

Interventional radiological retrieval of embolized vascular access device fragments

Baran Önal, Bilgen Coşkun, Ramazan Karabulut, Erhan T. Ilgıt, Zafer Türkyılmaz, Kaan Sönmez

PURPOSE

Vascular access device fragment embolization is a relatively rare but potentially serious complication. The purpose of this study was to report our experience with endovascular retrieval of embolized vascular access device fragments by interventional radiological means.

MATERIALS AND METHODS

Ten patients with a vascular access device fragment embolism were treated between 2004 and 2010. Attempted retrieval from the vascular bed was performed for five port catheter fragments, two temporary catheter fragments and three guide wires. The demographic data, underlying disease of the patients, type of inserted catheters, interval between implantation and discovery of embolism, interval between discovery of embolization and retrieval and localization and length of the embolized fragments were identified from the patient charts.

RESULTS

In nine of the ten patients (90%), radiologic intervention retrieval of the embolized vascular access device fragments was successful. The reasons for intravascular fragment embolism consisted of rupture at the connection site of the chamber or the external hub and the intravascular catheter (n=4), pinch-off syndrome (n=3), operator inexperience (n=3). Embolized catheter fragments or guide wires were retrieved under fluoroscopy by a gooseneck snare. The postprocedural course was uneventful.

CONCLUSION

The radiological retrieval of embolized vascular access device fragments is the preferred method, and it has a high success rate. Considering the potential for devastating complications, patients should be referred to interventional radiology, and the embolized catheters should be retrieved using interventional endovascular techniques.

Key words: • catheterization, central venous • foreign bodies
• device removal • radiology • interventional

Central venous catheters and ports play an important role in the care of patients with oncological and gastrointestinal diseases and are commonly used for parenteral feeding and fluids and chemotherapy administration. Central venous catheters are also lifesaving in critically ill patients and are well accepted for hemodialysis access. Catheters and ports are usually implanted via the subclavian vein or the jugular vein. However, their use has been associated with some complications (1). The most common complications resulting from the insertion of central venous catheters are local bleeding and hematoma, heart dysrhythmias, arterial puncture, hemothorax, pneumothorax, air embolism, and perforation of the central vein or cardiac chamber. Infection, venous thrombosis, and catheter dysfunction are complications that occur after the insertion of a catheter. In addition to the insertion complications listed above, occlusion of the port, thrombosis, infection, catheter fracture, and intravascular dislocation are the major port complications.

Port catheter fragments or guide wire migration during catheter insertion can cause an embolism in the right atrium, right ventricle, or pulmonary artery. Severe complication rates of up to 71% have been reported for patients with catheter embolism (2–4). Dislocation and partial occlusion of pulmonary circulation can cause life-threatening complications, such as arrhythmias or pulmonary thromboembolism with hemodynamic changes.

Successful retrieval of these fragments can obviate the need for major surgeries. The purpose of this study was to present our experiences with the endovascular retrieval of embolized vascular access device fragments by interventional radiological means.

Materials and methods

We performed a retrospective analysis of consecutive patients referred to the radiology department for retrieval of embolized vascular access device fragments from February 2004 to July 2010. Ten patients (6 males, 4 females; age range, 10 months–90 years) were included in this study. All vascular devices were placed bedside or surgically by clinicians without imaging guidance. Five port catheter systems had been implanted through the subclavian vein (n=3, right side; n=2, left side). Two temporary catheters were inserted through the right subclavian vein (n=1) and right internal jugular vein (n=1). Attempts were made to insert three temporary catheters through the right femoral vein (n=2) and right internal jugular vein (n=1) by inexperienced physicians.

Patient charts were used to identify demographic data, underlying disease, type of inserted catheters, interval between implantation and discovery of embolism, interval between discovery of embolism and retrieval, and localization and length of the embolized fragment. In addition,

From the Departments of Radiology (B.Ö. ✉ baranonal@gazi.edu.tr, B.C., E.T.I.), and Pediatric Surgery (R.K., Z.T., K.S.), Gazi University School of Medicine, Ankara, Turkey.

Received 2 December 2010; revision requested 28 December 2010; revision received 4 January 2011; accepted 10 January 2011.

Published online 8 February 2011
DOI 10.4261/1305-3825.DIR.4098-10.1

tion, clinical symptoms on admission were noted.

