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Percutaneous intravascular retrieval of embolised fragments of long-term central venous catheters

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ABSTRACT: Embolisation of a catheter fragment is a rare mechanical complication of long-term central venous access devices. From 1995 to 1999 we observed 10 cases: the cause of embolisation was the 'pinch-off syndrome' in half of the cases, and in 8 cases out of 10 the fragment had embolised in the pulmonary arterial vessels. Percutaneous transvenous retrieval was successful in all cases; it was performed mainly (8 cases out of ten) through the left transfemoral route, using a single-snare-loop device sometimes associated with a pig-tail catheter. We had no mortality and no major complications. On the basis of our experience, we believe that catheter embolisation of long-term central venous devices can be effectively prevented by adequate insertion technique, proper management of the device during its clinical use, and accurate removal technique. Nonetheless, should catheter embolistion occur, the patient should be referred to a Centre with adequate experience in the field of interventional radiological techniques. Should the radiological retrieval procedure fail, evidence from the literature suggests that leaving the fragment in embolisation site might be safer than open extraction by surgical thoracotomy, particularly in oncological patients with reduced life expectancy.

KEY WORDS: *Central venous catheter, Port, Catheter embolisation, Complications*

INTRODUCTION

Long-term central venous access devices are routinely used in adult and pediatric patients receiving chemotherapy, parenteral nutrition or long-term intravenous therapy. Central venous systems have proved to be safe, with an overall complication rate ranging from 7 to 15% (1-2), the most frequent complications being thrombosis (approx. 4%) and infection (2 to 5%).

Intravascular damage and embolisation of the catheter fragment is a rare mechanical complication, occasionally described by several Authors (3-8). It is believed that such complication - though usually asymptomatic - may lead to a number of severe sequelae such as cardiac arrest, vascular and cardiac perforation and pulmonary embolism (9-10). Therefore, most Authors agree that dislocated catheter fragments should be removed as soon as possible, ideally by a non-traumatic procedure, such as using a percutaneous interventional radiological tecnique (8).

In this paper we report on our experience with 10 cases of embolisation of fragments of long-term central venous devices, all successfully retrieved by the percutaneous transvenous snare technique.

MATERIALS AND METHODS

Between 1995 and 1999 we observed 10 patients with long-term central venous devices (either implantable port or tunnelled catheter) complicated by embolisation of a catheter fragment. Embolisation was secondary to other causes, the most frequent being chronic trauma due to compression of the catheter between clavicle and first rib (so called 'pinch-off syndrome'). Diagnosis was suspected on clinical ground and confirmed by appropriate chest X-ray in all cases.

In all patients, interventional radiological retrieval of the embolised fragment was attempted within 24 hours after the diagnosis. The procedure was performed under local anaesthesia by a skilled radiol-

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ogist, particularly trained in percutaneous interventional radiology, with stand-by anesthesiologist and surgeon. The main indication for the central venous access, the type of device, and the time and site of insertion were recorded for each patient. The site of embolisation, type of percutaneous access, materials used for retrieval and complications related to the procedure were also recorded for each retrieval manoeuvre.

