Tricuspid valve vegetation related to leaflet injury: a unique problem of catheter malposition

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Abstract

The use of peripherally inserted central catheters (PICCs) has expanded substantially for drug delivery in clinical practice in recent years. However, PICC lines expose patients to potential complications associated with an increasing incidence of infective endocarditis. We herein report a case of a 57-year-old woman who was diagnosed with tricuspid valve endocarditis by echocardiography. The most probable cause was direct injury to the tricuspid valve by the tip of a PICC line with excessive length in the right heart. The vegetation disappeared with conservative treatment after removal of the PICC line. Clinicians must maintain vigilance against any suspected PICC-related infection in febrile patients with a PICC line. For echocardiographers, precise evaluation of the position of the PICC tip and the detection of endocarditis is important to devise the optimal clinical strategy.

Keywords: infective endocarditis, PICC-related complications, echocardiography, right heart failure

Case report

A 57-year-old woman was admitted to our hospital because of a two-month history of recurrent fever. She had been diagnosed with myelodysplastic syndrome (MDS) 15 months earlier and uneventfully completed four courses of chemotherapy with decitabine in our hospital. Two months prior to admission, the patient was hospitalised in another institute while waiting to undergo bone marrow transplantation. She developed a fever and was found to have a pulmonary fungal and bloodstream infection with an epidermal staphylococcus (methicillin-resistant coagulase-negative staphylococcus).

After undergoing combination antiseptic treatment, she was clinically well with normal chest computed tomography (CT) findings and a negative blood culture. Shortly thereafter, her symptoms recurred with the same manifestation on chest CT and blood culture. Although the clinician adjusted the patient’s drug treatment, her symptoms were not completely relieved, and her temperature ranged from 36.5 to 38.5°C with a body weight loss of 5 kg within two months.

On admission, the patient exhibited progressive fatigue and weakness. A complete blood count revealed a white blood cell count of 6.7 × 10^9 cells/l, haemoglobin level of 63 g/l and platelet count of 17 × 10^9 cells/l. She presented to our department for cardiac evaluation.

Transthoracic echocardiography (TTE) showed a PICC line in the right heart with a small echodensity (0.9 × 0.5 cm) on the tip. In diastole, the PICC tip floated into the right ventricle (Fig. 1A). In systole, it returned to the right atrium, but as it did so, the tip stabbed the tricuspid valve. Additionally, a large homogeneous echodensity (1.7 × 1.1 cm) was attached to the ventricular surface of the anterior tricuspid leaflet (Fig. 1B). No other structural or functional abnormalities were observed except moderate tricuspid regurgitation with peak velocity of 3.5 m/s.

A postero-anterior chest X-ray, which was performed at the time of the PICC placement before chemotherapy, showed that the tip position was located near the superior vena cava/right atrial junction (Fig. 2). Therefore, tricuspid valve endocarditis with PICC migration was diagnosed.

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She began treatment to prevent heart failure and her condition stabilised after a six-week complicated course of hospitalisation. She was followed up two months after discharge and was doing well. Repeat TTE revealed no vegetation on the tricuspid valve and only mild regurgitation.

**Discussion**

Right-sided infective endocarditis is an uncommon entity, accounting for 5 to 10% of all cases of infective endocarditis, and frequently involves the tricuspid valve. It occurs predominantly in intravenous drug abusers. In non-drug abusers, predisposing conditions include congenital heart disease, use of a PICC or central catheter, and right-sided cardiac instrumentation. The widespread use of PICCs worldwide has led to an increasing incidence of right-sided infective endocarditis, which is recognised as a serious PICC-related complication.

The incidence of infective endocarditis is higher when the tip of the catheter is deep in the right atrium. The potential mechanism is that when the tip is deep in the right atrium or in close proximity to the tricuspid leaflet, abrasion of the endocardium or tricuspid valve causes endothelial injury, allowing microorganisms to establish infection on the damaged endocardial surface. Suresh *et al.* reported a case of tricuspid valve endocarditis secondary to injury by a central venous catheter and found a large vegetation extending down the chordal apparatus during surgery.

In our case, the PICC tip floated into the right ventricle in diastole and injury of the chordae tendinae could not be excluded because TTE could not reveal tiny vegetations. More importantly, each time the PICC line returned to the right atrium in systole, the tip stabbed the tricuspid valve. This was almost sure to trigger direct injury of the valve. The large vegetation on the anterior tricuspid leaflet confirmed our hypothesis that direct injury induced by the tip of the overly long PICC line was the chief cause of the endocarditis. Perforation of the tricuspid leaflet was also possible because the tip stabbed the valve constantly and the tricuspid regurgitation was more severe than at the end of chemotherapy three months previously. Therefore, accurate localisation of the PICC tip is extremely important as the first and most important step of infection control.

