

Perforation of azygos vein and right-sided hydrothorax caused by peripherally inserted central catheter in extremely low birth weight infant

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We report a case in which routine chest roentgenograms of an 840 g infant led to the belief that the peripherally inserted central catheter (PICC) was appropriately positioned within the superior vena cava when, in actuality, it was within the azygous arch. Although many cases of pleural effusions have been reported to be caused by a central venous catheter, a right-sided hydrothorax caused by azygous vein rupture from the use of a PICC is an extremely rare complication. Sudden changes in the condition of a preterm infant with PICC should raise the suspicion of a catheter-related problem. (*Korean J Pediatr* 2006;49:902-905)

Key Words : Hydrothorax, Azygos vein, Central venous catheterization, Low-birth-weight infant

Introduction

Peripherally inserted central catheters (PICCs) are used routinely in neonatal intensive care units, to provide intravenous access for prolonged intravenous therapy. One of the most serious complications associated with the use of central venous catheters (CVCs) is the catheter-related erosion of the right atrium, which results in cardiac tamponade¹⁻⁵. In order to prevent this serious complication, it would appear reasonable to avoid the placement of the catheter tip within the right atrium. However, increasing evidence suggests that placing the tip in positions above the right atrium can also be associated with significant complications.

Catheter perforation of the thoracic central veins has been reported frequently, and can result in pleural effusion, hydrothorax, hemothorax, hydromediastinum, pneumothorax, and pneumomediastinum⁵⁻⁹. Most of these complications, which occur primarily at the time of insertion, are antic-

ipated, and can explain acute changes in cardiopulmonary status; however, the relationship of delayed complications to the placement and use of these catheters is less clear.

Several cases have been reported of extremely low birth weight infants with delayed right-sided hydrothorax resembling the fluid being infused^{5,10}. These cases were caused by PICCs in neonatal intensive care. However, these reports were not able to definitively ascertain the mechanism by which these catheter-related hydrothoraxes occurred.

Here, a case is described in which a malpositioning of the peripherally inserted central catheter (PICC) into azygous arch was followed by azygous vein perforation, subsequently resulting in massive right-side hydrothorax in an extremely low birth weight infant.

Case Report

An 840 g male infant was delivered vaginally at 28 weeks' gestation. The infant was immediately intubated due to poor respiratory effort and underwent mechanical ventilation and surfactant replacement.

On the third day, a 27 G Polyurethane PICC (PremiCath, Vygon GmbH & Co. KG, Aachen, Germany) was inserted via a distal portion of right antecubital vein and the cath-

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eter tip was positioned in the upper part of the superior vena cava (SVC), according to chest radiography. Total parenteral nutrition with 5% dextrose was infused through the catheter at a rate of 4.5 mL/hr. Eleven hours after the line placement, the infant progressively required increased ventilatory support.

On examination, the infant's right hemithorax was dull to percussion, and breath sounds were diminished. The infusion was immediately discontinued. A chest radiograph



Fig. 1. Anteroposterior radiograph revealed that the catheter tip (arrow) was displaced outward, due to elbow extension. A massive right-sided pleural effusion was observed.

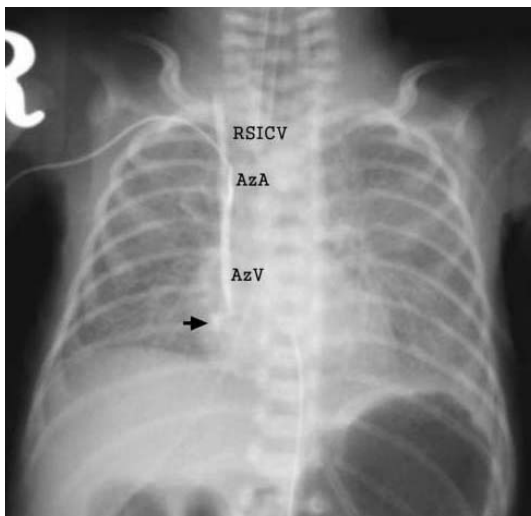


Fig. 2. After thoracentesis, an anteroposterior radiograph obtained after the injection of contrast medium into a malpositioned catheter demonstrated the right superior intercostal vein (RSICV), azygous arch (AzA), and azygous vein (AzV). The catheter tip was located in the azygous arch. The extravasation of contrast medium (arrow) into the pleural space through the perforation of the azygous vein was clearly seen.

revealed complete opacification of the right hemithorax, and the catheter tip was appeared to be displaced outward by elbow extension (Fig. 1).

