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The incidence and types of atrial tachyarrhythmias occurring after hybrid ablation procedures

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ABSTRACT

Background: Despite successful creation of box lesions during hybrid ablations, reoccurrence of atrial fibrillation (AF) and/or regular atrial arrhythmias (ATs) still occur. The goal of this study was to describe the incidence and types of regular ATs that occur after successful hybrid ablations.

Methods: Patients after hybrid ablation for persistent or long-standing persistent AF were enrolled. Patients, in whom regular AT occurred, were recommended for electrophysiological study and re-ablation. The mechanism of regular AT was described using activation and entrainment mapping.

Results: Regular AT occurred in 5 (10%) patients from 50 patients, in whom hybrid ablation has been performed. Peri-mitral flutter was found to be the mechanism of clinical AT in 4 patients, in the last patient, a typical right sided isthmus-dependent flutter was present. After ablation of the clinical arrhythmia, other ATs were inducible and ablated in two patients resulting in non-inducibility of any arrhythmia at the end of the procedure in all patients. All patients with regular AT were free of symptoms and free of any further tachyarrhythmia or AF during follow-up of 285 ± 122 days.

Conclusion: The incidence of regular AT in patients after hybrid ablation procedure was 10%, with the majority of them being associated with re-entry around the mitral annulus.

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Introduction

Atrial fibrillation (AF) is the most common sustained supraventricular arrhythmia with an incidence of 1–2%. It is associated with increased morbidity and mortality, in particular, it increases the risk of stroke and heart failure [1,2].

Pulmonary vein isolation (PVI) is the cornerstone for catheter treatment of patients with AF. However, in patients with the non-paroxysmal form of AF, the effect of PVI is limited. In addition to PVI, many other techniques for mapping and ablation of persistent (PeAF) or long-standing persistent (LSPeAF) AF have been developed. Despite the evolution of AF ablations, patients with PeAF or LSPeAF often have unsatisfactory results [3]. Modification of the arrhythmogenic substrate during Cox-maze surgery, with division of both atria into segments, could represent an aggressive, but effective treatment for such patients. However, due to its invasiveness (on-pump cardiac surgery), it cannot be used for the general AF population.

Over the last decade, surgical treatment of AF has shifted from open-heart surgery toward minimally invasive procedures [4]. The common goal of all thoracoscopic procedures is the creation of ''box-lesions,'' which means the isolation of all PVs as well as an ''en bloc'' of the posterior aspect of the left atrium (LA). The box lesion is also at the ''core'' of the complex surgical Cox MAZE III/IV lesion set. The addition of other lesions during thoracoscopic procedures (such as a trigonal lesion or resection of ligament of Marshal), in an effort to make the lesion set more closely resemble the Cox MAZE III/IV, varies in surgical reports. To ensure complete PV isolation, and to ablate structures that are surgically difficult to ablate (e.g., cavotricuspid isthmus (CTI), foci), the surgical procedure is often followed by a percutaneous endocardial electrophysiology (EP) study and catheter ablation (CA). This combined approach (performed either simultaneously or in two separate procedures) is called a hybrid ablation, and seems to be a very attractive alternative for overcoming the limitations of epi- or endocardial ablations alone.

According to recent reports, the efficacy of hybrid ablation procedures is promising. However, despite successful creation of box lesions during hybrid ablations, reoccurrence of AF and/or regular atrial arrhythmias (ATs) still occur. The goal of this study was to describe the incidence and types of regular ATs that occur after successful hybrid ablations.

Material and methods

Patients

In our center, the hybrid ablation procedure is offered to patients with symptomatic, drug-resistant, PeAF or LSPeAF, as a part of long-term research program. It is a prospective, observational project with the aim of meticulously tracking the efficacy and safety of hybrid ablations. The inclusion and exclusion criteria for hybrid ablation were previously published in detail [5]. In brief, inclusion criteria were symptomatic, non-paroxysmal AF and the absence of significant structural, valvular, and coronary heart disease. Exclusion criteria were AF secondary to a reversible condition, or known severe pericardial adhesions (e.g., history of cardiac surgery). Other risk factors (age, comorbidities, LA diameter, AF duration, etc.) were assessed individually with the intention of making the procedure available even when some risk factors were present. However, this involved a thorough discussion of those risks among the members of an informal AF team (composed of a cardiac surgeon, anesthetist, and electrophysiologist) and, of course, the patient. The AF types and definition of success were designed using actual recommendations [6] and the project was approved by our institutional ethics committee. All patients provided written informed consent.

For the purpose of the current analysis, patients who presented with AT during hybrid ablation follow-up were studied. Because AT often occurs months after the hybrid ablation procedure, an important inclusion criterion was a follow-up of at least 6 months.

Surgical ablation

A fully thoracoscopic, right-sided, off-pump, epicardial approach was used for the surgical ablation. During the procedure, a circumferential lesion was created anterior to the PVs with the goal of isolating all the PVs and a posterior LA ''en bloc'' (i.e., the ''box-lesion'' set). Lesions were created using a unipolar/bipolar, linear RF COBRA Fusion™ 150 catheter (Estech, an AtriCure® Company, San Ramon, CA). The catheter was placed into position encircling all PVs after blunt dissection of the transverse and oblique sinus. The catheter included six 25 mm electrodes; a maximum of 3 electrodes can deliver energy in the same time during the ablation (i.e., during one complete ablation cycle, at first three electrodes are active and deliver RF energy for 1 min and then the other 3 electrodes become active and deliver RF energy for an additional 1 min). Two to three of these ablation cycles were performed in both the bipolar and unipolar modes with temperature-controlled energy application setting of 70 °C. Between the cycles, the catheter is moved circumferentially to close the box-lesion by overlapping the ends of the lesion in the Waterstone's groove. If a patient remained in AF at the end of the surgical procedure, electrical cardioversion was performed. Next, the exit and entry block for the box-lesion was tested using a standard 6 F bipolar EP catheter (Pacel™, St. Jude Medical, Inc.) placed on the ostia of right sided pulmonary veins, and if not present, another ablation cycle was performed. Our exact surgical procedure was previously published in detail [7]. In the last 24 (48%) patients, ablation through the right chest was then followed by occlusion of the left atrial appendage (LAA), using the AtriClip® Pro device (AtriCure, Inc., Cincinnati, OH), via a left thoracoscopy.

EP study and catheter ablation

A staged EP study and CA were performed 2–3 months following the surgical procedure. The aim of the EP study was to verify (and complete, if needed) ''box'' isolation, and to perform an ablation of the CTI. In patients with regular AT, an additional objective was to map and ablate the ongoing arrhythmia. A detailed methodology of the EP study and

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