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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Post heart transplant extraction of the abandoned fragments of pacing and defibrillation leads: proposed management algorithm

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Abstract

Background: An increasing number of patients is referred for orthotopic heart transplantation (OHT) after previous implantable cardioverter-defibrillator (ICD) or cardiac resynchronisation therapy (CRT) device implantation.

Aim: To assess the rate of unsuccessful lead extractions during OHT and propose an appropriate management algorithm.

Methods: The study population included 73 consecutive patients who underwent OHT in our hospital between January 2009 and December 2011.

Results: In the study group, 36 (49.3%) patients previously underwent ICD (21 patients, 28.8%) or CRT (15 patients, 20.5%) implantation. In 29 patients, all previously implanted leads were completely removed during transplantation. In 7 (19.5%) patients, fragments of the leads could not be removed and were abandoned due to their adherence to the venous system, including a proximal defibrillation coil in 6 cases and a fragment of a left ventricular lead in 1 case. All abandoned lead fragments were extracted after the transplantation (10–70 days, mean 27 days) either with manual traction techniques (1 case, left ventricular lead), or with the assistance of lead extraction sheaths (6 cases, dual-coil defibrillation leads). Due to lead fracture, it was necessary to use femoral approach in 1 case. No complications of lead extraction were noted.

Conclusions: In a significant number of patients, previously implanted leads cannot be removed during OHT. Therefore, abandoned lead fragments should be removed after the transplantation using transvenous lead extraction techniques.

Key words: heart transplantation, lead extraction, defibrillation lead

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INTRODUCTION

One approach to reduce mortality in patients with heart failure (HF) is device therapy using implantable cardioverter-defibrillator (ICD) or cardiac resynchronisation therapy (CRT), usually with a device with defibrillation capability (CRT-D) that also allows terminating ventricular tachyarrhythmia [1]. Decreased mortality results from a reduction in both sudden deaths (ICD) and deaths due to HF (CRT) [1]. In addition, CRT reduces symptoms of HF and hospitalisations due to decompensated HF [1]. Despite beneficial effects of this therapy, some patients require consideration of orthotopic heart transplantation (OHT) due to progression of HF or recurrent ventricular arrhythmia refractory to drug therapy and other treatments (ablation). The implanted device is usually removed together with the leads during OHT. Sometimes, however, complete lead removal is not possible due to their adhesion to the walls of large veins.

The purpose of this study was to assess the rate of unsuccessful lead extractions during OHT and propose a management algorithm.

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METHODS

Study group

We studied all consecutive 73 patients who underwent OHT in our centre between January 01, 2009 and December 31, 2011. Patient selection for OHT was in accordance with the current guidelines of cardiac societies [1]. Table 1 shows patient characteristics in the study group.

Device removal during heart transplantation

The procedure of device removal during OHT takes two stages. When the native recipient heart is excised, right-sided leads are cut peripherally, with their tips remaining in the explanted heart, and the proximal parts left in the venous system together with the device remaining in its pocket. These parts are removed after thoracotomy closure, as it is necessary to prepare the operative field in the subclavicular area. After the device pocket is open and the ICD/CRT pulse generator is exposed, the leads are explored surgically up to the site of their ligation and entry into the venous system. Then, an attempt is undertaken to remove the leads by simple traction without fluoroscopic guidance. Complete device removal is verified by radiological imaging 24–48 hours after the surgery.

If it is not possible to remove leads (e.g., due to large resistance during traction), only the pulse generator is removed. The leads are screwed off the ICD or CRT-D cover and left with their proximal endings in the device pocket so as not to be damaged, as it will facilitate their removal using interventional cardiology techniques. In any case, the device pocket is closed using single sutures, with a Redon drain left in situ.

Removal of abandoned lead fragments using interventional cardiology techniques

The abandoned lead fragments were removed electively during the same hospitalisation or at a later time. The procedures were performed under intravenous general anaesthesia administered. The lead was explored and uncovered, and a mandrin was introduced into its lumen. It was then attempted remove the lead by simple traction under fluoroscopic guidance. It this proved unsuccessful, the Cook system for percutaneous lead extraction was used.

