Correspondence

Supraventricular tachycardia with alternating QRS morphology and cycle length

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To the editor,

The presence of a single atrioventricular (AV) node and accessory pathway associated with tachycardia is common. However, tachycardia with alternating QRS morphology and cycle length is uncommon, and may indicate the presence of a double loop. We reported the case of a 45-year-old man with tachycardia and continually alternating QRS morphology and cycle length.

The man with intermittent palpitations and tachycardia for 2 years was referred for an electrophysiologic study. During tachycardia, a continually alternating QRS morphology and cycle length were observed on a twelve-lead electrocardiogram (ECG) (Fig. 1). He denied a history of hypertension or coronary heart disease and conventional drug therapy was not effective. The ECG and echocardiogram were otherwise normal. The atrio-His (AH) interval, His-ventricular (HV) interval, and sinus rhythm cycle length were 822 ms, 226 ms, and 48 ms, respectively. Programmed ventricular stimulation showed 1:1 ventriculoatrial (VA) conduction with the preceding coronary sinus 1,2 (CS1,2), indicating VA conduction through concealed left accessory pathways.

During programmed S1S1 and S1S2 stimulation, progressive prolongation of the AH interval was observed, and there was evidence of a jump in AV nodal conduction and induced paroxysmal supraventricular tachycardia. Programmed atrial or ventricular stimulation was able to repeatedly induce alternating QRS tachycardia, and the VA interval was fixed. Initiation from the atrium was dependent on a critical AH interval. The cycle length of wide QRS tachycardia was 280 ms, with a 1:1 VA relationship, and the cycle length of narrow QRS tachycardia was 360 ms, with a 1:1 VA relationship (Fig. 2).

We concluded that with dual AV nodal physiology, AV reentry was the probable diagnosis, and undertook accessory pathway radiofrequency ablation using a standard posteroinferior approach. VA dissociation was observed during ablation and the arrhythmia was eliminated. The ECG after radiofrequency ablation was normal (Fig. 3). Programming of atrial stimulation may induce AV prolongation and a jump but cannot induce tachycardia. Thus, we did not attempt dual pathway radiofrequency ablation. This is a very uncommon form of AV reentry, and possible mechanisms are discussed below.

This was a narrow QRS tachycardia with alternating QRS morphology and cycle length. What inferences can be made with regard to the tachycardia mechanism? The differential diagnosis of the tachycardia included atrioventricular nodal reentrant tachycardia (AVNRT) with multiple pathways, atrial tachycardia with...
different conduction ratios, junctional tachycardia and sinus tachycardia with frequent atrial premature beats, and atrioventricular reentrant tachycardia (AVRT) with two accessory pathways. Atrial tachycardia was excluded because the PP intervals were variable and the tachycardia had a 1:1 VA relationship with the preceding CS_{1,2}. Junctional tachycardia was effectively excluded by the intermittent alternating cycle length. The CS_{1,2} preceding the tachycardia showed that concealed left accessory pathways participated in reentry. The alternating cycle length showed that atrial activation passed through fast and slow pathways.

Tachycardia with alternating QRS morphology and cycle length indicates that a double loop may be present. The most common form of antegrade AVRT passes through the atroventricular node and the retrograde form passes through an accessory pathway. An alternating AH interval during tachycardia is evidence for an additional pathway, and the VA interval is fixed. Wu et al\textsuperscript{1} described a double loop as the mechanism of multiple AVNRT. In all of these mechanisms, slow or fast pathways were used in the antegrade limb and a third intermediate pathway was seen intermittently within the retrograde limb. Bardyszewski et al\textsuperscript{2} reported one case of alternating QRS morphology and cycle length during AVNRT. The alternating cycle length could be due to the presence of three nodal pathways, with activation circulating in a figure-of-eight pattern using two slow pathways as the alternating antegrade arm of the reentry loop. Amasyali et al\textsuperscript{1} also reported one case of AVNRT with alternating QRS morphology and cycle length due to two distinct antegrade slow pathways. They postulated a single fast retrograde pathway and slow AV nodal antegrade pathway. More than one antegrade slow pathway was present, but a single lesion at the right posterior atrial septum successfully eliminated AVNRT using the conventional right-sided approach. Namgung\textsuperscript{4} reported a case of typical AVNRT coexisting with a left lateral accessory pathway. Although the left lateral accessory pathway was resistant to traditional endocardial ablation, it was eliminated successfully via the intracoronary sinus approach by radiofrequency ablation.

AVRT with alternating R–R variation and QRS variation is rare. We can postulate two mechanisms. The first involves alternating tachycardia originating from two different accessory pathways, and consists of two loops. However, the VA interval is fixed and the AH interval is variable in tachycardia. The second mechanism consists of a dual pathway and an accessory

![Fig. 1. Twelve-lead electrocardiogram of clinical tachycardia. R–R and QRS alternans were evident.](image)
Fig. 2. Intracardiac electrograms during tachycardia. The preceding CS_{1,2} and alternating AH intervals were observed during tachycardia. CS: coronary sinus; AH: atrio-His.

Fig. 3. Electrocardiogram after radiofrequency ablation.
pathway. In this scenario, atrial stimulation alternates over a fast and slow pathway, and retrograde conduction occurs via an accessory pathway. An aberrant block to the atrium might occur either because the upper common pathway is refractory or conduction may occur via the fast pathway.

This is a rare case of double loop reentry AVRT with 1:1 VA conduction. A dual pathway and concealed left accessory pathway participated in the reentry. This unusual conduction highlights the fact that we can still learn from the most common form of supraventricular tachycardia, AVRT.

References

1. Wu D, Yeh SJ, Wang CC, Wen MS, Lin FC. Double loop figure-of-8 reentry as the mechanism of multiple atrioventricular node reentry tachycardias. Am Heart J. 1994;127:83–95.
2. Bardyszewski A, Szumowski L, Kuśnierz J, Cioch-Domarska W, Gil RJ, Walczak F. QRS and cycle length alternans during atrioventricular nodal reentry tachycardia: case report. Kardiol Pol. 2006;64:649–651.
3. Amasyali B, Kose S, Celik T. Atrioventricular nodal re-entrant tachycardia with QRS voltage and cycle length alternation and aberrant conduction due to two distinct antegrade slow pathways. Europace. 2006;8:134–137.
4. Namgung J. Successful ablation of resistant left lateral accessory pathway and coexisting atypical atrioventricular nodal reentrant tachycardia. Korean Circ J. 2013;43:189–192.

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