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Characteristics and results of catheter ablation of arrhythmias coming from the transplanted heart

Short title: RF ablation in OHT recipients

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INTRODUCTION

Arrhythmias in the donor heart are observed in less than 0.5% of patients undergoing orthotopic heart transplantation (OHT) [1]. Radiofrequency catheter ablation (RFA) in a transplanted heart can present certain challenges due to the distinctive anatomical features and potential for complications. However, it can be considered when antiarrhythmic drugs are ineffective and RFA can result in significant improvements in patients' quality of life.

The aim of the study was to evaluate the safety and efficacy of catheter ablation of atrial arrhythmias in patients at varying stages after heart transplantation.

METHODS

Authors present a series of cases of heart transplant recipients undergoing RFA for supraventricular tachycardia. Patients were scheduled for RFA for symptomatic, drug-resistant supraventricular tachycardia. All patients were subject to regular follow-up and supervision by heart transplantation specialists in a dedicated outpatient clinic. The study was a retrospective follow-up of consecutive patients after OHT who were referred for ablation at our center. Patients provided informed consent for procedures and a retrospective analysis of medical records did not require approval from the Bioethics Committee.

Due to the limited sample size, statistical analysis was restricted to descriptive statistics.

RESULTS AND DISCUSSION

Out of a total of 550 patients monitored in the heart transplantation outpatient clinic at our centre, seven male patients, aged between 45 and 70 years, were scheduled to undergo RFA between the years 2017 and 2023. The clinical characteristics of the patients are presented in Supplementary material, *Table S1*. Six patients suffered from multiple comorbidities. Two patients were on cardiac support prior to OHT. One patient demonstrated a persistently reduced left ventricular ejection fraction (LVEF) subsequent to OHT, attributable to cardiac allograft vasculopathy. Another patient exhibited this reduction only during the sustained arrhythmic episode.

One patient in this cohort underwent biatrial OHT in 2003. The remaining 6 patients underwent bicaval OHT between 2012 and 2020. None of the donors had a medical history suggestive of arrhythmia-related symptoms. In the study group, the most common arrhythmia was atrioventricular nodal reentrant tachycardia (AVNRT), diagnosed in three patients. Two patients were diagnosed with typical atrial flutter (AFL), and one patient each had accessory pathway (AP) and atrial tachycardia (AT). The onset of arrhythmia symptoms occurred earlier in four patients with AVNRT or AP (1 to 75 months, mean 29 months after OHT) compared to three patients with AFL or AT who became symptomatic later (41 to 231 months, mean 135 months after OHT).

In view of the arrhythmia-related symptoms, pharmacological or electrical cardioversion was performed in two cases. In one patient with initially reduced LVEF and recurrent AT, there was a notable worsening of symptoms related to heart failure. After treatment, symptoms and LVEF returned to pre-arrhythmia levels. In all cases, vascular access was performed under ultrasound guidance. All ablations were conducted within the right atrium, including one case of septal posterior accessory pathway. RFA was performed using the conventional technique comprising an EP system and fluoroscopy in four patients. In three

patients (AFL and AT cases), RFA was performed with the aid of a 3D electroanatomical mapping system. All patients underwent echocardiography in the EP cath lab immediately following the procedure. No complications were observed in the post-procedural period. No arrhythmia recurrence was observed over the course of a follow-up period of 3 to 75 months, with a mean duration of 36 months.

The effective treatment of arrhythmias in the transplanted heart should aim not only to mitigate the potential complications and reduce symptoms, but also to enhance the patient's quality of life. As previously discussed [2], heart transplant recipients expressed a high level of anxiety when any complication with the “new heart” appears. It is therefore crucial to select a treatment that effectively reduces the recurrence of arrhythmia while maintaining safety. In light of these considerations, the choice of RF ablation appears to be a rational one, despite the technical challenges that must be taken into account. The presence of scar tissue at the anastomosis sites and the distorted atrial anatomy of the transplanted heart may have a particular impact during the ablation. Therefore, cardiac imaging including computed tomography or magnetic resonance may play a role in the preprocedural planning of successful ablation.

In larger patient groups, the success rate for CTI-dependent atrial flutter ablation reached 93%, with a recurrence rate of 10% with subsequent ablation, and the recurrence rate of typical and atypical atrial flutter was significantly reduced from 50% on antiarrhythmic therapy to 10% after ablation. [3]. No cases of arrhythmia recurrence were documented in our study cohort. Although the number of patients included in the study was relatively small, the results suggest that transcatheter ablation of supraventricular tachycardias can be performed safely and effectively in heart transplant recipients. In order to minimize the occurrence of complications associated with vessel access, ultrasound-guided cannulation was employed as a standard procedure in our EP lab. This is particularly beneficial for patients who have undergone multiple femoral vessel cannulations, a procedure commonly performed in heart transplant patients.

It is anticipated that arrhythmias that are already present, even if undiagnosed, in the donor heart will manifest at an earlier stage, whereas those that are attributable to electrical and mechanical remodeling following OHT are expected to emerge at a later phase after transplantation. This is consistent with our findings, which demonstrated that AVNRT and Wolff–Parkinson–White syndrome tend to become symptomatic earlier after OHT, sometimes as early as the first month after the procedure. In view of the shortage of organs for transplantation and good results of ablation, a history of AVNRT or Wolff–Parkinson–White in the donor does not necessarily mean that the heart should be excluded from donation.

