CLINICAL PROGRESS

Coronary Embolism

By E. Lee Shrader, M.D., M. B. Bawell, M.D., and V. Moragues, M.D.

The clinical diagnosis of coronary embolism has been made and reported 4 times in the literature. One case was reported by Hamman in 1941 of a 34-year-old woman who suddenly developed symptoms of heart failure following an acute respiratory infection. She had no previous history or evidence of heart disease and failed to show any residual evidence or symptoms of heart disease. He reasoned quite logically that she must have had some acute embolic accident, temporarily impairing the function of her heart, and thought that the lungs had been the source of the embolus. Since the patient survived, there was no postmortem examination to support the correctness of Hamman’s reasoning. He thought that the lungs, because of the frequency with which they are infected, should be a fruitful source of emboli to the coronary arteries. Actually, a survey of the reported cases reveals only 2 other cases in which the source of the embolus was due to an infectious process in the lungs. The rarity of this chain of events detracts from, rather than supports the diagnosis of coronary embolism in his case.

Mussafia in 1948 reported a case thought to be coronary embolism in a 24-year-old white woman with rheumatic heart disease and bacterial endocarditis. On the fourth day of treatment she developed violent retrosternal pain, which persisted for 2 days despite morphone. The electrocardiogram was that of an infarct of the anterior wall of the left ventricle. The patient survived the acute attack and was still alive and under observation a year later.

The third case, reported by Glushien, Reiter, and Fischer in 1952, was a 24-year-old man with diabetes, necrotizing renal papillitis, and acute bacterial endocarditis of the aortic valve. The clinical diagnosis was made 2 days before death and confirmed by autopsy. The right coronary artery was occluded by a vegetation from the aortic valve.

The fourth case diagnosed clinically was reported in 1953 by Cheng, Cahill, and Foley. Their case was a 21-year-old white woman with mitral stenosis; the source of the embolus was a thrombus in the left atrium and was confirmed by autopsy.

Thus, from the literature, we have 4 cases of coronary embolism that were diagnosed ante mortem. Two were proved by autopsy; the other 2 survived, and the diagnosis is therefore presumptive in them.

Textbooks of medicine rarely list coronary embolism in their indices. White in his “Diseases of the Heart” dismissed it with a 4-line statement as follows, “The coronary arteries, healthy or relatively healthy themselves, may rarely be blocked by emboli, even of air, so that death or cardiac infarction may result, or they may be more or less occluded at their mouths by syphilitic aortitis or by aortic valve vegetations in bacterial endocarditis.” This statement, factually correct, does not give a clear understanding of the clinical entity of coronary embolism. Yet it is the only statement found in 5 textbooks, 4 of which are devoted to heart disease.

Pathologically, the diagnosis was first made by Virchow in 1856. The description of his case gives the age and sex of the patient and the source of the embolus. He also stated that several coronary arteries were obstructed by emboli. He did not mention which arteries were involved, the state of the myocardium, nor the pathologic condition of the arterial walls. Since Virchow reported this case, other instances have been reported more and more frequently.

In 1926, Karsner denied the pathologic validity of a case of coronary embolus unless the source of the embolus was clearly indicated. He did not believe that a thrombus and an embolus could be histologically differentiated unless the arterial wall at the site of the occlusion was healthy. But even though this were
apparent, he insisted that the case should not be accepted as proved, unless the source of the embolus was also clearly demonstrated. Saphir,\textsuperscript{8} in 1933, and Garvin and Work,\textsuperscript{9} in 1939, concurred in Karsner's criterion for the acceptance of a case as a proved one and added that most cases of coronary embolism died suddenly. They implied that sudden death should be considered presumptive evidence of coronary embolism.

Saphir,\textsuperscript{8} in his 1933 review of the literature, found 40 reported cases of coronary embolism. He considered that 29 of these could not be accepted as proved cases. The remaining 11 he reviewed, giving the age and sex of the patient, the source of the embolus, the coronary artery involved, and the types of death. To this group, he added 3 more cases of his own. He obviously found it difficult to set up any rigid criterion for judging the validity of a case, for he commented on Marie's\textsuperscript{10} statement, in 1897, that Virchow's case was the only proved one. He implied that this seems to be "too extreme" a position, and yet he admitted several reports are not convincing.

