Relationship between Serum Lipids and Aortic Atherosclerotic Lesions in Sudden Accidental Deaths in Guatemala City[1,2]

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EPIDEMIOLOGICAL STUDIES of atherosclerosis in many population groups all over the world have suggested an association of serum cholesterol levels with deaths from atherosclerotic heart disease (1, 2). Furthermore, it has been shown that serum lipid levels, particularly serum cholesterol, are associated with dietary factors, such as amount and kind of fat and cholesterol in the diet (1–3). The evidence is conflicting, however, concerning the direct relationship between serum cholesterol levels and atherogenesis, and between these levels and the progression of atherosclerosis in man (4–7).

Serum cholesterol levels are low among population groups showing a low prevalence of coronary heart disease. This measurement has some predictive value for patients suffering from this disease. In most studies of this kind, however, information has been obtained indirectly by analyzing the serum lipid levels of the living population on the one hand, and the results of the postmortem prevalence of the disease on the other. Postmortem studies have rarely been carried out on the serum lipid levels and the degree of atherosclerosis in the same individuals (4–8), as in the present study.

EXPERIMENTAL

Serum Cholesterol Levels after Death in Clinical Cases

The investigation of postmortem serum cholesterol levels in clinical cases was considered because of the possibility of including them in the study of the relationship between lipid levels and the severity of the atherosclerotic lesions.

Blood samples were obtained from nine patients who died at the Roosevelt Hospital in Guatemala City, by puncturing the vena cava with a transfer pipette at its heart junction. In all cases, the time elapsed from death to sampling was within 2–5 hr. Serum cholesterol was determined in duplicate samples by the method of Abell et al. (9). The standard error of measurement was 3.29 mg and the coefficient of variation 3.35%.

The results obtained from the postmortem serum cholesterol determinations in clinical cases dying at the hospital are shown in Table I. Several cases showed abnormally low levels of serum cholesterol which were related to the cause of death, duration of prior hospitalization and, in particular, to the nature of the agonal period. These cases need to be eliminated from any study of the relationship between serum lipid levels and the severity of aortic atherosclerosis. Merkel (10) studying postmortem cases, has pointed out that cholesterol levels fall in acute infections and cancer.

TABLE I

Postmortem Serum Cholesterol Levels in Clinical Cases Dying at the Hospital

Case No.	Age, years	Choles-terol Level	Disease
1	20	68	Typhoid fever; perforated typhoid ulcer
2	15 hr	84	Neonatal, specific cause unknown
3	68	53	Bacterial mitral endo-carditis
4	3	52	First- and second-degree burns
5	9	192	Acute pyelonephritis; right kidney agenesia
6	4	178	Tuberculous meningitis
7	52	38	Acute ulcerative colitis
8	51	121	Diabetic glomeruloneph-ritis
9	18	64	Myeloid leukemia

TABLE II

Distribution of Types of Aortic Lesions in Sudden Accidental Deaths

Number of Cases	Age, years				
	10-19	20-29	30-39	40-49	50+
Male	3	12	7	7	4
Female	3	3	3	0	1
Total	6	15	10	7	5
Percent distri-bution	14.0	34.9	23.2	16.3	11.6
Number of cases with lipid streaks only	5	15	10	2	1
Number of cases with fibrous plaques	1	0	0	5	4

Serum Lipid Levels and Aortic Atherosclerotic Lesions in Sudden Accidental Deaths

As clinical cases showed serum cholesterol levels that probably do not represent the values during life and therefore are not adequate for the study of the association of serum lipid levels with atherosclerotic lesions, a group of 43 sudden accidental deaths from the National Med-ico-Legal Service in Guatemala City was obtained. Postmortem blood samples were collected, in the manner already described, within 2–5 hr after death. Aorta and coronary arteries were prepared for staining and grading, using the method indicated by the International Atherosclerosis Project (IAP) (11). Cholesterol was determined by the method of Abell et al. (9), and lipid phosphorus by the method of Zil-versmit and Davis (12).

Aortas showing lipid streaks only were ranked according to the extent of the lesions. The group showing fibrous plaques was ranked in the same manner. Spearman's rank correlation co-efficients as well as product moment correlation coefficients were calculated for aortic lesions and lipid levels, as well as for serum cholesterol and serum lipid phosphorus.

Table II gives the distribution by age and the type of aortic lesion observed. It can be seen that the older groups showed more cases with fibrous plaques than the younger ones. One case out of six had fibrous plaques in the 10- to 19-year age group, while five out of seven, and four out of five were observed in the age groups of 40–49 and over 50 years, respectively. No cases with fibrous plaques were observed in the 20- to 29- and 30- to 39-year groups. This distribu-tion of aortic lesions agrees very well with larger series reported in Guatemala (13). It was shown for example, that the Guatemalan popu-lation does not develop complicated athero-sclerotic lesions until later in life and that the predominant aortic lesions are the lipid streaks and fibrous plaques.

The age-related postmortem values for se-rum cholesterol are given in Table III. Choles-terol levels were higher than those reported for rural Guatemalan groups (14, 15) and similar to the values obtained in urban upper socio-economic groups in Guatemala City (15). This suggests that the majority of cases studied belong to the latter socioeconomic group. This table also shows a tendency for cholesterol levels to increase with age. The increase in cholesterol levels with age is a well-known fact in popu-lation groups with a high death rate due to car-diovascular diseases (16–18). This increase in cholesterol levels, however, is not seen in rural Guatemalan Indians (14).

