

EDITORIAL

Type I Wenckebach second-degree AV block: A matter of definition

KEYWORDS: Atrioventricular Block, Atypical Wenckebach Type I Second-Degree Atrioventricular Block, Cardiac Arrhythmia, Electrocardiography, Wenckebach Type I Second-Degree Atrioventricular Block

1 | INTRODUCTION

Type I block and type II second-degree atrioventricular (AV) block are electrocardiographic (ECG) patterns that refer to the behavior of the P-R intervals (in sinus rhythm) in sequences where a single P wave fails to conduct to the ventricles, provided there are ≥ 2 consecutive conducted P waves (ie, 3:2 AV block) to determine behavior of the P-R interval. This requirement rules out 2:1 AV block in the definition of type I and type II block. They are predicated on the absence of an escape QRS complex after the blocked impulse. The P-R interval after the blocked impulse is always the shortest in the sequence. Slowing or an increase of the sinus rate generally does not interfere with the diagnosis of type I block. The anatomic site of block should not be immediately characterized in terms of either type I or type II because the type I and II designations refer only to relatively simple ECG patterns.

2 | CLASSIC TYPE I SECOND-DEGREE AV BLOCK

Classic type I second-degree AV block is defined as the occurrence of a single nonconducted sinus P wave associated with progressive prolongation of the P-R intervals. The P-R interval after the blocked impulse is always the shortest in the sequence if the P wave is conducted to the ventricle.

The criteria for traditional type I second-degree AV block have not changed from Wenckebach's original observations.¹⁻³ Type I block is still commonly described in various publications, guidelines, and textbooks only in terms of the traditional form, where the mathematical behavior of the P-R intervals is emphasized, but the existence of atypical forms is ignored.⁴⁻⁹

Yet, many sequences of type I second-degree AV block are atypical and do not conform to the traditional mathematical behavior of the P-R intervals. The description of type I block solely in terms of the traditional or classic form has been untenable for many years. The 1978 World Health Organization document on the terminology of cardiac arrhythmias emphasized that most cases of type I block involve atypical varieties and promulgated a useful but generally

ignored definition of type I block in terms of "intermittent failure of impulse conduction in which the blocked impulse is preceded by prolongation of conduction time relative to the first conducted impulse."¹⁰ At a minimum, the term "progressive" pertaining to prolongation of the P-R interval in the traditional definition of type I block should be replaced by the word "variable" to describe the changing P-R intervals before a blocked impulse.¹¹

A definition of type I block involving the atypical forms can be formulated by examining the irregular sequential behavior of the P-R intervals.¹²⁻¹⁵ For example, the second P-R interval (after a blocked impulse) may not exhibit the largest increment (as in traditional type I block), and the increment of the last P-R interval (before the block) may sometimes be the largest. P-R intervals may stabilize and show no discernible change in the middle of a type I sequence or for several beats at the end of a sequence before the blocked beat.¹⁶ The P-R interval may actually shorten in the middle of a type I sequence. Less commonly, the P-R interval may shorten at the end of a sequence in the beat just before the blocked impulse. Such an arrangement may be puzzling to the uninitiated.^{12,17}

Changes in the sinus rate may influence the P-R interval. The duration of some of the R-R intervals may decrease or remain unchanged. The occurrence of longer R-R intervals may be linked to changes in the preceding P-P interval, vagal tone, and other factors.^{14,15}

3 | PROPOSED DEFINITIONS

We propose a more logical definition of type I second-degree AV block, as follows: The "classic" form is associated with progressive prolongation of the P-R intervals before the occurrence of a single nonconducted sinus P wave. The "common" or atypical form is characterized by block of a single P wave preceded by gradual but irregular P-R prolongation with occasional unpredictable changes anywhere within a conducted sequence manifested by disproportionate increments or decrements of the P-R intervals as well as periods of P-R stability. In both forms of type I block, the P-R interval after the blocked impulse always shortens if the P wave is conducted to the ventricle.

4 | INCIDENCE OF ATYPICAL TYPE I BLOCK

In 1975, Denes et al. studied the ECGs of 24 patients with type I block.¹² The majority of patients developed type I block secondary to acute diaphragmatic myocardial infarction or digitalis excess. There was no significant sinus arrhythmia. Of 98 forms of Wenckebach type I blocks, 86% were atypical and 14% were typical. Periods greater than 4:3 were all atypical.

