Influence of Magnetic Resonance Imaging in the Decision to Preserve or Resect Neurovascular Bundles at Robotic Assisted Laparoscopic Radical Prostatectomy

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Purpose: We evaluated the accuracy of preoperative multiparametric 3.0-T magnetic resonance imaging for local staging of prostate cancer and its influence in the decision to preserve neurovascular bundles at robotic assisted laparoscopic radical prostatectomy.

Materials and Methods: The study included 353 patients who had confirmed prostate cancer and underwent preoperative magnetic resonance imaging and robotic assisted laparoscopic radical prostatectomy between 2008 and 2011. The extent of neurovascular bundle sparing was initially determined on the basis of the clinical information and the nerve sparing surgical plan was reevaluated after review of the magnetic resonance imaging report. The value of preoperative magnetic resonance imaging in the prediction of extracapsular extension and in the decision of surgical plan according to D'Amico risk classification was analyzed.

Results: The magnetic resonance imaging performed correct staging, over staging and under staging in 261 (73.9%), 43 (12.2%), and 49 (13.9%) patients, respectively. After review of the magnetic resonance imaging reports, the initial surgical plan was not changed in 260 patients (74%) and was changed in 93 patients (26%). Robotic assisted laparoscopic radical prostatectomy was changed to a more preservable neurovascular bundle sparing procedure in 53 patients (57%) and changed to a more aggressive neurovascular bundle resecting procedure in 40 patients (43%). For the patients with a change to more conservative surgery, the appropriateness was 91%. The sensitivity of magnetic resonance imaging in predicting extracapsular extension showed a tendency to increase from low to high risk groups (33%, 46%, 80%, respectively, p <0.001). In intermediate and high risk groups, there was a surgical plan change in 40 patients (of 129, 31%) and 27 patients (of 67, 40%), respectively.

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Conclusions: Preoperative magnetic resonance imaging significantly improves the decision making to preserve or resect the neurovascular bundle at robotic assisted laparoscopic radical prostatectomy, which lacks haptic feedback.

Key Words: prostatic neoplasms, robotics, prostatectomy, magnetic resonance imaging

THE incidence of clinically localized prostate cancer at the time of diagnosis is increasing, likely due to serum PSA screening. Radical prostatectomy is one of the curative treatments for patients with localized PCa but it carries considerable risk of incontinence and impotence.[1,2] Since the nerve sparing technique was first described by Walsh et al,[3] various open and laparoscopic nerve sparing techniques, including robotic assisted laparoscopic radical prostatectomy have been developed to improve outcomes. However, operators performing RALRP lack tactile sense, as in other laparoscopic surgery, which may limit the ability to evaluate potential involvement of neurovascular bundles by PCa.

None of the conventional preoperative evaluation methods offers information comparable to tactile sense. The established preoperative clinical variables including DRE findings, serum PSA and biopsy Gleason score are used to plan the surgical technique.[4] However, the advent of more sophisticated MRI including multiparametric imaging and higher field strength capability, improved the staging performance of PCa.[5] Multiparametric MRI could provide preoperative knowledge such as tumor location and the presence of ECE or SVI to robotic operators. Previous studies showed that pelvic phased-array 3.0-T MRI was similar to endorectal coil 1.5-T MRI in evaluating local staging accuracy for PCa with good image quality.[6,7] Therefore, we evaluated the diagnostic ability of multiparametric PPA 3.0-T magnetic resonance imaging for local staging of PCa and its influence on the decision to preserve the neurovascular bundle in RALRP.

MATERIALS AND METHODS

Patients
A total of 418 patients who underwent RALRP between January 2008 and December 2011 were evaluated. All patients had biopsy proven PCa and preoperative 3.0-T MRI using a PPA coil performed for staging, and a surgical plan to determine the extent of NVB sparing at RALRP. MRI examination was performed at least 3 weeks after prostate biopsy. The mean interval between MRI examination and RALRP was 24 days. Study exclusions were patients with prior hormonal or radiation therapy or whose MRI was performed at other institutions. In all, 353 patients with MRI before RALRP were included in this study. This study was approved by our institutional review board. Clinical data were collected and analyzed retrospectively.

MRI Examinations and Imaging Analysis
MRI (Intera Achieva 3.0T, Philips Medical System, Best, The Netherlands) examination was performed with a PPA coil (CARDIAC SENSE, 6-channel). Axial T1-weighted turbo spin echo sequence, turbo spin echo T2-weighted imaging, diffusion weighted imaging and DCEI were performed after administering a bolus injection of 0.1 mmol/kg gadopentetate dimeglumine (Magnevist®, Schering, Berlin-Wedding, Germany). Before MRI all patients received intramuscular injection of 20 mg butyl scopolamine (Buscopan®; Boehringer, Ingelheim, Germany) to suppress bowel peristalsis.[6] The routine imaging protocols at 3.0-T MRI using a PPA coil are summarized in table 1.

We retrospectively reviewed the structured reports of MRI which were completed as a part of daily practice. All MR images were independently interpreted in a routine clinical setting by 2 radiologists. Radiologists 1 and 2 interpreted prostate MRI from 190 and 163 patients, respectively. Both radiologists had more than 7 years of experience in prostate MRI. The radiologists knew that all patients had biopsy proven PCa but they were blinded to PSA values, biopsy results and DRE findings. The definitions of PCa on MR images were previously described.[8] The criteria for ECE included irregular contour bulging, asymmetric NVB, obliterated rectoprostatic angle, overt extracapsular tumor and periprostatic infiltration. The criterion for SVI was a hypointense lesion in 1 or both seminal vesicles.[6] T1-weighted

Table 1. *Imaging protocols of routine PPA 3.0 T MRI used in the current study*

| Sequence | Axial | | | Sagittal | Coronal |
	T2	DCEI (3-D fast field echo)	Diffusion Weighted Imaging (single-shot echo planar imaging)	T2	T2
Field of view (cm)	18	20	20	18	18
Slice thickness (mm)	3	3	3	3	3
No. slices	20	18	15	21	20
Matrix	512 × 304	256 × 224	112 × 112	512 × 304	512 × 304
No. signals acquired	3	1	4	3	3
Voxel (mm)	0.35 × 0.59 × 3	0.89 × 1.11 × 4	1.78 × 1.78 × 3	0.35 × 0.59 × 3	0.35 × 0.59 × 3
b-values (s/mm^2)			0, 1,000		