A Subtle Sign of Dual Atrioventricular Nodal Pathways

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A 70-year-old man with end-stage kidney disease came into the hospital because a slow and irregular pulse was noted during hemodialysis. He had a long history of high blood pressure, and recent electrocardiograms had shown a long P-R interval. His medications were hydralazine 75 mg P.O. tid, carvedilol 25 mg P.O. bid, clopidogrel 75 mg P.O. qd, amlodipine 10 mg P.O. qd, and Renagel 1600 mg P.O. tid. In addition to a slow and irregular heart rate, physical examination revealed normal breath sounds, brisk and full carotid pulses, distended neck veins, a prominent right ventricular lift just to the left of the sternum, a palpable thrill in the left antecubital fossa over the arteriovenous fistula used for hemodialysis, and a loud and continuous bruit there that could be heard all the way back to the anterior chest wall. Figure 1 shows the admission electrocardiogram.

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DIAGNOSIS: Sinus rhythm with second-degree atrioventricular (AV) block, Type I, with each Wenckebach sequence being terminated by a premature, retrograde, reentrant P wave; left ventricular hypertrophy with repolarization changes.

The 12-lead rhythm strip shows the Wenckebach sequences best in lead V1. Each sequence ends with an upright, premature, retrograde, reentrant P wave that can be seen at the junction of the QRS and ST segment. The other QRSs do not have these upright deflections. The second reentrant P wave is slightly later than the others, and its separation from the preceding QRS allows it to be seen in leads II, III, and aVF, where it is negative, and in leads aVL and aVR, where it is positive – morphologies all consistent with retrograde depolarization of the atria.

The very long P-R interval before the last QRS of each Wenckebach sequence presumably is due to the electrical impulses traveling down the slow AV nodal pathway. The impulse then passes back up the fast pathway into the atria that, because of the long transit time down the slow pathway, have had time to repolarize. The reentrant P wave prematurely depolarizes the atria and resets the sinus node, resulting in a long P’-P interval before the next Wenckebach sequence begins. Thus, conditions requisite for reentry are present: dual pathways, slowing and asynchrony of conduction, unidirectional block, and recovery of excitability.

The patient gave a history of having coronary arterial stents placed in 2003 for intermittent chest heaviness that subsequently disappeared until 2-3 months ago. Episodes of heaviness then returned, accompanied by forceful palpitations that would begin shortly after the heaviness began. Soon after relating the story, the patient had such an episode of chest heaviness with palpitations, and a nonsustained run of slightly irregular ventricular tachycardia was recorded on a lead II telemetry strip (Figure 2).

Cardiac catheterization and coronary arteriography revealed a left ventricular end-diastolic pressure of 17 mmHg, an aortic pressure of 150/60 mmHg, and no systolic pressure gradient across the aortic valve. The coronary arteries were heavily calcified, and the left main coronary artery had a 90% distal stenosis. On echocardiogram, his left ventricular ejection fraction was >55%. He has undergone coronary artery bypass graft operation with saphenous vein grafts placed to the left anterior descending coronary artery and the largest obtuse marginal branch of the left circumflex coronary artery. Meanwhile, after carvedilol was stopped, his rhythm returned to first degree AV block, at first with a PR interval of 504 msec and 10 days later with a PR of 228 msec. Postoperatively, he is in normal sinus rhythm with no PR prolongation.

REFERENCE


Dr. Glancy is a Professor; Dr. LeLorier is an Associate Professor; Drs. Ali and Hanna are Assistant Professors; and Drs. Ayallore, Ilie, and Lathia are Fellows in the Section of Cardiology, Department of Medicine, Louisiana State University Health Sciences Center in New Orleans.

Figure 2: Lead II electrocardiographic rhythm strip recorded during an episode of chest heaviness with palpitations. See text for explication.