Signature: © Pol J Radiol, 2014; 79: 275-278
DOI: 10.12659/PJR.890408

Polish Journal of Radiology
www.PolRadiol.com
ORIGINAL ARTICLE

Received: 2014.01.20
Accepted: 2014.02.28
Published: 2014.08.25

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

The Malposition of Central Venous Catheters in Children

Maria Dzierzega[1B], Magdalena Ossowska[2E], Dariusz Chmiel[1A], Aleksandra Wieczorek[2E], Walentyna Balwierz[2D]

[1] Department of Pediatric Emergency, Medicine Children's University Hospital, Polish-American Institute of Pediatrics Jagiellonian University Medical College, Cracow, Poland
[2] Department of Pediatric Oncology and Hematology, Children's University Hospital, Polish-American Institute of Pediatrics Jagiellonian University Medical College, Cracow, Poland

Author's address: Maria Dzierzega, Department of Pediatric Emergency, Medicine University Hospital, Polish-American Institute of Pediatrics, Jagiellonian University Medical College, Cracow, Poland, e-mail: maria.dzierzega@uj.edu.pl

Summary

Background: Contemporary medical care, especially in the field of pediatrics often requires central venous line (CVC – Central Venous Catheter) implantation for carrying out treatment. Some conditions are treated intravenously for several months, other require long-term venous access due to periodical administration of medications or daily nutritional supplementation.

Material/Methods: A total number of 309 CVCs were implanted at Children's University Hospital in Cracow between January 2011 and December 2012 (24 months). Malposition of the CVC is not common. The target of our article was to present two rare cases of malposition of catheters and two displacements of catheter due to chest tumors, and to enhance the importance of differential diagnostic imaging when difficulties occur.

Results: CVC malposition was detected with different imaging modalities followed by appropriate medical procedures.

Conclusions: In case of any difficulties with central lines, it is necessary to investigate the underlying cause. The central line team at hospital cooperating with other specialists is needed to detect complications and to prevent them.

Keywords: Malposition of the Central Catheter • Children • Oncology

PDF file: http://www.polradiol.com/abstract/index/idArt/890408

Background

Contemporary medical care, especially in the field of pediatrics often requires central venous line (CVC – Central Venous Catheter) implantation for carrying out treatment. Some conditions are treated intravenously for several months, other require long-term venous access due to periodical administration of medications or daily nutritional supplementation [1].

A pediatric patient is exceptional. The small size of veins requires particular caution in decision making as to the type of catheter through which medications will be administered [1].

Material and Methods

The Children's University Hospital in Cracow is a 550-bed institution with 53 beds in the Pediatric Oncology Department, 6 beds in the Bone Marrow Transplant Department and 12 beds at Nutritional Therapy Ward where nearly all patients have a central venous access device. The Dialysis Therapy Department is a small ward and carries out kidney replacement therapy mainly, employing peritoneal dialysis which does not require central venous access. Patients hospitalized at Gastroenterology, Surgery, Pulmonology and Immunology Wards sporadically require implantation of a permanent intravenous catheter.

The following permanent catheters were used: Broviac, Hickman line, Permcath, PICC (Peripherally Inserted Central Catheter), silicone catheters with Groshong valve and vascular ports.

Decisions were mostly made by a central line team consisting of the attending physician, a nurse directly involved in

Table 1. Number and type of implanted catheters.

Type of catheter	Number	Percent (%)
Broviac	66	22
Hickman	138	44
Permcath	14	4
Port	28	9
PICC	63	21
Total	**309**	**100**

patient care and a physician being a member of the central access implanting team [2]. Parents/guardians' opinion was an important factor when deciding upon the specific catheter type.

The central access implanting team consists of two experienced pediatric surgeons, one resident fellow, one experienced oncological nurse and parenteral nutrition nurse if needed. Maintaining the catheter functionality, thromboprophylaxis and infection prevention was entrusted to specially trained nurses.

From January 2011 to December 2012 (24 months) 309 CVCs were implanted. As many as 44% were Hickman catheters, 22% Broviac catheters, 21% PICCs. Only 4% of all CVCs were Permcaths for hemodialysis. Ports constituted 9% (Table 1). The catheters were implanted in 75% of cases considered for chemotherapy.

PICC is a device not commonly used in Poland for pediatric oncology. This catheter is inserted through the brachial, cephalic or basilic vein, passes the subclavian vein, and its tip is located in the superior vena cava or the right atrium.

The venous ports are commonly used in adult oncology to introduce chemotherapy. In our hospital they are inserted in hemophilic patients for replacement of clotting factors, and occasionally for chemotherapy.

In our opinion, Hickman lines and PICCs are more convenient in pediatric patients. Those lines are connected with a lower risk of leakage but a higher risk of catheter infection than ports [3–7].

