The Journal of Vascular Access 2000; 1: 19-22

Catheter rupture and distal embolisation: a rare complication of central venous ports

R. BIFFI[1], S. POZZI[1], F. ORSI[2], F. GRASSO[2], F. DE BRAUD[3], S. CENCIARELLI[1], B. ANDREONI[1]

[1] Departments of General Surgery, [2] Radiology, [3] Medical Oncology, European Institute of Oncology, Milan - Italy

ABSTRACT: Central venous access devices placed through a percutaneous subclavian approach may be compressed by neighbouring bony structures, leading to biomaterial fatigue, catheter fracture at the compression site, and possible embolisation of distal fragment into the central veins. The aim of this paper is to review the experience of the authors, including more than 1300 subclavian port placements, carried out during a five-year period, discussing possible causes and therapeutic options of this rare complication. Nine patients out of 1320 (0.68%) experienced this complication during the five-year period of this study. Two patients only showed a retrospective radiologic evidence of the "pinch-off sign" (e.g. initial compression of the catheter at the costo-clavicular junction). No patients had symptoms from the embolised catheter fragment; the most frequent symptom (8 out of 9 cases) was a painful swelling around the port area during infusion, related to the extravasation of medications or fluids into the subcutaneous tissue. The site of embolised segment varied from azygos vein to right pulmonary artery; however, these findings did not affect the outcome, and all the embolised fragments were successfully retrieved through a transfemoral approach using a radiologic interventional technique. No fatality occurred.

The catheter fracture and embolisation of the distal fragment are a well-known complication of subclavian central venous long-term cannulation, whose estimated overall incidence is 0.5-1%. Diagnosis is usually based on the radiologic appearance of the catheter compression (so called "pinch-off sign"), which is far from being constant; a clinical suspicion can derive from intermittent malfunction, which claims differential diagnosis with the presence of a fibrin sleeve around the tip of the catheter. Once diagnosed, the treatment is always an interventional radiologic approach, which has a very high success rate. When it fails, the possibility to leave the fragment embolised in the central veins, heart or pulmonary arteries, should be considered, being the thoracotomy and open catheter retraction questionable, at present time, in patients who have no symptoms and limited life-expectancy.

KEY WORDS: *Central venous catheters, Ports, Pinch-off syndrome, Catheter embolisation*

INTRODUCTION

Central venous acces devices placed through a percutaneous subclavian approach may be compressed by neighbouring bony structures, leading to biomaterial fatigue, catheter fracture at the compression site, and possible embolisation of distal fragment into the central veins. This condition has been called "catheter pinch-off", although this descriptive phrase does not deal with the wide range of possible clinical manifestations of this complication. The overall incidence of the catheter pinch-off is at present unknown; looking at previous, large series and case reports, it could be estimated around 0.5-1% (1, 2, 3). In an attempt to define the real incidence and the main features of this problem, we reviewed our own experience, including more than 1300 subclavian port placements, carried out during a 5-year period. Possible causes and therapeutic options will also be discussed.

PATIENTS AND METHODS

One thousand three hundred twenty ports were placed in patients at the European Institute of On-

1129-7298/019-04$02.00/0

cology, in Milan, during the 60-month period from January 1, 1995 to December 31, 1999 for chemotherapy of solid tumours. The devices were placed in the operating room under fluoroscopic control, even when the patient was treated and monitored in a day-hospital setting, or in an angiographic suite. A subclavian percutaneous approch was used. Preoperative evaluation included a history and physical examination that focused on possible anatomic pitfalls (clavicle fracture, cervical or mediastinal adenopathy, chest wall tumours, presence of rotation flaps as part of head and neck reconstructive surgery), body habitus and vascular access history (side used and pneumothorax history, previous line infection). The only laboratory studies requested as absolutely necessary were a complete blood count, including platelet and differential count, and coagulation tests. All patients had a chest radiograph to identify preoperatively mass lesions or anatomic anomalies. The patients received a local anesthesia, without routine additional intravenous sedation; a single dose (2 g) of Cefazoline sodium was given intravenously 15 minutes before implant. A confirmatory chest X-ray was always obtained after the placement and a physician always checked the patients before discharge.

