Esophageal and Gastric Carcinomas

Approximately one-third of the patients undergoing surgery for esophageal and gastric carcinoma are found to have occult metastases. The published experience with esophageal and gastric carcinomas suggests that FDG PET is highly sensitive to detect both the primary tumors and hepatic and distant metastases.\textsuperscript{1-15} The sensitivity of both PET and CT appears limited for the detection of local lymph node involvement, probably due to the proximity of the primary tumor. Peritoneal spread is also difficult to identify using CT or FDG PET. Because patients usually present more often with distant metastases at the time of recurrence than at the time of initial diagnosis, FDG PET may be most helpful in staging patients when they present with recurrence.\textsuperscript{16} For example, in the study of Flanagan et al.,\textsuperscript{1} PET detected the primary esophageal tumor in all 36 patients and detected distant metastases in 5 patients. CT failed to detect any of the distant metastases. Among the 29 patients who underwent surgery, the extent of nodal disease was revealed in 76% by PET and in 45% by CT. In the study of Block et al.,\textsuperscript{2} PET detected 53 out of 58 primary tumors and distant metastases in 17 patients as compared to 5 patients with CT. Of the 21 patients with lymph node involvement found at surgery, 52% were detected with FDG PET, and 28% with CT were detected. In a report of 35 patients,\textsuperscript{3} the sensitivity, specificity, and accuracy of FDG PET were 88%, 93%, and 91%, respectively, for distant metastases and 45%, 100%, and 48% for locoregional nodal metastases. In a prospective study of staging 74 patients with esophageal carcinoma, FDG PET had a higher accuracy than the combination of CT and endoscopic ultrasound for diagnosing stage IV disease (82% versus 64%).\textsuperscript{11} Endoscopic ultrasound was more sensitive than FDG PET for local lymph node staging (81% versus 33%), but the specificity of FDG PET was superior to CT and endoscopic ultrasound combined for staging local and distant lymph nodes. FDG PET changed the stage in 16 out of 74 (22%) patients, by upstaging two-thirds of the patients and downstaging one-third of the patients. For gastric carcinomas, the sensitivity, specificity, and accuracy of PET for the detection of the primary tumor, locoregional metastases, and distant metastases is in the same range as for esophageal carcinomas.\textsuperscript{5} In patients who had a PET scan before and after chemotherapy, FDG uptake appears to decrease in patients who respond to treatment but does not decrease in nonresponders.\textsuperscript{4}

In summary, FDG PET, by virtue of its whole-body technique, is more effective than CT or ultrasound in the detection of distant metastases from esophageal and gastric carcinomas. On that basis, PET may change the staging of up to 25% of these patients. Locoregional nodal metastases are detected better with FDG PET than CT but not as well as compared to endoscopic ultrasound. The utility of FDG PET may be more important in the evaluation of patients with recurrence or suspected...
recurrence and assessing the response to therapy.

**Pancreatic Carcinoma**

Pancreatic ductal adenocarcinoma is the fourth leading cause of death in the United States and is increasing in incidence. The preoperative diagnosis, staging, and treatment of pancreatic cancer remain challenging.

The suspicion for pancreatic cancer is often raised by US or CT findings, including the presence of a low-attenuation pancreatic mass and dilatation of the pancreatic duct and/or biliary tree. CT is the most common diagnostic imaging modality utilized in the preoperative diagnosis of pancreatic cancer. CT is also important to assess vascular involvement and invasion of adjacent organs. In a multicenter trial, the diagnostic accuracy of CT for staging and resectability was 73%, with a positive predictive value for nonresectability of 90%, but more recent studies have reported accuracies of 85 to 95%, likely related to improvements in CT technology.

Unfortunately, interpretation of the CT scan is sometimes difficult in the setting of mass-forming pancreatitis or questionable findings such as enlargement of the pancreatic head without definite signs of malignancy or discrete mass. The diagnosis of locoregional lymph node metastases is also difficult with CT, because they often are small. In addition, small hepatic metastases (<1 cm) cannot reliably be differentiated from cysts. Therefore, the reported negative predictive value for non-resectability is less than 30%. Despite recent technical improvements in MRI, including MR cholangiopancreatography (MRCP), the diagnostic performance of MRI remains similar to CT.

Endoscopic ultrasound offers the possibility of tissue diagnosis with fine-needle biopsy, but the field of view is limited. The accuracy of endoscopic retrograde cholangiopancreatography (ERCP) is 80 to 90% to differentiate benign from malignant lesions, including differentiation of tumor from chronic pancreatitis because of the high degree of resolution of ductal structures. The limitations include false-negative findings when the tumor does not originate from the main duct, a 10% rate of technical failure, and up to 8% morbidity due to iatrogenic pancreatitis. The main advantages are the possibilities of fine-needle aspiration biopsy and interventional procedures. Although fine-needle biopsy may provide a tissue diagnosis with a high degree of accuracy, this technique suffers from significant sampling error with a false-negative incidence of 8 to 17%.

The difficulty in making a preoperative diagnosis is associated with two types of adverse outcomes. First, less aggressive surgeons may abort attempted resection due to a lack of tissue diagnosis. This is borne out by the significant rate of “reoperative” pancreaticoduodenectomy performed at major referral centers. A second type of adverse outcome generated by failure to obtain a preoperative diagnosis occurs when more aggressive surgeons inadvertently resect benign disease. This is particularly notable in those patients who present with suspected malignancy without an associated mass on CT scan. This has been reported to occur in up to 55% of patients in some series.

**Role of FDG PET in the Preoperative Diagnosis of Pancreatic Carcinoma**

In order to avoid these adverse outcomes, metabolic imaging with FDG PET may improve the accuracy of the preoperative diagnosis of pancreatic carcinoma. Most malignancies, including pancreatic carcinoma, demonstrate increased glucose utilization due to the over-expression of glucose transporter proteins and increased hexokinase and phosphofructokinase activity. There is recent evidence that the over-expression of glucose transporters by malignant pancreatic cells contributes to the increased uptake of FDG by these neoplasms. In 11 studies, the overall performance of PET to differentiate benign from malignant lesions is: sensitivity, 85 to 100%; specificity, 67 to 99%; and accuracy, 85 to 93%. The majority suggest improved accuracy compared to CT. These results are similar to the findings in our series with a sensitivity of 92% and a specificity of 85% for FDG PET as compared to 65% and 62%, respectively, for CT scanning. In addition, the sensitivity of CT