**Tumor Imaging Positron Emission Tomography (PET) and PET-CT**

1. **Clinical Indications for Procedure**
   * Positron emission tomography (PET), with or without simultaneous computed tomography (PET-CT), for tumor imaging may be indicated for 1 **or more** of the following:
     + During initial treatment of cancer (from diagnosis through initial staging), as indicated by **ALL** of the following:
       - Strongly suspected or biopsy-proven solid tumor malignancy
       - Treatment not yet begun
       - Imaging information required to determine location or extent of disease to assess 1 **or more** of the following:
         * Whether patient is appropriate candidate for invasive diagnostic or therapeutic procedure
         * Optimal anatomic location for invasive procedure
         * Anatomic extent of tumor if this will assist in selecting optimal antitumor treatment
       - PET or PET-CT has not yet been performed during this period (prior to commencement of treatment)
   * During subsequent treatment of cancer (from re-staging after completion of initial treatment through monitoring for recurrence), as indicated by **ALL** of the following:
     + Imaging information is required for possible management decision(s) to assess 1 **or more** of the following:
       - Suspected residual disease just after completion of initial treatment (re-staging), for which no PET or PET-CT has yet been performed
       - Suspected recurrent disease well after completion of treatment (monitoring), based on **ALL** of the following:
         * New symptoms, abnormal findings on physical examination, or abnormal findings on laboratory tests or other imaging studies
         * No PET or PET-CT has yet been performed for this new constellation of signs or symptoms
2. **Discussion**

For breast cancer, PET has been shown to be useful in assess the extent of the disease, especially with regard to recurrence and metastases. However, PET is insensitive to micrometastases in the axillary lymph nodes and should not be used for staging in that area.

For cervical cancer, review studies and expert opinion indicate that PET should be considered a standard part of the evaluation of patients with initial clinical and imaging data suggesting stage IB2 (bulky disease) or higher, due to its inability to identify lymphatic and distant metastases in primary and recurrent disease.

For colorectal cancer, expert consensus guidelines do not recommend the routine use of baseline PET scan in the absence of evidence of synchronous metastatic disease on other imaging such as CT or MRI; however, PET-CT is indicated for suspected recurrent disease in patients with an unexpected rise in carcinoembryonic antigen after treatment.

For esophageal or gastroesophageal junction cancer, PET as a complement to CT scan and endoscopic ultrasound increases the detection of metastasis and helps avoid futile surgical treatment. PET-CT is preferred over PET alone for staging and evaluation of response to preoperative chemotherapy, radiation therapy or both.

For gastric cancer, PET or PET-CT is considered by expert consensus guidelines to be an option during initial workup and post-treatment assessment.

For head and neck cancer, clinical studies and reviews indicate effectiveness of PET in initial staging, monitoring of therapeutic effectiveness, and surveillance for recurrent disease. PET-CT has emerged as an accurate means of detecting localized disease, as well as ruling out confounding conditions, such as persistent laryngeal edema after radiation therapy.

For lung cancer, expert review indicates that PET is effective in identifying nodal and distant disease, as well as in evaluating the mediastinum in small cell cancer. It likely also provides helpful precision during restaging of small cell lung cancer. For non-small cell cancer, PET has a well-established role in diagnosis and staging, but positive mediastinal findings require pathologic confirmation. In a randomized controlled trial of patients with diagnosed non-small cell lung cancer, preoperative staging with PET-CT identified more patients with mediastinal and extrathoracic disease than conventional staging with abdominal CT and bone scan, sparing more patients from stage-inappropriate surgery. However, some patients had false positive mediastinal notes on PET-CT, which could inadvertently exclude such patients from curative surgery unless there was biopsy confirmation. Another randomized controlled trial on the use of PET-CT for preoperative staging in non-small cell lung cancer found that while there was no effect on overall mortality, patients receiving PET-CT had fewer total and unnecessary thoracotomies.

