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Left Atrial Posterior Wall: A Key Substrate in the Genesis and Perpetuation of Atrial Fibrillation-A short review

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Abstract

The pathogenesis of atrial fibrillation is driven by three key elements: an electrical trigger for arrhythmia initiation, an arrhythmogenic substrate for its maintenance and factors which may modulate the condition. A hybrid epicardial-endocardial approach, particularly the minimally invasive Convergent hybrid technique, to isolate pulmonary veins and silence the left atrial posterior wall is likely to provide improved outcomes.

Keywords: Cardiac motion • Myocardial fibrosis • Endocardial approach • Echocardial • Atrial fibrosis

Introduction

Whilst the pulmonary veins (PVs) remain the cornerstone of AF triggers [1,2], the posterior wall of the left atrium, which shares embryologic origins with the pulmonary veins, has recently garnered significant interest as a trigger and substrate for AF [3]. Studies have demonstrated that myocytes in the posterior wall of the left atrium contain a high arrhythmogenic potential and distinctive electrophysiological characteristics, which may contribute to the pathophysiology of AF [4,5]. In addition, the role of myocardial fibrosis is critical. The posterior left atrium is anchored at the pulmonary veins in the region of the pericardial reflections. Cardiac motion produces stretch and strain gradients in these regions which result in cellular changes and fibrosis [6].

Literature Review

Histological studies have related atrial fibrosis to the presence and persistence of AF [7]. In patients with persistent AF, higher amounts of interstitial fibrosis have been reported within the posterior left atrium [8]. Similarly, MRI studies on the extent and distribution of atrial fibrosis have demonstrated that in patients with AF the persistence of arrhythmia is independently related to the extent of delayed enhancement (DE), the DE is more frequently observed in the posterior wall of the left atrium, and the DE becomes more prevalent as AF progresses from paroxysmal to persistent forms [9]. Electrophysiological studies have further confirmed that as the duration in AF increases, a higher proportion of patients have drivers for AF outside the PV regions, and specifically in the inferior-posterior left atrium where fast and highly organised macro re-entrant circuits are formed, giving rise to significant substrates within the posterior wall [5].

Posterior wall ablation

For the reasons stated above, certain patients with persistent and longstanding persistent AF may remain undertreated with pulmonary vein isolation alone; modification of posterior wall substrate may be required in such cases. The electrical isolation of posterior wall may be achieved by creating linear lesions along the roof (superior PVs) and floor (inferior PVs) of the left atrium, and by anchoring these to the circular PVI lesions, or by forming extensive point-by-point ablations of the entire posterior wall. These lesions can be created either endocardially, epicardially or with an endocardial-epicardial hybrid approach.

Endocardial posterior wall ablation

Although some studies have reported improved outcomes with endocardial posterior wall ablation isolation [10,11], others appear to show no improvement [12,13]. Despite increasing evidence of posterior wall as a source of triggers and substrates for AF, the role of endocardial posterior wall ablation in persistent AF patients remains controversial [14]. A variety of supplemental procedures targeting non-PV triggers have found clinical applications, but unfortunately no catheter-based approach has consistently yielded an acceptable outcome in patients with advanced AF. One theory is that extensive ablation may cause new, iatrogenic areas of arrhythmogenesis where tissue is incompletely ablated or linear block is not achieved [15]. However, ablation at higher power or for longer duration to attain greater lesion depth poses an increased risk of oesophageal injury.

Hybrid Convergent ablation – posterior wall silencing

The desire for comprehensive and transmural lesions while keeping the risk of oesophageal injury low has led to the development of minimally invasive hybrid endocardial-epicardial ablation. The hybrid convergent ablation is a multi-disciplinary approach which compliments endocardial catheter ablation. This approach leverages the strength of the heart team (cardiac electrophysiologist and surgeon) to achieve improved outcomes on difficult to treat patients with advanced AF. The procedure involves epicardial posterior wall silencing, and possibly also PVI, followed by endocardial mapping and ablation to achieve complete PVI and address any other gaps. Debulking or silencing of the posterior wall reduces AF substrate to the level at which AF cannot easily sustain. Access to the epicardial aspect of the posterior wall can be achieved either via transdiaphragmatic or with sub-xiphoid approaches. Since 2015, the sub-xiphoid approach has been increasingly used. Several studies have reported on the outcomes of this procedure at 73-88% freedom from AF through 12 months [16]. The complication rates have declined with procedure evolution and learning curve over the past decade.

Surgical ablation

The Cox Maze III/IV procedure, which addresses PVI, posterior wall isolation and several other non-PV triggers, has reported high success rates of up to 80-90% off anti-arrhythmic therapy. The procedure, however, may require cardiopulmonary bypass and has higher morbidity [17].

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Discussion and Conclusion

The left atrial posterior wall may act as a trigger and substrate for maintaining AF, especially in patients with persistent and longstanding persistent AF. Endocardial posterior wall ablation may provide limited results due to the limitations of achieving transmural lesions while maintaining safety. A hybrid epicardial-endocardial approach, particularly the minimally invasive Convergent hybrid technique, to isolate pulmonary veins and silence the left atrial posterior wall is likely to provide improved outcomes.

Conflict of Interest

The authors declare that they have no competing interests.

Disclosures

Dr. R. A. Kaba is a consultant for Daiichi Sankyo, Bayer, Atricure and Biotronik. Mr. A. Momin is a consultant for Atricure.

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