PET/CT for Radiotherapy Treatment Planning in Patients with Soft Tissue Sarcomas

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Abstract

Purpose: To study the possibility of incorporating positron emission tomography/computed tomography (PET/CT) information into radiotherapy treatment planning in patients with high-grade soft tissue sarcomas (STS). Methods and Materials: We studied 17 patients treated with preoperative radiotherapy at our institution from 2005 to 2007. All patients had a high-grade STS and had had a staging PET/CT scan. For each patient, an MRI-based gross tumor volume (GTV), considered to be the contemporary standard for radiotherapy treatment planning, was outlined on a T1-gadolinium enhanced axial MRI (GTVMRI), and a second set of GTVs were outlined using different threshold values on PET images (GTVPET). PET-based target volumes were compared with the MRI-based GTV. Threshold values for target contouring were determined as a multiple (from 2 to 10 times) of the background soft tissue uptake values (B) sampled over healthy tissue. Results: PET-based GTVs contoured using a threshold value of 2 or 2.5 most closely resembled the GTVMRI volumes. Higher threshold values lead to PET volumes much smaller than the GTVMRI. The standard deviations between the average volumes of GTVPET and GTVMRI ratios for all thresholds were large, ranging from 36% for 2 B up to 93% for 10 B. Maximum uptake-to-background ratio correlated poorly with the maximum standardized uptake values. Conclusions: It is unlikely that PET/CT will make a significant contribution in GTV definition for radiotherapy treatment planning in patients with STS using threshold methods on PET images. Future studies will focus on molecular imaging and tumor physiology.