III. 18. Scintigraphic Assessment of the Intestinal Absorptive Capacity

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Introduction

With the recent advance of the nutritional management, the importance and difficulty have been emphasized in the nutritional support of the patients with various types of malabsorption.\(^1\)\(^-\)\(^6\)

For the purpose of assessing the intestinal absorptive capacity of each nutrient, various clinical tests are now practiced.\(^7\)\(^,\)\(^8\)

In an attempt to develop a more accurate and physiological way, we have introduced PET to assess the intestinal absorption scintigraphically.

Materials and methods

Three normal volunteers and two adult patients who underwent massive bowel resection were studied.

Both of the patients underwent massive resection of the small intestine, and the length of remaining small intestine is about 70 cm in both cases.

One patient has been running an uneventful course on normal diet for 5 years postoperatively, and no particular nutritional support is required.

The other patient is still running a poor course for 1 year after surgery, depending on total parenteral nutrition.

In each subject, intraduodenal feeding tube was placed and same dose of \(^{11}\)C-Methionine (approximately 10 mCi) was given.

And a series of 16 to 21 scans were taken consecutively for a total of 60 minutes, every 2 or 3 minutes for the first 30 minutes, every 5 minutes for the following 30 minutes, to visualize the hepatic uptake dynamically using ECAT- II (Ortec, USA).

ROI(region of interest) was arbitrarily determined on each of the hepatic PET images avoiding the margin of the liver.

And the dynamic change of the radioactivity in the ROI were compared among the subjects.
Results

A typical series of PET image of one normal volunteer is shown in Fig. 1. Dynamic radioactive changes showed similar patterns in three normal volunteers.

The ROI counts increase rapidly for the initial 4 to 7.5 minutes followed by the plateau approximately at the level of 15 to 20 Counts/mCi (Fig. 2).

In case of patients who underwent massive bowel resection, dynamic radioactive changes of the liver are as follows.

In a favorable case, the radioactivity rapidly increases for about 5 minutes following $^{11}$C-Methionine administration and leads to the plateau level of about 15 Counts/mCi.

In a poor case, this count rapidly increases for about 10 minutes and leads to the plateau level of about 23 Counts/mCi (Fig. 2).

Discussion

Various tests based on different principles are now in clinical practice to assess the absorptive capacity for each nutrient.

However, many of them require complicated and troublesome procedure, making it necessary to develop more physiological and convenient method. PET was introduced for our new scintigraphic assessment of intestinal absorptive capacity, because it expectedly meets foregoing requirement.

Although theoretically applicable to all sorts of nutrients, $^{11}$C-Methionine of which metabolic behavior is entirely the same as that of natural amino acid was first used because methionine is one of the essential amino acids and not metabolized by the intestine itself.

In the normal volunteers, the dynamic radioactive changes in the liver documented a similar pattern following enteral administration of $^{11}$C-Methionine as previously described.

On the other hand, Kubota 9) showed that $^{11}$C-Methionine accumulated mainly in the pancreas leading to high pancreas/liver ratio following parenteral administration of $^{11}$C-Methionine.

Unlike intravenous loading, $^{11}$C-Methionine has been demonstrated to accumulate in the liver soon after enteral administration which makes the visualization of the liver reflect the trans-portal hepatic accumulation.

Although intestinal absorptive capacity of the patients who underwent massive intestinal resection is reportedly enhanced in the long run, Andoh et al 6) who investigated 14 cases of pediatric patients with short bowel syndrome documented no functional compensation of the residual intestinal absorptive capacity.

Our scintigraphic assessment based on PET apparently failed to show significant differences in the absorbing patterns between short bowel patients and normal volunteers. Further investigation is needed to establish more appropriate administration protocol of $^{11}$C-Methionine and to clarify the biological significance of the dynamic changes of radioactivity in the liver.
Reference

9) Kubota K., personal communication.

Fig.1. A typical series of PET image of one normal volunteer.
Fig. 2. Dynamic radioactive changes of the liver.