A-V Block

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In 1969, Scherlag and co-workers reported the recording of His bundle electrogram (HBE) in man. Localization and classification of A-V block using HBE were proposed by many investigators. The use of HBE in conjunction with standard electrocardiographic leads may be of great value in the diagnosis, therapy and prognosis of disease of the cardiac conduction system in man. We have used this technique since 1971 in studying A-V block cases. Moreover, atrial pacing and pharmacological analysis with HBE in A-V block cases resulted in greater information. This paper presents and analysis and therapy of A-V block patients in our clinic for the past 5 years.

MATERIALS AND METHODS

Using HBE 61 patients were studied, and divided into the following groups: P(A)-H block, BH block, H-V block and mixed block according to the site of the A-V block. Moreover, these groups were further classified into subgroups of 1°, 2°, 3° block which, as usual indicate the degree of heart block.

Regarding the underlying disease, a large number of the older patients had arteriosclerotic heart disease, while idiopathic cardiomyopathy and primary heart block were the cases in younger patients. Ratio of male and female patients was almost equal.

Fig.1. A 71 yr. old female. Grade of block fluctuated between 1° to 3° A-V block with the same QRS morphology of C-LBBB. The record of HBE showed 2° P(A)-H block.

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TABLE 1  23 P(A)-H BLOCK PATIENTS EXAMINED BY THE HBE

<table>
<thead>
<tr>
<th>No. of cases</th>
<th>Sex</th>
<th>Dizziness</th>
<th>Syncope</th>
<th>Pacemaker implanted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1°</td>
<td>17</td>
<td>7</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>2°</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3°</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>10</td>
<td>13</td>
<td>8 (35%)</td>
</tr>
</tbody>
</table>

RESULTS

1. P(A)-H block

As shown in Table 1, in P(A)-H block, 17 cases of 1° block, 2 cases of 2° block, 4 cases of 3° block were investigated. In this group, dizziness developed in 8 cases (35%). Adams-Stokes (AS) syndrome occurred in 2 cases (9%) in which syncope followed after an attack of inferior myocardial infarction in one case, and in another, Wenckebach period in A-H was obtained and transient syncope occurred. One case was treated with temporary pacemaking after an operation for ECD. A permanent pacemaker was implanted in another case due to marked bradycardia (30/min). In this case, a 74-year-old female, as shown in Figure 1, the grade of A-H block was changing among 1°, 2°, and 3°, but always showed the same QRS morphology of the complete left bundle branch block (C-LBBB). The first row in Figure 1 showed 1° A-V block and the PQ interval was 0.23 sec. The HBE in the lowest row showed 3:1 A-V block and H deflection can not be found after the blocked A wave which indi-

Fig.2. Histology of A-V node with slightly impaired cells.

Fig. 3. Histology of proximal His bundle with markedly impaired cells.

Fig. 4. Histology of distal His bundle with moderately impaired cells.

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TABLE II  18 BH BLOCK PATIENTS EXAMINED BY THE HBE

<table>
<thead>
<tr>
<th>No. of cases</th>
<th>Sex</th>
<th>Dizziness</th>
<th>Syncope ē or ē convulsion</th>
<th>Pacemaker implanted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>1*</td>
<td>8</td>
<td>4</td>
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<td>5</td>
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<td>2*</td>
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<td>5</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>18</td>
<td>8</td>
<td>10</td>
<td><strong>13 (72%)</strong></td>
</tr>
</tbody>
</table>

TABLE III  12 H-V BLOCK AND 8 MIXED BLOCK PATIENTS EXAMINED BY THE HBE

<table>
<thead>
<tr>
<th>No. of cases</th>
<th>Sex</th>
<th>Dizziness</th>
<th>Syncope ē or ē convulsion</th>
<th>Pacemaker implanted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>1*</td>
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<td>2</td>
</tr>
<tr>
<td>3*</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12</td>
<td>5</td>
<td>7</td>
<td><strong>12 (10%)</strong></td>
</tr>
<tr>
<td>Mixed</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td><strong>6 (75%)</strong></td>
</tr>
</tbody>
</table>

cates the location of the block occurring between A and H. ECG usually showed 2° A-V block but rarely 1° or 3° A-V block, and AS syndrome never occurred. Although a trifascicular block might be considered in such cases as C-LBBB with 1° to 3° A-V block, the HBE revealed only A-H block in this case.

This patient died from pulmonary tuberculosis. Histological study of the conduction system revealed slightly impaired A-V node shown in Figure 2. The proximal His bundle in Figure 3 showed destruction of cells replaced by scar tissue. The distal his bundle in Figure 4, the cells of the conduction system again somewhat increased. These histological findings might help to explain the results of a HBE in which an A-H block has been recorded.

2. BH block

In this group, as illustrated in Table II, 8 cases of 1° block, 5 cases of 2° block and 5 cases of 3° block were investigated. In the subgroup of 1° BH block, cases of wide H deflection, split H deflection, and prolonged H-V intervals with normal QRS duration were included.

Characteristic feature of this group was that dizziness developed frequently and AS syndrome occurred equally in all subgroups (50%) but high in 3° block (80%); moreover, fainting, palpitation and decreased physical activity gradually progressed. Cases of permanent pacemaker implantation were distributed equally from 1° to 3° block and numbered 33 percent totally.

