Concealed Retrograde Conduction in Complete Atrioventricular Block

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SUMMARY
Atrio-ventricular (A-V) conduction and retrograde concealed conduction were assessed in 13 patients with complete heart block distal to the His bundle. Antegrade conduction was defined by His bundle study. The presence or absence of retrograde concealed conduction of the atrio-ventricular node was determined during ventricular pacing. Four instances of retrograde concealed conduction of the A-V node were observed.

Additional Indexing Words: Atrioventricular node His bundle

Incomplete transmission of impulses across the atrioventricular (A-V) junction has held a special fascination for many investigators. Variation in investigational techniques including venous pulse waves, standard electrocardiograms, and direct catheter electrode recordings from the cardiac chambers have been used to further the understanding of retrograde conduction of impulses into the A-V junction. In this report, His bundle study has permitted identification of retrograde concealed conduction of the A-V node in four of 13 patients with complete heart block distal to the His bundle.

Methods
Atrioventricular node conduction was studied in 13 patients with complete heart block who were referred for cardiac pacing. Catheter recordings of His bundle electrograms were performed by the method described by Scherlag et al. The intracavitary bipolar electrogram defined atrial excitation (A), His bundle excitation (H), and ventricular excitation (V). The A-H interval generally delineated A-V node conduction time, the normal range of which is 50 to 120 msec. Measurements were made from the onset of the A wave to the first clear deflection of the H wave. His bundle electrograms were validated by an increase in the A-H interval during either spontaneous or induced atrial premature beats.

Observations of retrograde concealed conduction were made during complete heart block when the right ventricle was being excited by another pacing catheter. The group studied consisted of eight men (average age, 74 years) and five women (average age, 79 years).

Results
Atrioventricular node conduction time was normal in eight patients with block distal to the His bundle and was prolonged (1° block of the A-V node) in the remaining five patients with distal block. His bundle study documented four instances of retrograde concealed conduction of the A-V node (figs. 1, 2) among the 13 patients.

Discussion
Langendorf noted in his initial description of concealed conduction that "the prolongation of the P-R interval after interpolated ventricular systoles is the most obvious example of this phenomenon." If the A-V node or junction is penetrated by the retrograde impulse of the premature systole, which does not then advance to the atria, the next atrial impulse of sinus origin may find the A-V node partially refractory because of the concealed retrograde conduction of the previous premature ventricular systole. The partially refractory state is evident from the transformation of the conduction velocity of the post extrasystolic beat to an abnormally prolonged duration as compared to atrioventricular conduction of control beats. His bundle studies by some investigators have attributed the post extrasystolic delay in P-R interval to prolonged A-V node conduction.

Retrograde concealed conduction of the A-V node in the presence of third degree block is impossible to recognize by standard electrocardiographic methods. Identification of altered A-V transmission (P-R interval) is not possible because of the absence of related R waves.
Figure 1

Retrograde concealed conduction of the A-V node. A-V block is present. Ventricular excitation (V) is under the influence of a ventricular pacemaker (E). The site of A-V block is below the bundle of His. A-V node conduction is defined by the A-H interval. As the E-A interval gradually shortens from 640 msec to 195 msec in four cycles, A-V node conduction time gradually lengthens from 66 msec to 200 msec before A-V node conduction is blocked. The progressive delay in orthograde conduction is the result of partial retrograde penetration of the A-V node by the preceding excitation which originated in the ventricle. The last E-A interval is too brief to permit adequate recovery of A-V node refractoriness in the area that had earlier been affected by partial penetration. Abbreviations: In this and other figures. II = standard ECG lead II. BE = Bipolar electrogram. A = Atria. H = His bundle.

Figure 2

Retrograde concealed conduction of the A-V node. A-V block is present. Ventricular excitation (V) is under the influence of a ventricular pacemaker (E). The site of A-V block is below the bundle of His. A-V node conduction is defined by the A-H interval. Top panel) As the E-A interval gradually shortens from 526 msec to 321 msec, A-V node conduction gradually lengthens from 132 msec to 197 msec before A-V node conduction is blocked. Bottom panel) As the E-A interval gradually shortens from 550 msec to 380 msec, A-V node conduction gradually increases from 130 msec to 170 msec. The ventricular pacemaker (E) fails to capture, permitting an unexpected additional increase in E-A interval to 1008 msec and a reversal of the progressive increase in A-V node conduction time to 125 msec.
waves. The His bundle electrogram, however, does define A-V node conduction time in those instances of third degree block distal to the His bundle. We have identified four examples of retrograde concealed conduction of the A-V node in the presence of third degree block distal to the His bundle. In each case, antegrade A-V node conduction time gradually increased as stimulated ventricular excitation preceded and approached atrial excitation. Eventually orthograde conduction block in the A-V node was identified by an absence of the His potential. We recognize in theory that the recording catheter may have moved from the area of the His bundle. However, in most studies, the characteristics of the atrial and His bundle waves did not significantly change even in the presence of very short ventricular pacemaker stimulus-P intervals (fig. 3). Incremental increases of A-H time until absence of the H wave could be interpreted as Wenckebach (Mobitz 1) block of the A-V node combined with third degree block distal to the His bundle.\(^\text{12}\) The proof of retrograde concealed conduction at the A-V node is shown by shortening, rather than prolongation, of the A-H interval which follows an ineffective pacemaker stimulus (fig. 2).

Gupta and Haft\(^\text{13}\) in this country and Peuch and Grolleau\(^\text{14}\) in France have reported one instance of retrograde concealed conduction of the A-V node in a similar setting. Our data confirms and firmly establishes this unusual phenomenon of retrograde concealed conduction of the A-V node in the presence of third degree block in the distal conducting system of man.

Figure 3


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