IMPACT OF LEFT ATRIAL POSTERIOR WALL ISOLATION ON THE OUTCOME OF ABLATION OF PERSISTENT ATRIAL FIBRILLATION

Thesis

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List of Abbreviations

Abbrev.	Full Term
AF	Atrial fibrillation
AFL	Atrial flutter
AI	Ablation Index
AOF	Atrio-oesophageal fistula
APD	Action potential duration
AT	Atrial tachycardia
AV	Atrioventricular
AVNRT	Atrioventricular Nodal Re-entrant Tachycardia
AVRT	Atrioventricular Reciprocating Tachycardia
BIFA	Box isolation of fibrotic areas
CBA	Cryoballoon ablation
CF	Contact force
CFS	Contact force sensing
CTI	Cavo-tricuspid isthmus
DE	Delayed enhancement
EAVM	Electro-anatomical voltage mapping
ECG	Electrocardiogram
ERP	Effective refractory period
FTI	Force-time integral
GP	Cardiac ganglionic plexi
LA	Left atrium
LAA	Left atrial appendage

LAPW	Left atrial posterior wall
LSPV	Left superior pulmonary vein
LIPV	Left inferior pulmonary vein
PAF	Persistent atrial fibrillation
PVs	Pulmonary veins
PVI	Pulmonary vein isolation
QOL	Quality of life
RA	Right atrium
RF	Radiofrequency
RFCA	Radiofrequency catheter ablation
TOE	Transoesophageal echocardiography

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Introduction

Atrial fibrillation (AF) is the commonest arrhythmia all over the world. In 2010, about 33.5 million humans were estimated to suffer from AF. [1] The risk of thromboembolic events rises 4- to 5-fold with AF and the proportion of strokes attributable to AF increases steadily from 1.5% in the sixth decade to 23.5% in the ninth decade of life.[2]

The 2016 European Society of Cardiology guidelines for the management of AF advocate rhythm control therapy to improve symptoms in AF patients who remain symptomatic on adequate rate control therapy and give a class IIa (Level of Evidence C) recommendation for catheter ablation of persistent AF. [3] The initial description of pulmonary vein triggers initiating AF and that AF can be prevented by radiofrequency (RF) pulmonary vein isolation (PVI) has been a monumental discovery in the history of rhythm control in AF. [4] Since then, PVI has remained the cornerstone of AF ablation. [5]

While the pulmonary vein isolation has yielded satisfactory outcomes in patients with paroxysmal AF, its long-term success rate has been suboptimal in cases with persistent AF. This has led to a long search for ancillary targets of ablation, including triggers and substrates. Over the

last two decades, a multitude of ablation strategies have been developed and compared with PVI alone. [6]

Extrapulmonary triggers of AF have been found in the coronary sinus (CS), left atrial appendage (LAA), superior vena cava (SVC), the crista terminalis, and the ligament of Marshall (LoM). [7–10]

Different sets of linear lesions have also been developed as adjuncts to PVI, including the 'roof line' connecting superior end of the PVI lesion sets and the mitral isthmus line. [11,12] Complex fractionated atrial electrograms (CFAEs), which are identified during fibrillation, may either indicate continuous re-entry of AF waves in a particular area or overlapping wavelets entering that region at different times. They have a short cycle length and their temporal and spatial distribution in humans is widely variable.[13,14] Recent trials have cast considerable doubt on the utility of both approaches. [15–17]

Similarly the initial enthusiasm for focal impulse and rotor modulation (FIRM) ablation[18–20] has been tempered by the dismayingly poor outcomes in more recent trials. [21–23]

A novel attractive target for adjunctive ablation strategies is the left atrial posterior wall. The rationale is that the LAPW and the PVs are embryologically related. The developing left atrium (LA), progressively incorporates the

single common PV into its wall, eventually resulting in four distinct PVs which enter the LAPW separately. The incorporated PVs form the smooth posterior wall of the LA. [24] Anatomically, there is an abrupt change and discontinuity in LA subendocardial fibres as this bundle traverses the posterior LA between the PVs, which create a favourable substrate for re-entry. [25] Moreover, the LAPW has been found to be a frequent source of non-PV triggers [9] as well as being a hub of autonomic activity, [26] both of which contribute significantly to the initiation and stabilization of arrhythmia.

The so-called box ablation is derived from the Cox maze III surgical procedure.[27] It connects bilateral PV-encircling lesions by placing two linear lesion sets both superiorly on the roof and inferiorly at the bottom of the LA. In this way, the entire LAPW is believed to be isolated from the rest of the atria. [28] An alternative approach is ablation or debulking of the left atrial posterior wall, pioneered by Natale and co-workers. While both approaches have shown promise in recent trials, [28, 29] the feasibility and efficacy has been the subject of controversy. [30] It is thus of considerable importance to try and resolve this question, which can be a significant adjunct to the therapy of persistent atrial fibrillation, for which there is still no accepted standard of care.

Aim of the Work

This study assesses the impact of left atrial posterior wall isolation, in addition to pulmonary vein isolation, on the outcome of radiofrequency ablation of persistent AF.

Review of Literature

Atrial Fibrillation (AF) is the most common sustained arrhythmia encountered in clinical practice, and is associated with significant morbidity and mortality.[31] The diagnosis of AF requires electrocardiographic rhythm documentation which shows irregular RR intervals with no distinct P wave lasting at least 30 seconds. [3]

AF has been classified according to the duration of the arrhythmia. These distinctions have been used in clinical research because of their prognostic and therapeutic implications when considering outcomes of catheter ablation. [3]

Classification of AF according to duration, adapted from ESC and ACC/AHA/HRS guidelines [3,32]

Term	Definition
Paroxysmal AF (PAF)	AF which terminates within 7 days of onset, either spontaneously or with intervention. [3,32]
Persistent AF	Continuous AF which lasts for more than 7 days. [3,32]
Long-standing persistent AF	Continuous AF which lasts for more than 12 months. [3,32]
Early persistent AF	Continuous AF which lasts for more

	than 7 days but less than 3 months. The outcomes of AF ablation have been shown to be better in this subset of patients than in persistent AF of greater than 3 months' duration.[5]
Permanent AF	Both the patient and their physician accept the presence of AF, restoring sinus rhythm is no longer attempted. As such, this term reflects a therapeutic decision and not a distinct pathophysiological entity.[5]

Most patients presenting with paroxysmal, self-terminating AF will eventually progress to persistent or permanent AF. [33,34]

Therefore, paroxysmal and persistent AF can be viewed as presentations associated with different disease stages.

Ablation strategies for persistent atrial fibrillation

Catheter ablation is a successful therapy for eliminating AF and reducing the symptomatic burden in patients with this arrhythmia and is superior to pharmacological rhythm maintenance in persistent AF. [35] Following the landmark STAR-AF II trial, a recent European