Review Article

Catheter ablation in atrial fibrillation – a burning issue

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Abstract

Catheter ablation has, over the recent years, become central to the management of atrial fibrillation. As the latest studies consistently demonstrate it safety and increasing efficacy, AF ablation is being performed in many centres worldwide, with a Class IA recommendation in those with recurrent symptomatic AF despite medical therapy. Concomitantly, continuous technological advances accompany the development on new electrophysiological techniques.

In this review, the authors seek to address the need among the local medical community of more in-depth knowledge of the technique and its indications, especially in view of the recent introduction of such service at our national hospital.

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Introduction

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia effecting two percent of the general population and one-in-ten octogenarians.[1] Around 8 million people are estimated to be effected in the EU, with the number predicted to double within the next half a century.[1] Whilst up to 40% of patients are asymptomatic, others may experience disabling symptoms, primarily palpitations.[2] Antiarrhythmic drugs provide effective symptom control in a further 30%, with the other half of symptomatic AF patients failing drug therapy.[2]

AF results from ectopic activity within the atria with subsequent complex multiple wavelet re-entry pathways.[3] Permanent AF is the most common type, present in up to one half of effected patients, with the rest suffering from paroxysmal or persistent AF.[1] This arrhythmia is associated with a negative impact on the quality of patient's lives, a five-fold increase in the risk of stroke, higher incidence of heart failure as well as elevated health care costs from hospitalisations, interventions and medications.[2]

Over the last two decades, AF ablation has evolved from a novel experimental procedure to a successful intervention performed at most large medical centres that provide a clinical cardiac electrophysiology service.

Local experience

Ablation for atrial fibrillation was

introduced locally in 2016 at Mater Dei Hospital. To date, 20 patients have undergone this intervention, with the majority being de novo cases. The technique used locally involves point by point radiofrequency ablation.

Management

Thromboprophylaxis is essential in the management of AF patients. Oral anticoagulation (OAC) can prevent ischaemic CVAs and reduce mortality in all patients except those at very low risk. [4]

The gold standard for risk stratification for thromboembolic events remains the CHA2DS2-VASc score, since its introduction in the 2010 ESC guidelines. The recently published 2016 guidelines have reduced to a Class IIa (level B) the indication for OACs in patients with one clinical risk factor (i.e. a CHA_2DS_2-VASc score of 1 for men, and 2 for women), and therefore treatment 'should be considered'. This decision was based on the fact that whilst there is increasing evidence regarding stroke risk in these individuals, this is based mainly on observed stroke rates in patients not receiving OAC. In CHA_2DS_2-VASc risk score of at least 2 in males, and 3 or more in females, evidence very strongly favours prophylaxic, with OAC maintaining a Class I (level A) recommendation.[4]

The role of biomarkers such as high-sensitivity troponin and NT pro-BNP as risk- stratifier is still being studied.[5] Various bleeding scores have also been developed, namely HAS-BLED, ORBIT and ABC. These tools should be used to identify and correct modifiable risks elements, but in general should not lead to withholding OAC. Unfortunately, OAC is too commonly withheld for reasons including bleeding risk, patient frailty and complexity of VKA monitoring, even though mortality and morbidity rates from stroke still exceed those from bleeding in the majority of such patients.[4]

Vitamin K antagonists (VKA) reduce risk of stroke by two-thirds and mortality by twenty-five percent.[6] Its narrow therapeutic range and the need of frequent monitoring and dose modifications may, however, prove challenging. Novel oral anticoagulants (NOACs) are a non-inferior alternative that eliminate such drawbacks.[7-8] In whom OAC is contra-indicated, left atrial appendage closure should be considered in order to reduce the risk of embolic strokes[4]. Aspirin with/out clopidogrel carries the same risk of bleeding as OAC without preventing strokes as effectively, and therefore antiplatelet therapy is not recommended.[9]

The primary aim of AF therapy remains that of achieving and maintaining sinus rhythm, in order to relief symptoms, improve exercise tolerance, reduce thromboembolic risk and prevent cardiomyopathy. Sotalol or flecainide are first line in healthy individuals, whilst amiodarone is the treatment of chose in patient with heart failure. In the presence of coronary artery disease, sotolol should be used.

