

## Catheter fragment embolization: a rare yet serious complication of catheter use in pediatric oncology

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Embolization is a rare but serious complication of venous central catheters in pediatric oncology. The reported cases in the literature are due in common to catheter ruptures. The most common cause is constant compression of the costoclavicular arch, known as “pinch-off” syndrome. We report a seven-year-old boy in whom embolization occurred as a late complication. Difficulty in the dissection of dense collagen periportal fibrosis was the main problem during the extraction session. The embolization occurred 10 months later. In an elective setting, percutaneous retrieval techniques were used successfully to extract the catheter fragments, and full recovery was achieved.

**Key words:** catheter surgery, catheter complications, embolization, retrieval devices, pinch-off syndrome.

Central catheters can cause a wide range of serious complications starting from the very first day of surgical engraftment. Possible complications regarding catheter applications have been previously reported as mechanical problems, thrombotic or malfunctioning catheters and infectious problems<sup>1,2</sup>. On rare occasions, severe complications like embolization during their use have also been observed in 0.1 to 1.5% of cases<sup>3,4</sup>. Since embolizations have a sudden onset without specific symptoms, depending on the place and size of the material, the situation is mostly critical. The aim is to extract the foreign material as early as possible and to solve the arising problems accordingly<sup>5</sup>. Although catheter fragmentation is an uncommon type of failure in catheter use, it can be seen even years after the extraction<sup>6</sup>. Surov et al.<sup>7</sup> had reviewed all articles published in English between 1985 and 2007, and found pinch-off syndrome to be the most common cause for catheter fragmentation, in 40.9%. Other causes were catheter injury during extraction in 17.7%, catheter disconnection in 10.7% and catheter rupture in 11.6% of the cases. In 19.1% of the cases, the cause of catheter embolization could not be identified<sup>7</sup>. In this report, we demonstrated a late catheter embolization

several months after surgical extraction and performed successful retrieval via interventional percutaneous methods. We also discuss catheter fragmentations in general as a consequence of their use after surgical engraftment.

### Case Report

A seven-year-old boy was diagnosed with pre B cell acute lymphoblastic leukemia (ALL) in 2008 and was treated according to the Children’s Oncology Group protocol numbered 1952-standard risk ALL. His treatment consisted of three-drug remission induction. Since he was a slow early responder but still attained remission on day 28, treatment was continued with arm C of the same protocol, which is used for high-risk patients. During remission induction, as soon as his counts returned to normal and he was free of any infection, a port-a-cath was placed by an experienced surgeon in his right infraclavicular fossa, and its catheter was inserted through his subclavian vein to help and ease the treatment. His treatment course comprised consolidation, intensification, interim maintenance, and maintenance phases, and was uneventful except for several admissions for fever and neutropenia. He remained in complete remission throughout treatment. According to

his history, after three and a half years of use, an extraction session of the port-a-cath had taken place as part of a routine application. Because the silicon port catheter, which was very rigid, was deeply embedded into the tissue on the lateral wall of the subclavian vein, a failure was noted by the surgeon, who had also inserted the port-a-cath in the beginning. Further surgical exploration was determined risky by the surgical team, and the catheter was left in its place and the session terminated.

The patient was well for 10 months until he developed fever and signs of pneumonia. A plain chest X-ray did not reveal any apparent infiltration or diagnostic appearance, and a computerized tomography (CT) was carried out. The imaging revealed two fragments of the catheter one on the left pulmonary artery and the other at the junction of the vena cava superior and the subclavian veins (Figs. 1, 2), which could lead to a serious thromboembolic complication.

A simultaneous approach to both fragments was planned by the cardiologist occasionally using a snare in an elective percutaneous retrieval procedure. After general anesthesia, a 6F sheath was inserted in the right femoral vein. A 6F (0.56") multipurpose catheter was used to reach the desired position with the use of biplane fluoroscopy. A "gooseneck" Amplatz 4-mm microsnare (Microvena, White Bear Lake, Minnesota, USA) was inserted through this catheter first to catch the catheter

