Pediatric Radiology (2023) 53:1207–1210
https://doi.org/10.1007/s00247-023-05599-5

CASE REPORT

Catheter fragment removal from a persistent left superior vena cava in a pediatric patient

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Received: 18 July 2022 / Revised: 21 December 2022 / Accepted: 11 January 2023 / Published online: 30 January 2023

Abstract
Tunneled central venous catheters and ports provide a long-term method of delivering nutrition, hydration, or medications in children. When these devices are no longer needed, it is best practice to remove them entirely. Complications associated with having long-term venous access devices or the process of device removal include site infections, venous thrombosis or occlusion, device fracture, and possible migration of fractured fragments. We present a case of catheter fragmentation that occurred in a pediatric patient during removal of a 3-year-old left chest port that had been placed into a left superior vena cava (SVC).

Keywords Implanted central venous ports · Persistent left superior vena cava · Coronary sinus · Catheter fragmentation · Children · Central line

Introduction

Types of long-term central venous accesses in pediatric patients include tunneled central venous catheters and central venous ports. Ports provide an ideal method of long-term intermittent delivery for medications such as chemotherapy agents, enzyme infusions, electrolytes, or hydration in the pediatric population. When patients no longer require central venous access, it is best practice to have the device removed in order to eliminate the potential complications of long-term indwelling catheters, such as infection, vascular thrombosis or occlusion, and catheter migration or fracture. Complications can also occur during the process of catheter removal. Of these complications, catheter fragmentation and retention are one of the least common, occurring only in 0.4–2% of all long-term central venous catheter removals [1]. We present a case of port catheter fracture and subsequent retrieval through the coronary sinus that occurred during removal of a left chest port placed with its distal tip in a left superior vena cava in a child.

Case report

A 5-year-old female who was born via C-section at 38 weeks gestation was found to have long-chain L-3 hydroxyacyl-CoA dehydrogenase deficiency on newborn screening. She had multiple complications due to her deficiency including the following: end-stage renal disease secondary to focal segmental glomerulosclerosis requiring living related donor renal transplant, erythropoietin resistant anemia, iron overload due to multiple transfusions, hypocellular bone marrow, and developmental delay. An echocardiogram was performed as part of her workup which documented a dilated coronary sinus with a left superior vena cava (SVC). Due to her need for enzyme therapy, a decision was made to place an implanted central venous port at the age of 20 months and weight of 9.9 kg. A 5 French port was placed from a left external jugular vein cutdown approach involving encircling the vein with 4-0 Vicryl suture. The tip of the port catheter was placed at the left SVC coronary sinus junction region

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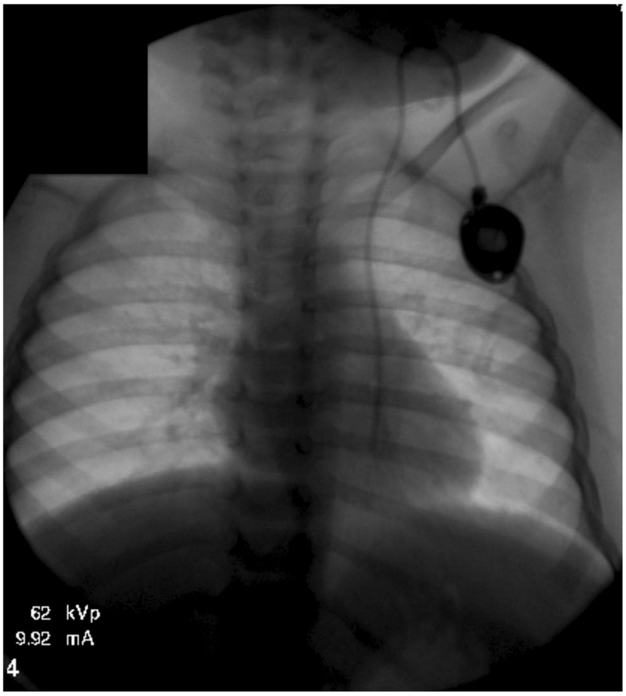

Fig. 1 Pre-operative posteroanterior fluoroscopic chest image—a 5-year-old female with left chest wall implanted venous port. Catheter courses from left neck venous access site into a patent left superior vena cava (SVC)

(Fig. 1). It is unclear why a left, rather than right, chest port was decided upon, although we speculate the operator was not aware of the anatomical variant prior to performing the cutdown. The port had intermittent difficulty aspirating blood, requiring several contrast injection studies. Contrast studies failed to demonstrate a fibrin sheath and after 3 years of dwell time and increasing familial frustration with port dysfunction, the decision was made to remove the left chest port and place a new right sided port.

