The Dissection of the Atrioventricular Node, Bundle and Bundle Branches in the Human Heart

By Jerrold Widran, M.D., and Maurice Lev, M.D.

The A-V node, bundle and bundle branches were grossly dissected in 41 human hearts. The method for this dissection is described. Given also are the sizes of the individual structures with advancing age. These structures grow more slowly than the remainder of the myocardium.

The dissectability of the A-V node, bundle, and bundle branches in the human heart has been questioned. Retzer1 originally performed the dissection, which was confirmed by Tawara,2 Keith and Flack,3 Curran,4 Walls,5 and Kistin.6 On the other hand, Holmes7 and Mahaim8 doubted its dissectability, and Glomset and Glomset's9 and Glomset and Birge's10 description of the gross dissection varied from that of other authors.

Accordingly, we undertook to dissect these structures in man and to study their gross morphology in various age groups.

Material and Method of Dissection

Forty-one formalin-fixed hearts of various ages, exhibiting no evidence of pathologic change, were dissected as indicated in the accompanying table 1, by the following method of dissection:

The pars membranacea is first inspected as to its anatomy. The pars membranacea normally consists of two parts: (1) an atrioventricular part, between the right atrium and left ventricle, and (2) an interventricular part. The relative sizes of these two parts varies markedly. The pars membranacea is roughly triangular, with proximal, distal and superior angles. At the proximal angle the central fibrous body is palpated. The coronary sinus, limbus, eustachian valve, medial tricuspid leaflet, septal band of the crista supraventricularis, muscle bundle of Lancisi, and moderator band are identified (fig. 1A).

The chordae tendineae of the medial part of the anterior tricuspid leaflet are now cut and these portions of leaflet detached at their ring base and from the pars membranacea and central fibrous body (fig. 1B). The atrial endocardium is removed from the region bounded by the eustachian valve, the coronary sinus, and the denuded valve ring attachment. This reveals a thin sheet of muscle coursing obliquely or at right angles to the base of the tricuspid valve. After cutting, the A-V node becomes evident, embedded in a varying amount of fat in the adult (not present in the child). Fat tissue posterior to this area is removed, revealing the ramos septi fibrosi coursing from its origin in the right (occasionally the left) coronary artery to enter the region of the node (fig. 2E).

The right layer of the posterior aspect of the pars membranacea (near its junction with the muscular septum) is now removed. This reveals the branching portion of the A-V bundle (fig. 2C). The posterior end of this bundle is followed into the central fibrous body, the right aspect of which is removed with a sharp scalpel. Continuity between the A-V node and bundle is thus established (fig. 2D).

The A-V bundle is then traced into the right branch at the distal angle of the pars membranacea (fig. 2D). This branch follows a course along the inferior aspect of the septal band, between the conus and sinus of the right ventricle. Its first portion is usually subendocardial, or relatively superficial, up to the level of the muscle of Lancisi. It then dips into the myocardium, becoming superficial only at its distal third, where it terminates at the moderator band. Occasionally it is intramyocardial in its first two-thirds, and occasionally it is subendocardial throughout its extent.

The pars membranacea and all tissue anterior to it are now removed so that one is able to see both sides of the ventricular septum from the vantage point of the A-V bundle (fig. 2E). The endocardium is then painstakingly separated from the left aspect of the ventricular septum, revealing the fasciculi of the left branch (fig. 2E and F). This is possible only for about one-third of the way to the apex.

