Calcified Aortic Sinotubular Ridge: A Source of Coronary Ostial Stenosis or Embolism

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A calcified lesion involving the aorta at the upper level of the aortic sinuses (the so-called sinotubular junction) has been described by our registry in several reports (1–3). Although specific, this lesion has generally not been distinguished from atherosclerosis. It is the purpose of this communication to identify the pathologic characteristics of this lesion and to indicate its tendencies for localization, coronary ostial stenosis and coronary embolism.

Material

A calcified aortic sinotubular ridge is very common in individuals aged 60 years or older. It has been coded by our registry 37 times, but this number does not reflect its incidence because many lesions presenting in a nondramatic state have not been coded. Thus, the 37 cataloged cases tend to be examples of uncommonly large lesions or those with obstructive complications.

Results

Morphologic features. The lesion is located principally at the sinotubular ridge, i.e., the junction of the sinus and tubular portions of the ascending aorta. It is characterized by a mass formed of amorphous accumulations of calcified material.

Distinguishing a calcified ridge from atherosclerosis is the absence of features of atherosclerosis in the lesion, although atherosclerotic lesions may involve nearby segments of the aorta. Atherosclerotic segments are characterized either by nonspecific collagenous thickening of the aortic intima or, more commonly, by accumulations in the aortic intima of lipoid deposits that, in turn, are separated from the intimal surface by fibrous tissue, the so-called fibrous cap (Fig. 1). Atherosclerotic lesions may be calcified. Under such circumstances, the process of calcification does not disturb the basic pattern of the atherosclerotic process.

In most cases, the calcified ridge is of minor significance and is represented by a flat focus of calcification at the sinotubular ridge. Less commonly, the lesion forms a distinct mass that protrudes into the aortic lumen (Fig. 2).

The basic structure of the lesion is that of amorphous masses, frequently calcified and separated by strands of collagen. Cholesterol crystals are not present. The lesion closely resembles those in calcified aortic valve (Fig. 3). It involves the intima and, at times, the media as well and tends to occur most frequently in the ridge related to the right aortic sinus. Among the 35 coded cases in which the hearts were available for restudy the lesion was related to the right aortic sinus in all but 2 cases. In 12 cases only the right sinus was involved, whereas in 9 cases there was involvement of both the right and the posterior sinus, in 6 of the right and the

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Figure 1. Low power photomicrograph of a longitudinal section through the ostium of the right coronary artery (RC) and related segments of the aorta (A) in a 65 year old man. In the upper part of the illustration the aorta shows a characteristic atheromatous lesion. In the lower part, the coronary artery lesion (CA) described in this report is evident. This has extended into and occluded the ostium of the right coronary artery (elastic tissue stain; original magnification ×5, reduced by 18%).

Figure 2. Lesion of calcified aortic sinotubular ridge involving both the right and the left aortic sinus area in a 78 year old woman. a, Gross view of opened aortic valve. Above the right coronary (RC) as well as the left coronary (LC) ostia are lesions of calcified ridge (CA). b, Low power photomicrograph through the lesion involving the left aortic sinus region. The left coronary ostium is shown. The calcified lesion involves the aortic intima and superficial media and is composed of amorphous masses encased in a thin, fibrous capsule (elastic tissue stain; original magnification ×5, reduced by 26%). c, Photomicrograph through the base of the lesion shown in b. The lesion is composed of masses of amorphous material involving the intima and encroaching on the underlying media (elastic tissue stain; original magnification ×20, reduced by 26%).
Figure 3. Photomicrograph of a portion of an aortic cusp in a 72-year-old man with calcific aortic stenosis. The aortic valve had been removed surgically. The features are characteristic of the calcifying lesions of the aortic valve representing accumulation of amorphous masses surrounded by strands of connective tissue and resemble those seen in calcified aortic ridge. Other illustrations from this case are shown in Figure 5 (elastic tissue stain; original magnification ×10, reduced by 13%).

Complications. Secondary effects include stenosis of a coronary ostium by direct extension of the aortic lesion (Fig. 4a). In addition, fragmentation may occur, with systemic embolism as a complication. The latter process has been shown to include the coronary artery system (Fig. 4b). In all cases of embolism in the coronary artery system that we observed the process was old; it was characterized by fibrous encapsulation of masses of material histologically like that of the primary lesion. In one of our cases, formation of bone marrow occurred within the embolic lesion.

In 10 of the 37 cases with calcified aortic sinotubular ridge, epicardial segments of coronary arteries were shown histologically to contain material like that in the aortic lesion. In each, the coronary artery lesion was considered embolic. In 5 of these 10 cases, calcified lesions of the aortic valve (4 cases) or aortic sinus (1 case) were also present. In the other five cases with coronary embolism no source for embolism other than the calcified ridge was found.

