Complications of permanent dual-chamber pacing such as late purulent pacemaker pocket infection with broken and looped atrial lead, complicated by pulmonary embolism after transvenous lead removal: a case report

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Abstract: We present a complication of the infected pacing system extraction by lobular pneumonia in a 73-year-old female patient. The pacing system involved DDD pacemaker, atrial and ventricular endocardial leads implanted 12 year beforehand. The defect of the atrial lead emerged during the pacemaker replacement 4 years ago. The diagnosis of the injury cause and its reparation were not undertaken at that time.
An interruption of the atrial lead which resulted in the formation of a loop inside the cardiac chamber was found when purulant pacemaker pocket infection had been diagnosed. The patient was referred for the pacing system extraction after preoperative specific antibiotic treatment. After a long-lasting, difficult, two-step leads extraction procedure, pneumonia developed. An echocardiogram revealed enlargement of the right atrium and ventricle, with elevated pulmonary artery pressure up to 40 mmHg. An atypical chest X-ray with the presence of a large pleural liquid volume led to the work-up of hemorrhagic complications and postponed the antithrombotic therapy. With the delay of 1.5 month the pulmonary scintigraphy showed features of pulmonary embolism. The embolism was most likely caused by a vegetation mobilized from the endocardial lead and/or endocardium during the extraction maneuvers. Before the surgery, the vegetations attached to the leads or to the endocardium had not been visualized. Anticoagulant therapy with antivitamins K was successful, which resulted in the pulmonary pressure normalization. The patient has remained in a good condition for the next 3 months of follow-up.

Keys words: complications, percutaneus lead extraction, permanent pacing, purulent pacemaker pocket infection

INTRODUCTION

The introduction of the permanent pacing system carries the risk of complications, similarly to all other medical procedures. The complications which develop within two weeks after surgery and result from the intervention are termed as early [1].

Later dysfunctions of the pacemaker system caused by mechanical and electrical inefficiency of endocardial leads that represent the weakest component of the system occur. In our previous paper the prevalence of lead injury was estimated as high as 8% [2]. However, the pacemaker system infections are rare. According to other authors, the infections develop in 0.13–19.9% of cases [3]. Large differences in the complication rate are likely associated with the quality of the intervation and the organization of follow-up. The most prominent pathogens responsible for pacemaker infections are *Staphylococci* such as *S. coagulase-negative, S. epidermidis*, and *S. aureus*.

The current case presents links that may occur between complications of the mechanical leads injury and infections of the pacemaker system.

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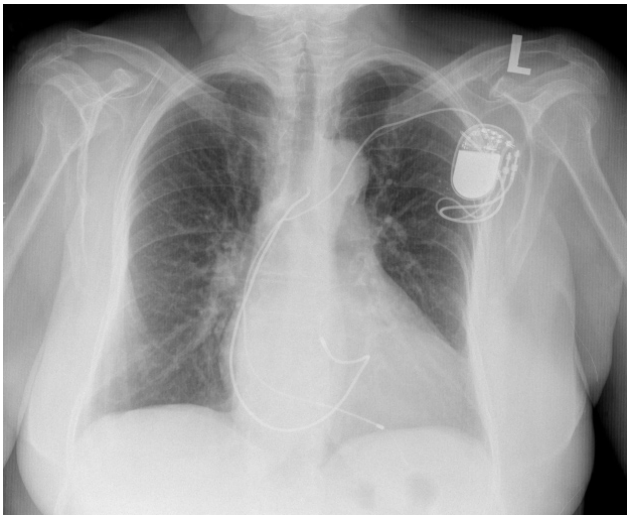

Fig. 1. PA fluoroscopic image before the removal, showing two endocardial leads: the active ventricular and the old, broken atrial one, pulled, coiled and entrapped to superior vena cava wall

CASE REPORT

A 73-year-old female with a dual chamber atrioventricular DDD pacemaker implanted 12 years ago was referred for transvenous lead removal due to purulent pacemaker pocket infection.

The pacemaker system was made up of the dual-chamber DDD pacemaker and two bipolar passive fixation electrodes. The atrial lead was positioned in the right atrial appendage, whereas the ventricular lead in the right ventricular apex. Pacing was introduced due to advanced atrioventricular block; it had remained effective until the pacemaker replacement because of battery depletion 4 years ago. In the post-operative period the patient was paced with VVI mode (ventricular pacing).

