Unusually Rapid Atrial Rate in a Patient with Thyrotoxicosis and Atrial Flutter*

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The patient is a 25-year-old Chinese woman who came to Bellevue Hospital with a complaint of dizziness, weakness, palpitation and diarrhea. Physical examination revealed blood pressure of 138/82 mm Hg, pulse rate 225/min and regular, and temperature 38.9°C. The point of maximal cardiac impulse was in the fifth intercostal space at the midclavicular line. The second heart sound was physiologically split, and there was a 2/6 systolic murmur at the lower left sternal border and the apex. No diastolic murmur was audible. The thyroid was nontender and diffusely enlarged, with a bruit. There was bilateral exophthalmos, with demonstrable lid lag. The patient had a fine extension tremor but was not hyperreflexic. A clinical diagnosis of thyrotoxicosis was made, confirmed by the following laboratory tests: thyroxine (T₄) by competitive protein binding 12.7 (normal 3.5 to 8.0); triiodothyronine (T₃) resin uptake 90 percent (normal 37 to 64) and free T₃ 22.9 (normal 2.9-9.2).

The electrocardiogram (Fig 1) demonstrates atrial flutter which was regular at 450/min, with typical sawtooth configuration. The ventricular response was regular at 225/min (2:1 atrioventricular conduction). This rhythm persisted for approximately one hour, finally reverting to sinus tachycardia after combined edrophonium chloride (Tensilon) 10 mg intravenously (total dose) and carotid massage.

Discussion

Atrial flutter has been reported to occur classically at rates between 240-350/min.¹ In adults atrial rates above 400/min are usually attributed to atrial fibrillation, but have been recorded in atrial flutter which...
has proceeded to atrial fibrillation within seconds.\(^2,3\)
There are several reports of flutter with atrial rates up to 464/min occurring in newborns, infants or very young children.\(^4,6\)

Atrial flutter is frequently associated with hyperthyroidism, although less often than is atrial fibrillation. It has been demonstrated that atrial automaticity increases and atrial action potentials shorten in laboratory animals made thyrotoxic.\(^7\) In the present case it was assumed, although not certain, that the unusually fast atrial rate and ventricular response were related to the patient's thyrotoxic state.

This case extends the range at which atrial flutter, with a persistent, stable atrial rate, may occur.

**References**


**Department Editor's Comment**

This interesting report by Deutsch et al emphasizes the fallibility of devising absolute rate criteria for the electrocardiographic diagnosis of arrhythmia. Although it is traditionally taught that atrial rates in flutter should be between 240 and 350/min, these arbitrary limits are not totally concordant with what is known about atrial electrophysiologic properties.

Current theories of flutter postulate either circus movements or rapidly firing ectopic foci in the genesis of this arrhythmia. In the former case, the atrial rate will depend on the dimensions of the circus and the conduction velocity of the propagating wavefront. In the latter case, the atrial rate will depend on the slope of diastolic depolarization and the threshold potential of automatic cells.

In both cases, the main atrial mass can respond 1:1 at a cycle length equal to or greater than the atrial functional refractory period (AFRP). In patients without conduction disease who are studied under basal conditions, AFRP may be as short as 190 msec. This would allow a maximum flutter rate of 315/min. However, varying endogenous or exogenous influences could shorten AFRP. One could expect shortening of AFRP under conditions of vagotonia and/or sympathetic stimulation. Increased levels of circulating catecholamines, digitalization, and thyrotoxicosis might produce similar changes. In patients with cardiac disease, we have demonstrated atrial functional refractory periods as short as 150 msec. This latter AFRP would allow flutter rates as fast as 400/min.

Similar analysis could be applied to the lower limits for flutter rates.

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