Chapter 13

LYMPHOMA IMAGING: NUCLEAR MEDICINE

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1. INTRODUCTION

Careful staging and treatment planning using a multidisciplinary approach is required to determine optimal treatment of patients with Hodgkin’s disease (HD) and aggressive subtypes of non-Hodgkin’s lymphoma (NHL). The advent of more sensitive imaging modalities have increased staging and restaging accuracy and provided more effective means to evaluate response to therapy. In the post-therapy setting, the unnecessary use of aggressive chemotherapy and external beam radiation could lead to development of secondary malignancies and various organ toxicity. Poor prognosis associated with some second malignancies warrants better and less harmful screening strategies (1). Hence, the early identification of high-risk and low-risk patients can effectively select subpopulations that would benefit from more intensive chemotherapy protocols and can avoid unwarranted further therapy.

Anatomic imaging modalities, primarily computed tomography (CT) and magnetic resonance imaging (MRI), are dependent on size criteria, thus, they provide limited information regarding lymphoma involvement in normal size lymph nodes. Additionally, CT or MRI cannot differentiate lymphadenopathy due to benign or therapy-related causes from that due to lymphoma infiltration (2). Accordingly, at initial staging all disease sites may not be detected and following therapy progression-free survivals may not significantly differ between patients with partial resolution (residual masses) and those with complete resolution based on post-therapy CT scans.
(3-6). MRI is reported to be helpful in distinguishing recurrent tumor from fibrosis or normal tissue on T2-weighted images. MRI findings, however, are not specific for tumor recurrence and cannot differentiate tumor from acute radiation pneumonitis, infection, hemorrhage or radiation fibrosis (7-9). MRI detects active lymphoma 6 months following completion of therapy more accurately than during the course of, or early after chemotherapy (6). Nevertheless, MRI offers advantages over CT in the evaluation of disease process in the bone marrow and central nervous system.

Ga-67 imaging has been the imaging modality of choice along with CT in the staging of lymphomas. However, the niche for Ga-67 imaging is in the assessment of therapy response in HD and aggressive NHL (5, 6, 10-12). At initial presentation, Ga-67 scintigraphy does not contribute significantly to the staging process due to its inherently low resolution, although a pre-therapy baseline scan is necessary for proper comparison purposes in the assessment of response to therapy. Ga-67 scintigraphy also lacks sensitivity in the assessment of abdominal lymphoma and for identifying lesion sites in indolent subtypes (13, 14). Thallium-201 thallous chloride (Tl-201) or Tc-99m-Sestamibi (MIBI) imaging have been proposed as alternative or complementary studies in patients with low-grade lymphomas, nonetheless, similar restrictions apply to both of these radiotracers in the identification of infradiaphragmatic disease (14, 15).

Positron emission tomography (PET) imaging using [F-18] fluorodeoxyglucose (FDG) has recently become a valuable part of the staging and restaging algorithm. FDG uptake in tumors is proportional to the glycolytic metabolic rate of viable tumor cells representing increased metabolic demand for glucose (16). A multitude of studies have reported that FDG-PET is a consistently reliable imaging modality in the staging and restaging as well as in the assessment of therapy response in malignant lymphomas (17-29). With the advent of the state-of-the-art dedicated PET scanners, a resolution of approximately 5 mm can be achieved. In the post-therapy setting, changes in tumor metabolic activity between pre- and post-therapy FDG-PET scans provide useful information on response to anti-tumor therapy. Recently, the accuracy of FDG-PET imaging has significantly improved with the introduction of iterative reconstruction algorithms and image fusion of PET data with simultaneously acquired CT (PET-CT). PET-CT imaging improves specificity in staging and re-staging of lymphoma and offers advantages over separate FDG-PET and CT imaging.

This chapter will focus on mainly on applications of FDG-PET in staging, restaging and evaluating response to therapy of lymphomas which has recently been integrated into the management algorithm of lymphomas. The use of traditional radiotracers such as Ga-67 citrate, Tl-201, MIBI will