Atheromatous Plaques in Aortas of Essential Fatty Acid Deficient Rats. (30369)

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Previous reports(1-3) indicate that experimental production of gross atherosclerosis in the rat was accomplished by feeding diets high in cholesterol and fat, supplemented with thiouracil. Hegstead *et al*(4) reported Sudanophilic staining in aortic tissue of male rats fed in casein (10%)-glucose diet containing cholesterol and cholic acid. Morin *et al.*(5) found no aortic atherosclerosis in male rats fed a casein (8.1%)-sucrose diet deficient in dietary fat but supplemented with cholesterol and cholic acid. Recently Morin, Bernick, and Alfin-Slater(6) showed that coronary atheromas were produced in EFA (essential fatty acid)-deficient rats by addition of 20% hydrogenated coconut oil to a cholesterol-cholic acid supplemented diet, but the development of aortic atherosclerosis was not reported.

Methods. Forty-four 3-week-old weanling Charles River C-D strain rats (22 males, 22 females) were fed a 2% cholesterol-20% coconut oil-1% taurocholate diet(7) deficient in EFA. An equal number of animals were fed a control diet of the following percentage composition: sucrose, 70.0; casein, 18.0; corn oil, 5.0; salt mix, 4.5; vitamin mix, 2.5. The composition of the mineral and vitamin mixes has been described previously(7). Six male and 6 female rats from each group were sacrificed at 13 and 25 weeks of age and the remaining animals sacrificed at 55 weeks of age. The intimal surface of the thoracic and abdominal sections of the aorta were scored as to gross and stereomicroscopic ($\times$ 14) appearance using the following criteria: normal, slightly fatty and/or slightly thickened, fatty and/or thickened, atherosclerotic (discernible plaque formation).

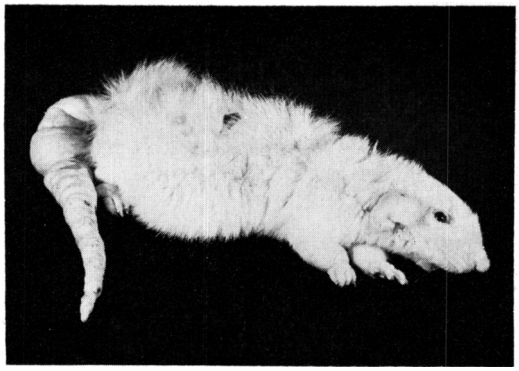

FIG. 1. Female rat fed an EFA-deficient diet for 1 year. Thickened appendages were due to unusual fatty deposits and not edema.

Results. After one year on the cholesterol-fat diet, female rats exhibited enlarged paws, ears, face, and tail and dermatitis probably indicative of EFA deficiency (Fig. 1). Male rats did not show any of these changes. As seen in Table I, some male rats did exhibit fattiness and/or thickening of the aorta but no discernible atheromatous plaques. However, female rats fed the experimental cholesterol-fat diet for one year developed gross atheromatous plaques in the abdominal section of the aorta (Fig. 2); whereas the thoracic aorta did not. Atheromatous plaques were not observed in 13- and 25-week-old female rats.

Discussion. The apparent difference between the sexes in the development of athero-

TABLE I. Aortic Appearance After 1 Year on Test Diets.

Aortic appearance	Atherogenic diet		Non-atherogenic diet	
	T*	A	T	A
Normal	5♂, 3♀	2♂	10♂, 10♀	3♂, 10♀
Slightly fatty and/or thickened	5♂, 7♀	4♂, 2♀		5♂
Fatty and/or thickened		4♂, 3♀		2♂
Atherosclerotic†		5♀		

* T is thoracic section of aorta, A is abdominal section.
† Atherosclerotic: discernible plaque formation.

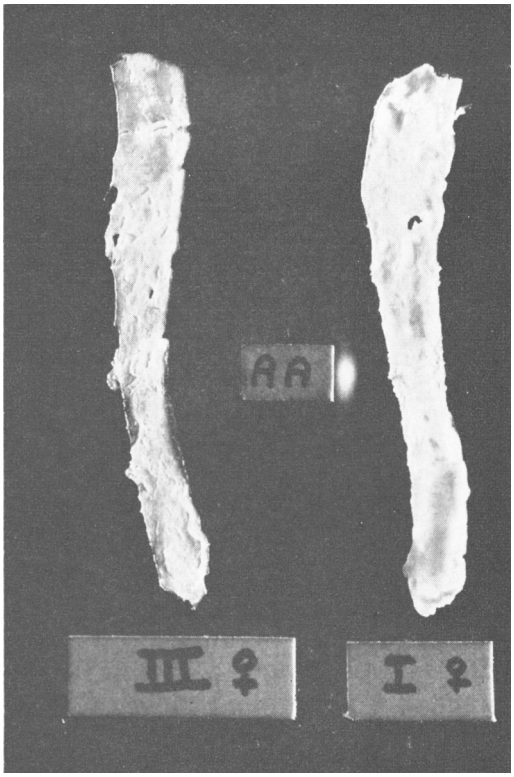

FIG. 2. Number I is the abdominal aorta (AA) of a female rat fed a cholesterol-fat atherogenic diet. Number III is that of a female rat fed a non-atherogenic diet. Aorta number I is atherosclerotic. Thickening of the aorta is indicated by its whiter appearance. Atheromatous plaques appear as shaded ridges.

sclerosis is interesting, since it is the general belief that the male is more disposed to develop the disease. These data indicate that, under the conditions described, the contrary occurs in the rat. This may explain why Morin and co-workers(5) did not detect aortic atherosclerosis in their experimental male rats. Recently, Wexler(8) reported that repeatedly bred female rats will develop grossly recognizable arteriosclerosis; whereas the male breeder's arterial lesion remains microscopic.

The thickened paws, ears, tail, and face observed in atherosclerotic female rats were not due to edema, but were composed of a hard fat similar in physical appearance to the cholesterol fatty liver found in these animals. Dietary cholesterol will accelerate an EFA deficiency in the rat(9), and it has been demonstrated by Alfin-Slater and Bernick(10,11) that exogenous cholesterol will accumulate in tissues of EFA-deficient animals. The unusual fatty deposition observed was probably precipitated by the feeding of an EFA-deficient diet containing cholesterol and a saturated fat, and possibly was a result of defective cholesterol transport in the EFA-deficient rat.

Summary. Gross atherosclerotic plaques were produced in the abdominal aortas of female rats maintained for one year on a diet deficient in essential fatty acids but with an elevated content of cholesterol and saturated fat. Male rates were not similarly affected.

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