Since Saphir's\textsuperscript{8} survey in 1933, 38 other cases have been reported, making a total of 81. Some of them cannot be considered in this clinical review for obvious reasons. For instance, Kirschbaum,\textsuperscript{11} in 1936, in a pathologic study of 612 cases of coronary disease found in 6,754 routine autopsies, stated that 4 were due to coronary embolism. He gave no clinical data nor did he state the coronary vessel involved. Similarly, in 1935, Applebaum and Nicolson\textsuperscript{12} found 4 cases in 168 cases of coronary disease studied pathologically. They gave no clinical data, but they did indicate that the left coronary artery was involved 3 times and the right 1 time. This greater involvement of the left rather than the right coronary artery is in agreement with the facts found in this survey of the literature. We have been unable to obtain the articles in which Greenstein,\textsuperscript{13} in 1943, and Ramos, LeVaci, and Fonseca,\textsuperscript{14} in 1946, reported cases. In 1882, Huber\textsuperscript{15} reported 3 cases but gave no clinical data. In 1925, Benson and Hunter\textsuperscript{16} reported 14 cases of myocardial infarction believed to be due to coronary embolism, but also did not give any clinical data.

There are, therefore, 27 cases reported with inadequately detailed clinical or pathologic data for the purposes of this discussion.

The clinical and pathologic data in the reports of the remaining 54 cases serve as the basis for our presentation and analyses of the clinical entity, coronary embolism. In these 54 selected cases, there have been omissions of data that would be helpful in evaluating the total group of reported cases. Frequently facts, such as the age and sex of the patient, the nature of the embolus, and the artery involved, are not stated in the reports.

Because of these omissions the total number of cases in the various categories chosen for analyses vary. This variation in data, however, is slight and does not appreciably alter the clinical picture constructed by this analysis of the reported cases. In analyzing these selected cases we have chosen the following categories: age, sex, source of embolism, the artery involved, the state of myocardium, the type of death, and the mortality rate.

**Age**

Age seems to be extremely significant and has been checked in a variety of ways. Of these cases, the age was stated in 49, and the range was from 10 to 70 years, with an average of 39. If these cases are catalogued by decades, 19 are in the range of 31 to 40. Ten cases occur in the next younger age group of 21 to 30, and 11 occur in the next older age group of 41 to 50. The remainder occur as shown in table 1. Forty-two of the 49 cases had a coronary embolism within the age limit of 20 to 50, with emphasis on the 31 to 40 age range.

**Sex**

In 47 of the cases the sex was stated. Thirty-five were male and 12 were female.

**Artery Ocluded**

In 51 cases the artery ocluded was noted. The left coronary and its various branches were

<table>
<thead>
<tr>
<th>Table 1.—Age Incidence by Decades</th>
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<tbody>
<tr>
<td>Age</td>
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<tr>
<td>---------</td>
</tr>
<tr>
<td>Number of cases</td>
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</table>
involved 36 times: 17 of them involved the left descending branch, 2 the circumflex, and 3 each the circumflex and anterior descending branch. The right coronary and its branches were involved 7 times: 6 were of the right main coronary, and 1 in one of its branches. The right and left main coronary arteries both were involved 4 times. In 1 case the main right and descending left were occluded.

When the age was plotted against the arteries involved, it was found that the majority of cases involving the left coronary arteries occurred between the ages of 20 and 50, with approximately one-half between 30 and 40.

As to sex, we have the same general correlation. In the 12 females the left coronary artery or its branches were involved 6 times, and the right coronary once. Both were involved once, and in 4 the artery was not named.

In the 35 male cases, the left coronary artery or its branches were involved 21 times, the right or its branches 5 times, both 3 times, and in 6 cases the location was not specified.

