Flutter-like P Waves in a Case of Atrioventricular Reciprocating Tachycardia

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Typical atrial flutter is characterized by its sawtooth flutter wave in leads II, III, aVF, and V1. Atrioventricular reciprocating tachycardia is characterized by its small retrograde P wave after completion of QRS complex, where sawtooth flutter-like P waves are rarely seen in the electrocardiogram during atrioventricular reciprocating tachycardia. We report on a 62-year-old patient who presented the characteristic sawtooth flutter-like P waves in the electrocardiogram during attack of supraventricular tachycardia. By electrophysiologic study, the mechanism of his supraventricular tachycardia was atrioventricular reciprocating tachycardia using the left posterior lateral concealed accessory pathway for retrograde conduction. The accessory pathway was successfully ablated by radiofrequency ablation therapy.

Key Words: atrioventricular reciprocating tachycardia, atrial flutter, sawtooth flutter wave
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Cardiac tachyarrhythmias are principally produced by one or more mechanisms, including disorders of impulse initiation and abnormalities of impulse conduction. The former are often referred to as automaticity, and the latter as re-entry. Triggered activity is a tachycardia mechanism associated with disturbances of recovery or repolarization. Tissues exhibiting abnormal automaticity that underlie supraventricular tachycardia (SVT) can reside in the atria, the atrioventricular (AV) junction, or vessels that communicate directly with the atria, such as the vena cava or pulmonary veins [1,2].

The most common mechanism of tachyarrhythmia is re-entry, which may occur in different forms. In its simplest form, it occurs as repetitive excitation of a region of the heart and is a result of conduction of an electrical impulse around a fixed obstacle in a defined circuit. This is referred to as re-entrant tachycardia. AV reciprocating tachycardia (AVRT) and atrial flutter are typical presentations of clinically re-entrant tachycardia.

Electrocardiographically, a tachycardia resulting from re-entry over a concealed (retrograde-only) accessory pathway can be suspected when the duration of QRS complex is normal and the retrograde P wave occurs after completion of QRS complex, in the ST segment, or early in the T wave.

In the typical atrial flutter, electrocardiograms (ECGs) reveal identically recurring regular sawtooth flutter waves, which are often best visualized in the leads II, III, aVF, or V1. The flutter waves for typical atrial flutter are inverted (negative) in these leads because of a counterclockwise re-entrant pathway.

We present a case where the patient suffered from palpitation for 30 years, and documented ECG during tachycardia revealed sawtooth-like flutter waves in leads II, III, aVF. He underwent cardiac electrophysiologic study with a diagnosis of AVRT involving a concealed left posteriolateral accessory pathway.

Case Presentation

A 62-year-old male suffered from intermittent palpitations for more than 30 years, and the frequency of palpitations

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had increased during the last half-year. The palpitations attacked abruptly and spontaneously, and there was no specific precipitating factor. Episodes of palpitation would last from seconds to hours, and had even been terminated by the patient squatting and holding his breath. Previously, one syncope episode even attacked him after carotid massage, as performed in another hospital. Documented ECG coincidence with palpitation episodes showed sawtooth flutter-like P wave features in leads II, III, aVF,V1 and V2 (Figure 1A), and he was admitted for cardiac electrophysiologic study under the impression of atrial flutter.

Electrophysiologic study was performed by introducing three quadripolar electrode catheters from the femoral vein to the high right atrium (HRA), His area and right ventricular (RV) apex, respectively. Another decapolar catheter was introduced to the coronary sinus. Incremental pacing and programmed extra stimuli were delivered to evaluate the electrophysiologic properties and the mechanism of the tachycardia. Twelve-lead ECG and intracardiac electrograms were simultaneously recorded by Bard Lab system (Bard Electrophysiology, Boston, MA, USA). The basic sinus cycle length was 980 msecs, with an atrioventricular nodal conduction time (AH interval) of 150 msecs and His-Purkinje conduction time of 45 msecs. During programmed atrial extra stimulation, the atrial and AV nodal effective refractory periods were 260 msecs and 320 msecs, respectively, at a pacing cycle length of 600 msec. No dual AV nodal pathway could be demonstrated.

