Clinical and Anatomic Features in Five Hundred Patients with Fatal Acute Myocardial Infarction

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An autopsy series of 500 patients who died with anatomic evidence of acute myocardial infarction is reviewed. The incidence of various clinical and anatomic features is presented. The clinical and anatomic features of patients who died from the first attack of myocardial infarction is compared with those of patients dying after repeated attacks. Similarly, various other features were studied, such as the time that elapsed between the onset of symptoms and death and also the presence or absence of old myocardial infarrets.

Acute myocardial infarction is one of the most common causes of death in the United States. Considerable data are available regarding some clinical and anatomic features, but more information must be compiled before the disease is fully understood.

During the period 1910 to 1954 autopsies were performed in the Department of Pathology of Washington University on 8,183 adults (over 20 years of age) from Barnes Hospital. Among these were 500 who died with anatomic evidence of acute myocardial infarction. This autopsy series has been analyzed from the epidemiologic standpoint in several previous reports.1, 2 In this report we present some of the clinical and anatomic features of these 500 patients with fatal acute myocardial infarction.

The current study has 4 principal purposes: (1) to establish the incidence of various clinical and anatomic features in a large group of patients with fatal acute myocardial infarction; (2) to relate various characteristics to the time that elapses between the onset of symptoms and death; (3) to compare the clinical and anatomic features of patients who die from the first attack of acute myocardial infarction with those in patients who die after repeated attacks; (4) to determine the differences that exist between patients whose condition was correctly diagnosed during life and those in whom the diagnosis of acute myocardial infarction was not made clinically (but who were found to have acute myocardial infarction at autopsy).

Material and Methods

The clinical and autopsy records of the 500 patients with acute myocardial infarction were reviewed and pertinent clinical and anatomic features were tabulated for each patient. The resulting tables included more than 20,000 separate entries and these are summarized in this report. Patients were studied as follows:

1. Elapsed Time Between the Onset and Death. Among the 500 autopsied patients with acute myocardial infarction were 429 patients who died within 3 weeks after the onset of recognizable clinical symptoms. This portion of our report is limited to these 429 and hence does not include patients in whom the symptoms were so vague as to make clinical dating of the infarct impossible, even in retrospect. Also excluded from the entire study are patients who died so soon after the onset of symptoms that no anatomic changes could be recognized. These 429 patients were classified into 5 subgroups according to the time that elapsed between the onset of symptoms and death, and various clinical and anatomic features were determined for each subgroup and for the entire group.

2. Presence or Absence of Old Myocardial Infarcts. Two hundred and thirty-nine of the 500 patients had anatomic evidence of previous myocardial infarction (old infarcts). The clinical and anatomic features of these patients were compared with the characteristics of the remaining 261 patients with no evidence of previous myocardial infarction.

3. Whether or not the Correct Clinical Diagnosis was Made During Life. The diagnosis of acute myocardial infarction was not made clinically on 97 of the 500 patients with anatomic evidence of acute...
myocardial infarction. The characteristics of these 97 patients were compared with those of the 403 patients who were diagnosed correctly during life.

**Results**

The results are summarized in tables 1 and 2.  
1. *Analysis of those whose Infarcts Could be Dated Clinically.* The 429 patients were classified into 5 subgroups according to the time that elapsed between the onset of symptoms and death and various clinical and anatomic characteristics were determined for each subgroup (table 1) and for the entire group of 429. Most characteristics appear to be similar in the 5 groups. The incidence of a few characteristics appeared to change with the elapse of time between the onset of symptoms and death. Certain of these characteristics were subjected to statistical analysis by comparing the "less-than-2-days group" in table 1 with the "more-than-2-weeks group." The characteristics thus compared and the p values obtained for the differences are as follows: Temperature over 39 C. (p < 0.01), systolic pressure less than 90 mm. Hg (p = 0.05), history of "hypertension" (p = 0.01), mural thrombo in the heart (p = 0.02), thromboembolic phenomena

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**Table 1.—Some Clinical and Anatomic Features of Four Hundred and Twenty-nine Autopsied Patients with Acute Myocardial Infarction Whose Infarcts Could Be Dated by the Clinical History**

