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TEMPORARY BALLOON OCCLUSION OF SUBCLAVIAN VEIN IN ITS INJURY DURING TRANSVENOUS LEADS EXTRACTION IN PATIENT WITH A SUPERIOR VENA CAVA SYNDROME: CASE REPORT

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In this article we have described clinical case of successful balloon catheter for peripheral angioplasty usage for occlusion of subclavian vein which was damaged during transvenous lead extraction of old leads. It helped to prevent life-threatening bleeding.

Key words: transvenous lead extraction; superior vena cava syndrome; permanent pacemaker; bleeding

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Patients with implanted electronic cardiac devices frequently experience infectious complications, which can be life-threatening if sepsis and infective endocarditis develop [1, 2]. Complete removal of the pacing system with transvenous lead extraction (TLE) appears to be the treatment of choice in most cases of device infection [3].

Myocardial damage and hemopericardium with cardiac tamponade constitute the most common complications of TLE [4]. Vein injury is a rare complication of TLE. It occurs in 0.16-0.41% of extractions [5]. Superior vena cava (SVC) injury poses the highest risk. The mortality rate for this dangerous complication can exceed 50% [6]. A Bridge balloon (Philips, Netherlands) has been proposed for temporary hemostasis of SVC (not registered in the Russian Federation) [7]. However, subclavian and axillary veins injury often related with major bleeding. Manual compression for hemostasis may be ineffective, whereas surgical reconstruction of the subclavian vein is technically challenging and may be associated with major bleeding blood loss.

We are aware of only one clinical case in which a balloon was used to stop bleeding from a subclavian vein injury during TLE [8]. In this particular clinical case in a patient with SVC syndrome, we also performed temporary hemostasis from an injured subclavian/axillary vein with a balloon.

The patient is a 35-year-old woman with a body mass index of 18.6 kg/m2. Due to congenital complete atrioventricular block, she was implanted with a Relay dual-chamber pacemaker with passively fixed leads (Intermedics, USA) in 1998, when she was 11 years old. The pacemaker pocket was formed in the left subclavian region. The ventricular lead was fixed at the apex of the right ventricle, and the atrial lead was fixed at the appendage of the right atrium. The pacemaker was subsequently replaced twice (2010, 2017) preserving initial leads. In 2018, the patient experienced an unmedicated vaginal delivery and breastfed her child for three years. The woman noted that there was traumatization of the pacemaker pocket area when feeding the child and decanting milk. In 2021, the patient noticed skin darkening in the pacemaker pocket area and subsequently devel-

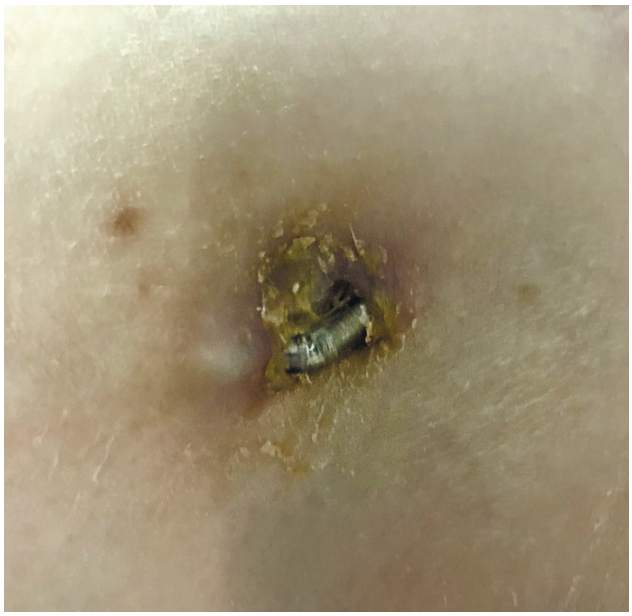

Fig. 1. Lead-associated skin erosion in the area of the pacemaker pocket.

oped a skin defect with cloudy discharge through which a foreign body was visually identified. No fever was observed in the patient.

