Atherosclerosis in Europeans and Bantu

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GARROD \(^1\) was one of the earliest workers to emphasize that human beings differ in the details of their biochemistry and that these differences are in part genetically determined. At present there is abundant evidence showing that groups differ in regard to the biochemical characteristics of their members.\(^2\) The concensus is that atherosclerosis of the aorta and coronary arteries, together with the associated complications, is less severe in South African Bantu than in white people, while the incidence of cerebrovascular accidents in the Bantu is at least as high if not higher.\(^3\)-\(^11\) In the studies cited the coronary or cerebral arteries were often not included. Likewise, very few of the reports contained studies on infants.

The present paper concerns the observations obtained by gross estimation of the extent and severity of atherosclerotic lesions in the aorta and the coronary and cerebral arteries of white and Bantu subjects.

Material and Methods

The vessels analyzed in the present study were obtained from the bodies of in-patients who died in the Pretoria General Hospital, which contains 913 beds for white and 665 for non-white patients. Postmortem examinations are conducted in this hospital on approximately 17 per cent of the deceased patients. The main reason for this low percentage is failure to obtain permission from relatives.

All the patients included in the study had died from natural causes, and the series was entirely unselected except for the exclusion of syphilitic and tuberculous cases. The present sample consisted of 540 cases: 194 whites and 346 Bantu, collected between March 1960 and March 1962. Patients died from a wide range of pathologic conditions. All postmortem examinations were done under our supervision. The majority of the adult Bantu subjects spent their childhood in rural areas and moved to urban areas after the age of about 16 years. Hence, it is impossible to classify these cases strictly into urban or rural groups.

The aorta was severed about 1 cm. above the aortic valve and about 1 cm. distal to its bifurcation into common iliac arteries. The artery was then removed and opened by a longitudinal incision, and the adventitia was stripped. For grading purposes the aorta was subdivided into five separate segments: ascending aorta together with the aortic arch, descending thoracic aorta, abdominal aorta, bifurcation of the aorta and common iliac. The extent of intimal involvement, the character and severity of the lesions, and the atherosclerotic index were calculated for each segment.

The coronary arteries were excised after the introduction of a stylet through the coronary ostia. As much adventitia as was possible was stripped.

The right vertebral artery and the left vertebral artery were severed on their respective sides at the lower level of the first cervical vertebra. The vertebral arteries together with the basilar artery and posterior cerebellar artery on each side were then dissected free. The internal carotid artery was severed on each side within the skull and removed together with the circle of Willis and the superficial part of the anterior, medial, and posterior cerebral arteries.

The grading of the vessels and the calculation of the atherosclerotic index were carried out according to the method described by Gore and Tejada.\(^12\) All material was treated in exactly the same manner and graded by the same person without knowledge of the race, age, or sex of the patient.

Results

Selective Onset and Progress of Atherosclerosis in Aorta and Coronary and Cerebral Arteries

The results obtained in the present study are presented in figures 1, 2, and 3.

Aortic lesions made their appearance in the
second decade, coronary lesions in the third decade, and cerebral lesions in the third and fourth decades. Exceptions did occur. The sequential development of lesions from lipid streaks to calcified plaques was best discernible in the aorta.

Especially in younger age groups the area and severity of atherosclerosis in any one artery did not necessarily correlate with lesions of another artery from the same individual. Yet severe aortic lesions were generally associated with severe coronary lesions. Broadly speaking there was no such association between the extent and severity of lesions in the cerebral arteries and in the aorta or coronary arteries in the age groups under 50 years (figs. 1, 2, and 3).

Lesions in the cerebral arteries were usually first detected with the naked eye in the basilar and intracranial portions of the carotid arteries and in the circle of Willis.

The degree of the lesions in aortas or coronary arteries or cerebral arteries showed a great range of variation within each age group.

Statistical Analysis of Data

The statistical evaluation is subject to the assumption that the autopsies were random.
and constituted representative samples of both Bantu and white populations. The U-test of Mann-Whitney,\textsuperscript{14} or the $\chi^2$-test in the case of large numbers of tied observations,\textsuperscript{14} was employed to ascertain whether differences in the atherosclerotic indices of the three vessels were related to sex, race, or age.

