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The efficacy of radiofrequency catheter ablation in ectopic atrial tachycardia

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Abstract

Background: *Ectopic atrial tachycardia (EAT) is a relatively rare form of supraventricular arrhythmia, which, if persistent, may lead to tachycardia-induced cardiomyopathy, associated with an equally poor prognosis, including the risk of sudden cardiac death, as other dilated cardiomyopathies. The aim of the study was to evaluate the efficacy and course of radiofrequency catheter ablation (RFCA) in the treatment of patients with EAT.*

Methods: *The study group comprised 33 consecutive patients (16 males and 17 females of mean age 41 ± 15 years) managed for EAT at our clinic. Each patient underwent an electrophysiological study and atrial mapping during an episode of arrhythmia using the CARTO system. Subsequent RFCA was undergone by 32 patients. The procedure was considered as successful if the arrhythmia was terminated during energy application and remained non-inducible by isoprenaline. The mean follow-up period was 23 ± 13 months.*

Results: *The ectopic focus was localised in the right atrium in 29 patients (88%) and in the left atrium in 5 patients (15%). In 6 patients more than one ectopic focus was found. The mean duration of the procedure was 159 ± 67 min and the mean duration of fluoroscopy was 25 ± 15 min. In 32 patients undergoing RFCA for the first time (the first session), the efficacy was 97%. In 2 patients with a recurrence of tachycardia and in 3 patients with EAT caused by another ectopic focus a re-ablation was performed (the second session) with an efficacy of 80%. The patient in whom re-ablation was unsuccessful underwent a third RFCA (third session). The total efficacy was 97%.*

Conclusions: *Radiofrequency catheter ablation is an effective and safe treatment in patients with ectopic atrial tachycardia.* (Folia Cardiol. 2006; 13: 600–604)

Key words: ectopic atrial tachycardia, radiofrequency catheter ablation, CARTO

Introduction

Ectopic atrial tachycardia (EAT) is a relatively rare, yet clinically important form of supraventricular arrhythmia [1]. Paroxysmal EAT may result in palpitations or racing heartbeat and significantly reduce exercise tolerance. Persistent EAT may lead to tachycardia-induced cardiomyopathy, which manifests itself in heart failure and is associated with an equally poor prognosis, including the risk of

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sudden cardiac death, as dilated cardiomyopathies of other aetiologies [2, 3]. As demonstrated in the published experimental studies, discontinuation of rapid atrial stimulation results in regression of the tachycardia-incuded cardiomyopathy in the majority of animal models [2, 4]. Clinical studies, on the other hand, demonstrate that an effective treatment of the tachycardia by surgery, drug therapy or radiofrequency catheter ablation (RFCA) results in the resolution of clinical manifestations of heart failure and the regression of signs of dilated cardiomyopathy [5–11]. These data point to the considerable importance of management of this form of arrhythmia, as its outcome may affect the prognosis.

The aim of the study was to evaluate the efficacy and course of RFCA in the treatment of patients with ectopic atrial fibrillation.

Methods

The study group comprised 33 consecutive patients (16 males and 17 females) managed at our centre for ectopic atrial fibrillation. The mean age of the patients was 41 ± 15 years old (range: 16––67 years). The mean ejection fraction in the study group was 51 ± 9% (range: 32–60%). Ischaemic heart disease was present in 3 (9%) patients, paroxysmal atrial flutter was observed in 2 patients (6%), 6 patients (18%) had a history of myocarditis and 6 patients (18%) were hypertensive. Each patient underwent an electrophysiological study (EPS) using two electrodes: a diagnostic electrode, which was introduced through the internal jugular vein and placed into the coronary sinus, and a mapping/ablation electrode (NaviStar, Biosense/Cordis-Webster), which was used for electroanatomical mapping and ablation and introduced through the right femoral artery. Bipolar signals recorded from the distal rings of the electrode placed in the coronary sinus served as reference.

