

Atrioventricular Block

Kartikeya Bhargava, MD, DNB, Gurgaon, India

A 71-year old gentleman presented with history of two episodes of syncope. The baseline ECG is shown in Fig. 1. The 2D-echocardiography and coronary angiography was normal. What is the ECG diagnosis?

wide (≥ 0.12 seconds) and are of RBBB morphology. Thus, the complete ECG diagnosis of the present case is sinus rhythm with 2:1 AV block and RBBB.

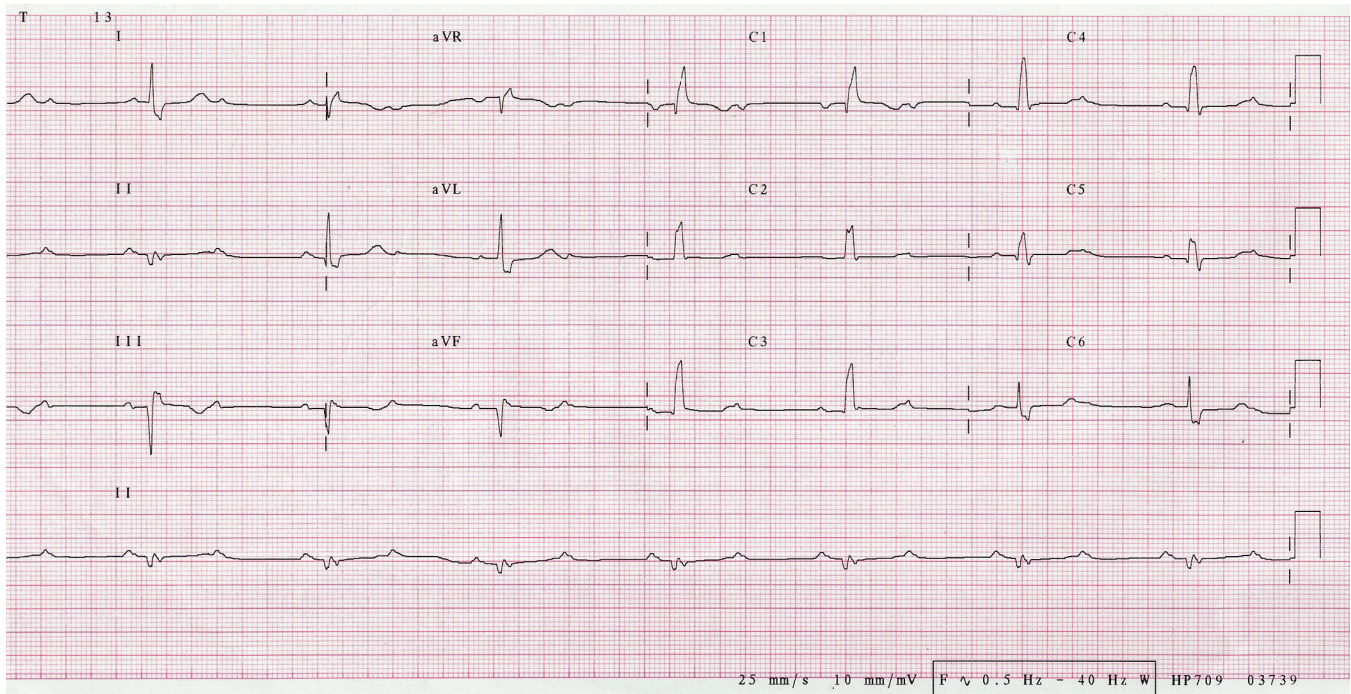


Figure 1. Twelve lead ECG of the patient.

