Editorial

Surgical ablation for atrial fibrillation: an editorial

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General consideration of atrial fibrillation (AF)

AF is the most common cardiac arrhythmias in background of cardiovascular structural disease as well as postoperative arrhythmic complication. Based on the international guidelines of American College of Cardiology and European Society of Cardiology, this phenomenon can be distinguished as one of the three classes including paroxysmal AF that terminates within 7 days of appearance, persistent AF that prolongs more than 7 days and can be terminated by pharmacological and non-pharmacological interventions, and permanent AF that is persisted for a long time (1). The appearance of every type of AF is strongly associated with underlying cardiac abnormalities including acute coronary syndrome, heart failure, valvular heart diseases, as well as some predisposing risk factors such as hypertension, diabetes, and obesity (2). Moreover, inflammatory and metabolic processes, hemodynamic stresses, respiratory disorders, drug and alcohol use, and endocrine abnormalities have been identified to promote AF (3). Furthermore, familial tendency of AF has been also well identified that parental AF is a trigger to increase likelihood of AF. Regardless of underlying etiological aspects and pathophysiological basis, the appearance of AF is related to increased risk for mortality and morbidity particularly due to risk for thromboembolic events (4). Some studies have revealed that people with sinus rhythm survive longer than those with AF. In fact, disruption of normal atrial conductive system may cause blood stasis leading development of thrombus and thus embolic events especially in cerebrovascular system results in brain stroke (5). Additionally, AF can predispose affected individuals to worsening heart failure and lowering functional class in these patients particularly in those patients with persistent hypertension or valvular defects. The progression of AF-induced heart failure finally leads to tachycardia-mediated cardiomyopathy if inadequate controlling arrhythmia (6). In some large cohort surveys, one-third of patients with uncontrolled AF suffered brain stroke or other thromboembolic events. These induced cerebrovascular events may also result in dementia, cognitive decline, and disabilities in daily living activities (7).

Non-surgical therapeutic approaches

The cornerstones of AF include controlling heart rate and considering anticoagulation medication especially in those patients with symptomatic state. In total, various decisional factors for treatment of AF include symptoms severity, baseline cardioversion success, the presence of underlying comorbidities, and ablation candidature (8). The final goal for controlling AF rhythm is hemodynamic stability, and increasing physical ability and tolerance leading finally left ventricular functional reservation and improving patient's survival. Various therapeutic approaches are considered to control sustain AF including anti-arrhythmic medication, compartmentalization of the atria by catheterization, and AF surgical ablation (9). One of the major managerial decisions is proper anticoagulation regimen to reduce the risk for thrombotic events and stroke. This thrombolytic therapy should be more considered in high risk groups including the presence of heart valve diseases, prior stroke, advanced age, congestive heart failure or left ventricular dysfunction, rheumatic heart disease, or underlying cardiovascular risk factors (10). In

medication approach, the use of warfarin is accompanied with high benefit in patients with mild risk for stroke, but its beneficial effects at intermediate risk have remained controversial because of the increased risk for bleeding, however it seems that the use of warfarin is more preferred to other medications such as clopidogrel or a combination of clopidogrel and aspirin for high risk patients (11). Another critical approach is controlling ventricular rate particularly in new onset AF. The first-line regimen for the rate control includes beta-blockers and calcium channel blockers which administered orally or intravenously with a rapid ventricular response (12). The second line regimens include digoxin and amiodarone especially in patients with intolerance to other agents such as in heart failure status. Anticoagulation management should be also considered especially in patients who candidate for cardioversion. In this regard and prior to cardioversion, the patient should be received intravenous heparin or low-molecular-weight heparin with the monitoring of INR (12). The new anticoagulants have been also examined such as dabigatran, rivaroxaban, and apixaban to be accompanied with higher efficacy and lower side effects. To restoration of sinus rhythm, cardioversion had been highly qualified especially within 7 days after AF onset (12).

Overview of surgical and catheter ablation

The main purpose of catheter ablation and surgical management of AF is disconnecting AF triggers as well as modifying AF substrate. Mapping and radiofrequency (RF) ablation is one of the successful approaches in this goal. Paroxysmal AF caused by ectopic activity in pulmonary vein can be successfully ablated around the veins leading AF termination. This ablative approach is frequently followed by 6 weeks treatment with anti-arrhythmic drugs leading reducing the need for further cardioversion (13). One of the main surgical approaches for terminating persistent AF is surgical compartmentalization of the atria, or the "maze" procedure. This procedure is based on making endocardial incisions in the right and left atria to isolate the pulmonary veins and interrupt potential reentrant pathways which maintaining AF (14). This procedure is safer than other approaches in those who undergoing concomitant mitral valve operations. Another approach for the patients with persistent AF is compartmentalization of the atria with continuous ablation lines of blockage. In fact, in line with the maze procedure, it is usually attempted to mimic surgical suture lines created by the RF lesions (15).

In paroxysmal AF condition without achieving appropriate response rate with antiarrhythmic drug therapy, RF ablation of AF is potentially indicated. In fact, this approach is considered in patients with persisted or severe symptoms despite controlling ventricular rate by medications. The success rate of this treatment approach depends on the type and duration of AF ranging from 60% to 80% within 1 to 2 years of follow-up (16). To achieve more success rate, repeating ablations may be also indicated. However this approach may be accompanied with some serious complications such as pericardial effusion, perforation, tamponade, pulmonary vein stenosis, thromboembolic events, and appearance of atrial flutter. Thus, long-term monitoring of candidate patients should be considered to lower risk for these complications.

Despite usefulness of antiarrhythmic agents to control rate in AF patients, the effectiveness of these medications are not complete and may leading reduce of quality of life and increase of drug-induced complications. In this regard, the long-term effect of surgical ablation of AF has been revealed (14). This approach can be planned as one of the three surgical procedures including a full Cox-maze procedure, isolated pulmonary vein isolation or in combination with left atrial lesion sets. The first procedure was introduced firstly in 1987 (15) by making incision scars for blocking abnormal macro-reentrant circuits developed in the atria. This procedure can successfully reserve both atrioventricular synchrony and sinus rhythm leading reduce the risk for brain stroke (16). The fundament of this procedure is making multiple incisions across the left and right atria that enable the sinus node to propagate sinus pulses throughout the atria that finally results in reservation of atrial function (17). This procedure is now acceptable as the gold standard treatment for AF. In spite of high effectiveness of this procedure, it is now prefer to perform the procedure concurrently with coronary revascularization or valve repairing. Furthermore, the surgeons now prefer to replace cut-and-sew Cox-maze with linear lines of ablation created by RF energy, microwave, or high intensity focused ultrasound technique (18). More importantly, using some of these devices may cause cardiac damages because of their related energy induction. Also, because of deeply penetration of energy, its usage should be limited to thickened zone of atria (19). These shortcomings can be overcome using bipolar RF ablation (20) since energy is delivered between two closely approximated electrodes embedded in the jaw of a clamp device that decreases the risk for cardiac damages. However, its potential limitation is

ablating only tissues clamped between the jaws of the device and thus cannot ablate fully right atrium and left atrial isthmus (20). In total, different new ablation techniques recently developed have resulted in high success in AF ablation. In this context, the replacement of full Cox-maze lesion set with linear lines of ablation has led to the highest clinical feasibility and effectiveness (19,20).

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Footnote

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