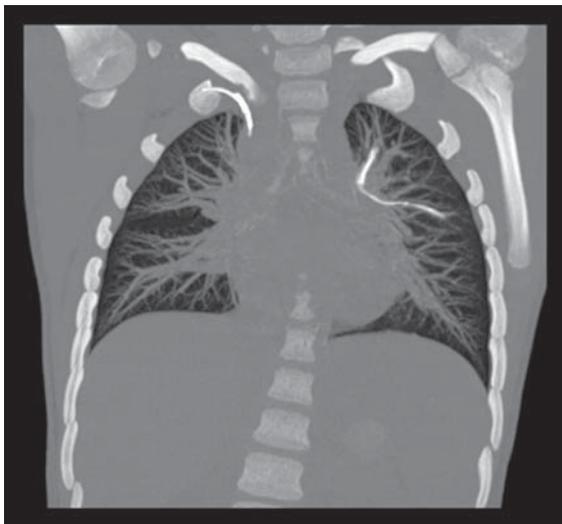


Fig 1. Fragments of the catheter on frontal CT plane

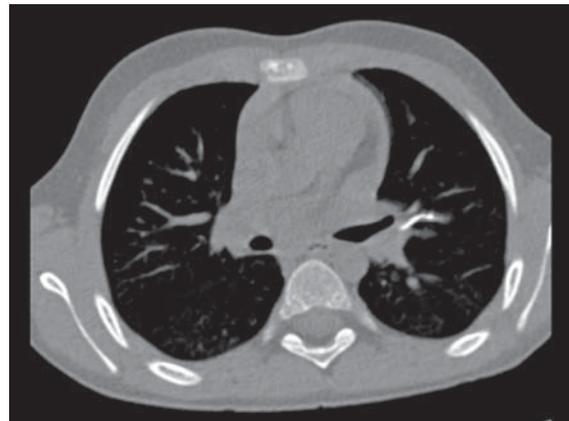


Fig 2. Fragment of the catheter on transverse CT plane

fragment located at the left pulmonary artery. This fragment of the catheter was captured easily by the snare catheter. The snare was then closed, and the procedure was completed by advancing the multipurpose catheter over the snare (Fig. 3). A serial capture along the free tail of the catheter fragment, which was stuck on the lateral wall of the vena cava superior, was then performed by moving along the "gooseneck" snare on the other side (Fig. 4). First the distal or free part of the catheter fragment was captured, and the snare was advanced to the proximal part that was adherent to the vessel wall. A slightly forceful pull-down was successful, and this procedure was finished without any complication. All the fragments were completely removed from the vasculature without causing any further fracture. The patient recovered completely with an additional 10-day course of antibiotic use without additional morbidity.

## Discussion

Catheter fatigue from prolonged use contributes to: *in situ* fracture, fragmentation and distal embolization. These catheter fragments migrate through large veins distally along the bloodstream. They may lodge finally in the vena cava, right atrium, right ventricle, or in the main pulmonary artery or one of its branches. Some serious complications due to embolization may occur, including myocardial infarction or necrosis, myocardial perforation, valvular perforation, arrhythmia, cardiac tamponade, and cardiac arrest. The catheter fragment might also act as a nidus for thrombus formation and lead to pulmonary embolism. There exists

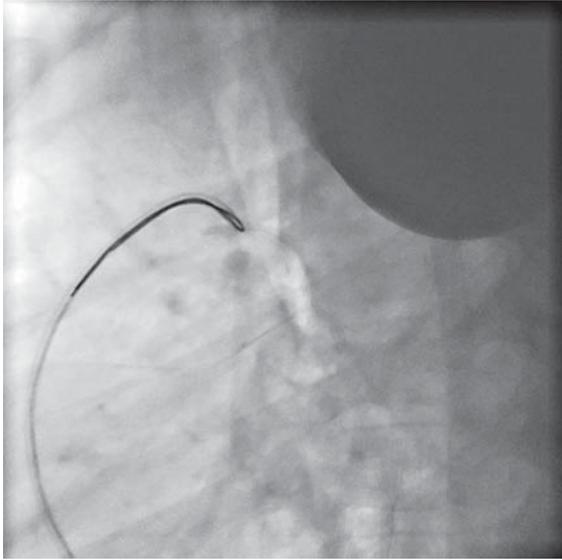


Fig 3. The capture of the catheter on the left pulmonary artery

some possibility of infectious complications, including endocarditis, secondary infection of the thrombi, and mycotic aneurysms, as well as pulmonary abscesses<sup>8</sup>.

