Symposium III

Today and Future Prospect of Cyclotron Nuclear Medicine

THE CYCLOTRON NUCLEAR MEDICINE PROJECT OF KYUSHU UNIVERSITY HOSPITAL.

Y.Ichiya, K. Matuura. Dep. of Radiology. Faculty of Medicine, Kyushu University. Fukuoka.

We started cyclotron nuclear medicine project of Kyushu University Hospital last year. The construction of the building was started in August of last year and completed in March 83.
We installed a cyclotron in January and started operation in May and also installed a positron camera in June.
We are now studying normal volunteers with 15O-CO2, 15O-O2, 11C-CO gases and planning to start clinical use lately.
We would like to present the situation of our project.
1. The cyclotron nuclear medicine building
The cyclotron nuclear medicine building, which is in the vicinity of the existing clinical nuclear medicine facility, has one basement and two stories with total space of 604 square meters.
There is a cyclotron room, a control room and a hot lab etc. in the basement and two positron CT rooms and a control room etc. on the first floor. When designing it, efforts were focused mainly on the availability for clinical use with the existing nuclear medicine facility. This houses the cyclotron in the basement making it easier to shield from radiation and rooms arranged for the effective operation by small parties.
2. The cyclotron and the apparatus for the production of the labelled compounds
We installed Japan Steel Works (JSW) BC1710 cyclotron which is devoted to the production of short-lived radioisotopes for medical use.
It accelerates fixed energy protons (17 Mev) and deuterons (10 Mev) and is rated for 50 uA variable beam currents.
We have realized 3-5 Ci yield of 11C and 15O labelled gases and over 600 mCi of 18F-F2.
The automated apparatus for the production of 11C-HCN, 13N-NH3 and 15O-H2O are now installed and that for 18F-FDG is under construction.
3. The positron camera
We installed a Shimazu positron camera SET120, which is a three slice machine with two parallel planes of crystals with 64 NaI crystals in each plane. We plan to install new positron camera with BGO detectors in February 84.
4. Future plan
For a while 15O-CO2, 15O-O2 and 11C-CO gases will be used in the clinical study of the brain diseases. later 18F-FDG etc. will be evaluated.

THE ROLE OF POSITRON COMPUTED TOMOGRAPHY IN NUCLEAR MEDICINE.

Y. Yonekura, H. Saji, and R. Morita. Kyoto University School of Medicine, Kyoto.

Recent development of positron computed tomography (PCT) has begun to explore physiological and biochemical mechanism in normal and diseased states. Although this method requires complicated and expensive system in addition to conventional nuclear medicine facilities, more extensive clinical applications are expected. This paper describes the role and the future development of PCT in nuclear medicine.

The major advantages of PCT are 1) availability to label substrates of physiological interest, 2) use of ultra-short lived tracer which provides the capability of repeat studies in the same subject with various intervention and 3) intrinsic quantitative capability, which permit us to obtain quantitative physiological and biochemical measurement. In order to accomplish this purpose, two types of substrates, natural substrates and analog compounds, are being labelled with cyclotron produced ultra-short lived positron emitter. The typical analog compounds for metabolic studies are 2-deoxy-2-(18F)fluoro-D-glucose, 2-deoxy-D-(11C)glucose, and 3-methyl-(11C)heptadecanoic acid. Originally this method was developed by Sokoloff to measure regional glucose metabolism in rat brain using an autoradiographic technique, and now plays an important role in PCT. Future development of this idea is to label these analog compounds with gamma emitter, such as 99mTc and 123I, or positron emitter which is produced by generator system, such as 68Ge-68Ga and 62Zn-62Cu. The success of these labelling will provide more wide clinical use.

Another type of labelled substrates for PCT is natural compound, such as (11C)-palmitate, (11C)glucose, and (11C) or (13N)amino acid. The metabolism of these compounds are very fast and sometimes require complicated model for understanding of kinetics of these compounds. Other natural substrates are radioactive gas, such as 11CO, 13N2, C15O2 and 15O2 which are the most promisive candidates for clinical use of PCT. To measure oxgen metabolism, 15O is the only radionuclide and no alternative substrate can be given. Regional cerebral blood flow measurement with C15O2 inhalation is an interesting use of PCT because of its simple technique and clinical usefulness.

In conclusion, PCT will continue to explore pathophysiology and biochemistry of human beings, and the idea of PCT will be followed by more simple and efficient method for clinical use.