Rate versus rhythm control has been studied in two major randomized trials, AFFIRM and RACE. There was no statistically significant difference in mortality between the two strategies, whilst the number of hospitalisations and adverse drug effects were lower in the rate control group. Both trials enrolled high risk patients with structural heart disease, and results therefore should not be extrapolated to healthy young individuals.[10]

Rate control strategy is an acceptable alternative whereby the ventricular response rate of AF. This can be achieved by the use of medications that act on the atrio-

ventricular (AV) node, supressing electrical conduction. If medical treatment fails, a last-resort approach involves the insertion of a pacemaker (VVI) followed by ablation of the AV node. Such technique is relatively simple to implement, with both complication and mortality rate being low.[11] Patients, however, are rendered pacemaker dependent for the rest of their lives. Other comorbidities, such as the presence on heart failure, help determine the type of pacemaker used (uni- or bi- ventricular,[12] with/out ICD[13]).

Maintenance of sinus rhythm is the main goal of the rhythm control strategy. Whilst antiarrhythmic drugs are first line in the rhythm control strategy of AF, catheter ablation can effectively restore sinus rhythm in those with recurrent symptomatic AF despite medical therapy (Class IA recommendation).[4] In obese patients, since weight loss should be considered to reduce AF burden and symptoms (Class IIa recommendation),[4] radiofrequency ablation should be offered in conjunction with lifestyle changes that promote weight reduction.

Contraindications to the procedure include left atrial thrombus, contraindication to anticoagulation (required post-ablation), severe mitral valve disease or mechanical mitral valve prosthesis, severe pulmonary hypertension and pregnancy.[4]

Patients considered to be potential candidates for AF ablation should be referred for review by an electrophysiologist in an outpatient's setting and undergo various investigations a 12-lead ECG, 24-hour Holter, echocardiography and cardiac CT/ MRI. Clinical evaluation and a discussion with the patient including benefits, risks and alternative strategies are crucial.

Patients should be started on oral anticoagulants at last four weeks prior to this elective procedure, whilst antiarrhythmic drugs should be stopped to unmask abnormal electrical activity. Closer to the procedure, adequate hydration minimises the risk of contrast-induced nephropathy, management of medical co-morbidities should be optimised and consultation with an anaesthesiologist arranged to evaluate the airway and risks for general anaesthesia.

Peri-procedurally, access to the left atrium is obtained transfemorally via a trans-septal approach. An oesophageal probe allows temperature monitoring to minimise risk of oesophageal damage and electrodes placed on the chest wall provide the electrical field used to create an anatomic map of the left atrium. Intravenous heparin is administered at the start of the procedure and activated clotting time (ACT) analysed every thirty minutes, giving further boluses of heparin as required in order to maintain ACT above 300ms

Ectopic electrical activity in the pulmonary veins (PVs) has for long been considered the culprit in AF initiation. The aim of the primary intervention, therefore, is to segregate such substrate from the left atrium.[14] The primary technique in AF ablation involves isolation of the pulmonary veins (Class IIa recommendation) through the creation of sequential point-by-point radiofrequency lesions over a circumferential margin encompassing all four PVs.[15] Other regions may be ablated at repeat procedures, namely the atrial roof, cavotricuspid and mitral isthmi.

Computerised electro-anatomic mapping systems allow the operator to create a three-dimensional image of the left atrium and the PVs that may also be merged with computerised-tomography or magnetic-resonance scans acquired prior to the procedure. This enables real-time

identification of electrical and anatomic targets. Intracardiac pacing and sensing provides electrophysiological data with the purpose of localising abnormal electrical activity and assessing the effectiveness of the ablation at isolating it.

