Correlation of the Roentgen Appearance of the Thoracic Aorta in Life with the Degree of Stenosing Arteriosclerosis of the Coronary Arteries at Necropsy

By Irving M. Liebow, M.D., Robert R. Oseasohn, M.D., George F. Badger, M.D., and Benjamin Kaufman, M.D.

In the absence of angina pectoris or a history of myocardial infarction the diagnosis of arteriosclerotic heart disease (coronary heart disease, coronary arteriosclerotic heart disease, coronary artery heart disease) is, in clinical practice, one of exclusion. The diagnosis is made in a patient in the “proper” age group who has symptoms or signs of heart disease and none of the other obvious causes (valvular disease, hypertension, hyperthyroidism, congenital heart disease, etc.).

The New York Heart Association has attempted to place the diagnosis of arteriosclerotic heart disease on a more objective basis and has stated¹ in part, “... the etiological diagnosis, 'Arteriosclerosis,' should be limited to those cases of heart disease showing definite evidence of arteriosclerosis of the coronary arteries or the arch of the aorta.” Definite evidence of arteriosclerosis of the coronary arteries would, of course, establish the etiologic diagnosis by definition. The reason for accepting evidence of arteriosclerosis of the arch of the aorta as a criterion for the etiologic diagnosis is not so clear, however, because such a criterion implies that there is a positive correlation between the presence of arteriosclerosis of the aorta and stenosing arteriosclerosis of the coronary arteries. A survey of the literature discloses little information and no unanimity of opinion on this point. Several authors²-⁵ deny the correlation but give no references. Willius, Smith, and Sprague,⁶ in a necropsy study of coronary and aortic sclerosis, found “fairly close parallelism between the degree of coronary and of aortic sclerosis ... [but] much discrepancy in many instances.” The proportion of cases in which discrepancy occurred was not given. Similarly, Higginson and Pople,⁷ in a study of arteriosclerosis in the South African Bantu, stated, “These cases (with marked arteriosclerosis of the coronary arteries) are frequently but not invariably associated with well-marked aortic disease.” The precise degree of association, or lack of it, was not given. Tejada and Gore,⁸ in a necropsy study of the aorta alone, showed a greater prevalence of arteriosclerosis in natives of New Orleans than in people of the low-income group of Guatemala and added, “It is pertinent to note that paralleling the difference in arteriosclerosis, over age 40 in the two localities, there were 51 cases of myocardial infarction in New Orleans from a total of 316 cases and only one in the Guatemalan group of 234 cases ... .” The authors obviously imply a correlation between coronary and aortic arteriosclerosis, but no actual study of the coronary arteries was presented in their paper.

In view of this lack of specific information we decided to determine if the diagnosis can be based on the presence of abnormality of the aorta and specifically on abnormality of the aorta that can be detected in the living patient. The finding of symptoms or abnormal physical signs indicating arteriosclerosis of the arch of the aorta, as required by the “Criteria,”¹ is uncommon. It would, in fact, be limited to the relatively rare case of aneurysm and to the occasional case of marked

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elongation with palpable pulsation in the suprasternal notch. Clinically, the more common way of noting abnormality of the aorta is by means of the standard 6-foot roentgenogram of the chest. It was decided, therefore, to compare the appearance of the thoracic aorta in life as seen on the x-ray film with the condition of the coronary arteries as noted at necropsy.

Method

A review was made of the autopsy protocols at the Institute of Pathology, Western Reserve University, beginning with those of January 1, 1956, and ending in November 1956. The beginning date was chosen because at that time standard printed diagrams for description of each organ system, including heart and coronary arteries, were introduced as a routine part of the protocols. All cases were listed except those autopsies that did not include examination of the heart, those in which the degree of coronary arteriosclerosis was not mentioned, autopsies on patients under 15 years of age, and cases showing syphilis of the aorta. The degree of stenosing arteriosclerosis of the coronary arteries and their main stem branches was recorded. The terms used to describe coronary arteriosclerosis were relatively few in number and easily fell into 5 groups of increasing degree of stenosis: (1) "normal" or "none," (2) "mild," "slight," or "minimal," (3) "moderate," (4) "severe" or "marked," (5) "complete" (with or without recanalization). The most marked degree of arteriosclerosis found in the coronary artery system was used. The protocols in some instances did not detail in which particular coronary artery or main stem the described degree of arteriosclerosis was found, so that in the final analysis the degree of arteriosclerosis used was the most severe found anywhere in a main coronary artery or one of the main stem branches. For tabulation "normal" and "none" were called "none," "mild," "slight," "minimal" was called "slight," and "severe," "marked," and "complete" were called "severe."

