Arteriography of Coronary Disease at Clinical Onset*

Robert I. Hamby, M.D., F.C.C.P.;† Stanley Katz, M.D.; and Irwin Hoffman, M.D.

The coronary arteriographic anatomic findings in 491 male patients clinically symptomatic for less than six months are described. Single and multiple vessel disease was noted, respectively, in 40 and 60 percent with 6.5 percent also manifesting left main coronary disease. Our findings indicate that severe coronary artery dis-

ease is present early in the symptomatic phase and that patients presenting with initial inferior myocardial infarctions may represent a select group having an excessive frequency of severe coronary disease suitable for early angiographic detection and surgical bypass therapy. Many studies have related coronary arteriographic anatomy to various clinical aspects of coronary artery disease.1-12 The patients were heterogeneous in terms of age, duration of clinical disease, and the presence of prior myocardial infarction. Other studies13-18 have related coronary arteriographic anatomy to the prognosis of ischemic heart disease and demonstrated that both the extent and location of coronary artery disease are important determinants of prognosis. Thus, since anatomy determines prognosis, it would be important to de-

fine the anatomy present at the earliest clinical manifestation of ischemic heart disease. This report describes the arteriographic findings observed in pa-

tients symptomatic for less than six months. Furthermore, the severity of the coronary artery disease at this early stage of clinical heart disease will be re-

lated to the initial clinical manifestation of the disease, eg, angina pectoris, unstable angina, and myo-

cardial infarction. Finally, various risk factors such as hypertension, cigarette smoking, diabetes mellitus, and blood lipids will also be related to the coronary anatomy found.

**Material and Methods**

During the five-year period (1974 to 1978), 491 male patients underwent selective coronary arteriographic studies within six months of the onset of symptomatic coronary artery disease. In 338 patients, the initial manifestation of the coronary artery disease was angina pectoris, of whom 28

*From the Department of Medicine, Division of Cardiology, The Heart Institute of the Long Island Jewish-Hillside Medical Center, New Hyde Park, NY; Queens Hospital Center, Jamaica, NY; and School of Medicine, Health Sciences Center State University of New York at Stony Brook, Stony Brook, NY.†Chief, Division of Cardiology.

Manuscript received November 26; revision accepted January 29.

Reprint requests: Dr. Hamby, Long Island Jewish-Hillside Medical Center, New Hyde Park, New York 11040

---

696 HAMBY, KATZ, HOFFMAN

CHEST, 78: 5, NOVEMBER, 1980
of a coronary artery by more than 50 percent of the wall lumen. A large marginal circumflex artery was considered an extension of the left circumflex artery. Subtotal obstruction was considered present if a vessel demonstrated significant disease but still filled in an antegrade manner. Total obstructive coronary disease was defined as complete obstruction of a major artery with distal filling, if present, occurring only via collateral vessels.\(^2\) In quantitating the severity of coronary artery disease, only the three major coronary arteries (left anterior descending, circumflex and right) were considered. The left main coronary artery was considered separately. Severity of the coronary artery disease was based on the number of major coronary arteries involved with significant disease. All clinical and arteriographic information had been prospectively coded and stored and was retrieved from our data bank and evaluated by standard statistical methods with the aid of a statistician.

**RESULTS**

**Arteriographic Findings**

In the 491 patients studied, single, double, and triple vessel coronary artery disease was present, respectively, in 40, 32, and 28 percent of the patients. Subjects under 50 years of age had a higher frequency of single vessel disease (Fig 1), compared to patients 50 years and older (50 percent vs 34 percent). The 196 patients with single vessel disease included 127 (65 percent) with left anterior descending artery disease, while 43 and 26 patients had, respectively, right coronary and left circumflex artery disease. Figure 2 presents the frequency of involvement of the three major coronary arteries and the main left coronary artery in various age groups. Main left coronary artery disease observed in 6.5 percent of the total group, demonstrated a significant (P < 0.01) increase corresponding to increase in age of the patient population. Thus, in 51 patients aged 30 to 39, only one (2 percent) had left main coronary disease, whereas of 101 patients, 60 and over, eleven (10.9 percent) had left main coronary disease. The right coronary artery was totally obstructed more frequently (40 percent) than either the left anterior descending (27 percent) or left circumflex (17 percent) artery (P < 0.005). In no case was the left main coronary artery totally obstructed.