Coronary atherosclerosis was commonly associated with the lesion, as was healed myocardial infarction, but because of the existence of obstructive coronary atherosclerosis it was not possible to attribute a particular old myocardial infarct to a specific embolic event.

Role of gender and age. Among the 37 cases in which calcified aortic sinotubular ridge was cataloged, the male to female ratio was 1.3:1 (compared with an overall male to female ratio at autopsy of 1.2:1) (4). The ages of the men ranged from 49 to 81 years (mean 68.3), whereas those of the women ranged from 56 to 88 years (mean 75.2). The average age for all subjects was 71 years. The age distribution by decades was as follows: 49 years, 1 case; 50 to 59 years, 3 cases; 60 to 69 years, 9 cases; 70 to 79 years, 12 cases and 80 to 88 years, 8 cases.

Calcification of the mitral ring was fairly common in hearts with calcified aortic sinotubular ridge. Among the 37 coded cases there were 11 (30%) with calcification of the mitral ring (6 cases in men and 5 cases in women). The subjects with calcification of the mitral ring ranged in age from 56 to 83 years (average 75.3).

Comment

Diagnosis. This report describes calcifying lesions that start in the sinotubular ridge of the ascending aorta. Because of their raised and calcified nature, they have commonly been considered atherosclerotic lesions. To distinguish these lesions from calcified atheroma it is necessary to perform histologic examination, which shows that the structure of these lesions is like that in calcified aortic valve and differs from that of atheromatous lesions.

Coronary obstruction or embolism. A calcified aortic sinotubular ridge has a tendency to protrude into the lumen of the aorta. In so doing, a large lesion may obstruct a coronary ostium. The lesion, although originating in the aortic intima, may invade the aortic media and, at times, encroach on and even occlude a coronary ostium. The study showed that embolism in the coronary arteries may occur from fragmentation of the lesion.

Role of aging. The youngest subject in our study was 49 years of age; the average age of the group was 71 years. Calcification of the mitral ring, a recognized feature of aging (5), occurred in 11 (30%) of our cases. By implication, a calcified aortic ridge is a process of aging, but this point is not proved. We are not aware that any hypercalcemic states have a particular tendency to be associated with the aortic lesion herein described.

Coronary artery changes. We have observed emboli in major coronary arteries that exhibit the histologic features of
Figure 4. Calcified aortic lesion involving the right aortic sinus associated with ostial stenosis of the right coronary artery and distal embolism into the right coronary artery, in a 65 year old man whose lesion involving the right coronary ostium is illustrated in Figure 1. a, Gross view of a portion of the aortic valve and related structures. Above the fenestrated right aortic cusp is a calcified aortic ridge involving the aortic wall and obscuring the right coronary ostium. b, Distal segment of the right coronary artery. The lumen is occluded by material having the histologic appearance seen in the calcified aortic ridge (elastic tissue stain; original magnification ×15, reduced by 23%).

c, Photomicrograph of the calcified lesion seen in the left part of b showing the amorphous masses considered to be embolic either from the aortic valve or some other source (hematoxylin-eosin stain; original magnification ×150; reduced by 29%).

d, From the endarterectomy specimen: within nonspecific fibrous tissue there is an accumulation of calcium. At the center of the latter site are cholesterol crystals. The process in this location is considered to be that of atherosclerosis and contrasts with the calcific lesion shown in c (hematoxylin-eosin stain; original magnification ×150, reduced 29%).

Figure 5. Sections from a living 72 year old man with calcific aortic stenosis and embolic calcified lesions involving the right coronary artery. A photomicrograph from this case is shown in Figure 3. a, A calcified congenitally bicuspid aortic valve. b, Photomicrograph of endarterectomy specimen from the right coronary artery. In the left half of the illustration is an encapsulated lesion formed by amorphous masses like those in the calcified aortic sinotubular ridge, as well as in the calcified aortic valve from which a photomicrograph is shown in Figure 3. At the right of the illustration is an atheromatous process (elastic tissue stain; original magnification ×15, reduced 29%).
the calcified ridge but in which the ridge cannot be implicated or established as the source of the embolism. Two examples follow:

In a coronary endarterectomy specimen, there was an old embolic lesion that was histologically like that of the calcified aortic sinotubular ridge (Fig. 5). In this case a calcified aortic valve had also been removed at the time of the coronary endarterectomy. Although the embolus might have come from the aortic valve, it is also possible that it came from an aortic ridge lesion. However, no mention of that abnormality was recorded by the operating surgeon.

In another case, coronary embolism of calcified masses was observed at autopsy. Restudy of the gross specimen of the heart failed to reveal a sinotubular lesion but disclosed a prominent calcified lesion involving the left aortic sinus (Fig. 6). We considered the latter lesion as the basis for the coronary embolism.

References