Target Delineation of Gross Tumor Volume for Radiation Therapy Planning Using Fusion Images of $^{18}$F-fluorodeoxyglucose Positron Emission Tomography and Computed Tomography

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Fig. 1

Abstract

Modern radiation therapy planning (RTP) has been performed using a large number of images obtained with computed tomography (CT), namely 3-dimensional RTP. Recently, F-18-fluorodeoxyglucose positron emission tomography (FDG-PET) has been used for RTP. FDG-PET can often distinguish between benign and malignant lesions when CT and magnetic resonance cannot. Although FDG-PET images lack anatomical precision (Fig. 1A), fusion images of FDG-PET and CT (PET/CT) have been extremely useful for determining the active sites of malignant disease. Particularly for patients with non-small cell lung carcinoma, both primary lesions and active lymph node metastases are well recognized (Fig. 1B). With PET/CT, which yields fewer false-negative results, smaller target volumes for radiation therapy can be delineated than with other imaging modalities (Fig. 2). The small radiation field (Fig. 3) leads to less toxicity in normal tissue, allows high radiation doses to be administered, and improves local control.

The patient in this case was a 61-year-old woman with hoarseness and abnormalities on chest x-ray films. Thoracic CT revealed a 2-cm apical tumor in the left lung and multiple enlarged mediastinal lymph nodes. The diagnosis of non-small cell lung cancer was established with transbronchial lung biopsy. Because the clinical stage was IIIB, concurrent chemoradiation therapy was performed.
Fig. 1  FDG-PET images (A) and fused PET/CT images (B): The areas with high uptake of FDG indicate the primary tumor (arrows) and multiple lymph nodes sites, which likely indicate metastasis.

Fig. 2  The treatment volume contour (jagged green line) using an FDG accumulation image: The doughnut-shaped uptake area (pink arrow) is the normal left ventricle.

Fig. 3  A Beam’s Eye View photograph: The actual radiation therapy field (the area outlined with jagged line) was drawn on the basis of PET/CT images. The overwritten rendering areas were the probable extents of lymph node metastasis (orange) and the primary site (red).