Rheumatic “Activity” as Judged by the Presence of Aschoff Bodies in Auricular Appendages of Patients with Mitral Stenosis

I. Anatomic Aspects

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Left auricular appendages from 183 patients, removed at operation for mitral stenosis, have been studied with regard to presence of Aschoff bodies and endocardial thrombi. An over-all incidence of Aschoff lesions of 40 per cent was found. There was a significant decrease in Aschoff lesions in the presence of thrombosis. The occurrence of Aschoff bodies in the appendages is correlated with the findings in the remainder of the heart in autopsied cases.

The development of methods for the surgical correction of rheumatic deformities of the mitral valve has afforded an opportunity for the examination of the left auricular appendage which is removed at the time of operation. It is thus possible to study cardiac tissue in living patients and to correlate simultaneously clinical and pathologic observations.

The microscopic anatomy of the auricle has been described by Gross. The auricular appendage is similar to the auricle, differing chiefly in that the appendage has a thinner wall and presents many irregular pockets and trabeculations. Rheumatic endocarditis involving the mural endocardium of the left auricle is a well-recognized entity, but Aschoff lesions in the auricular appendage have not been described except in connection with studies similar to the present one, although Von Glahn stated that superficial auriculitis which is responsible for the development of the MacCallum patch may extend into the first portion of the appendage.

Others have reported the pathologic findings in auricular appendages removed at the time of surgical intervention for the correction of mitral stenosis of rheumatic origin. Pinniger noted the presence of Aschoff nodules in 10 of 15 left auricular specimens. Kuschnar, Ferrer, Harvey and Wylie report finding Aschoff bodies in 4 of 11 auricular appendages. Biörek, Winblad and Wulff found Aschoff lesions in 7 of 18 specimens. Sabiston and Follis noted the presence of Aschoff bodies within the endocardium or myocardium of the auricular appendage in 32 of 43 cases.

The Aschoff lesion is generally regarded as the most characteristic finding of rheumatic inflammation in the heart, affording a useful criterion, when properly characterized morphologically, for the microscopic recognition of rheumatic inflammation. The specificity of the lesion has been questioned, but most authors agree that the lesion is a specific one indicative of activity of the rheumatic process. It has, therefore, been selected as the sole cri-
terion for the evaluation of rheumatic activity in the present study. The morphology of the Aschoff body has been well described by Gross and Ehrlich and, in general, their criteria for its identification have been followed in this study. Briefly, it is characterized by evidences of disorganization in the fibrous tissue in which it occurs, the collagenous fibers showing swelling, eosinophilia, granular degeneration or necrosis. The degenerative change is accompanied by a rather special sort of inflammatory infiltrate in which large, irregular cells with ragged edges, basophilic cytoplasm and one or more vesicular nuclei with "owl-eyed" nucleoli are present. In addition, various other less characteristic inflammatory cells may be present, for instance, lymphocytes, plasma cells and histiocytes.

Only lesions presenting these features have been identified as Aschoff bodies in this study, except that a few minimal lesions possessing some, but not all, of the features described have been included. The basic alteration occurring in the Aschoff lesion has long been thought to occur in the collagenous fibers. The Aschoff or "owl-eyed" cell usually has been considered a tissue histiocyte of a sort peculiar to cardiac tissues. Recently, however, it has been suggested that some, at least, of the myocardial Aschoff bodies may have their origin in a primary injury to cardiac muscle fibers and that the giant cells are derived from the damaged muscle cells.

Up to July 1, 1952, 223 left auricular appendages had been examined in the pathologic laboratories at the Boston City Hospital and the Peter Bent Brigham Hospital. After careful clinical appraisal, none of the patients from whom the specimens were taken was thought to have active rheumatic carditis at the time of operation. The histologic findings are presented in 183 appendages. Forty specimens have been excluded from the study for the following reasons: seven were excluded because the amount of tissue available for examination was considered inadequate for proper evaluation, 10 because the lesions found were equivocal and no agreement could be reached regarding their significance, and 23 more were rejected because clinical data were either not readily available or inadequate for proper appraisal of clinical activity. The 183 auricular appendages were studied for the presence of Aschoff bodies. The appendages were also studied for the presence of fresh or organized endocardial thrombi and the presence of thrombosis correlated with occurrence of Aschoff bodies.