<table>
<thead>
<tr>
<th>Survival days after onset of symptoms</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M &amp; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 days</td>
<td>58</td>
<td>20</td>
<td>66</td>
<td>33</td>
<td>53</td>
<td>22</td>
<td>72</td>
<td>48</td>
<td>36 21</td>
</tr>
<tr>
<td>2-4 days</td>
<td>62</td>
<td>60</td>
<td>62</td>
<td>67</td>
<td>60</td>
<td>64</td>
<td>61</td>
<td>63</td>
<td>58 66</td>
</tr>
<tr>
<td>5-7 days</td>
<td>40</td>
<td>45</td>
<td>35</td>
<td>51</td>
<td>34</td>
<td>46</td>
<td>29</td>
<td>40</td>
<td>25 48</td>
</tr>
<tr>
<td>8-14 days</td>
<td>7</td>
<td>20</td>
<td>11</td>
<td>36</td>
<td>15</td>
<td>36</td>
<td>18</td>
<td>38</td>
<td>8 24</td>
</tr>
<tr>
<td>15-21 days</td>
<td>33</td>
<td>65</td>
<td>69</td>
<td>73</td>
<td>47</td>
<td>77</td>
<td>61</td>
<td>67</td>
<td>58 81</td>
</tr>
<tr>
<td>Total</td>
<td>97</td>
<td>144</td>
<td>142</td>
<td>209</td>
<td>158</td>
<td>182</td>
<td>140</td>
<td>153</td>
<td>197 219</td>
</tr>
</tbody>
</table>

* The percentage listed (except in 3 instances) is that of autopsied patients of the sex and group indicated with the characteristic designated. The exceptions are “NPN”, "Hb" and "WBC." In these instances the percentage indicated is based only on patients on whom the designated procedure was performed.

† According to the tables for ideal weights of the Metropolitan Life Insurance Co.

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elsewhere than in the heart ($p < 0.01$), pleural or peritoneal effusions ($p = 0.02$), heart weight ($p = 0.5$), and bronchopneumonia ($p < 0.01$). It is apparent that all of the differences thus compared are statistically significant except that between the heart weights.

2. Analysis of those with Evidence of Old Infarction in Addition to Acute Infarction. Forty-eight per cent of the 500 patients had anatomic evidence of previous myocardial infarction (49 per cent of the men and 45 per cent of the women). No significant difference was present between the average ages of the patients in the 2 groups (with and without old myocardial infarcts). The body weights and weights of hearts were similar in the 2 groups. No consistent differences were noted in size and location of the recent infarcts in the 2 groups.

Only 25 per cent of the patients with anatomic evidence of old infarcts gave a clinical history of previous infarction. The interval that elapsed between the earliest previous infarct and death was stated in the records of 37 patients, and the average of these intervals was 3.3 years (range 6 months to 13 years).

3. Analysis of those with Anatomic Evidence of Acute Infarction who did not have a Clinical Diagnosis of Acute Infarction. Examination of the clinical records disclosed that the diagnosis of acute myocardial infarction was made clinically in $403$ (81 per cent) of the 500 patients, and was not made in the remaining $97$ (19 per cent). Sixty-six were men (19.5 per cent of the entire 335 men) and 31 were women (18.5 per cent of the 165 women). The average age of the 66 men was 62 and of the 31 women, 64; these average ages are similar to those for the entire group of 500.

Small infarcts were more than 3 times as common among these 97 patients than among the remaining $403$ patients ($p < 0.01$). However, there was no significant difference in the location of the infarcts among the 97 patients as compared with the remaining 403. Only 18 per cent of the 66 men and 13 per cent of the 31 women complained of chest pain during the course of their illness. The corresponding figures for chest pain among the 403 patients on whom the correct diagnosis was made clinically were 77 per cent for men and 68 per cent for women ($p < 0.01$ for the difference for each sex). Examination of the clinical records of the 97 patients for complicating circumstances associated with the terminal illness disclosed that 29 per cent had had a major operation within 1 month prior to death, 13 per cent had clinical evidence of cerebral infarction or hemorrhage, and 3 per cent were psychotic. Most of the remaining 55 per cent of the 97 patients were diagnosed as having “arteriosclerotic heart disease” or “hypertensive cardiovascular disease” without acute myocardial infarction. Electrocardiograms were taken on 75 per cent of the 97 patients and some evidence of coronary insufficiency was observed in most. However, none showed changes that were considered diagnostic of acute myocardial infarction.

