Prediction of Extracapsular Extension of of Prostate Cancer with Endorectal MRI: the Effects of Histological Tumor Size, Grade and Zonal Extent

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Introduction: In the literature, the sensitivity of MRI for detecting extracapsular extension (ECE) of prostate cancer ranges from 22% to 80% (1-4). The purpose of this study was to identify histological characteristics of prostate cancer lesions that significantly affect the sensitivity of MRI for detecting ECE. The following histological characteristics were considered: greatest diameter, greatest perpendicular diameter (defined as the maximal diameter perpendicular to the greatest diameter), bi-dimensional diameter product, Gleason grade, and zonal extent (i.e., whether the dominant lesion is in the peripheral zone or the transition zone and whether the cancer extends into both zones).

Materials and Methods: In 176 patients who underwent endorectal MRI (MRI) at our institution from 6/05-11/05 before radical prostatectomy with subsequent whole-mount pathologic step-section pathology, 339 tumor lesions were found that abutted the capsule of the prostate (Fig. 1). MR images were prospectively interpreted by 7 radiologists, and the likelihood of ECE of the lesions was retrospectively scored (score range: 1-5). Generalized estimating equation (GEE) regression models were used to determine the sensitivity of MRI as a function of several histological variables (5).

Results: Fifty-four lesions (16%; 54/339) had ECE; they came from 51 patients (3 patients had two lesions with ECE). Considering MRI scores ≥3 as indicating ECE, the sensitivity of MRI in detecting ECE was 67% (36/54) [95%CI: 53-78%]. MRI yielded false positive results for 27/285 lesions (9%) [95%CI: 6-14%] without ECE. The sensitivity of MRI for detecting ECE was significantly associated with greatest perpendicular diameter of prostate cancer lesions measured at histology (p=0.009). For lesions with a greatest perpendicular diameter > 3 cm, MRI sensitivity exceeded 90%. For lesions with a greatest perpendicular diameter > 2 cm the sensitivity was approximately 75% (Fig. 2). MRI sensitivity was not significantly associated with the histological greatest diameter, (p= 0.92), bi-dimensional diameter product (p=0.42), Gleason grade (p=0.43), or zonal extent (p=0.30) (Table 1).

Conclusions: The greatest perpendicular diameter of a prostate cancer lesion is significantly associated with the sensitivity of MRI in detecting ECE of the lesion. The greatest perpendicular diameter may therefore provide important diagnostic information regarding prostate staging and help stratify patients for appropriate treatment.

Size Covariate Considered	Parameter Estimate[a]	Relative Fraction	95% CI	p value
Greatest Diameter	0.012	1.012	(0.808, 1.267)	0.92
Greatest Perpendicular Diameter	0.169	1.184	(0.977 – 1.059)	0.009
Bi-dimensional Diameter product	0.017	1.017	(0.808 – 1.267)	0.42

Table 1: Sensitivity of MRI in detecting ECE for different histological variables. [a]Parameter estimates from the marginal generalized linear regression model $\log(\text{SENSITIVITY})=\beta_0+\beta_1\text{Size}$.

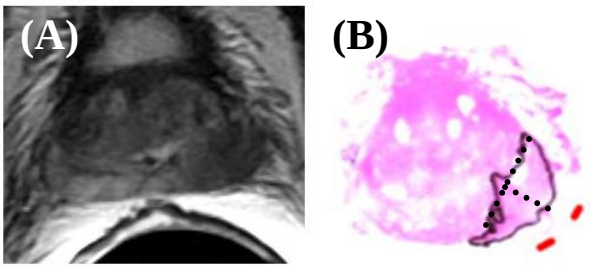

Fig. 1: (a) Axial T2-w FSE 3-mm image showing ECE of the tumor abutting the left posterior prostate capsule. (b) Step-section histopathology; Gleason grade 4 tumor in the left peripheral zone and the transition zone; greatest diameter 2.256 cm (dotted line); greatest perpendicular diameter 1.5 cm (solid line); bi-dimensional diameter product 3.384cm².

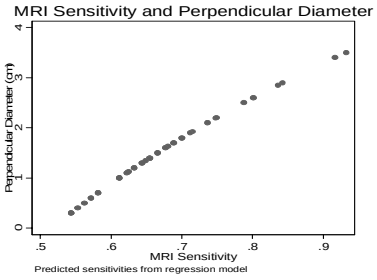

Fig. 2: MRI sensitivity in detecting ECE is only affected by greatest perpendicular diameter from the GEE logistic regression model.

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