Double A-V Nodal Rhythm: A-V Dissociation between Two A-V Nodal Pacemakers Complicated by Concealed A-V Nodal Capture and Ventricular Capture with Aberrant Ventricular Conduction

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Atrioventricular dissociation between two A-V nodal rhythms is a rare manifestation; only a few cases have hitherto been reported. The following is a further example of this unusual rhythm, which, in addition, was complicated by concealed A-V nodal captures and ventricular captures with aberrant ventricular conduction.

CASE REPORT

The electrocardiogram was recorded from a 72-year-old woman complaining of palpitations. She was on digitalis therapy. The electrocardiogram (Fig 1, a simultaneous recording of standard leads 1, 2, and 3) shows the following features:

1. A proximal "upper" A-V nodal rhythm. This is reflected by the P waves which are negative in standard leads 2 and 3, and almost equiphase (slightly positive) in standard lead 1. This represents a P wave axis of -85° which is characteristic of retrograde atrial activation by an impulse arising within, or conducted through, the A-V node. The P-P intervals measure 1.30 sec reflecting a rate of 46 beats per minute.

2. A distal—"lower"—A-V nodal rhythm. This is represented by the normal QRS complexes. The R-R intervals of the basic, uncomplicated rhythm ranged from 1.17 sec to 1.22 sec, reflecting a rate of 50 to 51 beats per minute.

3. A-V dissociation. There is no constant relationship between the P waves and the QRS complexes. The first P wave deforms the proximal S-T segment of the first beat simulating a broad S wave. The second P wave is superimposed upon the distal end of the second S-T segment. The third P wave is hidden within the third QRS complex. The fourth P wave is superimposed upon the S-T segment of the fourth QRS complex, and is related to the ensuing bizarre QRS complex. The fifth P wave is inscribed immediately before the fifth QRS complex. The sixth P wave is inscribed immediately after the sixth QRS complex (analogous to the first P wave).

![Electrocardiogram](https://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/20939/)

Figure 1. Electrocardiogram (simultaneous recordings of standard leads 1, 2 and 3) showing double A-V nodal rhythm with concealed A-V nodal capture and ventricular capture with aberration. N = Discharge of the distal A-V nodal pacemaker.

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4. Capture beats. a) The ventricular capture beat. The fifth beat (the bizarre QRS complex) is preceded by a P' wave at a P'-R interval of 0.53 sec. This was always evident whenever the bizarre QRS complex was observed, and it causes a causal relationship. This beat thus represents a conducted supraventricular beat, a ventricular capture beat, which is conducted with aberrant ventricular conduction, the aberration reflecting left bundle branch block with left anterior hemiblock (note the left axis deviation of the terminal QRS forces). The R-P' interval of the capturing impulse measures 0.17 sec. The capturing impulse during its passage through the distal A-V node reaches and discharges the distal A-V nodal pacemaker and thereby resets the A-V nodal cycle, which begins once again from the moment of its discharge. The R-R interval encompassing the capture beat measures 1.53 sec.

b) The concealed A-V nodal capture. The second R-R interval in the tracing is inordinately long and measures 1.51 sec. This long interval always occurred when the P' wave was inscribed at an R-P' interval of 0.20 sec from the preceding beat. This also reflects a causal relationship between the P' wave and the long pause. The phenomenon comes about as follows.

The proximal A-V nodal impulse is conducted into the lower or distal regions of the A-V node. It reaches and discharges—captures—the distal A-V nodal pacemaker, but is not conducted to the ventricles. The A-V nodal cycle is consequently reset. This results in a long R-R interval of 1.51 sec which is almost the same as the R-R interval embracing the ventricular capture beat which measures 1.53 sec. The A-V nodal capture is not manifest electrocardiographically, but is inferred from the ensuing long R-R interval. This is thus an example of concealed conduction which is inferred from subsequent disturbance of impulse formation—a resetting of the A-V nodal cycle.

DISCUSSION

A comparison of the temporal relationships associated with the ventricular capture beat, and those associated with the concealed A-V nodal capture, appears to reveal a paradox. The impulse affecting the concealed A-V nodal capture is relatively less premature (R-P' interval of 0.20 sec) than the impulse which affects the ventricular capture (R-P' interval of 0.17 sec). It could therefore be expected that the later impulse (that affecting the A-V nodal capture) should in fact be conducted to the ventricles since it should, theoretically, encounter conducting tissue whose state of recovery is better than that associated with the ventricular capture beat. The apparent paradox can, however, be explained. The impulse effecting the ventricular capture beat, because of its greater prematurity, is delayed in the proximal region of the A-V node, and consequently reaches the more distal region when it has recovered. The relatively later impulse which affects the concealed A-V nodal capture suffers no such delay in the proximal region of the A-V node. It is consequently conducted relatively quickly to the distal region of the A-V node and therefore encounters ventricular conducting tissue which is still completely refractory.

The manifestation of a proximal A-V nodal rhythm at a rate of 46 beats per minute (P' - P' interval of 1.30 sec) means that the potential sinus cycle must be longer than this. In other words, there must also be an associated sinus bradycardia which permits the A-V nodal rhythms to escape.

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REFERENCES

1 Luten D, Jensen J: Ventricular bigeminy (parasystole or reciprocal rhythm) in atrioventricular rhythm. Am Heart J 7:593, 1932
5 Sanghvi LM: Unusual cardiac arrhythmias in myocardial infarction. Am J Cardiol 8:147, 1961