Visualization of Valvular and Myocardial Calcification by Planigraphy

By Louis A. Soloff, M.D., Jacob Zatuchni, M.D., M.S. (Med.), and Herbert Fisher, M.D.

A preoperative diagnosis of valvular calcification that indicates advanced degeneration and implies potential immobility is now of more than academic interest. It is also of importance in uncovering aortic valvular disease that may contraindicate mitral commissurotomy. Surgical experience indicates that conventional roentgenography has a low positive yield. Fluoroscopy, in hands, has a high positive yield but has the disadvantages of dependence upon individual interest and knowledge and of failure to provide a permanent record verifiable by others. In this study, planigraphy is demonstrated to be superior to all other methods described for the detection of intracardiac calcification.

Calcification anywhere within the heart is a sign of localized dead tissue. Within the heart valves, it implies at least the possibility of a disturbance in motility. Within the left auricular wall, it may represent a final degenerative stage of an adherent auricular thrombus and by its presence warn the surgeon of this possibility. It may, also, uncover a hitherto unsuspected aortic valvular lesion that may contraindicate mitral commissurotomy. For these reasons, a preoperative diagnosis of valvular or auricular calcification is no longer of purely academic interest. Of 36 consecutive individuals subjected to mitral commissurotomy, 17 (or 47.2 per cent) had calcification of the mitral valve recognized at operation. Of these 17, however, in only 2 was calcification recognized before operation by the radiologist on the basis of conventional studies. Our own fluoroscopic examination disclosed a higher incidence of calcification than that reported by the radiologist.

Apparently, fluoroscopy, done by individuals who are well adapted to the dark and have both interest and knowledge of the subject, is far superior to conventional films in detecting calcification. However, fluoroscopy suffers because it does depend upon individual interest and knowledge, and also because it fails to provide a permanent record that can be verified by others. For these reasons, we have sought other means of detecting and of obtaining a permanent record of the presence of calcification.

The purpose of this study is to indicate that planigraphy is a simple and highly successful method of providing permanent evidence of significant calcification within the heart.

Material and Technic

This report consists of an analysis of 13 consecutive individuals who demonstrated intracardiac calcification by planigraphy. Nine had rheumatic heart disease and one in addition had a right aortic arch. All of these had mitral valvular disease, predominantly stenosis, and one of these in addition had aortic stenosis. They were between 26 and 59 years old. The other four, between 52 and 70 years, had aortic valvular disease, three with stenosis and one with insufficiency, but had no history of rheumatic fever. The one with aortic insufficiency had hypertension. Six had sinus rhythm and seven had auricular fibrillation. Seven were subjected to mitral valvular surgery and a diagnosis of calcification was confirmed in each.

Conventional roentgenograms were taken in the posterior-anterior, right and left anterior oblique, and left lateral views. Roentgenograms with the Potter-Bucky diaphragm were made in nine instances. Roentgenograms with the use of a cone, a Potter-Bucky diaphragm and short exposure time were made in six instances.

Planigraphy was done with the patient in the left lateral, right anterior oblique or left posterior oblique position. Sections were made usually at intervals of 1 cm., occasionally at 0.5 cm., at a distance varying from 6 to 15 cm. from the table-top.
TABLE 1.—Clinical and Roentgenologic Findings in Individuals with Valvular Heart Disease Studied for Intracardiac Calcification

<table>
<thead>
<tr>
<th>Patient</th>
<th>Clinical*</th>
<th>Special Fluoroscopy</th>
<th>Conventional Roentgenogram</th>
<th>Potter-Bucky Diaphragm</th>
<th>Supplementary Cone</th>
<th>Planigraphy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. L. C.</td>
<td>37° RHD. MS. AI. EH. AF.</td>
<td>+ M.</td>
<td>O</td>
<td>O</td>
<td>+ M.</td>
<td>RAO. 7 to 9 cm.</td>
</tr>
<tr>
<td>2. G. D.</td>
<td>49° RHD. MS. MI. EH. AF. S.</td>
<td>+ M.</td>
<td>O</td>
<td>O</td>
<td>+ M.</td>
<td>RAO. 7 to 10 cm.</td>
</tr>
<tr>
<td>3. M. D.</td>
<td>70° EH. AS. AF.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>+ M.</td>
<td>RAO. only</td>
</tr>
<tr>
<td>4. D. W.</td>
<td>26° RHD. MS. MI. EH. NSR. S.</td>
<td>+ M.</td>
<td>O</td>
<td>O</td>
<td>+ M.</td>
<td>RAO.</td>
</tr>
<tr>
<td>5. M. E.</td>
<td>41° RHD. MS. MI. EH. AF. S.</td>
<td>+ M.</td>
<td>O</td>
<td>O</td>
<td>+ M.</td>
<td>RAO.</td>
</tr>
<tr>
<td>6. A. M.</td>
<td>70° EH. AS. NSR.</td>
<td>+ A.</td>
<td>+ A.</td>
<td>+ A.</td>
<td>+ A.</td>
<td>RAO. 9 cm.</td>
</tr>
<tr>
<td>7. O. C.</td>
<td>42° RHD. AS. MS. EH. NSR. S.</td>
<td>+ A. &amp; M.</td>
<td>+ M.</td>
<td>+ A. &amp; M.</td>
<td>+ M.</td>
<td>RAO. 9 cm.</td>
</tr>
<tr>
<td>11. W. S.</td>
<td>52° EH. AS. NSR.</td>
<td>+ A.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>+ A. &amp; M.</td>
</tr>
<tr>
<td>12. P. H.</td>
<td>59° RHD. MS. NSR. EH. Rt. aortic arch</td>
<td>+ M.</td>
<td>O</td>
<td>O</td>
<td>+ M.</td>
<td>RAO. 9 to 11 cm.</td>
</tr>
<tr>
<td>13. L. S.</td>
<td>56° Hypertensive AI. EH. AF.</td>
<td>+ M.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>RAO. LPO. 9 to 13 cm.</td>
</tr>
</tbody>
</table>


RESULTS

1. Conventional roentgenography: Calcification was demonstrated in only 2 of these 13 patients, one with aortic and the other with mitral valvular calcification.

