

CASE REPORT

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PICC tip dislodgement causing massive pleural effusion and atelectasis with acute respiratory failure: a case report

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Abstract

Peripheral intravenous central catheter (PICC) is a common tool for intravenous infusion for children who need central venous access. Although it is safe for physicians and nurses to place, complications like infection, occlusion, phlebitis, and bleeding can occur. We report a 5-month-old infant who suffered respiratory failure caused by catheter malposition resulting in massive fluid infusion into the thoracic cavity. Point-of-care ultrasound (POCUS) was utilized to identify a massive pleural effusion that prompted urgent drainage. Complications related to PICC in pediatric patients are not common but difficult to immediately identify sometimes. Therefore, careful attention should be paid by physicians to identify and reduce the risk of complications associated with PICC. Thus, visual tools are strongly advised to enhance the safety of invasive procedures.

Keywords Pleural effusion, Ultrasound, PICC, Case report

Background

A peripheral intravenous central catheter, serves as a central venous access for children who need short or long-term intravenous infusion or parenteral nutrition and is meaningful for the critically ill. In the pediatric intensive care unit (PICU), peripheral venous access (PVA) is sometimes difficult to establish and cannot fully meet the drug treatment needs of critically ill children. PVA may reduce the efficiency of treatment in children who require infusion of vasoactive drugs, intravenous nutrition, blood

products, or intravenous drug bolus at any time. PICC is usually placed through a peripheral vein. Still, in younger children, especially those with lower weight, PICC placement through a peripheral vein may be difficult [1]. The central insertion of PICC catheters is practiced at certain facilities, and there are no specific differences in the management compared to peripherally inserted PICC catheters [2]. There was a risk of bloodstream infection (0.73% vs. 0.24%) [3] for both peripheral and central catheters as an invasive measure. In addition, complications including venous thromboembolism (0.93% vs. 0.52%) [3], catheter blockage, phlebitis, and bleeding were also possible. This report briefly describes a case of acute respiratory failure and massive pleural effusion resulting from catheter misplacement.

Case presentation

A 5-month and 9-day-old male infant was admitted to the pediatric surgery department for crying and vomiting that persisted for 24 h. On the same day, computed

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Fig. 1 PICC catheter (*), inserted from the left side

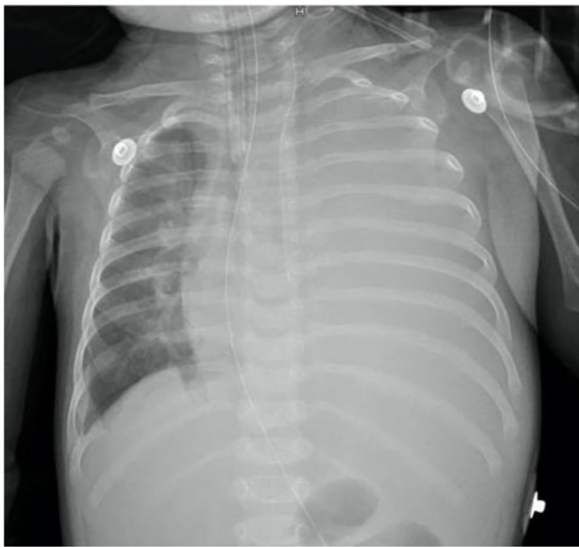


Fig. 2 Bedside chest X-ray, engorged thorax and white lung in the left side

tomography (CT) and ultrasonic inspection suggest Epigastric mass and “whirlpool” sign in superior mesenteric vessels. The infant was diagnosed with enteric volvulus and intestinal duplication. After an emergency operation, intestinal obstruction was relieved, and about a 3×4 cm diverticulum-like intestinal canal at a distance of approximately 55 cm from the duodenal flexor ligament against the mesenteric border was cut. There were also no episodes of hypotension, massive bleeding, or other unexpected events during the procedure.



