Endorectal Coil Magnetic Resonance Imaging (MRI) of the Prostate at 3 Tesla (3T) – Initial Experience.

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Purpose: The aim of the study was to evaluate the potential clinical utility of combined pelvic phased array and endorectal coils at 3T

Background: High Resolution MRI of the prostate has gained acceptance for pretherapeutic staging of prostate cancer, especially for the assessment of extracapsular extension[1]. It is widely excepted that the endorectal coil provides a means for achieving MR images with high spatial resolution at 1.5 T. Recently, dynamic contrast enhanced MRI (DCE- MRI) has shown clinical utility in the evaluation of prostate cancer.[2] However, even with endorectal coil at 1.5 T, compromises must be made between temporal and spatial resolution. We have previously shown that 3T MRI using an external phased array coil is equivalent to endorectal coil imaging at 1.5T.[3] This work is the initial step in the systematic evaluation of endorectal MRI of the prostate at 3T.

Materials and Methods: 6 volunteers were examined on a 3T scanner (3T Genesis Signa LX Excite, General Electric, Milwaukee, WI) with pelvic phased-array surface coil combined with a disposable endorectal prostate coil (MRinnervu, Medrad, Pittsburgh, PA, USA). 3 volunteers were examined on a 1.5 T and 3T Scanners (1.5T Signa Excite; 3T Genesis Signa LX Excite). After acquisition of sagital and transverse localizer sequences to check the coil position, we obtained axial T2-weighted fast spin-echoes (FSE) images from below the apex of the prostate to above the seminal vesicles with the following parameters: TR /TE 4500-7600/90-165 msec, 1,5-3 mm section thickness (ST), no intersection gap, 10-14 cm field of view (FOV), 256-512 x 192-256 matrix, no phase wrap. Dynamic contrast enhanced (DCE) images were acquired after bolus injection of gadopentetate dimeglumine using a 3D gradient echo sequence with temporal resolution of 1 min 35 sec. The imaging parameters include the following: TR/TE of 9.3/4.2 msec, flip angle of 18°, FOV 12cm, matrix of 256 x 224, ST: 1.5, no phase wrap. Two precontrast and five postcontrast sequential acquisitions were obtained. Gadopentetate dimeglumine was injected as bolus at a dose of 0.1 mmol per kilogram of body weight by an injection system at a flow of 4ml/sec.

Results: An example of T2-W FSE images acquired with the following parameters: TE: 160, TR: 6200, AT 2x5min 45sec (2x28 SL) ST: 1.5 mm, FOV 12, Matrix: 320x192, voxel size 0,35 mm^3 is shown in Figure 1. Note the excellent anatomic detail and good T2 contrast showing a well defined pseudocapsule, seminal ducts, intraprostatic urethra, nerves in the neuro-vascular bundle. An example of a coronal reconstruction is shown in Figure 2. Small anatomical structures, cysts and ducts, are visualized. An example of DCE-MR is shown in Figure 3a+b. Excellent spatial resolution (voxel size 0.38 mm^3) and temporal resolution lead to visualization of features reflecting micropermeability and vascular density. By achieving this level of anatomic information in dynamic images we can clearly distinguish between intra- and extracapsular contrast enhancement. Note the non-enhancing BPH nodule in the right transitional zone, and the diffuse early enhancement in the peripheral zone.

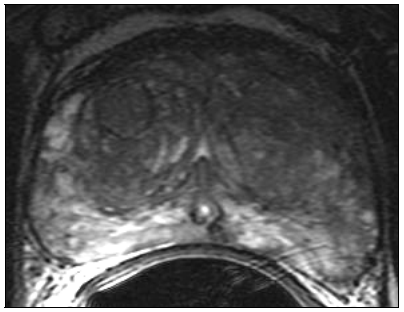

Figure 1.

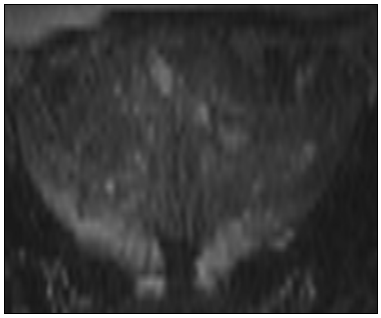

Figure 2.

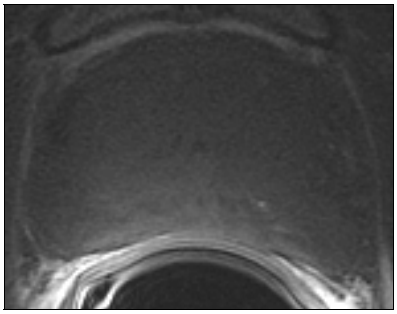

Figure 3a.

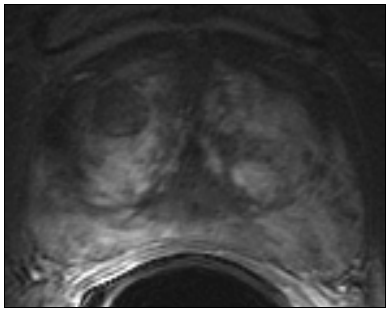

Figure 3b.

Figure 1: Image of the midthird of the prostate (axial T2-W FSE).
Figure 2: Coronal reconstruction.
Figure 3a: DCE-3D GE image corresponding to Figure 1; Precontrast.
Figure 3b: DCE-3D GE image corresponding to Fig. 3a; Early post contrast.

Conclusion: The endorectal coil MR images at 3T are of high diagnostic quality and provide excellent anatomic detail. Using a modified T2- FSE sequence we obtained whole gland coverage with 35 cubic microns resolution, without any disturbing artifacts, in reasonable acquisition times and staying well below the SAR guidelines. The ST of 1.5 mm allows meaningful multiplanar reconstructions. Extremely high resolution DCE-MR is achievable in time frames amenable to kinetic analysis while maintaining diagnostic SNR. The initial results demonstrate the clinical utility of endorectal 3T for the non-invasive evaluation of the prostate with image features and quality not achievable at 1.5 T.

References:

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3. Sosna, J., Rofsky, N.M., Gaston, S.M., DeWolf, W.C. & Lenkinski, R.E. Determinations of prostate volume at 3-Tesla using an external phased array coil: comparison to pathologic specimens. *Acad Radiol* 10, 846-53 (2003).