Although optimal tip location is controversial, most guidelines recommend localisation in the lower one-third of the superior vena cava to the superior vena cava/right atrial junction. The major issue in PICC placement is how to determine the catheter length or tip position. Various anthropometric measurement techniques have been described. In one report, for instance, the insertion length was evaluated by measuring the distance...
between the puncture point and mid clavicle, and the distance between the suprasternal notch and acromioclavicular joint was then added to this.\textsuperscript{1} However, the predicted length of the PICC obtained using anatomical landmarks is not always precise enough to reflect the real anatomical distance, and the reported rate of tip malpositioning using anthropometric measurements varies among studies from 10 to over 70%.\textsuperscript{6}

Some researchers have recently evaluated new techniques to resolve this issue. Liu et al. demonstrated that ECG-assisted tip localisation of the PICC, based on the P wave, was accurate and safe for patients without heart disease.\textsuperscript{2} Fluoroscopic guidance is also recommended for optimal tip positioning but a limitation of this technique is that the patient and operator are exposed to X-ray radiation.\textsuperscript{2} Finally, precise real-time ultrasound-guided PICC positioning was confirmed as an effective technique in neonates in a randomised, controlled trial;\textsuperscript{3} however, this method remains problematic in adult patients because the superior vena cava is not easily accessible on such images.

With consideration of the limitations of these assisted techniques, we believe the performance of echocardiography may help to ensure that the PICC tip is not in the right heart. In addition to cardiac infection, potentially serious complications of incorrect PICC placement include arrhythmias and pericardial tamponade/perforation. Moreover, causal migration of the PICC line tip with arm abduction has been demonstrated, and the magnitude is about 21 mm with a range of 2 to 53 mm.\textsuperscript{10}

In our case, the PICC was confirmed to have optimal tip positioning as displayed on the postero-anterior chest X-ray before chemotherapy, but it migrated to the deep right heart 15 months later. Additionally, no follow-up inspection of the PICC position was performed during this time. Therefore, considering the possibility of PICC migration, periodic checks of the PICC tip are very important, especially for patients requiring long-term PICC placement. Furthermore, evaluation of cardiac function by echocardiography is always performed multiple times while patients are undergoing chemotherapy; this may provide a good opportunity to check whether the tip is located in the right heart.

Unfortunately, the position of the PICC line was not mentioned in the multiple echocardiography reports in our case.

Moreover, echocardiographic findings can help to predict the prognosis by showing the size of the vegetation and the status of the right heart. A vegetation of less than 1 to 2 cm in patients with right-sided endocarditis has a better prognosis and frequently responds to conservative treatment.\textsuperscript{11} However, because of the lower pressure and lower flow velocities within the right heart, such vegetations grow faster and are frequently larger, and they can be found at any site on the endocardium.\textsuperscript{1} Vegetations larger than 2 cm are associated with in-hospital mortality, and surgical intervention is indicated when it is associated with other predictors of a complicated clinical course (e.g. heart failure, persistent infection despite appropriate antimicrobial therapy, abscess formation and progressive valve destruction), despite the probable imperfect outcomes after surgery.\textsuperscript{12}

In addition, echocardiographic evaluation of the systolic pulmonary pressure may provide evidence of pulmonary embolism because vegetations have the potential for embolisation to the pulmonary vasculature. Right ventricular systolic dysfunction was independently associated with increased in-hospital mortality, and it may serve as an echocardiographic marker to identify high-risk patients with right-sided infective endocarditis for more aggressive intervention.\textsuperscript{13} Therefore, a thorough echocardiographic examination is important to aid clinicians in devising an optimal treatment strategy. In our case, the vegetation was relatively small and medical therapy was effective after removal of the PICC line as the initial therapeutic manoeuvre.

Importantly, our patient did not undergo an echocardiographic examination at the outside hospital. We speculate that the recurrent mixed infection may have predominantly occupied the clinician’s mind and that the risk of PICC-related infective endocarditis was not realised. PICC lines are not benign and have been associated with serious bloodstream infection as well as fatal bacteraemia and fungaemia, and nearly 9 to 25% of patients with such infections die as a direct result.\textsuperscript{14} PICC-related complications should always be kept in mind by both the clinician and sonographer.

Conclusion
This unique case highlights the significance of appropriate tip location of PICC lines and the importance of awareness of PICC-related complications, especially in patients with low resistance. Periodic checks of the position of the PICC tip are necessary for patients requiring long-term PICC placement.

A complete echocardiographic evaluation is important in any patient with a PICC line because it may influence the clinical strategy by confirming the tip position, showing the vegetation in detail and allowing for evaluation of the cardiac condition.

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References


