Studies of Vitamin B_{12} Metabolism by Whole Body Counter
(2) A Double Tracer Absorption Test of ^{58}Co-free-B_{12} and ^{60}Co-bound-B_{12}

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A simultaneous and quantitative absorption test of ^{85}Co-labeled free vitamin B_{12} (free-B_{12}) and ^{60}Co-labeled intrinsic factor bound vitamin B_{12} (bound-B_{12}) was succesfully performed by a whole body counter.

Materials and Methods: The study was carried out on 18 test subject; 8 controls, 4 pernicious anemia, 3 atrophic gastritis and 3 gastrectomy. The overnight fasting subjects were given approximately 1.0μCi (0.30 μg ^{58}Co-free-B_{12} orally followed, one hour later, by the second dose of 0.30 μCi (0.30 μg) ^{60}Co-B_{12} bound to neutralyzed normal human gastric juice, from which unbound ^{60}Co-B_{12} had been removed by a 48 hour-dialysis. The radioactivity measurements were made by a 8 $\times$ 4 inch NaI (T1) scintillation counter in the "Multiple Detector" counting geometry, of which details had been reported in 1967 by Hibino et al. at the 7th Annual Meeting of the Japanese Society of Nuclear Medicine. The energy separation of both ^{58}Co- and ^{60}Co-B_{12} was done by a dual channel pulse height analyzer, set in the energy region of 0.70 to 1.0 MeV for ^{58}Co and in that of 1.0 to 1.5 MeV for ^{60}Co-B_{12}, respectively. The whole body counting of the subjects were performed: 1) before oral dose of radio-B_{12} for body background, 2) immediately following the first does to determine the 100% value and contribution factor for ^{58}Co-B_{12}, 3) immediately following the second dose to determine the 100 % value and contribution factor for ^{60}Co-B_{12}, 4) 7 days later to determine the ammount of both vitamins retained.

Calculation: The ^{60}Co and ^{58}Co activities retained in the body were calculated mathematically by the following equations;

$$^{58}\text{Co activity} = \frac{N_2 - N_1 \times F_1}{1 - F_1 \times F_2}$$

$$^{60}\text{Co activity} = \frac{N_1 - N_2 \times F_2}{1 - F_1 \times F_2}$$

where; N_1 and N_2 were the observed net count rates for ^{60}Co- and ^{58}Co-photopeak, respectively. F_1 and F_2 were the contribution fraction of ^{60}Co photopeak (1.17 and 1.33 Mev) and ^{58}Co photopeak (0.81 MeV) to the photopeak of the other radionuclide, respectively. The observed values for F_1 and F_2 averaged 42.86% of N_1 in 63 cases (range: 36.3-46.8%), and 1.697% of N_2 in 33 cases (range: 0.62-2.69%), respectively. Contribution factors, F_1 and F_2, varied slightly from subject to subject, but with negligible daily fluctuations on the same subject. ^{58}Co activities wer corrected for the energy decay during the test period.

Results and Conclusion: The results were essentially similar with those reported by Reizenstein et al. in 1961 who used, however, hog intrinsic factor concentrates for B_{12} in each group were as follows; 72.3 and 65.5% in control subjects, 6.1 and 45.1% in pernicious anemia, 22.6 and 58.5% in atrophic gastritis, 28.1 and 48.5% in gastrectomized subjects. Control subjects absorbed less intrinsic factor bound B_{12} than free B_{12}, of which mechanisms remained to be determined. The simultaneous quantitation of bound-B_{12} and free-B_{12} could be valuable in rapid and simple diagnosis of intrinsic factor deficiencies as well as in the study of vitamin B_{12} absorption mechanism.