Two types of ports constructed from titanium and silicone rubber were used: Dome PortTM, Bard Inc., Salt Lake City, USA, with 8 F silastic GroshongTM catheter tubing (Bard Inc., Salt Lake City, USA) in 1092 cases, and Port-A-CathTM (SIMS Deltec, St. Paul MN, USA) in 228 cases.

A central venous access form was filled in by the operator after the procedure follow-up data on these patients were entered into this form and collected in a software registry.

RESULTS

Nine patients out of 1320 (0.68%) experienced this complication during the five-year period of this study. Table I summarizes population characteristics and pertinent data. A first group of patients (# 2, 4, 6, 7 and 8) experienced this problem immediately after the implant (0-3 days), whereas a second group (# 1, 3, 5 and 9) suffered from it after the initial course of the planned chemotherapeutic treatment, 11-150 days after the implant. Two patients only (# 1 and 5) showed a retrospective radiologic evidence of the "pinch-off sign" (e.g. initial compression of the catheter at the costo-clavicular junction). Neither patient had symptoms from the embolised catheter fragment; the most frequent symptom (8 out of 9 cases) was a painful swelling around the port area during infusion, related to the extravasation of medications or fluids into the subcutaneous tissue. Palpitations or chest dyscomfort have never been detected in this series, confirming the high rate of really asymptomatic cases.

The site of embolised segment varied from azygos vein to right pulmonary artery (Fig. 1); however, this findings did not affect the outcome, and all the embolised fragments were successfully retrieved through a transfemoral approach using a radiologic interventional technique. No fatality occurred (Fig. 2).

DISCUSSION

Our data indicate that the overall incidence of central venous catheter fracture and embolisation is low (<1%); interestingly, compression and fatigue of biomedical devices in this

TABLE I - POPULATION DATA AND CHARACTERISTICS OF THE CLINICAL SERIES

Pt. #	Age/sex	Diagnosis	Side of implant	Symptoms/signs related to rupture or embolisation	Time-interval after implant (days)	Evidence of radiologic pinch-off sign	Site of distal fragment
1	68 F	Breast cancer	Right	Painful swelling around port	20	Yes	Azygos vein
2	45 F	Breast cancer	Left	Withdrawal occlusion	3	No	R. ventriculum
3	63 F	Breast cancer	Right	Painful swelling around port	12	No	R. pulmonary a.
4	70 M	Cholangiocarcinoma	Left	Painful swelling around port	0	No	R. pulmonary a.
5	44 F	Breast cancer	Right	Painful swelling around port	150	Yes	R. ventriculum
6	55 F	Breast cancer	Left	Painful swelling around port	0	No	Sup. vena cava
7	53 F	Breast cancer	Right	Painful swelling around port	1	No	R. pulmonary a.
8	32 F	Breast cancer	Right	Painful swelling around port	1	No	R. atrium
9	50 F	Breast cancer	Right	Painful swelling around port	11	No	R. ventriculum

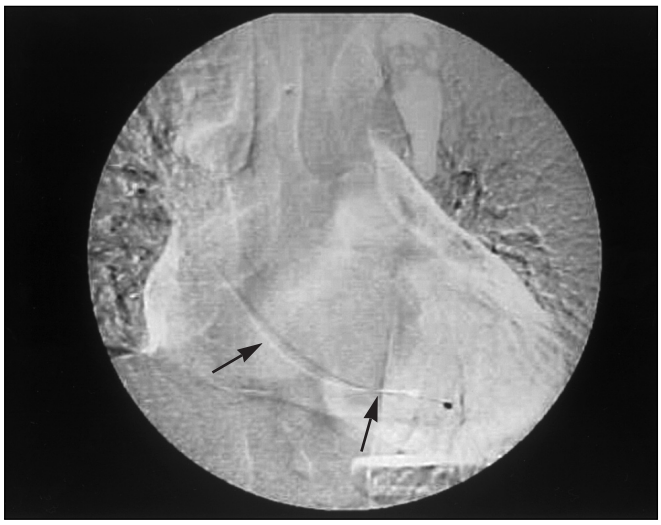

Fig. 1 - ***Embolised distal fragment in the right atrium. The tip of the catheter is clearly evident.***