Discussion

Group 1

Angina Pectoris. It is rather surprising that only one half of these 429 patients had a history of previous angina pectoris. The first explanation that occurred to us was that many of the patients who died in the first few days were unable to give an adequate history. However, this explanation proved untenable because those who died later (1 to 3 weeks after onset of symptoms) did not have a higher incidence of angina pectoris than those who died in the first few days. Thus, it appears that fatal acute myocardial infarction often strikes down the unsuspecting victim without previous warning. The corresponding figures

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**Table 2.—Comparison Between Ninety-Seven Patients with Anatomic Evidence of Acute Myocardial Infarct Misdiagnosed Clinically and Four Hundred and Three Patients with Anatomic Evidence of Acute Myocardial Infarct Correctly Diagnosed Clinically**

<table>
<thead>
<tr>
<th>Diagnosis missed clinically</th>
<th>Diagnosis made clinically</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No. of patients</td>
<td>66</td>
</tr>
<tr>
<td>Ave. age, Years</td>
<td>62</td>
</tr>
<tr>
<td>Chest pain, %</td>
<td>18</td>
</tr>
<tr>
<td>Dyspnea, %</td>
<td>38</td>
</tr>
<tr>
<td>Small infarct, %</td>
<td>50</td>
</tr>
</tbody>
</table>
for the incidence of prior angina pectoris in other series (clinical and autopsy) vary from 20 per cent to 70 per cent.3-6

Dyspnea. Dyspnea is considered to be one of the most common symptoms of acute myocardial infarction.7-8 Although some degree of dyspnea was undoubtedly present in most of our patients, it was considered severe enough to warrant discussion in the clinical records in only 34 per cent. Dyspnea was not more common in those who died soon after the onset of symptoms than in those who died later.

Shock, Markedly Elevated Temperature, Leukocyte Count of Over 20,000/mm.3, Gallop Rhythm, and Marked Tachycardia. These characteristics are all known to indicate a poor prognosis.9-12 However, no single 1 was common in this series.

Chest Pain as Part of the Chief Complaint. According to the medical histories only 64 per cent of these 429 patients with fatal acute myocardial infarction complained of chest pain (including “soreness,” “oppression,” and “discomfort,”) and the incidence of chest pain was not related to the interval between the onset of symptoms and death. Corresponding figures from other series vary widely.13-15 The highest incidence of chest pain was that reported by White16 who found 96 per cent of 56 patients with acute myocardial infarction (proved at autopsy) had chest pain.

Economic Status. The economic status of our patients (as indicated by their ability to pay for medical care) did not appear related to the incidence of acute myocardial infarction, nor to the number of days that elapsed between the onset of symptoms and death. The ratio of ward to private patients in this series was similar to the ratio of ward to private patients in the entire Barnes Hospital autopsy population.

Group 2

All of the clinical and anatomic characteristics of these 239 patients were similar to the characteristics of patients who died of their first episode of acute myocardial infarction. It is interesting that only 25 per cent of these 239 patients with anatomic evidence of old myocardial infarction gave a history of previous myocardial infarction.

Group 3

Acute myocardial infarction in its classic form can be diagnosed by any medical student. However, the fact that 19 per cent of our patients with anatomic evidence of acute myocardial infarction were not diagnosed clinically emphasizes that acute myocardial infarction does not always manifest itself in “classic form.”

Only 16 per cent of these 97 patients complained of chest pain, and only 39 per cent had marked dyspnea during the course of their illness. In almost half of these 97 patients the clinical picture was obscured by complicating circumstances (major operations, cerebral infarction or hemorrhage, or psychoses).

The only anatomic characteristic that we found to be different in this group (as compared with those who were diagnosed correctly during life) was the size of the myocardial infarct. Approximately one-half of the 97 patients who were not diagnosed correctly during life as having acute myocardial infarction had “small” infarcts. Only 12 per cent of the remaining 403 patients had “small” infarcts.

