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Brief Correspondence

The Incremental Role of Magnetic Resonance Imaging for Prostate Cancer Staging before Radical Prostatectomy

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Abstract

In the present report we aimed to analyze the incremental value of preoperative magnetic resonance imaging (MRI), in addition to clinical variables and clinically-derived nomograms, in predicting outcomes radical prostatectomy (RP). All Mayo Clinic RP patients who underwent preoperative 1.5-Tesla MRI with endo-rectal coil from 2003 to 2013 were identified. Clinical and histopathological variables were used to calculate Partin estimates and Cancer of the Prostate Risk Assessment (CAPRA) score. MRI results in terms of extracapsular extension (ECE), seminal vesicle invasion (SVI), and lymph-node invasion (N+) were recorded. Using RP pathology as gold standard, we developed multivariate logistic regression models based on clinical variables, Partin Tables, and CAPRA score, and assessed their predictive accuracy before and after the addition of MRI results. Five hundred and one patients were included. MRI + clinical models outperformed clinical-based models alone for all outcomes. Comparing Partin and Partin + MRI predictive models, the areas under the curve were 0.61 versus 0.73 for ECE, 0.75 versus 0.82 for SVI, and 0.82 versus 0.85 for N+. Comparing CAPRA and CAPRA + MRI models, the areas under the curve were 0.69 versus 0.77 for ECE, 0.75 versus 0.83 for SVI, and 0.82 versus 0.85 for N+. Our data show that MRI can improve clinical-based models in prediction of nonorgan confined disease, particularly for ECE and SVI.

Patient summary: Magnetic resonance imaging, together with clinical information, can be useful in preoperative assessment before radical prostatectomy.

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Prediction of adverse pathological features at surgery, in terms of extracapsular extension (ECE), seminal vesicle invasion (SVI), and node positivity (N+), is of particular interest when defining the surgical approach and the role of magnetic resonance imaging (MRI) in this setting is still a matter of debate.

The European Association of Urology [1] and National Comprehensive Cancer Network guidelines [2] do not provide definitive indications for MRI use, simply hypothesizing a role for this technique, especially in high-risk disease. A recent meta-analysis [3] concluded that MRI has a good specificity for T staging, while sensitivity is highly variable. As such, there remains a high-level of clinical uncertainty regarding the potential role of MRI, particularly when compared with conventional, clinically-based risk classification models. In the present study, we compared MRI with existing models (the Cancer of the Prostate Risk Assessment [CAPRA] score and the

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Partin tables) [4,5] and analyzed if the addition of MRI information could improve these clinical models in terms of pathological outcomes at the time of radical prostatectomy (RP).

All patients who underwent preoperative 1.5-Tesla MRI and subsequent RP with pelvic lymph node dissection at Mayo Clinic Rochester, MN, USA, between 2003 and 2013 were included in this retrospective, Institutional Review Board approved study. Detailed methods are reported in Supplementary Data 1. In brief, we used age, prostate-specific antigen (PSA) at diagnosis, clinical stage (digital rectal exam), primary and secondary Gleason grade, Gleason score, percentage of positive/total cores to calculate Partin Table estimates and CAPRA scores. MRI results for ECE, SVI, and nodal disease (N+) were collected. Pathological features (pT, pN, Gleason score, surgical margin status, SVI, and ECE) were recorded. We developed logistic multivariable regression models including: clinical variables (PSA, clinical stage, percentage of involved cores/total cores, primary Gleason 4–5), Partin Table estimates (for each specific outcome) and CAPRA scores; MRI results (in terms of negative/positive exam for each outcome) were then added in each model and the multivariate modeling was reassessed. The predictive ability of each model was further compared developing receiver-operating characteristic curves and analyzing the area under the curve (AUC) before and after the addition of MRI.