Mortality depends on the duration as well as the site of embolization. In a 20-case review, Richardson et al.<sup>9</sup> found mortality highest when the foreign body was lodged in the right atrium and lowest when lodged in the pulmonary artery<sup>9</sup>. In one report, embolization was observed even 11 years after the catheter extraction due to catheter fragmentation<sup>6</sup>. The catheter fracture rate is highest among central catheters that are inserted from peripheral veins, with 9.7% reported in a series consisting of 322 applications<sup>10</sup>. The mortality rate was reported as 1.8% by Surov et al.<sup>7</sup> in 215 cases of catheter embolization. Advances in noninvasive methods like imaging help in both the diagnosis and treatment of this group of patients, with a better outcome<sup>8</sup>.

During or after an extraction procedure, the remnants of catheters persisting in the area should be removed by available percutaneous techniques. A number of different devices and techniques have been utilized to retrieve foreign bodies, including snare catheter, basket catheters, hooked guidewires, Fogarty balloon catheters, biopsy forceps, and filter devices<sup>11</sup>. The percutaneous retrieval of a broken segment of a spring steel guide from the right atrium and inferior vena cava was first reported in

1964<sup>12</sup>. The choice of device and technique used to perform foreign body retrieval are dependent on the circumstances and size of the foreign body. Before attempting percutaneous removal, noninvasive imaging may be considered to exclude thrombus that may predispose to pulmonary embolism. Wire snares among those above are the most commonly used retrieval devices available<sup>13</sup>. Since Yedlicka et al.<sup>14</sup>, gooseneck snares have been used successfully in various cases, and recently, their use has been adopted as the first-line therapy for all foreign body removals<sup>15-18</sup>.

Dismantling a full-length, unfragmented catheter during the extraction session is very important and requires a high concentration, especially for those catheters used for long intervals. Unapproachable or missing fragmented materials can be retrieved by percutaneous methods successfully in either an emergency or elective setting. In case of failure, surgery should be considered again to reduce the risk of morbidity. In some cases, however, removal of a foreign body may be extremely difficult, especially when both ends are fixed or entrapped, and thus impossible to grasp. In a failed extraction with those snares, surgical retrieval may be necessary despite the use of different extraction methods<sup>19,20</sup>. The thoracotomy rate was 2.3% in a large multi-center report consisting of 215 cases<sup>9</sup>.

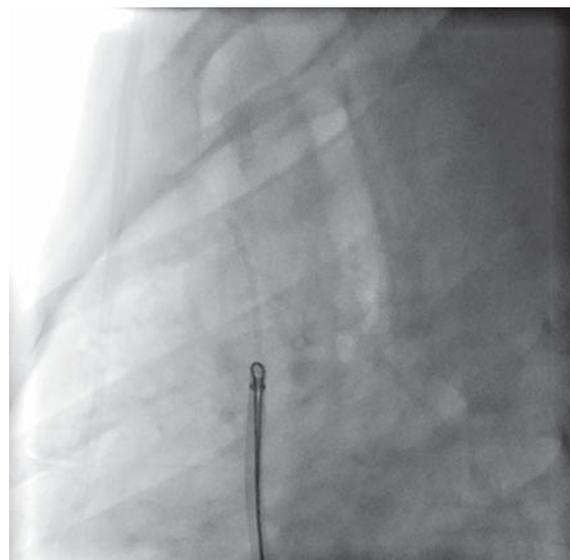


Fig 4. A serial capture along the free tail of the catheter fragment on the lateral wall of the vena cava superior

Repetitive microtraumas account for subcutaneous catheter fracture in some cases, and the remnants of these fractures might be harmful to the patient. Embolization itself is a serious problem and may cause significant morbidity in these patients. The catheter remnants should be extracted immediately by noninvasive interventional methods available or by a surgical approach to prevent short- and long-term morbidity.

In conclusion, catheter use in critically ill children and in childhood malignancies is a useful and safe way for administering chemotherapy as well as other supportive or therapeutic products. This report emphasizes the importance of precise and sequential teamwork for the management of the complications of catheter fragment embolization.

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