THE EFFICACY AND UTILISATION OF PREOPERATIVE MAGNETIC RESONANCE IMAGING IN ROBOT-ASSISTED RADICAL PROSTATECTOMY: DOES IT CHANGE THE SURGICAL DISSECTION PLAN? A PRELIMINARY REPORT

***Hasan Hüseyin Tavukçu,[1] Ömer Aytaç,[1] Cem Balcı,[2] Haluk Kulaksızoğıu,[1] Fatih Atuğ[1]**

1. Department of Urology, School of Medicine, Istanbul Bilim University, Istanbul Florence Nightingale Hospital, Istanbul, Turkey
2. Department of Radiology, School of Medicine, Istanbul Bilim University, Istanbul Florence Nightingale Hospital, Istanbul, Turkey
**Correspondence to hhtavukcu@yahoo.com*

Disclosure: The authors have declared no conflicts of interest.
Accepted: 01.05.15
Citation: EMJ Urol. 2015;3[3]:45-49.

ABSTRACT

Purpose: We investigated the effect of prostate magnetic resonance imaging (MRI) on the dissection plan of the neurovascular bundle and the oncological results of our patients who underwent robotic radical prostatectomy operation.
Materials and Methods: We prospectively evaluated 30 consecutive patients, 15 of whom had prostate MRI before the operation, and 15 of whom did not. With the findings of MRI, the dissection plan was changed as intrafascial, interfascial, and extrafascial technique in the MRI group. Two groups were compared in terms of age, prostate-specific antigen (PSA), and Gleason scores (GSs). Surgical margin status was also checked with the final pathology.
Results: There was no significant difference between the two groups in terms of age, PSA, biopsy GS, and final pathological GS. MRI changed the initial surgical plan to a nerve-sparing technique in 7 of the 15 patients. Only one patient in the MRI group had a positive surgical margin on bladder neck. MRI was confirmed as the primary tumour localisation in the final pathology in 93.3% of patients.
Conclusion: Preoperative prostate MRI influenced the decision to carry out a nerve-sparing technique in 46% of the patients in our study; however, the change to a nerve-sparing technique did not seem to compromise the surgical margin positivity.

Keywords: Prostate cancer (PrC), prostate magnetic resonance imaging, robotic radical prostatectomy (RRP).

INTRODUCTION

In recent times, robotic radical prostatectomy (RRP) has increased worldwide and advanced disease is being operated on more frequently. A nerve-sparing approach in both open and laparoscopic techniques is the main advantage in this surgical era.[1] RRP has the advantages of improved visualisation and also improved instrument controls, whereas the lack of tactile feedback is the main disadvantage while dissecting the neurovascular bundle (NVB) and adjacent tissues around the tumour. Extensive resection of the NVB carries the high risk of impotence and compromised continence. On the other hand, preservation of the NVB without a preliminary evaluation of the tumour extent may lead to residual tumour tissue at the bundle and/or fascial sites. For a better preoperative visualisation and planning for the dissection of NVBs, a preliminary prostatic magnetic resonance imaging (MRI) could be a useful tool. A preoperative assessment of the tumour location,

the presence of extracapsular extension, or seminal vesicle and NVB invasions may lead the surgeon to plan nerve-sparing or not. With the ongoing technological innovations in radiology, multi-parametric and endorectal coil MRI localises the high volume and high-grade prostate cancer (PrC) tumour areas.[2-9] Recent studies have detailed the prostate and the adjacent tissue anatomy, especiallythe fascial content NVB.[10] In light of these studies, a preoperative MRI of the prostate may guide the surgeon's dissection plan in RRP. We aimed to report the preliminary data of the oncologic results of patients who underwent RRP with or without prior MRI.

MATERIALS AND METHODS

Between January 2014 and February 2015, we prospectively evaluated 30 consecutive patients who had a biopsy proven adenocarcinoma of the prostate and were candidates for RRP, 15 of whom had a preoperative prostate MRI (Group I), and 15 of whom did not (Group II). Exclusion criteria of the study were diagnosis of metastatic disease, previous anti-androgen or androgen blockage usage, and pre-existing erectile dysfunction. All MRI were evaluated for extracapsular extension by a single radiologist specialising in prostate MRI. With the findings of prostate MRI, the dissection plan was chosen as intrafascial, interfascial, and extrafascial technique in Group I. In Group II, the dissection plan was planned according to digital rectal examination and in the preoperative risk group of patients according to the D'Amico risk classification. A single surgeon carried out all operations. Two groups were compared in terms of mean age, PSA ranges, the biopsy, and final pathologic Gleason scores. Surgical margin status and localisation of tumour was also determined with the final surgical specimen and was subsequently mapped on macroscopic photographs to demonstrate tumour extent and multifocality. Univariate analysis for age, PSA, biopsy Gleason score, and prostatectomy Gleason score was performed using the Mann Whitney U test and T test for continuous variables. SPSS version 15 was used for statistical analysis with the 2-tailed level of significance set at $p<0.05$.