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Table 1.—Number of Dissections in Various Age Groups and Size of A-V Node, Bundle, and Bundle Branches

<table>
<thead>
<tr>
<th>Age</th>
<th>0-1</th>
<th>1-15</th>
<th>15-40</th>
<th>40-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Dissections</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Length of A-V Node</td>
<td>2-4 mm.</td>
<td>3-5 mm.</td>
<td>5-7 mm.</td>
<td>5-7 mm.</td>
</tr>
<tr>
<td>Width of A-V Node</td>
<td>1-4 mm.</td>
<td>2-5 mm.</td>
<td>2-5 mm.</td>
<td>3-5 mm.</td>
</tr>
<tr>
<td>Width of A-V Bundle (Penetrating)</td>
<td>1-1.5 mm.</td>
<td>0.5-2.5 mm.</td>
<td>0.5-2.5 mm.</td>
<td>1-2.5 mm.</td>
</tr>
<tr>
<td>Width of A-V Bundle (Branching)</td>
<td>1-2 mm.</td>
<td>1-2.5 mm.</td>
<td>1-3 mm.</td>
<td>1-3 mm.</td>
</tr>
</tbody>
</table>

**Fig. 1.** Method of dissection of the A-V node, bundle and bundle branches. A. View of the right side of the heart before dissection. B. The node dissected.

**Dissectability and Gross Morphology**

The accompanying table 2 indicates the degree of success in dissecting the various structures by the above method. It will be noted that the right branch cannot be followed down to the moderator band in some cases because of the identical appearance of the structure with the surrounding muscle. In a few cases this similarity is so marked that the right branch is lost immediately. The lower half of the left branch is dissected with difficulty in all cases, due to the fineness of its fasciculi and its intimacy with the endocardium.

The general location of all structures is as indicated by previous authors. The A-V node is situated on the atrial side of the base of the medial tricuspid leaflet, above the level of the coronary sinus and between the limbus fossa ovalis and the tricuspid valve (fig. 3). It proceeds into the bundle of His, which consists of
two parts; a penetrating and a branching part. The penetrating portion passes through the central fibrous body to reach the pars membranacea. Here the branching portion may be situated either directly above the muscular ventricular septum or on the upper part of the left or right side of the septum, in diminishing order of occurrence. Numerous fasciculi of the left are given off in two radiations—first posterior and then anterior—each going to the vicinity of the corresponding papillary muscle.

The average size of the various structures in the various age groups is indicated in table 1. It will be noted that the structures are relatively larger in the young than in the old. This would indicate that their relative growth in postnatal life is less than the atrial and ven-

Table 2.—Dissectability of the A-V Node, Bundle, and Bundle Branches

<table>
<thead>
<tr>
<th>Structures</th>
<th>Dissectability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node</td>
<td>100%</td>
</tr>
<tr>
<td>Bundle</td>
<td>100%</td>
</tr>
<tr>
<td>Right Branch</td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>65%</td>
</tr>
<tr>
<td>Partial</td>
<td>30%</td>
</tr>
<tr>
<td>Not dissectable</td>
<td>5%</td>
</tr>
<tr>
<td>Left Branch</td>
<td></td>
</tr>
<tr>
<td>Partial</td>
<td>100%</td>
</tr>
<tr>
<td>Complete</td>
<td>0%</td>
</tr>
</tbody>
</table>

tricular musculature. This confirms the statements of Tawara, Keith and Flack, and Mönckeberg.11

The node and the penetrating portion of the bundle are distinctly paler than the atrial and ventricular musculature. This is less true of the branching portion of the bundle and the left branch. The color of the right branch is the same as that of the surrounding myocardium. In addition, the node has a very typical reticulated structure.

SUMMARY

1. The human A-V node, bundle, and bundle branches are grossly dissectable.
2. A method for such dissection is described.
3. With advancing age, these structures grow more slowly than the atria and ventricles.

ACKNOWLEDGMENT

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REFERENCES


FIG. 3A. Dissection of the A-V node, bundle and right branch in adult. B. Same in child. C. The right branch seen in relation to the muscle of Lancei. D. View of the bundle from above, showing left fasciculi. E. View of the bundle from the left ventricular aspect of septum, showing left fasciculi. (1) Ramus septi fibrosi. (2) Node. (3) Bundle, penetrating portion. (4) Bundle, branching portion. (5) Right bundle branch. (6) Left bundle branch.
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