Continuing Problems with the Diagnosis of Mobitz Type II Second-Degree Atrioventricular Block

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ABSTRACT

Second degree atrioventricular block remains poorly understood despite the major advances in cardiac electrophysiology. In this paper, we summarized the continuing problems with the diagnosis of Mobitz Type II second degree atrioventricular block.

KEYWORDS
Atrioventricular block, Second degree Möbitz type II atrioventricular block, Second degree type I atrioventricular block

ÖZET

Kardiyak elektrofizyolojide büyük gelişmelere rağmen ikinci derece atriyoventriküler blok tam olarak anlaşılamamıştır. Bu yazida ikinci derece Mobitz tip II atriyoventriküler bloğun tanısında devam eden sorunlar özetlenmiştir.

ANAHTAR KELİMELER
Atriyoventriküler blok, ikinci derece Mobitz tip II atriyoventriküler blok, ikinci derece tip I atriyoventriküler blok.
Second-degree AV block remains poorly understood despite the major advances in cardiac electrophysiology in the last four decades. The literature is replete with varying definitions of second-degree AV block especially Mobitz type II block. It should therefore not be surprising that during formal testing, physicians score more poorly with second-degree AV block ECGs than with those of other arrhythmias. Several workers have indicated that Mobitz type II block is misunderstood more than any other abnormality of rhythm or conduction. The reasons for these difficulties and the pitfalls in the diagnosis of second-degree AV block form the basis of this review.

Contemporary Definitions
Type I block and type II second-degree AV block are electrocardiographic patterns that refer to the behavior of the PR intervals (in sinus rhythm) in sequences (with at least 2 consecutive conducted PR intervals) where a single P wave fails to conduct to the ventricles. The anatomic site of block should not be characterized in terms of either type I or type II because the type I and II designations refer only to electrocardiographic patterns. The definitions of type I and type II second-degree AV block are purely descriptive, do not refer to the site of the block. They are predicated on the absence of an escape QRS complex after the blocked impulse.

Type I Second-Degree AV Block
Type I second-degree AV block describes visible decremental or varying AV conduction with large or small increments in AV conduction time and is defined as the occurrence of a single non-conducted P wave associated with inconstant PR intervals before and after the blocked impulse provided there are at least two consecutive conducted P waves (i.e., 3:2 AV block) to determine behavior of the PR interval (Figure 1). The PR interval after the blocked impulse always shortens if the P wave is conducted to the ventricle. The term “inconstant” PR or AV intervals is important because many sequences of type I second-degree AV block are atypical and do not conform to the traditional mathematical behavior of the PR intervals described in standard textbooks. For example, the second PR interval (after a blocked impulse) often does not show the greatest increment, whereas the PR interval may actually shorten in the middle of a type I sequence. The term “progressive” is misleading because PR intervals may stabilize and show no discernible change in the middle or at the end of a type I sequence (Figure 1 and 2). This arrangement at the end of a type I structure simulates type II block (Figure 2).

Type II Second-Degree AV Block
Type II describes what appears to be all-or-none AV conduction without visible increments in conduction time in the standard ECG. According to the definitions codified by the World Health Organization (WHO) and the American College of Cardiology (both in 1978), type II second-degree AV block is defined as the occurrence of a single non-conducted P wave associated with constant PR intervals before and after the blocked impulse, provided the sinus rate or the P-P interval is constant (no slowing) and there are at least two consecutive conducted P waves (i.e., 3:2 AV block) to reveal the behavior of the PR interval (Figure 2 and 3). The pause encompassing the blocked P waves should equal two (P-P) cycles. Stability of the sinus rate with absence of slowing is an important criterion because a vagal surge can cause simultaneous sinus slowing and AV nodal
Diagrammatic representation of various forms of second-degree AV block. The 3 levels represent activation of the atria, AV junction (PR intervals are shown between the lines), and ventricles respectively. All values are in msec. (A) Classic type I AV block. (B) Relatively long and atypical type I sequence. Note the irregular fluctuations of the PR intervals before the dropped beat. (From Barold SS, Friedberg HD. Second-degree AV block. A matter of definition. Am J Cardiol 1974;33:311–313, with permission.)

