

PET/MRI/TRUS image fusion guided prostate biopsy: development of a research platform and initial clinical results

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Abstract

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Objectives The gold standard for prostate biopsy, transrectal ultrasound (TRUS) guided random biopsy (RB), suffers from low sensitivity. Recent advancements in prostate PET imaging with ⁶⁸Ga-HBED-PSMA (Prostate Specific Membrane Antigen), combined with multiparametric MR, provide improved identification of suspicious areas. The development of a dedicated framework for PET/MR to TRUS image fusion guided biopsy (IFGB) might improve prostate cancer (PCa) detection rates.

Methods We propose a platform with minimal overhead in the clinical workflow that provides both rigid PET/MR to TRUS registration based on the manual selection of landmarks and elastic registration supported by automatically segmented images. The distance between the surfaces of manual and automatic segmentations and registration errors (RE) on manually selected landmarks evaluate the technical performance. The initial clinical study includes 16 patients who had at least one prior negative RB. A targeted biopsy was carried out following a systematic 10-core RB. All samples were histologically analyzed.

Results The mean surface distance between manual and automatic segmentation is below 2 mm. The average RE for the rigid and elastic registration are 4.6 mm and 2.5 mm. On PSMA-PET/MR, 7 prostates revealed at least one PCa-suspicious lesion, 5 were described as equivocal and 4 as inconspicuous. The histological analysis indicated PCa in 8 of the patients, out of which 6 had suspicious and 2 equivocal findings on PSMA-PET/MR.

Conclusions PSMA-PET/MR to TRUS IFGB could be a valuable tool for PCa detection in patients with prior negative RB. Further developments and studies are necessary to improve and evaluate its full potential.