

A narrow complex tachycardia with intermittent atrioventricular dissociation: What is the mechanism?

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Case presentation

A 57-year-old woman underwent diagnostic electrophysiology study because of recurrent symptomatic supraventricular tachycardia refractory to combination therapy with metoprolol and Cardizem. Her resting 12-lead electrocardiogram and transthoracic echocardiogram were normal. Baseline atrio-His and His-ventricular intervals measured 59 and 52 ms, respectively. Dual antegrade atrioventricular (AV) node physiology was observed during programmed atrial extrastimulation. Ventriculoatrial conduction was midline but only intermittent at a paced cycle length of 500 ms. Multiple episodes of tachycardia initiated and terminated spontaneously (Figure 1). Right ventricular (RV) premature depolarizations delivered when the His bundle was refractory failed to affect the tachycardia. The response of tachycardia to overdrive RV and coronary sinus (CS) pacing as well as atrial premature depolarizations (APDs) delivered during His bundle refractoriness are shown in Figure 2. Based on these observations, what is the mechanism of tachycardia?

Discussion

The top panel of Figure 1 shows 2 sinus complexes followed by the initiation of tachycardia with an “AHH” response. During tachycardia, there is midline retrograde conduction (earliest at the His bundle region) that demonstrates delay and then block (Wenckebach) followed by AV dissociation and sinus rhythm. During AV dissociation, both early (Figure 1, middle panel) and late (Figure 1, bottom panel) coupled sinus complexes (see the asterisk in the figure)

KEYWORDS Supraventricular tachycardia; Atrioventricular dissociation; Junctional ectopic tachycardia; Atrioventricular nodal reentrant tachycardia
ABBREVIATIONS APD = atrial premature depolarization; AV = atrioventricular; AVNRT = atrioventricular nodal reentrant tachycardia; CS = coronary sinus; FP = fast pathway; JET = junctional ectopic tachycardia; RV = right ventricular; SP = slow pathway (Heart Rhythm 2014;0:1–4)

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conduct over the AV node to the ventricle and terminate or reset tachycardia, respectively—the latter also with an AHH response. The differential diagnosis of supraventricular tachycardia with AV dissociation is short and includes (1) atrioventricular nodal reentrant tachycardia (AVNRT) with upper common final pathway block, (2) junctional ectopic tachycardia (JET) with junctional-atrial (JA) block, (3) orthodromic reentrant tachycardia using a concealed nodofascicular accessory pathway with nodal atrial block, and (4) intrahisian reentrant tachycardia with His-atrial block.¹ The absence of split His bundle potentials during sinus rhythm excludes intrahisian reentry. The top panel of Figure 2 shows rapid RV pacing that retrogradely captures the His bundle but fails to accelerate the atrium. The 155-ms longer postpacing interval relative to tachycardia cycle length and failure of His-refractory RV premature depolarizations to affect tachycardia argue against nodofascicular accessory pathway, which leaves AVNRT and JET as the 2 remaining possibilities. The middle panel of Figure 2 shows rapid CS pacing that accelerates the His bundle to the paced cycle length and produces an AHH response upon pacing cessation, while the bottom panel of Figure 2 shows a His-refractory APD delivered from the CS that resets tachycardia with the delay of the His bundle and shortening of the subsequent HA interval.

Three pacing maneuvers that can be used to differentiate AVNRT from JET are (1) ventricular pacing at the tachycardia cycle length, (2) overdrive atrial pacing, and (3) single atrial extrastimulation.^{2–5} A negative (AVNRT)/positive (JET) ΔHA ($\text{HA}_{\text{pacing}} - \text{HA}_{\text{SVT}}$) value with ventricular pacing at the tachycardia cycle length was found by some, but not others, to be a useful criterion distinguishing these 2 diagnoses.^{2,3} The inability of ventricular pacing to accelerate the atrium despite retrograde capture of the His bundle made this criterion not applicable in this case. Another criterion is an “AHA” (AVNRT)/“AHH” (JET) response to atrial overdrive pacing.⁴ The AHH response accompanying rapid CS pacing along with multiple AHH responses during tachycardia initiation and resetting favor JET. However, a third criterion (any perturbation [resetting or termination] of tachycardia by a His-refractory APD) has been considered diagnostic of AVNRT, thereby excluding JET.⁵ Which then

