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Prostate MRI: Access to and Current Practice of Prostate MRI in the United States

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Abstract

Purpose—Magnetic resonance imaging (MRI) of the prostate has increasingly become more important in clinical medicine due to the risk of over-detection of low-grade, low-volume prostate cancer as well as due to the poor sampling of transrectal ultrasound-guided prostate biopsy in high-risk patients. We sought to determine the access, imaging protocols, and indications for MRI imaging of the prostate in the United States.

Materials and Methods—A brief survey was sent through mailing lists to members of the Society of Abdominal Radiology and Texas Radiological Society.

Results—Thirty-six academic centers responded to the survey, 88.9% of which routinely perform prostate MRI. Nine centers routinely performed imaging at 1.5T with an endorectal coil (25%), 11 performed at 3.0T without an endorectal coil (31%), and 10 performed at 3.0T with an endorectal coil (28%). All institutions used T1-weighted axial and orthogonal T2-weighted sequences. Most groups used diffusion weighted imaging (94.7%) and dynamic contrast enhancement (81.6%). Only 21.1% of groups performing prostate MRI routinely performed magnetic resonance spectroscopy as part of their protocol.

Conclusions—Prostate MRI is becoming a commonly performed examination at academic institutions, with most locations performing prostate MRI at minimum standards. There is a need to educate non-academic practices regarding the addition of functional MRI techniques to anatomic techniques, increase the number of institutions that regularly perform prostate MRI, and increase access to direct MRI-guided biopsy in institutions that perform prostate MRI on a regular basis.

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Keywords

Prostatic neoplasm; access to health care; United States; magnetic resonance imaging; magnetic resonance spectroscopy

Introduction

The American Cancer Society estimates that there will be 241,740 new cases of prostate cancer in 2012, ranking in incidence behind only skin cancer. While approximately 28,170 men will die of prostate cancer in 2012, an almost 100% five-year survival can be achieved if diagnosis is made at an early stage. Worldwide, magnetic resonance imaging (MRI) is increasingly performed in the diagnosis and staging of prostate cancer. Despite the growing utilization of prostate MRI, it is not a standard procedure performed at all institutions in the United States (US). There is also wide variability among the methods and protocols in which prostate MRI is performed. For example, in addition to standard MR T1- and T2-weighted imaging, dynamic contrast enhanced imaging (DCE), magnetic resonance spectroscopy (MRS), and diffusion-weighted imaging (DWI) methods are frequently performed. There is extensive literature on the accuracy of these techniques. Debate is ongoing related to the MRI field strength and endorectal coil requirements for these studies. The initial indication for prostate MRI was for cancer staging, to evaluate the presence of extracapsular extension and seminal vesicle invasion. The indications for prostate MRI have shifted towards the search for ‘missed tumors’ in patients with prior negative biopsies, for planning biopsy targeting, radiation planning, and for the selection of patients for active surveillance.

Recently, the European Society of Urogenital Radiology (ESUR) developed prostate MRI recommendations based on consensus expert opinions, with minimal and optimal requirements. Unlike other imaging techniques in the United States, there is not a definitive and universal protocol for prostate MRI. Also, while best practice guidelines may exist, many practices throughout the US may not follow this standard. This survey was undertaken to determine the access and practice of prostate MRI amongst academic, private practice, and community groups throughout the United States.

Materials and Methods

This study was approved by our Institutional Review Board. A brief online survey was created to achieve the study objectives of determining access to prostate MRI and the commonly performed protocols. An email invitation to participate in this electronic survey was sent through the Society of Abdominal Radiology (SAR) and the Texas Radiological Society (TRS) mailing lists. The survey questions are listed in Appendix 1. Institutional affiliation was collected to determine duplicate responses. As physicians from the same institution may not have provided the identical responses, the most common answer was selected. The responder type of practice was self-reported, as they would best describe their practice. Survey responses and data were analyzed using Stata 10 (Stata, College Station, TX). In choosing these two societies to distribute the survey, it was anticipated that responses would come from the United States. Six non-US institutions responded to the survey, the responses which where excluded from the analysis given the low numbers.

