Sextant localization of prostate cancer: comparison between Magnetic Resonance Spectroscopic Imaging and ^{11}C-Choline PET-CT

C. Testa[1], R. Schiavina[2], E. Salizzoni[3], B. Corti[4], J. Kurhanewicz[5], A. Bertaccini[2], F. Manferrari[2], E. Brunocilla[2], S. Concetti[2], A. Franceschelli[2], G. Martorana[2], R. Franchi[6], N. Monetti[6], M. Farsad[6], S. Fanti[6], R. Canini[3], M. Coe[3], W. F. Grigioni[4], A. D'Errico[4], P. Castellucci[6], R. Lodi[1], B. Barbiroli[1]

[1]Clinical Medicine and Biotechnology, University of Bologna, Bologna, Italy, [2]Department of Urology, University of Bologna, Bologna, Italy, [3]Department of Radiological and Histopathological Sciences, University of Bologna, Bologna, Italy, [4]Pathology Unit, Insitute of Oncology, University of Bologna, Bologna, Italy, [5]Department of Radiology, University of California-San Francisco, San Francisco, California, United States, [6]Nuclear Medicine, P.E.T. Center Policlinico S.Orsola Malpighi, Bologna, Italy

Introduction

Prostate cancer is the second most common form of cancer in males having a very high incidence and a much lower but significant mortality rate. Several studies have demonstrated that the addition of MRI and 3D-MRSI data to PSA, digital rectal exam (DRE) and transrectal ultrasonography (TRUS) can help in the detection and characterization of prostate cancer. Additionally, preliminary studies have demonstrated the potential of ^{11}C-choline PET-CT in the detection of prostate cancer. The purpose of this study was to assess the effectiveness of MR spectroscopic imaging, MR imaging and PET-CT either independently or combined together, for tumor detection and localization using histopathologic review after radical prostatectomy as the standard of reference. To our knowledge this is the first paper that combines MRI and 3D-MRSI to ^{11}C-choline PET-CT in the evaluation of prostate cancer.

Materials and Methods

MR imaging was performed on a 1.5 T MR imaging system (Signa, GE Medical System, Milwakee, Wis) with a flexible endorectal coil (Medrad, Pittsburgh, Pa) combined with a pelvic phased-array coil. Proton spectra were collected from the prostate using PRESS volume selection with 3D phase encoding (16x8x8). Spectral data were aligned with the MR imaging data and analyzed using dedicated spectroscopic programs developed at the University of California-San Francisco [1]. Choline, creatine, and citrate peak areas were calculated for all voxels and the (Choline+Creatine)/Citrate (CC/C) ratio and the Choline/Creatine (C/C) ratio were evaluated. All spectroscopic voxels were classified as malignant both if CC/C> 3 standard deviations above the mean healthy value and if CC/C>2 standard deviation and C/C≥2.-PET/CT studies were carried out 5 min after i.v. administration of approximately 400 MBq ^{11}C-Choline using a PET/CT scanner (GE Discovery LS). Each focal accumulation of ^{11}C-Choline was recorded and the maximum standard uptake value (SUV max) was calculated. Patient population (n=22) was scanned prior to radical prostatectomy. Four mm-sections of each post-prostatectomy specimen were obtained. The matching between spectroscopic imaging, MR imaging, PET-CT imaging data and histopathologic findings was made on the basis of a sextant evaluations.

Results

Post-prostatectomy pathological examination detected a tumor in 21 out of 22 cases with a Gleason score range of 4-8 (one negative case had high grade prostatic intraepithelial neoplasia, "HGPIN", throughout the whole prostate). MRSI was positive for cancer in 21 patients: the only false negative MRSI was due to a small low-grade tumor (Gleason score 3+2); PET-CT was positive in all patients: in 20 cases PET-CT was correctly positive and the remaining 2 false positives were due to the presence of HGPIN. There was also one PET-CT false negative for cancer. On the basis of sextant evaluation sensitivity, specificity and accuracy were 80%, 73% and 76% for MRSI, 52%, 82% and 64% for PET-CT, and 88%, 94% and 79% for the two techniques combined together [3].

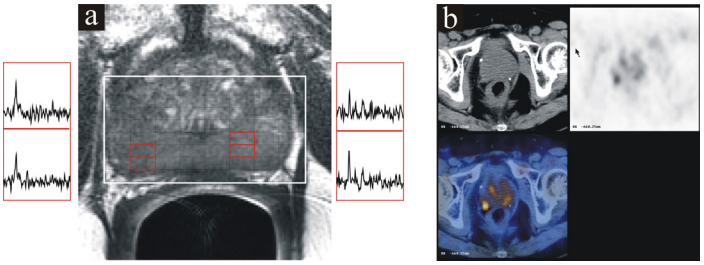

Figure 1. Selected MRSI prostate spectra (a) and PET-CT axial image (b) of the same patient. Both MRSI and PET-CT indicate the presence of cancer bilaterally in the prostate which was later confirmed by pathological analysis after surgery (Gleason score 3+3).

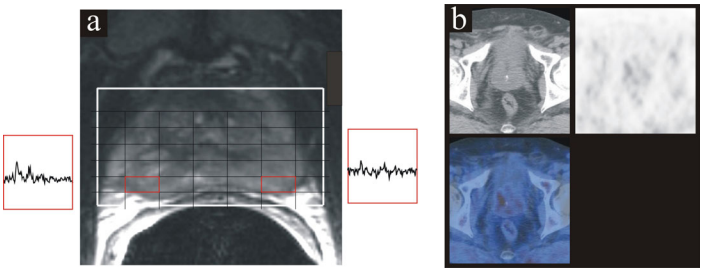

Figure 2. Selected MRSI prostate spectra (a) and PET-CT axial image (b) of the same patient. Spectra show a bilateral metabolic abnormalities indicative of cancer that was confirmed by pathological analysis (Gleason score 4+3), while PET-CT did not show a pathological accumulation of ^{11}C-Choline.

Conclusions

The sensitivity specificity and accuracy of MRSI determined in this study are in good agreement with previously published data [2]. The PET-CT accuracy was lower presumably due to the lower spatial resolution of PET-CT reducing it's ability to identify the exact location of cancer within prostate and because it seems unable to distinguish HGPIN from cancer. However, the sensitivity and specificity of MRSI were higher when PET-CT results were combined.

References

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