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Calcified central venous catheter fibrin sheath: case report and review of the literature

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ABSTRACT

We present a 6-year-old girl with acute lymphoblastic leukemia who demonstrated on chest X-ray a radiopacity in the superior vena cava after removal of an implanted venous access device. This radiopacity was initially thought to be a retained catheter fragment. On review of previous imaging, we were able to document the temporal development of a calcified catheter cast as distinct from the catheter. This case represents a rare consequence of central venous catheterization in children. Knowledge of this finding as a possible complication may help avoid performance of unnecessary follow-up imaging or invasive procedures.

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1. Introduction

Central venous access devices have been used in pediatric patients who require chemotherapy, transfusions, and blood sampling for an extended period of time. These catheters allow large volumes to be delivered to patients in a short time and also allow for the delivery of medications that may be irritating to peripheral veins. Long-term access to the central venous system may be achieved by direct venous puncture of the internal jugular, cephalic, or subclavian veins with the tip of the catheter positioned at the right atrium or superior vena cava [1].

Removal of chronically implanted central venous access device in the pediatric population can occur in the operating room or in the interventional radiology suite depending upon the institution, age of patient, and complexity of intervention. Potential complications associated with central venous access removal include thromboembolism, hemorrhage, and catheter fracture with retained fragments. A calcified catheter "cast," more commonly referred to as a fibrin sheath, is a known possible consequence of central venous catheterization that may be mistaken for the presence of a retained catheter fragment. We present a patient with a calcified catheter fibrin sheath in the superior vena cava identified on follow up chest X-ray after removal of an implantable venous access device. Because of its uniform shape and presence of central lucency, this was initially felt to be a retained fragment of catheter. However, the operative note clearly stated that the removed catheter was intact and measured to the same length as the time insertion. In retrospect, the fibrin sheath can be identified in various stages of formation over 18 months, which confirmed that this was not a piece of the catheter but rather a cast formed around it.

2. Case report

A 6-year-old female with acute T cell lymphoblastic leukemia presented to the surgical service for removal of a Port-a-cath after having successfully completed a course of chemotherapy. The patient's chemotherapy regimen had been prescribed according to the Children's Oncology Group protocol AALL0232 (vincristine, oral methotrexate, mercaptopurine, and prednisone). Eighteen months earlier, the child had insertion of a 5-Fr Infusaport (Kendall Healthcare, Mansfield, MA, USA) via the right internal jugular vein to facilitate chemotherapy administration.

On presentation, she was afebrile, with no signs of tenderness or erythema at the catheter site. Chest X-ray showed the tip of the right-sided central venous catheter at the junction between the superior vena cava and the right atrium. The patient was taken to the operating room for catheter removal. In the operating room, an incision was made over the port site on the right upper chest wall. The port was easily identified and dissected free from the surrounding tissues, but there was some difficulty in removing the central venous catheter as it appeared to be tethered in the neck. A second incision was made in the neck at the initial puncture site of the right internal jugular vein. The catheter appeared to be encased in a fibrous sheath within the soft tissues. The catheter was dissected free from the soft tissue fibrous sheath and was removed intact from within the internal jugular vein without appreciation of any intravascular sheath structure.

Follow-up chest radiograph revealed a 3-cm linear density overlying the superior vena cava with an appearance suggesting a residual catheter fragment (Fig. 1). Secondary to the uncertainty regarding the

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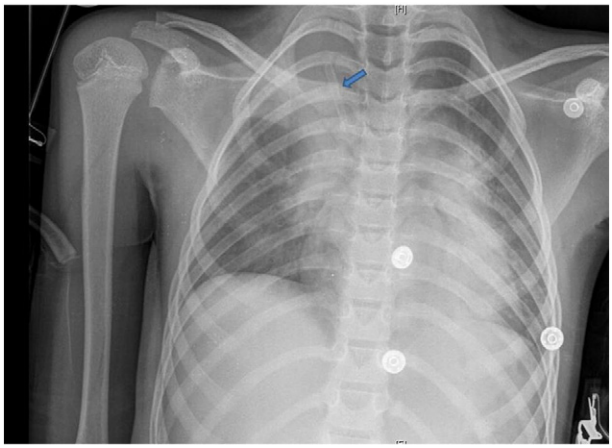

Fig. 1. Post catheter removal plain film reveals a 2-cm opacity suspicious for a retained catheter fragment.

possibility of a catheter fragment, the prior imaging on this patient was re-reviewed. Previous X-rays demonstrated development of a calcified fibrin sheath around the catheter over sequential examinations (Fig. 2). The consensus among the services was that the radiological finding was suggestive of a calcified fibrin sheath which formed circumferentially around the catheter while it was in situ and which remained after catheter removal and that further investigations or interventions were not necessary. The patient was subsequently discharged, and at 1-year follow-up postremoval, the fibrin sheath has become slightly denser but has not changed in position. Additionally, the patient remains disease free with no evidence of superior vena cava obstruction.

