

## Interesting Electrocardiogram

# ISORHYTHMIC DISSOCIATION

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This EKG was obtained on a 41 year old asymptomatic male, who was very athletic and a regular long-distance runner. Aside from a minor intraventricular conduction delay, the EKG demonstrates a bradycardic rhythm with a variable relationship between the P waves (P-P rate of 44-46) and the QRS complexes (R-R rate of 45-46), consistent with isorhythmic dissociation.

Isorhythmic dissociation falls under the category of, and is a particular type of, A-V dissociation. All types of A-V dissociation are characterized by independent atrial and ventricular pacemakers, with the ventricular rate faster than the atrial rate, and the absence of retrograde conduction from the ventricular depolarization to the atria.<sup>1,2</sup> In general, A-V dissociation is the secondary result of some primary disorder in the cardiac rhythm, usually atrial slowing. That primary disorder may be benign, as in the case of isorhythmic dissociation, or the underlying disorder could reflect more serious disease.

In the insurance population, isorhythmic dissociation is seen most commonly in well trained athletes. Much has been written on the numerous and various arrhythmias known to occur in athletes.<sup>3,4</sup> While isorhythmic dissociation is not the most common of these arrhythmias, it may occur in as many as 20% of athletes.<sup>5</sup> The initiating event is slowing of the S-A node rate to bradycardia. Then a second, independent pacemaker takes over depolarization of the ventricles. The second pacer is either junctional (giving a normal or near normal QRS appearance and duration) or idioventricular (with a more bizarre, wide QRS). The bradycardic rates of the two independent pacemakers are nearly identical, in contrast to other types of A-V dissociation, and cause a relationship between the P waves and the QRS complexes which is often called flirtatious. The P wave moves closer to, then farther away from, the QRS, maintaining an illusion of a normal atrioventricular conduction sequence. Occasionally, the P wave will move into, and be buried within, the QRS complex, only to move back out again in front of the QRS in subsequent beats. The two pacemakers remain independent so long as the S-A node rate is bradycardic. When this rhythm occurs intermittently with normal sinus rhythm, it is called *accrochage*; and when isorhythmic dissociation is persistent, it is called *synchronization*.

When this 41 year old runner was put on an exercise treadmill, and his heart rate (specifically his atrial rate) rose about 60-70, his conduction became completely normal with ventricular capture. The PR interval became stable and physiologically decreased with increased levels of stress. There were no ischemic ST-T changes or arrhythmias. Isorhythmic dissociation is, in this setting, associated with neither coronary artery disease, nor primary disorders of the conduction system such as progressive Sick Sinus Syndrome, or Lev's and Lenegre's diseases. This rhythm should not be confused with complete heart block: where the atrial rate is faster than the resulting ventricular rate, and where the atrial depolarization cannot be conducted to the ventricles. Atrial depolarization can be conducted to the ventricles in isorhythmic dissociation given the proper temporal opportunity. In the well trained athlete with no other structural heart disease, isorhythmic dissociation is a benign arrhythmia.

Isorhythmic dissociation is sometimes seen during, and as a direct result of, general anesthesia for surgery.<sup>6</sup> Individuals with and without underlying heart disease may demonstrate this. Moderate drops in the arterial blood pressure can result from this intraoperative arrhythmia.

The more serious causes of A-V dissociation include ischemic heart disease (e.g., acute inferior wall myocardial infarction), rheumatic fever, or a result of antiarrhythmic therapy with atropine, digitalis, quinidine, procainamide or the calcium channel blockers. These conditions may cause slowing of the sinus node, failure of the S-A node to initiate a depolarization, or failure of the S-A impulse to be conducted down to the A-V junction. As the atrial rate slows, the conditions are favorable for the development of A-V dissociation, with a second pacemaker depolarizing the ventricles at a faster rate. A retrograde block prevents the appearance of inverted P waves. The second pacer, either junctional or ventricular, occasionally becomes frankly tachycardic, while the atrial rate remains slow.

Isorhythmic dissociation is not a common arrhythmia in the general population, but given the proper clinical setting, it is the most innocent of the A-V dissociation arrhythmias, and warrants a favorable underwriting action.

## REFERENCES

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