Face and eyelids swelling was revealed during the first examination. When a more detailed history was taken, the patient reported that the face and upper extremities swelling had developed about two years ago. Enlarged veins are observed on the anterior and lateral surfaces of the chest. A 2x1 cm skin defect with a small amount of mucopurulent discharge is observed in the area of the pacemaker pocket. A section of the lead can be seen through the skin defect (Figure 1). No abnormal pacing is noted on analysis of the ECG data and during device interrogation. Lead-associated endocarditis ruled out by transoesophageal echocardiography (Echo):the heart valves are not altered, no vegetations are present. Haemoglobin on admission was 120 g/l. No inflammatory markers are detected in the blood. It was decided to completely remove the pacing system with TLE and implant a new system on the right side. The EROS and SAFeTY TLE scales define the risk of extraction as high [9, 10].

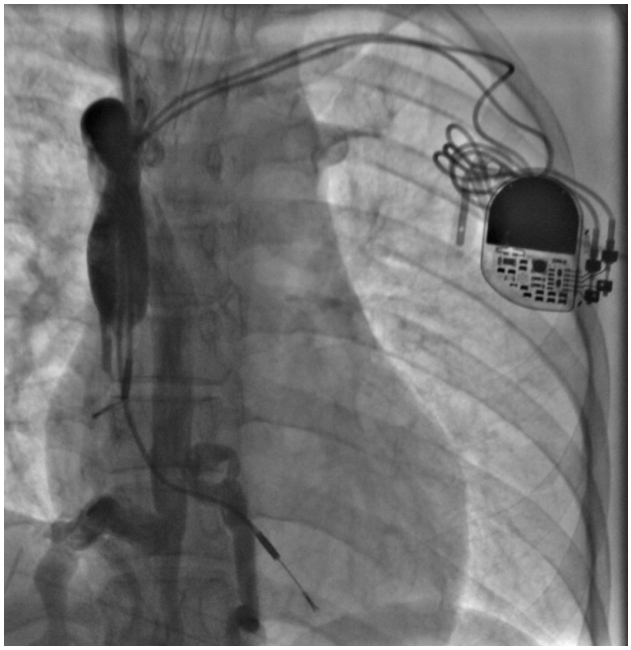

Fig. 2. Phlebography: narrowing of the superior vena cava at its junction with the right atrium (extensive collateral network).

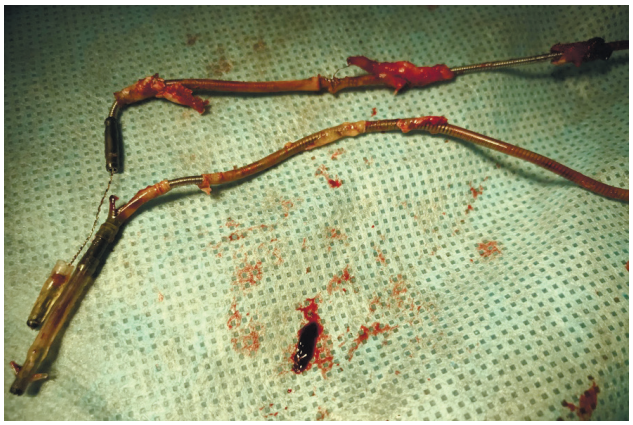

Fig. 3. Removed leads showing areas of calcified fibrous capsule.

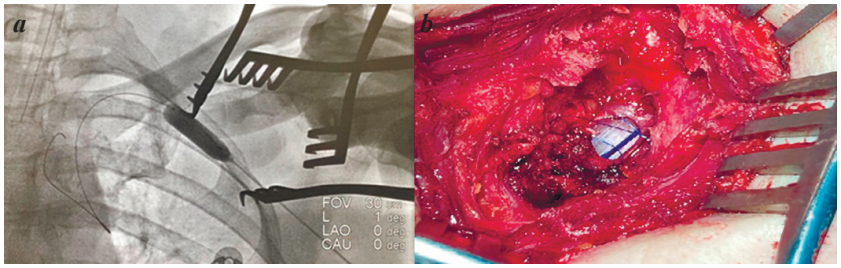

Fig. 4. Balloon catheter inflated in the left subclavian vein: a) chest radiograph, b) photograph of the surgical phase.

