CASE REPORT

Recurrent migration of peripherally inserted central catheter into the azygos vein

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SUMMARY

Peripherally inserted central catheter (PICC) migration into azygos vein (AV) is a rare complication. It is recognised only when catheter malfunction occurs or when patients develop associated complications. PICC migration into AV has been reported to be associated with various complications such as catheter malfunction, perforation, haemorrhage, thrombosis, infection and stenosis of AV. Pleural effusion and trachea–azygos fistulas have also been reported. We present a patient with recurrent migration of PICC into AV after an initial corrective repositioning during the same hospital stay. In this case, PICC migration was possibly related to left-sided approach, use of smaller diameter PICC, severe congestive heart failure and her bedbound status. PICC migration should be considered when PICC found be malfunctioning, especially if associated with the above risk factors.

BACKGROUND

Peripherally inserted central catheter (PICC) is indicated for a variety of conditions including difficult peripheral intravenous access, administration of long-term intravenous antibiotics, total parenteral nutrition, infusion of chemotherapies and frequent phlebotomy.¹ PICC insertion is routinely performed in both outpatient and inpatient settings. Appropriate insertion and close monitoring for complications is critical in the management of PICC to prevent malfunction and other adverse events. Reported complications associated with PICC are catheter-associated blood stream infections, venous thrombosis, catheter kinking, malposition, migration² and catheter fracture.³

Spontaneous migration of PICC tip into azygos vein (AV) is rare but can lead to catheter malfunction and other associated complications. There are several factors related to the patient, the technique of insertion and the type of catheter used that can increase the risk of catheter migration into AV. Hence, taking necessary measures for prevention and early detection of PICC migration is critical in PICC management. Anteroposterior and lateral chest X-rays help to understand the position of PICC. Fluoroscopy imaging or venography are more useful in identifying the location and confirming PICC position,^{4,5} especially during placement. We present here a rare case of recurrent migration of PICC into the AV after its initial repositioning with power flush in a patient during the same hospital admission.

CASE PRESENTATION

A 31-year-old woman was admitted to the hospital with sepsis and bacteraemia. Her comorbidities included obesity, automatic implantable cardioverter defibrillator (AICD), severe systolic heart failure (ejection fraction of 30%) and bedbound status from severe peripheral neuropathy. A transoesophageal echocardiogram showed AICD lead vegetations for which AICD was replaced. Due to difficult intravenous access, a 4-French (Fr) single lumen PICC was placed through the left basilic vein for the administration of intravenous antibiotics. This PICC had a cut length of 40 cm with the catheter tip ending at the cavoatrial junction. This position was confirmed with fluoroscopy and guide wire at the time of insertion. A chest X-ray (figure 1) also confirmed the placement of PICC tip in the appropriate position.

The PICC stopped functioning a day after its placement. A chest X-ray (figure 2) showed the PICC arching over the right mainstem bronchus and appeared most likely to be in the AV. This was confirmed by two different radiologists. The tip was repositioned into superior vena cava (SVC) by forceful flushing with normal saline into the PICC. Appropriate positioning of PICC was confirmed on a follow-up chest X-ray (figure 3). Following this, PICC was fully functional but noted to be non-functional again after 3 days. A repeat chest

Figure 1 Portable anteroposterior view of chest X-ray confirming the appropriate position of PICC tip in SVC after initial placement. PICC, peripherally inserted central catheter; SVC, superior vena cava.

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Figure 2 Portable anteroposterior view of chest X-ray showing initial migration of PICC tip likely into AV. AV, azygos vein; PICC, peripherally inserted central catheter.

X-ray revealed PICC in similar previous non-functioning position, above right mainstem bronchus and appeared to have migrated again to the AV (figure 4). This was confirmed by official radiology report. At this time, we removed the PICC and placed an ultrasound-guided peripheral intravenous line.

DISCUSSION

Reviewing the anatomy of AV helps to understand PICC migration into AV. The AV has venous drainage from abdominal and

Figure 3 Portable anteroposterior view of chest X-ray showing correction of PICC tip position from AV into SVC after a saline flush. AV, azygos vein; PICC, peripherally inserted central catheter; SVC, superior vena cava.