However, this information is most often not known at the time of donating, as also shown by the experience of another Polish transplant center [4]

In contrast, AFL and AT were observed several years after OHT. A review of the existing literature reveals that atrial flutter and atrial fibrillation are the most commonly observed arrhythmias in the long-term follow-up of heart transplant recipients [3, 5]. Atrial arrhythmias in the transplanted heart can be attributed to two pathophysiological conditions that are not present in the native heart: acute cellular rejection and subsequent focal scar formation and the type of surgical anastomosis (the biatrial method has been demonstrated to result in a higher incidence of arrhythmias than the bicaval method) [3]. In the former case, prompt diagnosis of this condition should be a priority. Our findings indicated the absence of any evidence of an ongoing acute cellular graft rejection. Additionally, AFL was diagnosed in one patient with bicaval anastomosis and one with biatrial anastomosis. Finally, the electrophysiological study prior to ablation is of great diagnostic importance, as the traditional 12-lead electrocardiogram is often of little diagnostic value (Figure 1) and mechanisms of target arrhythmia very often involve complex atrial or atrio-ventricular re-entry circuits demanding invasive electrophysiological differentiation and meticulous mapping.

This study has a number of limitations inherent to its retrospective case series methodology: small sample size, lack of control group, potential selection bias among others.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/polish_heart_journal.

Article information

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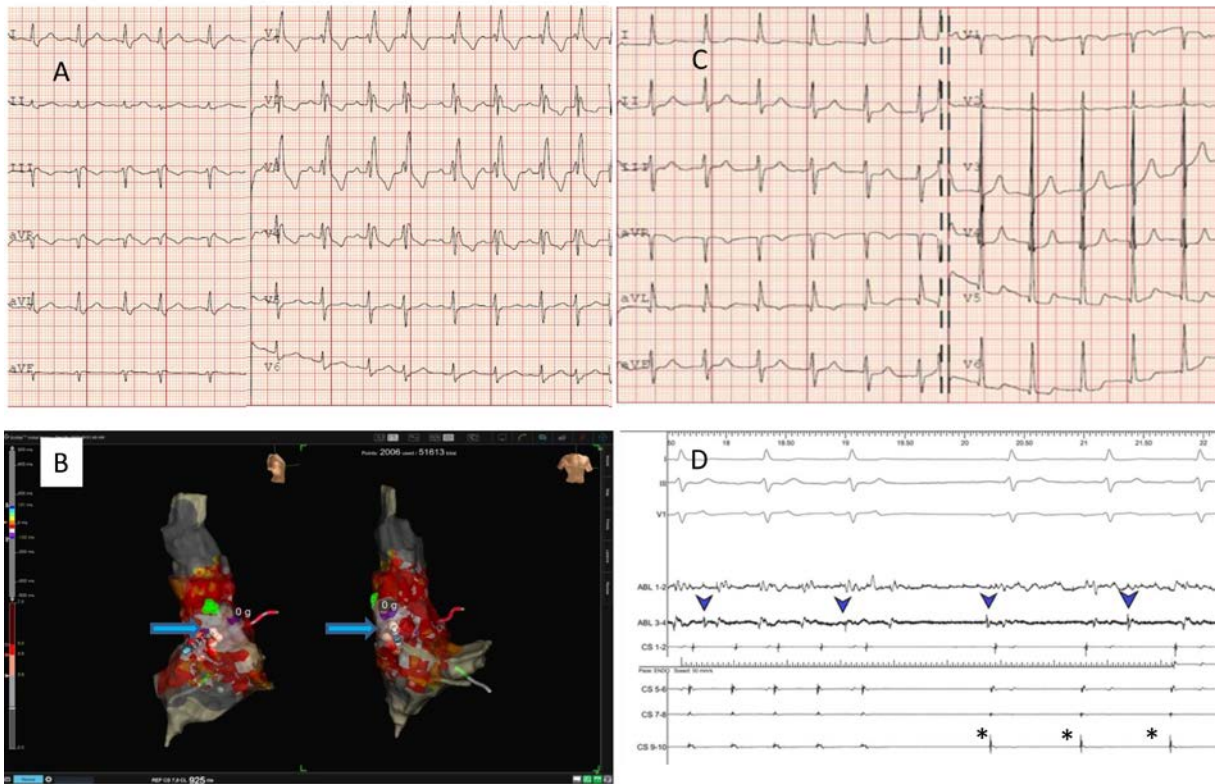


Figure 1. **A.** Surface electrocardiogram of an arrhythmia identified during electrophysiological study as an atrial tachycardia originating from the right atrium. **B.** A 3D electroanatomical map indicating area of origin of the atrial tachycardia on the lateral wall of right atrium (arrow) below the sinus node (green dot). **C.** Surface electrocardiogram of an arrhythmia identified during electrophysiological study as a typical atrial flutter. **D.** Endocardial tracings depicting termination of arrhythmia during cavo-tricuspid isthmus ablation. Arrows indicate electrical activity in recipient's native atrium independent from the rhythm in the donor heart. Asterisks indicate the sinus rhythm in the donor heart restored by successful ablation