Twenty-two patients came to autopsy at the Boston City and Peter Bent Brigham Hospitals. The sections of the hearts in these cases have been reviewed and the presence or absence of Aschoff lesions correlated with the findings in the auricular appendages. An additional series of 11 rheumatic hearts in the general autopsy material at the Boston City Hospital was also studied with particular reference to the correlation of rheumatic activity in the left auricular appendage and in the remainder of the heart.

Occurrence of Aschoff Lesions

An approximation of the frequency with which Aschoff bodies were encountered in the appendages has been indicated by a system of grading. Specimens graded as showing 1 plus activity were those in which only one or two recognizable Aschoff lesions were seen (fig. 1). The appendages showing the largest numbers of Aschoff bodies, sometimes as many as 10 or 12 in a single low-power field, were graded 3 plus (fig. 2). Specimens showing intermediate degrees of activity were graded 2 plus.

The Aschoff lesions seen in this study were located within the endocardium or, more commonly, in the loose-structured subendocardium (fig. 3). No lesions were seen which could be interpreted as properly myocardial in location. The auricular appendage presents such a convoluted pattern that lesions which are separated from the main cavity of the appendage may still be related to an isolated pocket of endocardium. The lesions seen in the subendocardial tissues correspond mostly to the reticular and mosaic forms described by Gross and Ehrlich (fig. 4). Those occurring in dense fibrous tissue often appeared compressed. Some

* Eight of the 23 rejected cases showed Aschoff bodies, an incidence comparable to that in the remainder of the series.
Fig. 1. One of two endocardial Aschoff lesions in the auricular appendage of autopsied case 2. Note the double nucleated cell. One plus activity.

Fig. 2. Thirteen subendocardial Aschoff lesions in a low-power view. Three plus activity.
lesions of this sort show an alignment of Aschoff cells along swollen collagenous bundles suggestive of the auriculitis seen in the left auricle (fig. 5). Other features seen include both diffuse and focal endocardial fibrosis, a finding also noted by others who have examined similar material. Focal lymphocytic collections were frequently present in the endocardium, myocardium and epicardium. Their relation to Rheumatic disease is not clear. It seemed that they were frequently associated with endocardial thrombosis.

Aschoff bodies were found in 83 of the 183 auricular appendages, a total incidence of 45.3 per cent (table 1). Despite the fact that the biopsies from the two hospitals were interpreted by different observers, except for the doubtful cases which were seen by all, it is interesting that there is close agreement in the results reported from the two sources, the incidence of
Aschoff lesions being 43.9 per cent in the specimens from the Boston City Hospital and 43.8 per cent in the larger series at the Peter Bent Brigham Hospital. Two and 3 plus activity have been separated from 1 plus or minimal activity, as the higher grades of activity may have a somewhat greater significance as will be pointed out in connection with the autopsied cases. Twelve of the 41 appendages from the Boston City Hospital showed considerable endocardial fibrosis. One of these showed Aschoff lesions.

The incidence of rheumatic activity in the auricular appendages in the present study conforms generally to the published observations of Pinniger, of Kuschner, Ferrer, Harvey and Wylie and of Biörck, Winblad and Wolff. The incidence of Aschoff lesions in similar material reported by Sabiston and Follis is considerably higher, 32 of 43 specimens.