Malposition of the CVC is not common [6]. In our group of patients we observed three cases (1%) of malposition – two due to wrong assessment of the length of the catheter and one detachment from the port.

The aim of our article was to present two rare cases of malposition of catheters and two displacements of catheter due to chest tumors.

The location of malpositioned PICC may include the ipsilateral and contralateral internal jugular vein, contralateral brachiocephalic vein, azygos vein, right ventricle, as well as loop formation and right ventricle or pulmonary artery [8,9]. Malpositions of ports are not common but in infants and small children they may occur due to difficulties with assessment of the length of catheter or detachment [5].

Figure 1. The tip of PICC in the left pulmonary artery on a routine Scout view.

If malposition is suspected, the line must not be used until radiological confirmation is obtained. In most cases, standard chest X-ray confirms the position of the catheter but in chest tumors, ECHO, MRI or CT might be helpful.

Clinical Cases

The first patient: a 12-year-old boy with sarcoma synoviale located on the right side of the neck. PICC line was inserted through the right brachial vein under local anesthesia. There was no clinical evidence of malposition, no resistance was felt during insertion and venous blood was aspirated through the catheter without signs of obstruction. Unfortunately, the chest X-ray was not performed after catheter insertion, but the following day the CT of the neck was scheduled according to the chemotherapy protocol. On a routine Scout view malposition of PICC was visible. Unfortunately, the radiologist interpreting the results did not pay attention to the Scout view. He only focused on evaluation of the primary tumor site. On the 3rd day after PICC insertion, the nurses reported difficulties with blood aspiration. The chest X-ray was performed and malposition of the tip of the catheter was confirmed (Figure 1). The catheter passed through the right brachial vein, the right subclavian vein, then the superior vena cava, the right atrium, right ventricle, and into the left pulmonary artery. Repositioning of the catheter was not problematic.

The second patient: a 6-year-old boy with hemophilia A. Such patients require clotting factor replacement from an early age. In this particular case, the boy had a Broviac line implanted at the age of 2. When the patient was 5, due to CVC infection the central line team removed the line and replaced it with a vascular port. The decision was made upon agreement with attending physician, patient's parents and trained nurse. Vascular port does not require thromboprophylaxis as often as Broviac or Hickman line. At our hospital, we cooperate with patients' parents/guardians and teach them how to maintain catheter's functionality

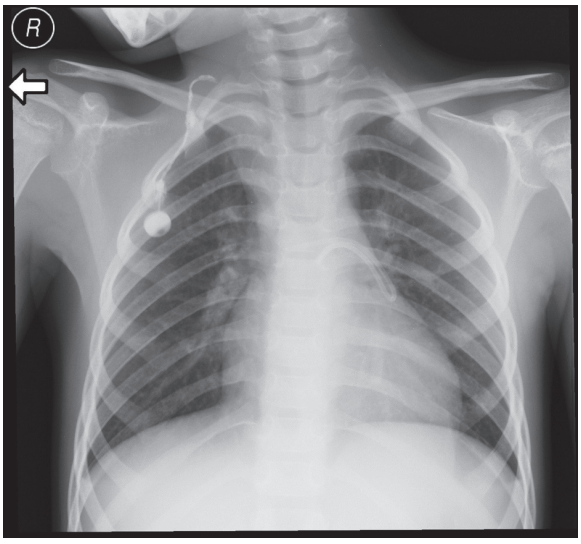

Figure 2. Chest X-ray with contrast agent infusion. Malposition of the catheter was detected: detachment of the portable catheter from the port. Detached catheter migrated into the left pulmonary artery.

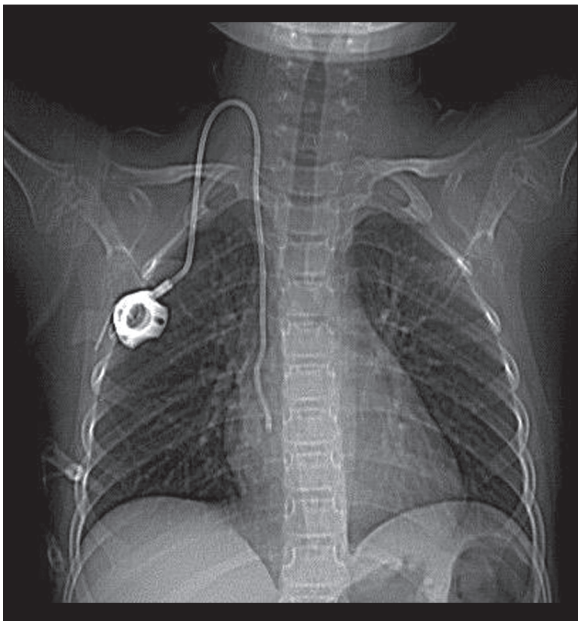

Figure 3. Chest CT showed the PORT's catheter and a calcified tumor – clot in the right atrium (arrow).

at home. This approach allows for fewer visits to hospital during life-long treatment.