An alternative technique to radiofrequency is cyroablation, that uses refrigerant N_2O to induce tissues necrosis. Both methods have their advantages and drawbacks, with cryoablation considered to be performed with more ease whilst RF ablation allows more manoeuvrability as well as applicability to re-do procedures. FIRE and ICE, a multicenter, randomized trial by Kuck et al., showed non-inferiority of cryoablation versus RF ablation in both primary efficacy and safety end-points. Procedure time was longer, but fluoroscopy time shorter in the radiofrequency group.[16] What was their respective success rates? Which technique will win the race rests on further technological developments and the reproducibility of the results.

Major complication rates have fallen below five percent in recent years. Cardiac tamponade, pericardial effusions, atrio-oesophageal fistula, stroke, transient ischaemic attack, persistent phrenic nerve palsy, pulmonary vein stenosis and death have been reported. Other minor complications include femoral pseudoaneurysms and artero-venous fistulae. In an analyses by Yong-Soo Baek et al.[17], persistent AF and duration of procedure were associated with higher rates of major complications.

Close follow-up of patients after ablation is important especially in the initial phase where both patients and physicians should be aware of the signs and symptoms of complications, enabling prompt referral for their management. AF recurrences are not uncommon, with further rhythm control therapy being reserved mainly for the symptomatic patients. All post-ablation patients should be reviewed at last once by an electrophysiologist during the first year post-procedure.

Observational studies indicate that the risk of thromboembolic event is low after AF ablation, yet data and risk stratification has been adopted from non-ablation AF cohorts. Patients should remain anticoagulated for at last two months after ablation. The decision for long term use of anticoagulants post-procedure should be based on general anticoagulation recommendations, the long-term risk of recurrent AF and the safety profile of anticoagulation.

Way forward

Ongoing advances in technique and technology are reflected in more durable PV isolation and lower rates of AF recurrence post-ablation. Ouyang F et al. [Circulation, 2010] reported only 6% of patients with complete PVI at repeat procedure using 1st generation radiofrequency catheters. Recent figures indicate up to 66% durability of PV isolation with 2nd generation RF technology.[18] The use of real-time contact force measurements has increased atrial arrhythmia freedom in comparison to a standard non-force sensing catheter (88% versus 66% of patients respectively), though this came at the expense of longer procedure and fluoroscopy time.[19] Ablation technique developments, such as the 'CLOSE' protocol, have also paved the way for better success rates as measured by post single-procedure freedom from atrial fibrillation or tachycardia.[20] The future is even more promising with 3rd generation devices providing more reliable temperature and EGM at the tip-tissue interface as well as temperature controlled irrigated RF ablation

with high-resolution EGM. In addition, the advent of catheters using ultrasound and laser modalities may also contribute towards further improvements. Concurrently, better mapping technologies are being developed. With ever increasing success rates, ablation may in the near future become the first line treatment of choice. Data from the RAFT-2 study has demonstrated a lower rate of recurrence at two-year follow-up in patients undergoing RF ablation versus antiarrhythmic drugs.[21]

Conclusion

Atrial fibrillation is an increasingly common condition with a high burden on our health system. Further developments in techniques and technologies, together with data from recent studies, are reflected in the recently published 2016 ESC Guidelines for the management of atrial fibrillation. The principles of management, however, remain those of appropriate anticoagulation coupled with a rate or rhythm control strategy, with the aim of controlling symptoms and reducing morbidity and mortality.

To date, the mainstay of the rhythm control strategy is pulmonary vein isolation either by RF ablation or cryoablation. Alternatively, rate control has been shown to be a non-inferior option for the management of AF patients. The CHA_2DS_2-VASc score keeps its place as the gold-standard risk-stratification tool for thromboprophylaxic. Whilst most patient can be managed by their physicians, those with symptomatic AF should be referred for assessment by an electrophysiologist, especially if symptoms persist despite medical therapy.

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