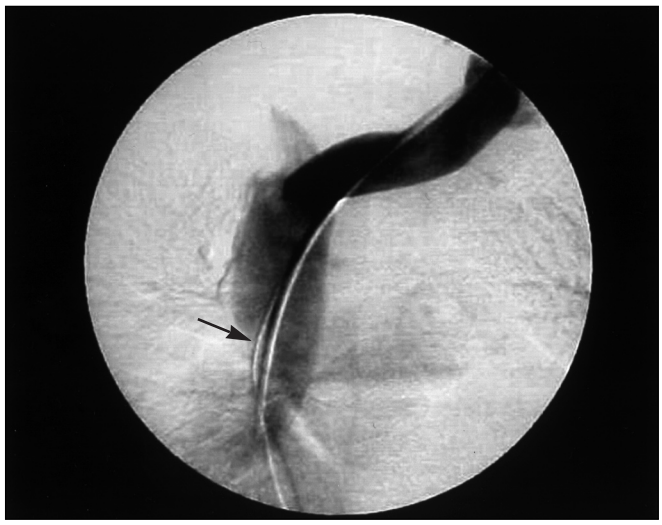

Fig. 2 - ***Retrieval of the embolised catheter through a share loop by transfemoral approach.***

anatomic area have also been described in the pace-maker literature (4), thus confirming the subclavian-limited feature of this complication, which has never been described for jugular percutaneous or surgical approach. However, the pathophysiology is not fully understood and remains unclear for many cases; looking at our series, only the group with a significant time-interval from the implant has probably suffered from a real pinch-off of the catheter, whereas the second group could have experienced a minimal lesion during implantation, at the point of catheter-port connection, leading to a circumferential tear of the catheter and subsequent complete rupture and separation of the distal part. Indirect proof for this hypothesis is the highly reduced length of the catheter which remained attached to the subcutaneous port, and the absence of the "fish-mouth" deformation of the ruptured catheter at the place of separation, indicating compressive forces at this point (Fig. 3) (5).
The most important factor in avoiding this complication seems to be technique, such that the subclavian vein is always accessed lateral to the bend in the clavicle, far away from the ligament joining the clavicle and the first rib, where the damage might occur. Clinically, this compression may be associated with intermittent catheter dysfunction, improved with changes in the patient's shoulder position, also called "pinch-off syndrome" (6, 7, 8). This situation is not specific and can also be commonly seen when a fibrin sheat has been formed around the catheter tip (9). The "pinch-off sign" is the radiologic finding of severe compression of the

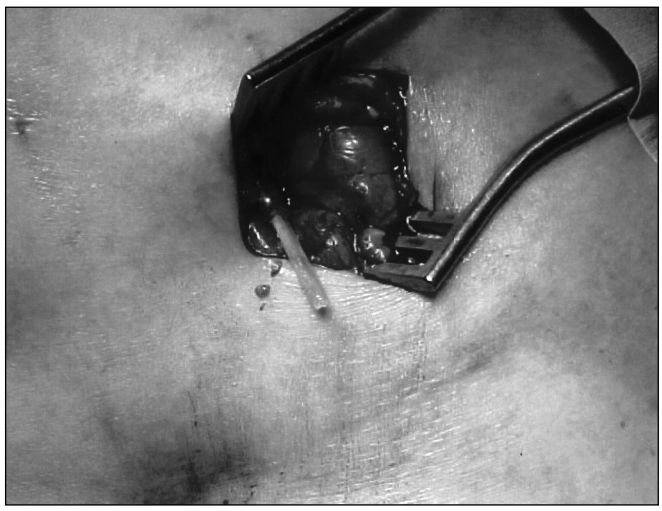

Fig. 3 - ***"Fish-mouth" deformation of the ruptured catheter at the place of separation. This suggests a compressive force at this point.***

catheter and is more likely to be apparent on chest X-rays with the patient in an upright position; this sign indicates a high-risk catheter that should be removed as soon as possible (2). Manually applied force to the shoulder, mimicking the effect of gravity in the upright position, could help to identify a catheter compression in the operating department and allow for immediate correction, usually reposition. Nonetheless, catheter rupture may occur without any radiologic abnormality: we detected retrospectively 2 cases of mild compression (# 1 and 5), whereas it was not observed in the rest. For one case in the literature, a normal chest radiograph result was obtained for other reasons within 12 hours of the fracture event and, as in most cases

of our series, there was no radiologic evidence that this catheter was compressed by bony structures, even in retrospect (10).