Statistical analysis

Normally distributed variables were described with mean values and standard deviation, and those with a non-normal distribution were also described with median values.

RESULTS

Among 73 patients who underwent OHT, 36 (49.3%) patients had had a device implanted previously, including an ICD in 21 (28.8%) patients and a CRT device in 15 (20.5%) patients implantation (Table 1). In 29 patients, all previously implanted leads were completely removed during OHT. In 7 patients (19.5% of patients with an implanted device), fragments of the leads could not be removed during OHT and were abandoned due to their adherence to the venous system. These included a proximal defibrillation coil indwelling between the subclavian vein and the entry of the vena cava superior to the right atrium in 6 cases, and a fragment of a left ventricular lead in 1 case.

Table 1. Clinical characteristics of the study group (n = 73)

Age [years]	44.1 ± 14.9
Female gender	13 (17.8%)
Underlying heart disease:	
Coronary artery disease	26 (35.6%)
Dilated cardiomyopathy	36 (49.3%)
Hypertrophic cardiomyopathy	3 (4.1%)
Other	8 (11%)
Implanted ICD/CRT, including:	36 (49.3%)
ICD	21 (28.8%)
CRT	15 (20.5%)
Mean time from ICD/CRT implantation to OHT [months]	27.1 ± 59 (range 2–120)
Mean time from ICD/CRT implantation to delayed extraction of abandoned lead fragments [months]	39.7 ± 29.6 (range 4–84)

Mean values ± standard deviation (SD) and range or numbers and percentages (in parentheses); ICD — implantable cardioverter-defibrillator; CRT — cardiac resynchronisation therapy; OHT — orthotopic heart transplantation

All abandoned lead fragments were extracted 10–70 days after OHT (mean 27 days) using the following techniques:

- Direct traction after inserting a mandrin into the lead lumen. This technique was used in 1 case to remove a left ventricular lead fragment.
- The Cook lead extraction system that was used in 6 cases to remove abandoned fragments of defibrillation leads. In 5 cases, the abandoned fragments were removed using metal, polypropylene, and teflon Byrd dilators. In 1 case, the proximal fragment of the lead was fractured and detached during the procedure (Fig. 1). To remove the remaining proximal defibrillating coil, a set of teflon sheaths with a snare that allowed grasping the lead fragment and withdrawing it into the sheath (Needle's Eye, Cook) was introduced through the femoral vein.

No complications of lead extraction were noted. In 1 patient, removal of the abandoned lead resulted in resolution of previously observed chronic fever.

DISCUSSION

Understandably, a large proportion of patients referred for OHT have previously undergone implantation of a device, i.e., ICD or CRT [1]. In our study group, nearly half of all patients have had a CRT or ICD implanted. This proportion is much higher compared to that reported previously (< 20%)