Informed consent was obtained from all patients or the parents of patients. In all patients, diagnostic chest radiographs were acquired to confirm the exact location of the embolized fragments. Local anesthesia was applied in 8 patients and general anesthesia in two pediatric patients.

Embolized catheter fragments or guide wires were retrieved under fluoroscopy as soon as they were identified via the femoral veins in all patients, except for one patient whose fragment was retrieved via the left internal jugular vein. In two pediatric patients, a microsnares kit including a 2.3–3 F catheter and a gooseneck snare with a loop diameter of 4 mm (ev3, Plymouth, Minnesota, USA) was used. Embolized fragments were located in the pulmonary artery in these patients. For the other patients, snare kits including gooseneck snares with a loop diameter of 5 to 20 mm in 4 to 6 F catheters (ev3) were used because the fragment tips were in wider locations. To enclose the fragments caught with snares, 6 to 8 F introducer sheaths were preferred. In one patient, diagnostic 5 F pigtail and Simmons 1 catheters were used to migrate the catheter fragment to a location more suitable for catching it with the snare. The

catheter fragment lengths were measured after retrieval, and it was fluoroscopically verified that no catheter fragments were left. Three patients presented on an outpatient basis, and the others were already hospitalized for other reasons. No hospitalization specific to the procedure was required after the interventions.

Results

A total of ten patients with a catheter fragment or a guide wire embolism were treated. Embolized catheters were located in the pulmonary artery (n=2); brachiocephalic vein, superior vena cava and right atrium (n=2); superior vena cava and right atrium (n=1); superior vena cava, right atrium and hepatic vein (n=1); and right atrium and right ventricle (n=1). In other cases, guide wires extended from the right atrium to the femoral vein (n=1); from the femoral vein to the brachiocephalic vein (n=1); and from the femoral vein to the superior vena cava (n=1). The mean length of these fragments, other than the guide wires, was 10.1 ± 3.4 cm, with a range of 7 to 15 cm. The interval between the discovery of the embolism and the transcatheter retrieval ranged from < 1 day to 2 days (median, 1 day).

The demographic and clinical data for these patients are summarized in Table. Six of the ten patients with frag-

ment embolism were asymptomatic, and the remaining four, who were port patients, presented with pain that occurred at the injection site. None of the patients presented with arrhythmia or any other cardiological problems that indicate an embolism. Two pediatric patients (Cases 1 and 3) had surgery for port chamber and catheter removal. During the operation, it was realized that the port catheters were separated at the site of the chamber–catheter connection and were embolized. The other three adult patients also had a catheter rupture, but they were within the infraclavicular region, presumably as the result of pinch-off syndrome. In two patients with inserted temporary catheters, it was realized that the catheters were removed without intravascular catheter fragments. Ruptures at the connection site of the external hub and the intravascular catheter were also observed in these patients. In the last three patients, who had undergone attempted temporary catheter insertion, the guide wire had migrated into the vascular system because of operator inexperience.

In nine of ten patients (90%), the embolized vascular access device fragments were retrieved successfully under fluoroscopy by a gooseneck snare (Figs. 1 and 2) without any difficulty during the procedure or any immedi-

Table. Demographic and clinical data of the patients with the embolized fragments

Case Number	Age (years), gender	Diagnosis	Embolized fragment	Interval between implantation and discovery of embolism	Interval between discovery of embolism and retrieval	Localization of embolized fragment	Length of embolized fragment
1	55, M	Leukemia	Port catheter	1.5 years	<1 day	SVC-RA	9 cm
2	42, F	Breast cancer	Port catheter	2.2 years	2 days	SVC-RA-HV	15 cm
3	10/12, F	Rhabdomyosarcoma	Port catheter	5.5 months	<1 day	PA	8 cm
4	43, F	Breast cancer	Port catheter	1.5 years	<1 day	BV-SVC-RA	14 cm
5	3, M	Leukemia	Port catheter	2 years	<1 day	PA	7 cm
6	52, F	Pancreatic carcinoma	Dislodged temporary central venous catheter	5 days	1 day	RA-RV	8 cm
7	48, F	Aortic and mitral valve insufficiency, intraoperative catheter placement	Dislodged temporary central venous catheter	6 days	<1 day	BV-SVC-RA	-
8	90, M	Cerebrovascular event	Guide wire	<1 day	<1 day	FV to BV	>30 cm
9	76, M	Cerebrovascular event	Guide wire	<1 day	<1 day	FV to SVC	>30 cm
10	42, M	Necrotizing pancreatitis	Guide wire	<1 day	<1 day	RA to FV	>30 cm

M, male; F, female; SVC, superior vena cava; RA, right atrium; RV, right ventricle; HV, hepatic vein; PA, pulmonary artery; BV, brachiocephalic vein; FV, femoral vein.

