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Comparison of ^{95}Zr and ^{95}Nb Distributions in Maternal and Fetal Rabbit Tissues.* (30122)

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(Introduced by G. V. Taplin)

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The fission products ^{95}Zr and ^{95}Nb form a radioactive "parent-daughter" pair whose metabolic behavior in animals and man is of interest because of their appearance in the environment following the detonation of nuclear devices. Peaks in the concentrations of ^{95}Zr-^{95}Nb on airborne particles were observed during early 1962 and 1963(1), and these nuclides have been identified in food(2) and humans(3,4). The early work of Hamilton and associates(5) and others(6,7) has shown that small but measurable amounts of ^{95}Zr-^{95}Nb can enter the mammalian body *via* ingestion and inhalation. ^{95}Zr and ^{95}Nb both emit gamma rays, but their energies (0.72-0.76 Mev) are so similar that it is impractical to assay the amounts of each nuclide in a mixture by γ-scintillation spectrometry. This has made it difficult to compare the metabolic behavior of the parent ^{95}Zr to that of the daughter ^{95}Nb, in the carrier-free condition. Sastry *et al*(8) approached this problem by determining the effective physical half life of γ-activity in tissues obtained from rats following intraperitoneal administration of ^{95}Zr-^{95}Nb. They utilized the fact that the physical half life of ^{95}Zr is 65 days while that of ^{95}Nb is 35, and reported that bone tissue accumulated more ^{95}Zr than ^{95}Nb. However, we have found no published data on the transplacental movement and subsequent disposition of these isotopes between a pregnant animal and its fetus. The purpose of the work now to be reported was to compare the distribution of ^{95}Zr and ^{95}Nb in an adult mammal to that in the growing fetus.

Methods. Five pregnant Dutch rabbits, estimated to be within one week of completion of full term, each received an intravenous injection of approximately 50 μc carrier free ^{95}Zr-^{95}Nb as oxalates in normal saline solution. The ^{95}Zr/^{95}Nb ratio was 1.38 expressed in terms of gamma activity of each nuclide after separation by ion exchange as described below. Twenty-four hours later each was killed with intravenous barbiturate and weighed samples of the following tissues were obtained; muscle, liver, kidney, tibial metaphysis and tibial diaphysis from the maternal body; the same tissues pooled from 3-4 fetuses of the liter; and placental tissue. All tissues were ashed at 600°C and dissolved in 15 ml of 12 N-HCl containing 0.2 ml of concentrated HNO_3. The ^{95}Zr was then separated from the ^{95}Nb in each sample by slow addition of the acid solution to an anion ex-

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TABLE I. Concentrations of ^{95}Zr and ^{95}Nb in Maternal and Fetal Tissues.

	^{95}Zr		^{95}Nb		
	Mean	Range	Mean	Range	^{95}Nb/^{95}Zr
Maternal					
Muscle	.03	.002- .07	1.05	.44- 1.35	35
Liver	.84	.37 - 1.28	15.0	8.73- 22.2	18
Kidney	1.22	.64 - 2.19	26.0	13.2 - 38.8	21
Tibia head	12.7	2.24 -37.1	.52	0- 1.84	.04
" shaft	4.79	1.77 -11.7	.52	0- 2.77	.1
Fetal					
Muscle	.56	.07 - 1.55	.00	<.002	<.002
Liver	.18	.05 - .28	81.2	31.8 -131	450
Kidney	.61	.16 - 1.50	.07	0- .21	.1
Tibia head	9.12	2.00 -19.6	47.2	14.7 - 99.1	5.2
" shaft	22.9	7.5 -50.6	54.5	12.1 - 98.2	2.4
Placental	2.12	.67 - 3.88	47.1	27.2 - 58.2	22

All tabulated values are to be multiplied by 10^{-2} and are expressed as % of dose per g of wet tissue. Each mean value is for the tissues from 5 pregnant rabbits. The ratio of ^{95}Nb/^{95}Zr in the dose was 1.38 on day of injection which was the date to which all counting data were corrected.