Permanent EAT was observed in 23 patients (70%) and in the remaining 10 patients (30%) EAT was induced by programmed stimulation. All the study patients underwent a subsequent atrial activation mapping during the episode of arrhythmia using the electroanatomical system CARTO, demonstrating an EAT-specific activation sequence. The mean rate of EAT was 131 ± 15 beats per minute (bpm) (range: 110–170 bpm).

Left atrial mapping was performed following a prior puncture of the interatrial septum, following the method previously described in [12].

A total of 33 patients underwent EPS, resulting in the localisation of ectopic foci according to the time of the earliest activation. Of these patients 32 (97%) underwent RFCA of the ectopic focus (up to 50°C at up to 40 W). The procedure was considered successful if the arrhythmia was terminated during energy application and remained non-inducible by isoprenaline.

Results

The ectopic focus was localised in the right atrium in 29 patients (88%) and in the left atrium in 5 patients (15%). More than one ectopic focus was revealed in 6 patients (18%) with two foci in 4 patients and three foci in 2 patients. The localisation of the ectopic foci is shown in Tables 1 and 2. The mean duration of the procedure in the study group was 159 ± 67 min (range: 45–330 min). The mean duration of fluoroscopy was 25 ± 15 min (range: 3–65 min). The mean duration of follow-up was 23 ± 13 months (range: 8–65 months).

In 27 patients (96%) in whom the site of earliest activation was found in the right atrium and in all the patients with ectopy in the left atrium (n = 5, 100%), RFCA proved to be an effective treatment for EAT.

In one female patient, following right atrial mapping performed during tachycardia, the site of earliest activation was found near the atrioventricular node. Because of the high risk of atrioventricular block, ablation was abandoned.

Table 1. Localisation of left-sided ectopic foci.

Area between the ostia of the right pulmonary veins	1 (2%)
Area near the ostium of the left superior pulmonary vein	1 (2%)
Area near the ostium of the right superior pulmonary vein	3 (7%)
Interatrial septum from left atrial aspect	1 (2%)

Table 2. Localisation of right-sided ectopic foci.

Area near the ostium of the superior vena cava	6 (15%)
Area near the ostium of the inferior vena cava	2 (5%)
Crista terminalis	12 (29%)
Area near the ostium of the coronary sinus	7 (17%)
Area near the atrioventricular junction	7 (17%)
Interatrial septum from right atrium side	2 (5%)

Of the total of 32 patients undergoing a first RFCA for EAT (first session) the procedure was successful in 97% (n = 31).

In one case (a 16-year-old patient with a history of surgical closure of ASD II) right atrial mapping revealed two atrial ectopic foci, one localised around the Dacron patch sewn onto the interatrial septal defect and the other localised near the superior vena cava. While the application of radiofrequency current at the sites of earliest activation resulted in their resolution, the follow-up 24-hour ECG performed during the same hospitalisation revealed brief episodes of self-limiting EAT of similar rates. Following drug therapy the patient did not require re-ablation.

Five patients underwent a second RFCA session. Re-ablation was successful in all 3 patients in whom the recurrence of EAT was caused by activation of another ectopic focus (mean time since the first ablation: 7.8 ± 7.3 months, range: 1–17 months) and in one of another two patients in whom the arrhythmia recurred as a result of reactivation of the same focus (mean time since the first ablation: 9.5 ± 9.2 months, range: 3–16 months). The other patient, in whom the arrhythmia could not be terminated, underwent radiofrequency re-ablation 3 months later (a third session). The total efficacy and the efficacy of individual sessions are shown in Table 3.

In the group taken as a whole one complication was observed in patients with EAT who underwent EPS followed by RFCA (3%). The complication was observed in a female patient who had been using oral contraceptives for many years and consisted in sudden dyspnoea which developed on the first night after successful ablation of two ectopic foci localised near the superior vena cava and between the ostia of the right pulmonary veins. On the basis of laboratory and imaging studies, including echocardiography and pulmonary artery angiography, a diagnosis of massive pulmonary embolism was established. The treatment involved a selective infusion of tissue plasminogen activator at a dose of 80 mg into the pulmonary trunk with a pigtail catheter and fragmentation of the thrombus. A follow-up angiography performed approximately 1 hour later revealed a partial recanalisation of the pulmonary bed. On the basis of the ultrasound image of the veins of the lower extremities, deep vein thrombosis of the right lower extremity was diagnosed. Further management involved heparin followed by acenocoumarol. The patient was discharged in good general condition and over the 6 months of follow-up no recurrence of EAT or adverse outcomes of the complication were observed. In our opinion the pulmonary embolism was linked to deep vein thrombosis, for which predisposing factors existed in the form of pressure dressing at the femoral vein puncture site and the use of oral contraceptives.

