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Fibrin sheath of a peripherally inserted central catheter undepicted with gray-scale (real-time B-mode) ultrasonography: A case report

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ABSTRACT

An 11-year-old male was admitted to our hospital with the acute exacerbation of chronic heart failure. A peripherally inserted central catheter (PICC) was inserted from the left forearm. Ten days after its insertion, the withdrawal of PICC was attempted because of occlusion. However, it was not possible to remove PICC because a fibrin sheath had attached around its tip. A color Doppler and probe compression technique revealed the presence of a fibrin sheath, which could not be detected by gray-scale (real-time B-mode) ultrasonography. This case demonstrated that the color Doppler and probe compression technique is useful for detecting a fibrin sheath.

Introduction

A peripherally inserted central catheter (PICC) is a type of central venous catheter that is inserted through peripheral veins in the extremities. PICC is generally used under the following conditions: (1) when venous access for a prolonged period is needed; and (2) when substances that are difficult to administer from peripheral veins, such as chemotherapeutic agents, have to be injected directly into the central veins. Venous occlusion due to thrombosis or fibrin sheath formation is associated with this device [1]. Previous studies reported that a fibrin sheath may form around venous access devices. Although a fibrin sheath is typically depicted as a high echoic lesion with ultrasonography [2,3], that around PICC in the present case showed unusual findings. We herein report the ultrasonographic findings of a fibrin sheath surrounding the tip of PICC in our case and review the literature.

Competing Interests: The authors have declared that no competing interests exist.

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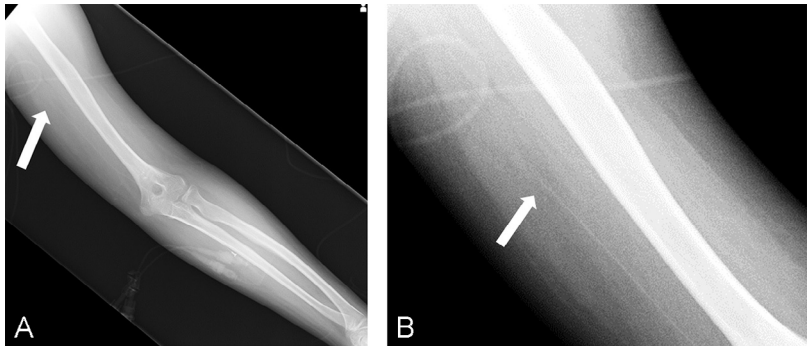

Fig. 1 – (A) Radiograph of the left forearm after catheter insertion. (B) An enlarged image around the tip of the peripherally inserted central catheter (PICC). The tip of PICC was present at the level of the left upper arm (arrows).

Case report

An 11-year-old male with Duchenne muscular dystrophy, who was being monitored due to chronic heart failure, was admitted to our hospital with the acute exacerbation of chronic heart failure. The insertion of PICC was attempted through a peripheral vein in the left forearm. However, as it was not possible to forward the tip of PICC proximally beyond the level of the left upper arm, it was used as a peripheral venous line (Fig. 1). Ten days after its insertion, the withdrawal of PICC was attempted because it was occluded. However, its complete withdrawal was not possible; a length of 7 cm remained in the vein. Heparin (8 U/kg/day) was administered to resolve PICC tip anchoring. One day later, the tip of PICC was withdrawn further, and radiography revealed that a length of 1 cm remained in the vein; therefore, it was still not possible to completely remove PICC (Fig. 2). To identify the cause of PICC tip anchoring, ultrasonography with a 5-18 MHz linear probe was performed (HI VISION Ascendus, Hitachi Aloka Medical Ltd, Tokyo, Japan). In the peripheral vein of the left upper arm, ultrasonography showed a fine and slightly meandering high echo, which was considered to be the tip of PICC (Fig. 3). The circumference of the tip of PICC was shown as a hypoechoic area, similar to a normal venous lumen, on ultrasonography; an abnormal echoic lesion that may cause anchoring, such as thrombosis, was not detected (Fig. 3). On color Doppler and power Doppler imaging, there was no blood flow around the PICC tip (Fig. 4). Using manual compression with the probe, the venous lumen at the PICC tip did not change shape (Fig. 5). In the distal vein without PICC, the shape of the venous lumen was easily changed by compression with the probe.

