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Case report

Cryoballoon catheter ablation of atrial fibrillation

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Atrial fibrillation (AF) is the most common arrhythmia encountered in clinical practice, affecting up to 2% of global population[1] and accounts for more than 30% of hospital admissions for cardiac rhythm disorders[2]. It is associated with increased morbidity and mortality[3]. Catheter ablation of AF has emerged from investigational procedure to the most effective procedure for symptomatic patients with promising outcome data[1,4]. Patients with heart failure can benefit from the procedure[5] and it improves quality of life[6].

The most commonly used procedure for AF ablation is a point by point ablation via a single tip catheter usually combined with a three-dimensional 3D mapping system and the most commonly utilized energy source is radiofrequency energy.[7,8]

The second most common form of catheter ablation is by cryoballoon technology, a variant of single shot ablation, which revolutionized treatment of AF.

First cases of cryothermal technology were successfully applied in 1970s,[9] but it was in 2003 when we saw the introduction of balloon based cryogenic catheter for pulmonary vein isolation (PVI)[10]. Today, cryoballoon (CB) catheter ablation is recognized ablation method, mainly because of reproducible and fast procedures[11-20].

Case presentation

A 66 years old female was presented in our outpatient clinic due to recurrent attacks of atrial fibrillation. She is on antihypertensive drugs for more than ten years which include beta blockers and on Class Ic antiarrhythmic drugs since the diagnosis of AF five years ago. She was also on warfarin for thromboembolic risk reduction. CHA2DS2-VASc score was 3. During the course of evaluation, an echocardiogram was done, normal dimension for cardiac chambers, LV EF was estimated to 55%, left atrial dimension was measured as 39 mm.

Coronary angiogram was performed two years ago, with no stenosis found.

Approximately three times a year she had to presented to emergency clinic for parenteral drug conversion of symptomatic AF. Sometimes, the episodes subside spontaneously.

Figure 1. Chest CT scan of left atrial anatomy.

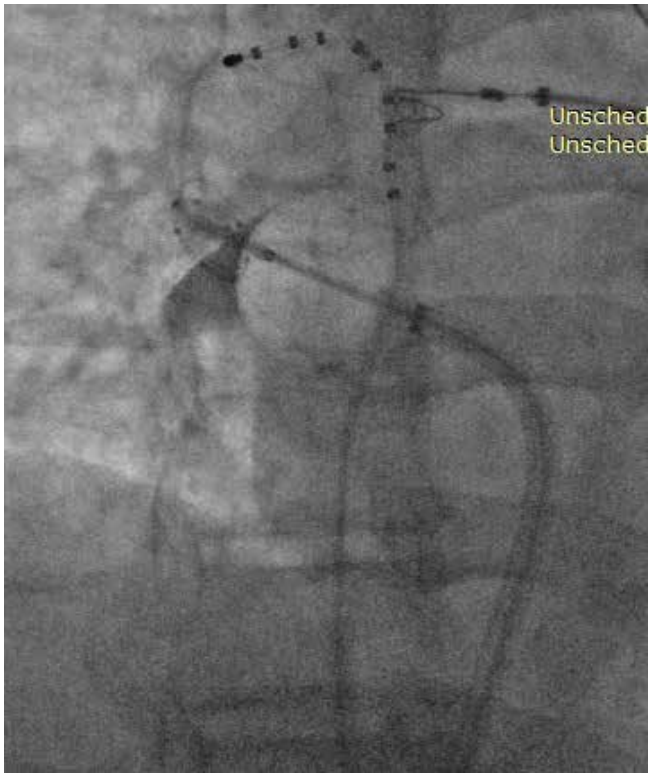

Figure 2. Fluoroscopy of cryoballoon vein occlusion.