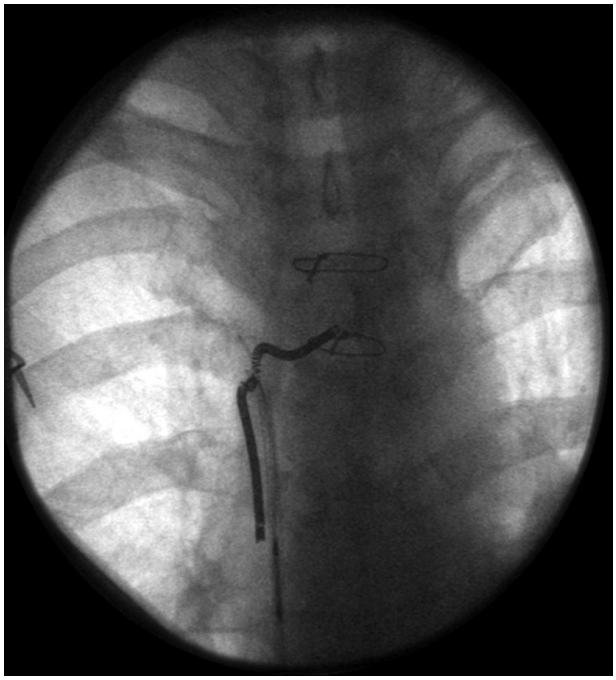

Figure 1. A fragment of a dual-coil defibrillating lead at the junction of the innominate vein and the vena cava superior. A proximal fragment of the lead was detached during an attempt to remove the lead using Byrd dilators. The remaining proximal fragment is caught with a snare (Needle's Eye, Cook) introduced with teflon sheaths through the femoral vein

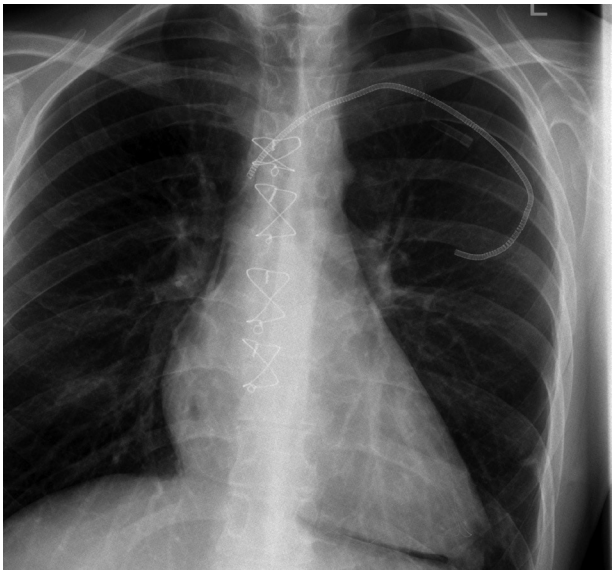

Figure 2. A fragment of a dual-coil defibrillating lead seen in the venous system and at the subclavicular area in a patient after heart transplantation. The lead is stretched, and its ending has been cut off which hampers future extraction. Note a coupler left in the device pocket area which may be a source of future infection

[2], probably reflecting expanded indications for ICD/CRT implantations in the recent years. The number of patients undergoing OHT who require lead removal may by thus expected to increase but the approach to this issue has not been established.

In most cases, it is possible to remove the leads completely at the time of OHT. In some patients, however, lead adhesion to the vessel wall renders removal using manual traction only impossible and it is necessary to use specialised percutaneous lead extraction systems. The most common sites of these adhesions, where abandoned lead fragments dwell after removal of the recipient heart, include the subclavian vein, the innominate vein, and the vena cava superior [3–6]. In our sample, problems with lead removal were usually encountered in case of dual-coil defibrillating leads (6 of 7 cases), with a distal defibrillating coil in the right ventricle which is removed together with the recipient heart during OHT, and a proximal defibrillating coil which is usually placed at the entry of the vena cava superior to the right atrium [7]. In practice, however, the proximal defibrillating coil is often located more peripherally in the venous system, even in the subclavian vein, which results in adhesions to the vessel wall and/or development of venous thrombosis. With lead adhesion to the venous wall, lead removal is hampered and more dangerous, as it is associated with a risk of vessel wall damage [8], and forceful traction may result in lead fragmentation, with some fragments or fixating parts left in the patient body (Fig. 2). Evaluating whether a lead has been completely removed, particularly after it was cut during OHT, requires fluoroscopic imaging of the procedural field.

Abandoning lead fragments in patients after OHT is associated with the risk of infective complications which are particularly dangerous in these patients due to concomitant chronic immunosuppressive therapy. Lead-dependent infective endocarditis has been reported that results from bacterial colonisation of wear and tear areas within functioning leads [9–11]. Cut and damaged lead fragments are even more likely sites of bacterial or fungal colonisation, especially with limited antibiotic penetration to these locations. In our study population, 1 patient had chronic fever which resolved after lead fragment extraction. Although no reports on infections related to abandoned lead fragments in patients after OHT can be found in the literature, such fragments remain a potential source of infection. Thus, their prompt removal seems reasonable so as to avoid leaving bare metal lead endings in the venous lumen.

