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Evaluation of delayed FDG-PET in differentiating progressive disease from post-treatment radiation effect in brain tumors

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Traditional and advanced magnetic resonance imaging techniques are often unable to differentiate progressive central nervous system neoplasm from post-treatment radiation effect (PTRE). ^{18}F-fluorodeoxyglucose positron emission tomography (FDG-PET) with delayed imaging has been shown to increase the specificity of PET imaging for cerebral neoplasm in small studies. We sought to further evaluate the potential diagnostic benefits of delayed imaging at 5 hours versus standard imaging at 1 hour to differentiate progressive disease (PD) from PTRE in patients with primary or metastatic brain tumors treated with radiation therapy. Ten patients with primary (n=4) and metastatic (n=6) brain tumors were identified, with diagnostic confirmation of PD or PTRE provided by pathology or $\geq$3 month clinical and radiographic follow-up. Maximum standard uptake values (SUV) were calculated for suspicious areas of abnormal contrast enhancement (lesion) and compared to contralateral normal appearing brain (background) at both early and delayed time points. Seven patients were classified as having PD and 3 as having PTRE based pathology or clinical/radiographic follow up. The average lesion to background ratio (L/B) at the early time point (1.16 $\pm$0.50) was significantly different than L/B for the later time point (1.72$\pm$1.10), p=0.030. The mean L/B for PD was 2.17$\pm$1.01 at the later time point compared to 0.65$\pm$0.06 for PTRE (p=0.010). For the earlier time point, L/B for PD was 1.40$\pm$0.42, compared to the L/B for PTRE which was 0.61$\pm$0.10 (p=0.003).L/B ratios at early and delayed time points successfully differentiated between patients with PD and PTRE, with significantly greater L/B ratios seen at delayed time points. These initial results are promising and further investigation is underway to evaluate the contribution of delayed imaging in differentiating PD from PTRE.