**Source of the Embolus**

In reference to the source of the embolus, there are complete data in 54 cases. In 22 cases, the source of the embolus was stated to be an endocarditis, either acute, subacute, or chronic, and in some cases unspecified. Seventeen of these cases were said to be due to either acute or subacute bacterial endocarditis involving the mitral or aortic valves (mitral 3, aortic 9, aortic and mitral 3, unspecified 2); 1 was chronic bacterial endocarditis, and the involved valve was unspecified; there are 4 cases in which the nature of the endocarditis was not specified. In 3 of these 4 cases the valves involved were not specified, and in 1 it was the mitral valve. In 28 cases, the source of the embolus was stated to be a thrombus. In 6 of these 28, the thrombus was on 1 or both ventricular walls, and in 14 it was on the first portion of the aortic wall, aortic valve, or the left atrial wall. In 3, the thrombus was in the main coronary artery (1 right and 2 left). In 4, it was in the veins of the pelvis and reached the left side of the heart through a patent foramen ovale (paradoxical). In 1, it was thought to have occurred from an abscess in the lung, and in another from an acute pulmonary infection.

There are 3 other types of embolic phenomena that deserve special mention. One was a mass of caseous material found in a main coronary artery in a patient with advanced tuberculosis. Microscopic sections of this embolus showed many tubercle bacilli. Another was a calcareous mass occluding the left main coronary artery for which no source was reported. The third was a very unusual case, previously reported by the authors, of a calcified aortic valve.

**State of the Myocardium**

After 1933 the reports of cases in the literature were more complete. Prior to 1933, no reports gave any information about pathology involving the myocardium. We collected 23 subsequent cases in which the myocardium was described. In 15 there was an infarction of the ventricle, and 1 had a rupture of the right ventricle. In 4 cases diffuse fibrosis or scarring of the ventricular muscle was noted. In 4 cases the ventricle was stated to be normal.

**Type of Death and Mortality Rate**

The last category in this analysis involves the type of death and mortality. Twenty-three of the cases died suddenly, 21 died gradually, and in 8 the type of death was not specified. Among the 23 cases dying suddenly, myocardial infarctions were noted 4 times. Among those cases in which death occurred gradually, infarctions were noted 12 times. There were no infarctions in which the type of death was not specified.

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**Table 2.—Source of the Embolus**

<table>
<thead>
<tr>
<th>Source of the Embolus</th>
<th>Bacterial vegetations</th>
<th>Thrombi mural and first portion aorta</th>
<th>Thrombus main coronary artery</th>
<th>Paradoxical embolism (extremities)</th>
<th>Lungs</th>
<th>Calcified heart valve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21 cases</td>
<td>20 cases</td>
<td>3 cases</td>
<td>4 cases</td>
<td>2 cases</td>
<td>1 case</td>
</tr>
</tbody>
</table>

**Table 3.—Sudden Deaths by Age Groups**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>10–20</th>
<th>21–30</th>
<th>31–40</th>
<th>41–50</th>
<th>51–60</th>
<th>61–70</th>
<th>71 and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
The mortality rate was high, approximately 96 per cent.

**Discussion**

A comparison of these cases with those of coronary thrombosis is of interest. The age pattern in coronary embolism is at least 2 to 3 decades younger than in coronary thrombosis. In both groups the arteries involved are usually the same. Schlesinger and Zoll found that the descending branch of the left coronary artery, the left circumflex artery, and the right coronary artery were all equally involved. It is thus apparent that the left coronary artery and its left branches (left descending and left circumflex) are involved twice as often as the right coronary artery. The type of death varied in each group. In coronary embolism it occurred suddenly in about 50 per cent of the cases. This is not so in the initial attack of myocardial infarction from coronary thrombosis. Furthermore, myocardial infarction from coronary embolism is almost invariably fatal, whereas a large percentage of patients recover from the myocardial infarction from coronary thrombosis, with a more or less satisfactory state of health. This is, however, what one would expect, for the sudden occurrence of a myocardial infarction due to an embolus does not permit time for the development of new collateral circulation. In myocardial infarction resulting from coronary thrombosis the process is a slowly developing one of atherosclerosis and thus the coronary circulation has time to develop collateral anastomosis.

In coronary embolism there is usually some preceding cardiac damage or pathology, in the form of endocarditis or thrombi from previous damage to some part of the heart, such as the ventricular walls or a sclerotic artery. In a few cases the embolus arises in distant parts of the body and reaches the left side of the heart through a patent foramen ovale. In contrast, coronary thrombosis occurs in numerous cases without any preceding cardiac disease or damage. The rarity of coronary embolism and its predilection for the left coronary arterial tree make possible its confusion with coronary thrombosis, especially if no autopsy is performed. One of the criteria previously discussed for a diagnosis of an embolism in a coronary artery was an adequate autopsy revealing a normal arterial wall at the site of the occlusion.

