Silent Myocardial Ischemia in the Aged: A Retrospective Study from the Evaluation of Necropsy Hearts

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The diagnosis of silent myocardial ischemia in the aged remains controversial. In this study to evaluate the basic state of silent ischemia in the aged, a total of 972 consecutive autopsy cases (mean 79.0 yrs of age) were analyzed in terms of coronary atherosclerotic diseases. The following results were obtained: (1) Severe coronary occlusive lesions simultaneously detected in the three major coronary arterial branches were found in 85 cases (8.7%), of which 10 (12%) had neither history of angina nor myocardial infarction (MI), which may correspond to one representation of silent ischemia. (2) There were 218 cases of MI (22.4%), of which 106 (49%) were never documented to have MI during life. The latter may correspond to unrecognized MI. It was considered to be caused by 1) small or middle-sized MI in 66 cases and 2) lateral or nontransmural MI in 29 out of 40 large MI cases (more than 4.9 cm in diameter). (3) 30 cases (54%) out of 56 fresh and large MI with a correct diagnosis revealed no chest pain. This is an incidence of painless MI in the aged. This painless group showed a significant difference in the incidence of a correct diagnosis of MI (51% vs 89%), combined arrhythmia (47% vs 79%) and the association of CVD (47% vs 11%) compared with chest pain group.

RECENTLY the existence of silent myocardial ischemia (SMI) has become well recognized. However, the details of its definition and treatment remain controversial.

Cohn1 classified SMI into three types: Type I. Persons who are totally asymptomatic. Type II. Persons who are asymptomatic following a myocardial infarction, but still demonstrate active ischemia. Type III. Persons with angina who are asymptomatic during some episodes of myocardial ischemia, but not others. Later, he2 listed possible characteristics of silent coronary artery disease or silent myocardial ischemia (SMI) as the following six types: (1) The silent or unrecognized myocardial infarction; (2) A positive exercise test without symptoms; (3) Electrocardiographic abnormalities such as left ventricular hypertrophy, intraventricular conduction disturbance, or nonspecific repolarization abnormalities without other explanation; (4) The asymptomatic postmyocardial infarction state; (5) Angiographically encountered major coronary artery disease in the absence of ischemic symptoms; and (6) Ischemic electrocardiographic findings on ambulatory monitoring unaccompanied by symptoms. In particular, the last point has been considered as essential in the diagnosis of SMI. However, it is difficult to perform routinely the exercise test in the aged because of physical or mental limitations. In addition, signs, and symptoms of ischemic heart disease are often atypical in the aged, therefore the detection of SMI in the aged is difficult. On the other hand, the degree of atherosclerosis

Key words:
- Coronary stenotic index (CSI)
- Myocardial infarction (MI)
- Silent myocardial ischemia (SMI)
- Painless MI
- Unrecognized MI

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Coronary Stenotic Index (CSI) & Myocardial Infarction (MI)

TABLE 1 SEVERE CORONARY STENOSIS

<table>
<thead>
<tr>
<th>CSI</th>
<th>No.</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>≥ 13/15</td>
<td>85 (8.7%)</td>
<td></td>
</tr>
<tr>
<td>MI (+)</td>
<td>76 (89.4%)</td>
<td></td>
</tr>
<tr>
<td>AP (+)</td>
<td>32 (37.6%)</td>
<td></td>
</tr>
<tr>
<td>without MI/AP</td>
<td>10 (11.8%)</td>
<td></td>
</tr>
</tbody>
</table>

(silent myocardial ischemia)

SUBJECTS AND METHOD

A total of 972 consecutive autopsy cases over 60 years performed at Tokyo Metropolitan Geriatric Hospital were analyzed. The population composed 503 men and 469 women with an average age of 79.0 years. To evaluate the degree of coronary atherosclerotic occlusive lesion, the coronary stenotic index (CSI) was applied as previously reported. The extent of narrowing was graded from 5 to 0: 5 = complete occlusion, 4 = 75% stenosis, 3 = 50% stenosis, 2 = 25% stenosis and 1 = minimal stenosis. A stenotic index was obtained as the sum of the largest count in each major coronary artery. The degree of the lesion of left main coronary artery was also defined as 100% occlusion = 5; 75% stenosis = 4; 50% stenosis = 3; 25% stenosis = 2; 10% lesion = 1 and no lesion = 0. All hearts were grossly and microscopically examined. For individual cases clinical records were retrospectively analyzed, especially concerning the history or presence of angina and/or myocardial infarction.

