

PET/CT Characterization of Lymph Nodes

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Introduction

Currently, most initially diagnosed cancers are staged according to the American Joint Committee on Cancer classification to evaluate the extent and size of the primary tumor (T), regional lymph node metastasis (N), and distant metastasis (M). Among them, lymph node status is especially important as patients' management and prognosis depends on it in many kinds of cancers. Several kinds of imaging modalities are used for the nodal staging in cancer. According to the advances in functional imaging techniques, positron emission tomography (PET) becomes an important lymph node imaging modality in oncology. ^{18}F -fluorideoxuglucose (FDG), a glucose analogue, is most widely used PET tracer. Except FDG, several PET tracers such as ^{11}C -acetate, ^{11}C -methionine and ^{18}F -fluorothymidine (FLT) may be used for characterizing lymph nodes complementary to FDG. However, the low image resolution of PET and lack of anatomical information have been prohibitive in anatomic accuracy. The implementation of PET and CT hardware fusion by integrated PET/CT scanner has evolved to overcome this weakness. This lecture deals with the diagnostic PET/CT criteria for metastatic lymph nodes, and results of PET and PET/CT for characterizing lymph nodes in several representative types of cancer.

PET/CT Criteria and PET Tracers for Characterizing Lymph Nodes

Visual interpretation is usually accepted for characterizing lymph nodes in FDG PET/CT. Lymph nodes with focal discrete increased uptake significantly more than surrounding background tissue are considered malignant. Semi-quantitative analysis such as SUV has complementary role to visual interpretation for characterizing lymph nodes. Although there is no definite cut-off SUV generally accepted, a cut-off SUV of 2-4 may be used for routine clinical practice

In an era of PET/CT, CT component is also helpful for characterizing lymph nodes. As lymph nodes with calcification or high attenuation are considered benign, it should be considered that hypermetabolic lymph nodes with calcification or high attenuation may be benign reactive [1, 2]. Dual-time point FDG PET/CT is also helpful to characterize lymph nodes. Delayed SUV or retention index derived from early and delayed SUVs may be more accurate than conventional early 1 hr post-injection SUV for diagnosing malignant lymph nodes [3-6]. However, the benefit of dual time point

PET is not consistent in literatures. Further evaluations are necessary.

FLT, a biomarker reflecting cell proliferation, shows lower uptake in inflammatory reactive lymph nodes than with FDG, which potentially may improve the specificity of PET for detecting malignant lymph nodes [7-9]. However, FLT uptake in malignant lymph nodes is relatively lower than FDG uptake. Therefore, further investigations are necessary. Other PET tracers such ^{11}C -acetate and ^{11}C -methionine can be used for characterizing lymph nodes [10]. For example, in prostate cancer, ^{11}C -acetate PET showed better sensitivity than FDG PET for detecting metastatic pelvic lymph nodes.

Non-Small Cell Lung Cancer

FDG PET is useful for initial staging of non-small cell lung cancer (NSCLC). According to a meta-analysis including 2,226 patients from 29 studies, PET shows a 79% of sensitivity and 91% of specificity for detecting metastatic mediastinal lymph nodes, which is significantly better than a sensitivity of 60% and 77% of specificity of chest CT [11]. In another meta-analysis with 1,959 patients from 32 studies, PET shows a sensitivity of 85% and specificity of 90% for detecting metastatic mediastinal lymph nodes, which is significantly better than a sensitivity of 61% and specificity of 79% in chest CT [12]. In a recent meta-analysis with 833 patients from 17 studies, PET shows a sensitivity of 83% and specificity of 92% for detecting metastatic mediastinal lymph nodes, which is significantly better than a sensitivity of 59% and specificity of 78% in chest CT [13]. PET/CT is more accurate than PET for mediastinal nodal staging.

Combined PET/CT interpretation using CT attenuation may be helpful to decrease false positive interpretation for mediastinal nodal staging [14]. Dual-time point PET has a potential to have a complementary role to conventional FDG PET/CT for nodal staging in lung cancer [1,2,15]. Combined PET-CT/MRI interpretation may be helpful to improve the accuracy of PET/CT for the mediastinal nodal staging in NSCLC [16, 17].

Esophageal Cancer

FDG PET is useful for initial nodal staging of esophageal cancer. For N-staging, PET shows a sensitivity of 45-81% and specificity of 69-100%, which is significantly better than a 31-60% sensitivity and 71-100% specificity of chest CT [18-27]. PET demonstrates better or similar results in N-staging than CT or endoscopic ultrasound [22, 23, 26]. In addition, EUS has a limitation that complete exam is not available in 20-30% of patients due to severe esophageal stenosis. The number of PET positive lymph nodes is a significant prognostic factor [28]. PET/CT is more sensitive and accurate than PET for nodal staging of esophageal cancer [29].

Head and Neck Cancer

FDG PET is useful for initial nodal staging of esophageal cancer. For cervical node metastasis, PET shows a sensitivity of 67-100% and specificity of 89-100%, which is significantly better than a 53-84% sensitivity and 71-95% specificity of neck CT and/or MRI [30-35]. Accuracy of PET/CT is better than that of CT by providing additional information by lesion localization and characterization in 1/3 of patients [34,36]. Dual-time point PET has a potential to have a complementary role to conventional FDG PET/CT for cervical nodal staging in head and neck cancer [37].

Gastric and Colorectal Cancer

In nodal staging of gastric and colorectal cancer, FDG PET has a complementary role with contrast-enhanced abdominal CT. PET had a worse sensitivity and better specificity than CT [38-48].

Summary

FDG PET and PET/CT is useful for characterizing lymph nodes in many types of cancer. PET/CT is better than PET for the nodal staging in cancer. Dual-time point FDG PET/CT and FLT PET/CT may be helpful to increase the specificity for detecting metastatic lymph nodes. However, further evaluations are warranted.

Suggested Readings

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