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05/27/94 09:44 703-703-7033 MAY 26'94 13:35 No.005 P.11

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Reprinted from COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY
VOLUME XIII · 1948

THEORETIC AND EXPERIMENTAL CONSIDERATIONS OF BIOLOGIC DECAY PERIODS: STUDIES IN MAN WITH THE USE OF Na^{22}

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The rates of turnover of isotopes in organisms or isolated compartments of organisms are of considerable interest to general and human biologists. For obvious reasons, most studies of biologic decay of tracer materials have been conducted in small organisms or experimental animals. Through the kindness of Drs. A. L. Hughes and Martin Kamen of Washington University and Drs. M. Tuve and Dean Cowie of the Carnegie Institution in Washington, Na^{22} was obtained for certain experiments in man. Because of its long physical half-life (3 years), Na^{22} is the only isotope of sodium suitable for tracer studies which require relatively long periods of time. Although these studies were not designed primarily for observation of biologic decay periods in man, the data were suitable for analyses concerned with such problems both in normal man and in patients with chronic congestive heart failure or with the nephrotic syndrome of chronic glomerulonephritis. The rates of biologic decay were influenced by drugs and dietary factors studied in these experiments. Theoretic considerations, which are of some interest in tracer principles in general, were applied. It is the purpose of this presentation to summarize these data, which will be reported in more detail elsewhere (Burch, Threefoot and Reaser, 1948; Threefoot, Burch and Reaser, 1949; and Burch, Threefoot and Cronvich, 1949).

MATERIALS AND METHODS

Twelve subjects were observed continuously for periods varying from 20 to 90 days. Four of these were normal, six had chronic congestive heart failure (2 slowly improving, 2 rapidly improving and 2 slowly becoming worse) and two had the nephrotic syndrome of chronic glomerulonephritis (see Table 1 for details).

Na^{22}, as NaCl in approximately 2 cc. of water, was administered intravenously to each subject. Doses of Na^{22} with an activity such that there were 17.7×10^6 disintegrations per minute (about 0.09 mc.) were administered to seven of the subjects, 12.5×10^6 (about 0.06 mc.) to three subjects, and 1×10^6 (about 0.05 mc.) to the other two subjects. The dosage was reduced as more sensitive counting equipment became available.

The urine was collected separately at each voiding, and at least daily blood samples were taken. The volume and radioactive count of each sample of urine were recorded so that the total elimination of radiosodium could be determined. Radioactive counts of blood serum were followed as an index of the concentration of radiosodium in the extracellular fluid.

TABLE 1. CLINICAL DATA

Subject No.	Age in years	Sex	Wt., initial, in lbs.	Diagnosis
A. *Normal or control*				
1	41	M	142.3	Ulcerative colitis
2	10	F	134	Acute rheumatic fever
3	44	F	127	Esophageal peptic ulcer
4	39	F	123	Duodenal ulcer
B. *Congestive heart failure* (slowly improving)				
5	47	F	153	Hypertension
6	45	F	182	Arterial hypertension
C. *Congestive heart failure* (rapidly improving)				
7	63	M	131.5	Hypertension
8	47	F	134	Rheumatic heart disease (mitral); auricular fibrillation
D. *Congestive heart failure* (slowly becoming worse)				
9	46	M	155.5	Syphilitic aortic insufficiency
10	54	F	129.5	Hypertension
E. *Chronic hemorrhagic nephritis* (nephrotic syndrome)				
11	15	F	138	Renal function 25-50% normal; slowly improving
12	28	F	145.25	Renal function 25-50% normal

The aliquots of serum and urine were delivered as free falling drops from a calibrated micropipette to the surface of discs of filter paper. When dry, the paper discs were cemented to metal discs so that the quantity and geometric characteristics of each sample remained constant. The preparations were counted for five minutes, and the necessary corrections for background were made. Data were recorded as counts per minute per cubic centimeter of

[1] Aided by grants from the Life Insurance Medical Research Fund, A War Contract No. WD-49-001-MD-309, State Institute for Medical Research, and the Mrs. E. J. Caire Fund for Research in Heart Disease.

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