Central venous catheter disruption and embolization: percutaneous retrieval. A case report

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Abstract. – Disruption followed by intravasal embolization is a rare (0.5%) however possible complication secondary to the insertion of a central venous catheter. The carriers of these implantable systems are patients who, for their cure and at times even for their survival, require the chronic intravenous infusion of drugs and solutions. Therefore materials that can allow long-term insertion with a minimum of complications are the most suitable. There are several causes of disruption and embolization of cannulae. The most common are represented by the pinch-off syndrome and catheter disconnection from reservoir.

The literature on the subject is illustrated and a personal case treated with intravascular retrieval is reported.

Key Words: Central venous catheter, Percutaneous retrieval, Catheter disruption.

Introduction

Long-term implantable systems are indispensable to ensure the cure and survival of an increasing number of patients1. In oncologic, immunosuppressed patients and in case of domiciliary parenteral nutrition it has become a routine. While a number of options are available, there are two groups of most commonly used systems: those completely implantable (port type) and those external with a short cannula2. Each system has many advantages and as many possible complications. Therefore the selection among them should be based on motivations and evaluations exclusively correlated with the type of support to be provided to the patient in terms of quality and quantity of the fluid to be infused and with treatment duration. Infection (0.5-5%) together with thrombosis represents the most common complication3. When considering that in Intensive Unit Care almost 90% of sepsis is secondary to CVC infection, one is aware of the importance of an in-depth knowledge of all possible problems associated to the use of implantable systems4. There are many complex causes underlying the pathogenesis of infections. Schematically, the onset of contamination can be referred to four groups5:

1) through the infusion of contaminated solutions or drugs;
2) through catheter colonization by germs coming from other septic foci present in the organism;
3) through the periluminal route, microorganisms present on the skin or subcutaneous layer “migrate” along the catheter and reach the blood stream;
4) through the intraluminal route microorganisms present on the skin are introduced, when the reservoir is pierced, into the system, where they multiply.

The most common pathogens in sepsis are staphylococci in particular and gram-positive germs in general. Staphylococcus epidermidis deserves a special attention since it produces the glycocalyx which allows a better adhesion of bacteria to the prosthesis and forms a barrier to antibiotic penetration, an initial step for the system chronic infection. Glycocalyx is an extracellular glycoprotein composed of N-acetylglucosamine (70%) which binds the...
bacteria to the prosthesis with the creation of an insurmountable barrier to antibiotic penetration (Table I). Several hypotheses have been advanced on the mode of action of glycocalyx (Table II). Its study has clarified numerous aspects on the in vivo drug activity and kinetics. Prosthesis-associated complications are divided into physical and bacterial according to their origin from the prosthetic material itself or supported by it.

As for implantable systems the need for long-term CVC led to in-depth studies on the management of related complications, namely all disturbances and pathologic conditions, in turn grouped into early and late. In the first group, all complications due to the insertion of implantable systems are included (Table III). In their genesis, the surgical procedure, the application of all measures of sterility, the patient immune status, the antibiotic prophylaxis play a major role. The most common complications are: sepsis (0.2-5%), pneumothorax (0.8-2%), and in decreasing order: arterial puncture, malpositioning, hydrothorax, chylothorax, hemothorax etc. Overall, they appear in approximately 9% of treated cases. This is a significantly relevant percentage which should lead to carefully consider the need and opportunity of the application of these systems.

The second group, besides sepsis, includes all complications associated to the system use (Table IV). They are caused by its wear in the course of time, its misuse or long-term insertion into the bloodstream. Therefore at times they behave as true mechanical complications. The most common are: sepsis, catheter obstruction, contamination, deep thrombosis, reservoir decubitus, catheter disruption and dislocation, possible embolization of dislocated fragment. The most common causes of catheter disruption are:

1) the chronic trauma due to catheter compression between the clavicle and first rib, the so-called pinch-off syndrome;
2) the damage caused by its insertion with subsequent fragility and disruption following microtraumas associated to myocardial pulsatility;
3) incorrect use by operators (puncture of the cannula instead of the reservoir, with its shearing);
4) disconnection of the cannula from reservoir during cleansing for obstruction due to incorrect procedure (use of insulin syringes which may cause high pressure within the system);
5) wrong manoeuvres by operators during retrieval.