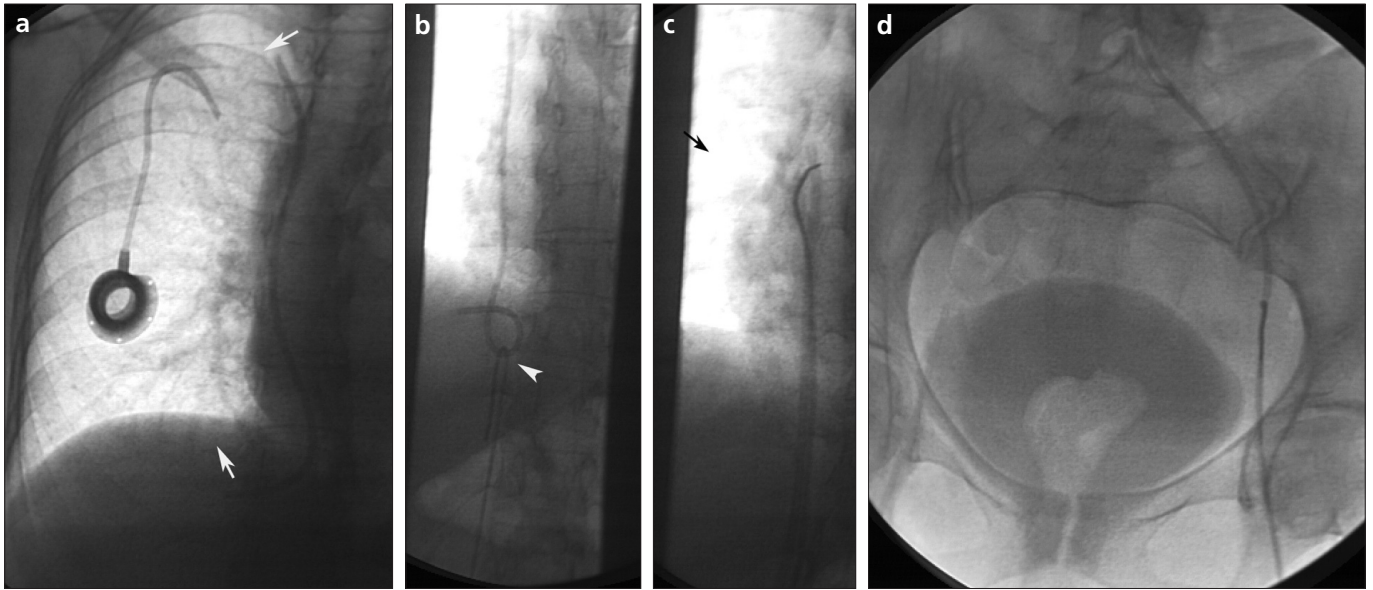


Figure 1. a–d. Port catheter retrieval with a diagnostic Simmons 1 catheter and gooseneck snare. Plain radiograph (a) shows the dislodged port catheter extending from the superior vena cava to the right hepatic vein (*white arrows*). Repositioning of the distal tip (b) toward the inferior vena cava by a Simmons 1 diagnostic catheter (*arrowhead*). Catching the displaced proximal tip (c) with a gooseneck snare (*black arrow*). Catheter retrieval (d) through the left femoral vein.