RESULTS

The mean follow-up time after surgery was 8.4 (1-16) months. There was no statistically significant difference in terms of age, PSA, biopsy, and final pathologic Gleason scores between two groups (Table 1). Patients were stratified according to the D'Amico risk groups as low, intermediate, and high risk (Table 2).

Table 1: Demographics of two groups in terms of age, PSA, biopsy and final pathologic Gleason scores, and surgical margin positivity.

	Group I (n=15)	Group II (n=15)	p
Age	62.56	62.26	0.662
PSA* (ng/dl)	8.1	6.17	0.184
Positive surgical margin (n)	1	0	
Biopsy Gleason score	7.06	6.66	0.513
Prostatectomy Gleason score	7.0	6.86	0.857

*PSA: prostate specific antigen.

Table 2: D'Amico risk classification of groups.

Preoperative	Low risk	Intermediate risk	High risk
Group I (n=15)	4	7	4
Group II (n=15)	7	6	2

Only one patient in Group I had a positive surgical margin (PSM), which was spotted on the bladder neck. MRI predicted 93.3% of the primary tumour localisation in comparison to the final pathology of the specimens. After the final pathology, extracapsular extension (pathologic T3) was reported in six patients from Group I and four patients from Group II (Table 3). The initial planned dissection technique was changed to the nerve-sparing technique (intrafascial or interfascial) following MRI evaluation in at least one side in 7 of the 15 patients (46.6%). An example case where the dissection plan was changed to nerve-sparing technique after performing prostate MRI is summarised with MRI and pathologic pictures in Figure 1.

Table 3: Pathologic T2 and T3 of groups.