Results

A total of 66 responses were received from the survey within 30 days of the initial request. There were 9 duplicate responses and 6 responses from international institutions. A total of 51 responses from separate United States institutions remained after eliminating duplicates. Responses were received from 40 Academic radiology groups (36 US), 5 large private practice groups (5 US), and 12 community groups (10 US). As there are 109 academic radiology practices in the US, we estimate that as many as a third of these groups are represented by this survey. The total number of email requests to academic, large private groups, and community groups are unknown as this information was not provided by the Societies. A summary of responses is displayed in Table 1.

Among the US responses, 89% of the responding academic institutions performed prostate MRI (32/36), compared to 60% of large private practice groups (3/5), and 30% of community groups (3/10). Academic groups were almost evenly divided on their method of performing prostate MRI, with 9 performing at 1.5T with endorectal coil (25.0%), 11 performing at 3.0T without endorectal coil (30.6%), and 10 performing at 3.0T with endorectal coil (27.8%). Two institutions that perform prostate MRI did not respond to this question. None of the large private practice groups of community groups perform prostate MRI with an endorectal coil. Five out of the six non-academic groups reported performing prostate MRI at 1.5T without endorectal coil (one performed at 3.0T without endorectal coil).

The number of studies performed per month at the responding institutions varied substantially with the most common ranges being 6–10 studies per month (9 responses) and 11–20 studies per month (10 responses). Only 9 (25%) of the institutions perform 20 studies or more per month. Most groups have been performing prostate MRI for 10 years or less, demonstrating the fairly recent integration of this technique into clinical practice. Of the US groups performing prostate MRI, 37.8% have done so for less than 5 years, while 40.5% have performed prostate MRI for 6–10 years.

All groups that perform prostate MRI include axial T1-weighted, axial T2-weighted, and coronal T2-weighted images in their protocol. A few institutions also perform sagittal (7.9%) or coronal T1-weighted images (18%), while only three institutions do not perform sagittal T2-weighted images. All institutions perform additional imaging sequences such as DWI, DCE, or MRS; DWI is the most frequently performed additional sequence (94.7%). Only 8 institutions (21.1%) perform MRS. No group performed MRS without also performing DWI and usually DWI and DCE. None of the large private practice or community groups perform MRS. The most common protocol combination was T1-weighted axial, T2-weighted axial, T2-weighted coronal, DWI, and DCE image sequences; with half of institutions and almost 60% of academic groups using this MRI protocol (Table 2).

The indications for prostate MRI are listed in Table 3. Most commonly, institutions state that they receive referrals for cancer staging, concern for cancer with prior negative biopsies, and evaluation for recurrence after therapy.

The ability to biopsy MRI identified lesions using MRI-guided techniques or fusion of MRI to ultrasound images is becoming available in some academic institutions. Twelve academic programs that perform prostate MRI describe the ability to perform MRI guided biopsy. Six reported the ability to biopsy by MRI guidance, two by MRI-TRUS fusion, and four with access to both techniques. No large private practice group or community group reported the ability to perform MRI guided prostate biopsy.

Discussion

Prostate MRI has been described since the early 1980's. The technique is receiving increased attention both clinically and in the development of new techniques. Despite the adoption of prostate MRI into clinical practice, a standard-of-care for prostate MRI does not appear to have developed in the United States (US). Recently, in attempt to provide direction to groups performing prostate MRI, the European Society of Urogenital Radiology (ESUR) developed recommendations for minimum and optimal prostate performance based on expert opinion and literature. In this study, we sought to determine the current practice of MRI in the United States and to determine the difference in practice among academic institutions and non-academic institutions. While we did receive responses from about one third of academic groups in the US, unfortunately, we did not receive sufficient responses from private practice or community groups to allow an accurate comparison among all groups. Although a suboptimal sample, these data provide significant insight into the practice of prostate MRI in the United States.

