1H-MRS and 18FDG PET: Metabolism in head and neck cancers

J. F. Jansen1, H. Schoder1, N. Lee1, H. E. Stambuk1, D. G. Pfister1, J. P. Shah1, J. A. Koutcher1, and A. Shukla-Dave1

1Memorial Sloan-Kettering Cancer Center, New York, NY, United States

Introduction

Today, with many treatment options available, pretreatment radiological evaluation is gaining widespread acceptance for better patient management [1]. Proton MR Spectroscopy (1H-MRS) and 18Fluoro-deoxyglucose (FDG) PET provide insight in the tumor metabolism [2]. These techniques are indicators of malignant grade in several cancers [2]. Few studies have correlated 1H-MRS and 18FDG PET in brain gliomas and have found conflicting reports regarding the relationship between the two [3,4]. 1H-MRS provides data for metabolites; choline (product of phospholipid metabolism) and lactate (end product of anaerobic glycolysis) which enhance prognostication and patient selection and thus helps in improving overall patient treatment [5]. Similarly, 18FDG PET evaluates the regional glucose utilization rate (GUR; reflecting glucose metabolism) which has shown to be valuable for staging patients [6]. In the present study to better understand the metabolism in head and neck we attempted to see whether there is a correlation between 1H-MRS and 18FDG PET data.

Material and Methods

Patients 18 newly diagnosed head and neck cancer patients with metastatic nodes (M/F: 16/2, age: 56±11y) were included. Tumor metabolism was assessed using 1H-MRS and 18FDG PET imaging prior to chemo-radiation therapy or surgery. MRI MRI/1H-MRS was performed on a 1.5 Tesla GE Excite scanner using a 4-channel neurovascular phased-array coil. The protocol consisted of standard clinical MR imaging covering the entire neck or oral cavity/tongue or nasopharynx using T2-weighted and T1-weighted images. During 1H-MRS, spectra were acquired on the tumor identified on T2-weighted images, and a volume of interest (VOI) was placed over the node. Single voxel spectroscopy data (PRESS, TR/TE=1600/136 and 256 averages) was obtained. Additionally, a spectrum (16 averages) was recorded of unsuppressed water. PET For 18FDG PET imaging, F18-fluoride was produced by the cyclotron by proton irradiation of an enriched O-18 water target in a small-volume titanium chamber. 10 to 18 mCi of 18FDG was administered by IV and image acquisition at the PET/CT scanner (Discovery ST) started after 2 hours of the injection. PET/CT images were reconstructed with the standard reconstruction array processor and corrected for attenuation. Analysis 1H-MRS spectra were analyzed using LCMModel (Version 6.2-0X) [7]. The metabolite basis set (PRESS, TE 136 ms, 1.5 T) including simulated macromolecule peaks was kindly provided by Dr. Provencher. The ppm range included for analysis was -1 to 3.8 ppm. The standard ‘breast’ setting was used, which provides concentration estimates for choline and lipids. Choline concentrations are reported in arbitrary units, relative to water (Cho/W). Metabolite estimates were excluded from analysis, if the Cramer-Rao lower bounds (CRLB) exceeded the 50% range. 18FDG images were transferred to a workstation for image analysis. 1H-MRS uptake by the tumor was assessed by an experienced nuclear medicine physician. Semi-quantitative analysis included calculation of tumor-to-muscle ratios as standardized uptake value (SUV) measurements. This was followed by the evaluation of CT and PET/CT images. Whole blood samples collected from each patient were counted in a calibrated multichannel gamma well counter and the blood activity was expressed in as µCi/ml, decay corrected to time of the injection. PET/CT images were transferred to a work station for image analysis.

Results

In Table 1, the results from 15 patients are shown. Three patients (pt 4, 12 and 15) were excluded for analysis. Two had CRLB that exceeded the 50% threshold, and 1 patient had an extremely high Cho/W concentration (value between an interquartile range of 1.5 and 3, hence an outlier [8]). Figure 1a displays the prescribed PRESS box on the right node of patient 9; Figure 1b shows the corresponding 1H-MRS data of this node. A correlation analysis of Cho/W concentration estimates and 18FDG SUV PET uptake yielded a positive Pearson correlation’s coefficient of r=0.584 (p = 0.022, Figure 3).

Conclusion

The results in the present study show a positive correlation between choline levels as assessed by 1H-MRS with glucose levels as indicated by 18FDG uptake. This observation is indicative of a correlation between glucose metabolism (18FDG) and an increased cellular proliferation (choline).

References