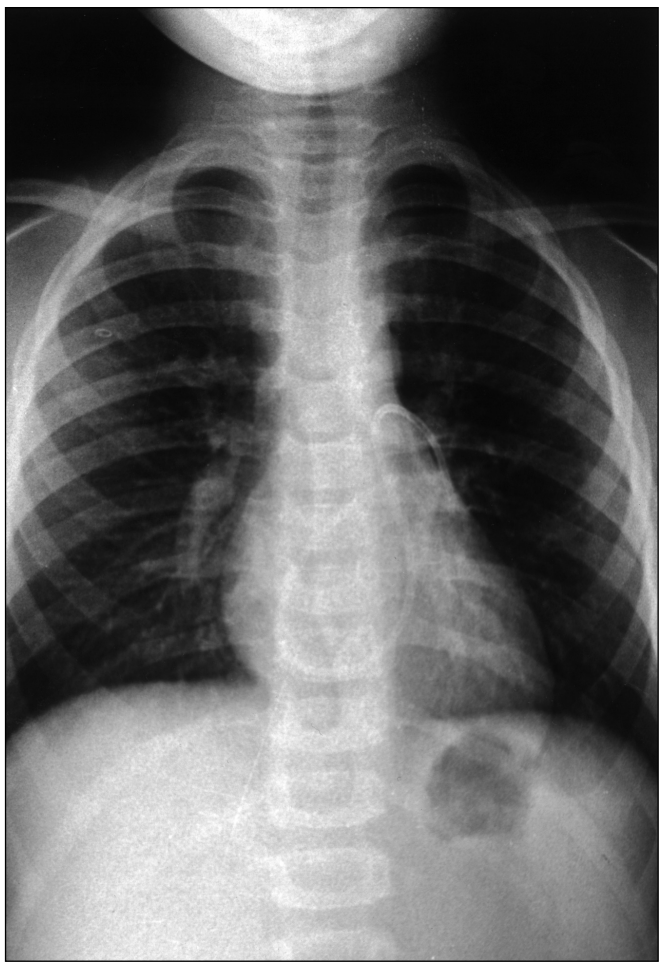

Fig. 1 - *Chest X-ray showing an embolised catheter; the ends of the fragment are located in the right pulmonary artery and in the discendent branch of the left pulmonary artery respectively.*

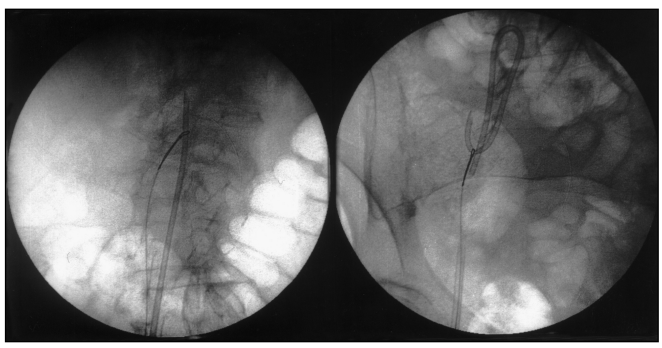

Fig. 2 - *Percutaneous retrieval of a fragment, hooked by the snare loop (left) and moved downwards (right) for the extraction.*

RESULTS

Indication for central venous access, type of device and site of insertion are reported in details in Table I.

All patients were asymptomatic at the time of diagnosis except for catheter malfunctioning. The embolised catheter fragments were visualised in the superior vena cava in 3 cases and in the pulmonary artery in 7 cases (Tab. II) (Fig. 1).

In 5 patients, a totally implanted port had been inserted in the subclavian vein, by the infraclavicular route, and disruption had occurred just below the clavicle - due to catheter compression between the clavicle and the first rib (so called 'pinch-off syndrome'). In 4 cases, the catheter had abruptly detached from the reservoir due to inappropriate attempts to disobstruct the system using small-sized syringes (i.e. high pressures). In one more case, a

