



Chapter 29

ABSORPTION STUDIES

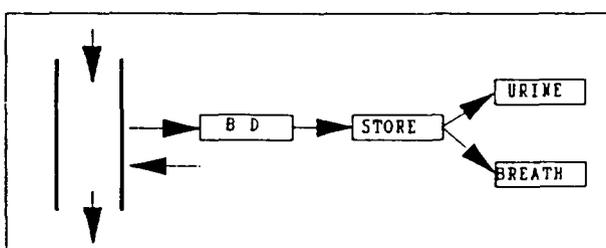
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Introduction

Absorption studies were once quite popular but hardly anyone does them these days. It is easier to estimate the blood level of the nutrient directly by Radioimmunoassay (RIA). However, the information obtained by estimating the blood levels of the nutrients is not the same that can be obtained from the absorption studies. Absorption studies are primarily done to find out whether some of the essential nutrients are absorbed from the gut or not and if they are absorbed, to determine how much is being absorbed. In the advanced countries, these tests were mostly done to detect pernicious anaemia where vitamin B₁₂ is not absorbed because of the lack of the intrinsic factor in the stomach. In the tropical countries, "malabsorption syndrome" is quite common. In this condition, several nutrients like fat, folic acid and vitamin B₁₂ are not absorbed. It is possible to study absorption of these nutrients by radioisotopic absorption studies.

The primary requirement of an absorption study is a labelled nutrient. The radionuclide label should be stable enough so that it is not dissociated in the gut. The basic principle of the tests is quite simple. Labelled nutrient is administered orally to a fasting subject and for quantitative determination total collection of faeces is required for several days. Most of the technology has evolved around finding an appropriate method for reliably counting the collected faeces and counting the administered dose as a standard in an identical geometry. Total collection of the faeces is always unreliable; particularly so in the developing countries

where suitable toilet facilities are not usually available to the patient. This difficulty undermines the diagnostic usefulness of these procedures. In addition, counting of faeces is always an unpleasant task and that also limits their popularity.



Characteristics of the tracer used in absorption studies:

- Radioactive label should be stable. It should not be broken down in the gut, nor should it be re-excreted in the gut.
- The carrier associated with the tracer should be low and constant from one study to the other. For example, in case of vitamin B₁₂ it should be 1 μC per 1 μg .
- Natural label is better than an artificial label because it is less likely to break down. Cobalt radionuclide is a natural label for B₁₂ but ¹³¹I is an artificial label for

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triolein, used for fat absorption studies. In the latter case, the label might alter the metabolic characteristics of the nutrient.

Methods of counting faeces:

- (a) liquify and then homogenize. Definitely not favoured by any one.
- (b) large crystal counter with sample in front or on top of the detector.
- (c) sample between two crystals.
- (d) annular counter; GM, plastic, or liquid scintillation counter.

All these methods have the problem of counting the standard in a comparable way. Unless the patient referral for absorption studies is large, none of the above methods is cost effective.

Schilling's test:

This has been the most widely used test for B₁₂ absorption, especially for the diagnosis of pernicious anaemia, where a qualitative answer is acceptable. Protocol for the test is described in the chapter on Haematology. About 1 μ c of the labelled B₁₂ is given orally. After 30 minutes, a dose of 1 mg of stable B₁₂ is given parenterally, which doesn't allow the labelled B₁₂ to settle down in the stores but flushes it out in the urine. Limitations of the test are that it provides a semi-quantitative answer only, 24 hours urine collection is also not likely to be reliable and the flushing dose is in the therapeutic range, likely to vitiate all other related investigations.

Plasma counting:

Counting of the radioactivity in the plasma sample|weight various times after the administration of the labelled nutrient is also not favoured. Because of the dilution, the counts from an aliquot of blood sample are usually very low.

External counting.

Organ counting for some substances is possible when the organ is conveniently located for external counting (e.g. liver for B₁₂ and iron) and where it is known that the nutrient after absorption is primarily stored.