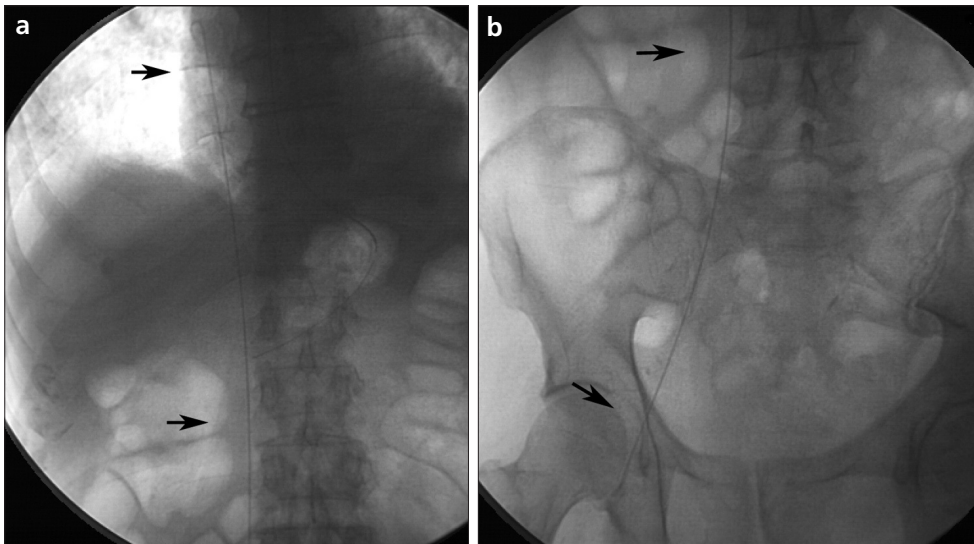
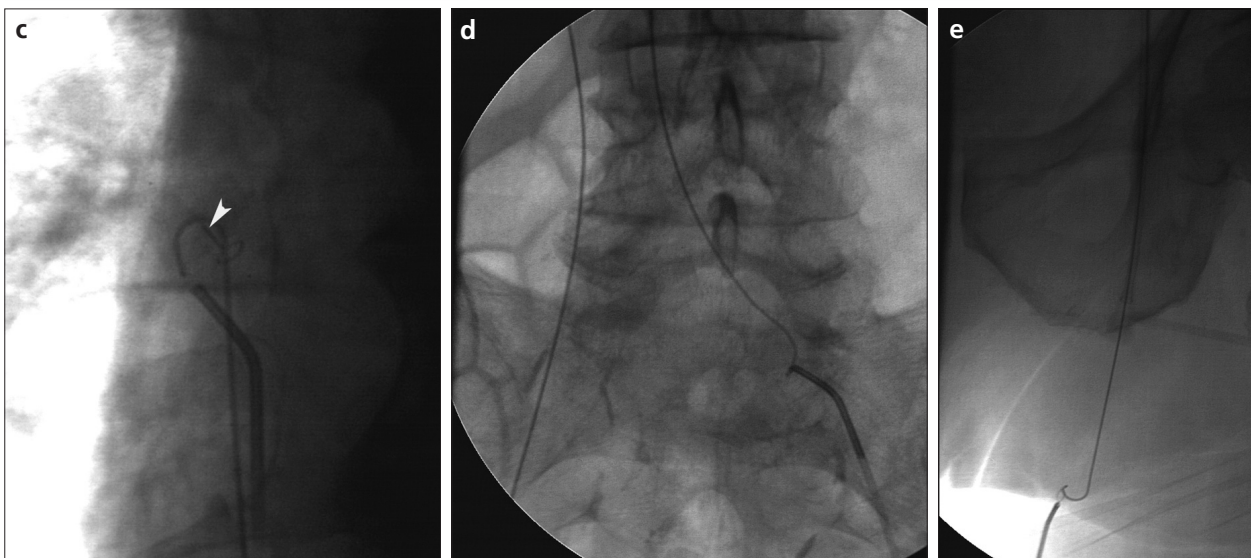


Figure 2. a–e. Guide wire retrieval with a gooseneck snare. Plain radiographs (a, b) show the dislodged guide wire during temporary catheter placement through the right femoral vein (*black arrows*). Guide wire retrieval (c–e) with a gooseneck snare (*white arrow*) through the left femoral vein.



ate procedure-related complications, except for one fragment that had been intraoperatively inserted and sutured to the vascular wall. It was possible to catch this catheter fragment but impossible to migrate it for retrieval, so it was surgically removed (Case 7). The right or left femoral vein approach was applied in all patients except one. The left internal jugular vein approach was more suitable for this particular patient (Case 4). No medications, such as anticoagulants, were applied during or after the intervention. In the postoperative chest radiographs, no residual fragments were seen. The postprocedural course was uneventful in all patients.