Once the catheter is disconnected from reservoir this tends to migrate into the lesser circle: this is not always associated to clinically relevant symptoms. There are three options available:
1) to leave the fragment on the embolization site until there are signs of its presence;
2) to remove the fragment soon after the complication, ensuring its complete extraction;
3) to remove the fragment in a controlled embolization phase.

### Table I.

<table>
<thead>
<tr>
<th>Known glycocalyx activity</th>
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<tr>
<td>- A dhesion to biomaterials (electromagnetic bonds) is favored</td>
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<td>- Bacterial adhesion (formation of microcolonies) is favored</td>
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<tr>
<td>- Interaction with the immune system (less effective reactions)</td>
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<td>- Lower antibiotic efficacy (limited local diffusion)</td>
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### Table II.

<table>
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<th>Glyocalyx effects on the immune system</th>
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<tr>
<td>• Inhibition of opsonization</td>
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<tr>
<td>• Inhibition of S. epid. uptake by polymorphonuclear granulocytes</td>
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<tr>
<td>• Inhibition of polymorphonuclear granulocyte chemotaxis</td>
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<td>• Inhibition of B and T lymphocyte blast cell formation</td>
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<td>• Inhibition of immunoglobulin synthesis</td>
</tr>
<tr>
<td>• Increased polymorphonuclear granulocyte adhesion</td>
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<tr>
<td>• Increased polymorphonuclear granulocyte degranulation</td>
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### Table III.

<table>
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<th>Early complications: 9% of treated cases</th>
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<tbody>
<tr>
<td>Sepsis</td>
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<tr>
<td>Malpositioning</td>
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<tr>
<td>Subcutaneous infection</td>
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<tr>
<td>Arterial puncture</td>
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<tr>
<td>Pneumothorax</td>
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<tr>
<td>Hydrothorax</td>
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<td>Chylothorax</td>
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<td>Hemothorax</td>
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2) to attempt percutaneous retrieval;
3) to perform direct retrieval with cardio-
surgery.

However, also in the absence of correlated
disturbances, most authors believe that frag-
ment retrieval should be performed as soon
as possible. The preferred procedures are
those of interventional radiology which allow
the fragment retrieval and removal with
snare-loop catheters introduced percuta-
neously into the venous system\textsuperscript{12,13}.

A case is reported here of a patient in
whom the presence of a dislocated fragment
from a venous catheter was followed by rele-
vant clinical symptoms which required urgent
therapeutic intervention.

Case report

It concerns a 38-year-old female patient, un-
dergoing five years previously QSE quan-
tectomy of the left mammary gland for infl-
trating ductal carcinoma. On histology,
metastases to lymph nodes of first (2 over 8)
and second (1 over 7) level were demonstrat-
ed. Aproximately 3 years after surgery, on
sonography, multiple hepatic lesions were de-
tected. On CT and MRI at least four lesions
in the right lobe with structural disruption of
left lobe, were observed. Local radiotherapy
plus systemic chemotherapy was planned. A
Port was positioned into the right subclavian
vein. The system was regularly used for about
a year. The excellent results achieved by the
treatment (overall 60% reduction in the
metastatic mass) encouraged by a marked
improvement in the subjective conditions sug-
gested to continue the chemotherapy infu-
sion. After over a year of daily use, the sys-
tem was replaced. After 11 months at the day
hospital visit, the fluid infusion was shown to
be difficult (very slow perfusion). Cleansing
was therefore performed with insulin sy-
ringes, but it was ineffective. The same
night, at home, the patient, with no apparent
cause, complained of tachycardia, dyspnea
and was admitted in our division. Chest X-
ray showed the disruption of implantable
system with tube disconnection and CVC
embolization into the right ventricle (Figure
1). Catheterization of the right femoral vein
was performed in emergency and a snare-
loop catheter was advanced into the right
ventricle through a 7F guidewire (Figure 2).
Via the chambers of the heart and the inferior
vena cava it was advanced into the right
common femoral vein from where it was re-
trieved together with the guidewire and with
preservation of the venous wall (Figure 3).
After 4 days, a new implantable system was
inserted and the patient could be discharged.