Fig. 3 Ultrasound suggested massive pleural effusion, and severe collapsed left lung (*) with “jellyfish” sign

The infant was then transferred to PICU to receive post-operative therapy. To give parenteral nutrition (PN), a 3Fr PICC catheter (Bard Access Systems, Inc, Salt Lake City, Utah) was placed in the left internal jugular vein, after being admitted into PICU, guided by ultrasound. A bedside chest X-ray (CXR) (Fig. 1) was performed again to confirm the catheter tip’s location. Considering his condition, supportive treatments like mechanical ventilation, intravenous infusion, sedation, and analgesia were given, and arterial blood gas (ABG) (pH=7.38, PaO₂=173.2mmHg, PaCO₂=23.7mmHg, BE=-9.61, FiO₂=50%, Hb=115.1g/L) indicated that his condition was normal. The infant was stable with an oxygenation index greater than 300 on the second day after surgery. After a spontaneous breathing trial, we removed the endotracheal tube. One hour later, the infant showed severe dyspnea with oxygen saturation decreased, ABG (pH=7.24, PaO₂=72mmHg, PaCO₂=44mmHg, BE=-8.33, FiO₂=50%, Hb=106.9g/L) suggested acidosis. Following intubation, a bedside CXR was performed, which showed an almost white left lung (Fig. 2). Bedside ultrasonography showed a 26.9 mm liquid dark area with heterogeneous echogenicity (Supplementary file. 1) in the left thoracic cavity, along with the complete collapse of the left lung, showing a typical “jellyfish” sign [4] (Fig. 3). We considered left-sided massive pleural effusion and excluded hemothorax since hemoglobin did not decline consistently. The thoracic puncture was then performed, and approximately 400 mL of light bloody fluid was drained out (Fig. 4). After recruitment maneuvers, milky fluid was drained out, which was propofol infused from PICC. 8 h after the effusion was drained, oxygenation improved consistently. At that time, given the need for continued sedation and analgesia as well as PN, a new PICC was placed.

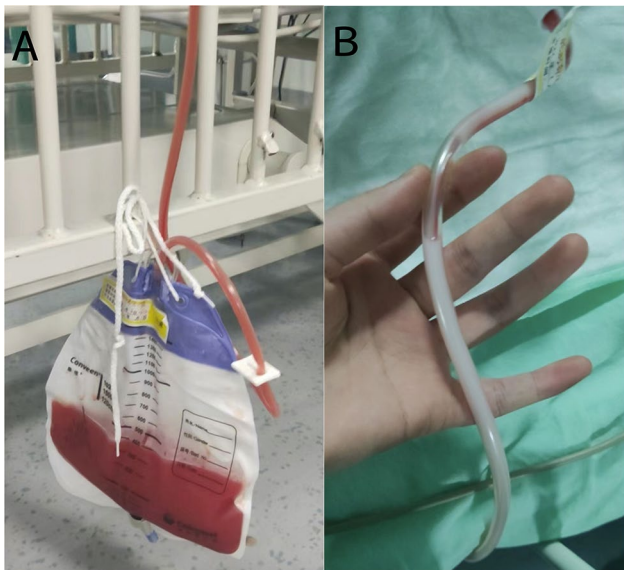


Fig. 4 Light bloody liquid in the drainage pack and milky liquid in the tube

A bedside CXR within 48 h showed complete drainage of effusion and left lung reexpansion. On the third day after drainage, the endotracheal tube was removed and the infant was transitioned to noninvasive ventilation. The infant was finally transferred to the general ward and discharged successfully.

Discussion and conclusion

PICC was first used to infuse PN in 1975 [5]. With the development of material science and the expansion of clinical application, it generally became the primary method to infuse critically ill patients. In 1905, Bleichröder applied a central venous catheter (CVC) to the patient for the first time [6] but did not popularize it. In 1949, Duffy used CVC in different types of patients for treatment [7]. Since the invention of PICC, there has been a trend to replace CVC, especially in pediatric critically ill patients and cancer patients undergoing chemotherapy. In some research about PICC, the viewpoint about making CVC out of use is even presented due to the protectiveness, safety, durability, and comfortability of PICC [8–11].

