

Editorial: PET/CT for Cancer Diagnosis, Staging and Prognosis

Positron emission tomography/computed tomography (PET/CT) has been widely utilized in the clinic and in animal research for detecting and serially staging various types of neoplasms, including lymphomas, melanoma, lung cancer, thyroid cancer, head and neck cancer, esophagus and gastric cancer, colorectal cancer, pancreatic cancer, gynecologic cancers, osteosarcoma, breast cancer, pheochromocytoma [1-7]. The most commonly utilized radiopharmaceutical for PET/CT is 2-deoxy-2-[18F] fluorogluucose (18F-FDG), a glucose analogue that is taken up by the cell through glucose transporters, and then phosphorylated within the cell reflecting the rate of glucose metabolism. Compared with normal cells, cancer cells have increased glucose metabolism. Accordingly, PET/CT imaging with 18F-FDG is able to reveal an increased glucose metabolism in tumors and to identify both primary neoplasm and their metastases.

PET/CT images can be interpreted visually and quantitatively. Standardized uptake value (SUV) is the most widely utilized quantitative parameter, with a SUV above 2.5 suggesting malignancy [8]. In addition, the highest pixel in the object of interest (SUVmax) and the average SUV value in a region of interest (SUVmean) are also useful parameters in the characterization of a neoplasm [9]. A higher SUV value indicates that the cancer is more aggressive and associated with a poorer prognosis.

PET/CT has been a valuable imaging approach in the diagnosis, staging and restaging of cancers. Many publications have demonstrated that PET/CT plays an important role in the staging and detecting of metastasis for non-small-cell lung cancer (NSCLC) [10, 11], lymphomas [12, 13], breast cancer [14] and other types of neoplasms. Due to the superior sensitivity of PET/CT over other anatomic imaging methods, PET/CT has been employed for the staging of Hodgkin Lymphoma at baseline and the restaging after therapy [12], the whole body staging of recurrent and metastatic breast cancer [14, 15], the localization of melanoma metastases [16, 17], as well as the detection of gynecologic cancers recurrence [18, 19].

PET/CT also provides insightful information about the patient's response to treatment intervention. Reduction or resolution of 18F-FDG uptake suggests a favorable response. For instance, Wei and colleagues (2015) [20] utilized the SUVmax and evaluated the prognostic values of interim and post therapy 18F-FDG PET/CT for adult Burkitt's lymphoma patients. They observed that compared to the SUVmax at baseline before treatment (a median SUVmax of 18.3, range 1.6-35.9), the SUVmax at mid-therapy PET/CT (a median SUVmax of 4.0, range 0-17.6) and the SUVmax at post-therapy PET/CT (a median SUVmax of 3.0, range 0-14.5) decreased significantly, indicating a promising response to chemotherapy [20]. On the other hand, no significant change of 18F-FDG uptake is an indicator of a lack of response to treatment and therefore alternative intervention should be considered. The NEOSCAN trial has utilized FDG PET/CT to measure the response to prechemotherapy in patients with resectable stage IB-IIIa non-small cell lung cancers [21]. For patients with less than 35% decrease in SUVpeak on the repeated FDG PET/CT, they were considered non-responding and then their chemotherapy was modified. Later these patients showed metabolic response to the alternative therapy on FDG PET/CT scan [21]. This clinical trial indicates the utility of FDG PET/CT to monitor and adjust perioperative chemotherapy in order to improve patients' outcomes.

Another application of PET/CT is to search for occult tumors or unknown primary tumors. Utilizing PET/CT, Ducry and colleagues (2015) [22] detected mid-gut ACTH-secreting neuroendocrine tumors. Malkan and colleagues (2015) [23] discovered a case of diffuse large B cell lymphoma with extensive cutaneous relapse. Park and colleagues (2015) [11] found that volume-based PET parameter metabolic total volume and SUVmax are risk factors for occult lymph node metastasis in small-sized peripheral NSCLC. These findings result from the higher sensitivity of PET/CT scan than conventional diagnostic procedures.

However, not every abnormal 18F-FDG PET/CT imaging is consistent with malignancy. False positive FDG PET/CT scans may be observed in conditions including inflammation, infection or granulomatous disease [24]. Tuberculosis is a well-known cause of false-positive finding on PET-CT scan [25]. Suture granuloma also presented with high 18F-FDG accumulation and generated false-positive finding on PET-CT scan after surgery for gastric cancer [26]. Recently, a false positive axillary lymph node hypermetabolism has been reported on a PET/CT scan, and histopathologically it was induced by the leakage of silicone breast implant and silicone adenitis [27]. Accordingly, special attention should be paid to these conditions when interpreting positive PET/CT imaging.

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