Diagramatic representation of various forms of second-degree AV block with the same format as in Fig 1. (C): Relatively long and atypical type I sequence with several constant PR intervals before a dropped beat. Note the shorter PR interval after the blocked P wave. This pattern should not be called type II AV block. It is essential to examine all the PR intervals in long rhythm strips and not merely several PR intervals preceding a blocked impulse. (D): True type II AV block. Every atrial impulse successfully traverses the AV node which is not afforded a long recovery time as occurs in type I AV block. Note that the PR interval after the blocked beat is unchanged. (From Barold SS, Friedberg HD. Second-degree AV block. A matter of definition. Am J Cardiol 1974;33:311–313, with permission.)

Sinus rhythm with second-degree type II AV block in the presence of right bundle branch block and left anterior hemiblock. There are tiny q waves in V2 and V3 probably related to left anterior hemiblock rather than old anterior myocardial infarction. Note that the sinus rate is constant and the PR interval after the blocked beat remains unchanged.

block, generally a benign that can superficially resemble type II second-degree AV block (Figure 4). The 2008 ACC/AHA/HRS guidelines do not state that the diagnosis of type II block requires the absence of heart rate slowing. The literature of type II block is replete with errors because the diagnostic importance of the rate criterion (no slowing) and need for an unchanged PR interval after a single blocked impulse are often ignored. A constant PR after the
blocked beat is a *sine qua non* of type II block. The diagnosis of type II cannot be made if the P wave after a blocked impulse is not conducted with the same PR interval as all the other conducted P waves. In other words, type II second-degree A V block cannot be diagnosed whenever a shortened A V interval occurs after the blocked P wave regardless of a string of constant PR intervals before the block (Figure 2). In such a situation the pattern is either type I or unclassifiable. The shorter PR interval after the blocked P wave may either be caused by improved conduction (type I block) or A V dissociation from an escape A V junctional beat bearing no relationship to the preceding P wave.

**Site of AV Block**

Type II block according to the strict definition occurs in the His-Purkinje system and rarely above the site of recording of the His bundle potential in the proximal His bundle or the nodo–Hisian junction. Type II second-degree AV block has not been convincingly demonstrated in the N zone of the AV node. Type II block is associated with bundle branch block in at least 70% of the cases and should be a Class I pacemaker indication regardless of QRS duration.

The 2008 ACC/AHA/HRS guidelines should remove confusing recommendations for Type II second-degree AV block. In the section on acquired AV block, the guidelines state

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**Representative Holter recordings from an asymptomatic patient with a type I block variant that was misdiagnosed as type II block by several physicians.**

A: Type I block with constant PR intervals before the blocked beat. Note that there is a slight increase in the sinus rate in the sequence before the blocked beat. However, the sinus rate then slows and the blocked P wave occurs in association with sinus slowing a combination consistent with a vagal phenomenon. The PR intervals after the blocked beat are inconstant. B: Type I variant simulating type II block. The PR intervals are constant before and after the blocked beat. However, there is obvious sinus slowing simultaneously with the nonconducted P wave. C: Type I block.

Note that in the presence of a narrow QRS complex, the occurrence of type I (with fairly large increments of the PR intervals) and what appears to be type II block basically rules out the presence of a true type II block.
“Permanent pacemaker implantation is reasonable for asymptomatic type II second-degree AV block with a narrow QRS as a Class IIa indication. When type II second-degree AV block occurs with a wide QRS, including isolated right bundle-branch block, pacing becomes a Class I recommendation.” There is no evidence that type II block with a narrow QRS has a better prognosis than type II block with a wide QRS. Thus, all type II blocks should receive a pacemaker regardless of symptoms.

The presence of type I second-degree AV block with a narrow QRS complex is almost invariably owing to a lesion in the A-V node, because type I in the His bundle is rare. In the case of type I block with a broad (0.12 sec) QRS complex, outside the setting of acute MI, the block may be AV nodal in 30% to 40% of patients, whereas in the His-Purkinje system in 60% to 70% of cases. Infranodal type I block carries the same prognostic significance as type II second-degree AV block: Both indicate severe disease of the His-Purkinje system, with a relatively poor prognosis. Any belief that an asymptomatic patient with type I second-degree AV block and bundle branch block deserves an electrophysiologic study to determine the site of block.