In addition, abandoned metal lead fragments may limit future diagnostic applications of, or pose a risk in case of magnetic resonance imaging.

As heart transplantation is never an elective procedure, it is not possible to provide an additional team with qualifications necessary for lead removal, and the surgical room is not equipped with an X-ray machine. Lead removal might

also prolong the operation time. As pacing and defibrillating systems vary in design, cardiac surgeons are unable to confirm whether all implanted leads have been completely removed, and definitive verification is often difficult without fluoroscopy. Cases of a defibrillating lead fragment dislocating to the left ventricle of the donor heart during OHT were reported [12].

In summary, the following approach can be recommended: distal lead fragments should be cut off at the level of the vena cava superior during OHT, and the remaining lead fragments and the device itself should be removed under fluoroscopic guidance at a later time, if complete lead removal during OHT seems to be associated with any risk, particularly of vessel damage or leaving a lead fragment in the patient body. Percutaneous removal of any abandoned lead fragments at a later time should be performed by an adequately experienced team with a full cardiac surgical backup as recommended by the cardiac societies [13]. Lead fragments dwelling in the device pocket should not be cut off, as it hampers their future percutaneous removal. The optimal timing of lead extraction after OHT to is difficult to establish, but the procedure should be performed as soon as possible once the patient condition is stabilised after the surgery.

Limitations of the study

Due to retrospective nature of our study and lack of detailed data (patients had their ICD/CRT implanted in various centres), we did not perform an analysis regarding the type of the defibrillating lead being removed (single vs. dual-coil, passive vs. active fixation). Despite a longer mean time from device implantation in patients who required delayed lead extraction, we believed that formal statistical analyses should not be performed as the compared study groups were too small, and the time from device implantation to OHT varied extensively in both of them (range 2–120 and 4–84 months, respectively).

CONCLUSIONS

In a significant number of patients, previously implanted pacing or defibrillating leads cannot be removed during heart transplantation. Therefore, abandoned lead fragments should be removed after the transplantation using transvenous lead extraction techniques.

Conflict of interest: *none declared*

References

1. Dickstein K, Cohen-Solal A, Filippatos G et al. ESC Committee for Practice Guidelines (CPG). ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008: the Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association of the ESC (HFA) and endorsed by the European Society of Intensive Care Medicine (ESICM). Eur Heart J, 2008; 29: 2388–2442.
2. Ermis C, Zadeii G, Zhu AX et al. Improved survival of cardiac transplantation candidates with implantable cardioverter defibrillator therapy: role of beta-blocker or amiodarone treatment. J Cardiovasc Electrophysiol, 2003; 14: 578–583.
3. Bongiorni MG, Soldati E, Zucchelli G et al. Transvenous removal of pacing and implantable cardiac defibrillating leads using single sheath mechanical dilatation and multiple venous approaches: high success rate and safety in more than 2000 leads. Eur Heart J, 2008; 29: 2886–2893.
4. Novak M, Dvorak P, Kamaryt P et al. Autopsy and clinical context in deceased patients with implanted pacemakers and defibrillators: intracardiac findings near their leads and electrodes. Europace, 2009; 11: 1510–1516.
5. Kennergren C, Bjurman C, Wiklund R, Gäbel J. A single-centre experience of over one thousand lead extractions. Europace, 2009; 11: 612–617.
6. Kutarski A, Małecka B, Ruciński P, Ząbek A. Percutaneous extraction of endocardial leads — a single centre experience in 120 patients. Kardiol Pol, 2009; 67: 149–156.
7. Oręziak A. Elektrody defibrylujące. In: Przybylski A, Sterliński M eds. Implantowane kardiowertery-defibrylatory. Wydawnictwo AiM, Warszawa 2011: 57–64.
8. Małecka B, Kutarski A, Grabowski M. Is the transvenous extraction of cardioverter-defibrillator leads more hazardous than that of pacemaker leads? Kardiol Pol, 2010; 68: 884–890.
9. Kolodzinska A, Kutarski A, Grabowski M et al. Abrasions of the outer silicone insulation of endocardial leads in their intracardiac part: a new mechanism of lead-dependent endocarditis. Europace, 2012 [Epub ahead of print].
10. Małecka B, Kutarski A. Lead-dependent infective endocarditis: an old problem, a new name. Cardiol J, 2010; 17: 205–210.
11. Kutarski A, Trojnar M, Tomaszewski A et al. Diagnosis and treatment of lead-dependent infective endocarditis. Kardiol Pol, 2011; 69: 502–504.
12. Luehr M, Daehnert I, Mohr FW, Barten MJ. Three-dimensional computed tomography imaging of an implantable cardioverter-defibrillator lead fragment in the left ventricle of a heart transplant followed by successful transarterial extraction with a snare catheter. Interact Cardiovasc Thorac Surg, 2012 [Epub ahead of print].
13. Wilkoff BL, Love CJ, Byrd CL et al. Transvenous lead extraction: Heart Rhythm Society expert consensus on facilities, training, indications, and patient management: this document was endorsed by the American Heart Association (AHA). Heart Rhythm, 2009; 6: 1085–1104.

