IV. 9. Localization of $^{18}$F-FDG in a Mouth Cavity Using Oral Intake PET Study

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Introduction

$[^{18}\text{F}]$-2-deoxy-2-fluoro-D-glucose (FDG), which has positron emitter, is an analogue of glucose. The FDG is accumulated to high metabolic organs or tissues. We can observe accumulated FDG as a tracer for evaluation of organ or tissue glucose metabolism by Positron Emission Tomography (PET). The FDG-PET method is widely applied to investigate physiological functions of the organs or tumor detection in vivo in human.

Ingestion of foods is one of the most basically behavior of the creatures. Especially a sugar is the most important material for creatures as energy sources. However, sugar reception mechanism by gustatory receptors in the mouth is not still clearly. Because binding force between receptors and ligands is very weak and many kind of receptor exist, we can hardly separate and purify the receptor proteins. So it is difficult to investigate the taste receptors. Recently some kind of candidate receptor proteins is reported$^{1-3)}$. But there are few reports about receptor function and the properties of taste stimuli localization to specific areas of oral cavity.

We attempt to apply the FDG oral intake method to identification of the glucose receptor localization.

Materials and Methods

Seven normal male volunteers (mean age 29.4 ± 3.3 y.o.) were examined using $^{18}$F-FDG and SET-2400W (Shimadzu, Japan) in three-dimensional data acquisition mode.

The Volunteers took in the FDG 0.37 ± 0.02 MBq (10 ± 0.5 μ Ci) in 10 ml water or sucrose water by 30 seconds gargling. After gargling, solution was immediately taken out from the mouth. A sucrose concentration is 100 mM or 500 mM for observation of competitive inhibitions against the FDG. After that they immediately took 30 ml water gargling for twice to wash out non-specific binding the FDG.

Pet scanning time is 15 minutes for emission scanning immediately after taking the FDG. Normally we have one emission scanning, but some case has 3 times. Transmission scanning is performed last 15 minutes using a $^{68}$Ge/$^{68}$Ga external rotating line.
source (370 MBq). PET image data were reconstructed by 3D back projection algorithm using a supercomputer SX-4 (NEC, Japan).  

Results and Discussion

Figure 1 shows one of the typical examples of the PET scan data. We applied about 0.37 MBq for each volunteer. But almost 70% of administration dose is washed out from the mouth. It is means that 30% (almost 0.11 MBq) of FDG was remained of their mouth. It is reasonable result that we estimated from the figures. Left hand side of figure 1 is a copy of PET console display. Right hand side is the 3D image made from the left hand side image plus transmission image. Red one is the tongue or the mouth cavity. Actually it is not so easy to determine the anatomical location of the FDG, but it looks like a tongue. This result shows that some FDG were trapped in the mouth cavity.

Figure 2 shows the summary of the data. The sucrose 0 mM means only water and the FDG. The FDG dose of mouth cavity is decrease on 50 mM and 100m M sucrose data as against no sucrose one. If it is true, it means that there is possibility that the FDG is competitive inhibition material for sucrose binding receptor. But we cannot apply for statistical analysis because number of test is not enough. Anyway we can observe the FDG binding localization in the mouth cavity. Hopefully it is reflected sugar binding receptor. We need to have another data to confirm.

Figure 3 shows that a time course of remaining the FDG in the mouth cavity. We have 2 data of this protocol. Both of them have no deference depending of the time for about 30 minutes. It means that the FDG is hardly removed from receptor or something another binding site in the mouth cavity.

We attempted to make a visualization of taste receptor localization in the mouth cavity. We can show that one of the possibility for this purpose using the FDG-PET. If it is confirmed, we can apply this method not only to investigate receptor characterizations but also to diagnose the illness of the taste reception.

References

Fig. 1(a). The tongue and the mouth cavity image of oral intake $^{18}$F-FDG.
Fig.1(b). The tongue and the mouth cavity image of oral intake $^{18}$F-FDG.
Fig. 2. The result of the analysis. Axis of ordinates shows the data of PET counts (multiply seventh power of ten) per seconds. Axis of abscissas shows the concentration of sucrose. N=15 (0 mM sucrose), N=5 (50 mM sucrose), N=3 (100 mM sucrose). Error bar shows standard deviation.

Fig. 3. Time course of remaining FDG in the mouth cavity.