Although abnormal echogenicity was not directly detected in gray-scale (real-time B-mode) imaging, we considered there to be some lesions around the tip of PICC based on these indirect ultrasonographic findings with the color Doppler and probe compression technique. Because it was not possible to manually pull PICC out, the catheter was removed surgically. A fibrin sheath that was elongated, reddish, and translucent was observed at the tip of PICC (Fig. 6). Fibrin sheath formation was detected around the tip of the removed catheter, which tested negative in a bacterial culture.

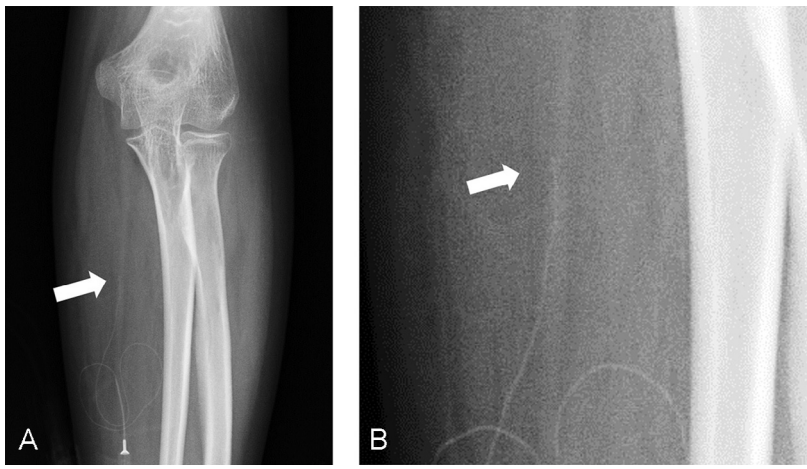

Fig. 2 – (A) Radiograph after withdrawal 10 days after catheter insertion. (B) An enlarged image around the tip of the peripherally inserted central catheter (PICC). It was not possible to pull PICC out, and the PICC tip (1-cm length) remained in the vein of the forearm (arrows).

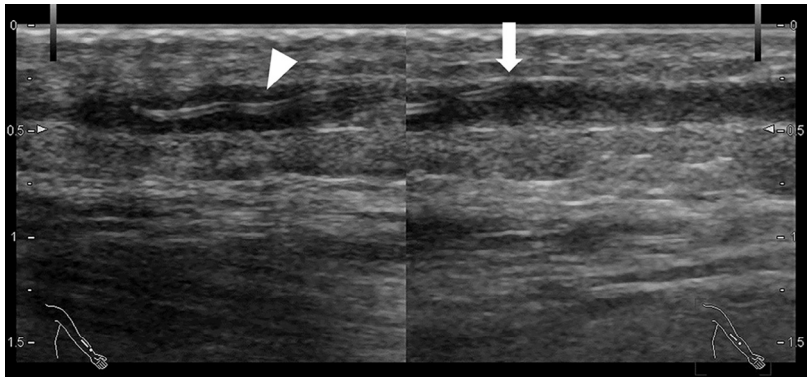

Fig. 3 – Ultrasonography around the tip of the catheter left in the vein of the left forearm (arrow: inserted portion). The linear hyperechoic line is the catheter (arrowhead). There was no abnormal echogenicity around the catheter.

Discussion

Fibrin sheaths form around catheters and often cause the stenosis or occlusion of a central venous catheter [4]. Fibrin sheath formation around a venous central catheter sometimes leads to persistent occlusion that may result in chemotherapy extravasation [5] and enhance catheter-related infections [6] and persistent bacteremia [7].

Previous studies reported that fibrin sheaths were depicted as high echogenic lesions with ultrasonography [2,3]. However, difficulties were associated with detecting the fibrin sheath around the PICC tip in the present case using gray-scale (real-time B-mode) ultrasonography because the fibrin sheath was hypoechoic, similar to the lumen of the vein. A potential reason for this phenomenon was the histological composition of the fibrin sheath. Histopathologic studies using animal experiments for fibrin sheaths have been conducted. In a previous study using a swine model [8], the sheaths of catheters inserted for 7 days contained a partial or circumferential mixed cellular and noncellular covering consisting of smooth muscle cells, a thrombus, and areas with endothelial cell populations. After 14 days, the sheaths of catheters showed the prominent proliferation of endothelial cells and smooth muscle cells. The sheaths of catheters at 30 and 45 days showed less prominent cellularity and greater collagen content than those