2. Roentgenographic study with the Potter-Bucky diaphragm: Calcification was revealed in only two of nine patients, one with aortic and the other with aortic and mitral valvular calcification.

3. Potter-Bucky diaphragm with the use of a cone and short exposure time: Calcification was demonstrated in four of six cases studied, three with mitral and one with aortic calcification.

4. Fluoroscopic study by each of us independently revealed calcification in 12 of these 13 patients, in 9 calcification being in the mitral valve, in 2 in the aortic valve, and in 1 in both the aortic and mitral valves.

5. Planigraphic study: Calcification was demonstrated in the mitral valve alone in seven patients, in the mitral and aortic valve in three, in the mitral valve and left auricular wall in two, and in the aortic valve alone in 1. A summary of all these findings is shown in the accompanying table.

DISCUSSION

Planigraphy is not only superior to all other methods in the number of individuals demonstrating calcification, but calcification is more readily recognized in these films because its shadow stands out in marked contrast to the surrounding cardiac densities. Unfortunately, this marked contrast clearly
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Fig. 1. Right anterior oblique planigram at a level of 8.5 cm. from the tabletop. Note the calcifications in the upper midportion of the cardiac density. Case M. D., female, 70 years old, with aortic stenosis, left ventricular hypertrophy, auricular fibrillation and heart failure. Fluoroscopy and conventional roentgenography also demonstrated aortic valvular calcification.

Fig. 2. Left posterior oblique planigram at a level of 11 cm. from the tabletop. Note the globular calcification in the midportion of the cardiac density. Case L. S., female, 56 years old, with hypertensive vascular disease, aortic insufficiency, auricular fibrillation and no history of rheumatic fever. The mitral valvular calcification was totally unsuspected and gave credence to the possibility of underlying rheumatic heart disease as the cause for the aortic murmur. Conventional roentgenograms failed to disclose any calcification.

Fig. 3. Left lateral planigram at a level of 11.5 cm. from the tabletop. Note the calcification of the mitral and aortic valves and the enlarged left atrium. Case O. C., male, 42 years old, with rheumatic heart disease, aortic and mitral stenosis, and sinus rhythm. Calcification of the mitral valve was found at surgery. Conventional roentgenography revealed calcification of the mitral valve only.

Fig. 4. Right anterior oblique planigram at a level of 6 cm. from the tabletop. Note the calcification of the wall of the left auricle and of the mitral valve. Operation confirmed the presence of calcification in these regions. Case W. S., male, 36 years old, with rheumatic heart disease, mitral stenosis and insufficiency, auricular fibrillation and heart failure. Conventional roentgenography disclosed no calcification.
seen in the original planigrams and in reproductions on lantern slides is partly lost by paper photographs of the film.

The calcified valve may be seen as a solid or a broken group of globular, linear or punctate shadows. The position of these shadows is readily located because the cardiovascular landmarks are easily recognized. Calcification of the aortic valve, in planigrams taken in the right anterior oblique position, is seen in its relationship to the ascending aorta in the upper and anterior part of the cardiac density (fig. 1). Calcification of the mitral valve is seen in the midportion of the cardiac density at the level of the inferior border of the left atrium in planigrams taken in the right anterior or left posterior oblique projections (fig. 2).* When both valves are calcified (fig. 3), calcification of the mitral valve is seen inferior and posterior to that of the aorta.

The calcifications are most commonly seen in sections taken approximately 9 cm. from the table top. Although we employed principally the left lateral and the right anterior oblique projection, Davies and Steiner obtained satisfactory results using only the left posterior oblique projection. Studies are now in progress to determine, among other things, the optimum projection for the demonstration of specific intracardiac or vascular calcification.

In two instances, planigraphy clearly demonstrated calcification of the left auricular wall (fig. 4) totally unsuspected by all other studies and confirmed at surgery. It appeared on the planigram as a sharp linear density in the lateral portion of the left auricular density. A roentgenologic diagnosis of left auricular calcification has rarely been made. Based upon this small group and upon our operative findings, it is likely that such a diagnosis will be made more frequently, if the technique of planigraphy is employed.

* Right anterior oblique projection indicates that the right anterior thorax is adjacent to the film. Left posterior oblique projection indicates that the left posterior thorax is adjacent to the film.

Conclusions
1. An analysis is made of the findings by conventional roentgenological methods in 13 consecutive individuals who demonstrated intracardiac calcification by planigraphy.
2. It is demonstrated that planigraphy is superior to all other methods described in detecting calcification.
3. It is suggested that planigraphy become a routine study if the detection of intracardiac calcification is regarded as important.

Sumario Español
El diagnóstico preoperatorio de calcificación valvular que indica degeneración avanzada e implica inmovilidad potencial, en el presente, es considerado de más que interés académico. También es de importancia en revelar enfermedad aórtica valvular que pudiera contraindicar comisurotomía mitral. Experiencia quirúrgica indica que el estudio radiológico convencional produce un rendimiento bajo. La fluoroscopía en nuestras manos tiene un rendimiento alto pero tiene las desventajas de depender de interés y conocimientos individuales y la falta de poder proveer un record permanente que pueda ser verificado por otros. En este estudio, la planigrafía demostró ser superior a todos los demás métodos descritos para la detección de calcificaciones intracardíacas.

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