One patient was a 56-year-old male, whose ECG showed rate dependent complete-Right Bundle Branch Block (C-RBBB) and always normal PQ intervals. In such a case, it may be generally considered that the site of the block is either the right bundle or Purkinje fibre of the right bundle. As shown in Figure 5, as RA pacing at the rate of 113 per minute started, a normal QRS and a C-RBBB pattern appeared alternately. The H deflection was present in front of normal QRS with a normal H-V interval of 41 msec and could not be found in wide QRS.

As indicated on the right panel of Figure 5, when the rate of RA pacing increased to 137 per minute, the C-RBBB pattern alone was recorded with the minimum H deflection in front of the
wide QRS and the HV interval was prolonged to 56 msec. From these phenomena, it is understood that the catheter missed catching the H deflection because of inappropriate location of the electrodes under the circumstance of RA pacing at the rate of 113. Prolonged HV interval, slightly prolonged H duration and different morphology of the H wave in C-RBBB may indicate cell destruction of the His bundle. In this case latent BH block was disclosed by the RA pacing. Meanwhile, simultaneous occurrence of prolonged H-V interval, varied H deflection and C-RBBB pattern may be explained by the longitudinal dissociation at the level of A-V junction.

The next case is a 16-year-old male with frequent atrial premature beats. RA pacing coupled with A wave occasionally caused a BH block of the H-H' type as shown in the second beat in the left panel of Figure 6. In the right panel of Figure 6, the first premature atrial stimulation with the shorter coupling interval than the left panel caused a H-H' block with changes in morphology and voltage of H and QRS configuration. The second premature atrial stimulation with the progressively shorter coupling in the right panel induced C-RBBB pattern with only a H deflection and a prolonged H-V interval.

It is considered that a longitudinal dissociation might have developed in the A-V junction and His bundle, as has been noted in the conduction system of animals. Firstly, incomplete and finally complete block was developed in components of the right bundle at the level of the A-V junction; as the result a H-H' block and a H deflection with wide QRS of C-RBBB pattern appeared in proportion to coupling intervals.

3. H-V block

In H-V block as illustrated in Table III, the total number of patient was 12. Two cases of 1° block, 2 cases of 2° block and 8 cases of 3° block were included. In this group, the cases of prolonged H-V interval with a wide QRS are classified in the 1° block. Nine cases had episodes of AS syndrome (75%). In 3° block, two cases had not developed AS syndrome but only experienced dizziness. In this group, all cases were implanted with permanent pacemakers with favourable results.

There were 8 patients of mixed block. In this group, 3 patients that revealed H-V block by HBE were implanted the permanent pacemakers.

**DISCUSSION**

In P(A)-H block, AS syndrome was rarely developed and permanent pacemaker implantation was not indicated for prevention of AS syndrome even in 3° P(A)-H block cases.

The histological findings of one case who died from pulmonary tuberculosis showed the cell destruction of proximal His bundle which was well coincident with the results of HBE.

The BH block patients had experienced frequent occurrence of SA syndrome (50%) and
permanent pacemaker implantation was needed to some patients (33%).

Regarding the anatomy of His bundle\textsuperscript{7,8} it is most common to find Purkinje fibres arranged in a longitudinally partitioned strand and thus the longitudinal dissociation theory was recently proposed especially in the impaired A-V junction and His bundle.

We presented two cases of A-V block, showing split H block, H-V prolongation and varied H and QRS configuration in proportion to the coupling intervals in premature RA stimulation. There may be many explanations of these phenomena. It is not reasonable to consider that refractory period in the His bundle only related to these phenomena, because always changing QRS pattern appeared at the same time. We prefer to explain them by the longitudinal dissociation at the junctional level, as suggested by Sherf and James\textsuperscript{9} in clinical cases.

In H-V block group, all patients were needed to implant the permanent pacemaker unrelated to the history of AS syndrome.

H-V block indicates the presence of a block between the distal His bundle and Purkinje fibre, and it is preferable to record the potentials of left and right bundle simultaneously\textsuperscript{3,10} if we want to find a more exact site of block, which is considerably difficult in practise with HBE. Because of the occasional presence of QRS morphology in 3\textdegree{} H-V block resembling that in the conducted beats, it was considered that moderate number of patients with 3\textdegree{} H-V block might have disturbances in the distal His portion and/or the bifurcation region.

**Summary**

In this report, 61 A-V block patients were analysed using HBE. According to the site of the block, these cases were classified into P(A)-H block, BH block H-V block and mixed block.

In P(A) H block group (23 cases), the permanent pacemaker implantation was not needed except for one patient with persistent heart failure due to marked bradycardia. Postmortem histology of this patient was well coincident to the results of HBE.

In BH block group (18 cases), moderate number of patients were needed to have permanent pacemakers implanted (33%). RA pacing induced split H block with H-V prolongation and varied H and QRS configuration in two cases of this group. These phenomena may be well explained by the longitudinal dissociation theory.

In H-V block patients, permanent pacemakers were implanted in all patients (12 cases). In this group, it is difficult to decide the exact location of block, either distal His, bifurcation or bundles, because of the difficulty to record the left or right bundle potentials in clinical practise.

Finally, it is important to record the HBE in order to decide the exact site of block, and to choose the suitable therapy for A-V block patients.

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REFERENCES