The roentgenograms for the cases listed from the autopsy protocols were drawn from the files. The last posteroanterior roentgenogram made during the hospitalization that terminated in necropsy was used, providing the examination was made within 90 days of death (with the day of death being considered as the ninetieth day), and providing a satisfactory view of the aorta was afforded. Cases that did not meet these requirements were dropped from the study. All remaining cases were retained as the final study material; they totaled 137. Consecutive autopsy protocols of 463 patients were reviewed initially. Of these, 128 were omitted because the patients were under age 15. Of the remaining 335, 108 could not be used because no chest film had been made within 90 days of death. Of the 227 remaining cases 90 were omitted for the following reasons: there had been no examination of the heart at autopsy; syphilis of the aorta had been found at necropsy; the degree of coronary arteriosclerosis was not mentioned in the autopsy protocol; the roentgenogram did not give a satisfactory view of the aorta; or the roentgenogram was missing from the files.

A review of the original x-ray reports showed that the terms used to describe abnormalities of the aorta were few: "calcification," "tortuosity," "widening," "dilatation," and "prominent knob." A pilot study showed that when films were reread without specific questions asked but simply with attention focused on the aorta, not only were observations made that were different from the original, but a greater number of observations were made. For this reason the original interpretations were ignored and all the films were reread by one individual, a trained roentgenologist. The re-interpretation was made by means of a "Yes-No-Maybe-Unable to interpret" check-off list, which specifically asked the examiner to state whether or not calcification, tortuosity, elongation, widening, dilatation, or prominence of the knob of the aorta was present.

These terms really describe only 2 types of abnormality of the aorta, disease of the intima and disease of the media. Calcification of the crescentic type seen in the knob and the linear type seen in the descending portion of the thoracic aorta is indicative of intimal atherosclerosis. All the other terms are indicative of the increase in caliber or length of the aorta, or both, resulting from medial sclerosis. Two sets of analyses were made, therefore: (1) an analysis to see if there was any correlation between calcification of the aorta (intimal disease) as noted in the chest film of each patient and the degree of stenosing coronary arteriosclerosis of the same patient as noted at necropsy; (2) a similar analysis for enlargement (medial disease) of the aorta.

Results

Calcification (Intimal Disease) of the Aorta

Table 1 shows the degree of atherosclerosis of the coronary arteries found at necropsy in patients with and without calcification of the thoracic aorta as seen in a posteroanterior chest film.

The totals show that when calcification was present 71 per cent of the patients had moderate or severe coronary atherosclerosis, and when calcification was absent 58 per cent had moderate or severe coronary atherosclerosis.
ROENTGEN APPEARANCE OF THORACIC AORTA

Table 1

Prevalence of Various Degrees of Coronary Atherosclerosis in Patients with and without Aortic Calcification Noted Roentgenographically, by Age Groups

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Degree of coronary atherosclerosis at necropsy</th>
<th>% Moderate or severe</th>
<th>Degree of coronary atherosclerosis at necropsy</th>
<th>% Moderate or severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None or slight</td>
<td>Moderate or severe</td>
<td>Total no.</td>
<td>None or slight</td>
</tr>
<tr>
<td>20-49</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>50-59</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>60+</td>
<td>7</td>
<td>37</td>
<td>44</td>
<td>84</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>46</td>
<td>65</td>
<td>71</td>
</tr>
</tbody>
</table>

Table 2

Prevalence of Various Degrees of Coronary Atherosclerosis in Patients with and without Aortic Enlargement Noted Roentgenographically, by Age Groups