change column 0.7 cm × 15 cm (Dowex 1-X2), followed by elution with a solution 12 N in HCl and 0.06 N in HF, according to the method of Wish(9). For each tissue sample 25 successive 8 ml eluate fractions were collected in vials, following which the column fluid residue and resin were transferred to similar vials. All eluate vials were then made up to a volume of 15 ml with HCl to standardize geometry and were then counted in a NaI well crystal gamma detector with an automatic sample changer and single channel pulse height analyzer within 3 days of the time of separation. A dose aliquot of the solution used for injection was also treated in the same manner—including the ashing step which was necessary to destroy the original oxalate complexes which would otherwise interfere with the ion exchange separation. Counting times were sufficient to reduce statistical counting error to below 3%. Fractions 9 to 16 usually contained the ^{95}Zr activity and 18 to 23 the ^{95}Nb activity (verified by rough estimation of half life). All other fractions, including the resin, contained negligible radioactivity. Since the sample preparation and counting of the more than 1,100 separate eluate fractions required several months, all ^{95}Nb results were corrected for radioactive decay during the time between injection and date of counting. All ^{95}Zr results were corrected for decay of ^{95}Zr and simultaneous ingrowth of fresh ^{95}Nb between date of injection and date of counting by a standard method(10).

Results. The mean concentrations of ^{95}Zr and of ^{95}Nb found in each tissue are presented in the Table, from which the following conclusions may be drawn:

(1) Both ^{95}Zr and ^{95}Nb cross the placental membrane into the rabbit fetus after introduction of the carrier-free oxalates into the maternal blood; (2) All tissues examined exhibited a higher concentration of ^{95}Nb than of ^{95}Zr, in terms of percent of dose injected, except maternal bone, fetal muscle and fetal kidney. The fetal muscle and kidney contained measurable amounts of ^{95}Zr, but practically no ^{95}Nb. (3) In the mother, for ^{95}Zr, bone accumulated the highest concentration among the maternal tissues whereas for ^{95}Nb, the kidneys and liver received the greatest concentrations, with very little ^{95}Nb appearing in the bones. (4) In the fetus, in the case of ^{95}Zr, bone again accumulated a much greater concentration than the other fetal tissues. For ^{95}Nb the liver showed a very high concentration—even greater than in maternal liver. Practically none appeared in the fetal kidneys in contradistinction to the high burden of ^{95}Nb in the maternal kidneys. It is conceivable that this low accumulation of ^{95}Nb in fetal kidneys is related to a functional immaturity. (5) The fetal bones showed a surprisingly high deposition of ^{95}Nb in view of the very small concentrations of ^{95}Nb

in the maternal bones. (6) These observations illustrate the likelihood of introducing serious errors in theoretical calculations of radiation dosages to fetal tissues by estimating fetal tissue distributions from data obtained from adult animals. For example, in the case of ^{95}Zr, bone is the target tissue of greatest concern in both the maternal and fetal body, since concentrations were 5-20 times those in the other tissues, at least at 24 hours following contamination. For ^{95}Nb the liver and kidneys receive the greatest burden in the maternal body, but in the fetus on the other hand, liver and bone attain even higher concentrations. (7) Rigorous conclusions regarding the relative ease of transport of ^{95}Zr *vs* ^{95}Nb across the placenta cannot be drawn from this data. For example, although there was more ^{95}Nb than ^{95}Zr in the fetal bone and liver, the reverse was true for fetal muscle and kidney. Thus the large differences in avidity for these radionuclides among the various fetal tissues obscured any possible differences in placental transport, *per se*. Information concerning relative turnover rates in the tissues and the fate of ^{95}Nb which "grows in" from the decay of deposited ^{95}Zr must await further experimentation.

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Plasma and Tissue Lipids in Hypercholesteremic Pigeons. (30123)

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We reported earlier that feeding vegetable oils, especially sesame oil, along with cholesterol increased total cholesterol, phospholipids, β-lipoprotein cholesterol, triglycerides and free fatty acids of plasma in monkeys(1) and chicks(2). There was also disturbances in the distribution of lipids in the tissues of the monkeys(3). As pigeons are susceptible to natural atherosclerosis, it was our interest to study the effect of feeding sesame oil with or without simultaneous administration of cholesterol on the different fractions of plasma and tissue lipids in these birds.

Materials and methods. Three-months-old pigeons *(Columbia livia)* were fed the basal diet(1) for one week, to make them accustomed to the diet, and divided into 3 groups. Group A birds received only the basal diet. Group B birds received the basal diet mixed with sesame oil at 10% level and birds of Group C received the basal diet mixed with sesame oil (10%) and cholesterol (1%). All birds were fed 5 mg ascorbic acid per bird and 2 drops of a concentrate of vit. A once a week. Each bird consumed daily about 30 g of the diet.

After 8 weeks on these diets, the pigeons were fasted overnight and blood collected by cardiac puncture in heparinized tubes. They were killed subsequently by decapitation, different tissues were removed, freed from adherent blood and weighed. Weighed portions of liver, brain, heart, skin and carcass were cut into small pieces, dried at 60°, Soxhleted