While penetrating the pacemaker pocket and removing the infected system it became evident that the fixation sutures had disrupted and were tied around the outer sheath of the lead. The lead had probably been damaged beforehand, and during the removal procedure it broke up completely when it was pulled. The failure to detect the breakage in the perioperative period and actually leaving the damaged lead with its tip unprotected from displacement by the subsequent motion of the upper left extremity resulted in electrode extrusion into the cardiovascular system. The broken proximal electrode tip with uncovered metal wires grew into the wall of the superior vena cava, whereas the lead formed a loop in the right atrium (Fig. 1). There was a short uncovered electrode tip in the pacemaker pocket connected to the pulse generator.

Chest x-rays were not obtained during follow-up visits, therefore it was not possible to find out when exactly electrode entangling had occurred. The lead dislodged to the heart was detected only when the patient referred with purulent pacemaker pocket infection. The culture of purulent samples confirmed the presence of *S. epidermidis*, and the patient received specific antibiotics for 3 weeks. She was also referred for transvenous lead removal in an experienced center.

Removal of leads

After opening of the pacemaker pocket the proximal tip of the ventricular lead was unscrewed from the pulse generator and removed. Temporary pacing was introduced because of the absence of endogenous cardiac rhythm at a rate sufficient to maintain a stable hemodynamic state (Fig. 2A). During surgical excavation the lead fixation sutures were found before its entrance into the left subclavian vein with disrupted insulation, discolored metal coil and purulent substance in the outer sheath (Fig. 3). After the stabilizing stylet had been introduced into the lumen of the exposed ventricular lead, the Byrd dilator sheath was advanced. By applying rotating cutting force, the lead was dissected from the vascular walls and cardiac cavities, and finally entirely removed.

The knotted atrial lead was extracted via the femoral vein approach. The working stations were placed in the right and left femoral vein. A temporary pacing lead was advanced through the left vein, whereas a pigtail catheter was advanced through the right vein to separate adhesion of the superior vena cava wall, however unsuccessfully.

A classical guide-wire introduced through the right working station was pushed through the lead loop, caught with a lasso catheter and extracted via the left femoral vein after prior removal of the temporary pacing lead. The endogenous rhythm was accelerated pharmacologically (Fig. 2B–C).

Despite traction applied to both ends of the guide-wire protruding from the right and left femoral vein, it was not possible to dissect the adhesion. The classical guide-wire was then replaced with a 0.35". Amplatz guide-wire which is very stiff. Performing the same maneuver, the lead was stretched and practically dissected but not separated from the myocardial and vascular walls. Then, the stretched lead loop freely hanging in the inferior vena cava was caught with a lasso catheter (Fig. 2D) and by applying traction it was pulled out of the right femoral vein (Fig. 2E), and then with alternate traction applied to the loop fixed in the superior vena cava the lead was finally separated from the binding tissue (Fig. 2F). The Byrd dilator was advanced over the straightened wire with fragmented outer sheath (a remnant of the coil) (Fig. 2G) and the lead head was dissected free from the endocardium of the right atrial appendage. In this way the atrial lead was removed from the heart and vessels (Fig. 2H).

The patient tolerated the procedure well with no significant hemodynamic complications. However, a DDD pacemaker was simultaneously introduced via the right subclavian vein using active fixation electrodes. It was decided not to postpone the implantation procedure as the patient had been receiving targeted antibiotic therapy for 3 weeks with no symptoms of generalized infection and she was pacemaker-dependent. The patient left the EP lab in good clinical state.

