

A New Look at Breast Cancer

Histopathology was introduced more than a century ago and retains its role as the principal means of characterizing lesions, especially in oncology. It seems likely that biochemical characterization of lesions in the living patient with methods such as ¹⁸F-fluorodeoxyglucose (FDG) imaging will become equally important in the next century.

Histopathology has certain limitations:

1. Even though the tissue is obtained from living patients, histopathologic study is performed on dead tissue.
2. When lesions are heterogenous, which is often the case in cancer, the limited size of the sample may give an erroneous idea of the nature of the disease.
3. The interpretation is subjective and difficult to quantify. Genetic studies involving the use of the polymerase chain reaction, however, represent an important and exciting advance in histopathology.

The article by Yutani et al. (1) is one of many studies of the role of FDG imaging in oncology and compares the more widely available dual-coincidence imaging with the results of dedicated PET imaging in the same patients. The increasing importance of dual-coincidence imaging in nuclear medicine is illustrated by the fact that the sales of dual-coincidence systems in the U.S. in 1997 were 10 times higher than sales of dedicated PET systems. For many hospitals, the choice is not between dedicated PET or dual-

coincidence PET but between dual-coincidence PET and nothing.

Quantitative measurements of the biochemistry of lesions, such as the rate of accumulation of FDG, take us beyond the state of the tissue frozen at one point in time to examination of one or more biochemical processes that are the essence of living tissue. The focus is on process rather than structure.

Increased accumulation of FDG reflects increased transport of the tracer into malignant cells and an increased rate of phosphorylation that results from the shift in hexokinase isoenzymes from type I to type II in many cancer cells. Type II hexokinase is involved in primitive anaerobic metabolism. One hypothesis is that cancer cells are de-differentiated and their increased anaerobic metabolism reflects both ontogeny and phylogeny.

Since FDG studies in the differentiation of benign and malignant pulmonary masses with both dedicated and dual-coincidence PET became approved for coverage by Medicare, FDG studies have become commonplace in nuclear medicine departments throughout the world. Another important role for FDG PET is in the determination of the extent of disease (staging) in the presurgical decision-making process. In the U.S., in more than half of patients undergoing thoracotomy for lung cancer, the disease has either spread to contralateral lymph nodes (15%) or there are distant metastases (40%). If the surgeons had known the extent of the disease before surgery, thoracotomy would not have been performed, and the patient would have begun radiation therapy or chemotherapy immediately without fruitless thoracotomy and its attendant morbidity and cost.

In the case of breast cancer, the situation is similar in some ways and different in others. Of the 600,000

breast lesions removed surgically in the U.S. every year, 400,000 prove to be benign. (In the case of lung lesions, 30,000 lesions prove to be benign each year.)

There is, however, an important difference between lung and breast lesions. The morbidity and cost of a thoracotomy are far less than those of lumpectomy, and, postoperatively, the patients question whether the surgery was necessary.

Thus, it is likely that the widespread extension of FDG studies beyond lung cancer to other cancers will not be in breast cancer but in head and neck, colorectal and other types of cancer. On the other hand, Yutani et al. have provided further evidence that most breast cancer lesions accumulate FDG, which raises the possibility that measurement of FDG accumulation may provide an important indicator of the response to chemotherapy. In such cases, the question is not whether the lesions is benign or malignant, and either dual-coincidence or dedicated PET can be used to assess the response to treatment or to direct radiation therapy.

In the study by Yutani et al., attenuation correction did not improve the results with dedicated PET. Attenuation correction was not available with their dual-coincidence system at the time. In the case of lung lesions, especially deep-seated lesions, attenuation correction is helpful, and it is probable that it will help in the detection of mediastinal node involvement in breast cancer. Only time will tell.

The authors used filtered back-projection rather than ordered-subset expectation maximum (OSEM) iterative reconstruction of the data. Perhaps with OSEM, the results would have been better in the small number of patients in whom axillary nodes were detected.

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However, the small size of the lesions in the case of axillary nodes makes it likely that dedicated PET will be more satisfactory than dual-coincidence PET.

We thank our Japanese colleagues for sharing their preliminary results

with us, and we hope to hear more in the future.

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REFERENCE

- Yutani K, Tatsumi M, Shiba E, Kusuoka H, Nishimura T. Comparison of dual-head coincidence gamma camera FDG imaging with FDG PET in detection of breast cancer and axillary lymph node metastasis. *J Nucl Med*. 1999;40:1003–1008.