Kinoshita and Konishi in 1978 reported their studies of 37 male athletes (age 16–36 years) with AV type I periodicity.¹⁴ The main sport was long-distance running. No athlete had organic heart disease or was receiving antiarrhythmic therapy. In only 1 of the 37 athletes, all Wenckebach periods showed a 3:2 AV conduction ratio. In the other 36 athletes, AV Wenckebach periods with AV conduction ratios greater than 3:2 were seen. In 34 of these 36 athletes, atypical Wenckebach periods were found; only 2 athletes did not have atypical periods. Typical Wenckebach periodicity was seen in 76 of 150 Wenckebach periods of 4:3 AV conduction ratio (50.7%), in 27 of 140 periods of 5:4 AV ratio (19.3%), and in only 4 of 200 periods of ratios greater than a 5:4 AV ratio (2.0%). According to the literature, typical sequences with ratios greater than 5:4 are virtually unknown.¹⁸

No further comparison has since been done. Many publications simply state that the atypical form of type I block is more common than the typical type. On the basis of our experience with Holter recordings for many years, we believe that atypical type I block occurs in 70% to 85% of cases of type I block.¹⁹

4.1 | Site of type I AV block

The presence of type I second-degree AV block with a narrow QRS complex is almost invariably owing to a lesion in the AV node, because type I in the His bundle is rare.²⁰ In the case of type I block with a broad (≥ 0.12 s) QRS complex, outside the setting of acute myocardial infarction, the block may be AV nodal in 30% to 40% of patients and in the His-Purkinje system in 60% to 70% of cases.²¹ 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.²²

4.2 | Increments of the P-R interval

Type I second-degree infranodal block is often associated with tiny but measurable increments of AV conduction, but this is not diagnostic because the increments of AV nodal conduction delay can also be minuscule. However, the presence of bundle branch block and relatively long Wenckebach cycles with tiny increments of the P-R intervals strongly suggests infra-Hisian block. Conversely, large increments in AV conduction strongly favor a site in the AV node, but large increments and atypical type I sequences can also occur with His-Purkinje disease.¹⁶ P-R increments in type I block may be variable in long-term Holter recordings to the point where tiny P-R increments mimic type II block. In this situation, the diagnosis of type I block is virtually certain when typical type I sequences with a

narrow QRS complex are seen in the recording, thereby ruling out the possibility of type II block.²⁰

4.3 | Vagally induced type I block

Vagally induced second-degree AV block is a variant of type I block. An acute increase in vagal tone may occasionally produce AV block without preceding prolongation of the P-R interval before the blocked beat, giving the superficial appearance of a type II AV block mechanism. A vagally induced nonconducted beat occasionally may be followed by an unchanged P-R interval (the latter mimicking type II second-degree AV block).²³ The above mechanisms simulate type II second-degree AV nodal block. The clue to the diagnosis of vagally induced 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 in the absence of sinus slowing. Even slight sinus slowing favors the diagnosis of vagally induced AV block.

4.4 | Plus ça change, plus c'est la même chose

Upshaw and Silverman² reported that in early observations, Wenckebach, using a preparation of the frog left atrium and left ventricle (based on his experience when he worked with Theodor Engelmann, a pioneer in the study of arrhythmias in frogs) was able to record type I sequences now considered atypical.^{24,25} In their Figure 3, representative of Wenckebach's original recording, it is clear that the largest increment in the last P-R interval occurred before the block. Furthermore, in their Figure 4, representative of Wenckebach's original recording, 6:5 type I block occurred in association with a stable duration of the last 2 P-R intervals before the block.²

4.5 | Caveats in the diagnosis of second-degree type I AV block

- Minuscule increments of the P-R interval may obscure the diagnosis of type I block.
- What appears to be a narrow QRS type II block may be a type I variant. Atypical type I sequences may be mistaken for type II block. This problem occurs most commonly when a type I sequence displays a string of constant P-R intervals immediately before a blocked impulse.
- Vagally induced type I AV block may be misdiagnosed by ignoring sinus rate slowing, which may be subtle. The diagnosis of vagally induced type I block may become problematic when the P-R interval following the block is not shorter and equal to the conducted P-R intervals. In such a case, sinus slowing is critical to the diagnosis.
- Most type I blocks with a wide QRS are infra-Hisian blocks.
- Type I and type II blocks almost never occur in the same ECG or Holter recording. What appears to be type II block in this setting with a narrow QRS complex is almost certainly a type I sequence with tiny increments of AV conduction.²⁶
- In an otherwise-healthy top-ranking athlete, second-degree AV block with block of a single sinus beat is always type I block and never type II, especially without bundle branch block.²⁷

Concealed extrasystoles refers to (AV junctional [His] and ventricular) extrasystoles causing pseudo-AV block with manifest variable AV block. These concealed extrasystoles are rare and may produce conduction patterns resembling type I block and/or type II block. The diagnosis is suggested by the combination of apparent type I and/or type II sequences in the setting of a wide QRS complex, as many cases occur in patients with His-Purkinje.^{28,29}

5 | CONCLUSION

Because the so-called atypical form is typical of type I block, it makes little sense to retain the term “atypical” because it is associated with the far commoner form of type I block. The term atypical should be discarded and replaced by more logical terms as described: “classic” and “common.” Our definition of type I block should improve the understanding of puzzling ECGs, promote teaching of the various manifestations of type I block, and avoid errors in diagnosis.

Conflicts of interest

The author declares no potential conflicts of interest.

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