

Atrial Fibrillation to Atrio-Ventricular Nodal Reentrant Tachycardia: Shocking!

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Short Title- Shock inducing AVNRT

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ABSTRACT

N/A

1 —INTRODUCTION

Electrical cardioversion of atrial fibrillation resulting in simultaneous initiation of atrio-ventricular nodal reentrant tachycardia is a rarely reported electrophysiological phenomenon whose mechanisms are poorly understood. This case report aims to speculate the plausible underlying mechanisms.

2 —CASE PRESENTATION

A 70-year-old male with a history of regular complex short RP supraventricular tachycardia (SVT) underwent an invasive electrophysiology study (EPS). The SVT was repeatedly terminated with adenosine in the past. During EPS, dual atrioventricular node (AVN) physiology was demonstrated based on AH jump. Single atrial extra stimulus reproducibly induced an ‘A on V’ tachycardia with a cycle length (CL) of 360 milliseconds (ms). Its mechanism was ascertained to be typical slow-fast AVN reentrant tachycardia (AVNRT) after performing standard EP maneuvers.^{1,2} Atrial burst pacing induced sustained atrial fibrillation (AF) at one instance. Synchronized electrical direct current (DC) cardioversion (150 joules) resulted in termination of AF and initiation of a regular narrow complex tachycardia, both at the same instance (Figure 1). Such an occurrence is rarely reported in literature. What are the plausible explanations behind this phenomenon?

3 —DISCUSSION

The left side of the tracing (Figure 1) shows variable RR intervals on the surface electrocardiogram leads with concurrent chaotic atrial activity in the coronary sinus (CS) electrograms. This is consistent with AF. Pursuant to the DC shock artifact, there is termination of AF as evidenced by a brief pause of 390 ms. This is followed by resumption of the same AVNRT (similar CL of 360 ms and ‘A on V’ sequence). The underlying mechanism is not precisely clear but can be speculated as enunciated below.

The prerequisite for initiation of a reentrant tachycardia such as AVNRT is the difference in the refractory periods of the dual limbs of the circuit with unidirectional conduction block in one limb and slow propagation in the other. The degree of perturbation of such a circuit is directly proportional to the duration of the excitable gap. The latter is a measure of the relative refractory period between the head and tail end of the electrical wave front propagating within the circuit. With this predisposing construct already in existence in this patient, a superimposed DC shock can be postulated to convert AF to AVNRT in one of the following ways.

In the initial scenario, termination of AF may be immediately followed by the first beat of typical slow-fast AVNRT. The implication is that the critically-timed DC shock stimulus propagated through the limbs of the circuit but created selective and conducive differential refractoriness within them. Thus, there is antegrade conduction in the slow pathway but block in the fast pathway. The AVNRT ensues as the conduction from the slow pathway retrogradely enters the fast pathway following its recovery from refractory period.

Alternatively, it is plausible that a shock-induced accelerated junctional beat follows the termination of AF and initiates AVNRT. Initiation of typical AVNRT is a well understood electrophysiological phenomenon predicated on the same construct as detailed above. Given the fact that there was irregular ventricular conduction during AF, it is unlikely that there was dual tachycardia (AF and AVNRT) and that the shock simply unmasked the AVNRT.

This seemingly rare phenomenon is reported only once before but without any mechanistic explanation.³ The authors anticipate that this report would engender a nuanced deliberation regarding this phenomenon.

References

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Figure Legends

Figure 1- Three- channel electrocardiogram (ECG) and intracardiac electrograms from a decapolar catheter

placed in the coronary sinus showing electrical cardioversion (notice the shocking artifact) of an irregular narrow complex tachycardia to a regular narrow complex ‘A on V’ tachycardia