Our results confirm that catheter embolisation itself is usually asymptomatic. Less than one third of the literature-reported cases have had associated symptoms, such as palpitation or chest dyscomfort.

The problem of therapeutic options in case of rupture-embolisation of a central venous catheter is far from being precisely defined; there is general consensus to remove, if possible, the embolised fragment, once a catheter is documented to be fractured. The rational background of this policy is that an embolised fragment can lead to a number of severe further complications, such as cardiac arrest, perforation and pulmonary embolism (11). The method of choice is the interventional radiologic technique, using an intravascular snare to grab the catheter piece and drag it out. Nevertheless, there are several documented cases in the literature in which the fragment has been left in the patient without untoward effects (11), particularly before the development of many of the present interventional radiologic techniques.

In conclusion, the catheter fracture and embolisation of the distal fragment is a well-known complication of subclavian central venous long-term cannulation, whose estimated overall incidence is 0.5-1%. The most important factor in avoiding it rests with the actual technique, such that the subclavian vein is always accessed lateral to the bend in the clavicle; most cases do not exhibit any clear evidence of compression in this anatomic region and the possible role of different susceptibility by biomaterials has not yet been addressed by clinical trials. Diagnosis is usually based on the radiologic appearance of the catheter compression (so called "pinch-off sign"), which is far from being constant; a clinical suspicion can derive from intermittent malfunction, which requires a differential diagnosis with the presence of a fibrin sleeve around the tip of the catheter.

Once diagnosed, the treatment is always an interventional radiologic approach that has a very high success rate; when it fails, the possibility of leaving the fragment embolised in the central veins, heart or pulmonary arteries should be considered, right now a thoracotomy and open catheter retraction is questionable in patients who are free of symptoms and who have a limited life-expectancy.

Reprint requests to:
Roberto Biffi, M.D.
Department of General Surgery
European Institute of Oncology
Via Ripamonti, 435
20141 Milano, Italy
e-mail: Roberto.Biffi@ieo.it

REFERENCES

1. Biffi R, Corrado F, De Braud F, et al. Long-term, totally implantable central venous access ports connected to Groshong catheter for chemotherapy of solid tumours: experience on 178 cases using a single type of device. Eur J Cancer 1997; 33: 1190-4.
2. Hinke DH, Zandt-Stastny DA, Goodman LR, et al. Pinch-off syndrome: a complication of implantable subclavian venous access devices. Radiology 1990; 177: 353-6.
3. Zieren J, Thul P, Romanink P, Muller JM. Intravascular disruption of central venous ports. Clin Nutr 1998; 17: 89-91.
4. Jacobs DM, Fink AS, Miller RP, et al. Anatomical and morphological evaluation of pacemaker lead compression. PACE 1993; 16: 434-5.
5. Rubenstein BR, Alberty RE, Michels LG. Hickman catheter separation. JPEN 1985; 9: 754-7.
6. Lafreniere R. Indwelling subclavian catheter and a visit with the "pinched-off sign". J Surg Oncol 1991; 47: 261-4.
7. Aitken DR, Minton JP. The "pinch-off sign": a warning of impending problems with permanent subclavian catheters. Am J Surg 1984; 148: 633-6.
8. Andris DA, Kraywda EA, Schulte W, et al. Pinch-off syndrome: a rare etiology for central venous catheter occlusion. JPEN 1994; 18: 531-3.
9. Hoshal VL, Anse RG, Hoskins PA. Fibrin sleeve formation on indwelling subclavian central venous catheter. Arch Surg 1971; 102: 353-7.
10. Whitman ED. Complications associated with the use of central venous access devices. Curr Probl Surg 1996; 33 (4): 319-78.
11. Richardson JD, Gnover FL, Trinkle JK. Intravenous catheter emboli: experience with twenty cases and collective review. Am J Surg 1974; 128: 722-7.