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Head-to-head comparison of in vivo inflammation and hypoxia imaging in patient’s aorta using positron emission tomography

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Background. Atherosclerosis is often associated with hypoxia which has been linked with adverse plaque’s features including inflammation and intraplaque hemorrhage, well known markers of plaque vulnerability. Purpose. Whether quantifying hypoxia in human atherosclerotic plaques by using [18F]fluoroazomycin arabinoside (FAZA), a highly selective hypoxia marker, is feasible and could help in risk stratification remains unknown. Therefore, in this proof-of-concept study, we retrospectively assessed both the presence of inflammation and hypoxia in the aortic wall of patients scheduled for lung cancer imaging. Methods. Fifteen consecutive oncological patients (mean age 69 years; 66% male; 6 with previous cardiovascular events) underwent [18F]fluorodeoxyglucose (FDG)-positron emission tomography/computed tomography imaging PET/CT and (FAZA)-PET/CT on 2 consecutive days for measuring arterial inflammation and hypoxia respectively in their descending aorta. A region of interest was drawn around the aortic wall on 5 cross sections of the coregistered transaxial PET/CT images and the maximum standardized uptake value (SUV) measured. Target-to-background ratio (TBR) was calculated by dividing the maximal arterial wall SUV by the mean blood activity. Results. Albeit not significant, we observed a higher FDG uptake (TBR: 9.0±3.2 vs 6.7±1.7 respectively, p=0.093) and a higher FAZA uptake (TBR: 5.7±1.4 vs 4.7±0.8, respectively, p=0.077) in patients with previous cardiovascular events compared to patients without. Furthermore, we identified a significant correlation between FDG-uptake and FAZA-uptake in the aortic wall of our patients (see graph, R²=0.39, p = 0.011) suggesting that hypoxia contributes to the FDG signal in atherosclerosis PET studies. Conclusion. We present a noninvasive imaging approach to visualize and quantify hypoxia in the aortic wall of patients. Our data suggest a pathophysiological link between inflammation and hypoxia in human atherosclerotic lesions. Prospective studies are needed for determining the potential role of FAZA-PET/CT for identifying patients at risk for presenting subsequent cardiovascular events.
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Methods. Fifteen consecutive oncological patients (mean age 69 years; 66% male; 6 with previous cardiovascular events) underwent [18F]fluorodeoxyglucose (FDG)-positron emission tomography/computed tomography imaging (PET/CT) and (FAZA)-PET/CT on 2 consecutive days for measuring arterial inflammation and hypoxia respectively in their descending aorta. A region of interest was drawn around the aortic wall on 5 cross sections of the coregistered transaxial PET/CT images and the maximum standardized uptake value (SUV) measured. Target-to-background ratio (TBR) was calculated by dividing the maximal arterial wall SUV by the mean blood activity.

Results. Albeit not significant, we observed a higher FDG uptake (TBR: 9.0±3.2 vs 6.7±1.7 respectively, p=0.093) and a higher FAZA uptake (TBR: 5.7±1.4 vs 4.7±0.8, respectively, p=0.077) in patients with previous cardiovascular events compared to patients without. Furthermore, we identified a significant correlation between FDG-uptake and FAZA-uptake in the aortic wall of our patients (see graph, \( R^2 = 0.3974 \), \( p=0.011 \)) suggesting that hypoxia contributes to the FDG signal in atherosclerosis PET studies.

Conclusion. We present a noninvasive imaging approach to visualize and quantify hypoxia in the aortic wall of patients. Our data suggest a pathophysiological link between inflammation and hypoxia in human atherosclerotic lesions. Prospective studies are needed for determining the potential role of FAZA-PET/CT for identifying patients at risk for presenting subsequent cardiovascular events.