Autopsy Studies in Atherosclerosis

II. Distribution and Severity of Atherosclerosis in Patients Dying with Morphologic Evidence of Atherosclerotic Catastrophe

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This is the second of a series of reports on a study that was performed to observe the distribution and severity of atherosclerosis in the major arteries of 500 consecutive adults dying in a general hospital. The first report\(^1\) dealt with atherosclerosis in the 347 patients from this group who died without morphologic evidence of atherosclerotic catastrophe in the heart, aorta, or brain. The present paper describes the atherosclerosis in 153 patients in this group who died with morphologic evidence of atherosclerotic catastrophe. The third report\(^2\) deals with the distribution and severity of atherosclerosis in patients from this study dying with obesity, hypertension, nephrosclerosis, and rheumatic heart disease.

Methods and Procedures

Description of the subjects included in this study, and the methods employed in collecting and analyzing the data are detailed in the preceding paper.\(^1\) Figures 1 to 9 are the group “atherosclerosis profiles” of the various patients with atherosclerotic catastrophes; below each atherosclerosis profile are recorded the sites which were studied statistically. The vessels are listed across the tops of the atherosclerosis profiles.

In the preceding paper, the “noncatastrophic” patients were subdivided into age groups and the distribution and severity of atherosclerosis in the various arteries discussed. Unfortunately, the catastrophic groups are of insufficient size for analysis by decades.

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Results

Heart Catastrophes. Figures 1 to 3 summarize the atherosclerosis found in the males and females with evidence of myocardial infarction. When either of these groups was compared with age-matched controls (i.e., patients with no evidence of atherosclerotic catastrophe in the heart, brain, or aorta) it was obvious that those with catastrophes had significantly more atherosclerosis in almost all sites studied. When the females with catastrophes were compared with a randomly selected age-matched male group with catastrophes (fig. 3), the distribution and severity of atherosclerosis were almost exactly the same.

Cerebral Catastrophes. Figures 4 to 6 illustrate the atherosclerosis in the males and females with evidence of cerebral infarction. Unfortunately, the internal carotid arteries were not examined routinely in this study. When groups of either sex were compared with “noncatastrophic,” age-matched controls, it appeared that those with cerebral catastrophes had somewhat more atherosclerosis in almost all sites (figs. 4 and 5). However, the differences were not so prominent as the differences noted in patients with cardiac or aortic catastrophes. Since both sex groups with cerebral catastrophes had almost the same age distribution, they were compared with each other, and the similarity of the groups with reference to atherosclerosis was striking (fig. 6).

Aortic Catastrophes. The profiles and statistical results from the males and females with evidence of aortic aneurysm or occlusive thrombosis are seen in figures 7 to 9. The males with these complications had much more atherosclerosis in all sites than their age-matched controls. In females this difference
is much less prominent. As in the cardiac and cerebral "catastrophic" groups, there were no significant differences in the atherosclerosis of the two sexes.

Multiple Catastrophes. Those patients with multiple catastrophes were too few for statistical evaluation.

Catastrophe Correlations
In patients of both sexes with cardiac catastrophes atherosclerosis in the abdominal aorta and cerebral vessels was significantly more severe than in control patients. In male patients with cerebral catastrophes the atherosclerosis in the abdominal aorta was also sig-
significantly more severe, but that in the coronary arteries was not. In female patients with cerebral catastrophes the findings were reversed (i.e., the atherosclerosis in the coronary arteries was significantly increased but that in the abdominal aorta was not). In patients with aortic catastrophes, again a sex difference was noted: men with aortic catastrophes had diffusely more severe and widespread atherosclerosis than their controls, but women with aortic catastrophes had significantly increased atherosclerosis only in the abdominal aorta.

**Pulmonary Arteries.** As in the patients
without catastrophe, the pulmonary arteries showed relatively little atherosclerosis. Significant increases were found only in males with cardiac catastrophes.

Coronary Arteries. In patients with catastrophes all coronary arteries showed more atherosclerosis than the coronary arteries of the control patients. However, the posterior descending coronary arteries of the "catastrophic" patients were not so severely involved as the other major arteries. This difference among the arteries has been noted by others in "catastrophic" disease and by us in "noncatastrophic" disease.1, 3-5
Aorta. As in those patients studied with "noncatastrophic" atherosclerosis, the abdominal aorta contained more atherosclerosis than the other vessels. In patients with cardiac and cerebral catastrophes, however, this difference between aorta and other vessels was seldom as striking as in the "noncatastrophic" patients.

Iliac Arteries. The common iliac arteries demonstrated larger differences between the atherosclerosis of the study and control groups than did the abdominal aortas. In the previous report,\(^1\) it was noted that the internal iliac arteries showed more atherosclerosis in the later decades than the external iliac arteries. This increased internal iliac athero-

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**Fig. 7 Top.** Aortic catastrophes, males vs. controls. Statistical analyses. Right main coronary, 0.001*; anterior descending coronary, 0.001*; descending thoracic aorta, 0.001*; middle abdominal aorta, 0.001*; right internal iliac, 0.001*; right renal, 0.022; right middle cerebral, 0.001*; basilar, 0.001* (*Significant at 0.01 or less.)

