Volumetric reconstruction with superimposed MRS metabolic map for the assessment of prostate cancer

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Introduction

The diagnosis and accurate localization of prostatic carcinoma by 3D multivoxel MR spectroscopy (MRS) analysis is often complicated on a slice-by-slice basis. Our objective was to develop a semi-automated individualized method to obtain a 3D reconstruction of the prostate superimposing metabolic results for an intuitive depiction and rapid localization of the suspicious malignant zones.

Materials and methods

MR spectroscopy acquisitions were performed using a 3 Tesla magnet (Achieva, Philips Healthcare) with a 5-channel surface coil. The MRS sequence consisted of a 3D multivoxel point-resolved spectroscopy (PRESS) configuration (TE=100ms, TR=1200ms). The spatial resolution was of 7x7x7mm and the acquisition time was around 16 minutes. The Choline (Cho), Creatine (Cr) and Citrate (Cit) peak areas were quantified in each voxel after proper data preparation (residual water subtraction, apodization filtering, and phase adjustment). The (Cho+Cr)/Cit ratio was calculated in a voxel-by-voxel basis and stored in a 3D array.

For prostate segmentation, a T2 weighted turbo spin-echo (TSE) sequence (TE=90ms, TR=3800ms) with spectral-selective fat saturation and high spatial resolution (0.48x0.48x2mm) was used (Figure 1). Prostate central gland and peripheral zone volumes were independently segmented using a semiautomated method based on splines. Extracted volumes of both regions were smoothed using a 3-point moving average to improve visual aspect and reduce the computational burden of the triangulation algorithms in the rendering process.

The matrix containing metabolic data was interpolated and rigidly coregistered to the extracted volumes. Finally, the central gland and peripheral zone volumes were rendered and the data of the metabolic matrix was superimposed (Figure 2). All the methods were integrated in an automated processing sequence taking around 20 minutes per dataset to complete.

Results

Two experienced radiologists analyzed the volumetric representation of the metabolic quotient in 10 cases. It was found to be of high utility and fast efficiency in the diagnosis and location of prostate carcinoma probability maps based on MRS.

Conclusion

Data reduction methods to synthesize in regional maps the metabolic information generated from MRS acquisitions of the prostate are highly useful in the pre-biopsy diagnosis and localization of suspicious prostatic carcinoma. This method could be further extended to other MR techniques used in prostate cancer diagnosis, such as DW and pharmacokinetic imaging to obtain multimodal multivariate volumetric datasets.
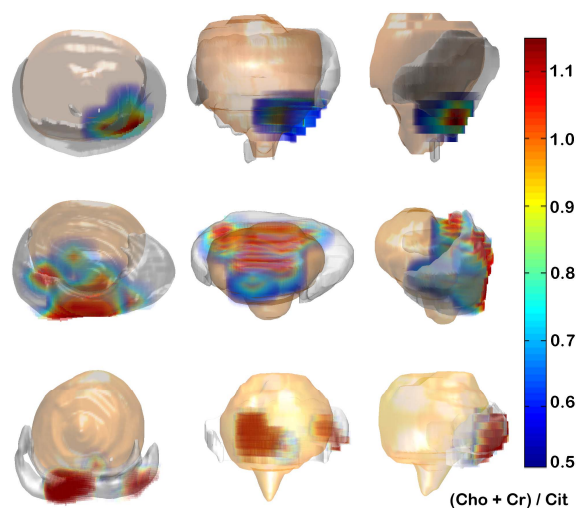

Figure 1. TSE T2W image.

Figure 2. Volumetric MRS-based parametric maps in 3 representative cases (CC, AP and lateral views).