Figure 4 Portable anteroposterior view of chest X-ray showing recurrent migration of PICC tip in to AV. AV, azygos vein; PICC, peripherally inserted central catheter.

thoracic walls. It ascends in the posterior mediastinum and arches ventrally over the right mainstem bronchus to enter the posterior aspect of SVC facing left brachiocephalic vein at the level of thoracic vertebrae T2–T5. The Left brachiocephalic vein opens at the left anterior aspect of SVC at the level of thoracic vertebrae T2–T3. The diameter of AV can vary from 4 to 16 mm. This anatomical position keeps both veins nearly face to face. There can be congenital variations in the diameter or level of the opening into superior vena cava which can predispose the risk of central line migration into the AV.^{6 7}

There are several factors related to the patient; the technique of insertion and the type of catheter used that can increase the risk of catheter migration into AV. Notable patient-related factors are severe congestive heart failure, increased right atrial pressures and dilated AV.^{6 8 9} Conditions associated with raised intrathoracic pressures like coughing or vomiting have been reported to contribute this migration.¹⁰ Anatomical variations between AV, SVC and brachiocephalic vein are also important contributing factors in migration.¹¹

Among technical factors associated with migration, left-sided approach is noteworthy. A left-sided approach may be chosen due to a patient's preference for left-sided PICC insertion due to right-hand dominance (for convenience) or the result of a physician's preference due to the presence of other devices on right side (like AICD in our case). According to a study by Marcy *et al*, 5% of left-sided approach in PICC placement can lead to initial misplacement into AV.⁶ Short insertion length of PICC (1.4–1.5 cm below carina) and using PICC for power catheter injection, which can lead to whiplash movement, can cause displacement of the catheter into AV.^{6 10} Interestingly, a similar technique of power flush has been noted to cause reposition of displaced catheter tip from AV to SVC by the same mechanism of whiplash movement.¹¹ However, multiple trials of power flushing may put vein at risk of rupture. Intraoperative factors associated with this migration are intraoperative traction during surgery, change in thoracic pressures, forceful flushing of PICC and vigorous movements of upper extremities.¹⁰ Highly flexible

silicone PICCs and small diameter PICCs (4 Fr vs 7 Fr) are some of the PICC-related factors associated with recurrent migration of PICC into AV.⁶ Compared with polyurethane PICCs, silicone PICCs are softer and prone to easy movements with external or internal pressures, which can put them at risk of malposition.¹⁰

In our case, in addition to left-sided approach, the small diameter of PICC (4 Fr) and heart failure are possible risk factors for recurrent migration. We believe our patient's bedbound status could also have contributed by the gravitational pull of PICC tip posteriorly into AV from left brachiocephalic vein. Although short PICC is one of the contributing factors, this may be the less likely cause in our case as PICC placement was confirmed at the level of cavoatrial junction with fluoroscopy and guide wire at the time of placement. However, we cannot rule out this possibility during second time migration due to the likelihood of change of PICC length during dressings. Lack of confirmatory imaging studies other than chest X-ray after second time migration is another reason why we cannot rule out short PICC in this case. Also, our images quality is limited by multiple leads crossing the chest. PICC migration into AV can be associated with serious complications, hence it is important to take necessary measures immediately to prevent adverse events.⁴⁻⁸ Patients are usually asymptomatic after PICC migration until they develop PICC malfunction or related complications. Catheter malfunction is usually one of the initial signs. It may also be discovered as an incidental finding after a chest X-ray when PICC is functioning. Other complications include perforation of the vein, thrombosis of the vein, haemorrhage, infection and stenosis of AV, pleural effusion, mediastinal effusion^{4,12} and azygos tracheal fistula.¹³

Learning points

- ▶ Peripherally inserted central catheter (PICC) insertion teams must consider the risk factors associated with PICC migration into azygos vein (AV). Although migration is rare, this can lead to severe complications.
- ▶ Individual patients need to be stratified based on their risk factors. Appropriate technique and PICC material should be used accordingly to prevent PICC migration and associated complications.
- ▶ In addition to catheter-related factors and technique of insertion, severe congestive heart failure, increased right atrial pressures, left sided approach, obesity and bedbound status are possible risk factors for PICC migration into AV.
- ▶ Adequate securement and appropriate post-PICC insertion care is important in preventing PICC-related complications.

Right-sided approach of PICC insertion in high-risk patients, insertion under fluoroscopy and placing the catheter tip 1–2 cm below atriocaval junction may decrease the risk of migration.⁶ Once migration is diagnosed and confirmed on imaging, power flushing to dislodge PICC tip from AV may be the initial management strategy, especially when the catheter tip appears to be kinked and causing PICC malfunction.¹¹ Withdrawing and readjusting (increasing) the length may be another step in the management of migrated PICC in to AV followed by confirmation with an X-ray. If such conservative measures are not successful, removal of PICC may be warranted.¹⁰

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