Immediate thoracentesis yielded 32 mL of slightly blood-stained fluid. Laboratory analysis revealed a red cell count of $3,420/\text{mm}^3$, white blood cell count of $10/\text{mm}^3$, lactic dehydrogenase 53 Unit/L, specific gravity of 1.015, protein 2.7 g/dL (serum protein 5.6 g/dL) and glucose 1,389 mg/dL, which was similar to the parenteral infusion the infant had been receiving. A radiograph just after this revealed resolution of the pleural fluid, and the catheter tip was seen to overlie the medial end of the 4th rib on the right via elbow flexion, most likely in the SVC. In order to verify the placement of the PICC, a chest roentgenogram was taken as Visipaque (Amersham Health, Cork, Ireland) was injected into the catheter. A contrast medium-enhanced anteroposterior view revealed that the catheter tip was located in the azygous arch. The extravasation of contrast medium into the pleural space through the perforation in the azygous vein was clearly observed (Fig. 2). The central catheter was removed and then there was no re-accumulation of the pleural fluid. The remainder of the infant's hospital course was unremarkable.

Discussion

A major problem with regard to the correct positioning of CVC is the lack of reliable surface landmarks. Although radiographs are recommended as a practical and reliable test for the verification of correct positioning, they do not exclude the placement of the catheter in smaller vessels, such as the azygous arch, or extravascular sites which are adjacent to the correct site.

The frequency of catheter malpositionings in the azygous arch/vein occurs with a frequency of between 0.7% and 1.2%^{11, 12)}. Although azygous arch cannulation is quite rare, a hazardous CVC malpositioning in the azygous arch carries with it a substantial risk of perforation, thrombosis, and vascular stenosis¹²⁻¹⁶⁾.

Catheter malpositioning in the azygous arch/vein can normally be detected on post-procedural radiographs. The diagnosis was made from the typical anteroposterior course of the catheter, as seen on the lateral chest roentgenogram. The frontal projection revealed a slight curling of the catheter tip. A chest roentgenogram acquired during the injection of contrast material into a catheter may help to con-

firm the catheter malpositioning in the central venous circulation. This venogram revealed a free retrograde flow of the contrast medium into the vertical portion of the azygous vein.

In our case, routine anteroposterior and lateral chest radiographs led us to believe that the PICC tip had been appropriately positioned within the SVC. However, in actuality, a contrast medium-enhanced anteroposterior view made it clear that the catheter tip was positioned in the azygous arch.

In addition, the extravasation of contrast medium into the pleural space through the perforation in the azygous vein at the level of the 8 to 9 thoracic vertebra was noted, and was quite far away from the catheter tip. The flow direction of fluid administered through a CVC misplaced in the azygous arch tends to prevent the physiological flow inherent in the azygous vein. The factors which resulted in the azygous vein perforation were thought to be as follows: hydrostatic pressure due to the infusion rate following vessel wall perforation, and osmotic pressure due to solution concentration following vessel wall necrosis.

Our case underlines the importance of continuous monitoring of the catheter tip, as well as periodic radiographs to exclude subsequent catheter-related complications. Also, any acute deterioration in the status of an infant with a PICC in place should indicate immediate chest radiography, with contrast medium if necessary, in order to investigate the possibility of catheter malpositioning.

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한글 요약

**초극소 저출생 체중아에서
중심 정맥 도관술로 발생한
홀정맥 파열과 우측 흉수증 1례**

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중심 정맥 도관술은 미숙아들의 출생과 생존율의 증가로 현

재 신생아실에서 많이 시행 되고 있는 수기이며, 최근 중심 정맥 카테터 사용이 증가함에 따라 혈전이나 색전, 혈관 손상과 파열, 흉막 삼출, 화학적 폐렴과 같은 합병증이 보고되고 있다. 이에 저자들은 경피 중심 정맥 카테터 삽입 후 우측성 흉막 삼출액이 발생하여 시행한 혈관조영술에서 카테터가 홀정맥에 위치하였던 초극소 저출생 체중아에서 경피 중심 정맥 카테터를 제거한 후 흉막 삼출액이 호전되었던 1례를 경험하였기에 보고하는 바이다.

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