Summary

Some clinical and anatomic features have been presented from 500 autopsied patients who died with acute myocardial infarcts. These patients have been classified in several ways:

1. According to the time that elapsed between the onset of symptoms and death. The time of onset of acute myocardial infarction could be dated clinically (at least in retrospect) for 429 of the 500 patients. Only half of these patients gave a history of previous angina pectoris. Thus it appears that fatal acute myocardial infarction often occurs without previous warning. The 429 patients were divided into 5 subgroups according to the time that elapsed between the onset of symptoms and death. Comparisons are made of the features in the 5 subgroups.
2. According to the presence or absence of old myocardial infarcts. Almost half of the patients had anatomic evidence of old infarction in addition to their recent myocardial infarct. The clinical and anatomic features that were studied in the patients with associated old myocardial infarcts were all similar to those in the patients without associated old infarcts. It is interesting to note that only 25 per cent of the patients with old myocardial infarcts gave a history of previous myocardial infarction.

3. According to whether or not the correct clinical diagnosis was made during life. In 19 per cent of the 500 patients with anatomic evidence of acute myocardial infarction the correct diagnosis was not made during life. In many of these patients complicating features (such as major surgical operations) were present that obscured the clinical picture. Chest pain was much less common and small infarcts were much more common in these patients than in those who were diagnosed correctly during life.

**SUMMARIO IN INTERLINGUA**

Es presentate certe caracteristicas clinico e anatomic de 500 patientes necropsiate, morte con acute infarciamento myocardic. Iste patientes esseva classificate in plura manieras:

1. Secundo le intervallo de tempore inter le declaration del symptomas e le morte. Le tempore del declaration de acute infarciamento myocardic poteva esser fixate (al minus in retrospecto) pro 429 del 500 patientes. Solmente un mediate de iste patientes presentava un historia de previe angina de pectore. Assi il pare que mortal infarciamento myocardic acute occurre frequentemente sin signal premonitori. Le 429 patientes esseva dividite in 5 subgruppos secundo le intervallo inter le declaration del symptomas e le morte. Le caracteristicas trovate in le 5 subgruppos es comparate.

2. Secundo le presentia o absencia de ancian infarciamento myocardic. Quasi un mediate del patientes habeva vestigios anatomic de ancian infarciamento, a parte lor recente infarcto myocardic. Le caracteristicas clinica e anatomic studiate in le patientes con associate vestigios de ancian infarciyos myocardic esseva omnes simile al constatationes trovate in patientes sin ancian infarciyos. Il es interessantese notare que solmente 25% del patientes con ancian infarciyos myocardic habeva reportate le previe occurrentia de infarciamento myocardic.

3. Secundo que si o non le correcte diagnose clinica esseva establite durante le vita del paciente. In 19 pro cento del 500 patientes con probas anatomic de acute infarciamento myocardic, le correcte diagnose non esseva establite durante le vita del paciente. In multes de iste casos, complications (p. ex. major operationes chirurgic) esseva presente, le quales obscureva le aspectos clinica. Dolores thoracic esseva multo minus frequente e parve infarciyos esseva multo plus frequente in iste gruppo de patientes que in illes pro qui le correcte diagnose habeva essite establite durante le vita.

**REFERENCES**


FATAL ACUTE MYOCARDIAL INFARCTION

13 SAPHIR, O., PRIEST, W. S., HAMBERGER, W., AND KATZ, L. N.: Coronary arteriosclerosis: Coro-


A study was undertaken to determine (1) the operative risk of cholecystectomy for patients with coronary heart disease and (2) whether removal of a diseased gallbladder influenced the subsequent course of the patient with coronary heart disease. There were 100 patients in the series. The actual surgical procedure was well tolerated with no deaths or other serious complications on the operating table. Three patients died in the hospital; one from acute pancreatitis, another from pancreatic necrosis, and the third patient died on the seventeenth postoperative day. This patient had cardiac failure and suffered from a cerebrovascular accident earlier in the postop-
erative course, neither of which seemed directly responsible for his death. The postoperative morbidity rate was not unusual for intra-abdominal procedures in patients of the age of these patients.

The survival rate of this group of patients 6 years after operation was 71 per cent as compared with 84 per cent in the normal population of similar sex and age constitution. This study establishes the relatively low risk of cholecystectomy in patients with symptomatic coronary heart disease and emphasizes the dangers inherent in the complications of chronic biliary disease itself. Such complications must be considered even more serious in patients with coronary heart disease. It is doubt-
ful whether removal of a diseased gallbladder influences the course of coronary artery disease di-
rectly but it is likely that life may be prolonged by preventing the serious complications of biliary disease by performance of cholecystectomy preferably during the quiescent phases of gallbladder disease.

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