Discussion

Since the first report of an embolized catheter fragment in 1954 (5), the incidence of this complication is reported to be 0.3%–2.9% in adults (6–8) and 1.4%–3.6% in children (9, 10). Poor connection between the port and the catheter, angulation or distortion of the anastomosis site, severing of the catheter, improper catheter position, fatigue of the catheter, chronic compression of the catheter between the clavicle and the first rib (pinch-off syndrome) and damage by chemotherapy drugs are the causes of catheter embolism (11, 12).

Pinch-off syndrome occurs when a subclavian catheter passes through a confined anatomic space between the first rib and the clavicle and becomes compressed or kinked during arm motion. This leads to catheter fracture with time. It is observed in approximately 40% of catheter embolizations in adult patients (12, 13). In our series, pinch-off syndrome caused catheter fracture and embolism in three of five patients, all of whom were adults. However, in our pediatric population, no embolism was caused by pinch-off syndrome because the catheters were inserted via the internal jugular vein. The access site obviated the compression of the catheter between the clavicle and the first rib. Separation of the port catheter from the port chamber was the reason for access device fragment embolization in these patients, and this was realized during the operation for port removal. Port chamber removal without the catheter caused confusion in the operation room. If the patients had received chest radiographies before the operation, the

catheter embolism would have been diagnosed beforehand, and they would have been directly referred to the interventional radiology unit for both port chamber and catheter removal. Separation or disconnection, which is another mechanism of catheter embolism, is estimated to occur in 0.2% to 2% of cases (6, 14, 15). Traction on the extravascular portion of the catheter by the soft tissues of the chest wall or incorrect locking of the port catheter connection has been suggested as a root cause (16). Aside from port catheters, embolism due to temporary catheters is a very rare entity; we encountered this type of embolism in two patients. Separation due to rupture at the connection site between the external hub and the intravascular catheter was also the cause in these patients.

Guide wire migration during catheter insertion and its endovascular management has been reported (17). This complication occurs in unskilled hands through any of the access sites, as it happened in our three cases. It is preventable if the standards described for central vein catheterization are followed.

Early reports from the 1970s revealed that catheter embolism is associated with a high mortality. Fisher and Ferreyro reported that the combined rate of pulmonary thromboembolism, perforation of the right ventricle, cardiac arrest, and death was 71% (13). This high mortality and complication rate might be attributed to the use of rigid materials in the early 1970s. In modern practice, more-flexible materials are used for central venous access (16). However, current catheter embolism can still be associated with serious complications. Sudden death as a late complication of a catheter fragment embolism, a polymorphic ventricular tachycardia refractory to lidocaine treatment, and a ventricular tachycardia triggered by changes in body position from a catheter with cardiac migration have been reported (18–20). In our study, none of the patients presented with an arrhythmia or any other cardiological problems specific to embolism.

Nonsurgical retrieval of a foreign body in the circulatory system was first reported in 1964; a bronchoscope forceps were used to retrieve a broken guidewire (21). In modern practice, a

variety of commercially available devices (loop snare, grasping forceps, basket, deflecting wires, and balloon catheters) have been used for percutaneous retrieval of intravascular foreign bodies. Among them, the most popular device is the gooseneck loop snare; the basket is the second most commonly used tool for this purpose (22–24). When there are no free ends of the catheter accessible, multipurpose catheters can be used to reposition the fragment to the optimal site. We used the gooseneck loop snare directly to capture the catheter in nine of ten patients. Diagnostic 5 F pigtail and Simmons 1 catheters were used to reposition the catheter fragment to a more suitable location in one patient. The most common complication of this percutaneous technique is cardiac arrhythmia during the procedure, which we did not encounter in our patients.