**Relationship of Arteriographic Findings to Risk Factors**

Neither hypertension nor cigarette smoking influenced the frequency distribution of the number of coronary arteries involved (Table 1) or the degree of obstruction. The 52 patients with diabetes mel-
Table 1—Severity of Coronary Artery Disease and Risk Factors

<table>
<thead>
<tr>
<th></th>
<th>Single Vessel Disease, Percent</th>
<th>Double Vessel Disease, Percent</th>
<th>Triple Vessel Disease, Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>155</td>
<td>35.7</td>
<td>34.1</td>
</tr>
<tr>
<td>Absent</td>
<td>338</td>
<td>41.3</td>
<td>31.9</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>246</td>
<td>38.6</td>
<td>35.7</td>
</tr>
<tr>
<td>Absent</td>
<td>245</td>
<td>41.1</td>
<td>29.2</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>52</td>
<td>22.2</td>
<td>37.5</td>
</tr>
<tr>
<td>Absent</td>
<td>439</td>
<td>42.1</td>
<td>31.8</td>
</tr>
<tr>
<td>Serum cholesterol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>441</td>
<td>40.2</td>
<td>32.9</td>
</tr>
<tr>
<td>Abnormal</td>
<td>50</td>
<td>36.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Serum triglyceride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>302</td>
<td>38.1</td>
<td>33.1</td>
</tr>
<tr>
<td>Abnormal</td>
<td>189</td>
<td>42.8</td>
<td>31.4</td>
</tr>
</tbody>
</table>

Lititis had single and triple vessel disease in 23 and 39 percent, respectively, compared to 42 percent frequency of single vessel disease (P < 0.005) and 26 percent frequency of triple vessel disease (P < 0.05) in the 439 nondiabetic patients (Fig. 3). Patients with an abnormal serum cholesterol level tended to have a higher frequency of triple vessel disease (36 percent vs 26.9 percent), however, this difference was not statistically significant. An abnormal triglyceride level did not alter the anatomic localization or the number of vessels involved (Table 1). The mean serum cholesterol or triglyceride level was not significantly different in patients with triple vessel disease than in those with single vessel involvement.

Table 2—Clinical Profile

<table>
<thead>
<tr>
<th></th>
<th>Angina Pectoris</th>
<th>Myocardial Infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Manifestation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of patients</td>
<td>338</td>
<td>153</td>
</tr>
<tr>
<td>Age (mean ± 1 SD)</td>
<td>54 ± 16</td>
<td>56 ± 17</td>
</tr>
<tr>
<td>Hypertension, percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cigarette smoker, percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus, percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family history of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary artery disease, percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension, percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus, percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol (mg/100 ml) mean ± 1 SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triglyceride (mg/100 ml) mean ± 1 SD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Relationship of Arteriographic Findings to Initial Clinical Presentation

In 338 patients with angina pectoris as their initial manifestation, single, double, and triple vessel disease was present in 39.6, 35.5 and 24.9 percent, respectively. Left main coronary artery disease was noted in 7.1 percent. Unstable angina was present in 28 patients, disabling angina associated with either resting or nocturnal chest pain in 148, while the remaining 162 patients had classic exertional chest pain refractory to medical therapy. The number of vessels involved, as well as the degree of obstruction, was not significantly different when these clinical patterns of angina pectoris were compared to each other.

In the 153 patients with acute myocardial infarc-
Inferior atherosclerotic coronary disease was present in 48 percent of patients with inferior infarctions, compared to only 14 percent with anterior infarctions ($P < 0.001$). Single vessel disease was observed (Fig 4) in 58 percent with an anterior, and only 24 percent with inferior, infarctions ($P < 0.001$). Thus (Fig 4), coronary artery patients with inferior infarctions had the highest frequency of triple vessel disease, while the anterior infarction group had the highest frequency of single vessel disease. The mean total coronary score in the anterior infarction group was not significantly different from the group presenting with angina pectoris only; however, the mean total coronary score for the inferior infarction group (9.7 ± 2.4) was significantly ($P < 0.001$) higher than either the angina (8.2 ± 2.7) or anterior infarction (8.0 ± 2.5) groups.

Comparison of the angina only and overall infarction groups revealed no significant differences in the frequency of involvement of the three major coronary arteries or left main coronary artery (Fig 5). However, 90 percent of patients with an inferior infarction had significant right coronary artery disease, compared to 30 percent with an anterior infarction ($P < 0.001$). The left anterior descending artery was involved in all patients with
anterior infarction compared to 67 percent with an inferior infarction ($P < 0.005$). Evaluation of the severity of coronary artery disease in a given coronary artery (subtotal vs total obstruction) revealed that 70 percent or more of each of the three major coronary arteries was subtotally obstructed in the group presenting with angina pectoris only (Fig 6). In patients presenting with inferior infarctions, involvement of the right coronary artery was totally obstructive in 66 percent, compared to 41 percent in those with an anterior infarction ($P < 0.05$) and 29.5 percent ($P < 0.001$) of patients with angina only (Fig 6). Finally, in patients presenting with an anterior infarction, total obstruction of the left anterior descending artery was found in 58 percent, compared to 12 percent in patients with an inferior infarction ($P < 0.001$) and 24 percent in those presenting with angina pectoris only ($P < 0.005$). Less than 20 percent of patients had total obstructive disease of the left circumflex artery, regardless of clinical presentation (Fig 6).

