INNOVATIVE COLLECTIONS

COMPLEX CASE STUDY

Sustained Ventricular Tachyarrhythmia Complicating the Radiofrequency Ablation of Typical Atrial Flutter

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ABSTRACT. A 51-year-old patient with a history of non-ischemic cardiomyopathy presented with symptomatic paroxysmal atrial flutter which was demonstrated to be cavotricuspid isthmus-dependent during electrophysiology study. During radiofrequency energy delivery, the patient developed a sustained ventricular arrhythmia with hypotension that necessitated emergent external defibrillation. This case illustrates the proarrhythmic potential of radiofrequency energy which unexpectedly complicated an atrial ablation procedure.

KEYWORDS. atrial flutter, radiofrequency ablation, ventricular arrhythmia.

Case presentation
A 51-year-old male presented to the clinic complaining of 3 to 4 months’ history of intermittent palpitations. His past medical history included hypertension, dyslipidemia, schizophrenia, and a distant history of transient ischemic attack that was not well documented. Four days prior to presentation, he was evaluated at a local emergency department where 12-lead electrocardiogram (not shown) demonstrated findings consistent with typical counterclockwise atrial flutter with variable ventricular conduction. Electrophysiologic study and radiofrequency ablation (RFA) were recommended and the patient agreed to proceed.

Pre-procedural transthoracic echocardiogram demonstrated globally reduced left ventricular systolic function with ejection fraction of 35–40%. (A diagnostic left heart catheterization performed 6 months earlier had demonstrated no evidence of any significant coronary artery disease.) Upon presentation to the electrophysiology laboratory, his rhythm was sinus with a cycle length (CL) of 920 ms. A decapolar catheter was placed into the coronary sinus (CS) and the clinical flutter was induced via decremental atrial pacing. The tachycardia CL was 230 ms with a proximal-to-distal CS activation sequence. Entrainment pacing at the cavotricuspid isthmus (CTI) using a mapping catheter (8 mm EPT Blazer, large curve) yielded a post-pacing interval of 235 ms, confirming the CTI dependence of tachycardia. Radiofrequency energy (temperature limit 65°C, power 80 watts) was delivered to the CTI in a linear fashion beginning on the ventricular side of the tricuspid annulus (Figure 1). As the mapping catheter was slowly withdrawn toward the inferior vena cava, there were several isolated premature ventricular contractions noted. Approximately 50 s into the ablation, a sustained polymorphic ventricular tachycardia (VT) was abruptly induced (Figure 2) and quickly degenerated into ventricular fibrillation (VF). Power delivery was interrupted and an immediate external defibrillation was performed, restoring sinus rhythm. CTI ablation was continued to its completion. No further ventricular arrhythmia was inducible. Post-ablation, bidirectional conduction block was confirmed by medial and lateral isthmus pacing.

Discussion
RFA resulting in transient or sustained VT/VF is a rare phenomenon which has been reported previously in the literature. However, these four published cases were associated with the ablation of ventricular arrhythmia.
Figure 1: Presenting rhythm is typical atrial flutter exemplified by the surface P-wave morphology and intracardiac coronary sinus activation sequence. Note that at the starting location of ablation (mapping catheter), there is a small A-to-V ratio. Polymorphic ventricular tachycardia/ventricular fibrillation had an abrupt onset during the power delivery which was immediately interrupted. The patient became hemodynamically unstable and required urgent external defibrillation.
To the best of our knowledge, there have not been any reported cases during the RFA of arrhythmias of atrial origin.

The customary starting point for power delivery in the case of typical flutter is on the tricuspid annulus at the CTI, where the local electrogram demonstrates a large ventricular deflection with a smaller atrial deflection. This position ensures all atrial electrograms along the length of the CTI are “covered” by the lesion. Figure 2 suggests that the mapping catheter tip was annular (slightly more ventricular with an A:V amplitude ratio <1), as there is a well-defined atrial electrogram when the ventricular arrhythmia was induced. Possible mechanisms include 1) mechanical irritation by inadvertent ventricular migration of the mapping catheter, 2) development of local ischemia as the result of ablation, or 3) induction of arrhythmia by high-frequency RF stimulation of ventricular myocardium. In rare instances, the right coronary artery can be in an anomalous intracavitary location vulnerable to damage by RFA of CTI. In such a setting, sustained local ischemia could potentially lead to the induction of ventricular arrhythmia. We have no evidence to believe that the catheter tip position itself (inferobasal right ventricle) was an important factor. It should be noted that this patient had a pre-existing non-ischemic cardiomyopathy. As the VF/VT threshold is characteristically lower for myopathic (as compared with normal) myocardium, one could hypothesize that one or more of these factors led to a predisposed state for arrhythmia induction.

In summary, this is an unusual case in which a routine RFA of typical atrial flutter was unexpectedly complicated by an induction of sustained ventricular arrhythmia requiring emergent external defibrillation. Etiology, as postulated above, is likely to be multi-factorial. This case illustrates the ventricular pro-arrhythmic potential of radiofrequency energy even when the site of planned ablation does not involve the ventricle.

Figure 2: Presenting rhythm is typical atrial flutter exemplified by the surface P-wave morphology and intracardiac coronary sinus activation sequence. Note that at the starting location of ablation (mapping catheter), there is a small A-to-V ratio. Polymorphic ventricular tachycardia/ventricular fibrillation had an abrupt onset during the power delivery which was immediately interrupted. The patient became hemodynamically unstable and required urgent external defibrillation.

Reference
1. Ito S, Tada H, Lee J-D, Miyamori I. Ventricular fibrillation induced by a radiofrequency energy delivery for idiopathic...


