Coupled beats in a boogie dance duet. What is the mechanism?

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Answer to the rhythm puzzle

This is a junctional escape rhythm in the setting of digitalis intoxication (Fig. 1). The first manifestations of digitalis toxicity are usually mediated by increased vagal tone. Digitalis suppresses phase 4 depolarisation and causes conduction problems in the sinoatrial (SA) region. Sinus bradycardia, sinus arrest and sinus Wenckebach conduction are not uncommon in digitalis toxicity [1]. The reason why the sinus node is inhibited in our patient is due to digitalis intoxication with extreme sinus bradycardia/SA block combined with overdrive suppression by the retrograde P waves.

The slow junctional escape rhythm conducts retrogradely - suggested by the superior P wave axis - with a long ventriculoatrial (VA) interval. Besides slowing the antegrade atrioventricular (AV) conduction, it has also been shown that digitalis slows/blocks the retrograde fast pathway conduction [2]. The reason why the

retrograde impulse conducts via the retrograde slow pathway - suggested by the long VA interval - is probably due to retrograde fast pathway block in the setting of digitalis intoxication or due to the absence of retrograde fast pathway conduction. The impulse then re-enters the ventricle via the fast pathway and initiates the so-called ventricular echo beat (Fig. 2). The RP interval is longer than the PR interval, signifying that the impulse is travelling in a retrograde fashion via the slow pathway and then antegradely down to the ventricle via the fast pathway and not vice versa. The degree of right bundle branch block is slightly more in the echo beats than in the escape beats due to the shorter coupled interval.

Echo beats are an unusual type of coupled beats in which the impulse is initiated in one chamber and propagates to the other and then returns to its chamber of initiation. A dual AV nodal physiology provides the basis for AV nodal re-entry manifesting as atrial or ventricular echoes. Classically, ventricular echo beats are most frequently seen after a ventricular premature beat. A ventricular premature beat will conduct retrogradely to the atrium using the slow pathway with its short refractory period, since the fast pathway with its long refractory period is still refractory. By the time the impulse travels down the slow pathway, the fast pathway regains its excitability allowing antegrade conduction and reactivates the ventricle resulting in an echo beat.

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Fig. 1 Electrocardiogram on admission showing group beating with an alternating short-long cycles and narrow QRS complex

Fig. 2 Ladder diagram explaining the mechanism of the group beating. An AV nodal escape rhythm is travelling in a retrograde fashion to the atrium via the slow pathway and then antegradely to the ventricle (echo beat) via the fast pathway

In our patient, the rhythm normalised and patient was discharged a few days after discontinuing the digitalis.

References

1. Smith TW. Digitalis: Mechanisms of action and clinical use. *N Engl J Med.* 1988;318:358–65.
2. Josephson ME. *Clinical cardiac electrophysiology: techniques and interpretations.* Lippincott Williams & Wilkins, 2008:226.