**Sex and Atherosclerosis**

Except in the case of the coronary arteries of white subjects in the fifth decade (40 to 49) and of the Bantu in the sixth decade (50 to 59), no sex-related differences at the 5-per cent level of significance were found. The atherosclerotic indices for the vessels of the two sexes were therefore pooled [except that in the 40 to 49 white and 50 to 59 Bantu age groups the sexes were considered separately and the probabilities (p-values) were combined] and the vascular differences for the two races analyzed.

The differences between white men and women for the age groups 30 to 39 and 50 to 59 did not reach statistical significance. This is probably on account of small numbers of women in these categories, for the trends in figures 1 and 2 suggest that real differences exist. No similar sex difference is noticed in the Bantu (figs. 1, 2, and 3).

![Graph](http://circ.ahajournals.org/)

*Figure 2*

Atherosclerotic index: coronary arteries.

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Race and Atherosclerosis

Statistical analysis of the atherosclerotic indices showed that the aorta and coronary arteries of white subjects were always more affected than the same vessels in the Bantu, the coronary arteries slightly more so than the aorta. Similar trends are noticeable in figures 1 and 2. On the other hand, the atherosclerotic indices of the cerebral arteries of the two races showed no statistically significant differences—the probability of obtaining the observed value or more extreme values always exceeded 5 per cent. The high average indices of some of the Bantu age groups (fig. 3) were caused by the presence of a single case with severe atherosclerosis in the age group concerned. Without exception these odd cases had atherosclerotic indices higher than the sum total of the indices for the other cases in the respective age group.

Race, Sex, and Vascular Deaths

The sample of 540 cases included, inter alia, 87 white males, 58 white females, 111 Bantu males, and 85 Bantu females over the age of 25 years. Of the 87 white males, 10 died from coronary thrombosis and five from cerebrovascular accidents, whereas of the 58 white females, five died from coronary thrombosis and six from cerebrovascular accidents. The age at which patients died from coronary thrombosis shows two peaks in the males, a more prominent first peak between the age of 38 and 50 years and a less prominent second peak between the age of 65 and 71 years. However, the number of cases is too small to justify any definite assumption. Only one of the females who died from coronary thrombosis was below the age of 70; one was 73, and the other three were over 80 years. None of the 111 Bantu males and 86 Bantu females died from coronary thrombosis, while seven of the Bantu males and seven of the Bantu females died from cerebrovascular accidents.

The coronary arteries in every patient who died from coronary occlusion showed macroscopically discernible atherosclerosis. Only in two of the 15 cases of coronary occlusion can the degree of atherosclerosis as gauged by the atherosclerotic index perhaps be labeled rela-
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The atherosclerotic index may, however, be low in the presence of severe narrowing of a single small segment of an artery, and such a lesion may be more fatal than an extensive area of atherosclerosis with mild vascular narrowing.

Altogether 25 of our patients, 11 white and 14 Bantu, died from cerebrovascular accidents. Of this number, 11 suffered from hypertension (pressures over 140 mm. systolic and 90 mm. Hg diastolic), and possibly as many as nine died from cerebral hemorrhage due to rupture of a cerebral artery aneurysm (congenital aneurysm). On a percentage basis, deaths from cerebrovascular accidents occurred slightly more often in women than in men. Macroscopically discernible atherosclerosis was not always present. Five of the Bantu men and women who died from cerebrovascular accidents were younger than the youngest of the white subjects who died from this cause; in four of these cases death was due to rupture of a “congenital” aneurysm, and on macroscopic examination atherosclerosis was either absent or of a very slight order. Of the 11 white persons who died from cerebrovascular accidents, eight showed relatively severe atherosclerosis, while only three of the 14 Bantu who died from cerebrovascular accidents showed severe atherosclerosis. On the other hand, only two of the 11 white subjects, but 11 of the 14 Bantu who died from cerebrovascular accidents, were under the age of 50 years. In the majority of cases that died from cerebrovascular accidents, atherosclerosis was much less severe than in the cases that died from coronary heart disease. When macroscopically discernible atherosclerosis was not present in the cerebral arteries, the fatal cerebrovascular accident was a cerebral hemorrhage, almost invariably due to hypertension or to the rupture of a cerebral aneurysm. The vulnerability of the cerebral arteries in contrast to the coronary arteries to a rise in intraluminal pressure to the extent that actual rupture may occur, may be in part because the walls of the cerebral vessels are structurally weaker.