Discussion

Ectopic atrial tachycardia is most prevalent in children and young adults. Its underlying mechanism is unclear. Some authors point to triggered activity and abnormal automatism as the causative factors [13]. There is also evidence to suggest a genetic aetiology of EAT [14]. Some reports suggest the presence of areas predisposing to the development of ectopic foci within the atrium.

In a group of 23 patients free from structural heart disease with right atrial focal tachycardia Kalman et al. [15] showed that two-thirds of the ectopic foci are localised along the *crista terminalis*. In our group of patients, some of whom suffered from structural heart disease and had a history of cardiac surgery, the most common localisation of ectopic foci was also the area along the *crista terminalis*, consistent with the findings of Kalman et al. [15]. The percentage of these localisations, however, was lower and amounted to 29%. The frequent occurrence of ectopic foci in the area of the *crista terminalis* is explained by the extreme anisotropy and evidence of slow conduction in this region, which could be pivotal in generating this type of arrhythmia. Furthermore, cardiac myocytes in this region could demonstrate pacemaker properties or abnormal automatism [16, 17].

Ectopic atrial tachycardia may be oligosymptomatic until the development of the first symptoms of heart failure, the clinical manifestation of tachycardia-incuded cardiomyopathy.

Table 3. Results.

	1st session	2nd session	3rd session	Total
Number of patients undergoing radiofrequency catheter ablation	32	5	1	38
Number of successful radiofrequency catheter ablations	31	4	1	37
Efficacy	97%	80%	100%	97%

There are literature reports of clinical and experimental studies which have demonstrated the reversibility of tachycardia-induced cardiomyopathy following a successful treatment of tachycardia. Early diagnosis and elimination of the arrhythmia may therefore be advisable. RFCA is the current treatment of choice in patients in whom drug therapy fails [18]. Various methods of localising the site of ectopy are reported in the literature, such as conventional mapping using one or two electrodes, the electroanatomical system CARTO or the non-contact mapping system (EnSite 3000).

The available reports on using the three-dimensional electroanatomical system in the treatment of EAT are based on relatively small groups of patients [19–21].

In our group of patients with EAT the use of the CARTO electroanatomical mapping proved to be an effective and safe method for localising ectopic foci both in the right and in the left atrium. The efficacy of RFCA of ectopic foci was 96% in the case of right atrial localisation and 100% in the case of left atrial localisation. The most likely causes of failed procedures seem to include the presence of more than one ectopic focus, anatomical changes to the cardiac chambers caused by previous surgery and the presence of the focus near the atrioventricular junction.

In a group of 42 patients with EAT managed with RFCA using the CARTO system Hoffmann et al. [19] achieved a success rate of 82% in the case of ectopic foci of left atrial localisation and 85% in the case of right atrial localisation. The authors pointed to the application of insufficient energy to ectopies localised near the His bundle and the presence of multiple foci as the possible causes of unsuccessful ablation of the right atrial foci. Failure to establish a stable contact between the ablation catheter and the atrial wall, especially in its inferior portion, was considered to be the main cause of failed ablations in the left atrium.

The publication by Natale et al. [20], based on the results of treatment of 24 patients with EAT, demonstrated a 100% efficacy of RFCA using the CARTO system, with a mean duration of 110 min for the procedure and a mean duration of 17 min for fluoroscopy. Our results for the duration of procedures and the duration of fluoroscopy are similar to those published by other authors [19–22].

Conclusion

Radiofrequency ablation is an effective and safe treatment for ectopic atrial tachycardia.

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