**Discussion**

The purpose of the present study was to define, in a large population of referred patients, the severity of coronary artery disease as close to clinical presentation as was realistically feasible. Review of our stored data revealed 491 male patients with coronary artery disease referred for study within less than six months of the onset of symptomatic coronary artery disease. Limitations of the present study are evident, since it is restricted to a referred patient population manifesting symptoms that warranted angiographic evaluation. Thus, this study did not include patients with symptoms controllable by medical therapy, or those patients who suffer a myocardial infarction but are able to function without major symptoms or restrictions. Despite these limitations, the present study does attempt to present the coronary angiographic aspects of ischemic heart disease in a patient population studied early after the onset of clinical heart disease.

Single vessel coronary artery disease was observed in 40 percent of the patients studied, compared to a range of 23 to 33 percent previously reported in patients not selected on the basis of the duration of clinical heart disease. Thus, the severity of disease, as reflected by the number of vessels involved, indicates that the early stages of clinical disease are less severe anatomically. However, it still should be noted that 60 percent of patients in the present study with symptomatic coronary disease for less than six months had multiple vessel coronary disease. Furthermore, 6.5 percent of the patients had main left coronary artery disease, which is almost comparable to the eight percent observed in an unselected patient population. One half the patients under age 50 had single vessel disease, compared to a range of 31 to 36 percent in patients 50 years and older (Fig 1). This would suggest, as noted by us, and others, that younger patients tend, at the onset of clinical disease, to have less severe disease than older patients. Furthermore, as shown in Figure 2, the frequency of left main coronary disease correlates with increasing age. In an earlier study by Welch et al, 3.9 percent of male patients under age 40 had left main coronary disease, compared to 10 percent in an unselected
patient population. In a study by Davia et al
d of
patients age 35 or less, only one (2.5 percent) had
left main coronary disease compared to about eight
percent observed by others1,10,25,39 in unselected
age populations with coronary artery disease. Thus,
the present study, confirms the report by Welch et
al4 that in a patient population with coronary artery
disease, the frequency of left main coronary disease
is directly related to the age of the patients. In the
present study, one in ten patients over the age of 60
had left main coronary artery disease at the onset
of clinical symptoms (Fig 2). In previous
studies1,6,10,25 of unselected patient populations
with coronary disease, the left anterior descending
artery was the most frequent coronary artery in-
volved, but the right coronary artery was more
commonly the site of total obstructive disease. In the
present select group of patients, similar findings
were noted; 79 percent of the patients had significant
disease of the left anterior descending artery,
and total obstructive disease of the right coronary
artery was found in 40 percent.

Many studies2,4,25,28,35 have attempted to relate
the severity of coronary artery disease to the presen-
tce of various risk factors. Fuster et al,29 in a study
of patients with clinical ischemic heart disease for
one year or less, could find no relationship between
the number, distribution, and degree of vessel in-
volvement and the presence of either smoking or
hypertension. Other studies2,4,25,28,31,43 have at-
tempted to relate blood lipid level with various fac-
tors of coronary artery disease severity such as num-
ber of vessels involved, various coronary scores,
and the degree of involvement of individual coro-
nary arteries. Some of these studies31-33 have ob-
served a correlation between plasma cholesterol
level and coronary disease severity while others have
not.2,4,28,39 In the present study, there was no relation-
ship between the number of vessels involved
(Table 1) or the degree of vessel involvement when
related to the presence of cigarette smoking, hyper-
tension, or lipid levels. As shown in Table 1 and
Figure 3, the presence of diabetes mellitus was asso-
ciated with more severe coronary disease at the
onset of clinical symptoms than in the non-diabetic.
This was reflected in the diabetic group by a lower
frequency of single vessel disease (23.2 percent vs
41.1 percent) and a higher frequency of triple vessel
disease (39.3 percent vs 26 percent). Prior studies
by Dortimer et al48 and by us35 also suggest that dia-
betic patients have more severe coronary disease
than do nondiabetics.

