11449 P

Transfer of Radioactive Sodium Across the Placenta of the Cat.*

LOUIS B. FLEXNER AND HERBERT A. POHL. (Introduced by C. G. Hartman.)

From the Department of Anatomy, The Johns Hopkins University.

Radioactive sodium, Na_{24}, was prepared by use of the electrostatic pressure generator of the Department of Terrestrial Magnetism, Carnegie Institute of Washington. Samples emitting about 10^5 beta-rays per second were injected intravenously, as the chloride, into pregnant cats. At various intervals of time after injection, fetuses were removed by Caesarian section and a sample of blood taken from the mother. The radioactivity of the samples, in terms of beta-particles per second, was measured by a pressure ionization chamber and string electrometer, using the method previously described.[1]

Typical data are presented in Tables I and II. Analysis of these data reveal the following relationships:

1. Table I. The fetus near term comes to within 10% of a limiting equilibrium value with respect to sodium ion in the maternal plasma only after 12 to 18 hours. This is in striking contrast to the extracellular fluid of the mother which comes to the same value in about 4 minutes.[2]

2. Table II, column 6. The rate of transfer across the placenta per unit weight of placenta is very low in early stages of pregnancy (gestation age, 15 to 20 days) but increases in linear manner to a

TABLE I.

Delivery time of fetus after injection of Na_{24}, hours	Fetal wt, g	Betas/sec/ total fetus*	Betas/sec/ g fetus
1.0	132	2.11	.0160
6.7	116	11.9	.102
19.0	96	19.5	.206
23.5	130	26.0	.200

*In each instance the number of beta-particles per second emitted by the sample (in all directions) has been corrected for background and radioactive decay and to unit activity of the maternal blood plasma. This makes the data from the several experiments immediately comparable.

These fetuses have a gestation age of 55 days or over.

* Aided by a grant from the Rockefeller Foundation Fluid Research Fund of the School of Medicine, Johns Hopkins University.

1 Flexner, L. B., and Roberts, R. B., *Am. J. Physiol.*, 1939, **128**, 154.

2 Hevesy, G., *J. Chem. Soc.*, 1939, **1939**, 1213.

value 60 times that of the early stage at a gestation age of 57 days. After this stage, the rate of transfer per unit weight of placenta decreases somewhat until term (62 days).

3. Table II, column 5. The rate of transfer to a unit weight of fetus, however, is high in early stages and falls with the duration of pregnancy. For example, the ratios of rates of transfer for gestation ages of 15-20 days, 40 days and 60 days are 5.5:2.5:1. The relatively high rate of transfer per unit weight of fetus in the youngest fetuses is accounted for by the large size of the placenta compared to that of the fetus (Table II, columns 2 and 3).

TABLE II.

Gestation age days	Fetal wt, g	Placental wt, g	Betas/sec/ total fetus/hr*	Betas/sec/g fetus/hr	Betas/sec transferred/g placenta/hr
15-20	.15	7	0.013	.085	.002
40	15.0	17.7	0.61	.041	.035
50	52.0	13.5	1.20	.023	.089
57	102.0	13.6	1.60	.0157	.118
62	132.0	25.4	2.11	.0160	.083

*Corrected for background and radioactive decay, and to unit activity of the maternal blood plasma as in Table I.

4. Using the data of Coronios,[3] a curve has been constructed relating the percentage daily increase in fetal weight to the fetal age. This curve parallels a curve relating the rate of transfer of Na_{24} per unit weight of fetus to fetal age. It consequently appears that changes in rate of fetal growth in the cat are accompanied by parallel changes in rate of placental transfer per unit weight of fetus.

The study presented here is part of a comprehensive investigation now proceeding on the comparative physiology of the placenta as revealed by radioactive isotopes.

We are indebted to Dean B. Cowie of the National Cancer Institute for making the sodium bombardments with the Carnegie generator.

[3] Coronios, J. D., *Genetic Psychol. Monographs*, 1933, **14**, 283.