Prostate MRI has become a commonly practiced technique among academic groups. Of the academic groups that responded, almost 90% indicated that they routinely perform prostate MRI. Prostate MRI access appears to be much lower in the community/private practice setting. We speculate that the actual rate of prostate MRI practice in the community may be even lower than the 30% rate our survey found, as groups that perform prostate MRI may have been more likely to respond to the survey. The number of studies per institution is highly variable, with most institutions performing between 1 and 40 studies per month and few institutions performing greater than 20 studies per month (25%). Given the low number of examinations performed by most institutions, the experience and reliability of prostate MRI interpretations may be limited. While the number of cases needed to maintain proficiency is unknown, the impact of reader experience is well documented in prostate MRI literature. Institutions must perform enough studies for every prostate MRI reader to be able to see enough studies to maintain expertise.

Endorectal coil use in prostate MRI varied significantly among institutions and practice groups. No non-academic group reported using an endorectal coil. This may be due to the cost of the coil or the time required for placement. Conversely, almost all academic centers used an endorectal coil if prostate MRI was performed at 1.5T. This is consistent with recommendations that endorectal coil is necessary if performing prostate MRI at 1.5T. There is more controversy as to the need of endorectal coil when performing prostate MRI at 3.0T. This controversy is reflected in our survey, with almost evenly divided response at the institutions performing prostate MRI at 3.0T.

Similar to the use of endorectal coil, prostate MRI protocols varied among institutions. Nonetheless, 29/36 institutions performed protocols within the minimum ESUR guidelines – that is T2-weighted plus two functional techniques, including DWI. All of the institutions performing prostate MRI reported performing T1-weighted axial images and T2-weighted axial and coronal images, and only three centers did not perform sagittal T2-weighted scans. All academic institutions reported performing DWI as part of their protocols. DWI has been shown to improve cancer detection specificity typically without altering sensitivity and adds minimal time to imaging protocols. We assumed that institutions performing DWI also determine apparent diffusion coefficients (ADC), although we did not address this through our survey Additionally, we did not determine the b-value that institutions perform their DWI. While diffusion tensor imaging has been reported, this sequence is not part of common practice with only two institutions (both academic) reporting that diffusion tensor imaging (DTI) is part of their MRI protocol. DCE has been shown to be helpful in detecting prostate cancer, especially in the anterior horn. While all academic institutions perform DWI, 15.6% of the institutions reported that they do not perform DCE. Interestingly, two of the non-academic centers use this sequence as their one functional sequence.

Magnetic spectroscopic resonance imaging has received substantial attention for prostate imaging. While the technique demonstrates high specificity, implementation in clinical practice is limited by the requirement of special MR physics expertise, additional time and software for data analysis, and technical difficulties with image acquisition. The ESUR did not include MRS in their minimum recommendations due to lack of evidence and noted that MRS is not commonly performed in Europe; they did comment that they believed US groups use MRS more frequently. Our study shows, however, that MRS is also not commonly performed among US institutions. MRS was the least commonly used functional technique of those suggested as functional techniques by the ESUR, with only eight of the responding institutions reporting routine use of MRS; all were academic institutions. Of the eight performing MRS, four do so at 3.0T with endorectal coil, three at 1.5T with endorectal coil, and one at 1.5T without endorectal coil. There are several likely reasons for this trend, not only does MRS require a long acquisition time, but a multicenter trial to investigate its efficacy did not show improved performance over T2-weighted images.

The indications for prostate MRI are important to consider. Whereas, in the past prostate MRI was used for staging, the focus now is on other indications. Within this survey, there is an equal role for MRI for radiation planning (72%), evaluation after negative biopsy (69%), surgical planning (69%), recurrence (69%) and active surveillance (53%). That implies a shift from “therapeutical assistance of invasive techniques” to detection and guiding of active surveillance. This is in agreement with increasing evidence in the role of prostate MRI in active surveillance and use in men with prior negative biopsies. The use of prostate MRI for staging is well established, with high sensitivity and specificity reported for extracapsular extension and seminal vesicle invasion; it is therefore not unexpected that this was a common indication for prostate MRI. Fairly new in the literature, however, is the use of prostate MRI in men with prior negative biopsies, with a recent study suggested that 59% of men with prior negative biopsy were subsequently found to have cancer after MRI guided biopsy. Of interest, this was one of the most common indications for prostate MRI in our survey. While groups have advocated for prostate MRI in active surveillance, this was the

least common indication for prostate MRI with only 53% of institutions performing prostate MRI for this indication.