2:1 AV Block

Although 2:1 AV block can occur in either the AV node or the His-Purkinje system, this form of AV block cannot be classified into type I or type II, an important concept clearly emphasized in the 2008 ACC/AHA/HRS guidelines.

2:1 AV block is best considered advanced second-degree AV block, as are higher degrees of block such as 3:1, 4:1, and so on, according to the definitions promulgated by the WHO and ACC, although some experts recommend advanced AV block as an additional category (outside of type I, type II, and 2:1 AV block) in which multiple consecutive P waves are blocked but complete AV block is not present. Asymptomatic 2:1 AV block with bundle branch block does not automatically indicate infranodal block because the site of block is in the AV node in 15–20% of the cases and thus not necessarily a Class II indication for pacing.

Is the Diagnosis of Type II AV Block Possible Based on the PR Interval After Block of 2 or More Consecutive P Waves?

When all PR intervals remain constant before and after AV block of 2 or more consecutive impulses in the setting of a stable sinus rhythm, the purist will insist on calling this pattern type II AV block by citing the original description by Mobitz. Some workers still respect the original definition. According to the codified definitions such an observation should not be labeled type II AV block (but advanced second-degree block). The 2008 ACC/AHA/HRS guidelines classify this pattern as advanced second-degree AV block (Figure 5C). Admittedly, the constant PR intervals before and after the block strongly suggest infranodal block and the potential need for a pacemaker. When the first PR interval after the blocked P waves is not equal to previous P waves the block can be either in the AV node or the His-Purkinje system.

Problematic Definitions of Type II Block: Historical Aspects

In 1906 John Hay from Liverpool, England described a new form of second-degree AV block now considered type II second-degree AV block. In 1924 Mobitz, using the electrocardiograph, classified the well known Wenckebach form of
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Type I describes electrocardiographically visible varying and generally decremental AV conduction with large or small increments in conduction time and type II describes what appears all-or-none conduction without visible changes in AV conduction time as it appeared to Mobitz.

In 1955 Katz and Pick described type II block as a condition that develops “without warning, that is it occurs after a series of beats with a constant PR prolongation.” It is noteworthy that the required number of constant PR intervals before the blocked beat was missing from this statement. The Katz and Pick description of type II block created the still popular definition of type II block found in most textbooks as an “electrocardiographic pattern characterized by failure of a single impulse to conduct to the ventricles in the absence of antecedent lengthening of the PR interval (normal or prolonged).” This definition of type II block in fact also describes type I block when the terminal portion of a long atypical type I sequence exhibits PR intervals with no discernible or measurable change before the blocked impulse (Figure 7). Consequently by citing the Chicago definition of type II block, some workers have made the diagnosis of type II block with only 2 or 3 constant PR intervals before block of single P waves (and ignoring the first postblock PR interval). Further more the Chicago School allowed shortening of the postblock PR interval by 0.02 sec for the diagnosis of type II block (Figure 5).
Definitions of type II block with statements such as “all conducted PR intervals are constant or all the conducted P waves have constant PR intervals” also contain a loophole. They could be interpreted to mean that an absent or non-conducted P wave after the blocked impulse carries no diagnostic value and can be ignored by the very fact that it is nonconducted.

**Influence of Heart Rate on Diagnosis**

A modest increase or decrease in sinus rate permits the diagnosis of type I block. Classically, the sinus rate must be constant when PR intervals are measured to determine the presence of type II block. However block in the His-Purkinje system can be tachycardia-dependent so that the diagnosis of type II can be made in the setting of an increasing sinus rate.

The diagnosis of type II block has not been carefully studied during sinus arrhythmia. Type II block can be diagnosed when there is an increase in the sinus rate (and block occurs in the shorter cycle) because a vagal effect can be ruled on the basis of rate increase and provided there are no associated episodes of type I block. One should not diagnose type II block with a narrow QRS if the P-P interval lengthens before the block, even if the PR intervals are constant before and after the block. This situation is almost always a type I variant with AV nodal block.

