Radiovitamin B₁₂ as a Dilution Indicator in Gastrointestinal Research

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A dilution indicator is valuable in studies of gastric and intestinal emptying and secretion since it makes it possible to follow net changes in intraluminal volumes. According to Hollander and Glickstein 1 a dilution indicator must be (1) nontoxic; (2) not absorbed in the stomach; (3) not destroyed, precipitated, or absorbed by any constituents of the gastric contents; (4) noninterfering with respect to acidity or other determinations; and (5) easily and exactly measured. It may be added that the indicator must be (6) without pharmacological or physical (i.e., osmotic) effects concerning the functions studied; (7) measurable in opaque or bile-stained samples; and (8) usable in parallel with other indicators.

Phenol red, dextran, and polyethylene glycol (PEG) have been used as indicators. Phenol red, which Hollander and Glickstein 1 found to be the only suitable indicator of those used up to 1940, is absorbed in the intestine; hence it can be used only in the stomach. By a special method, phenol red can be determined in the presence of bile and in protein suspension, 2 but we do not know if it can be determined in the presence of opaque fat. Dextran 3 is difficult to measure and is degraded in the lower gastrointestinal tract. PEG 4 (molecular weight 4000) is not destroyed or absorbed during passage through the gastrointestinal tract, but is difficult to measure.

Thus, no indicator used hitherto seems to meet all the specifications mentioned above; it will be shown that radiovitamin B₁₂ does. It is known that it satisfies conditions 1, 5, 6, 7, and 8. It is likewise known that it is not absorbed in the stomach and since, maximally, 1–1.5 μg. are absorbed in the human intestine, 5, 6 the fraction absorbed after a 1000-μg. dose is negligible.

It will be shown that this vitamin satisfies conditions 2, 3, and 4 also.

In order to test the usefulness of radiovitamin B₁₂, it was compared

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with PEG in five secretin tests, using constant infusion into the duodenum of the test substances and duodenal and gastric drainage in 5 normal persons. Eight clinical units of secretin (Vitrum) per kilogram of body weight was injected intravenously, and the juices were collected in every 15 min. for 2 hr.

MATERIAL AND METHODS

IN VITRO STUDIES

A PEG solution was incubated with duodenal juice at 37° C. for 28 days in order to check the effect of bacterial growth and pancreatic enzymes on the PEG measurement. It was tested if the presence of vitamin B₁₂ (Cykobemin, Militärapoteket, Stockholm) influenced the determinations of PEG in vitro in the concentrations used in the following tests.

IN VIVO STUDIES

Radiovitamin B₁₂ and PEG were injected simultaneously and continuously into the duodenum at the level of the papilla of Vater during five secretin tests, and the recovery of the two substances compared. The contents of the duodenum and the stomach were drained continuously and analyzed.

The PEG was analyzed according to Hyddn, with the modification that the standard solutions were mixed with duodenal juice. Radiovitamin B₁₂ was measured in a well-type NaI (Th) crystal scintillation counter.

RESULTS

IN VITRO STUDIES

Incubation of PEG with duodenal juice at 37° C. for 28 days did not alter the PEG concentration. No effect of vitamin B₁₂ upon the determinations of PEG was detected.

IN VIVO STUDIES

The relation between the duodenal concentrations of radiovitamin B₁₂ and PEG in the five secretin tests is shown in Fig. 1. The concentrations are given as percentages of the concentrations in the infused solutions.

The concentrations of radiovitamin B₁₂ were, on an average, 1.045 (S.D., 0.049; S.E. of mean, 0.008) times the corresponding concentration of PEG, which coefficient is highly significantly different from 1.000 (p < 0.001). The correlation coefficient was 0.9982.

In only two secretin tests were gastric samples recovered. The relation