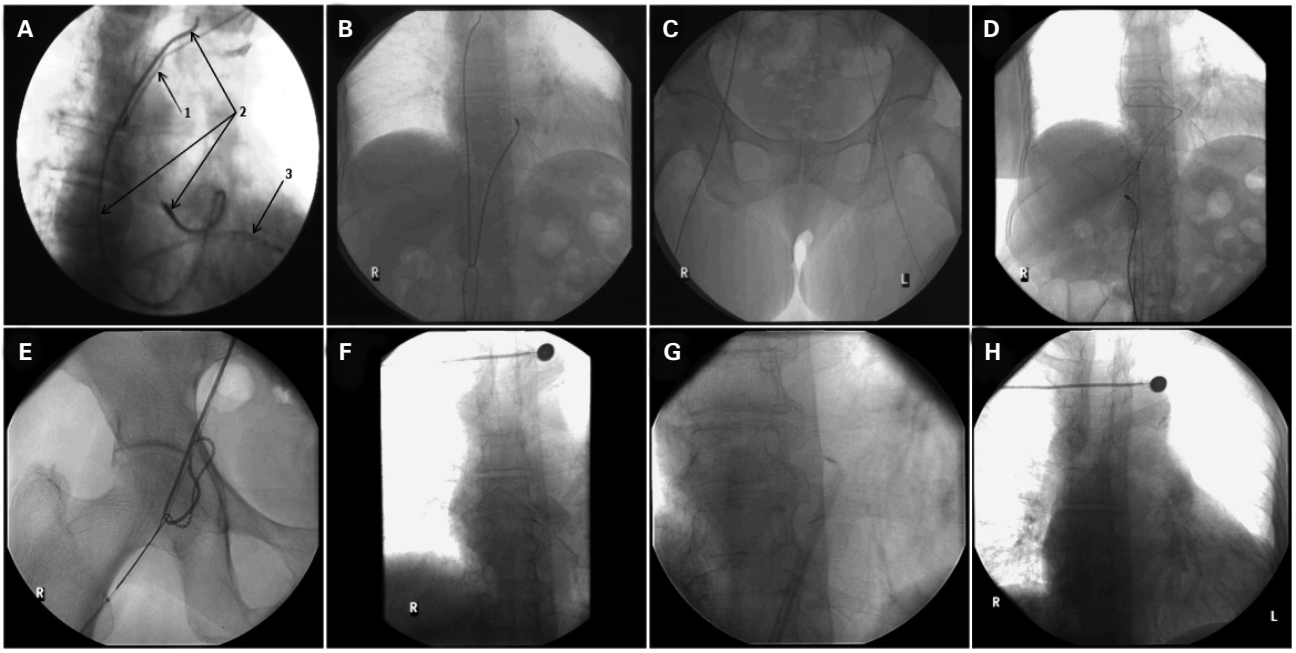

Fig. 2. Intra-operative fluoroscopy: **A** – ventricular lead extraction: the extracted ventricular lead (1), the broken atrial lead (2), the lead for temporary pacing (3). **B–H** – atrial lead extraction: the guide-wire passing above the extracted atrial lead loop (**B**), being pulled by the guide-wires advanced through the working stations in the right and left femoral veins (**C**). The stretched lead loop hanging in the inferior vena cava with a lasso catheter (**D**). The lead loop pulled out of the right femoral vein with a lasso catheter (**E**). A remnant of the coil fixed in the right atrial appendage (**F**). The Byrd dilator over the remaining fragment of the atrial lead (**G**). The heart without the leads (**H**)

Postoperative course

The control chest X-rays taken 4 days after the lead removal and pacemaker implantation, revealed the presence of fluid in the right pleural cavity. Episodes of atrial fibrillation occurred and D-dimer levels were increased 10 times over the upper limit of the normal range. Right-sided pneumonia with inflammatory pleural reaction was confirmed by laboratory tests such as markers of inflammation (C-reactive protein [CRP]) were significantly elevated. The patient had attacks of cough requiring pharmacological treatment. An echocardiogram showed enlargement of right cavities and elevated pulmonary artery pressure up to 40 mmHg.

Suspecting pleural hemorrhage the chest X-rays was performed several times, the CT-scan one time. The pleural liquid did not display the density characteristic for blood. Antithrombotic drugs were not administered since bleeding to the pleural cavity has been suspected. She was subjected to liquid extraction twice because of its large volume leading to dyspnoe. In the macroscopic examination the liquid was contaminated by blood, however, the microscopic diagnosis revealed inflammatory features. The patient was put on two antibiotics, clindamycin and ciprofloxacin. A 1.5-month hospital treatment resulted in regression of fluid in the right pleural cavity and resolution of inflammatory symptoms. With the delay of 1.5 month, after her return to the home place, pulmonary scintigraphy was carried out. It revealed features of pulmonary embolism in the subsegmental vessels. Antithrombotic therapy with antivitamin K was intiated and conducted successfully, which resulted in pulmonary pressure normalization. The patient has remained in a good state for 3 months (Fig. 4).

