Non-invasive Prostate Tumor Volumetry Using Parametrically Analyzed Dynamic Contrast Enhanced MRI (DCE-MRI): Correlation With Whole Mount Prostatectomy Specimens - Initial Results.

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Propose: To evaluate the accuracy of DCE-MRI in determining tumor volume in the prostate gland.

Background: Previous attempts to estimate cancer volume preoperatively with use of sextant biopsy, transrectal US, or MR imaging have been disappointing. Attempts at quantifying length of needle core involvement are labor intensive and subject to interpretative variability. TRUS has insufficient sensitivity for tumor detection for an ability to accurately determine tumor volume. The initial enthusiasm for using three-dimensional MR spectroscopic imaging to accurately estimate tumor volume has recently been tempered(1). Findings in histopathologic studies have demonstrated that prostate cancer volume is a significant predictor of several tumor prognostic factors, including extracapsular extension (2). Furthermore, pre-treatment assessments of tumor volume can assist in therapeutic decisions (3). Despite the clinical demand and theoretical appeal of noninvasive volumetric tumor assessment, to date, there are no satisfactory techniques, clinical or imaging, needed to quantify tumor volume in patients who are considering prostatectomy or radiation therapy.

Methods: MRI of the prostate was performed on a 1.5 T unit (Vision, Siemens, G) with combined surface and endo-rectal coils (Prostate-Coil, Medrad, USA) in 10 patients prior to prostatectomy. High spatial resolution Dynamic Gd-DTPA enhanced (Magnevist, Schering, G) Gradient Echo (3D-FLASH) (8.1/4; 01 min 35 s; FOV 160; 2 pre-, 5 post contrast acquisitions) sequences were acquired. DCE-MRI images were analyzed pixel by pixel with a three time point (3TP) pharmacokinetic model. Tumor areas were marked on whole mount histology and MRI slices by two readers and the volumes of each tumor, total tumor volume and total volume of the whole gland and the ratio of the total tumor volume / total gland volume were assessed with customized software developed in house using Matlab 6.1 (The MathWorks, Inc.). The MRI derived volumes and the histopathologically determined volumes were compared.

Results: MRI detected 26/34 tumors correctly. All of the tumor foci >143 cubic mm were detected. All of the false positive tumors seen on MRI were ≤150 (5 false positive: range: 55-150 cubic mm mean volume:102 cubic mm, 4 false negative: range: 20-143: mean=80.75). The mean MRI tumor volume of the correctly detected tumors was 1138 cubic mm (range 50-6040 cubic mm). The mean volume of histopathologically determined tumors was 1001 cubic mm. (range 20-6540 cubic mm). We found an excellent linear correlation (R= 0.89) between the tumor volumes (histology) and the tumor volumes determined by DCE-MRI.

Conclusion: These initial results suggest that parametrically analyzed high spatial resolution DCE-MRI is an accurate method for non invasive prostate tumor volume assessment.

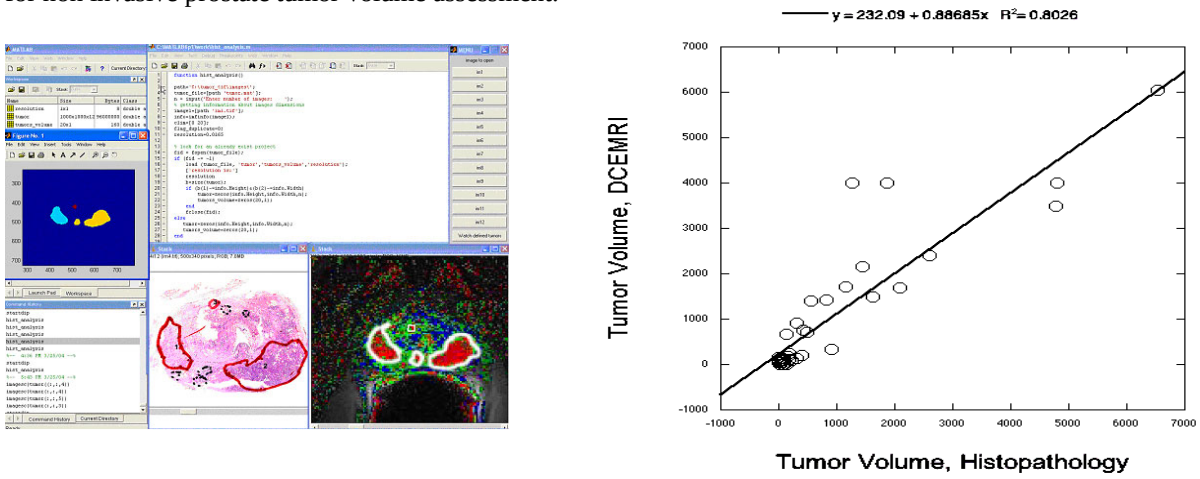

Figure 1.Output from the customized program created in Matlab 6.1. Tumor volumes on the parametric display (lower right) and the histo-pathology (center) are compared. The volume map with the blue back-ground (left) displays tumor volumes for quantification. The correlation between regions identified on MRI and histo-pathology are shown in **Figure 2.**

References: 1. Coakley FV et al. Prostate cancer tumor volume: measurement with endorectal MR and MR spectroscopic imaging. Radiology 2002;223(1):91-97.

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