For a solitary pulmonary nodule, reviews of clinical studies and expert opinion indicate that PET is very helpful and is a preferred option for characterizing nodules 1 cm in diameter or larger, which are indeterminate as to composition on higher-resolution CT scan.

For Hodgkin lymphoma and aggressive non-Hodgkin lymphoma, reviews and expert opinion indicate that PET is effective in routine initial staging evaluation, in assessment of early response to chemotherapy, in post-treatment assessment (including evaluation of residual masses), and for follow-up to investigate suspected relapse. A technology assessment has concluded that for lymphoma in general, PET has at least comparable or better accuracy than CT, is more specific than CT for restaging to assess residual tumor masses after induction therapy, can assist in predicting response during mid-therapy and has led to change in therapy in at least 25% of cases in children. While there is some controversy as to the extent of incremental utility of PET-CT in lymphoma, most recent studies have found that its sensitivity, specificity, and accuracy are significantly higher than contrast CT alone, and that it helps provide better anatomic certainty in terms of delineating active disease.

For melanoma, expert consensus guidelines recommend that PET scan is most useful as a whole body imaging tool for initial evaluation and follow-up of stage III or IV disease. For evaluation of possible recurrence, studies have suggested that PET has resulted in management changes in at least 30% of patients.

For osteosarcoma or Ewing sarcoma, an expert consensus guideline suggests that PET is an option for primary disease staging, as well as for evaluation of response to chemotherapy. While CT scan remains the primary tool for staging and restaging of osteosarcoma, a study found that PET-CT is accurate for preoperative staging.

For ovarian cancer, PET is not sensitive enough to identify microscopic or small-volume (i.e., less than 1 cm3) intra-abdominal spread, and consequently its use in initial staging is limited, although some reviews maintain that it is useful for initial staging. For suspected recurrent disease, guidelines suggest PET or PET-CT as an appropriate imaging study, especially in the setting of rising CA 125 levels. A systematic review concluded that PET-CT may be useful for detection of recurrent ovarian carcinoma; however, it is unproven whether the identification of patients with recurrent disease at an earlier stage provides survival benefit.

For pancreatic cancer, reviews of clinical studies indicate that PET is not effective in differentiating benign from malignant masses, but it may be helpful in detecting previously unknown metastatic disease, thus preventing unnecessary surgery. PET-CT may provide additional diagnostic benefit primarily during diagnosis and staging, although evidence for effectiveness during subsequent treatment such as restaging or monitoring for recurrence is limited.

For testicular cancer (seminoma), reviews of clinical studies and expert opinion indicate that PET is especially helpful during diagnosis and staging in stage IIB, IIC, or III disease, after chemotherapy, and for the evaluation of residual masses seen on CT scan if tumor markers are normal.

For thyroid cancer, reviews of clinical studies indicate that PET is effective in initial evaluation of disease extent in anaplastic cancer, and for follow-up of patients treated for medullary, papillary, or follicular cancer with a rising thyroglobulin level.

For cancer with unknown primary, PET may detect the unknown primary cancer site in up to 20% to 40% of cases, although PET-CT probably provides higher diagnostic accuracy than either method alone. However, it is important that the diagnosis of malignancy be established prior to recommended use of PET-CT.

For diagnosing recurrent breast cancer, reviews suggest PET has a mean sensitivity of 93% and a specificity of 82%.

In cervical cancer, PET-CT has been shown to better localize abnormal F-18 fluorodeoxyglucose uptake, possibly reducing the false positive rate of scans in patients with suspected recurrence.

For gastric cancer, a retrospective review of 92 patients suspected of recurrent disease found sensitivity, specificity, and diagnostic accuracy of PET to be as high as 81%, 87%, and 83%, respectively, especially when recurrent disease was suspected on the basis of other imaging findings or elevated serum tumor markers.

**Reference**

* + MCG, Ambulatory Care, 23rd Edition, “Tumor Imaging Positron Emission Tomography (PET) and PET-CT”; 6/23/2019.