SPECIAL ARTICLE

Report on Symposium on Atherosclerosis

48TH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF NEUROPATHOLOGISTS

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A symposium on atherosclerosis was part of the meeting of the American Association of Neuropathologists, which was held in Chicago, Illinois, during June, 1972. At this symposium, five lengthy reports were given which were of interest to readers of STROKE.

The first three speakers reviewed data pertinent to atherosclerosis in general. These speakers were: Dr. Jack C. Geer, Department of Pathology, Ohio State University College of Medicine, Columbus, Ohio; Dr. Robert W. Wissler, Department of Pathology, University of Chicago, Chicago, Illinois; and Dr. Seymour Glagov, Department of Pathology, University of Chicago, Chicago, Illinois. Dr. Geer described the cellular and biochemical changes in the evolving atherosclerotic plaque. He pointed out that lipid streaks precede the fibrous plaque. But, while streaks appear with equal frequency in all populations, the plaques or atheroma vary greatly in incidence from population to population. In addition, according to Dr. Geer, atheromas do not necessarily appear at the same location as the fatty streaks. Thus streaks may not be a necessary precursor of atheroma. Moreover, it is the atheroma, not the streak, which leads to clinical symptoms through such complications as ulceration and thrombosis. Thus it would appear to be of vital importance to investigate the mechanism of fibrous plaque or atheroma formation, be it from pre-existing lipid streaks or de novo. Unfortunately, according to Dr. Geer, most of the knowledge of atherosclerosis comes from investigations of the lipid streak.

With that introduction, Dr. Geer described electron microscopic investigation of the streak and of the plaque or atheroma. He pointed out that foam cells and cells elaborating connective tissue in the atheroma appear to be derived from smooth muscle, that the plaque is actively exchanging materials with its environment, and that the arterial wall itself is metabolically active. Also, he reviewed the biochemical evidence about the change in the ratio of fatty acids in the fatty streak, and the atheroma. Apparently, highly abnormal ratios in the streak revert to normal in the atheroma, even though the latter is, morphologically and chronologically speaking, the more advanced lesion.
Dr. Wissler followed Dr. Geer with a further review of recent advances in the understanding of arteriosclerosis. He felt that the two most dramatic advances were the discovery of the importance of low-density lipoproteins, and the involvement of smooth muscle cells in the production of connective tissue and the uptake of lipid.

Dr. Wissler reviewed studies from many laboratories (utilizing light microscopy, electron microscopy, tissue culture, and immunological techniques involving antibodies to actomyosin), which appear to firmly establish a muscle cell, migrating into the plaque from the arterial wall, as the key cellular actor in the drama of arteriosclerosis.

Dr. Wissler also elaborated upon the evidence that increased vascular permeability to lipoproteins, plus high blood levels of cholesterol, play a major role in the production of atheromas. Apparently a variety of agents or pathological processes may increase vascular permeability to the lipid. Special mention was made of the ability of very low concentrations of angiotensin B to increase permeability of endothelial cells to lipoprotein. This "trap door effect" might provide a new basis for understanding the acceleration of arteriosclerosis in hypertension where angiotensin levels may be elevated.

The use of Rhesus monkeys in experimental models of atherosclerosis also was discussed. On normal diets these monkeys develop arteriosclerosis at a slow rate, which accelerated by raising their cholesterol levels to 400 or higher. The production of lesions like those seen in man seemed best obtained by adding both butter fat and coconut oil to the monkey's diet.

Finally, Dr. Wissler presented some of Stamler's evidence for true plaque regression of dramatic degree in animals who had been returned to normal diets or to diets rich in polyunsaturated fats. This information on plaque regression not only provides us with hope for reversal of lesions, but also contrasted somewhat with Dr. Geer's caution, cited in the preceding paper, about the definition of "regression." In the examples which Dr. Geer showed, a protruding lipid-laden plaque was simply converted into a smaller, much more fibrous plaque which, in Dr. Geer's view, could conceivably be thought of as a biologically more advanced lesion, though possibly one of less clinical significance.

In the third presentation of the symposium, Dr. Glagov discussed the physical principles that might account for the patchy localization of lesions in atherosclerosis. By taking into account the complex interaction of such factors as flow rate, shear stress, turbulence, and rate of change in flow, particularly at curvatures, branch points, and ostia, one might begin to explain the predilection of such sites for atheromas, or the asymmetric development of atheromas at such sites.

However, the most provocative part of Dr. Glagov's presentation was the evidence that lack of vasa vasorum, wall thickness and wall tension, working in concert, may be primary determinants of atherosclerosis. Dr. Glagov stated that in all mammalian species examined to date, no vasa vasorum exists in the inner 29 lamellae of the media. These lamellae, defined by arrays of elastic tissue, are best visualized in vessels distended by pressures at least as high as diastolic pressure. Because of the absence of vasa vasorum, this inner half millimeter of vessel is nourished by diffusion from the lumen. As one goes from birth to adulthood, the width of these lamellae increases much more in the human abdominal aorta than in the thoracic aorta. At the same time, wall tension, which is proportional to the diameters of the vessel, also increases more in the abdominal aorta than in the thoracic aorta. Thus the inner portion of the media requires more and more nutrition, while diffusion from the lumen is becoming increasingly difficult. Dr. Glagov said that these events may account for the well-known predilection of atherosclerosis for the abdominal, as compared to the thoracic, aorta.

Finally, in this symposium were two reports dealing directly with cerebral blood vessels. Dr. John Moossy, Professor of Pathology (Neuropathology) and Neurology, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, reviewed the basic pathology of a variety of atherosclerotic lesions. Then, Dr. Stanley Aronson (the Association's president), Department of Pathology, Brown University Medical School, Miriam Hospital, Providence, Rhode Island, presented new data...
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on the relationship of diabetes mellitus to cerebral vascular disease.

Dr. Aronson's material came from a review of 5,400 autopsies, all subjects being 25 years old or older. In this sample were several hundred diabetics of both the Caucasian and the Negro races. As expected, the incidence of cerebral infarction, in both diabetics and nondiabetics, increased with age. A similar increase was observed associated with diabetes itself and with cardiomegaly, which was taken as pathological evidence of hypertension. The combination of diabetes and cardiomegaly was associated with a still higher incidence of cerebral infarction. Surprisingly, the increased incidence of infarction in diabetes was not associated with an increased incidence of atherosclerosis in the circle of Willis, or with thrombi in the circle. In fact, the difference in incidence of infarction between diabetics and nondiabetics appeared largely accounted for by the presence of small pontine infarcts, usually located near the midline of the basis pontis in the diabetic group. The precise explanation for these infarcts was really not at hand, although involvement of certain pontine vessels and their distribution was discussed.

Unlike cerebral infarction, the incidence of cerebral hemorrhage was not increased in diabetics. In fact, the incidence of fibrinoid arteritis or lipohyalinosis of small cerebral arteries was much less in diabetics. This fibrinoid necrosis is thought by many to be the basis of massive intracerebral hemorrhage, even in patients without clinically malignant or accelerated hypertension, and without necrotic vessels in organs other than the brain. This hypothesis is strengthened by Dr. Aronson's finding of a decreased incidence of intracerebral hemorrhage paralleled by a decreased incidence of fibrinoid degeneration in brain vessels of diabetics. The mechanism by which diabetic vessels are protected from fibrinoid degeneration is unknown.
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