According to the standard process of PICC placement, the patient was placed in the supine position with her left arm abducted to approximately 90°. The following measurement was used to identify the insertion length: the distance from the insertion site to axilla + axilla to sternal notch + skinfold thickness. A 4-Fr single lumen power PICC (Solo 2, BD/Bard Access) was used, and insertion was performed under aseptic technique following institutional standard operation procedures. PICC placement was carried out using the ultrasound-guided Seldinger technique. The catheter was inserted through an introducer and advanced to the predetermined length. The catheterization procedure was performed without any difficulty. A chest X-ray was taken to confirm the tip location and showed that the catheter was positioned at the left paravertebral border near the T8 vertebrae instead of crossing the midline to the right to enter the SVC (Figure 1). The presence of a vascular anomaly was suspected, but confirmation of the anomaly and exclusion of extra-vascular placement was necessary. Echocardiography showed a PLSVC which drained the left subclavian vein and joined with the coronary sinus (Figure 2) to empty into the right atrium (RA). As the mispositioned PICC did not drain into the left atrium, we chose to leave the catheter in situ and use it as an ordinary PICC. Then, we informed the patient and her family of the venous anomaly and current situation. After obtaining informed consent, we performed a CT scan to compare the lengths and inner diameters of the PLSVC with the SVC to ensure that the PLSVC could function normally (Figure 3). Next, we re-adjusted catheter tip placement under ultrasound guidance. Once the catheter almost reached the RA, we withdrew it by approximately 3 cm so that the tip of the PICC could lodge at the lower third of the left SVC. FEC (fluorouracil, epirubicin, cyclophosphamide) chemotherapy protocol was utilized. We established a special case record for this patient and strengthened catheter maintenance and tip position detecting procedures. The patient was requested to come to our PICC specialist Outpatient Department each week in intervals between chemotherapy sessions. Aside from normal maintenance, the arm circumference, PICC length outside
the body was measured, and any symptoms of the patient were recorded. The tip position by X-ray was checked before each chemotherapy. The patient and her family were given unique health education on the PICC. Maintenance fluids and intravenous medications were administered through the PICC without any problem. The patient had an uneventful recovery after six cycles of chemotherapy. The dwell time of this PICC was 192 days.

**Discussion**

PLSVC is the most common thoracic vascular anomaly and is a persistent congenital remnant of the vein of Marshall, which serves as a counterpart to the SVC in early embryonic development. Although it may be found in 0.3%–0.5% of the general population, PLSVC, in the absence of other congenital cardiac anomalies, is seldom diagnosed because it tends to be hemodynamically insignificant and rarely leads to symptoms. Being familiar with such an anomaly could help clinical medical staff avoid complications during the placement of central lines, Swan–Ganz catheters, PICCs, dialysis catheters, defibrillators, and pacemakers.

PLSVC has several anatomic variations. PLSVC typically coexists with the right SVC in up to 80%–90% of cases. In many cases, these bilateral SVCS are of relatively equal size. In about 80%–92% of cases of PLSVC, the PLSVC drains into the RA via the coronary sinus, leading to no hemodynamic consequence. Conversely, in approximately 10%–20% of cases of PLSVC, the PLSVC can drain via the left atrium, either through a coronary sinus or in a straight line fashion into the roof of the left atrium or through the left superior pulmonary vein. This places those patients at significant risk for subsequent paradoxical embolic complications to the arterial system, either from thromboembolism or air emboli, with resultant neurologic, cardiac, renal, mesenteric, and peripheral sequelae.

In the instance of bilateral SVCs, the right SVC generally drains normally into the RA. When a PLSVC is identified, the right SVC can be absent in approximately 10%–20% of cases. This patient has bilateral SVCs and the PLSVC drains into the RA via the coronary sinus. Using CT, we compared the lengths and inner diameters of the PLSVC with the right SVC and found that there was no significant difference in the inner diameter between the bilateral SVCs. Rey and Li concluded that in the situation that the PLSVC coexisted with a right SVC, if the lumen of the PLSVC was significantly larger than or similar to that of the right SVC, the CVC could be used normally after confirmation of the tip position. This conclusion was backed up by this case, resulting in the safe use of PICC throughout chemotherapy without complications.

In most cases, PLSVC is sometimes difficult to find because it is accessed through the right subclavian vein. However, in this instance, a right-sided approach was no longer viable, so we performed successful implantation of a PICC from the left basilic vein in the patient with PLSVC. Kostantinou reported a case of PICC tip located in PLSVC in which they removed the tip after confirming its position. After weighing the pros and cons, we left the catheter in situ and continued to use it for therapy. Leaving the catheter in situ would minimize the potential risk of infections and mechanical damages to the vessels caused by re-insertions, as well as delay in treatment. The relative disadvantage is the potential for immediate or late complications, especially for those that are cardiovascular related. We provided special nursing to the patient and established a follow-up note for strengthening catheter maintenance and tip position detecting procedures. As the patient completed the chemotherapeutic regimen without any occurrence of complications, we determined that a PICC inserted through the PLSVC could function normally given the following conditions: (1) the pros and

![Figure 3](https://example.com/figure3.png)

**Figure 3.** Computed tomography showing the PICC. (a) Mediastinal transverse CT section of the thorax showing the catheter in the subclavian vein. (b) Mediastinal transverse CT section of the thorax showing the tip of the left internal jugular line at the level of the aortic arch. (c) Mediastinal transverse CT section of the thorax showing the tip of the left internal jugular line in the coronary sinus.
Rigorous nursing measures should be taken. First, a special case record for the patient must be set up. Second, the follow-up of the tip position and catheter maintenance procedures should be highlighted. Third, the patient should be educated on PICC catheter maintenance. All of these measures make PICC infusion in a patient with PLSVC safe throughout chemotherapy without complications. The patient in our study was requested to come to PICC outpatient services each week during their chemotherapy interval. Aside from regular maintenance procedures, we took unique care of the patient during their PICC maintenance and set up special case follow-ups for any unusual symptoms. We used an X-ray to check the PICC tip’s position before each chemotherapy session and found no malposition of it. After the catheterization, the patients and their families were notified of about the process so they could understand the importance of catheterization observation and regular maintenance procedures. In addition to the routine nursing contents, they were asked to carefully and regularly observe for arm circumference, swelling, and redness. If there was any palpitation, chest distress or other discomforts, they were called upon to return to the hospital.

Conclusion

We generally suggest that a malpositioned catheter not uses. The lower third of the SVC to the junction of SVC and RA is considered to be the best location for tip placement. In this case, we provided a credible choice to leave the malpositioned PICC for patients with a PLSVC. Although the PICC tip position was located in the PLSVC, given that the PLSVC coexisted with a right SVC with a similar lumen, the PICC can be utilized normally under close attention. Prior imaging should be checked before CVC insertion to find possible anatomic abnormalities. The need for exceptional caution in catheter placement can be overstated, because catheter tip manipulation in the PICC may cause complications. A correction of tip position should be made to prevent immediate complications. If an abnormality is noted, the catheter must be removed as soon as possible to reduce the risk of late complications.

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Ethical approval and informed consent

The Qingdao Municipal Hospital Medical Ethics Committee reviewed the research protocol and informed consent and agreed that the study design is in accordance with the Helsinki Declaration principles, and fully respect the subjects’ and their families’ informed consent. The techniques used in the research are an advanced scientific sampling research process in line with standard medical practice. The project meets medical ethics requirements.

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