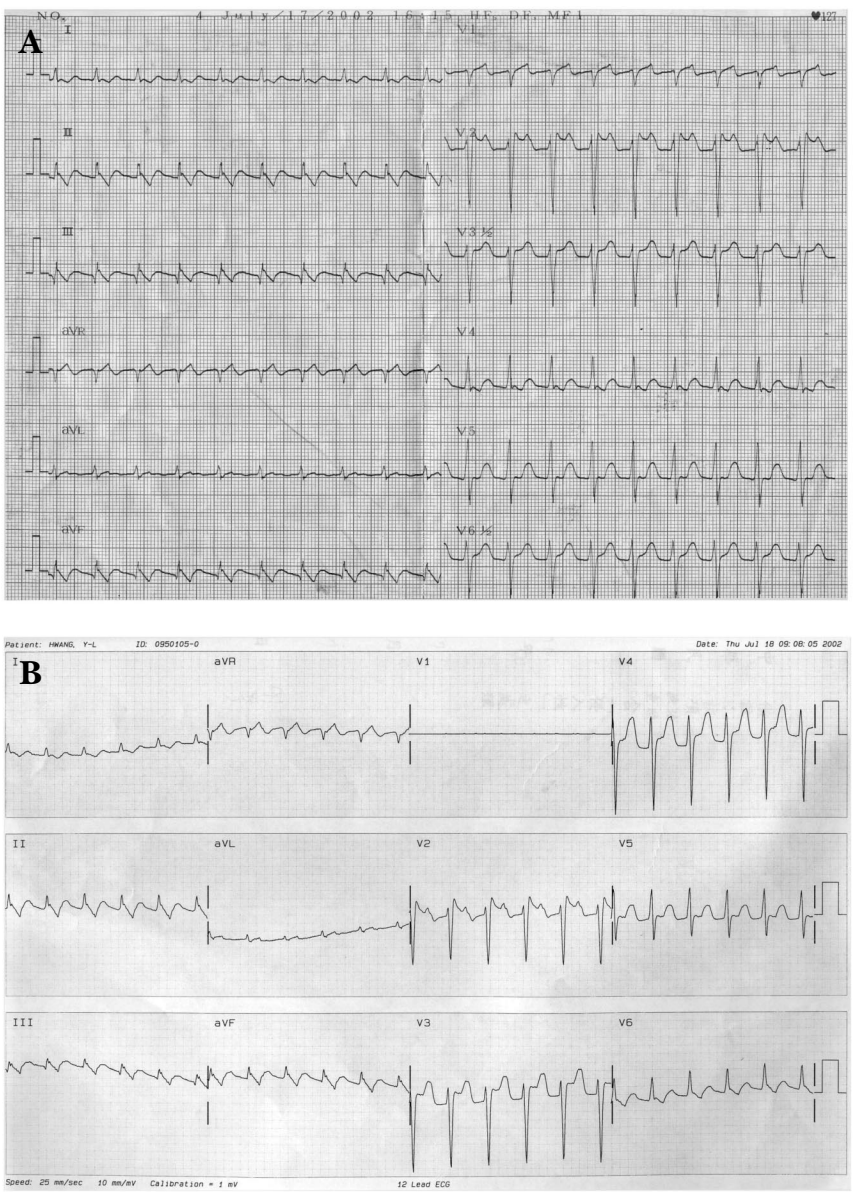

Figure 1. *(A) Documented electrocardiograms during palpitation episodes demonstrating sawtooth flutter-like P waves in leads II, III, aVF and precordial leads. (B) Electrophysiologic study during palpitation episodes demonstrating sawtooth flutter-like P waves in leads II, III, aVF and precordial leads.*

During programmed ventricular stimulation, retrograde 1:1 ventriculoatrial (VA) conduction could be demonstrated until a pacing cycle length of 320 msec was observed. The retrograde VA conduction was eccentric with the earliest atrial activation at the middle coronary sinus region, and no significant decremental conduction property could be demonstrated during premature ventricular extra stimuli (Figure 2).

At a pacing cycle length of 600 msec from RV apex, the effective refractory periods of the retrograde left concealed accessory pathway and RV were 320 msec and 290 msec, respectively. At a pacing cycle length of 400 msecs, the effective refractory periods of the left concealed accessory pathway and RV were 320 msec and 260 msec, respectively. During atrial program, extra stimulation from the HR (the clinical documented narrow QRS tachycardia with sawtooth flutter-like P waves) was easily induced.