The ECG shows an atrial rate of 88/min with two P waves for each QRS complex resulting in ventricular rate of 44/min. The P waves are positive in leads II, III, and aVf and biphasic in V1 suggestive of sinus node origin of atrial activity. Alternate P waves are not followed by a QRS complex (blocked) producing 2:1 atrioventricular (AV) block. The PR interval of the conducted beat is 0.18 seconds and is constant. The QRS complexes are

The AV block is classified in three degrees as described below:

1. First-degree AV block. Each P wave is followed by a QRS complex with a prolonged PR interval (> 0.20 seconds). Hence, the PP, PR and RR intervals are constant in first-degree AV block. Actually speaking, there is no AV block and a more appropriate terminology is prolonged AV conduction.
2. Second-degree AV block. Here, only some of the P waves are conducted to the ventricles and some are blocked. It is of four types:
 - a. Mobitz type 1 AV block or Wenckebach AV block. The PR interval gradually prolongs till a

From: Medanta-The Medicity, Gurgaon, India. (K.B.)

Corresponding Author: Kartikeya Bhargava
 Medanta Heart Institute, Medanta-The Medicity,
 Sector 38, Gurgaon -122001, Haryana, INDIA.
 Ph: +191-124-4141414 | 91-124-4834111
 Email: drkartikeya@hotmail.com

- P wave is blocked resulting in a pattern of 3:2 or 4:3 or 5:4 (or similar) AV conduction. The PR interval of the conducted beats is variable and this difference can be best appreciated in the PR intervals of the beats encompassing the blocked P wave. The RR intervals are also irregular, though the PP intervals are constant. It is interesting to know that Karel Frederik Wenckebach, a Dutch physician, had described this type of block by observing the JVP waveforms even before the ECG was invented.
- b. Mobitz type 2 AV block. There is sudden block of the P wave and the PR interval in the conducted beats remains constant. Hence, the pause in RR interval is twice the regular RR interval. The pauses in the rhythm make RR intervals nonconstant.
 - c. 2:1 AV block. Alternate P waves fail to conduct to the ventricles in this type of second-degree AV block. Since, it is not possible to know whether it is Mobitz type 1 or type 2, it has been classified as a separate category of second-degree AV block. The QRS complex of the conducted beat may be narrow or wide depending on the site of AV block. The PP intervals and RR intervals are constant, with RR intervals twice that of PP interval.
 - d. Advanced or high-degree AV block. In this type of block, two or more consecutive P waves are blocked.
3. Complete or third-degree AV block. It is diagnosed when none of the P waves conduct to the ventricles. The atria and ventricles are dissociated from each other (see Fig. 2). The ventricular rhythm is maintained by escape rhythm that arises distal to the site of AV block. Hence, the RR intervals are constant and ventricular rhythm is usually regular and much slower than the atrial rhythm. If the ventricular rate is nearly half of the atrial rate, it may be confused with 2:1 AV block. To differentiate the two, the PR intervals of the apparently conducted beats need to be compared. In Fig. 2, the apparent PR intervals are varying implying the presence of complete AV block, whereas the PR intervals in Fig. 1 are constant suggesting a diagnosis of 2:1 AV block. Also, since the junctional escape rhythm in the example shown is of narrow QRS, it is arising from the AV junction, hence the site of AV block has to be either AV node or intra-Hisian.

Whenever 2:1 AV block is present, the possible sites of block are AV node, His bundle, and bundle branches. There are few pointers to localize the site of block from the ECG. These include the PR interval, width of the QRS, and the effect of exercise, carotid sinus massage,