DISCUSSION

The inactive atrial lead left in the heart and disrupted by crushing at the fixation suture site within the pacemaker

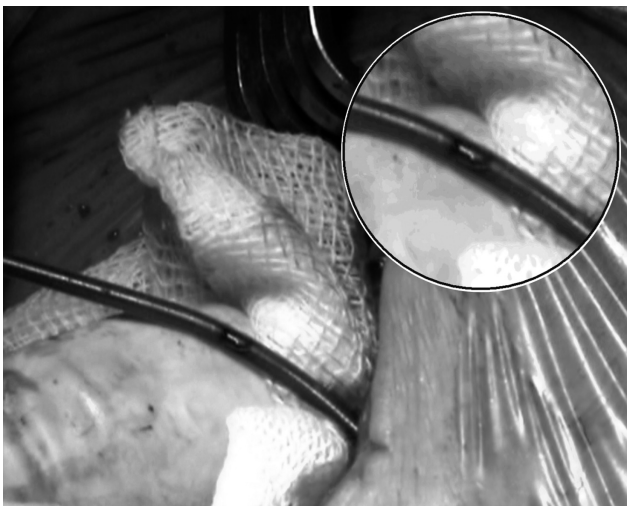

Fig. 3. The intra-operative photography. The ventricular lead outer insulation disruption at the level of fixation sutures

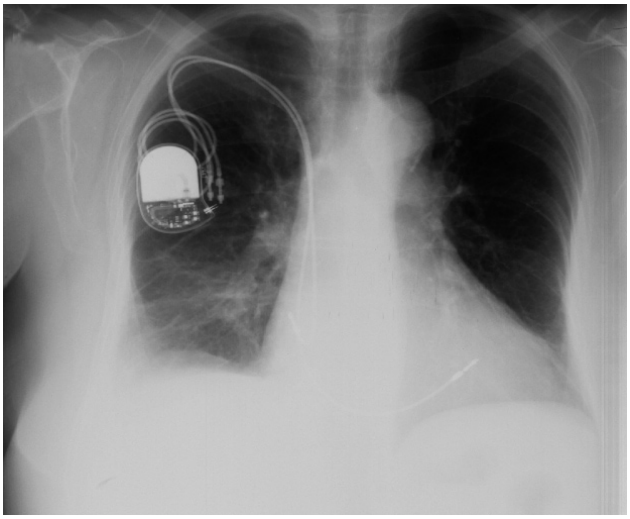

Fig. 4. PA fluoroscopic image after the removal and implantation of new pacing DDD system on the right side

pocket spontaneously dislodged to the cardiovascular system. Purulent pacemaker pocket infection prompted the decision to remove the lead system after antibiotic premedication.

The ventricular lead was removed using a standard "over the wire" technique (Cook), whereas the atrial lead was extracted using an original and unconventional technique invented by the authors with good outcomes.

This clinical scenario emphasizes the need for detailed assessment of patients with implanted cardiac rhythm devices to detect damaged permanent pacing leads. It is also recommended to remove disrupted leads as soon as possible [4].

Postponing a decision to remove disrupted leads may result in actually growing the broken tip into the walls of the cardiovascular system, triggering late complications including dislodgement of infected emboli and post-embolization lobular-type pneumonia.

The case presents difficulties encountered at the evaluation of pulmonary embolism risk factors, even in the highly-qualified electrocardiology center specialized in pacemaker extractions. The transesophageal echocardiographic diagnosis of intracardiac leads vegetations on the leads and endocardium was not performed [5,6]. An atypical chest X-rays with a large volume of pleural liquid led to the diagnosis of hemorrhagic complications after the complicated extraction procedure, and postponed the onset of antithrombotic therapy.

The presented data remain in line with that found in the literature which describes a less intensive approach to pulmonary embolism as compared to cardiac and pulmonary diseases [7].

An early detection of unrepairable mechanical damage to endocardial leads should be an indication for early lead removal. The time from electrode dislodgement to decision-making regarding removal is a unfavorable factor affecting the procedure and involving late complications.The removal of old purulent endocardial leads is associated with pulmonary embolism with infected material, possibly leading to lobular pneumonia. A large volume of pleural liquid, with strong suspicion of the superior vena cava injury, can hamper establishing the diagnosis of infection superimposed on thrombosis and delay the administration of antithrombotic therapy.

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