A pacing cycle length of 600 msec from HRA showed the atrial extra stimulus with coupling interval of 390 msec, conducted antegradely through AV node without a significant jump of AH intervals to the ventricle, and retrogradely through the left lateral concealed accessory pathway (Figure 3). The induced AVRT was sustained with cycle length of 450 msec, and a big retrograde negative P wave could be demonstrated in surface ECG leads II, III and aVF. A positive P wave was sustained in precordial leads. The characteristic ECG pattern (Figure 1B) was compatible with the clinical documented ECG (Figure 1A).

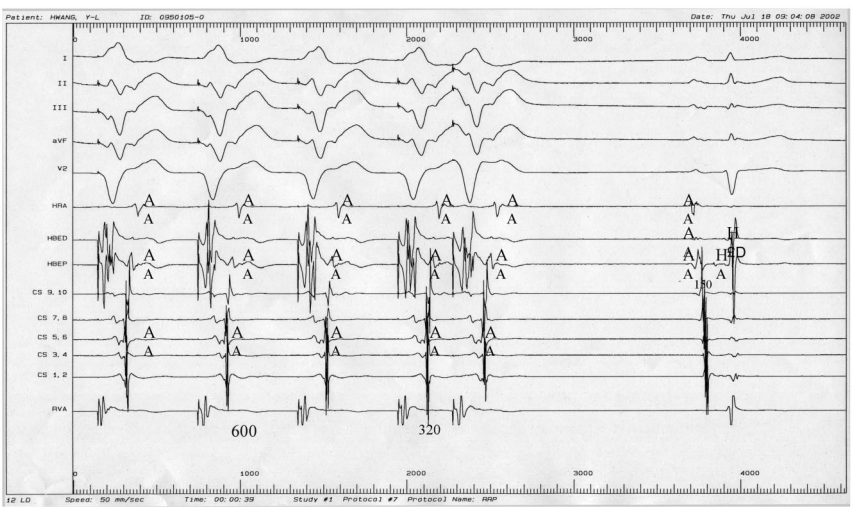

Figure 2. *Retrograde ventriculoatrial (VA) conduction was eccentric with the earliest atrial activation at the middle coronary sinus region, and no significant decremental conduction could be demonstrated during premature ventricular extra stimuli.*

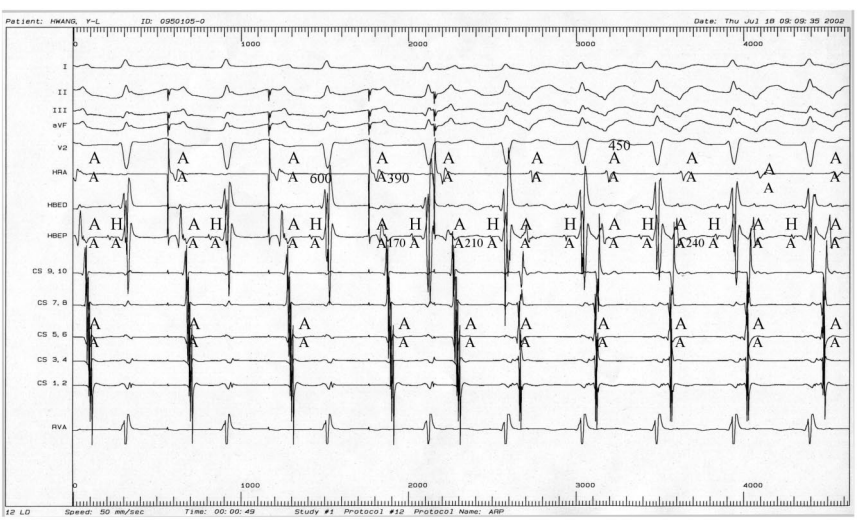

Figure 3. *At a pacing cycle length of 600 msec from the high right atrium, the atrial extra stimulus with a coupling interval of 390 msec conducted antegradely through the atrioventricular (AV) node to the ventricle and retrogradely through the left posterior lateral concealed accessory pathway to initiate sustained AV reciprocating tachycardia with a cycle length of 450 msec.*