Recent data from the SEER-Medicare database demonstrate the increasing awareness of the risk of prostate biopsy, further arguing for non-invasive methods of following prostate cancer. Targeted biopsy of concerning lesions, without biopsy of normal prostate tissue, may decrease this risk. While most institutions perform prostate MRI after prior negative biopsies, only 11 performed targeted biopsy and all of these were academic centers. Selecting those institutions that performed prostate MRI for prior negative biopsy, 14 of the 22 locations were unable to perform MRI guided biopsy. While the ability to perform MRI guided biopsy is not currently recommended for those performing prostate MRI, the American College of Radiology (ACR) does have such a recommendation in other MRI modalities, such as breast MRI. The number of prostate biopsies per month was not assessed in this survey, but would be of interest in subsequent evaluations.

There are a number of limitations of this study. Our survey and the responses are limited by bias operational in any study requiring voluntary response. Additionally, while we attempted to use societies that would include non-academic radiologists, very few community and private practice groups responded to the survey. Additionally, while almost a third of academic institutions are represented, these responses may also be biased and we hypothesize that the rates of MRI for prostate imaging may be lower in the non-responding institutions. While we addressed major areas of variation in prostate MRI, there are many areas where national variation would be important to investigate. Potential areas to further evaluate include DWI parameters such as b-values, DCE parameters including time duration and temporal resolution, MRI preparation including glucagon or enema use, and image interpretation processes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Take Home Points

- Prostate MRI is increasingly being performed for the clinical care of men with prostate cancer.
- The majority of surveyed academic institutions now perform prostate MRI
- While there remains variability in the practice of prostate MRI, there are common MRI equipment expectations and MRI protocols that are ubiquitous among practices
- The minority of centers are performing prostate cancer MRI on a regular basis with adequate numbers. This may have a negative effect on quality.
- Sections of variability raised in this study demonstrate areas where investigation and education can be can be focused to improve the uniformity of prostate MRI acquisition and quality throughout the United States.

Table 1

Response demographics. Radiologists per practice that read prostate MRI and body MRI are reported as mean and standard deviation.

	Academic	Large Private Practice	Community Group
US Responses	36	5	10
Perform prostate MRI	32 (88.9%)	3 (60%)	3 (30%)
Radiologists read Prostate MRI	5.23 (3.77)	6 (0.82)	1.89 (3.02)
Radiologists read Body MRI	10.27 (8.77)	21.5 (25.7)	4.22 (3.53)

Table 2

MRI sequence protocols. Common MRI protocol combinations are displayed. All institutions perform axial T1-weighted and axial T2-weighted sequences. All institutions perform at least one sequence in addition to anatomic images. T1ax = T1-weighted axial, T2ax= T2-weighted axial, DWI-diffusion weighted imaging, DCE-dynamic contrast enhancement, MRS-magnetic resonance spectroscopy imaging.

MRI Sequence	Academic	Private Practice	Community Group
T1ax/T2ax/DWI/DCE/MRS	7		
T1ax/T2ax/DWI/DCE	19		2
T1ax/T2ax/DWI/MRS	1		
T1ax/T2ax/DCE/MRS	-		
T1ax/T2ax/DWI	5	2	
T1ax/T2ax/DCE	-	1	1

Table 3

Indications for Prostate MRI. Table demonstrates the response of institutions as to why they perform prostate MRI. Percentages of responses (of institutions performing prostate MRI) are demonstrated in parenthesis. 32 responses were given for this question.

PROSTATE MRI INDICATION	
Cancer Staging	24 (75.0%)
Radiation Planning	23 (71.9%)
MRI after Prior Negative Biopsy	22 (68.8%)
Surgical Planning	22 (68.8%)
Cancer Recurrence	22 (68.8%)
Active Surveillance	17 (53.1%)