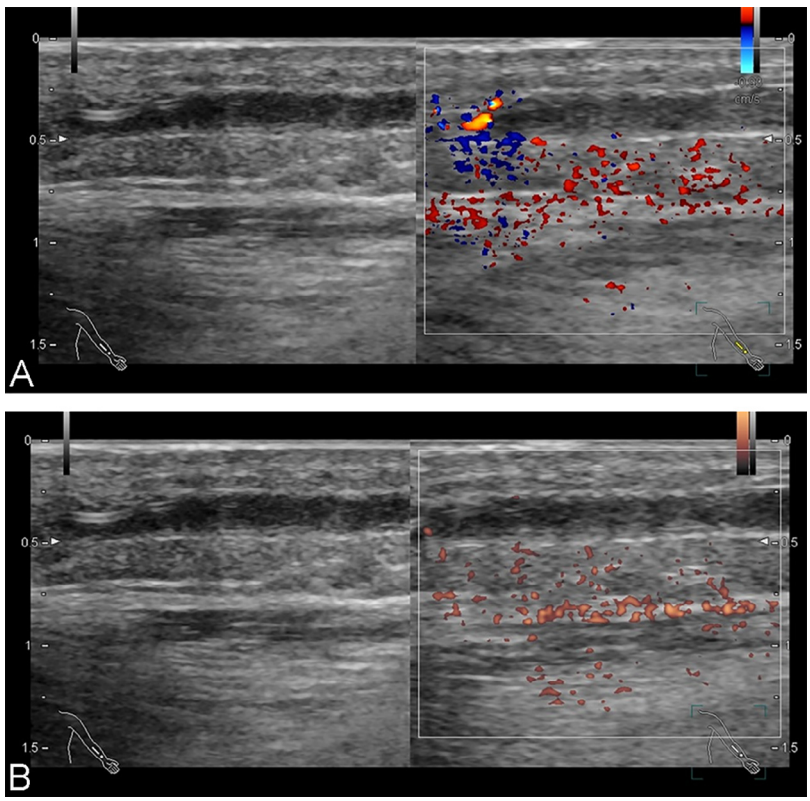

Fig. 4 – Color Doppler image (A) and power Doppler image (B) did not reveal blood flow around the catheter.

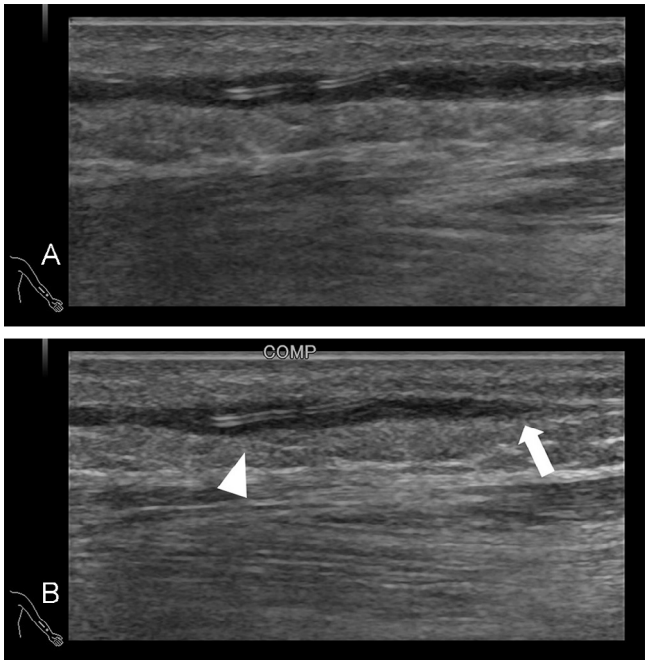

Fig. 5 – (A) Ultrasonography of the catheter tip. There was no abnormal echogenicity around the tip of the catheter. (B) Gray-scale (real-time B-mode) image with the probe compression technique. In the area of the vein without the catheter, the vein was easily compressed (arrow). However, the shape of the vein around the catheter tip did not change (arrowhead).

at 7 and 14 days. In another study using rats [9], the sheaths of catheters inserted after 3 days consisted of a thrombus containing red and white blood cells as well as fibrin. After 7 days, the amount of fibrin in the sheaths decreased. The thrombus of the sheath became organized by mesenchymal cells and was more cellular. After 2 months, there were few fibrin strands in the sheaths. The thrombus of sheaths became an almost completely organized fibrous connective tissue containing numerous spindle-shaped fibroblasts and collagen. This sheath is called a "fibrin sheath" because it contains fibrin. However, this term is not accurate because the sheath may only contain fibrin at the early stages (3-7 days in rats). The fibrin sheath may contain various components such as a thrombus, endothelial cells, and collagen [8,9]. Moreover, these components change over time. Thus, echo findings may change over time depending on changes in fibrin sheath components. We were unable to pathologically examine the sheath of the catheter in the present case because the whole fibrin sheath around the tip was subjected to a bacterial culture. Discrepancies in echo findings between the present and previously reported cases may be attributed to differences in the components of fibrin sheaths and the timing of ultrasonography.