Table III gives the serum lipid phosphorus levels by age. The lipid phosphorus concentra-tion is also much higher than reported for rural

Guatemalan Indians (14) and similar to those for upper socioeconomic Guatemalan urbanites.

The Spearman's rank correlation coefficients between aortic lesions and serum lipids are shown in Table IV.

No significant correlation was observed between either the aortic lesions and serum cholesterol, aortic lesions and serum lipid phosphorus, or aortic lesions and serum cholesterol-to-lipid phosphorus ratios. The product moment correlation coefficient of serum cholesterol and serum lipid phosphorus of 0.57 was significant at the 1% level of probability. No calculation of correlation coefficients was attempted with the coronary lesions because of the small number of cases with lesions in this artery.

COMMENTS

Several authors have indicated a relative stability of serum lipid levels in postmortem blood samples even when taken several hours after death (6, 8, 10).

In 143 consecutive sudden deaths, Spain et al. (8) reported a close correlation between the degree of coronary atherosclerosis and the serum beta-lipoprotein pattern. This correlation was most accurately reflected in females and in the mesomorphic males. The ectomorphic males studied, however, revealed no significant relationship between the degree of coronary

TABLE III

Postmortem Serum Lipid Levels in Sudden Accidental Deaths in Guatemala City, mg/100 ml

	Age, years				
	10-19	20-29	30-39	40-49	50+
Number of cases	6	15	10	7	5
Serum Cholesterol					
Mean	176	186	199	242	168
Standard deviation	40	38	55	50	28
Serum Lipid Phosphorus					
Mean	9.5	10.0	9.3	11.4	9.0
Standard deviation	2.0	3.7	3.7	2.6	1.8

TABLE IV

Spearman's Rank Correlation Coefficients between Aortic Lesions and Serum Lipids

	df	Choles-terol	Lipid Phos-phorus	Choles-terol-to-Lipid Phos-phorus Ratio
Lipid streaks	31	−0.13	0.13	0.01
Fibrous plaques	7	−0.12	−0.03	0.35

df = degrees of freedom.

atherosclerosis and the serum beta-lipoprotein pattern.

The lack of association between serum cholesterol and aortic lesions encountered in this study agrees with the sets of several other authors. Landé and Sperry (4) failed to find a correlation between the level of cholesterol in blood serum and the degree of atherosclerotic changes. In 106 cases studied, Marek et al. (7) concluded that the level of cholesterol does not vary directly with the intensity and localization of atherosclerotic changes. Also, no relationship was found between free cholesterol in arterial walls and the total cholesterol in blood serum. In 200 cases from medicolegal autopsies, Mathur et al. (6) found no correlations between serum cholesterol and atherosclerosis (AI).

From 50 fatalities in a series of 800 patients (40–90 years), Paterson et al. (5) have shown that total serum cholesterol and S_f 12–20, S_f 20–100 and S_f 100–400 lipoproteins are not associated with the morphologic grade of atherosclerosis for the abdominal aorta, coronary, cerebral, and femoral arteries. They reported that the serum cholesterol-to-phospholipid ratio and S_f 0–12 lipoprotein concentration are related to atherogenesis, but they indicated that these results were not consistent. In this case, significant correlations were obtained between the cholesterol-to-phospholipid ratio and coronary arteries, but not with other vessels; also between S_f 0–12

lipoprotein levels and coronary arteries, and between these same levels and the abdominal aorta.

Although the number of subjects in the present series may be considered too small to permit significant assessment of the problem under investigation, several general comments could be made.

Because severe complicated lesions were not present in older individuals, particularly above the age 40, one might assume that those cases with complicated lesions had died from causes other than "sudden accidental death," and thereby eliminated themselves from the available pool of individuals subject to accidental death. Therefore, the possibility of including cases with abnormal serum lipid levels and severe atherosclerotic disease would be small. This does not apply in the present series because previous observations in Guatemala (13) have shown that this population is relatively free of complicated severe atherosclerotic lesions. The findings on aortic lesions reported here, therefore, can be taken as representative of the Guatemalan population.

Another possibility is that the serum lipid levels studied are not associated with the development of lipid streak or fibrous plaque lesions. It has been shown in this respect that lipid streak lesions appear early in life in all population groups regardless of food habits and serum cholesterol levels (19).

Although in the present series there was no correlation between serum lipid levels at death and aortic atherosclerotic lesions, it is recognized that the lipid levels of an earlier period in the subject's life might have had a more significant influence.

SUMMARY

Postmortem blood samples were collected from 43 individuals, who died suddenly in accidents in Guatemala City, within 2–5 hr after death. Aortas and coronary arteries were obtained for staining and grading.

No significant correlation was found between the extent of the lipid streak or fibrous plaque lesions in the aorta and either serum cholesterol or lipid phosphorus concentration, or serum cholesterol-to-lipid phosphorus ratio. Correlation with the coronary lesions could not be calculated due to the small number of cases presenting such lesions. Although there was no correlation between serum lipid levels at death and aortic atherosclerotic lesions, it is recognized that the lipid levels of an earlier period in the subject's life might have had a more significant influence.

The postmortem serum cholesterol levels of nine patients dying in the hospital were abnormally low in some cases, because of the specific cause of death, time of prior hospitalization and, in particular, of the agonal period suffered before death. These cases need to be eliminated from any study of the relationship between serum lipid levels and atherosclerosis.

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