Physical examination was unremarkable. TA 135/80 mm Hg, pulse 66/min, sinus rhythm on ECG. Laboratory findings as well as thyroid gland function tests were in normal range.
The indication for catheter ablation of atrial fibrillation was made.
Protocol for preparing the patients at Institute for Cardiovascular disease Dedinje is to perform transesophageal echocardiography (TEE) to all patients preparing for catheter ablation of AF due to exclusion of left atrial appendage (LAA) thrombi and computer tomography (CT) chest scan to delineate left atrial anatomy.
TEE did not show any thrombi in LAA.
After preparation of the patient, cryoballoon catheter ablation of AF was preformed as pulmonary vein isolation (PVI) with a single transseptal punction. All 4 pulmonary veins were isolated at the end of the procedure. Occlusion of all the veins during the ablation was estimated to be 4/4. Approximate time to isolation (TTI) was around 60 seconds, the temperature at the time of isolation was - 27 to -37°C. The minimal achieved temperature during the ablation was - 52° C. The procedure time was 55 minutes. The ablation was performed on uninterrupted warfarin therapy and using conscious sedation.
The patient was discharged home the second day after the procedure, in sinus rhythm and with no pericardial effusion.
6 months after the procedure, the patient did not have any symptomatic episode of atrial fibrillation, and no sustained atrial arrhythmia was registered at 1, 3 and 6 months 24h ECG holter monitoring.

Discussion

The primary selection criterion for ablation of AF is the presence of symptoms, such as palpitations, fatigue and dyspnea. Current guidelines recommend that additional variables should be considered because if they are present, they could result in higher complication rate and reduced success of the procedure such as obesity, sleep apnea, concomitant heart disease, left atrial size, type of AF and patient age[1,11].
Catheter ablation of AF is recommended as a second-line therapy for patients with symptomatic paroxysmal AF (PAF) or persistent AF for whom therapy with antiarrhythmic drugs (AADs) (Class I) has failed and for patients with long-standing persistent AF with a Class IIb indication. Although invasive cardiac procedures involve the potential for life-threatening complications, long-term AAD therapy has been shown to be more commonly associated with considerable side effects compared to ablation (17 vs. 8%).[25]

The success of catheter ablation

The multiple procedure success rate of pulmonary vein isolation (PVI) in patients with PAF after a 5-year follow-up period has been reported to be approximately 80%, failing to about 60% after 10 years[26,27]. For patients with persistent AF, stable sinus rhythm (SR) after successful PVI was reported in 25% after a single procedure and in 68% after multiple procedures, during a median follow up of approximately 7 years[28].
Estimation of the real success rate after catheter ablation of AF remains difficult due to inconsistencies in the definitions pf procedural success and post procedural rhythm monitoring and differences in the analysis of outcomes after single or multiple procedures. To date, the electrophysiology community has defined AF recurrence as the occurrence of any symptomatic or asymptomatic atrial tachyarrhythmia after the procedure lasting for > 30 seconds. Newer studies have presented a novel definition focusing on the AF burden which may represent a more relevant parameter for risk stratification and efficacy assessment after AF ablation.
While RF based PVI in combination with a 3 D mapping system was long considered to be the " gold standard", the CB has emerged as the most commonly used alternative ablation tool for PVI and is now established as the second gold standard in patients with paroxysmal atrial fibrillation in the current guidelines[1,21].
CB based ablation is associated with a low incidence of major complications, specifically driven by a low number of pericardial effusions or tamponades[22]. In addition, the incidence of phrenic nerve palsy, which is the most common balloon associated complication, can be kept considerably low by implementing safety algorithms, such as phrenic nerve pacing and monitoring of the compound motor action potential. Furthermore, the incidence of PV stenosis is a rare finding in patients undergoing CB ablation and has only been mentioned in incidental case reports[22,23]. Most data on CB ablation have been collected from patients suffering from PAF, with the data showing encouraging outcomes. The multicenter FIRE AND ICE trial, which prospectively randomized PAF patients to either RF or CB based PVI, demonstrated non-inferiority of CB ablation versus RF ablation in terms of efficacy and safety[21]. However, the positive findings from recent analyses encourage the application of CB based catheter ablation to patients with persistent AF also. The Cryo4persistent study focused not only on the recurrence of AF after previous CB based PVI but also on the symptoms and demonstrated a significant improvement in patients' quality of life following CB ablation in those with persistent AF[24]. These findings were confirmed in the analysis of two large prospective registries (the AF Ablation Long-Term registry within the EURObservational Research Programme [AFA EOPR] and the Swedish catheter ablation registry with reported lower EHRA (European Heart Rhythm Association) score, a measure of AF related symptoms and a lower rate of AF related symptoms and a lower rate of continued antiarrhythmic drugs after CB based AF ablation.
Catheter ablation is a well-established treatment option for patients with symptomatic AF and more effective at maintaining SAR than antiarrhythmic drugs. Currently, the most effective technique for AF ablatio is circumferential isolation of the PVs, irrespective of AF type. RF based and CB ablation are equally effective in patients with PAF.

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