MYOCARDIAL EFFECTS OF DOCOSENOIC FATTY ACID ISOMERS IN RATS AND MONKEYS. A COMPARATIVE STUDY

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MATERIALS AND METHODS

Two widely used dietary lipids, rapeseed (Brassica sp.) oil (RSO) and herring oil (HO), containing docosenoic fatty acids (RSO with 25.8 % 22:1 as erucic acid; partially hydrogenated HO (PHHO) containing 26.8 % 22:1 as cis-docos-11-enoic acid) were fed to Spraque-Dawley rats and Cynomolgus monkeys (Macaca fascicularis). For details see (8, 12).

Rats received RSO and PHHO up to 8 months each, and monkeys for 4 months. Other Cynomolgus monkeys were placed on a PHHO diet for a longer period of time, with blood sampling, physiological and biochemical measurements carried out at 6, 12, 18 and 24 months, and necropsies performed at 6 and 12 months. This study is still continuing until 30 months are completed.

RESULTS OF BIOCHEMICAL TESTS

PHHO fed rats had significantly lower blood cholesterol levels than controls (RSO not tested). In the primates both RSO and PHHO feeding at 4 months duration resulted in higher blood cholesterol concentrations, which remained high in the PHHO group after 4 months. Triglyceride concentrations, thyroxine (T 4) values, LDH or HBDH activities did not reveal any significant intergroup differences. In the PHHO fed monkeys serum GOT and CPK values were occasionally higher and GGTP was consistently higher.

RESULTS OF MYOCARDIAL CONTRACTION STRENGTH AND CONDUCTIVITY TESTS, AND MITOCHONDRIAL STUDIES

After four month of feeding RSO and PHHO, myocardial contraction strength and conductivity tests of monkey hearts did not show any intergroup differences. PHHO feeding of 6 months caused a slight depression of the oxygen uptake by isolated heart mitochondria in the monkeys (5). In rats, palmityl CoA oxidation was significantly increased after 10 weeks of feeding PHHO (5).

NECROPSY FINDINGS

Rats fed RSO and PHHO developed severe lipidosis of skeletal and myocardial muscle and focal myocarditis and fibrosis in all groups. Small foci of myocardial inflammation occurred in all monkeys, but foci of fibrosis or scarring have not been observed in monkeys after 4 months of feeding RSO, and 4, 6 and 12 months of feeding PHHO, respectively. However, the myocarditis index (decimal equivalent of number of foci of inflammation divided by number of sections examined) rose slightly, yet remained well below the indices obtained for rats fed PHHO for up to 32 weeks.

Electromicroscopic studies confirmed the extensive lipidosis in skeletal and myocardial muscle of monkeys and revealed moderate mitochondrial degenerative changes in both RSO and PHHO fed monkeys.

DISCUSSION

The light microscopic findings may be classified as myocarditis of unknown etiology (9, 13), and do not resemble findings observed in rats fed the same diet (12), or after feeding other high-lipid content diets (for references see 1, 7). However, it should be noted that the myocarditis index rose from the time of a first observation (4 months) to the 12 months observation period (last observation so far) after feeding PHHO. The ultrastructural findings are in agreement with those described for rats (2, 3, 4, 11, 14, 16) and pigs (10, 15) fed diets containing high C:22 content. It is possible that the accumulated fat inhibits the mitochondrial respiration thus supporting the results obtained from mitochondrial respiration studies. Prolonged feeding of PHHO however does not appear to aggravate this pattern.

Besides the consistently higher blood cholesterol levels, the various biochemical tests do not suggest any significant deviations from the control animals.

CONCLUSION

Although feeding of mustard oil with a 40 to 44 % C 22 content resulted in myocarditis and fibrosis after one year of feeding (6), it is concluded that the primate heart may respond differently from the rat heart to dietary oils containing about 25 % of the fatty acids as C:22. This may be a true species difference; but one has to consider the fact that a 12 months feeding period (so far) is about 1/15 of the total lifespan in Cynomolgus monkeys as compared to a feeding period of about 1/5 of the total lifespan in rats (after 8 months of feeding). Results obtained at the time of termination of this experiment will probably help to answer this question.

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