After general anesthetic induction, the pre-existing scar was opened and the port reservoir was identified and freed from the surrounding tissues. The port catheter, however, was found to be well adhered in the subcutaneous tract. Gentle tension did not free the catheter but instead led to the catheter stretching to the point of nearly breaking. Blunt and sharp dissection also failed to release the catheter from the surrounding tissues. The site of maximal catheter adhesion appeared to be the neck venotomy site. For this reason, the skin overlying the venotomy site in the left neck was prepped and anesthetized. A small skin incision was made over the region of the subcutaneous port catheter in the neck. The catheter was freed from the surrounding subcutaneous tissue and fully exposed. At this point, the catheter was cut and a 0.035-inch stiff hydrophilic guidewire was advanced via the catheter into the inferior vena cava by going through the coronary sinus and right atrium (Fig. 2). The port reservoir and the attached subcutaneous catheter were then

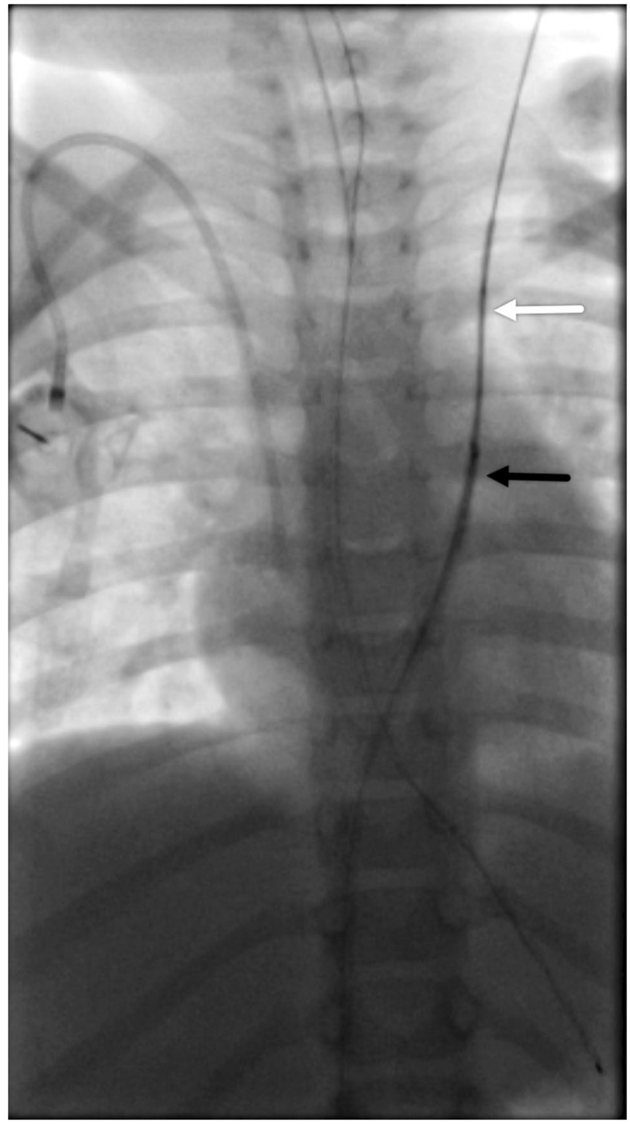

Fig. 2 Intraprocedural posteroanterior fluoroscopic image—a 5-year-old female with through and through guidewire access from left neck via left SVC, coronary sinus, right atrium, and into inferior vena cava. A loop snare (black arrow) is shown pulling the intravascular catheter fragment (white arrow) over this through and through guidewire. A new right sided implanted venous port is in place, which was placed during the same procedure prior to removal of left sided malfunctioning venous port

dissected free and able to be removed. An attempt to dissect the remaining catheter (with the guidewire through it) free from the tissue was made. While holding traction and pulling on the catheter, the catheter fractured allowing only a small portion to be removed. Most of the catheter remained within the left SVC.

Ultrasound-guided right common femoral vein access was obtained with subsequent placement of a 10 French short vascular sheath. Through the sheath, a 4 French by 10-mm Amplatz Gooseneck Snare was advanced to grasp the floppy end of the 0.035-inch stiff hydrophilic guidewire, previously passed through the port catheter and left in the inferior vena cava after coursing via the coronary sinus and right atrium from the left SVC. The stiff hydrophilic guidewire was then pulled out through the femoral vein sheath while maintaining hold of the other end coming out of the left neck incision with a hemostat, thus providing “through and through'' access. Next, the snare was advanced over the hydrophilic guidewire and used to grasp the intravascular portion of the retained port catheter as cranially as possible (Fig. 2). Retracting with the snare also led to catheter breakage and removal of only a small portion of the catheter. This small portion was pulled out through the groin sheath and then the snare was re-advanced and again used to grasp the retained portion of the catheter as cranially as possible. While retracting the snare from the femoral vein side, a 6 French dilator was advanced over the 0.035-inch hydrophilic guidewire from the left neck site in an attempt to loosen the fragment and allow for it to be removed from the groin sheath. This proved to be successful and all fragments of the port catheter were removed via the groin venous sheath. Fluoroscopic images confirmed no retained catheter fragments.