Discussion

The insertion of Port CVC through the
right subclavian vein is an increasingly com-
mon procedure. Its success has been deter-
mined by the good patient tolerance of the
reservoir in the area of the greater pectoral
muscle and the simple, effective technique
used for its insertion. For numerous patients
it is an irreplaceable device for chronic or
continuous infusion of intravenous solutions.
The most common instances are those associ-
ated to parenteral nutrition or cycles of anti-
neoplastic therapy. Complications are rela-
tively few considering that long-term im-
plantable venous systems are common.
Disruption of port catheters and subsequent
embolization of dislocated fragment (or the
entire cannula in case of disconnection from
reservoir) represents a rather rare complica-
tion. Its real incidence is of difficult quantita-
tion (0.5%) since definitive data are lacking
in literature. The reported cases are usually
mentioned for their peculiarity and unusual
treatment rather than for their real incidence.
There are early and late causes of disruption.
The former appear within 24/72 hours of in-
sertion or first use of the system and are al-
most always attributable to an incorrect pro-

<table>
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<th>Late complications: 11%</th>
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<tr>
<td>• Sepsis</td>
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<tr>
<td>• Catheter obstruction</td>
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<tr>
<td>• Deep venous thrombosis</td>
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<tr>
<td>• Systemic infection</td>
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<tr>
<td>• Disruption</td>
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<tr>
<td>• Embolization (fragment migration into the blood stream)</td>
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<tr>
<td>• Decubitus and exteriorization of reservoir</td>
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<tr>
<td>• Dislocation</td>
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<td>• Contamination</td>
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Figure 1. Chest X-ray showing catheter disconnection from reservoir and its migration into the right ventricle.

Figure 2. Hook catheter technique (percutaneous puncture of the right femoral vein). Positioning of hook in the middle of catheter.
The latter are most frequently caused by the pinch-off syndrome which involves different pathologic conditions which share the final outcome of catheter disruption. It is therefore suitable to briefly mention the procedure: the insertion of cannulae in the subclavian vein is performed through the puncture of the vein between the clavicle and first rib, through the ligament and costoclavicular muscles. The relationship of the catheter with these structures depend on two variables: the angle of the venous puncture and especially its more or less medial site of insertion. When it is close to the middle it reaches the bony structures and results in compression or the catheter acquires a point of “fixity”: because of the intravenous flow myocardial contractility there is more marked deterioration of biomaterials in a limited area with consequent higher risk of disruption. The puncture should therefore be as lateral as possible. In our case, the complication might have been iatrogenic, caused by incorrect manoeuvres. The malfunctioning system induced the operators to perform high pressure cleasing with insulin syringes, the cause of disconnection between the reservoir and the cannula. In literature, this complication is related with the material (metal or plastic etc.) of which the catheter is made rather than with embolization.

Various authors did not report any symptoms related with silicone catheters, even after several months, and independently of the site of dislocation. At times, even the time of embolization was of difficult definition. These observations together with the initial difficulties in retrieval, justified a conservative approach. However, in our case, the associated symptoms were relevant (severe tachycardia) and its removal could not be postponed. Interventional radiology enables the retrieval with minimal complications and a more rapid resolution of the problem. Furthermore, retrieval under local anesthesia is feasible also in patients with severe underlying disease or in poor general condition. In case of technical failure and in the absence of correlated clinical symptoms, thoracotomy for direct removal is questionable. The growing need for long-term vascular access has led to a new chapter of pathology where all complications associated to the insertion and use of these implantable systems are considered.

Figure 3. Catheter retrieval through the right femoral vein.
The precise knowledge of these pathological conditions is fundamental for the application of these therapeutic systems. In fact, possible complications have been carefully characterized in literature and relative systems have been detailed for each of them.

References