The future of coronary embolism seems worthy of discussion. Two of the most common preceding diseases that had injured the heart in the reported cases were syphilitic heart disease and rheumatic heart disease or complications of them. The effective and adequate treatment of syphilis over the past few decades has made syphilitic heart disease a rarity in this country. No case of coronary embolism resulting from syphilitic heart disease has been reported in the past 10 years. With the use of antibiotics bacterial endocarditis is less frequent and, when diagnosed, is in most cases curable. With the use of antibiotics for the prevention of rheumatic fever, rheumatic heart disease should become less frequent. It is interesting that in only 1 case did a thrombus arise in the atria.

The frequency with which myocardial occlusion occurs from embolism in the left anterior descending branch and the left circumflex is of interest. This parallels, in general, the occurrence of myocardial infarction from a

### Table 4.—Gradual Deaths by Age Groups

<table>
<thead>
<tr>
<th>Age Group</th>
<th>10-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
<th>61-70</th>
<th>71 and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 5.—Comparative Data on Coronary Embolism and Thrombosis

<table>
<thead>
<tr>
<th></th>
<th>Embolism</th>
<th>Thrombosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td>Male predominates</td>
<td>Male predominates</td>
</tr>
<tr>
<td><strong>Site of occlusion</strong></td>
<td>Left coronary distribution</td>
<td>Left coronary distribution</td>
</tr>
<tr>
<td><strong>Etiology</strong></td>
<td>Bacterial endocarditis; thrombi intra- and extra-cardiac; “calcified material” etc.</td>
<td>Atherosclerosis of coronary arteries</td>
</tr>
<tr>
<td><strong>Previous cardiac or arterial damage</strong></td>
<td>Rheumatic fever; syphilitic aortitis; bacterial endocarditis</td>
<td>Rarely (except coronary thrombosis)</td>
</tr>
<tr>
<td><strong>Exitus</strong></td>
<td>Sudden in approximately 50 per cent</td>
<td>May be sudden but not usually</td>
</tr>
<tr>
<td><strong>Mortality rate</strong></td>
<td>96 per cent</td>
<td>15-25 per cent</td>
</tr>
</tbody>
</table>
coronary thrombus. There seems no adequate explanation for the similarity of the site of the occurrence of myocardial infarction from both coronary embolism and coronary thrombosis at the present time. It is a topic for further study by the authors. The higher incidence of syphilis and bacterial endocarditis in men may lead to the same sex incidence in coronary embolism, since these 2 conditions form the largest group of preceding heart disease in coronary embolism.

Sudden death in young persons with thrombophlebitis of the lower extremities or the pelvis but otherwise healthy, should raise the possibility of a paradoxical coronary embolism through a patent foreamen ovale.

There is no treatment for coronary embolism except the treatment of the underlying causes. With the better treatment of rheumatic heart disease, bacterial endocarditis, and syphilitic heart disease, coronary embolism may become a much rarer condition in the future.

Summary

Data were selected in a review of the literature from about 54 cases of coronary embolism. A majority of the cases were men between 30 and 40 years of age. The sources of the emboli were chiefly vegetations from bacterial endocarditis and cardiac thrombi from pre-existent heart disease. These 2 sources accounted for the majority of the emboli. The left coronary artery was involved most frequently, and the type of death was usually sudden. Coronary emboli almost always produce death. A comparison of the various factors involved in coronary embolus has been made with coronary thrombosis.

Summario in Interlingua

Es presentato datos seligite ab un revista del litteratura relative a circa 54 casos de embolismo coronari. In le majoritate del casos le patientes eseva homines de etates de inter 30 e 40 annum. Le origine del embolos eseva principalmente in vegetationes ab endocarditis bacterial e in thrombos cardiac ab pre-existente morbo cardiac. Le arteria coronari sinistre eseva involvite le plus frequentemente, e le typo de morte eseva generalmente subitanee. Embolos coronari resulta quasi semper in le morte del patiente. Esseva interprendite un comparation inter le varie factores involvite in embolos coronari e thromboses coronari.

REFERENCES
Coronary Embolism
E. LEE SHRADER, M. B. BAWELL and V. MORAGUES

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