Pathologic stage	T2	T3
Group I (n=15)	9	6
Group II (n=15)	11	4

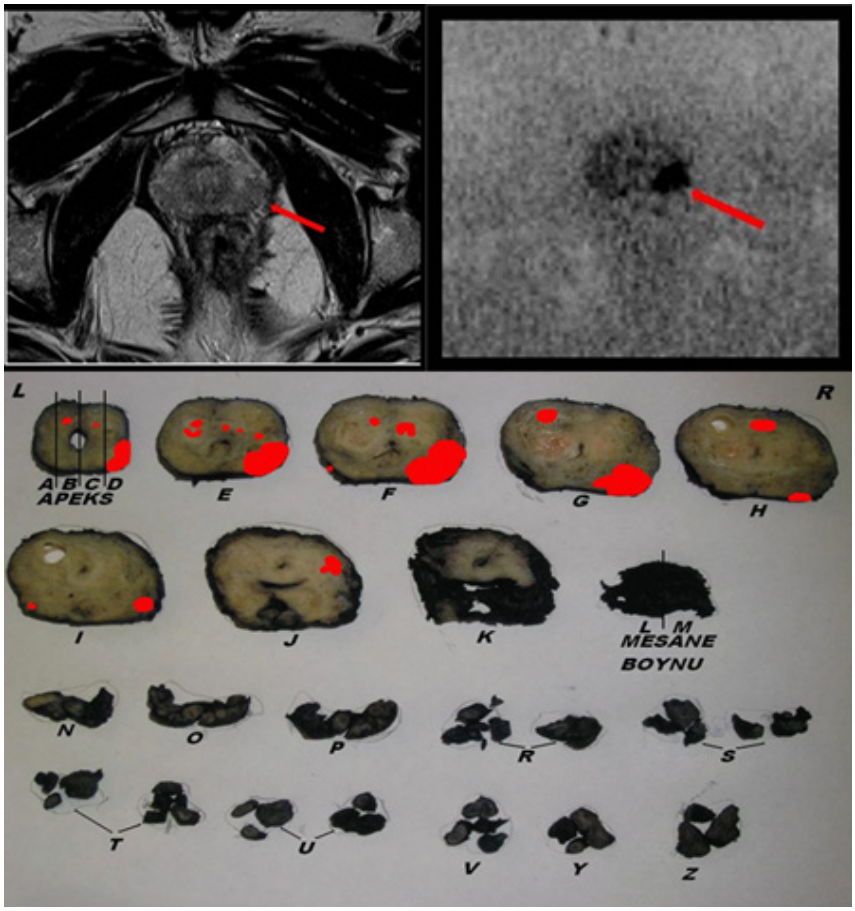

Figure 1: Example of dissection plan changed to nerve-sparing (interfascial) technique.
Images of a 58-year-old man with a prostate specific antigen (PSA) level of 6.42 ng/dL and a biopsy Gleason score (4+4=8) in two of seven cores on the right. Digital rectal examination was abnormal on the right side of the prostate. Non-nerve sparing dissection was initially planned on the right side in accordance with biopsy. Magnetic resonance imaging (MRI) showed no involvement of the neurovascular bundles or seminal vesicles but reported adjacent tumour to capsule. MRI images of T2-weighted and diffusion phase was focussed on the tumour at the right posterolateral gland (shown with arrow). Right interfascial dissection plan was performed and the final pathology demonstrated Gleason 3+4, confirming imaging findings of extracapsular extension on the right posterolateral gland although surgical margins are negative.

DISCUSSION

Radical prostatectomy is the most common treatment for clinically localised PrC and the number of RRP has been rapidly increasing since it was introduced in 2000.[11] RRP is especially popularised due to the successful achievement of the trifecta, which is described as successful control of cancer, preservation of erectile function, and continence after prostatectomy. The NVBs that mediate erectile function and continence lie posterolateral to the prostatic capsule and adjacent tissues. With the latest studies, periprostatic anatomy is better defined, and now three different dissection plans can be utilised, of which two are nerve-sparing techniques (intrafascial and interfascial).[10]

Comparative studies demonstrated perioperative and functional advantages for RRP versus open radical prostatectomy (ORP).[12,13] Surgeons performing ORP demonstrate that tactile feedback enables intraoperative decision of dissection plans for cancer control with reducing PSMs.[14] During RRP, lack of tactile feedback is the main disadvantage while dissecting the NVB and adjacent tissues around the tumour. Current specialised techniques of prostate MRI have been shown to be accurate in detecting tumour localisation and extent; thus directing the surgeon to choose the dissection plan in RRP.[2-9] In our study we prospectively followed up the patients who had RRP with or without preliminary MRI-guided dissection planning. This is the first study to our knowledge comparing the oncologic results of RRP with or without MRI-guided dissection techniques. This is a preliminary report of the data involving a limited number of patients.

In Group I patients who underwent MRI, any suspicion of extracapsular extension was the main factor that influenced the dissection plan. The planning criteria of dissection technique in Group II were digital rectal examination and the D'Amico risk classification. Magnetic resonance spectroscopy of the prostate was not performed on all patients because it is not covered by most health insurance policies and not all patients can pay this additional cost. McClure et al.[15] have reported a series of cases of MRI-guided preservation of the NVB in RRP. In their study the initial plan was changed in 28 of the 104 patients (27%) according to MRI findings, while in our study, the initial plan was changed in 7 of the 15 patients (46.6%). This higher percentage in our study may be associated with a limited study population. They also reported that in 11 of the 28 patients, surgery was changed from a nerve sparing to a non-nerve sparing technique, but in our study we did not have to change the nerve sparing to a non-nerve sparing plan on any side. In McClure's study,[15] no PSM was reported in patients where the surgical plan was changed according to MRI findings; in our study we had only one PSM at the bladder neck that was not related to NVB dissection plan. In another study by Hricak et al.,[16] MRI was used for evaluation of NVB invasion before ORP to decide on the dissection plan. They reported that the surgical plan was altered in 39% of the NVBs in their series, which is also lower than our results.[16]

Only one patient in our MRI group had a PSM at the bladder neck that was only defined as a microscopically focal area in pathology; at the 15th month follow-up period the patient also had no PSA recurrence. These findings were not related to the nerve-sparing route or area. A previous study reported a 6.7% PSM rate in patients who had undergone a more aggressive non-nerve sparing technique according to MRI findings on the affected side.[15] A comparative study reported that RRP had fewer PSM rates than ORP (13.6% versus 18.3%; odds ratio: 0.70), and RRP was associated with a lower use of additional cancer therapy within 24 months.[11] Because of the limited study group, we did not analyse statistics for a PSM but only one patient had a PSM in the MRI group and not in another group.

The specificity of prostate MRI in the differentiation of T2 disease from T3 in some previous studies was reported in the range of 73%,[17] 89%,[18] 95%,[19] and 97.5%.[15] Our results showed a 93% specificity for the primary tumour extension and localisation. One patient had focal cancer on one side in the final pathology but MRI could not define it before the operation. In a previous study, it was reported that the positive predictive value of multi-parametric MRI for extra-capsular extension was best in intermediate and high-risk groups;[18] in conclusion they recommended that in high-risk cases, MRI might be useful for decreasing the risk of PSM when performing non-nerve sparing prostatectomy.