The high incidence of Aschoff lesions in the present study, 45.3 per cent of 183 auricular specimens, does not differ greatly from the incidence of Aschoff bodies noted in various series of autopsied cases of rheumatic heart disease. Rothschild, Kugel and Gross report the finding of Aschoff bodies in 95 of 161 autopsied cases of rheumatic heart disease. Other evidences of rheumatic activity, such as pericarditis, acute myocarditis and auricularitis, were found in an additional 11 of their cases. The high incidence of activity reported by these authors was in material which had been examined by the standardized method of Gross, Antopol and Sacks by which no less than six sections, representative of the most likely sites for rheumatic activity, are examined. Wartman and Hellerstein noted activity in 34 of 120 cases. Claiborne and Wolff collected 62 cases of rheumatic heart disease from autopsy records and found Aschoff bodies in 22 of them. The frequency with which Aschoff lesions are found in the heart depends upon the amount of cardiac tissue examined and also upon the age composition of the group being studied, a higher incidence occurring in younger persons. This relationship of rheumatic activity to age also obtains in the present study as is pointed out elsewhere.

### Table 1.—Aschoff Bodies in Auricular Appendages

<table>
<thead>
<tr>
<th>No. of appendages</th>
<th>Boston City Hospital</th>
<th>Peter Bent Brigham Hospital</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rejected</td>
<td>3</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Doubtful lesions</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>No. studied</td>
<td>41</td>
<td>142</td>
<td>183</td>
</tr>
<tr>
<td>Aschoff bodies present</td>
<td>18 43.8%</td>
<td>65 45.8%</td>
<td>83 45.4%</td>
</tr>
<tr>
<td>1 plus</td>
<td>3 7.3</td>
<td>25 17.6</td>
<td>28 15.3</td>
</tr>
<tr>
<td>2 plus</td>
<td>6 14.6</td>
<td>28 19.7</td>
<td>34 18.6</td>
</tr>
<tr>
<td>3 plus</td>
<td>9 21.9</td>
<td>12 8.5</td>
<td>21 11.5</td>
</tr>
<tr>
<td>Total 2 and 3 plus</td>
<td>15 36.5</td>
<td>39 28.2</td>
<td>54 30.1</td>
</tr>
</tbody>
</table>

### Auricular Thrombosis

One hundred seventy-two auricular appendages have been studied for the presence of fresh or organized endocardial thrombi, 41 from the Boston City Hospital and 131 from the Peter Bent Brigham Hospital. Fresh thrombi were infrequent and presented as small laminated masses of fibrin containing entrapped erythrocytes and leukocytes, the latter often showing nuclear disintegration. More frequent were organized thrombi which were identified by the presence of vascularized tufts of fibrous tissue usually showing hemosiderin pigmentation. Adjacent to many of these areas of organization, particularly the more cellular ones, could be found focal collections of lymphocytes and plasma cells. These were not regarded as evidence of rheumatic activity, but rather as a nonspecific inflammatory infiltrate accompany-
ing the reparative process. Seventy-one of the 172 specimens studied showed evidence of fresh or organized endocardial thrombosis (table 2), an incidence of 41.3 per cent. Only seven of the specimens showing auricular thrombosis also presented Aschoff lesions, an incidence of 4.1 per cent, which is significantly lower than the over-all incidence of Aschoff lesions in the entire series.

The finding of a decreased incidence of rheumatic activity in the presence of auricular thrombosis has previously been reported. Weiss and Davis\textsuperscript{19} found auricular thrombosis in 28 of 164 cases of rheumatic heart disease in which the disease was directly responsible for death. Among the 28 cases showing auricular thrombosis, rheumatic activity was noted in five and suggested in another. The activity in the cases showing thrombosis was 18 per cent as contrasted with an over-all incidence of activity of 47 per cent in the entire series. Weiss and Davis

Table 2.—Incidence of Thrombosis in Auricular Appendages

<table>
<thead>
<tr>
<th></th>
<th>Boston City Hospital</th>
<th>Peter Bent Brigham Hospital</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of appendages</td>
<td>41</td>
<td>131</td>
<td>172</td>
</tr>
<tr>
<td>Thrombosis present</td>
<td>14 (34.1%)</td>
<td>57 (43.5%)</td>
<td>71 (41.3%)</td>
</tr>
<tr>
<td>Thrombosis with Aschoff bodies</td>
<td>1 (7.1%)</td>
<td>6 (4.6%)</td>
<td>7 (4.1%)</td>
</tr>
</tbody>
</table>