3. Discussion

Placement of a central venous catheter in children introduces several risks while in situ as well as at the time of removal, with reported complication rates of between 0.7% and 23% [2]. After catheterization, 42%–100% of central venous catheters are surrounded by a fibrin sleeve which has been considered a cause of withdrawal occlusion, catheter-related infections, and pulmonary embolism [3]. Retained elements or calcific fibrin sheaths after removal of a central venous catheter or implantable venous devices are less common, with few reports in the literature [4,5]. Despite this, the incidence of retained fibrin sheaths may be more common than previously thought. One study of 147 adults found fibrin sheaths to be present in 13.6% of patients who underwent computed tomographic (CT) scan after central venous catheter removal, with 45% of those being calcified [6]. The radiologic finding of a calcified fibrin sheath from a previously inserted catheter is significant as its appearance may be mistaken for a retained catheter fragment. Knowledge of this finding may prevent unnecessary interventions and is important to identify with regard to future line placement.

There have been a few case reports in pediatric literature that describe the retention of broken central venous catheters at the time of insertion or removal. If a catheter appears fixed when removal is attempted, the options are either to leave the catheter fragment in situ or to attempt either intravascular removal or open surgical removal. It is recommended that all central venous catheters be inspected and accurately measured at the time of removal to ensure that its length at extraction equals the length at insertion. In 2003, Jones et al. reported on a series of 132 central line removals in a pediatric population [7]. Of the 132, they reported 3 patients with retained catheter fragments after a difficult dissection. In these three cases, the physicians knew at the time of removal that a fragment had likely been left behind. In the current case, the catheter was felt to be intact on gross inspection, and its length was similar to that recorded at the time of insertion. The management of these patients can be more difficult as the actual diagnosis is not as clear-cut.

Various studies have reported on the association between the formation of intravascular sleeves and all categories of central venous catheter devices. The development of this sheath-like covering was reported first in the 1960s on an autopsy report showing a subclavian vein catheter surrounded by a visible sheath. These sheaths may be completely asymptomatic or can result in catheter occlusion, infusate extravasation, pulmonary embolus at catheter removal, or loss of the access site due to thrombosis [8]. The cellular development of this catheter sleeve has been described by Xiang et al. [3]. During the first week after catheterization, a thrombus is formed in the tissues surrounding the catheter as the foreign body activates the coagulation system and becomes coated by plasma proteins such as fibrinogen. Platelets then adhere and aggregate with subsequent activation of the intrinsic coagulation system next. The interaction between vein wall and catheter results in denudation of endothelial cells and activation of smooth muscle cells. After roughly 7 days, activated smooth muscle cells migrate from the injured vein wall into the pericatheter thrombus to transform it to a cellular–collagen tissue, covered by a layer of endothelial cells resulting in the development of a pericatheter sheath. This pericatheter sheath is composed of a well-organized tissue that cannot be dissolved in the blood stream and is permanently attached to the vein wall.

Thrombotic events in cancer patients are probably multifactorial and complicated by the use of antineoplastic drugs such as vincristine used in our patient [9]. These drugs may be harmful to endothelial cells by exposing the subendothelial matrix or inducing the expression of adhesion molecules on endothelial cell surfaces, increasing the reactivity of

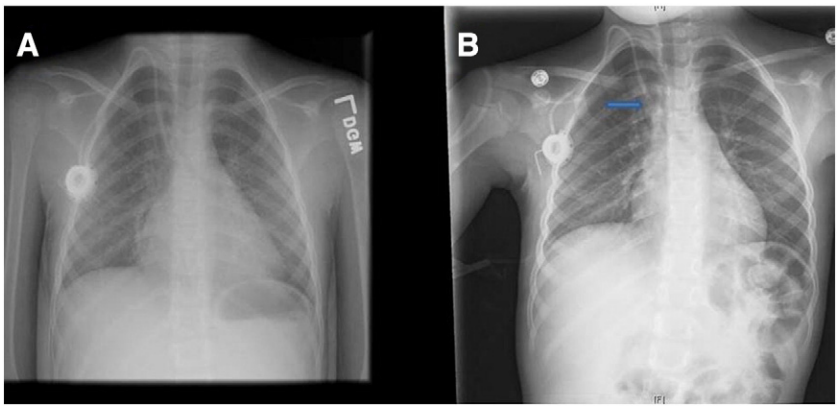

Fig. 2. (A) Plain film at 3 months post catheter placement. (B) Plain film at 12 months post catheter placement. The catheter has migrated, revealing the formation of the catheter cast at the distal end as marked by the arrow.

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