Comment

The work of Singer and Rob15 and of Bloor16 suggests that the presence of atherosclerosis in any one artery implied arterial disease elsewhere. Robertson,17 however, emphasized the lack of correlation between the extent and severity of atherosclerosis in one arterial bed and in another. According to Mitchell and Schwartz18, 19 there is a tendency for atherosclerosis to develop in parallel in the different arterial systems. Young et al.20 reported significant correlations between coronary and cerebral lesions in 37 autopsied cases. The coronary lesions usually were more advanced, however, than those in the cerebral vessels within a given age group. According to Holman and Moosy,21 aortic lesions are already evident in the first decade; coronary lesions appear in the second, and cerebrovascular lesions in the third decade. In each decade the aortic lesions are on the average quantitatively the greatest, the coronary arteries coming second, and the cerebral arteries last. Our data for white and Bantu subjects resemble those of Holman and Moosy’s closely. As the composition of the blood circulating through the different vascular beds is more or less the same, local factors such as the continuous elastic recoil of the aorta and the rhythmic flexions of the coronary arteries during each cardiac cycle, must be important in the determination of the selective onset and progress of atherosclerosis in the different vascular beds.

According to Laurie and Woods10 “there is enough evidence to refute the view that the Bantu enjoy any relative freedom from atherosclerosis.” The present results, however, support the view that atherosclerosis and its complications occur with greater severity in the aorta and coronary arteries of white persons than of Negroes,3-8, 11 but that the incidence and clinical characteristics of cerebrovascular accidents do not differ significantly in the two racial groups.10, 11, 13, 23

The absence of a logical explanation for the lack of harmony between the severity of the disease and its complications in the aorta and coronary arteries in the two racial groups prompted us to investigate local vascular fac-
tors as a possible contributory cause. In these studies it was shown that in general Bantu possess a better coronary anastomotic circulation than white persons, but do not differ from them with respect to the quantitative distribution of mast cells.

The striking degree of harmony between the severity of cerebrovascular accidents in the two racial groups, which was conclusively demonstrated in the present study, lends further support to the thesis that local vascular factors are more heavily implicated than is generally accepted by the proponents of the theory that atherosclerosis is a manifestation of a systemic metabolic disease. Whether the local lesions are in the nature of defects in structural composition or in the hydrodynamics of the intracerebral circulation, which are of course also influenced by the extracranial arteries, must still be decided. We believe that before further morphologic or hemodynamic studies are done on the cerebral circulation of the two groups, it is necessary to compare the vessels as regards biochemical composition. Such a study is in progress.

Summary

The atherosclerotic "profile" of the aorta, coronary, and cerebral arteries was gauged by the atherosclerotic index method of Gore and Tejada in 540 unselected white and Bantu autopsy cases. The atherosclerotic indices were very low in all cases until about the third decade. Thereafter there was a progressive rise, which was most dramatic in the aorta and coronary arteries of white men.

The aorta and coronary arteries of the white subjects were more severely affected than those of the Bantu whereas the cerebral arteries were about equally affected in the two racial groups.

The 540 cases included 87 white men, 58 white women, 111 Bantu men, and 85 Bantu women over the age of 25 years. Of the 87 white men 10 had died from coronary occlusion and five from cerebrovascular accidents. Of the 111 Bantu men none died from coronary occlusive disease and seven of cerebrovascular accidents. Five of the 58 white women died at an advanced age from coronary occlusion; seven died from cerebrovascular accidents. None of the Bantu women died from coronary occlusion and seven from cerebrovascular accidents.

Severe atherosclerosis was almost invariably present in cases that died from coronary occlusion suggesting that at least in white persons, coronary atherosclerosis directly predisposes to coronary occlusion. In patients who died from cerebrovascular accidents, macroscopically discernible atherosclerosis was not invariably present.

It is suggested that the wide difference in the percentage of "coronary deaths" in the two ethnic groups is due to the much greater frequency of severe coronary atherosclerosis in white persons than in the Bantu. The close correlation between the percentage of "cerebral deaths" in white and Bantu subjects, on the other hand, is not merely the result of equal occurrence or equal susceptibility of the cerebral arteries to atherosclerosis in the two racial groups, but is rather the integrated result of one or more of the following factors: (1) the relative weakness of the cerebrovascular walls, (2) the relative common occurrence of cerebral artery aneurysms (congenital aneurysms), (3) such atherosclerosis as may be present, and (4) rise in blood pressure.

Atherosclerosis of the cerebral arteries apparently played a somewhat more important role in white persons than in the Bantu.

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