A Case of Atrial Bigeminy

Leo Schamroth, M.D.* and H. David Friedberg, M.D., F.C.C.P.**

The coupling interval of atrial extrasystoles can, at times, suggest the state of the underlying myocardium. This is illustrated by the following case.

CASE REPORT

The electrocardiogram (Fig 1) reflects a basic sinus rhythm. Each sinus beat is associated with a blocked atrial extrasystole. This is evidenced by the premature and bizarre P' wave which is superimposed upon, and deforms, the S-T segment, and which is not followed by a QRS complex. The coupling interval of each extrasystole, the P-P' interval, is very short and measures 0.32 sec. The P'-P interval measures 1.03 sec. This represents the return cycle of the sinus pacemaker, i.e., from the time of its premature discharge by the atrial extrasystolic impulse to the time of its ensuing spontaneous discharge. A sinus cycle of 1.03 sec represents a rate of 58 beats per minute. It must, however, be borne in mind that premature discharge of a pacemaker may depress it momentarily so that the true sinus rate is probably a little faster than 58 beats per minute.

*Department of Medicine, Baragwanath Hospital and the University of the Witwatersrand, Johannesburg, South Africa.
**Marquette School of Medicine, Cardiovascular Section, Veterans Administration Center, Wood, Wisconsin.

A P' wave which is inscribed so soon after the sinus P wave may be an expression of reciprocal atrial activation—an atrial echo. This, however, is not the case here since the frontal plane P' wave axis is directed to +80 degrees.

Very premature atrial extrasystoles usually occur on the distal limb of the T wave and rarely appear earlier than the apex of the T wave. Most atrial extrasystoles thus have coupling intervals of 0.50 sec or longer. It is therefore evident that the coupling interval of 0.32 sec in this case is exceptionally short, and is rarely seen in the clinical context, and it is further evident that an atrial myocardium which can, and does, respond again after so short an interval must have a very short refractory period.

Note that shorter atrial cycle lengths of 0.20 sec to 0.30 sec are seen in cases of atrial flutter and atrial tachycardia. This does not, however, reflect the inherent refractoriness of the atria, for in these situations the advancing head of excitation follows a tail of diminishing refractoriness. In the case of an atrial extrasystole this does not occur, and the S-T axis of the extrasystole is reversed since the extrasystole is induced by an impulse from the still refractory atrial myocardium. This is illustrated by the very short coupling interval, and by the fact that the extrasystole was blocked. The foregoing is illustrated by the tracing in Figure 1, the first tracing of which was recorded on a different day than the other two tracings (Figures II and III).
extrasystole complicating sinus rhythm, however, the analogy does not lie; in this circumstance the excitation fronts are in opposite directions. Furthermore, shortening of atrial refractory periods may be perceived in other circumstances. Studies with the extrastimulus technique often show short effective refractory periods. However, one cannot necessarily extrapolate from an artificial stimulus given during a rapidly paced atrial (non-sinus) rhythm, to the natural separation of an atrial extrasystole during slow sinus rhythm. Thus, an atrial refractory period less than 0.32 sec is very short when deduced from the clinical context of an atrial extrasystole, and is an accurate reflection or close approximation of the state of atrial refractoriness. The short atrial refractory period is further substantiated by a concomitant shortening of the ventricular refractory period, as reflected indirectly by a short corrected Q-T interval.

The Q-T interval measures 0.40 sec. The R-R interval measures 1.34 sec. The Q-T interval corrected for rate (the Q-Tc) is, according to Bazett's formula, as follows:

$$Q-Tc = \frac{Q-T}{\sqrt{R-R}} = \frac{0.40}{\sqrt{1.34}} = 0.34 \text{ sec}$$

This represents a shortened Q-Tc since the normal Q-Tc is 0.39 sec ± 0.40 sec.

It is also important to note that repetitive responses did not occur with the atrial extrasystoles. Very premature atrial extrasystoles almost invariably precipitate atrial flutter or fibrillation. This is because stimuli which follow each other so closely will encounter the out-of-phase end-stage of atrial recovery and will thus tend to initiate further activation in the form of atrial flutter or fibrillation. In this case, the question may well be asked why the very premature atrial extrasystole does not initiate a repetitive response. There are nine such atrial extrasystoles in the illustration, and many more occurred which are not illustrated; yet none of these precipitated atrial flutter or fibrillation.

Clearly, the answer must lie in the fact that the atrial myocardium was completely repolarized at the crucial time. In this respect it is of interest to apply the rule propounded by Killip (quoted by Marriott1).

If the P-P' interval is less than 50 percent of the preceding P-P interval, it precipitates atrial flutter or fibrillation. If the P-P' interval is greater than 60 percent of the preceding P-P' interval it does not and premature impulses with P-P' intervals between 50 percent and 60 percent may or may not. In this case the ratio is 31 percent. Yet, the atrial extrasystole does not precipitate fibrillation or flutter.

The shortening of both the atrial and ventricular refractory periods was due, in this case, to hypercalcemia. The electrocardiogram was recorded from a 48-year-old man with a serum calcium level of 14 mg/100 ml due to an adenoma of the parathyroid glands. This case illustrates the following: in hypercalcemia with a shortened Q-T interval, an atrial extrasystole can occur very prematurely with a markedly shortened coupling interval; the atrial premature impulse need not initiate a sustained or repetitive response because the myocardium is completely responsive; analogous analyses may also apply to the ventricles. Thus, it is evident that atrial bigeminy with a very short coupling interval may constitute a pointer to the presence of hypercalcemia.

**REFERENCE**

1 Marriott HJL: Workshop in Electrocardiography. Oldsmar, Florida, Tampa Tracings, 1972, p 185