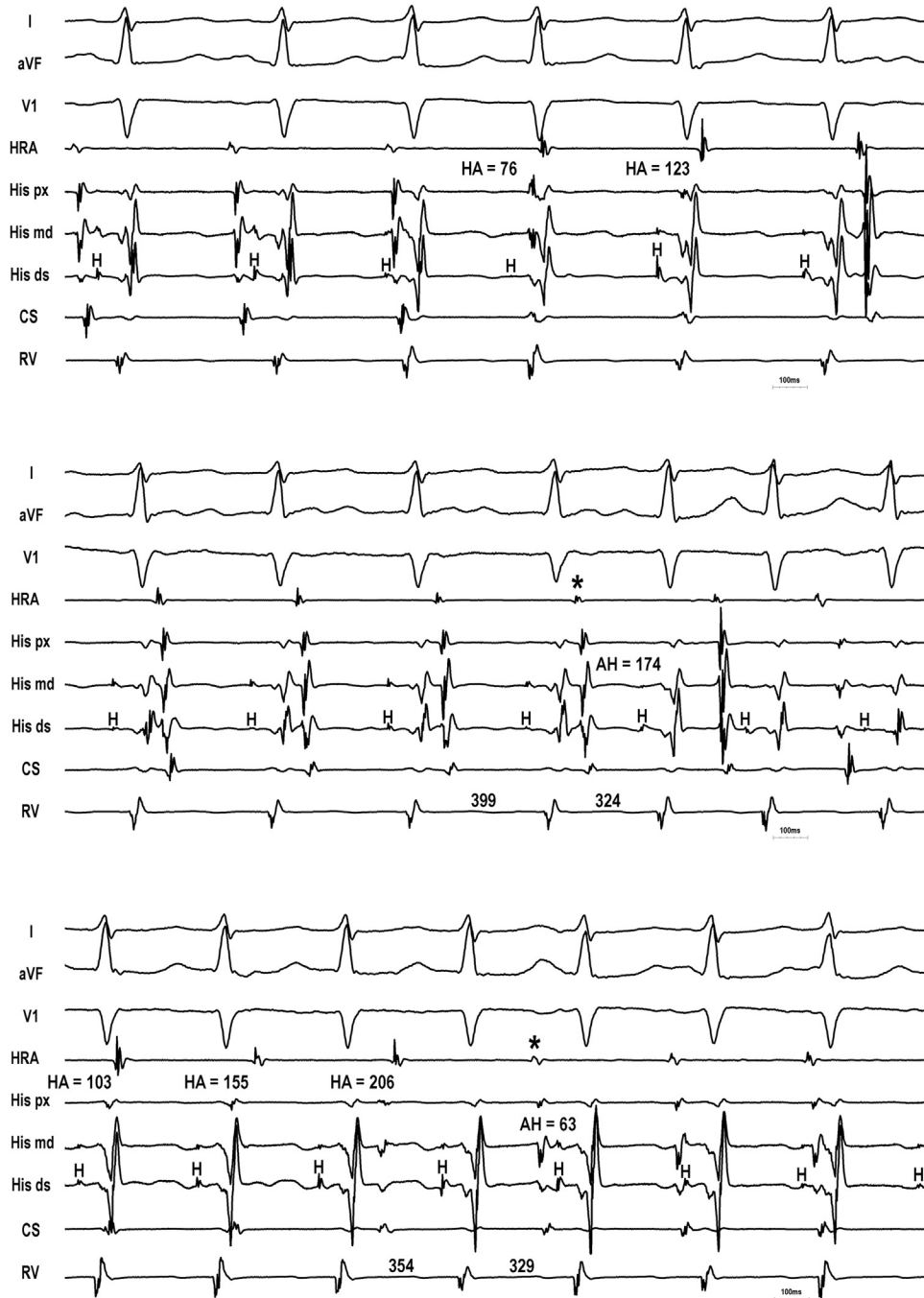


Figure 1 Spontaneous initiation (top), termination (middle), and resetting (bottom) of tachycardia. CS = coronary sinus; ds = distal; HRA = high right atrium; md = mid; px = proximal; RV = right ventricular.

is the correct diagnosis? The one and most likely diagnosis that can explain all these findings is AVNRT with repetitive dual antegrade responses (“double fire” phenomenon). Simultaneous conduction over the fast pathway (FP) and slow pathway (SP) during initiation, resetting, and entrainment can produce multiple AHH responses resembling JET. After resetting of AVNRT by a His-refractory APD, the unexpected 25-ms prolongation of the HA interval without any change in tachycardia rate results from exposure of the

upper common final pathway to a long-short sequence, rendering it relatively refractory with ongoing tachycardia.

One theoretical alternative, however, is JET arising from the proximal SP. While the third criterion may be true for JET originating close to the His bundle (eg, compact AV node or FP) where the junctional focus and surrounding tissue remain refractory when the His bundle is depolarized, it may not be so for JET arising from the proximal SP distant from the His bundle. In such a scenario, an ectopic focus near

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