Performance of fluorine-18 fluorodeoxyglucose (^{18}F-FDG) dedicated breast PET for early breast cancer

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Diagnostic imaging in primary breast cancer is used for screening, staging, deciding the resection area, detecting other lesions, evaluating the treatment response, and other purposes. The fluorine-18 fluorodeoxyglucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) was developed to detect hyper-glucometabolism in cancer tissue and its use in clinical management (1). In breast cancer, whole body (WB) PET/CT is used for functional imaging because it is useful not only for staging the lymph nodes and distant metastasis, but also for early prediction of the response to neoadjuvant treatment (2). Hence, WB-PET is commonly used in advanced metastatic stages of breast cancer. However, WB-PET/CT has poorly detected tumors that are small in size (<10 mm) and low in grade due to its spatial resolution and the characteristics of the tumor (3,4).

For the detection of breast tumors that are sub-centimeter sized, dedicated breast PET (dbPET) scanners have been developed that have a higher photon sensitivity and improved spatial resolution. Their detectors are positioned close to the breast and use smaller elements than those used by WB-PET (5). The dbPET scanners are classified into two types: the positron-emission mammography (PEM) type that compress the breast with two parallel photon detectors, and the tomographic dedicated PET type that use a ring-shaped scanner. The PEM type allows only a limited angle tomography by mildly compressing the breast with the two parallel detectors. Whereas, the dbPET that uses the ring arrangement of detectors can provide fully tomographic images of the breast (6).

In a previous meta-analysis report, the pooled sensitivity and specificity of PEM for the evaluation of known breast cancer and suspicious lesions were 85% and 79%, respectively (7). In histologically proven breast cancers, the lesion-based detectability of the ring type dbPET and that of the WB-PET/CT were 92% and 88%, respectively. However, further examination of cases with small lesions may be needed to make a conclusion on the diagnostic performance of dbPET in detecting small lesions (8). The dbPET was more accurate than the WB-PET in detecting residual primary tumors, particularly intraductal carcinomas after neoadjuvant chemotherapy. The sensitivity of the dbPET and the WB-PET for ypTis were 77.1% and 54.3%, respectively (9). However, although a previous study reports that PEM appears to have the potential for use in breast cancer screening (10), no such report on the potential for using dbPET with a ring-shaped scanner in breast screening is present, to the best of our knowledge.

The Preemptive Medicine and Lifestyle-related Disease Research Center was established and started opportunistic screening in Kyoto University Hospital from 2016. The aim of this center is to promote research for preemptive medicine. Preemptive medicine aims at individualized medicine and tries to detect latent disease, such as non-communicable diseases and cancers, in which early intervention before the onset of clinical disease is possible (11). The data, images, and clinical information of the participants are collected prospectively based on the study. This study was approved by the institutional review board and the ethics committee of Kyoto University, and a written informed consent for access to their data was obtained from each participant. As part of a program for opportunistic screening, breast screening was performed 3D mammography, ultrasonography and dbPET with a ring-

shaped scanner. In this highly specialized screening, big data from the cancer screening and from the general health-check were generated multi-directionally. This may enable us to develop a risk prediction model and explore new biomarkers that could identify high-risk groups and detect cancers in their early stages.

Moscoso *et al.* reported that the dbPET parameters show new and stronger correlations with the subtype of breast cancer (12). In our series, even a sub-centimeter lesion was successfully detected using the dbPET (unpublished data). The dbPET is expected to be able to detect small malignant lesions and premalignant lesions with aggressive characteristics and to predict tumor characteristics. However, further examination is needed.

In the near future, we will be able to establish a medical platform that can provide efficient and sophisticated screening programs for each individual using an integrated system of imaging, clinical information, genomics, and biomarkers. Further, to identify early cancers with rapid metabolisms, and to assess parenchymal metabolism, the dbPET would be included in the system.

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Footnote

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