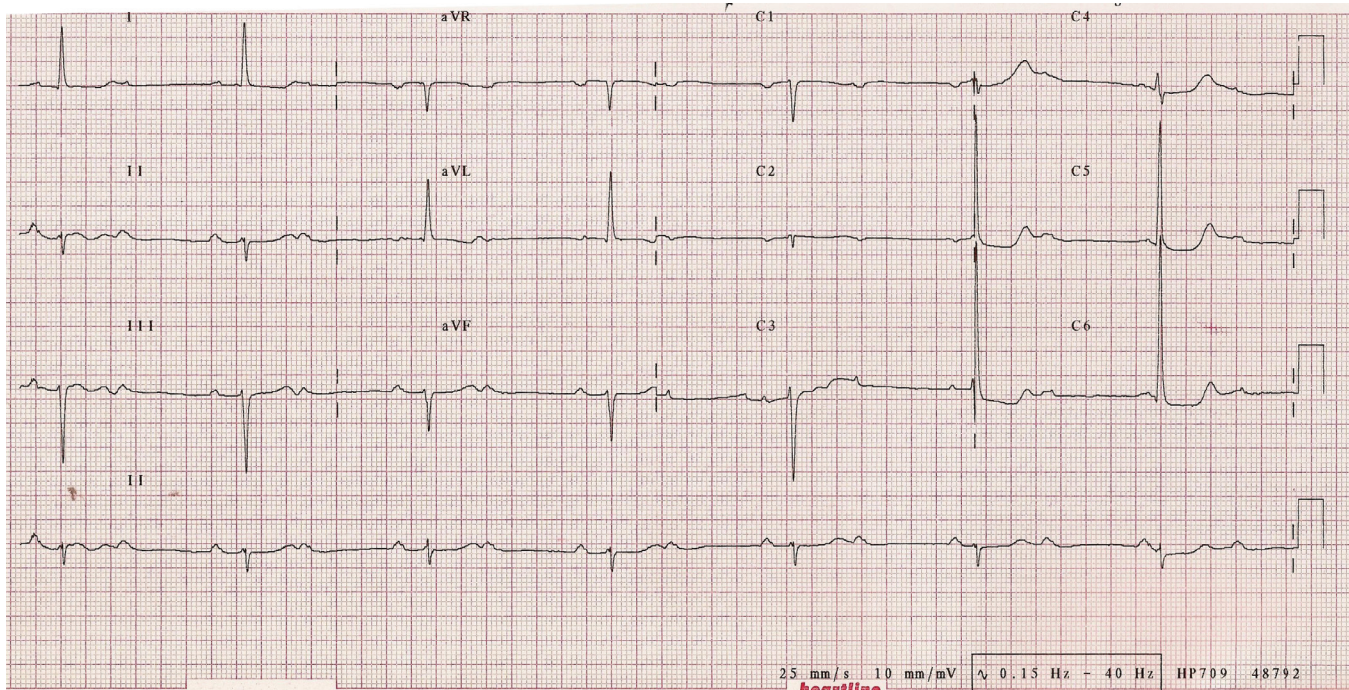


Figure 2. Twelve lead ECG of another patient showing sinus rhythm with complete AV block with narrow QRS (junctional) escape rhythm.

and atropine on AV conduction. The features of different site of 2:1 AV block are described in Table 1.

Narrow QRS indicates AV node or His bundle as the site of block whereas it is wide if the block is in the bundle branches. However, wide QRS can also exist even if the site of block is in AV node or His bundle. Similarly, a short PR interval of <160 ms suggests infra-nodal block and a long PR interval >280 ms suggests AV nodal block. PR interval does not help in localizing the site of block if it is between 160 to 280 ms.

Table 1.

ECG pointers to localize the site of block in 2:1 AV block.

Site of Block	AV Node	His Bundle	Bundle Branches
PR interval	> 280 ms	< 160 ms	< 160 ms
QRS width	Narrow	Narrow	Wide
Effect of exercise on AV conduction	Improves	Worsens	Worsens
Effect of carotid massage on AV conduction	Worsens	Improves	Improves
Effect of atropine on AV conduction	Improves	Worsens	Worsens

Hence, in the present case the wide QRS and a relatively short PR interval of 180 ms suggest that the site of block is infra-Hisian, that is, in the bundle branches.

The site of block in a patient with 2:1 block has clinical implications too. Infra-nodal block (in His bundle or the bundle branches) is a strong indication for pacemaker implantation even if the patient is asymptomatic because there is a likelihood of unexpected worsening of conduction in these structures. AV nodal 2:1 block is also an indication of pacemaker implantation in symptomatic patients provided any AV nodal slowing drugs are not being used or are essential. In asymptomatic patients with AV nodal 2:1 block, the decision to implant a pacemaker needs to be individualized.

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Conflict of Interest

None