Alternating atrial and ventricular tachycardia¹

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SUMMARY A patient with alternating atrial and ventricular tachycardia is described. He had an acute myocardial infarction and was taking digitalis. The atrial tachycardia, which was occasionally associated with aberrant ventricular conduction, was able to interrupt the ventricular tachycardia though the reverse was not true, suggesting a retrograde conduction block. This patient shows that atrial and ventricular arrhythmias can alternate and, since tachycardia with aberrant ventricular conduction can closely resemble ventricular tachycardia, intra-atrial electrocardiography may be necessary to establish an accurate diagnosis.

Simultaneous or double tachycardias are uncommon arrhythmias. Simultaneous atrial and atrioventricular junction tachycardia has been previously reported and is thought to be associated with digitalis toxicity (Wishner *et al.*, 1972). In addition, simultaneous atrial and ventricular tachycardia has been observed (Katz and Pick, 1956; Halkin and Kaplinsky, 1971; Puech, 1975). Distinguished from a double tachycardia is an alternating tachycardia in which two separate arrhythmias alternate in control of the ventricles. No previous mention of this entity in a 30-year review of the world reports on tachycardia including major textbooks of electrocardiography (Katz and Pick, 1956; Corday and Irving, 1961; Dreifus *et al.*, 1966; Sandoe *et al.*, 1970; Bellet, 1971; Chung, 1971; Puech, 1975) suggests that such an arrhythmia is rarely recognised. Reported here is a patient who had alternating atrial and ventricular tachycardia in the course of a recent myocardial infarction, mild congestive heart failure, and possible digitalis intoxication.

Case report

A 57-year-old Caucasian man was admitted to the coronary care unit with a 2-day history of chest pain. An electrocardiogram showed an acute inferolateral and posterior myocardial infarction with normal sinus rhythm. Two days after admission the patient developed rales bilaterally. A chest x-ray film showed pulmonary vascular congestion with slight cardiac enlargement. The patient was treated with 0.5 mg digoxin followed by an additional 0.25 mg

in 8 hours. Two hours after the last dose of digoxin an arrhythmia developed, which by intra-atrial electrocardiography was shown to be episodes of atrial tachycardia with a rate of 180 per minute and aberrant ventricular conduction in the initial few beats (Fig. 1). Spontaneous conversion to sinus rhythm occurred. One hour later a tachyarrhythmia again developed with a broad QRS configuration similar to the pattern of the aberrant ventricular complexes seen intermittently with the previous atrial tachycardia. The new arrhythmia had a slower rate (150 beats/minute), with occasional fusion beats and alternated with episodes of atrial tachycardia at a rate of 180 per minute (Fig. 2, top). Intra-atrial electrocardiography revealed the rhythm to be ventricular tachycardia which was terminated by a short burst of atrial tachycardia. This latter arrhythmia converted spontaneously to sinus rhythm (Fig. 2, bottom). A pattern of alternating atrial and ventricular tachycardia was then seen (Fig. 3). At no time did the ventricular rhythm interrupt the atrial tachycardia, and it resumed when the atrial tachycardia stopped. Both rhythms were successfully ablated with intravenous lignocaine.

Discussion

The alternating nature of these arrhythmias and the demonstration of the related unidirectional interference are unique. Both would have been more difficult to recognise without the use of intra-atrial electrocardiography. The use of this technique for the diagnosis of cardiac arrhythmias has been emphasised previously (Goldreyer, 1972).

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Fig. 1 Simultaneous surface electrocardiogram (SE) and atrial electrocardiogram (AE). The surface electrocardiogram was recorded from the cardiac monitor and shows 3 wide QRS complexes at the onset of atrial tachycardia. The simultaneously recorded atrial electrocardiogram shows that the wide QRS pattern is a result of aberrant ventricular conduction, as each is preceded by an atrial depolarisation. The surface electrocardiogram and the atrial electrocardiogram were obtained from separate recorders and mounted such that corresponding complexes coincided. Recording speed was 25 mm/s. a, atrial depolarisation, v, ventricular depolarisation.

Fig. 2 Non-simultaneous surface electrocardiogram (SE) and atrial electrocardiogram (AE). The surface electrocardiogram (monitor lead position unchanged from Fig. 1) shows a broad QRS pattern resembling the QRS configuration of the aberrantly conducted ventricular complexes with the previous atrial tachycardia (see Fig. 1). A fusion beat (f) and a normal complex (n) are present. Two beats of atrial tachycardia are seen at the end of the tracing. A non-simultaneous atrial electrocardiogram (AE) shows atrioventricular dissociation and ventricular tachycardia. Ventricular tachycardia ends with a short run of atrial tachycardia before conversion to sinus rhythm. Recording speed was 25 mm/s.

Fig. 3 A continuous intra-atrial recording of alternating atrial and ventricular tachycardia which is initiated by sinus rhythm. Sinus rhythm with a rate identical to that at the beginning of the tracing is seen during ventricular tachycardia. Recording speed was 25 mm/s.

The first surface tracing was confusing because a wide QRS pattern was seen intermittently with what appeared to be a paroxysmal atrial tachycardia. The atrial electrocardiogram showed that the wide QRS pattern was a result of aberrant ventricular conduction (Fig. 1). The second rhythm disturbance could have been assumed to be paroxysmal atrial tachycardia with aberrant ventricular conduction at a slightly slower rate; however, the atrial electrocardiogram showed that there was dissociation between the atria and ventricles (Fig. 2).

It is interesting to note that anterograde conduction allowed the atrial arrhythmia with the more rapid rate to 'overdrive' and suppress the ventricular tachycardia. At no time did the ventricular arrhythmia interrupt the atrial arrhythmia or affect the atrial firing rate indicating a block of retrograde conduction. Though the genesis of this rhythm disturbance remains speculative, recent work suggests that most atrial and ventricular arrhythmias are due to re-entrant mechanisms (Coulter and Barold, 1975). One or both arrhythmias, however, could have originated from isolated ectopic foci.

The simultaneous occurrence of two tachycardias has been well documented (Wishner *et al.*, 1972). The unequivocal demonstration of separate arrhythmogenic foci during a junctional or ventricular tachycardia, however, has not been apparent in all cases (Bernstein *et al.*, 1952; Halkin and Kaplinsky,

1971). It is possible that some previously reported simultaneous tachycardias were actually alternating tachycardias. Though different mechanisms could be responsible for alternating and simultaneous tachycardias, both rhythm disturbances appear to be equally serious and occur during similar clinical circumstances.

These arrhythmias occurred in the clinical setting of a recent myocardial infarction, mild congestive heart failure, and digitalis therapy. Ventricular tachycardia is not uncommonly associated with myocardial infarction; however, atrial tachycardia is unusual in this setting, and, when present, is frequently seen among patients receiving digitalis (DeSanctis *et al.*, 1972). There was no evidence for an atrial infarction on the admission electrocardiogram or post-arrhythmia electrocardiogram arguing against this as an aetiology for our patient's atrial tachycardia.

Atrial tachycardia with aberrant ventricular conduction can closely resemble ventricular tachycardia and, as seen in this case, both arrhythmias can occur together. Atrial electrocardiography may be necessary to establish an accurate diagnosis and to select the proper treatment modality.

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