RESULTS

1. Distribution of coronary stenotic index (CSI):

   The distribution of CSI of the aged autopsy cases is shown in Fig. 1. The average CSI of all 970 cases was 9.1 ± 2.9 /15. Normal or slight coronary sclerosis with less than 8/15 of CSI was found in 379 cases, moderate sclerosis with 9-11/15 of CSI in 331 cases and marked or severe coronary sclerosis with 12-15/15 of CSI was found in 260 cases. There were 218 cases of myocardial infarction (MI) with the pathologic evidence, of which CSI was 11.2 ± 2.5 /15 on average.

2. Severe coronary atherosclerotic lesion:

   Severe coronary stenosis showing more than 12/15 of CSI (CSI ≥ 13/15) was found in 85 cases (8.7%) as shown in Table I. Among them...
76 cases (89.4%) had MI, 32 (37.6%) showed a history of angina pectoris (AP). On the other hand 10 cases (11.8%) were free from both MI or AP, which might be compatible with silent myocardial ischemia (SMI).

3. History of angina pectoris (AP):
   Among 972 cases only 81 (8.3%) had a history of angina pectoris (Table II), of which MI was found in 44 cases (45.3%). In addition among 218 cases of MI proved by autopsy there were only 44 (20.2%) of AP, and 42 (30%) out of large MI (fresh or old) of 142 cases showed AP. Except in MI cases, AP was also associated with valvular heart disease in 16, cardiac amyloidosis in three, cardiomyopathy in five and congenital heart disease such as atrial septal defect (ASD) in five.

4. Myocardial infarction (MI): (Table III)
   Among 218 cases of MI, clinical diagnosis of MI was made in 112 (51.4%), while 106 (48.6%) were never documented to have MI. This may be termed unrecognized MI. In cases of fresh and large MI with a correct diagnosis, chest pain during attack was associated with 26 (46%) out of 56 cases. The remaining 30 cases (54%) without chest pain may correspond to the incidence of painless MI in the aged. An analysis of 106 cases of such unrecognized MI (Table IV) showed that 19% were small MI, 43% were middle-sized MI less than 5 cm in diameter and 38% were large MI. The last group chiefly consisted of lateral and subendocardial or nontransmural MI. Table V shows the comparison of several factors according to the presence or absence of the chest pain during the onset of acute MI (79 cases), in which patients were pathologically proved to have fresh and large MI. The chest pain group (n = 28) revealed a significant increase of the incidence in the correct diagnosis for AMI and the prevalence of arrhythmias, while they showed a significantly lower incidence of cerebral vascular disease (CVD) compared with the group without chest pain (n = 51). The incidence of diabetes mellitus (DM) was not significantly different between the groups.

5. Lesion of left main coronary artery (LM):
   Table VI shows average score of LM lesion among 972 cases, counting 1.8 ± 1.0/5. Severe lesion of LM with more than 75% narrowing was found in 58 cases (6.0%), of which 35 (60%) were associated with MI, 8 (14%) with AP. On the other hand 20 cases (34%) showed no MI and/or AP. This may also be a morphological expression of SMI.

Reviewing the above-mentioned clinicopathologic findings, the following results were obtained: (1) 12% of elderly patients with severe