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Degree of coronary atherosclerosis at necropsy</th>
<th>% Moderate or severe</th>
<th>Degree of coronary atherosclerosis at necropsy</th>
<th>% Moderate or severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None or slight</td>
<td>Moderate or severe</td>
<td>Total no.</td>
<td>None or slight</td>
</tr>
<tr>
<td>20-49</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>44</td>
</tr>
<tr>
<td>50-59</td>
<td>10</td>
<td>13</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td>60+</td>
<td>13</td>
<td>54</td>
<td>67</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>71</td>
<td>99</td>
<td>72</td>
</tr>
</tbody>
</table>

This difference is more apparent than real, however, and is largely due to the fact that those with calcification are really an older group than those without calcification. When the figures were examined age-by-age, no difference was seen under 60 years of age, and only a minor and statistically insignificant difference (84 versus 70 per cent) in the older age group.

Enlargement (Medial Disease) of the Aorta

Table 2 shows the degree of atherosclerosis of the coronary arteries found at necropsy in patients with and without enlargement of the thoracic aorta as seen in a posteroanterior chest film. Again, the difference in the prevalence of moderate or severe atherosclerosis in the 2 groups is largely due to the age distribution. Most of those with aortic enlargement were over age 60, while most of those without enlargement were under age 50. Actually there were too few patients without enlargement to warrant any conclusion about a relationship between enlargement of the aorta and coronary atherosclerosis. From the point of view of clinical diagnosis, however, it is clear that very few older patients showed normal aortic outlines, that coronary atherosclerosis was present in the majority of patients over age 50 regardless of roentgenographic evidence of aortic enlargement, and that the latter is of little value in predicting the presence of coronary atherosclerosis.

Discussion and Conclusion

The ‘‘Nomenclature and Criteria . . .’’ of the New York Heart Association states in part that the diagnosis of coronary artery heart disease rests upon the finding of abnormal physical signs indicating arteriosclerosis of the aorta. This implies that there is a positive correlation between the presence of arteriosclerosis of the aorta and stenosing arteriosclerosis of the coronary arteries. To test the validity of this assumption a comparison was made between the appearance of the thoracic aorta as seen on an x-ray film shortly before death with the degree of stenosing coronary arteriosclerosis noted at necropsy.

The results indicate that roentgenographic evidence of arteriosclerosis of the thoracic...
aorta, whether calcification (intimal atherosclerosis) or enlargement (medial atherosclerosis), does not constitute an accurate basis for the diagnosis of coronary arteriosclerosis. Indeed, more accurate information regarding the state of the coronary arteries is obtained by simply noting the patient's age.

It is therefore concluded that arteriosclerosis of the aorta noted roentgenographically should not be a criterion for the etiologic diagnosis of coronary artery heart disease.

Acknowledgment
The authors are most grateful to Dr. Alan Moritz for his cooperation in the use of the protocols at the Institute of Pathology, Western Reserve University.

Summario in Interlingua
Le "Nomenclatura e Criterii pro le Diagnose de Morbos del Corde e del Vasos Sanguinei" ("Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels") del Association Cardiologic de New York assere in parte que le diagnose de morbo cardiae del arteria coronari depinde del constatation de anormal signos physicque indica arteriosclerosis del aorta. Isto presupone que il existe un correlation positive inter le presentia de arteriosclerosis del aorta e arteriosclerosis stenotisante del arterias coronari. Pro testar le validitate de iste supposition, un comparation esseva faite inter le apparentia del aorta thoracae in roentgenographiche obtenite brevemente ante morte e le grado de stenotisante arteriosclerosis coronari notate al necropsia.

Le resultatos indica que le evidentia roentgenographiche de arteriosclerosis del aorta thoracae—si illo consiste de calcificazione (atherosclerosis intimal) o de allargamento (atherosclerosis medial)—non constitue un accurate base pro le diagnose de arteriosclerosis coronari. De facto, plus accurate information con respecto al stato del arterias coronari pote essere cotistitute per simplemente notar le etate del paciente.

Es conclusite, per consequente, que arteriosclerosis del aorta secundo constatationes roentgenographiche non debe essere reguardate como un criterio in le diagnose etiologic de morbo cardiae de arteria coronari.

References
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