also point out that auricular fibrillation had been present in 22 of 25 cases showing thrombosis in which the rhythm was known. Börck, Winblad and Wulff\textsuperscript{7} point out, in connection with their study of auricular appendages, that Aschoff bodies were infrequent in the specimens showing thrombosis. Söderström\textsuperscript{20} also, in studying auricular mural thrombosis, noted that rheumatic granulomas are rare in cases with auricular thrombosis. Graef, Berger, Bunim and de la Chapelle\textsuperscript{21} studied 24 cases of rheumatic heart disease showing auricular thrombosis and noted a history of auricular fibrillation in 14 of these and other arrhythmias in two other cases. Microscopic findings interpreted as indicative of rheumatic activity were noted in 14 of their 24 cases, a much higher incidence than that noted in the present study or in that of Weiss and Davis. The specific lesions noted were a superficial auricular endocarditis in one case and collections of lymphocytes, histiocytes and basophilic mono-

nuclear cells with occasional swelling of collagen fibers in the other cases. No Aschoff bodies were seen. The frequent occurrences of nonspecific inflammatory changes in areas involved by endocardial thrombosis makes these findings difficult to interpret. De la Chapelle, Graef and Rottino\textsuperscript{22} studied 92 rheumatic hearts in detail according to the method of Gross, Antopol and Sacks\textsuperscript{18} and came to the conclusion that auricular thrombosis in rheumatic heart disease was encountered most frequently in the hearts of individuals with auricular fibrillation, severe mitral stenosis and active rheumatic inflammation. The differences between these observations and those of Börck, Winblad and Wulff, Weiss and Davis,\textsuperscript{19} Söderström\textsuperscript{20} and of the present study are possibly related to the nature of the material studied and the number of sections taken. In a study of auricular thrombosis in hearts showing mitral stenosis, McGoon and Henly\textsuperscript{23} found little difference in the activity of rheumatic lesions in the hearts, as determined by microscopic study, whether associated with auricular thrombosis or not. In studying auricular appendages removed at the time of surgical intervention for the correction of mitral stenosis, Sabiston and Follis\textsuperscript{8} noted the presence of auricular thrombosis in 13 of 43 auricular specimens. Nine of the specimens showing thrombosis also showed Aschoff lesions.

The only common factor associated with auricular thrombosis by various authors\textsuperscript{19-21, 23-28} is the presence of auricular fibrillation in the majority of cases, and it is generally agreed that there are no characteristic histologic changes associated with this state.\textsuperscript{4, 25, 29} The present series is studied with reference to the presence of auricular fibrillation elsewhere.\textsuperscript{14}

**Autopsied Cases**

Autopsies were performed on 21 patients whose auricular appendages are included in this series. An additional patient is included
who died after the termination of the auricular biopsy series. Eight of the autopsies were performed at the Boston City Hospital and 14 at the Peter Bent Brigham Hospital. The number of autopsies at the former hospital is swelled by the presence of five cases from 1950 when the surgical technic for the correction of mitral stenosis was not well developed and the criteria for operability not well defined. Survival time after operation was 11 days or less in 21 of the 22 cases. One patient came to autopsy 16 months after operation. Aschoff lesions were present, either in the auricular appendage or in the remainder of the heart at autopsy, in 6 of these 22 autopsied patients (table 3). Five patients among the 22 showed Aschoff lesions in the auricular appendage, and five also showed Aschoff lesions in the remainder of the heart at autopsy. It may be noted, however, that the two groups do not coincide. Patient 2 showed minimal evidence of rheumatic activity in the auricular appendage (fig. 1) but failed to show recognizable activity in the remainder of the heart at autopsy seven days after operation. Patient 5 showed minimal activity in the left ventricular myocardium at autopsy, whereas no recognizable Aschoff body had been present in the original specimen of the auricular appendage. The three patients who evidenced activity graded 2 plus and 3 plus in the appendages did not fail to show Aschoff lesions in the heart at autopsy (figs. 5 and 6). Patient 4, whose auricular appendage was graded as showing activity of 2 plus degree, showed at autopsy 16 months later the most extensive rheumatic carditis noted in any case studied. Aschoff bodies were noted in 7 of 20 sections prepared from the heart. The lesions were chiefly in the left ventricular myocardium, as is true of the other cases showing active lesions at autopsy as well, but occasional lesions were also noted in this case in the left auricular endocardium and in the root of the pulmonary valve. No valvular endocarditis of acute type was noted in any of the hearts studied at autopsy.