TABLE V COMPARISON OF SEVERAL FACTORS BETWEEN CHEST PAIN GROUP AND NON-CHEST PAIN GROUP IN FRESH AND LARGE MI

<table>
<thead>
<tr>
<th></th>
<th>(+) n = 28; 35.4%</th>
<th>(-) n = 51; 64.6%</th>
<th>Total (n = 79)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis of AMI</td>
<td>25 (89%)</td>
<td>26 (51%)</td>
<td>51 (65%)</td>
</tr>
<tr>
<td>History of Angina</td>
<td>10 (36%)</td>
<td>12 (24%)</td>
<td>22 (28%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>18 (64%)</td>
<td>40 (78%)</td>
<td>58 (73%)</td>
</tr>
<tr>
<td>DM</td>
<td>12 (43%)</td>
<td>13 (26%)</td>
<td>25 (32%)</td>
</tr>
<tr>
<td>CHF</td>
<td>16 (57%)</td>
<td>24 (47%)</td>
<td>40 (51%)</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>22 (79%)</td>
<td>24 (47%)</td>
<td>46 (59%)</td>
</tr>
<tr>
<td>Cardiac Death</td>
<td>24 (86%)</td>
<td>35 (69%)</td>
<td>59 (75%)</td>
</tr>
<tr>
<td>CVD</td>
<td>3 (11%)</td>
<td>24 (47%)</td>
<td>27 (34%)</td>
</tr>
</tbody>
</table>

Chest Pain (+) vs (-) (in Fresh & Large MI)
*p < 0.01

TABLE VI LEFT MAIN CORONARY ARTERY DISEASE

<table>
<thead>
<tr>
<th>Average LMG</th>
<th>1.8 ± 1.0/5</th>
</tr>
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<tbody>
<tr>
<td>LMG ≥ 4/5</td>
<td>58 (6.0%)</td>
</tr>
<tr>
<td>MI</td>
<td>35 (60.0%)</td>
</tr>
<tr>
<td>AP</td>
<td>8 (14.0%)</td>
</tr>
<tr>
<td>without MI/ AP . . .</td>
<td>20 (34.5%)</td>
</tr>
</tbody>
</table>

(silent myocardial ischemia?)

coronary occlusive lesion were silent, (2) 49% of MI cases were not diagnosed during life, (3) painless MI was found in 54%, and about one half of them were highly associated with CVD, and (4) 35% of severe lesions of LM remained silent.

DISCUSSION

Recently the concept of silent myocardial ischemia (SMI) has been widely accepted and the relationship between SMI and sudden death or acute myocardial infarction has been also recognized. Thus, even in the aged, SMI is also important, but it is difficult to determine whether the lack of chest pain during possible ischemic episodes may be attributed to SMI or to other factors. However tests to detect latent or silent myocardial ischemia, such as Master's two step test, the bicycle ergometer or the treadmill test, cannot be routinely performed in the aged because of several factors of limitation. Therefore, an accurate diagnosis of SMI in the aged remains difficult.

In this study to obtain fundamental data concerning of SMI in the aged we evaluated approximately 1,000 consecutive autopsy cases. We paid particular attention to cases without chest pain during life despite the presence of marked coronary atherosclerosis.

Twelve percent of patients with severe coronary occlusive lesions were silent, which might indicate the real incidence of SMI in the aged.

Among 218 cases of MI proved by autopsy, 112 cases (51.4%) were correctly diagnosed, while the remaining 106 (48.6%) were not documented to have MI (unrecognized MI). The reasons for unrecognized MI were considered to be small or middle-sized MI in 62%, and although the remaining 38% of cases were large MI, they were not diagnosed because of lateral or non-transmural MI, as reported by many authors. In our study painless MI was present in 54%, and patients with painless MI showed a significantly higher incidence of CVD compared with patients also experienced chest pain.

So-called unrecognized MI was discovered in more than 25% of newly diagnosed MI cases during biennial electrocardiographic examinations in the Framingham study. Uretsky et al pointed out that so-called unrecognized MI was detected in a high proportion of aged people. Oda et al showed that chest pain during the onset of acute myocardial infarction (AMI) was only detected in 36% of elderly patients. Instead of the chest pain, atypical signs and symptoms such as dyspnea, shock or consciousness disturbance were first noted at the onset of AMI in

some cases.

Our results show that many cases were never documented to have episodic symptoms such as chest pain or their equivalent despite the presence of marked coronary obstructive lesions. However, all such cases do not seem to be compatible with cases of silent myocardial ischemia (SMI) in the aged, because of differences in pain threshold. To obtain a more accurate evaluation of SMI in the aged it will be necessary to elucidate the chest pain or the other atypical symptoms.

In addition it will be necessary to accumulate cases with SMI among elderly patients with known MI and/or AP, and even cases without MI/AP showing silent ischemic episodes detected by noninvasive technique such as Holter monitoring and myocardial scintigraphy.

Acknowledgement

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