Arrhythmia graphics

Markedly varying PR intervals during second degree atrioventricular block: possible mechanisms

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KEYWORDS

Atrioventricular block
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ABSTRACT

A case of second degree atrioventricular block following mitral valve replacement is presented during which varying PR intervals with sudden marked increase in PR interval in consecutive beats was seen. The electrocardiogram is discussed and various hypotheses to explain the possible electrophysiological mechanism are presented.

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Case history

A 22-year-old lady underwent mitral valve replacement with a prosthetic bileaflet valve for symptomatic severe rheumatic

calcific mitral stenosis. The electrocardiogram (ECG) done after the surgery showed second degree atrioventricular (AV) block (Figure 1). The patient remained asymptomatic during her entire postoperative stay and the AV block recovered to

Figure 1 Twelve-lead electrocardiogram showing second degree atrioventricular block.

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Figure 2 Ladder diagrams explaining the possible electrophysiological mechanisms for the atrioventricular block in Figure 1. See text for details.

first degree at the time of the discharge from the hospital. What is/are the likely electrophysiological mechanism/s to explain the AV block in Figure 1?

Discussion

The ECG in Figure 1 shows regular sinus rhythm (SR) at a rate of 75/min with P waves that are bifid in lead II and have a large terminal force in V1 typical of left atrial enlargement due to mitral valve disease. The ventricular rate is slower and the rhythm has a regularly irregular pattern with four QRS complexes for every five P waves. Since the PR interval is varying, it is a second degree type 1 AV block but multiple electrophysiological mechanisms are possible.

The simplest explanation is depicted in Figure 2A, wherein the block is due to Wenckebach type of conduction in the AV node with 5:4 conduction pattern. However, since the increment in the PR interval is not decreasing on subsequent beats, it is a type of atypical Wenckebach operation.

Since the increment in PR interval from second (A2) to third (A3) P wave is huge, it may be possible that A3 is actually blocked in the AV node and the QRS following A3 is a junctional escape beat (Figure 2B). The junctional escape beat then conducts retrogradely to cause concealed conduction in the AV node resulting in block of the subsequent (A4) P wave. The 4th QRS results from another junctional escape beat that

subsequently leads to block of the 5th and last (A5) P wave in the cycle by a similar mechanism. The 5:4 cycle then continues regularly.

Also, since the increment in PR interval from A2–A3 is marked and sudden, it may be possible to explain the ECG by invoking dual AV nodal pathways¹ (Figure 2C). The fast AV nodal pathway shows Wenckebach conduction with 3:2 pattern (A1, A2, and A3). A3 blocks in the fast pathway and conducts over the slow pathway. Retrograde concealed conduction from the slow pathway leads to block of A4 in the fast pathway and its conduction over the slow pathway with a longer PR interval. A5 gets blocked in the fast pathway due to retrograde concealment and also in the slow pathway due to Wenckebach. Thus, the slow pathway also shows Wenckebach operation with 3:2 pattern (involving A3, A4, and A5 P waves) and thus the cycle continues.

The present case describes how a complex ECG can be dissected out to explain an atypical feature by invoking different electrophysiological mechanisms.

Reference

1. Di Biase M, Tritto M, Sabato G, Pitzalis MV, Rizzon P. Electrocardiographic patterns during Holter monitoring in patients with first and second degree A-V block due to 'dual A-V nodal pathways'. *Eur Heart J* 1991;12:368–77.