Whole body counting:

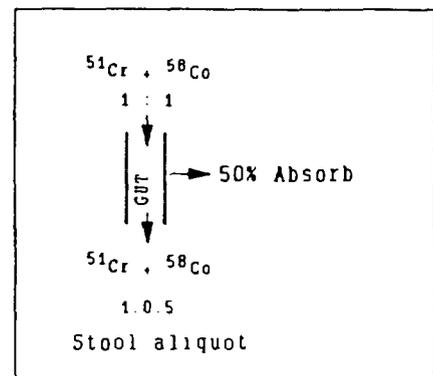
This is reliable but possible only in case of those nutrients where they are not rapidly excreted from the body e.g. B₁₂ or iron. The counting will have to be carried out for several days till a stable count rate is obtained. The counts in the patient immediately after the administration of the oral dose are taken as standard counts but many investigators feel that the ideal time for this would be after the distribution of the substance in the body which is, unfortunately, not a precise point and varying from patient to patient. The method is not

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cost-effective unless the counter is used for other purposes also. If the counter is used for health physics monitoring, the physicists will not tolerate the presence of the patient with administered radioactivity in their counters.

Double tracer technique:

This is an ingenious method to get a quantitative answer by faecal counting without total collection of the faeces. In the method for B₁₂ absorption along with the labelled B₁₂, a non-absorbable marker like radioactive chromic chloride is administered to the patient. Ratio of the two substances in the standard and in an aliquot of the faecal sample obtained at 24 hours allows computation of the amount absorbed. The method has been tried extensively for B₁₂ but can be used for any labelled substance where the energy characteristics of the radionuclide are such that it can be differentiated from that of the unabsorbable marker. The method requires careful spectrometry and a good understanding of the energy spectra of the radioisotopes. The method has been applied for Iron absorption by simultaneous administration of ⁵⁵Fe and ⁵⁹Fe, one by the oral route and the other by the intravenous route and by differential counting of a blood sample.



Radiorespirometry:

The most common application is breath analysis after administration of a ¹⁴C labelled nutrient like fat. The breath is collected in a liquid scintillation vial which traps a constant amount of ¹⁴CO₂. There is a general reluctance to use ¹⁴C in human subjects and this method has never been popular as a clinical diagnostic tool.

Absorption of Bile Acid from the gut:

This is homocholic acid, an analogue of naturally occurring taurocholic acid, labelled with ⁷⁵Se (commonly known as SeHCAT). Normally it is absorbed from the terminal ileum, passes through the liver, excreted in the bile and remains confined to the enterohepatic circulation. If there is no absorption in the ileum, it will be excreted in the faeces. It is usually administered in 10 μ c doses and the patient measurements done in a whole body counter. The first count is for the 100% value and the second count is after seven days. It traces bile acid metabolism and is useful in assessment of ileal function in chronic diarrhoea, Crohn's disease, and after intestinal surgery. In the absence of a whole body counter, attempts have been made at quantitation by placing a gamma camera on the abdominal region. The test is mostly of research interest and the requisite radiopharmaceutical is available from only one commercial firm.

Protein losing enteropathy

This condition is also supposed to be quite common in the developing countries. The total faecal collection is unavoidable in the studies. The radioactive label should be stable and it should not get reabsorbed in the gut. For a quantitative study, it is essential to collect faeces for several days. It is therefore, necessary that the label has a long half life. Macromolecules which resemble protein are usually chosen, for example ^{131}I albumin, ^{131}I PVP, ^{51}Cr albumin, ^{67}Cu ceruloplasmin etc.

As the total collection of faeces is never a favourite with any one these tests are seldom done for routine diagnostic studies. From a plasma disappearance curve of the protein kinetics it is also possible to surmise if there is an abnormal leak from the plasma compartment.

For "malabsorption syndrome" and for the "protein losing enteropathy" no etiology is yet established and there is no specific therapy. This also might be a reason for these tests not being utilized to a great extent in a clinical nuclear medicine department. However, these tests are few of the non-imaging applications of nuclear medicine still surviving.