Operation description

The operation was performed in a hybrid operating room by a cardiovascular surgeon together with a specialist in endovascular diagnosis and treatment under complete intravenous anaesthesia with mechanical ventilation. Invasive blood pressure monitoring via the radial artery was performed. A Prelude 6Fr haemostatic introducer (Merit Medical Systems, USA) was inserted into the right internal jugular vein. Phlebography was performed through the introducer. SVC stenosis greater than 20 mm in length and over 90-95% in diameter was noted at the junction of the vein with the right atrium with the formation of collaterals and overflow into the inferior vena cava via the non-compartmental vein (Figure 2). For diagnostic purposes, a 145 cm Roadrunner PC.035 hydrophilic guidewire (Cook, USA) was inserted into the SVC through the introducer set. The lead was placed behind the stenosis in the right atrium. The possibility of implanting new leads on the right side was thereby determined. The right femoral vein was catheterized with a double lumen infusion catheter, and a Prelude 6Fr introducer (Merit Medical Systems, USA) was inserted into the right femoral vein through which a temporary pacing lead was inserted into the right ventricle. A Radifocus 10Fr introducer (Terumo, Japan) was inserted into the left femoral vein through which an AcuNav 8Fr transducer (Siemens, Germany) was passed for intracardiac echocardiography.

The surgical field was treated for the subsequent sternotomy. The skin defect was dissected, and the pacemaker and leads were isolated from the scar tissue using a monopolar coagulator. The mucous secretion from the pocket was collected for culturing and determining the sensitivity of the flora to antibiotics. The fibrous capsule of the pocket was removed with a coagulator. The leads were exposed through a separate incision in the left subclavian region. It was not possible to locate the fixation sleeves. In the search for fixation sleeves, the atrial lead was isolated at the entrance to the subclavian vein, and the ventricular lead was isolated at the entrance to the axillary vein. After cutting off the connector part of the leads, the LLD EZ stilettos (Spectranetics, USA) were inserted. The atrial lead was removed using a TightRail 11Fr device (Spectranetics, USA). The section of the SVC around the stenosis was calcified (Figure 3), which caused difficulty in

extraction. The ventricular lead was then also removed using a rotary dilator, with technical difficulties. When the device was inserted into the axillary vein, there was severe venous bleeding from the axillary/subclavian vein. Manual compression for 10 minutes showed no effect. TLE was continued using a TightRail 11Fr device (Spectranetics, USA) with single stage manual venous compression by an assistant. The lead was removed.

Intracardiac Echo showed no fluid in the pericardial cavity after lead extraction. Prolonged manual compression of the axillary/subclavian vein (about 30 minutes) showed no effect. The attempt to suture the venous defect was complicated by massive venous hemorrhage. It was decided to perform temporary hemostasis with a balloon catheter and suture the venous defect. The left cubital vein was punctured, a hemostatic introducer (5Fr) was inserted into the vein and a hydrophilic guide V18 (Boston Scientific, USA) with a diagnostic catheter Radiofocus OPTITORQUE JR 3.5 cm 5Fr (Terumo Europe N.V., Belgium) was inserted into the subclavian vein. A Sterling 10x60 mm balloon catheter (Boston Scientific, USA) was guided to the defect site; the balloon was inflated to 4 atmospheres (Figure 4a). Manual compression was then discontinued. The bleeding was stopped.

An axillary vein with a junction with the subclavian vein was visualized in the wound. There was a 30x6 mm defect on the anterior wall of the vein and an inflated balloon was observed through the defect in the vein (Figure 4b). The vein was isolated medial and lateral to the defect and placed on turnstiles. The venous defect was sutured with 5/0 Prolene. Blood flow was released. The vein filled and the lumen of the vein appeared to be 50% narrowed. It was decided not to perform vein reconstruction. There was no disturbance of haemodynamics during the procedure. The wounds on the left side were sutured after control of hemostasis. Given the mild clinical features of SVC syndrome and the calcification of the vein, it was decided not to stent the vein.

A new Estella DR -T dual chamber pacemaker (Biotronik, Germany) was implanted on the right side against the background of temporary pacing. A new pacemaker pocket was formed under the right pectoralis major muscle. The right axillary vein was punctured twice and 145 cm long Roadrunner PC.035 hydrophilic guidewires (Cook, USA) were passed behind the subtotal SVC stenosis and into the right atrium and further into the inferior vena cava. A 25 cm Radifocus 7 Fr (Terumo, Japan) introducer was placed along the leads, through which ventricular and atrial leads were positioned with active fixation were positioned with satisfactory pacing parameters (Figure 5). In the postoperative period, hemodynamics remained stable. Blood tests showed a decrease in haemoglobin to 88 g/l and no haemotransfusions were performed. The wounds healed with primary tension.

