Normal H-V Time in a Patient with Right Bundle Branch Block, Left Anterior Hemiblock and Intermittent Complete Distal His Block*

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This report presents a patient who demonstrated right bundle branch block, left anterior hemiblock and intermittent complete block distal to the His bundle recording site. The H-V time for conducted beats was 45 msec and indicates that a normal H-V time may be present in a patient with complete block on other occasions.

Several investigators1-3 have recorded His bundle activity in patients with left axis deviation and right bundle branch block (RBBB), using the catheter method Scherlag et al described in 1969.4 According to the concepts of trifascicular conduction,5 conduction delay or block in the right bundle branch (RBB) and anterosuperior division of the left bundle branch (LBB) is responsible for this electrocardiographic manifestation and establishes the posteroinferior division of the left bundle branch as the major pathway leading to ventricular activation from the A-V node and His bundle. The anterosuperior division of the LBB and the RBB may contribute (to some degree) to ventricular activation, however. If the hemiblock concept is correct (the anatomic basis for which has been challenged recently),6 His to ventricle conduction time (H-V) in these patients represents primarily conduction through the posterior fascicle of the left bundle branch plus conduction through the His bundle distal to the recording site, and the mainstem left bundle. Narula and Samet2 reported 75 percent of 68 patients with RBBB and left anterior hemiblock (LAH) have prolonged H-V time, strongly suggesting that these patients have impaired conduction in the primary remaining pathway from His bundle to ventricle. The purpose of this report is to present a patient with RBBB and LAH who manifested intermittent complete heart block distal to the His bundle recording site, but who had a normal H-V time during conducted beats. Therefore, recording a normal H-V time on one occasion does not necessarily provide assurance of normal H-V conduction, and is somewhat analogous to finding a normal P-R interval in patients with intermittent type 2 A-V block.

CASE REPORT

An 85-year-old Caucasian man presented with complaints of nausea, generalized abdominal pain and constipation, but denied congestive heart failure symptoms, chest pain or syncope. Physical examination revealed a blood pressure of 200/40 in the right arm sitting, and a regular pulse rate of 36 beats/min. There was no jugular venous distension; bilateral carotid bruits were present. The chest was symmetrical and clear to both percussion and auscultation. The heart was not enlarged clinically. Chest x-ray examination revealed a normal cardiovascular configuration, with bilateral hilar and lung calcifications.

Admission electrocardiogram was interpreted as complete A-V dissociation due to advanced, possibly complete, A-V heart block, and a ventricular escape rhythm manifesting a QRS contour, with a right bundle branch block and left anterior hemiblock pattern.5 On the day of admission, a His bundle study was performed and a temporary transvenous pacemaker was inserted into the apex of the right ventricle. Although 1:1 A-V conduction returned at completion of the His study, a permanent Medtronic unipolar demand pacemaker Model 5943 was implanted on the third hospital day.
The proximal terminals of the catheter electrodes were connected to a switch box from which bipolar leads were obtained. His bundle tracings were recorded on an oscillographic photographic recorder (Electronics for Medicine DR8) between frequencies of 40 to 500 cps at a paper speed of 100 mm/sec. In addition, a standard ECG lead 1 was recorded simultaneously.

Atrial pacing was accomplished by passing a bipolar pacing catheter retrogradely in the right antecubital vein to the right atrium. Atrial to His conduction times (A-H) were measured from the earliest detectable atrial deflection recorded with the tripolar catheter to the beginning of the His deflection. H-V times were measured from the beginning of the His spike to the beginning of ventricular activity recorded by the His catheter or lead 1, whichever occurred earlier. Care was taken to assure that all equipment was adequately grounded.

We did not attempt His bundle pacing in this patient because of the large energy required to consistently pace by the catheter technique. A right bundle branch deflection interpreted as a His bundle deflection may give a falsely short H-V time. The large atrial and ventricular electrograms of almost equal amplitude and the constancy of the His recording and measured intervals, despite slight shifts in the position of the recording electrode catheter, suggest a catheter position more likely to record His than right bundle branch deflection.

**RESULTS**

A 12 lead scalar electrocardiogram recorded during intermittent heart block revealed a marked similarity between both the conducted and the escape QRS complexes (Fig 1). QRS contour remained virtually unchanged after return to 1:1 conduction (Fig 2). In addition, the vectorcardiogram recorded during 1:1 conduction was consistent with the electrocardiographic pattern of RBBB and LAH.

Figures 3 to 5 record His bundle activity during
various degrees of A-V heart block. Figure 3 shows the ECG during complete A-V block. Each atrial electrogram is followed by a His deflection at a constant A-H interval of 110 msec. Ventricular activity is completely independent of, and bears no relation to, atrial activity. No ventricular complex is preceded by a His spike. Therefore, the site of block is either in the His bundle distal to our recording site or in all branches of the ventricular conduction system simultaneously. During rapid atrial pacing Wenckebach block proximal to the His bundle recording was elicited (Fig 4).

Figure 5 depicts the rhythm after the development of 2:1 A-V conduction. A-H time is constant (110 msec) for both conducted and nonconducted beats. All atrial complexes which did not conduct to the ventricles are followed by His deflections indicating 2:1 block distal to the His recording site. The H-V time for the conducted beats is 45 msec and is considered within normal limits.\(^6,10\) Note that the contour of the conducted QRS complex in Figure 5 is identical to the escape QRS complex recorded in Figure 3. Shortly after this tracing was obtained and the procedure terminated, the patient developed 1:1 A-V conduction, with a P-R interval measuring 170 msec. The P-R interval of the conducted beats during the His study was also 170 msec.

