Panel Discussion

Cyclotron Nuclear Medicine

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BABY CYCLOTRON FOR NUCLEAR MEDICINE

Schuichiro Wakasa
The Japan Steel Works, Ltd.

Using the short lived radio nuclides, in a recent nuclear medicine, the study for the application to the diagnosis was rapidly developed and the clinical testing to the patient has now started further. In this case, the short lived radio nuclides, ^{11}C, ^{13}N, ^{15}O and ^{18}F were strongly watched. However, since the necessary that the performance for radio isotope production, labelling, dosing and imaging in a continuous processing shall be done in a short time. Under this circumstance, the relative people are looking forward to the compact cyclotron available to the installation in a hospital for the clinical diagnosis in nuclear medicine.

In answering to this requirement in a nuclear medicine, we, The Japan Steel Works, Ltd. developed the compact cyclotron as in house type with our own philosophy since 1973 . In addition, we challenged and succeeded in developing the automatic changeable target box by the remote control system, R.I. gas processing system, R.I. analysis system, synthesis equipment for labelled compounds as well as the compact cyclotron with the Institute of Physical and Chemical Research in Tokyo & Tohoku University's advice.

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PRODUCTION OF POSITRON EMITTING RADIOPHARMACEUTICALS.

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The application of the positron emitting nuclides in nuclear medicine with a recently developed positron camera and positron tomograph is able to give us the more efficient four dimentional diagnostic image with the in vivo dynamic informations.

The carbon-11, nitrogen-13, oxygen-15 and fluorine-18 are particulary useful nuclides for labelling to the compounds of the biological importance. For the radiopharmaceutical design, the compound such as the bio-metabolic reactant, the metabolic trapping agent, the enzyme inhibitor and receptor binding drug is labelled with the positron emitting nuclid and applied to a diagnosis as the quantitative in vivo tracer. The synthesis of these compounds labelled with the very short half-lives of these nuclides require the development of rapid synthetic and analytic methode.

The modified classical chemical synthesis and biosynthesis have been used in the labelling. And hot atom reaction and radiation reaction are effectable for the symple compounds as the precurcer of further synthesis. The tracer of energy metabolism, ^{11}C-glucose and ^{11}C-fatty acid, is synthesised from $^{11}CO_2$ by bio-photosynthesis and Grignard reaction. ^{18}F-FDG, FDM, FDGal and ^{11}C-β-methyl fatty acid are developed for metabolic trapping of energy metabolic pathway. ^{11}C-, ^{13}N-amino acid have been used to trace the protain synthesis. ^{18}F-fluorouracils, the enzyme inhibitor, are applied to tumor scanning.

And ^{11}C-benzylguanidines which are inhibitor of norepinephylin methyl transferase are incorporate to adrenal grands. ^{11}C-dimethyl triptamine, ^{11}C-acetylcholine, ^{11}C-adenine and ^{18}F-fluoromethane are produced for the brain reseach.

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POSITRON NUCLEAR MEDICINE SCIENCE.

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The field of positron nuclear medicine science consists of three parts; production, measurement and kinetics analysis of positron tracers. A balanced collaboration of these parts is essential for progressive development of positron nuclear medicine science. Positron emission tomograph (PET) is a key tool in this area for assessing tracer distribution in the body tissues. For properly utilizing the PET data, it is important to understand the followings; resolution and partial volume effect, non uniformity of spatial resolution over the field of view, correction methods of attenuation effect, rejection techniques of scatter and random coincidences, statistic noise, system noised caused by mechanical inaccuracy. Ideal PET in future will combine two complementary technologies of the signal amplitude technique and the time of flight. The data of PET measurement are analysed with data of blood activity measured by the well detector. Kinetics analysis of the tracer is carried out using the two data and tracer model. The tracer model is classified into two categories, steady state and dynamics. The knowledge of measurement technique and kinetics of the tracer is indispensable to well understand limitation and accuracy of images of physiological function in vivo.

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CLINICAL APPLICATION OF POSITRON CT IMAGING.

F.Shishido. National Institute of Radiological Sciences, Chiba.

Positron computed tomography (PCT) is a technique that indicates regional functions of various tissues. Since 1979, we have investigated regional functions of cerebrovasclar diseases and neuro-psychatric disease.

At present we began toutilize for myocardial PCT imaging. The used PCT devices are Positologica-I for head and Positologica-II for whole body. The used radiopharmaceuticals are F-18-FDG, N-13-NH3, C-11-CO, O-15-02, and O-15-CO2.

At first we investigated cerebro-vasclar disease, and some interesting evidences were proven. Perfusion-metabolism mismatches are shown in PCT images clearly. One type of this phenomenon is called misery perfusion. Another one is luxury perfusion. PCT images are demonstrated the lesion of distant functional defect with less perfusion defect from forcal infarcted area. PCT images also demonstrates that deficits in metabolism and perfusion are typically larger than those of X-ray CT images.

Next we investivated neuro-psychiatric disorders, such as Huntington's chorea, Alzheimer's disease and schizophrenia. Now we are studying cases of myocardial infarction.

From our investigations PCT images demonstrate the tissue function and hemodynamics, so PCT imaging will take an important role in diagnosis for verious diseases and human biology.