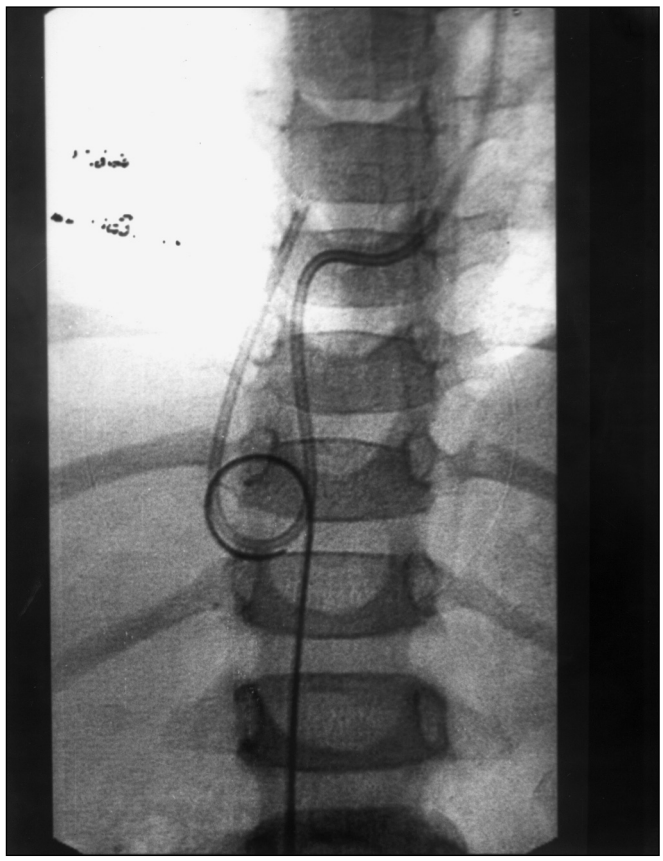

Fig. 3 - *Percutaneous retrieval of the fragment: since the catheter could not be easily hooked by the snare, it was displaced with a pig-tail catheter (left); one end was then hooked by the snare-loop (right) and retrieved through the introducer sheath.*

Groshong catheter had been accidentally damaged proximally to the dacron cuff during the surgical procedure for removal, and the central fragment had embolised in the pulmonary circulation (Tab. II).
Percutaneous transvenous retrieval was perfomed in all cases: right transfemoral approach in 8 patients, transfemoral bilateral in one and right transjugular in another one. In 7 cases the catheter fragment was retrieved using a single-snare-loop device (Fig. 2). In 3 cases mobilisation with an additional pig-tail catheter was necessary before the fragment could be retrieved with the snare (Fig. 3). As catheter diameters ranged from 6 to 8 Fr, we used different-sized introducer sheaths so to allow an easy percutaneous extraction of the fragments.
The procedure was successful in all 10 cases and was not associated with any major complication. In 3 patients, transient benign ventricular arrhythmias occurred, probably due to mechanical stimulation of the myocardium by the radiological catheter. The time elapsed between diagnosis and radiological retrieval did not increase the difficulty of the manoeuvre, or the risk of complications.

TABLE I - LONG-TERM CENTRAL VENOUS ACCESS: PATIENT CHARACTERISTICS

Number of patients	10
Indication	
- chemotherapy	5
- parenteral nutrition	3
- intravenous therapy	2*
Type of device	
- totally implantable port	9
- tunnelled Groshong catheter	1
Site of insertion	
- internal jugular vein	4
- subclavian vein	6
Time between insertion and embolisation	
- < 6 months	8
- ≥ 6 months	2
Causes of embolisation	
- pinch-off syndrome **	5
- inappropriate disobstruction manoeuvre	4
- accident during removal	1

** AIDS patients*
*** in all cases, port with catheter inserted by subclavian venipuncture*

TABLE II - PERCUTANEOUS RADIOLOGICAL RETRIEVAL OF CATHETER FRAGMENTS: RESULTS

Type of CVC	Embolisation site	Percutaneous access retrieval	Materials	Complications	Time from diagnosis to retrieval (hours)
Port	Pulmonary a.	Right femoral v.	Snare loop + pig-tail	-	5
Groshong	Sup. vena cava	Right jugular v.	Snare loop	-	10
Port	Left pulmonary a.	Right femoral v.	Snare loop	Ventricular arrhythmia	15
Port	Right pulmonary a.	Right femoral v.	Snare loop	-	6
Port	Right pulmonary a.	Right femoral v.	Snare loop + pig-tail	Ventricular arrhythmia	10
Port	Right pulmonary a.	Right femoral v.	Snare loop	Ventricular arrhythmia	15
Port	Sup. vena cava	Right femoral v.	Snare loop	-	20
Port	Sup. vena cava	Right femoral v.	Snare loop	-	20
Port	Right and left pulmonary aa.	Right and left femoral vv.	Snare loop + pig-tail	-	5
Port	Right pulmonary a.	Right femoral v.	Snare loop	-	15