DISCUSSION

The presence of complete or high degree atrioventricular block with normal or near normal H-V time has been noted previously. Narula et al\(^11\) reported a patient with type 2 second degree A-V block distal to the His bundle recording site and intermittent complete heart block. The ECG demonstrated left bundle branch block, and the H-V time for conducted beats was only slightly prolonged to 50 msec (normal 35-45 msec in their laboratory). The same group\(^12\) also reported a patient with RBBB, normal axis and high degrees of A-V block in whom conducted beats demonstrated normal H-V time. Rosen et al\(^13\) described a patient with diaphragmatic myocardial infarction who developed 2:1 A-V block distal to the initial His bundle recording site. After the catheter was advanced approximately 5 mm, P waves were no longer followed by a sharp His spike. They explained this finding by locating the site of block within the His bundle itself. The H-V time of conducted beats was 60 msec. They also reported a case of first degree A-V block in a patient with RBBB and left posterior hemiblock (LPH) who had H-V time of 80 msec. Atrial pacing at a rate of 150 produced 2:1 distal His block.\(^14\) It is important to note that none of the above mentioned cases demonstrated the pattern of combined LAH and

![Figure 3](image-url)  
Figure 3. His bundle electrogram (BHE) and lead 1 recorded simultaneously during complete heart block. Each atrial electrogram (A) is followed by His deflection (H) denoting block distal to His bundle recording site. His bundle deflection does not precede ventricular electrogram (V) and indicates that escape focus is distal to His bundle recording site. Atria and ventricles beat independently (A-V dissociation due to complete heart block). Time lines 200 msec.

![Figure 4](image-url)  
Figure 4. Rapid atrial pacing during complete heart block. Rapid atrial pacing progressively lengthens A-H interval until finally third atrial deflection blocks proximal to His bundle recording site (Wenckebach A-V block). Fourth P wave begins next Wenckebach cycle. P waves do not conduct to ventricle, indicating that two levels of block exist, one proximal (Wenckebach) and one distal (complete) to His bundle recording site. Wenckebach A-V block elicited at this pacing rate (107 beats/min) is normal phenomenon and does not indicate A-V node disease. Time lines 200 msec.
NORMAL H-V TIME

RBBB. A recent paper suggests that normal H-V times may be present in patients with a major lesion in the penetrating portion of the bundle of His or with bilateral bundle branch disease. Of those cases with the specific pattern of RBBB and LAH, Schuilenburg and Durrer reported a 75-year-old patient who experienced typical Stokes-Adams attacks. H-V time was 55 msec; however, block distal to the His recording site was not observed and complete A-V block could not be elicited. One patient in the series reported by Narula and Samet had an H-V time of 50 msec and exhibited transient 2:1 A-V block; however, all five patients who manifested either transient or chronic complete heart block had grossly prolonged H-V times. Berkowitz et al reported a patient with LAH and RBBB (H-V 55 msec) who demonstrated distal His block induced by atrial pacing. Subsequently, the patient developed complete heart block and required permanent pacing.

Ranganathan and associates reported five patients with RBBB and LAH who had normal H-V times, but had lightheaded episodes or syncope. Although a premature atrial complex blocked distal to the His bundle in one patient, type 2 or more advanced forms of A-V block were not demonstrated in these patients.

Therefore, we feel that our case is unique in that it reports advanced, probably complete heart block, improving to 2:1 atrioventricular block distal to His bundle recording site, in a patient who has RBBB and LAH, with an H-V time in the normal range for conducted beats. In addition, it is of great clinical importance that the patient subsequently manifested 1:1 A-V conduction and emphasizes that patients with this particular ECG pattern may manifest normal H-V times and still develop advanced heart block distal to His bundle recording site.

As noted earlier, the QRS complexes of both the conducted and escape beats are alike in our patient and demonstrate RBBB and LAH. If the block which produced the complete block were located in the bundle of His distal to our recording site, then a distal His escape focus could give rise to unaltered QRS complexes. Split His deflections reflecting intra-His block have been recorded in such instances. That we did not record an H and H' may be due to suboptimal electrode position, although that appears unlikely. However, it is possible that the number of cells present in the terminal portion of the His bundle are sufficient to act as a pacemaker but insufficient to generate a potential which can be recorded by extracellular methods. It is also conceivable that, with a combination of intra-His block, RBBB and LAH, the escape focus might arise in the right bundle branch or in the anterior division of the left bundle branch proximal to the site of bundle branch block (since the posterior division of the left bundle branch remains the major available route for ventricular activation) as well as in the upper portion of the posterior fascicle, and still give rise to a QRS contour similar to that which results from supraventricular conduction. One might expect a retrograde His deflection with a shortened H-V time to precede the escape beats in the situation. If conversion of bi-fascicular to tri-fascicular block produced the complete heart block (a likely possibility), then the escape focus would most probably be located in the posterior fascicle, just distal to the site of block, and retrograde His activation would not occur.

References

A Good Clinician Is a Good Observer

René Théophile Hyacinthe Laennec was born in Quimper, in Brittany, on February 17, 1781. In 1819 the first edition appeared of his famous work, *Traité de l’Auscultation Médiate*. He was the first to describe the subdeltoid bursa, the capsule of the liver, bronchiectasis, cirrhosis of the liver and emphysema. At a time when all physicians insisted that tuberculosis was a sequella of pneumonia or bronchitis, he insisted that it was a separate disease entity. These were great accomplishments. All grew out of his complete understanding of, and strict adherence to, the philosophy of science. He observed carefully and formed no theories and reached no conclusions which were not upon his observations. He preferred ignorance to unsubstantiated hypothesis. This philosophy was still rare and therefore still greatly needed.

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