The severity of coronary disease in the 338 pa-
tients presenting with angina pectoris only could not
be related to functional disability. When the 28
patients who presented with unstable angina were
compared to the remaining 310 patients with classic
angina pectoris, no difference was noted in the num-
ber of vessels involved or the degree of obstruction
of the coronary arteries. Other investigators1,2,28
have not observed consistent or striking differences
in the distribution of the number of vessels involved
when patients with angina pectoris were grouped
according to functional disability. Roberts36 re-
ported the only autopsy study relating to this subject
in patients who died during operative intervention
and failed to find any pathologic feature distinct-
ive for either stable or unstable angina. The present
study confirms these prior observations,1,2,28,36 but
also demonstrates that at the very onset of the an-
ginal syndrome, functional disability cannot be rela-
ted to coronary artery disease severity. However, it
should be emphasized that the present study
population represents a select group of patients re-
ferred for angiography. However, once such a selec-
tion is made, severity of disease cannot be predicted
on the basis of “severity” of symptoms. It should also
be emphasized that 25 percent of such patients with
angina pectoris had triple vessel coronary disease
despite a normal ECG. Others7,12 have also noted
that a normal ECG may be associated with triple
vessel disease. Thus, in an early study7 of 63 pa-
tients with a normal ECG and angina pectoris, 22 percent
had triple vessel disease. In a study reported by
Benchimol et al12 16 percent of patients with triple
vessel coronary disease had a normal ECG.

The finding that patients presenting with a myo-
cardial infarction had more severe coronary
disease than those manifesting angina pectoris only
was not unexpected.25,27 The group with a myocar-
dial infarction showed a good correlation between
the infarction pattern noted on the ECG and the
coronary artery involved (Fig 5). Thus, inferior in-
farction was associated with right coronary disease
(90 percent) and anterior infarction with left an-
terior descending disease (100 percent). Such a cor-
relation had been previously documented by us25,27
in unselected patients with ischemic heart disease.
Furthermore, the severity of the coronary involve-
ment (subtotal vs total obstruction) of these two
coronary arteries could also be related to the infar-
tion pattern (Fig 6). Thus, 66 percent of the right
coronary arteries involved in cases of inferior myocar-
dial infarction demonstrated total obstruction,
while 58 percent of the left anterior descending
arteries associated with anterior myocardial infar-
c tion had totally obstructed vessels. As noted in Fig-
ure 4, the differences in severity of the observed
coronary artery disease when patients with angina
pectoris only were compared with patients present-
ing with a myocardial infarction was entirely due to the subgroup of patients with inferior myocardial infarctions. Thus, single and triple vessel disease was present in 24 and 48 percent, respectively, in the group with inferior infarctions compared to a 58 percent frequency of single vessel disease and 14 percent frequency of triple vessel disease in patients with an anterior myocardial infarction. It was also apparent that the group with inferior infarctions compared to the patients presenting with angina pectoris only, had more severe coronary disease as reflected in both the number of vessels involved and the coronary score. Furthermore, the patients with an anterior myocardial infarction had the highest frequency of single vessel disease. It should be realized, when considering the coronary anatomy in the groups with a myocardial infarction, that we are describing patients who survived a myocardial infarction and subsequently went on to develop angina pectoris. The higher hospital mortality for an anterior infarction compared to an inferior infarction described by some\textsuperscript{28-40} may selectively eliminate patients with anterior myocardial infarctions who had more severe coronary disease. Bertrand et al.,\textsuperscript{9} in a study of patients who survived acute myocardial infarction, observed that 39.5 percent with acute inferior infarctions had triple vessel disease, compared to only 22 percent with acute anterior myocardial infarctions. We observed,\textsuperscript{28} in an unselected patient population, that the frequency of triple vessel disease was higher in patients with inferior than in anterior myocardial infarctions (57 percent vs 36 percent). Miller et al.,\textsuperscript{3} in a study of patients with chronic stable angina and inferior myocardial infarction, pointed out that such patients have an excessively high prevalence rate of major left coronary artery disease. This finding suggested to these investigators\textsuperscript{8} that such patients were at high risk for excessive mortality and deserved consideration for bypass surgery. Our study, furthermore, indicates that in the early clinical course (less than six months), patients presenting initially with an inferior infarction followed by angina pectoris do indeed represent a select group of patients having an excessive frequency of severe coronary artery disease. Such a group, on the basis of anatomic–correlative studies reported by others,\textsuperscript{13-16} will have a higher annual mortality rate compared to the groups with angina pectoris only, or with an anterior infarction. If future studies confirm prolonged life expectancy after coronary bypass surgery,\textsuperscript{41} then patients with inferior myocardial infarction could well represent a group which should be considered early in their clinical course for angiography and bypass grafting.

ACKNOWLEDGMENT: The authors would like to thank Naomi and Brenda Hamby and Dacia Horowitz for their assistance in the preparation of this manuscript.

REFERENCES

12 Benchimol A, Harris CL, Desser KB, Kwee BT, Promisloff SD: Resting electrocardiogram in major coronary artery disease. JAMA 1973; 224:1489-1492
17 Webster JS, Moberg C, Rincon G: Natural history of severe proximal coronary artery disease as documented by coronary cineangiography. Am J Cardiol 1974; 33:185-200


30 Banks DC, Raftery EB, Oram S: Clinical significance of the coronary arteriogram. Br Heart J 1971; 33:863-870