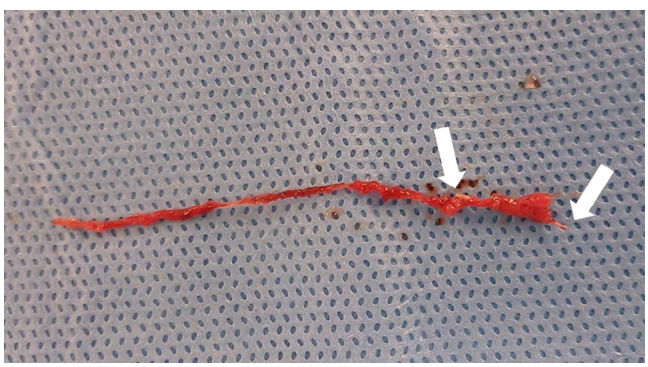

Fig. 6 – Fibrin sheath formation was detected around the tip of the removed catheter (arrow).

This chronological change in echogenicity has also been reported in the echo findings of deep venous thrombosis. The echogenicity of venous thrombosis differs depending on the time course. A fresh thrombosis is depicted as a hypoechoic lesion on ultrasonography. On the other hand, a clot at a chronic stage is echogenic [10]. Therefore, color Doppler and probe compression may be necessary for the diagnosis of deep venous thrombosis [10]. In our case, both of these techniques contributed to identifying the fibrin sheath because gray-scale (real-time B-mode) ultrasonography did not detect it. Therefore, we consider color Doppler imaging with probe compression to also be needed to confirm a diagnosis of fibrin sheaths in veins.

Conclusion

Ultrasonographic findings of a fibrin sheath may change in a time-dependent manner. Color Doppler with probe compression may be useful for accurately diagnosing a fibrin sheath.

REFERENCES

[1] Liem TK, Yanit KE, Moseley SE, Landry GJ, Deloughery TG, Rumwell CA, et al. Peripherally inserted central catheter usage patterns and associated symptomatic upper extremity venous thrombosis. J Vasc Surg 2012;55:761–7.
[2] Ríos-Méndez RE, Giménez P. [Intracardiac persistence of pericatheter fibrin sheath in a newborn: case report]. Arch Argent Pediatr 2014;112:e9–12.
[3] Sinno MC, Alam M. Echocardiographically detected fibrinous sheaths associated with central venous catheters. Echocardiography 2012;29:E56–9.
[4] Hacker RI, Garcia Lde M, Chawla A, Panetta TF. Fibrin sheath angioplasty: a technique to prevent superior vena cava stenosis secondary to dialysis catheters. Int J Angiol 2012;21:129–34.
[5] Mayo DJ. Fibrin sheath formation and chemotherapy extravasation: a case report. Support Care Cancer 1998;6:51–6.
[6] Mehall JR, Saltzman DA, Jackson RJ, Smith SD. Fibrin sheath enhances central venous catheter infection. Crit Care Med 2002;30:908–12.
[7] Lloyd DA, Shanbhogue LK, Doherty PJ, Sunderland D, Hart CA, Williams DF. Does the fibrin coat around a central venous catheter influence catheter-related sepsis? J Pediatr Surg 1993;28:345–8.
[8] Forauer AR, Theoharis CG, Dasika NL. Jugular vein catheter placement: histologic features and development of catheter-related (fibrin) sheaths in a swine model. Radiology 2006;240:427–34.

[9] O'Farrell L, Griffith JW, Lang CM. Histologic development of the sheath that forms around long-term implanted central venous catheters. JPEN J Parenter Enteral Nutr 1996;20:156–8.

[10] Raghavendra BN, Horii SC, Hilton S, Subramanyam BR, Rosen RJ, Lam S. Deep venous thrombosis: detection by probe compression of veins. J Ultrasound Med 1986;5:89–95.