Final pathology reports were highly concordant with MRI-reported primary lesions. Other smaller cancer foci (usually <5 mm) reported in the final pathology were not detected and reported with

the MRI in our series. Previous studies also concluded that prostate MRI highly correlated with final pathology in the intermediate and high-risk groups of patients.[15,18] The functional results of the two groups were not reported in this paper because of the limited data and short follow-up period, but we have observed earlier continence and erectile function rates in the MRI-guided operation group. In conclusion, prostate MRI is a useful tool in the surgical planning of RRP dissection choice, achieving the ultimate trifecta without compromising the oncological outcome.

REFERENCES

1. Walsh PC et al. Radical prostatectomy with preservation of sexual function: anatomical and pathological considerations. Prostate. 1983;4(5): 473-85.

2. Chandra RV et al. Endorectal magnetic resonance imaging staging of prostate cancer. ANZ J Surg. 2007;77(10):860-5.

3. desouza NM et al. Magnetic resonance imaging in prostate cancer: the value of apparent diffusion coefficients for identifying malignant nodules. Br J Radiol. 2007;80(950):90-5.

4. Kozlowski P et al. Combined diffusion-weighted and dynamic contrast-enhanced MRI for prostate cancer diagnosis--correlation with biopsy and histopathology. J Magn Reson Imaging. 2006;24(1):108-13.

5. Scheidler J et al. Prostate cancer: localization with three-dimensional proton MR spectroscopic imaging--clinicopathologic study. Radiology. 1999;213(2):473-80.

6. Turkbey B et al. Prostate cancer: value of multiparametric MR imaging at 3 T for detection--histopathologic correlation. Radiology. 2010;255(1):89-99.

7. Wang L et al. Prediction of organ-confined prostate cancer: incremental value of MR imaging and MR spectroscopic imaging to staging nomograms. Radiology. 2006;238(2):597-603.

8. Yu KK et al. Detection of extracapsular extension of prostate carcinoma with endorectal and phased-array coil MR imaging: multivariate feature analysis. Radiology. 1997;202(3):697-702.

9. Yu KK et al. Prostate cancer: prediction of extracapsular extension with endorectal MR imaging and three-dimensional proton MR spectroscopic imaging. Radiology. 1999;213(2):481-8.

10. Walz J et al. A critical analysis of the current knowledge of surgical anatomy related to optimization of cancer control and preservation of continence and erection in candidates for radical prostatectomy. Eur Urol. 2010;57(2): 179-92.

11. Hu JC et al. Comparative effectiveness of robot-assisted versus open radical prostatectomy cancer control. Eur Urol. 2014;66(4):666-72.

12. Hu JC et al. Comparative effectiveness of minimally invasive vs open radical prostatectomy. JAMA. 2009;302(14): 1557-64.

13. Ficarra V et al. Systematic review and meta-analysis of studies reporting urinary continence recovery after robot-assisted radical prostatectomy. Eur Urol. 2012;62(3):405-17.

14. Hubanks JM et al. Open radical retropubic prostatectomy using high anterior release of the levator fascia and constant haptic feedback in bilateral neurovascular bundle preservation plus early postoperative phosphodiesterase type 5 inhibition: a contemporary series. Eur Urol. 2012;61(5):878-84.

15. McClure TD et al. Use of MR imaging to determine preservation of the neurovascular bundles at robotic-assisted laparoscopic prostatectomy. Radiology. 2012;262(3):874-83.

16. Hricak H et al. The role of preoperative endorectal magnetic resonance imaging in the decision regarding whether to preserve or resect neurovascular bundles during radical retropubic prostatectomy. Cancer. 2004;100(12):2655-63.

17. Brajtbord JS et al. Endorectal magnetic resonance imaging has limited clinical ability to preoperatively predict pT3 prostate cancer. BJU Int. 2011;107(9): 1419-24.

18. Somford DM et al. The predictive value of endorectal 3 Tesla multiparametric magnetic resonance imaging for extraprostatic extension in patients with low, intermediate and high risk prostate cancer. J Urol. 2013;190(5):1728-34.

19. Bloch BN et al. Prostate cancer: accurate determination of extracapsular extension with high-spatial-resolution dynamic contrast-enhanced and T2-weighted MR imaging--initial results. Radiology. 2007;245(1):176-85.