DISCUSSION

The actual rate of central venous catheter fracture and embolisation is unknown, since this complication is usually reported in the literature as single-case reports or for a small number of cases.
We found that the pinch-off syndrome was the mechanism of fracture and embolisation in 5 cases. According to many Authors, this is the most frequent cause of catheter embolisation. The syndrome (3, 11-13) is characterised by the mechanical friction of the catheter between clavicle and first rib, typical of percutaneous catheters inserted in the subclavian vein through the infraclavicular approach. Should this infraclavicular route be adopted, the venipuncture and the insertion of the catheter should be performed laterally rather than medially, at least at the mid clavicular point - since the space between the clavicle and the first rib increases laterally. When inserting long-term venous devices, we strongly suggest taking into consideration alternative venipuncture techniques (jugular vein, by 'low lateral' approach, or subclavian vein, by supraclavicular route) (14-15), not associated with the risk of subsequent 'pinch-off syndrome'.
In 4 more patients with totally implanted ports, the catheter embolisation was not due to an actual fracture, but to the accidental detachment of the catheter from the reservoir. In such cases, the complication appeared to be provoked by repeated and inappropriately aggressive attempts to resolve catheter obstruction by using high pressure lavage of the system with a small-sized syringe (e.g.: 1-ml 'insulin' syringe).
According to most reported cases (16), intravascular catheter separation usually occurs completely asymptomatic. In some cases (5, 10) fragments were left at the embolisation site for a long time without any complication. Nevertheless, a number of rare but severe complications may theoretically occur – such as cardiac arrest, vascular or cardiac perforation, pulmonary embolism, septic endocarditis (10). Therefore, it is commonly recommended that dislocated catheter fragments should be removed as soon as possible, within 24 hours from diagnosis, and the interventional radiological catheter technique should be considered as the method of choice (6-8). This technique is non invasive and safe if performed by an experienced team, and has a very high success rate (100% in our experience). Should this technique fail, it is questionable whether thoracotomy and open catheter retraction should be performed in patients who are asymptomatic, particularly if they have limited life expectancy; some reports in the literature suggest that a catheter fragment may be left within the pulmonary arterial vessels without any apparent associate problem (5, 10, 17).
Percutaneous intravascular retrieval should be performed by a team with extensive experience in interventional radiological manoeuvres. Although the transfemoral approach is suitable in most cases, sometimes a transjugular or combined approach is needed. Tortuous vessels limit the use of the Dormia angiocatheter, while endovascular forceps may be highly traumatic, causing serious vascular damage. Therefore, we prefer to use a snare loop, possibly associated with a pig-tail catheter, which can be useful in mobilising fragments that cannot be directly grasped by the snare (Fig. 3). Also, we recommend that the size of the introducer sheath should be chosen carefully, taking into account the size of the catheter fragment, so as to facilitate the transvenous retrieval. In some cases, in spite of an adequate sized introducer device, percutaneous retrieval may be difficult, and surgical retrieval of the fragment at the peripheral venous site (femoral or jugular) should be performed under local anaesthesia by a skilled surgeon.
Potential complications of the percutaneous radiological retrieval technique are further fracture and embolisation of the fragment, vascular damage, cardiac and respiratory accidents. Although in our experience we observed only benign ventricular arrythmias due to mechanical irritation of myocardial wall, we recommend that both an anaesthesiologist and a surgeon stand by during the procedure.
In conclusion, we believe that catheter embolisation of long-term central venous devices can be effectively prevented by adequate insertion techniques, proper management of the device during its clinical use, and accurate removal tecnique. In particular, we have two strong recommendations:
- Preferably, long-term central venous catheters should not be inserted by percutaneous infraclavicular puncture of the subclavian vein; if the pinch-off syndrome is to be avoided, one must rely upon alternative techniques, such as (a) percutaneous venipuncture of the jugular vein (low lateral approach or low central approach), (b) subclavian venipuncture by the supraclavicular approach, or (c) 'surgical' insertion of the catheter into the subclavian vein through the cephalic vein.
When attempting to clear an obstructed central venous device, one should never utilize small-sized syringes; indeed, most management protocols recommend the use of either 10-ml or larger syringes.
For an early detection of catheter embolisation, we advocate regular chest X-ray controls after implantation of long-term venous access inserted by infra-

clavicular subclavian venipuncture, as well as after aggressive attempts at disobstruction.
Should catheter embolisation be diagnosed, the patient should be referred to a Centre with adequate experience in the field of interventional radiological techniques, and possibly with specific experience in the retrieval of intravascular objects. Open catheter extraction through surgical thoracotomy should be avoided in any case. Should the radiological technique fail, we believe that the most reasonable approach is the non-surgical approach, i.e. patient observation and regular chest X-ray controls, particularly in oncological patients with reduced life expectancy.

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