DISCUSSION

Subclavian or axillary veins injury with major bleeding is a rare complication of TLE. In this case, we mistakenly inserted a rotary dilator (11Fr), which is essentially a mechanically driven cutting tool, without proper visual inspection after visualizing the exposed axillary/clavicular vein (usually no vein is visualized in scar tissue in TLE), and thereby significantly damaged the anterior wall of the vein. The injury may also have been induced by the fact that the entry point of the ventricular lead into the vein was calcified (see Figure 3). Calcification of the fibrous capsule of the leads presents a typical situation in patients whose leads are more than 15 years old and who were implanted in childhood or at a young age. It is recognized that the time the leads remain in the body is a significant risk factor for extraction on the EROS and SAFeTY scores. In our opinion, to prevent this complication, the vein entry should be performed with close preliminary visual inspection using a SightRail Telescope propylene dilator (Spectranetics, USA) and preceded by a double cicatricial suture around the lead. A stenosis of the superior vena cava of more than 90% and the resulting venous hypertension also contributed to severe bleeding.

New device implantation after infected system removal is a significant problem, especially in patients with venous access issues. The methods to solve this problem are the following: epicardial implantation of the system, implantation through the iliac/femoral vein, recanalization and endovascular plastic surgery of the occluded/stenotic vein. Leadless pacemaker (not registered in the Russian Federation) may be considered in the future in a small group of patients with infectious complications of pacemaker and SVC occlusion [11,12]. According to current guidelines, implantation of a leadless pacemaker is recommended in the absence of venous access to the SVC or the presence of the high risk of device infection (history of infectious complications, haemodialysis patient) [13].

In this clinical situation, we believe that a leadless pacemaker is not recommended for several reasons: 1) the patient is indicated for implantation in the DDD mode; 2) the patient has a low risk of reinfection of the

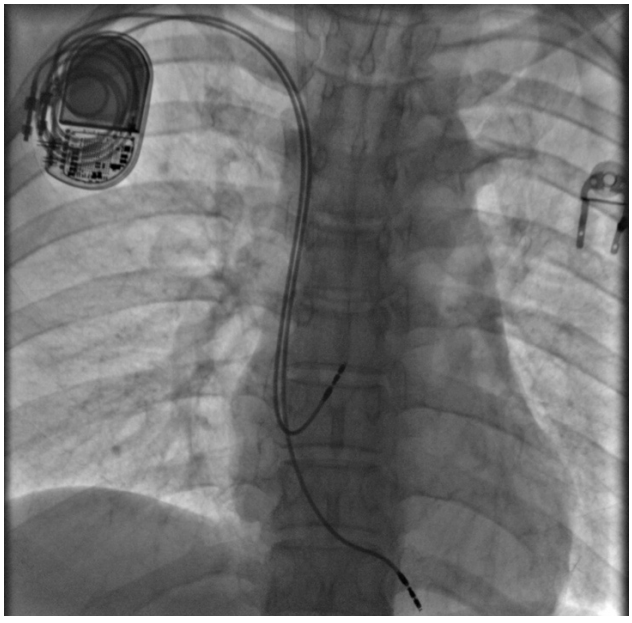

Fig. 5. X-ray after new pacing system implantation.

pacing system; 3) implantation of this device is not recommended in young patients with a life expectancy of more than 20 years [13].

We opted for endocardial lead implantation via long introducer through the stenosis of the superior vena cava as the most feasible, easiest, and least traumatic option. Modern surgical rooms in which cardiac electronic devices implanted and TLE performed are should include hydrophilic leads 140-200 cm long, introducers 23-25 cm long and balloon catheters. In some cases, a multidisciplinary approach needs to be considered in the management of patients with complications following electronic cardiac device implantation. In our case, temporary occlusion of the vein with a balloon catheter prevented life-threatening bleeding and we were able to suture the vein defect.

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