Comparisons of prostate cancer tissue metabolic intensities and metabolomic profiles from African American and Caucasian patients

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Introduction: Prostate cancer (PCa) is the most frequently diagnosed cancer in men. Furthermore, incidence rates are significantly higher in African American men, who are 1.4 times more likely to be diagnosed and 2-3 times more likely to die of PCa, than Caucasian men. African American PCa patients also often present with higher-grade tumors, are three years younger, on average, at the time of diagnosis, and may harbor more aggressive PCa than Caucasian PCa patients. Possible ethological factors or differences in biology that lead to this racial disparity have yet to be determined, but could aid in the development of alternative markers for early detection and more specialized treatment in this specific population. In this study, HRMAS 1HMRS is used to compare metabolic intensities and metabolomic profiles of PCa tissue from African American patients with the profiles of PCa tissue from matched Caucasian patients. By correlating this metabolomic data with traditional histopathology from the same tissue samples, we attempt to identify PCa metabolic markers, if in existence, that could potentially reveal metabolic differences for the racial disparity exhibited by PCa and also be used to guide early detection and intervention.

Methods: Twenty-three African American PCa patients with adenocarcinoma were analyzed. The mean age was 58.609 years with a standard deviation of 6.028, and the minimum and maximum ages were 45 and 69 years, respectively. Seven patients had Gleason score (GS) 6, fourteen patients had GS7, and two patients had GS9. They were each matched with a Caucasian PCa patient

Table 1.

Case	Age	Race	GS	pT	pN	% cancer	% benign epithelia	% benign stroma
YR11-001	64	African American	7	pT2c	pNo	0	0	100
1883-PZ	65	Caucasian	7	pT2c	pNo	0	7.3513	99.6487
YR08-041A	69	African American	6	pT2c	pNx	0	67.2305	32.7695
1825-PZ	70	Caucasian	6	pT2c	pNx	0	8.6573	91.3427
YR08-030	67	African American	7	pT2c	pNo	57.6001	14.8684	27.5315
1956-PZ	68	Caucasian	7	pT2c	pNo	26.3069	0	73.6931

based on age, Gleason score (GS), tumor stage (pT), lymph node stage (pN), and tissue pathological compositions, when possible. Examples of three of these matches are shown in Table 1. *MR Spectroscopy.* Samples and D2O were loaded into 4mm Zirconia rotors with spherical inserts. Spectroscopy measurements were carried out on a Bruker AVANCE spectrometer, pre-cooled to 4ºC and operating at 600 MHz (14.1T). Spectra were acquired using slow spinning rates of 600 and 700Hz and post-spectral edited with Min(A, B) scheme. Spectroscopic data were processed using an in-house MatLab based program. *Histopathology.* After spectroscopy, tissue samples were fixed in formalin, embedded in paraffin, cut into sets of 5μm sections at 100μm intervals, and stained with hematoxylin and eosin. Volume percentages of histological features (cancer, benign epithelium, and stroma) were analyzed and quantified by a pathologist.
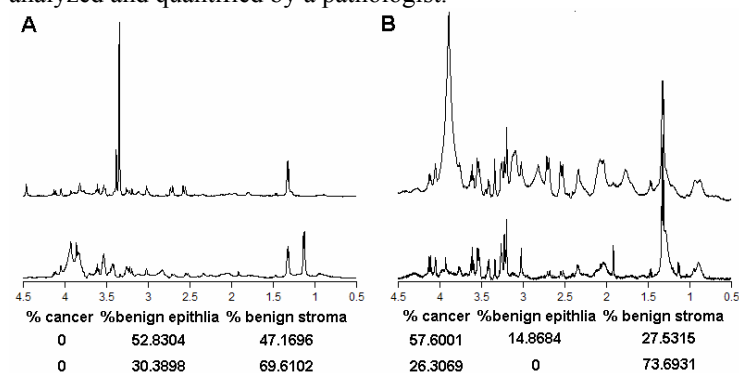

Figure 1. Spectra and pathological compositions obtained from African American tissue (upper) and Caucasian tissue (lower). Differences and similarities are evident.

Results: Spectroscopy and histology analyses of tissue specimens are designed to discover prostate cancer metabolite intensities and metabolomic profiles for African American PCa patients that can then be compared with those of Caucasian PCa patients. The spectral differences and similarities between African Americans and Caucasian samples can be appreciated through visual evaluations of the spectra in Figure 1. The upper spectra were obtained from African American PCa tissue samples, while the lower spectra were from the matched Caucasian PCa patients. From these spectral pairs, it is clear that the metabolic differences observed from these pairs were mostly due to the differences in tissue pathological compositions. Detailed analyses are currently underway in our laboratory.

Conclusions: This study is designed to evaluate the possible differences in tissue metabolic intensities and metabolomic profiles obtained from African Americans PCa patients versus those from Caucasian patients. Results from the current evaluations, similarities and differences in tissue metabolic intensities and metabolomic profiles between these two patient populations, will contribute greatly to understanding and developing effective treatment options for the African American PCa patients.