**Fig. 8 Bottom.** Aortic catastrophes, females vs. controls. Statistical analyses. Right main coronary, 0.013; anterior descending coronary, 0.072; descending thoracic aorta, 0.097; middle abdominal aorta, 0.001*; right upper common iliac, 0.058; right internal iliac, 0.090; right renal, 0.078; right middle cerebral, 0.136; basilar, 0.022. (*Significant at 0.01 or less.)
sclerosis was even more evident among the "catastrophic" patients.

Splenic and Celiac Arteries. The atherosclerosis in these vessels was moderate, resembling that in the pulmonary arteries.

Mesenteric and Renal Arteries. The superior mesenteric artery and the renal arteries were similar to the splenic and celiac arteries, and rarely showed more than moderate atherosclerosis. The inferior artery rarely showed more than slight atherosclerosis.

Cerebral Arteries. As in the "noncatastrophic" patients these arteries demonstrated no consistent pattern and were extremely variable. Again, in common with the "noncatastrophic" patients, cerebral disease tended to be focal, whereas the thoracic and abdominal vessels were relatively homogeneous in severity and distribution. The anterior cerebral arteries and the anterior communicating artery rarely demonstrated more than slight disease, and the basilar and middle cerebral arteries showed the most. The atherosclerosis in the posterior cerebral and posterior communicating arteries was intermediate between that in the above-mentioned vessels.

An observation emphasized in the preceding study was the similarity in distribution and severity of atherosclerosis in "nonecatastrophic" patients of both sexes after the age 40. The same similarity obtained in patients with catastrophes (figs. 3, 6 and 9). As indicated in the preceding paper, table 2, a larger proportion of males had vascular catastrophes than did females. Thus, the occurrence of catastrophes may be sex related, but the extent and severity of atherosclerosis are not necessarily so influenced.

**Summary**

The distribution and severity of gross atherosclerosis at autopsy in 153 patients dying with morphologic evidence of atherosclerotic catastrophe in the heart, aorta, or brain were compared with that in 347 "noncatastrophic" patients. This study used a grading system for atherosclerosis that included consideration of both the extent and severity of intimal involvement. The study groups contained 78 males and 28 females with catastrophes in the heart, 26 males and 10 females with catastrophes in the aorta, and 20 males and 20 females with catastrophes in the brain. A significantly larger proportion of

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**Fig. 9.** Aortic catastrophes, males vs. females. Statistical analyses. Right main coronary, 0.348; anterior descending coronary, 0.164; descending thoracic aorta, 0.046; middle abdominal aorta, 0.456; right internal iliac, 0.047; right renal, 0.235; right anterior cerebral, 0.221; right middle cerebral, 0.227; basilar, 0.436.
men had vascular catastrophes than did women. However, there was no sex difference demonstrated in the distribution and severity of atherosclerosis.

SUMMARIO IN INTERLINGUA
Le distribution e le severitate de atherosclerosis grossier notate in 153 necropsias de patients morte con evidentia morphologic de catastrophes atherosclerotic in corde, aorta, o cerebro esseva comparare con le observationes correspondente in 347 casos "nonecatastrophic." Le presente studio utilisa un sistema de notas evaluatori pro le varie casos de atherosclerosis que prende in consideration tanto le extension como etiam le severitate del affection intimal. Le serie includeva le casos de 78 masculos e 28 femininas con catastrophes cardiac, de 26 masculos e 10 femininas con catastrophes aortic, e de 20 masculos e 20 femininas con catastrophes cerebral. Un significativemente plus alte proportion de masculos que de femininas habeva catastrophes vascular. Tamen, nulle differencia sexual esseva demonstrabile in le distribution e le grado de severitate de atherosclerosis.

REFERENCES


The blood pressure was recorded in 400 consecutive healthy male military recruits. The behavior of the blood pressure was then observed in 200 of these individuals over a period of 10 years in 4 groups: 50 healthy recruits with normal blood pressure, 50 recruits with somewhat elevated blood pressure (150 mm. Hg systolic or 100 diastolic or both), 50 older male and female patients examined in private practice whose blood pressure was elevated without cardioarterial derangement (200 mm. Hg systolic or 110 diastolic or both), and 50 patients with proved arterial hypertension and cardioarterial changes. The normal recruits did not show any constant tendency toward an increase in blood pressure over the 10 year period. Forty-two of the 50 young adults with moderate hypertension showed lower readings at the second examination compared to 10 years previously. Thus, moderately high values in young people did not presage a significant hypertension in later life. High blood pressure in older adults was not serious provided it was not associated with cardioarterial derangement manifested by refractory contraction of the lesser arteries and electrocardiographic evidence of left ventricular hypertrophy. The term hypertonia is proposed for the more benign state.

Kurland
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