In PICC placement, the modified Seldinger technique is now mostly used for punctures, along with ultrasound-guided placement. Using ultrasound to guide the procedure has been proven necessary for improving the safety and success rate of catheter placement [12, 13]. After PICC is placed, a CXR is often used to ensure the catheter is in the proper position. According to the Infusion Nurses Society (INS) practice standards, The PICC tip should be positioned either in the lower third of the superior vena cava (SVC), the upper third of the right atrium (RA), or near the right cavoatrial junction (CAJ).

For lower body insertion catheter, the tip should be positioned in the inferior vena cava (IVC) above the level of the diaphragm [14–16]. In the case presented here, a bedside CXR was performed to affirm the location of the catheter after it was placed. Following operator confirmation, fluid infusion started through PICC. However, the tip of the catheter was positioned in the left thoracic cavity rather than SVC, ultimately causing iatrogenic injury (pleural effusion, atelectasis, and respiratory failure). Tip positioning via fluoroscope of the catheter is an important step in the placement of PICC. For infants and children, CXR positioning is also recommended [17], but it brings radiation damage and may cause long-term health problems [18].

Using the POCUS, intravascular electrocardiogram (ECG), and intravascular Doppler ultrasound can be applied to locate the catheter tip [19, 20]. For atrial fibrillation patients, the accuracy of intravascular ECG is equivalent to CXR [21, 22]. Nevertheless, for medical centers that lack equipment, POCUS can help to locate and also be used to monitor for complications during placement and fluid infusion. When the patient is in the supine position, placing the linear probe on the supraclavicular fossa can scan the long-axis view of bilateral subclavian veins afflux into the SVC and check the location of PICC [23]. Meanwhile, a phased array probe can scan a long-axis view of the IVC, right atrium, and inflowing segment of SVC in the subxiphoid, to check if the tip is in the right position, also avoid PICC being misplaced into the right ventricle to prevent arrhythmia and myocardial lesion [13]. POCUS can also monitor complications like tip dislodgement, accidental dislocation, and pleural effusion caused by dislodgement. In this case, POCUS was used to guide the puncture as well as to identify massive pleural effusion and atelectasis. It assisted in improving the infant's outcome from acute respiratory failure by tracing the origin of pleural effusion, preventing further injury to the patient.

In addition, proper fixation is an important step to ensure that the catheter and its tip remain in place for a long time after placement. Suture fixation was initially used to ensure the long-term use of the PICC catheter [24]. After the invention of suture-free catheter stabilization devices such as StatLocke device (Bard Access Systems, Inc, Salt Lake City, Utah) and SecurA cath®, many clinical studies have demonstrated that these stabilization devices not only ensure catheter placement compared to suturing, but reduce complications such as catheter-related bloodstream infection (CRBSI), leakage, and displacement [15, 25, 26].

Infants and children are at greater risk for medical emergencies [27–29]. Therefore, when performing invasive procedures, clinicians should pay increased attention to guiding the catheter, avoiding complications, and

monitoring patients' conditions. PICC is widely used in critical pediatric patients, whose complications related to the procedure are not rare. It is highly recommended to utilize POCUS throughout the entire process of PICC management, encompassing puncture and catheterization, confirmation of tip position, as well as monitoring for complications.

Abbreviations

PICC	peripheral intravenous central catheter
PICU	pediatric intensive care unit
PVA	peripheral venous access
CT	computed tomography
PN	parenteral nutrition
ABG	arterial blood gas
CXR	chest X-ray
CVC	central venous catheter
INS	Infusion Nurses Society
SVC	superior vena cava
RA	right atrium
CAJ	cavoatrial junction
IVC	inferior vena cava
POCUS	point-of-care ultrasound
ECG	electrocardiogram
CRBSI	catheter-related bloodstream infection

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12887-024-04856-2>.

Supplementary Material 1

Supplementary Material 2

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None.

Author contributions

YZ wrote the original draft and realized conceptualization. YQ collected the data, and participated in writing and funding acquisition. JFA participated in writing, reviewing, and editing. WY conducted conceptualization, supervision, and project administration. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analyzed during the case are available from the corresponding author upon reasonable request. If anyone needs data, please contact Wanhong Yin, e-mail: yinwanhong@wchscu.cn.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient to publish this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors have disclosed that they do not have any conflicts of interest.

Financial disclosure statement

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