IV. 1. Current states of Clinical Use of Positron Emission Tomography: Examples of Western Countries

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Introduction

Positron Emission Tomography (PET) was invented initially as a tool for basic research and did not attract much attention as a clinical diagnostic tool in the United States in the beginning. Similarly in Japan, PET was initially introduced as a research tool in the field of neuroscience. Recently, the term “clinical PET” has become a common key word for hot discussions in the field of nuclear medicine. It seems that the term “clinical” has double meanings. In a broader sense, it simply means all types of studies using human subjects while the term "basic" implies animal studies. In a narrower sense, “clinical” means medical investigations to make clinical decisions for diagnosis and treatment. The international standard is shifting to take the latter definition for “clinical PET” studies. Doctors in many Western countries such as the United States, the United Kingdom, Germany and so on use this term for the investigations already validated and reimbursed by health insurance organizations.

Nowadays, the most important field in clinical PET diagnosis would be oncology. It is interesting to note that the main part of pioneering works in this field was done at Tohoku University. The Cyclotron and Radioisotope Center (CYRIC) at Tohoku University was founded in 1978 as the first PET institute under the Ministry of Education in Japan. Various novel findings in the field of PET oncology have been reported from here. A PET research group at Tohoku University1-3) proposed potential use of PET for detection of malignant neoplasm. This was one of the precursors of clinical PET in the world. Use of glucose analogues other than deoxyglucose (FDG)4-5), such as deoxymannose6) and deoxygalactose7) were proposed, too. Other tracers have been also introduced for diagnosis of brain tumors8), epilepsy9-13) and heart disease14), too. Nowadays, requirements for clinical PET are expanding in many parts of the world. The main purpose of this report is to overview the current situation of PET use in leading countries such as United Kingdome, Belgium, and
United States and Germany.

**United Kingdom**

In the United Kingdom, St. Thomas & Guy's hospital already started clinical PET investigations as a selected center for clinical PET in 1991. At that time, it was the sole clinical PET center in UK, and other PET institutes were being run mainly for scientific research. At the same time, the British government started financial support for the clinical PET investigations performed at St. Thomas & Guy's hospital through National Health Service (NHS). Nowadays, the number of clinical PET institutes is gradually increasing in this country. The total number of the PET institutes doing human studies is said to be 12 (2001 present)\(^{(15,16)}\). Some of PET centers are not equipped with their own cyclotrons and are getting FDG delivered from nearby cyclotrons. This style of running a PET institute is often called a "satellite PET". Many clinical indications for PET studies have been carefully evaluated and determined by a PET group at St. Thomas & Guy's hospital\(^{(17)}\). They have published and constantly updating an excellent list of clinical indications, which is available from their Internet site\(^{(17)}\).

**Belgium**

Belgium is also one of the most important countries in the point that they started clinical PET investigations in early days. It is said that they started discussions over clinical PET investigations as early as in the late 1980s. FDG-PET, having been started for diagnosis of epilepsy, ischemic heart disease and recurrent brain tumors, were reimbursed in the late 1980s. Since July 1999, more indications have been added to the list of clinical PET indications reimbursed. It was partly because of drastic changes that took place in the US health administration policy concerning clinical PET. In this country, various malignant diseases, heart diseases and epilepsy are reimbursed in a similar fashion to the UK. The total number of PET scanners in this country is estimated to be 10 or so, but the number of PET per population is calculated to be the highest in the world, rivaling to Germany\(^{(15,16)}\).

**United States**

The Medicare coverage of clinical PET investigations is being constantly widened. In 1995, PET investigations with \(^{82}\)Rb for cardiac perfusion test were passed for Medicare support. After that, there had been almost no changes for a few years until the diagnosis of lung cancer was approved in 1998. In 1999, FDG-PET investigations for recurrent colon cancer, malignant lymphoma (staging), and malignant melanoma were approved. It is said that this decision influenced the political decision of Belgian government, which started reimbursement for oncology indications. Commercial-based FDG supply networks such as PET-Net has been significantly expanded until now. Establishment of the PET-Net has enabled medium to small sized hospitals to start PET service for clinical diagnosis, getting
FDG supply from nearby cyclotrons\textsuperscript{15,15}.

**Germany**

As for the organizational efforts to bring clinical PET into reality, situation in Germany is worth mentioning here. They have put forward "the satellite concept". In this country, the number of PET institutes without cyclotrons (PET satellites) is larger than the number of Cyclotron Centers that own both cyclotron and PET scanners. PET facilities can save much amount of money for installation and maintenance of cyclotrons if they are able to purchase radioactive pharmaceuticals from other facilities.

As to clinical PET indications, health insurance system should be one of the most important issues. There are private and public health insurance systems in Germany. And when one makes a contract with a private health insurance company, he does not have to keep the contract with public insurance organization. Private health insurance companies would pay basically for all clinical PET indications recommended by German Society of Nuclear Medicine. But, public health insurance organizations do not always reimburse for PET investigations even when the purpose of the study done is listed in the German Society’s indication list.

Additionally in Germany, interdisciplinary groups of nuclear oncologists, neurologists and cardiologists have already held “clinical consensus conferences” several times and have completed lists of clinical indications for PET. Summary of the list of indications for oncology PET, approved by German Society of Nuclear Medicine, is as follows: differentiated thyroid cancer, brain tumors, gastrointestinal tumor, head and neck tumor, malignant melanoma, lung cancer (NSLC), and pancreatic carcinoma as class1 indications. Additionally, class2 indication is given to bladder carcinoma, malignant lymphoma, breast cancer, germinal cell carcinoma, ovarian tumor, neuroendocrine tumor, renal cell carcinoma, prostatic carcinoma, and seminoma. An indication list for brain PET is prepared for cerebrovascular disease, brain tumor, basal ganglion disorder, dementia, depression, schizophrenia, and epilepsy. Class 1a indication is given for brain tumor, basal ganglion disease, dementia, and epilepsy only. Class 2 indication is given to cerebrovascular disease, depression, and schizophrenia. For cardiology PET, evaluation of myocardium viability, evaluation of cardiomyopathy etc. are included.

**Current Situation in Japan**

In Japan, full reimbursement by health insurance is approved only for \textsuperscript{15}O gas inhalation studies mainly for patients with cerebrovascular disease. Full reimbursement for FDG PET has not been approved yet. FDG PET applications can be applied as a special procedure of advanced medicine at selected institutions, where a part of medical costs can be charged to patients. A Clinical PET Working Group of Japan, evaluating previous FDG studies to clarify clinical efficacy of PET, has submitted the list of clinical indications for FDG
PET. It is expected that the Ministry of Health and Labor, in near future, make a decision toward approval of FDG PET as a fully reimbursed diagnostic procedures.

FDG supply from nearby cyclotrons to PET satellites has not been started yet, either. Since there are a large number of cyclotrons in Japan, satellite concept seems to be very useful to maximize cyclotron's potential because one cyclotron have a capacity of supplying FDG to 10 or more PET scanners. The current situation that every PET unit has its own cyclotron is not cost-effective. Among countries already doing PET studies, countries without satellite PET centers may be only Japan in the world. It is heard that a radiopharmaceutical company has already established a laboratory that fulfill strict safety-regulations and is ready for the delivery of FDG to nearby satellites at this moment. We hope that the PET environments change at last in Japan, too.

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