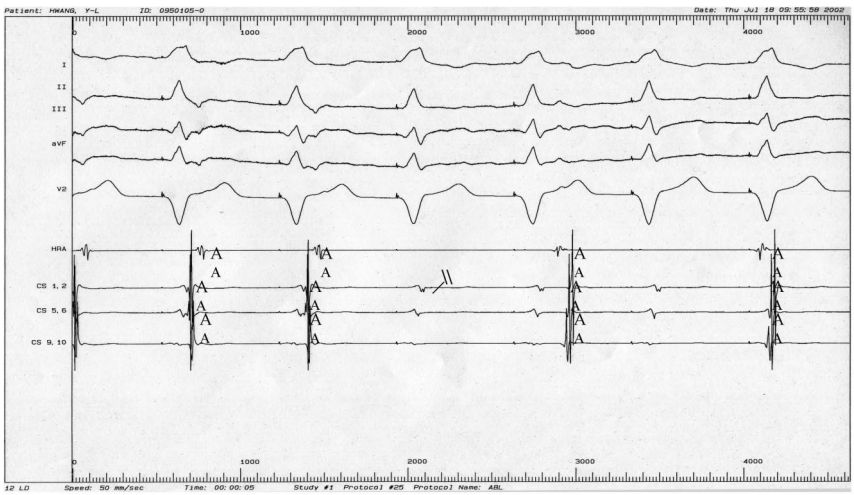

Figure 4. *The accessory pathway conduction was ablated by radiofrequency during right ventricular pacing and the retrograde P waves disappeared as of the third beat.*

The accessory pathway conduction was easily ablated by radiofrequency during RV pacing, at a temperature setting of 60℃, and for a 60 second duration (Figure 4). After ablation, no VA conduction could be demonstrated and the tachycardia with sawtooth-like flutter waves also could not be induced by programmed stimulation, either from HRA or RV apex.

Discussion

Atrial flutter is now recognized as a macro re-entrant atrial rhythm. Typical atrial flutter (sometimes called type I) is a re-entrant rhythm in the right atrium, constrained anteriorly by the tricuspid annulus and posteriorly by the crista terminalis and Eustachian ridge [3]. The flutter can circulate in a counterclockwise direction, around the tricuspid annulus in the frontal plane (typical flutter, counterclockwise flutter), or in a clockwise direction (atypical, clockwise, or reverse flutter) [4,5]. Because both of these forms of atrial flutter are constrained by anatomic structures, their rates and flutter wave morphology on surface ECG are consistent and predictable [4]. The atrial rate during typical atrial flutter is usually 250–350 beats/min, although it is occasionally slower, which can reduce the rate to the range of 200 beats/min. If such a slowing occurs, the ventricles can respond in a one-to-one fashion for the slower atrial rate.

AV RT can be suspected when QRS complex is normal and the retrograde P wave occurs after completion of the QRS complex, in the ST segment, or early in the T wave. Usually, the retrograde P wave is minute, being small in shape and voltage. Interestingly, in our patient and when AVRT attacked, surface ECG showed great and negative retrograde P waves in leads II, III, and aVF, and positive in leads V1 to V3. These latter waves are mimicking the common form of atrial flutter waves. Differential diagnosis from typical atrial flutter may be recognized in our case as the ECG still having an isoelectric interval between each negative P wave. The possible mechanisms to explain the big retrograde P wave may be attributed to a large left atrial size; an intra-atrial conduction delay between left atrium and right atrium; and, in this particular case, the retrograde atrial activation sequence during AV tachycardia produced a vector that is more pronounced and negative in II, III, and aVF leads.

The left atrial size by echocardiography was 4.8 cm. The inter-atrial conduction times from HRA to distal coronary sinus during atrial program stimulation and from the middle coronary sinus to HRA during ventricular stimulation were not significantly prolonged, when compared with other patients who had AVRT. The first and the third mechanisms were more likely to explain the ECG characteristics in this patient.

In conclusion, we present a case with AVRT who demonstrated a characteristic sawtooth flutter-like P wave in the ECG during his SVT attack.

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房室迴繞性頻脈以罕見之鋸齒狀撲動波形呈現

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典型之心房撲動之特色就是在心電圖II，III，aVF，及V1導極呈現鋸齒狀撲動波形。房室迴繞性頻脈之特色在於其逆傳性小的P波出現在QRS波完成之後。我們提出少見的一個62歲的房室迴繞性頻脈患者於頻脈發作時，以如此鋸齒狀撲動波形呈現於心電圖並討論房室迴繞性頻脈患者以鋸齒狀撲動波呈現於其心悸時所認證的心電圖隻可能機轉。

關鍵詞：房室迴繞性頻脈，心房撲動，鋸齒狀撲動波

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