**ECG for Students and Associated Professionals**

Narrow QRS Tachycardia at a Rate of 150 per Minute in a 48-year-old Healthy Woman

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**Case presentation**
A 48-year-old female presented to the emergency room with palpitation. She had been quite healthy and annual medical check-ups since the age of 40 years were reported to be normal. She suddenly felt palpitation while preparing dinner. Her palpitation lasted for one hour before she came to the emergency room. Her pulse was 150/min and BP was 110/70 mmHg, and her general condition was good. A physical examination showed no abnormality except for rapid pulse. A chest X ray was normal without cardiomegaly. Echocardiography performed in the emergency room showed normal left ventricular contraction without any structural abnormalities. ECG showed narrow complex tachycardia at a rate of 150 per minute (Figure 1).

What is your diagnosis of the tachycardia?

**Commentary**
ECG shows a regular narrow QRS complex tachycardia at a rate of 150 per minute (Figure 1). At this point, the possibility of 1) sinus tachycardia, 2) paroxysmal supraventricular tachycardia, and 3) atrial flutter (AFL) with 2:1 atrioventricular (AV) conduction should be considered. But, closer inspection of leads II and III reveals the existence of a P wave-like complex immediately before and after

![Figure 1](image-url)
each QRS complex. The fact that the rate of the P wave is 300 per minute and the shape of the P wave is biphasic in leads II and III (negative to positive) suggests that the P wave is most likely an AFL wave. Thus, the tachycardia is probably AFL with 2:1 AV conduction. However, sinus tachycardia and paroxysmal supraventricular tachycardia cannot be totally excluded. To confirm the diagnosis of AFL with 2:1 AV block, maneuvers or drugs that prolong the AV node refractory period to reveal the presence of flutter waves are helpful. Two methods to increase AV block during AFL used in clinical practice are vagal stimulation (such as carotid sinus pressure and Valsalva maneuver) and administration of drugs. Drugs that increase AV block include digitalis, beta-adrenergic blockers, calcium channel blockers and adenosine. Adenosine is the most commonly used drug for diagnosis as it is a very short-acting drug with few side effects. Ten mg of ATP (metabolized into adenosine in vivo) was injected in this patient. It reduced the frequency of QRS complexes and T waves, which had obscured the flutter waves, and the AFL waves became apparent (Figure 2).

Typical AFL is characterized by rapid, regular atrial depolarization at a rate of approximately 300 beats per minute. Typical AFL waves are detectable in leads II, III and aVF, showing rapid regular continuous undulating deflections of low amplitude and broad width (Figure 2). The ventricular rate is usually half the flutter rate in the absence of AV node dysfunction. This finding is common, and diagnosis of AFL should therefore be considered whenever ventricular rate is 150 beats per minute. On the other hand, AFL with a 1:1 response suggests catecholamine excess, parasympathetic withdrawal, or the existence of an accessory bypass tract in the pre-excitation syndrome.

AFL was traditionally classified into two types: type I and type II. Type I was separated from type II on the basis of flutter rate. The rate of type I is 240 to 340 beats/min and that of type II is 340 to 440 beats/min.1) The European Society of Cardiology and the North American Society of Pacing and Electrophysiology proposed a classification that takes into consideration both anatomic features and electrophysiologic mechanisms.2) Type I atrial flutter is referred to as isthmus-dependent macroreentrant atrial tachycardia and is classified into two forms: counterclockwise isthmus-dependent AF (common AFL) and clockwise isthmus-dependent AFL (uncommon AFL). Common AFL, which accounts for 90% of clinical AFL, is a macro-reentrant atrial tachycardia that travels up the atrial septum and down the right atrial free wall and the slowly conducted area of the isthmus (a path between the orifice of the inferior vena cava and the annulus of the tricuspid valve). Usually, flutter waves are easily detectable in leads II, III, and aVF, showing the appearance of a downsloping segment followed by a sharp negative deflection and then a sharp positive deflection leading to the next downward deflection, which produces a sawtooth appearance (Figure 2). In contrast, uncommon type I AFL (clockwise isthmus-dependent atrial flutter) has the same isthmus-dependent features, but the reentrant circuit has a clockwise rotation: it travels up the right atrial free wall and down the septum, producing positive F waves in leads II, II, and aVF. Type II atrial flutter also has a regular and rather constant morphology with an atrial rate greater than 340 per minute but not fitting the typical type I flutter wave patterns described above. The mechanism of type II atrial flutter is not fully understood.

References