Five hundred and one patients were included in the final analysis. Demographic, clinical, and pathological features are shown in Supplementary Table 1. ECE, SVI, and N+ were present in 42.3%, 30.7%, and 16.0% of patients, while MRI results were positive for ECE in 147 patients (29.3%), for SVI in 83 patients (16.6%), and for N+ disease in 24 (4.8%). As shown in Table 1, the multivariate clinical models for

Table 1 – Multivariate modeling analysis for predictors of histological outcome

ECE prediction	Without MRI				With MRI			
	OR	95% CI		*p* value	OR	95% CI		*p* value
Clinical variables								
PSA	1.025	1.000	1.051	0.054	1.021	0.991	1.052	0.173
% core involv.	1.014	1.005	1.023	0.003	1.015	1.004	1.026	0.007
Age at surgery	1.024	0.990	1.060	0.165	1.016	0.976	1.058	0.427
Clinical stage	1.348	1.124	1.616	0.001	1.220	0.975	1.525	0.081
Primary Gleason 4/5	2.344	1.374	4.000	0.002	4.145	2.194	7.833	<0.0001
MRI ECE result	–	–	–	–	2.379	1.262	4.488	0.007
Partin ECE	1.042	1.019	1.065	0.0003	1.023	0.995	1.052	0.102
MRI ECE result	–	–	–	–	7.522	4.108	13.773	<.0001
CAPRA score	1.328	1.191	1.481	<0.0001	1.244	1.095	1.413	0.0008
MRI ECE result	–	–	–	–	5.248	2.994	9.198	<0.0001
SVI prediction	**Without MRI**				**With MRI**			
	OR	95% CI		*p* value	OR	95% CI		*p* value
Clinical variables								
PSA	1.007	0.983	1.033	0.5572	1.010	0.983	1.038	0.4721
% core involv.	1.026	1.015	1.037	<0.0001	1.027	1.015	1.040	<0.0001
Age at surgery	0.997	0.959	1.037	0.8838	0.984	0.940	1.029	0.4768
Clinical stage	1.273	1.048	1.547	0.0148	1.152	0.922	1.441	0.2130
Primary Gleason 4/5	5.707	2.820	11.552	<0.0001	5.073	2.233	11.524	0.0001
MRI SVI result	–	–	–	–	7.024	3.003	16.431	<.0001
Partin SVI	1.109	1.075	1.145	<0.0001	1.098	1.058	1.139	<0.0001
MRI SVI result	–	–	–	–	7.582	3.449	16.669	<0.0001
CAPRA score	1.507	1.332	1.706	<0.0001	1.408	1.222	1.622	<0.0001
MRI SVI result	–	–	–	–	8.854	4.286	18.288	<0.0001
N+ prediction	**Without MRI**				**With MRI**			
	OR	95% CI		*p* value	OR	95% CI		*p* value
Clinical variables								
PSA	1.023	0.996	1.051	0.0964	1.032	0.996	1.068	0.0794
% involv core	1.024	1.009	1.039	0.0012	1.020	1.003	1.037	0.0235
Age at surgery	1.003	0.954	1.054	0.9170	0.986	0.928	1.048	0.6558
Clinical stage	1.304	1.025	1.658	0.0304	1.344	1.014	1.782	0.0395
Primary Gleason 4/5	7.147	2.066	24.726	0.0019	9.669	2.263	41.309	0.0022
MRI nodes result	–	–	–	–	4.831	1.320	17.674	0.0173
Partin nodes	1.115	1.074	1.157	<0.0001	1.102	1.056	1.150	<0.0001
MRI nodes	–	–	–	–	14.249	3.141	64.638	0.0006
CAPRA score	1.660	1.415	1.948	<0.0001	1.682	1.392	2.032	<0.0001
MRI nodes	–	–	–	–	15.060	4.348	52.165	<0.001

CAPRA = Cancer of the Prostate Risk Assessment; CI = confidence interval; ECE = extracapsular extension; MRI = magnetic resonance imaging; N+ = lymph-node invasion; OR = odds ratio; PSA = prostate-specific antigen; SVI = seminal vesicle invasion.

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