Although the number of cases is small, these findings suggest that frequent Aschoff bodies in the auricular appendage are paralleled by the presence of Aschoff bodies throughout the remainder of the heart, particularly the left ventricular myocardium. Nowhere do they ap-

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age</th>
<th>Auricular Lesions</th>
<th>Ventricular Lesions</th>
<th>Survival</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>46</td>
<td>++</td>
<td>+</td>
<td>6 days</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>34</td>
<td>+</td>
<td>0</td>
<td>7 days</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>28</td>
<td>+</td>
<td>+</td>
<td>12 hours</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>45</td>
<td>++</td>
<td>+++</td>
<td>16 months</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>48</td>
<td>0</td>
<td>+</td>
<td>2 hours</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>42</td>
<td>+</td>
<td>+</td>
<td>7 days</td>
</tr>
</tbody>
</table>

Fig. 6. Aschoff body from left ventricular myocardium of autopsied case 1.
stigmata of rheumatic disease were selected from the autopsy material at the Boston City Hospital. Each of these hearts was studied according to the standardized method of Gross, Antopol and Sacks. Additional sections were taken from the left auricular appendage. Two hearts of the 11 showed rheumatic activity. One of these was from a man of 82 who died with congestive heart failure following myocardial infarction. Rare Aschoff lesions were found in both the auricular appendage and in the left ventricular myocardium. The other active case was that of a 37 year old man with aortic stenosis in whose heart numerous Aschoff bodies were seen in the auricular appendage and in the left ventricular myocardium. The findings in this series of 11 cases of rheumatic heart disease are thus in general agreement with those in the larger series of autopsied patients who died following corrective surgery on a stenotic mitral valve.

**Conclusions**

1. A study of 183 left auricular appendages, removed at the time of surgical correction of mitral stenosis, shows evidence of active rheumatic carditis as determined by the presence of Aschoff bodies in 83 (45.3 per cent). This incidence is in general agreement with that reported in various series of autopsied cases of rheumatic heart disease.

2. Old or recent auricular thrombosis was noted in 71 of 172 auricular appendages (41.3 per cent). This group shows a decreased incidence of Aschoff lesions (4.1 per cent) when compared with the entire group (45.6 per cent).

3. In 6 of 22 cases in which autopsy was done rheumatic activity was noted in either the auricular appendage or the remainder of the heart. In the cases in which Aschoff bodies were frequent in the appendage, they were also present in the remainder of the heart, chiefly the left ventricular muscle. Minimal auricular and ventricular lesions were unassociated in two cases, suggesting that the correlation of activity in the two locations is poor at minimal levels.

**Summary**

Auricular appendages from patients undergoing operation for mitral stenosis have been studied with regard to presence of Aschoff bodies and endocardial thrombosis and correlated with Aschoff bodies in the remainder of the heart. Aschoff bodies were found in 45 per cent of 183 appendages, endocardial thrombosis in 41 per cent. Aschoff lesions and thrombosis occurred together in only 4 per cent. In cases in which Aschoff bodies were frequent in the appendage, they were also found in the remainder of the heart in autopsied patients.

**Sumario Español**

Las apéndices auriculares izquierdas de 183 pacientes removidas durante la operación para estenosis mitral fueron estudiadas con referencia a la presencia de cuerpos de Aschoff y trombos endocardiaceles. Una incidencia general de cuerpos de Aschoff de 40 por ciento se encontró. Un significante decremento en lesiones de Aschoff en la presencia de trombosis se encontró. El hallazgo de cuerpos de Aschoff en las apéndices se correlaciona con los hallazgos en el restante del corazón en casos sometidos a autopsia.

**References**


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