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Ectopic Triggers of Superior Vena Cava in Atrial Fibrillation

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Introduction

Superior vena cava (SVC) triggers constitute 6-8% of non-pulmonary vein (PV) foci that initiate atrial fibrillation (AF).¹ Since SVC cardiomyocytes originate from the right sinus horn they possess enhanced automacity and after-depolarization leading to arrhythmogenicity.² In a recent study by Arruda et al. 12% of patients had SVC triggers and empiric adjunctive isolation of SVC-right atrium along with PVisolation resulted in higher long term success rate than the group that underwent PVI alone. They demonstrated that adjunctive isolation of SVC along with PV isolation (PVI) is a safe and feasible strategy for ablation of AF.³

Case Report

We describe the case of a 64 year old with paroxysmal AF who continued to have inducible AF despite antral isolation of all 4 PVs. Adenosine challenge (12 mg IV) initiated AF with ectopy starting in the SVC. Complete isolation of the SVC after ruling out diaphragmatic stimulation resulted in independent firing from the SVC that failed to conduct to the rest of the atrium (Figures-1A & 1B).

Discussion

SVC - RA junction isolation can be very easily per-

formed by parking the circular mapping catheter (either the spiral or the Lasso) at the confluence of the sagital section of the SVC and the cross sectional junction of the right pulmonary artery and pulmonary vein. This helps as a landmark to identify the SVC-RA junction. Once the circular catheter is parked at the junction, double potentials are identified along the circumference. Pacing at 20 mA along the posterolateral/lateral/anterolateral aspects of the junction is performed to rule out diaphragmatic stimulation. In the event of positive diaphragmatic stimulation, radiofrequency ablation should be avoided along the lateral segments and application should be restricted to the septal segments alone. If no diaphragmatic stimulation is noted complete isolation should be attempted. Some times a triggered focus can be present right at the SVC-RA junction, in which case ablation of the trigger itself could be curative. In our patient, the trigger was at least 1cm above the SVC-RA junction and therefore ablation of the specific trigger was not performed. 3D mapping can be used for accurate localization of a trigger focus if complete isolation is not possible.

In 1992 Hashiba et al. described the differential distribution of fractionated electrograms in the right atrium in patients with a sick sinus. Patients with sick sinus and paroxysmal AF had widespread distribution of fractionated electrograms whereas those with sick sinus and tachycardia

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Figure 1A: The circular mapping catheter and the ablation catheter in the SVC- atrial junction after isolation.



Figure 1B: This figure shows independent firing from the SVC (Lasso 1-10) that fails to conduct to the rest of the atria, after isolating the SVC-RA junction.



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had abnormal electrograms localized to the high right atrium.⁴ In our patient we did not see any abnormally prolonged and fractionated right atrial electrograms at the high right atrium.

SVC stenosis, transient diaphragmatic paralysis and sinus node injury are known uncommon complications of SVC isolation.⁵ SVC stenosis has been reported following extensive ablation for inappropriate sinus tachycardia. However, stenosis following SVC isolation during AF ablation has not been reported.⁶ Sinus node injury is uncommon although one case has been reported following serial ablations.⁷ Incidence of phrenic nerve injury can be up to 0.48% and can occur with any form of energy delivery (radio frequency, ultrasound, laser or cryo).^{8, 9} Sacher F et al. reviewed the characteristics of phrenic nerve injury described in several studies. Dyspnea is the most common symptom and post ablation pneumonia or pleural effusion may occur. Transient hemi-diaphragmatic paralysis occurs which can last for a mean duration of 7 months. Pulmonary rehabilitation may be beneficial in these patients. This injury can be prevented by prior pacing with maximum output from the lateral aspects of SVC to rule out diaphragmatic stimulation. Occurrence of cough or hiccups during the ablation should prompt immediate termination of energy application to prevent further injury.¹⁰ More recently, a novel cryo mapping technique was used by Dib C et al. to successfully ablate the arrhythmogenic substrate at the SVC-RA junction without phrenic nerve injury.¹¹ In this method, despite phrenic nerve stimulation on pacing 4cm into the SVC, cryo energy is initially delivered at -30oc, a temperature at which reversible loss of conduction occurs. If diaphragmatic capture continues, cryoablation at -70oc to -80oc is carried out while ablation is terminated if diaphragmatic stimulation ceases.

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