The radiological retrieval of embolized vascular access device fragments is the preferred method, and it has a high success rate. Considering the potential for devastating complications, patients should be referred to interventional radiology, and the embolized catheters should be retrieved by using interventional endovascular techniques.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Denny DF. Placement and management of long-term central venous access catheters and ports. *AJR Am J Roentgenol* 1993; 161:385–393.
2. Richardson JD, Grover FL, Trinkle JK. Intravenous catheter emboli: experience with twenty cases and collective review. *Am J Surg* 1974; 128:722–727.
3. Fisher RG, Ferreyro R. Evaluation of current techniques for nonsurgical removal of intravascular iatrogenic foreign bodies. *AJR Am J Roentgenol* 1978; 130:541–548.
4. Bernhardt LC, Wegner GP, Mendenhall JT. Intravenous catheter embolization to pulmonary artery. *Chest* 1970; 57:329–332.
5. Turner DD, Sommers SC. Accidental passage of a polyethylene catheter from cubital vein to right atrium. *N Engl J Med* 1954; 251:744–745.
6. Ballarini C, Intra M, Pisani Ceretti A, et al. Complications of subcutaneous infusion port in the general oncology population. *Oncology* 1999; 56:97–102.
7. Biffi R, de Braud F, Orsi F, et al. Totally implantable central venous access ports for long-term chemotherapy. A prospective study analyzing complications and costs of 333 devices with a minimum follow-up of 180 days. *Ann Oncol* 1998; 9:767–773.

8. Kock HJ, Pietsch M, Krause U, Wilke H, Eigler FW. Implantable vascular access systems: experience in 1500 patients with totally implanted central venous port systems. *World J Surg* 1998; 22:12–16.
9. Babu R, Spicer RD. Implanted vascular access devices (ports) in children: complications and their prevention. *Pediatr Surg Int* 2002; 18:50–53.
10. Dillon PA, Foglia RP. Complications associated with an implantable vascular access device. *J Pediatr Surg* 2006; 41:1582–1587.
11. Liu JC, Tseng HS, Chen CY, Chern MS, Chang CY. Percutaneous retrieval of 20 centrally dislodged Port-A catheter fragments. *Clinical Imaging* 2004; 28:223–229.
12. Ho CL, Chou CM, Chang TK, Jan SL, Lin MC, Fu YC. Dislodgment of port-a-cath catheters in children. *Pediatr Neonatol* 2008; 49:179–182.
13. Fazeny-Dörner B, Wenzel C, Berzlanovich A, et al. Central venous catheter pinch-off and fracture: recognition, prevention and management. *Bone Marrow Transplant* 2003; 31:927–930.
14. Barrios CH, Zuke JE, Blaes B, Hirsch JD, Lyss AP. Evaluation of an implantable venous access system in a general oncology population. *Oncology* 1992; 49:474–478.
15. Lokich JJ, Bothe A, Benotti P, Moore C. Complications and management of implanted venous access catheters. *J Clin Oncol* 1985; 3:710–717.
16. Suvor A, Buerke M, John E, Kösling S, Spielmann RP, Behrmann C. Intravenous port catheter embolization: mechanisms, clinical features, and management. *Angiology* 2008; 59:90–97.
17. Khatami MR, Abbasi R, Sadigh G. Guide wire migration during femoral vein catheterization. *Iran J Kidney Dis* 2010; 4:333–335.
18. Suarez-Penaranda JM, Guitian-Barreiro, Concheiro-Carro L. Longstanding intracardiac catheter embolism: an unusual autopsy finding. *Am J Forensic Med Pathol* 1995; 16:124–126.
19. Denny MA, Frank LR. Ventricular tachycardia secondary to Port-A-Cath fracture and embolization. *J Emerg Med* 2003; 24:29–34.
20. Gowda MR, Gowda RM, Khan IA, et al. Positional ventricular tachycardia from a fractured mediport catheter with right ventricular migration--a case report. *Angiology* 2004; 5:557–560.
21. Thomas J, Sinclair-Smith B, Bloomfield D, Davachi A. Non-surgical retrieval of a broken segment of steel spring guide from the right atrium and inferior vena cava. *Circulation* 1964; 30:106–108.
22. Koseoglu K, Parildar M, Oran I, Memis A. Retrieval of intravascular foreign bodies with goose neck snare. *Eur J Radiol* 2004; 49:281–285.
23. Cheng CC, Tsai TN, Yang CC, Han CL. Percutaneous retrieval of dislodged totally implantable central venous access system in 92 cases: experience in a single hospital. *Eur J Radiol* 2009; 69:346–350.
24. Wang PC, Liang HL, Wu TH, et al. Percutaneous retrieval of dislodged central venous port catheter: experience of 25 patients in a single institute. *Acta Radiol* 2009; 50:15–20.