In this case, the patient's mother took care of the catheter and she reported difficulties with blood aspiration 12 months after the insertion. No abnormalities (e.g. swelling of the entrance site, arrhythmia) on physical examination were found. On chest X-ray with contrast agent infusion, malposition of the catheter was detected: detachment of the portable catheter from the port. The detached catheter migrated into the left pulmonary artery (Figure 2).

The third patient: A 12-year-old boy with non-Hodgking lymphoma and the mediastinal tumor. The port was

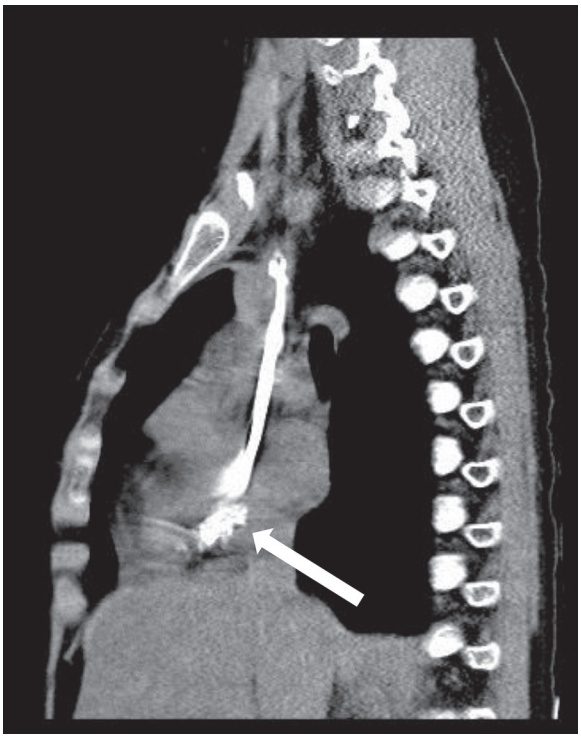

Figure 4. Chest X- ray presented a „strange" shape of the port's catheter in the right atrium due to the clot in right atrium (arrow).

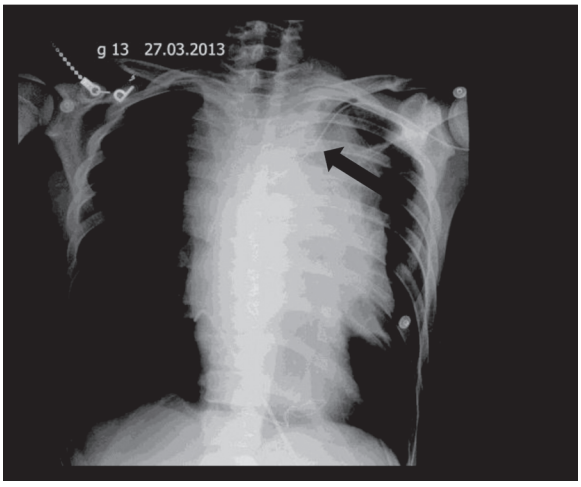

Figure 5. Chest X- ray presented a "strange" course of PICC due to the mediastinal tumor (arrow) shifting the left brachiocephalic vein.

inserted through the right internal jugular vein. After 2 months of therapy the patient was scheduled for an echogram, according to chemotherapy protocol. No difficulties with blood aspiration or regular flushing were reported. Ultrasonography was performed and a tumor close to the catheter's tip, in the right atrium was detected. The CT showed a calcified tumor in the right atrium and a "strange" curve of the distal part of the catheter (Figures 3 and 4).

The fourth patient: a 12-year-old boy with a mediastinal tumor – T-cell leukemia, chest tumor, pericardial effusion,

impending tamponade underwent emergency PICC implantation. A "strange" curve of the catheter due to left brachiocephalic vein being displaced by the tumor was found (Figure 5). The position of the catheter was correct.

Results

The malpositions of CVCs were corrected: in patient 1 – PICC was pulled under fluoroscopy so the tip reached the upper part of the right atrium. Patient 2 was qualified for invasive radiologic removal of the catheter, which was successful.

In patient 3 – open heart surgery was performed and the calcified thrombus was removed. The catheter in patient 4 moved to anatomical position when the mediastinal tumor decreased.

Discussion

We use all kinds of CVCs at our hospital. Patients undergo regular chest X- rays and other diagnostic imagining examinations several times during treatment. It is necessary for radiologists to know the radiological image of different CVCs.

For the neonates, we can use ultrasonography to detect the position of the catheter tip [10]. For adults, Bard has introduced Sherlock 3CG device for accurate placement of PICCs; others use ECG [11–16].

Conclusions

In case of any difficulties with central line use it is necessary to investigate the underlying cause. The central line team at hospital cooperating with other specialists is necessary to detect complications and to prevent them.

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