**All Type II Blocks are Really Type I Blocks**

It has been shown that type II blocks are in effect type I blocks with increments in AV conduction so miniscule that they cannot be recorded or measured with standard equipment. Although type II block is an artifact of the standard electrocardiograph because it cannot record ultra-short changes in AV conduction, the resultant all-or-none pattern remains immensely useful to localize the site of block.

**Does Narrow QRS Type II AV Block Really Exist in Inferior Myocardial Infarction?**

The documentation of occasional intra- and infra-Hisian blocks in inferior myocardial infarction (MI) suggests that true type II second-degree AV block is theoretically possible in this situation. Despite claims by many authors that narrow QRS type II block can occur in acute inferior MI, there are no published electrocardiograms showing true Mobitz type II second-degree AV block during an inferior MI, even in patients exhibiting various infranodal conduction disturbances.

**Vagally-Mediated AV Block**

Vagally-mediated AV block occurs in the AV node (at the level of the AH interval) and is the-
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Therefore associated with a narrow QRS complex. It is generally benign and must be carefully differentiated from true type II block which indicates the presence of an irreversibly damaged His-Purkinje system that always requires a permanent pacemaker. In contrast, vagally mediated second-degree AV block rarely requires a permanent pacemaker.

Vagally mediated AV block is characteristically paroxysmal and often associated with sinus slowing. As a rule, AV nodal block shows obvious irregular PP intervals and is bradycardia-associated (not bradycardia-dependent), that is, both AV block and sinus slowing result from vagal effects. An acute increase in vagal tone may occasionally produce AV block without preceding prolongation of the AH interval (constant PR), giving the appearance of a type II AV block mechanism when there is no PR prolongation before the blocked beat. In this situation, AH prolongation may occur during the initial few beats when AV conduction resumes. Vagally induced AV block may be followed either by a shorter or longer PR interval or rarely by an unchanged PR interval (the latter mimicking type II second-degree AV block). An unchanged PR interval after the blocked P wave may be caused by a nonconducted P wave occurring fortuitously with an escape AV junctional beat so that the P–QRS relationship or PR interval is equal to that seen before the blocked P waves. Alternatively, a residual vagal effect on the AV node may prevent the expected PR shortening. These mechanisms simulate type II second-degree AV nodal block. The clue to the diagnosis of AV nodal block is the presence of sinus slowing no matter how slight, especially if the QRS complex is narrow. The diagnosis of type II can only be made with confidence if the same pattern type II occurs repeatedly without sinus slowing and in the absence of any sequences, suggesting type I second-degree AV block.

Conclusion

The correct diagnosis of second-degree AV block is basically an exercise in logic based on the clinical application of relatively simple definitions and knowledge of the various diagnostic pitfalls (Table 1). Many of problems related to the diagnosis of type II block are best understood by reviewing the historical aspects of second-degree AV block. Unfortunately many misconceptions about type II block continue to complicate the evaluation of second-degree AV block.

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<th>TABLE 1</th>
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<tr>
<td>Electrocardiographic pitfalls</td>
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<tr>
<td>· Nonconducted atrial premature beats masquerading as AV Block</td>
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<td>· What appears to be narrow QRS type II block may be a type I variant. Failure to suspect type I block in the presence of miniscule increments of the PR interval</td>
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<td>· Atypical type I sequence mistaken for type II block. This occurs most commonly when an atypical type I sequence displays a string of constant PR intervals in its terminal part before the block.</td>
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<td>· Failure to realize that type I and type II almost never occur in the same ECG or Holter recording. What appears to be type II is a type I sequence with tiny increments of AV conduction.</td>
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<td>· Making the diagnosis of type II block without seeing a truly conducted first postblock P wave (“shortage” of PR intervals)</td>
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<td>· Concealed His or ventricular extrasystoles causing pseudo-AV block. (Look for associated unexpected sudden PR prolongation, combination of what appears to be type I and type II and isolated retrograde P waves from retrograde conduction of the concealed extrasystole)</td>
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REFERENCES