Discussion

Implanted venous ports are commonly placed for long-term reliable central access. Generally, these ports are removed without difficulty once they are no longer needed or device failure occurs. Overall catheter fracture with subsequent retention is a rare complication of all port removals, only occurring in 0.4–2% [1]. Factors leading to catheter fragmentation are unclear. Presumably, fixation of these catheters is caused by formation of a scar often with calcification of the fibrin sheath around the catheter. Fixation by scar tissue may extend far along both the intravascular and extravascular aspects of the catheter which may explain why these fragments are so resistant to dislodgement. In our experience, small catheter size and long indwell time make removal of these devices challenging. Teague et al. performed a single-center study assessing the outcome of removal for all pediatric ports by pediatric surgery or interventional radiology [2]. Their data shows complications occur when removing smaller caliber ports (less than 6 French) or after longer indwell times (greater than 2 years) [2]. Additionally, some authors have postulated that silicone catheters are more prone to adherence and fragmentation than polyurethane catheters, but other studies have failed to reach the same conclusion.

A left SVC is present when involution of the anterior cardinal vein does not occur. The prevalence of left SVC was found to be 0.3%; in 80–90% of such cases, the right SVC is also present [3]. It is reported that left SVC is more frequently connected to the coronary sinus (92%) rather than the left atrium (8%) [3]. If the anatomy of a left SVC has not been characterized prior to the procedure, a venogram is essential to confirm that the left SVC drains into the right atrium via the coronary sinus. Once the anatomy is established, a catheter and loop snare can be cautiously passed across the coronary sinus from the left SVC into the inferior vena cava (as was performed during this case), allowing for retrieval of catheter fragments from a groin venous approach. However, the operator should be aware of the risks when manipulating the coronary sinus in patients with left SVC because hypotension, angina, and cardiac arrest may occur as noted by Kwon [4]. This is due to the fact that the coronary sinus contains pacemaker cells which can lead to arrhythmia when manipulated by intravascular devices [5]. If the left SVC drains to the left atrium, arterial embolization can occur [5]. These risks should be accounted for when preparing for any intravascular procedure in patients with left SVC.

There are numerous published case reports describing retrieval of intravascular catheter fragments and foreign bodies. Of these, one study describes the retrieval of a fragmented guidewire from a left SVC but via left upper extremity venous approach [6]. This, however, is the first report of retrieval of a catheter fragment from the left SVC. Additionally, interventions performed via the coronary sinus have been described previously in the cases of pacemaker lead insertion, inferior vena caval filter placement, and creation of transjugular intrahepatic portosystemic shunts [3]. These papers validate the theory that interventions which require crossing the coronary sinus can be performed safely if the anatomy is known and the right tools are used.

The technique described in this case report for removal of adherent venous catheter fragments has been described previously albeit with small differences, in a prior case series [7]. In the authors' opinion, small caliber ports (less than 6 F) or long indwell times should necessitate guidewire placement through the port tubing to aid in port removal. Achieving through and through access at the time of catheter removal allows the entire catheter to be retrieved safely even if fragmentation occurs and prevents embolization into the pulmonary circulation. Using peel-away sheaths, balloons, or vessel dilators to dislodge the endothelialized segment of the stuck catheter fragment by pushing the fragment rather than pulling it via a snare only, is also made possible by this strategy. In the author's opinion, pushing the vessel dilator over the guidewire inside the catheter fragment stretches the catheter fragment as well as the surrounding fibrin sheath which allows for movement of the catheter fragment independent of the fibrin sheath subsequently. Pulling of the catheter fragment can also be attempted; however, we feel that it leads to further breakage of the fragment and most commonly results in incomplete removal. Huang et al. described a similar concept [8] where they placed a stiff guidewire through the stuck catheter fragment to help disengage the catheter fragment from surrounding tissues. Some authors have suggested a left upper extremity venous approach for retrieval of foreign bodies from a left SVC. We did not use this approach because only the free central end of the catheter fragment could be snared and the angles would have been very unfavorable to pull the entire fragment out over a guidewire.

Intervention through the coronary sinus can be used for procedures as a route to reach a left SVC. If catheter removal is perceived to be difficult, early placement of a guidewire through the catheter will prevent catheter migration in case of fragmentation and provide a means by which the fragment can be removed. In our opinion, ports, which meet the previously stated criteria, should preferentially be removed by an operator with an endovascular skill set, and knowledge of the risks associated with manipulation of catheters and guidewires in the coronary sinus, since there are endovascular techniques available to remove the port catheter in its entirety, with avoidance of serious adverse effects.

Declarations

Conflicts of interest None

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