Usunięcie fragmentów elektrod endokawitarnych u chorych po przeszczepieniu serca. Proponowany algorytm postępowania

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Streszczenie

Wstęp: Rośnie liczba chorych kwalifikowanych do przeszczepienia serca (OHT), którym wcześniej implantowano kardiowerter-defibrylator (ICD) lub urządzenie do terapii resynchronizującej (CRT).

Cel: Celem pracy jest ocena, jak często nie jest możliwe całkowite usunięcie elektrod w czasie OHT i przedstawienie metod postępowania w takich sytuacjach.

Metody: Badaniem objęto 73 chorych, u których w okresie od 01.01.2009 r. do 31.12.2011 r. wykonano OHT w ośrodku autorów.

Wyniki: W badanej grupie u 36 (49,3%) osób wszczepiono poprzednio ICD (21; 28,8%) lub CRT (15; 20,5%). U 29 chorych wszystkie elektrody usunięto w całości w czasie OHT. U 7 (19,5%) pacjentów jednoczesne usunięcie fragmentów elektrod było niemożliwe z powodu ich zrośnięcia w obrębie układu żylnego. W 6 przypadkach pozostawionym fragmentem elektrody po OHT był proksymalny biegun defibrylujący. U 1 chorej usunięto fragment pozostawionej elektrody lewokomorowej. Fragmenty te usunięto w okresie 10–70 dni (śr. 27) po transplantacji serca za pomocą następujących metod: (1) trakcji bezpośredniej — 1 przypadek (fragment elektrody lewokomorowej); (2) zestawu do ekstrakcji elektrod firmy COOK — 6 przypadków (pozostawione fragmenty elektrod defibrylacyjnych). W 5 przypadkach pozostawione fragmenty usunięto w całości za pomocą dylatatorów Byrda (COOK). W 1 przypadku pozostałą część usunięto, wprowadzając przez żyłę udową zestaw koszulek teflonowych zakończonych specjalną pętlą umożliwiającą chwycenie końca elektrody i wprowadzenie go do koszulki. Nie wystąpiły powikłania zabiegu.

Wnioski: U znacznego odsetka chorych nie jest możliwe usunięcie elektrod defibrylujących i stymulacyjnych w czasie OHT. Wydaje się celowe usunięcie pozostawionych fragmentów za pomocą zestawów do przeznaczyniowej ekstrakcji elektrod.

Słowa kluczowe: transplantacja serca, usuwanie elektrod, elektrody defibrylacyjne

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