Symposium

Potential of Positron Emission Tomography for Neurological Investigation

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The understanding of complex physiological and pathological process which affect the human brain and mind must be based on knowledge underlying intricated and multi-related regional physiological and metabolic changes occurring in the human brain. Although multi-disciplinary neuro-scientists have developed much sophisticated knowledge of physiological and biochemical events occurring in brain tissue by experimental and in vitro studies, their work has been hampered by difficulty in making direct measurement of specific dynamic and biochemical events occurring in the living human brain during physiological and disease process.

Conventional nuclear medicine detection and imaging using a variety of gamma-emitting radionuclides have been utilized to study complex cerebral events. However, the quality of information obtained is seriously handicapped by some of the fundamental physical limitations and characteristics of these conventional devices.

The positron emitting principle offers the advantages of depth-equal and depth-independent response to give quantitative as well as topographical information in any desirable cross-section of the brain. Besides this superiority of the physical detecting characteristic of the positron detecting principle, several significant developments related to positron emission tomography have made us closer to permitting in vivo quantitative and three dimensional mapping of regional hemodynamic and metabolic information in the human brain using non-invasive techniques. One is the recent development of high efficiency and multi-sliced positron emission tomographic devices. Second is the development of a compact medical cyclotron, coupled with ingenious techniques for rapid synthesis of positron emitting ^{11}C and ^{18}F labelled chemical compounds. Third is the parallel development of the appropriate quantitative biochemical and physiological model.

The positron emission tomography for the investigation of the brain offers promising potential not only as a new diagnostic tool for investigation of the many disorders, but also developing new methods of treatment for many unsolved neurological disorders that affect the human brain and mind.

We have been deeply involved in the development of the positron emission tomography methodology since 1966. We have been particularly engaged in developing a new method for measurement of regional cerebral blood flow by positron emission tomography. I would like to present particularly the current state of CBF measurement by PET and our experience in this field. Also, I would like to further discuss the current state and future plan for various biochemical measurement, pharmaco-kinetic studies and neuro-receptor studies in relation to neurological disorders by positron emission tomography.