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ORIGINAL REPORT

Predicting extracapsular involvement in prostate cancer through the tumor contact length and the apparent diffusion coefficient☆

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KEYWORDS
Prostate cancer;
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Abstract
Objective: To evaluate the diagnostic performance of the length of the tumor contact with the capsule (LTC) and the apparent diffusion coefficient (ADC) map in the prediction of microscopic extracapsular extension in patients with prostate cancer who are candidates for radical prostatectomy.
Material and methods: We used receiver operating curves to retrospectively study the diagnostic performance of the ADC map and the LTC as predictors of microscopic extracapsular extension in 92 patients with prostate cancer and moderate to high risk who were examined between May 2011 and December 2013.
Results: The optimal cutoff for the ADC map was 0.87×10^{-3} mm^2/s, which yielded an area under the ROC curve of 72% (95% CI: 57%–86%), corresponding to a sensitivity of 83% and a specificity of 61%. The optimal cutoff for the LTC was 17.5 mm, which yielded an area under the ROC curve of 74% (95% CI: 61%–87%), corresponding to a sensitivity of 91% and a specificity of 57%. Combining the two criteria improved the diagnostic performance, yielding an area under the ROC curve of 77% (95% CI: 62%–92%), corresponding to a sensitivity of 77% and a specificity of 61%. We elaborated a logistic regression model, obtaining an area under the ROC curve of 82% (95% CI: 73%–93%).
Conclusions: Using quantitative measures improves the diagnostic accuracy of multiparametric magnetic resonance imaging in the staging of prostate cancer. The values of the ADC and LTC were predictors of microscopic extracapsular extension, and the best results were obtained when both values were used in combination.

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PALABRAS CLAVE
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Predicción de la extensión extracapsular en el cáncer de próstata mediante la longitud del contacto tumoral y el coeficiente de difusión aparente

Resumen
Objetivo: Evaluar el rendimiento diagnóstico de la longitud del contacto tumoral con la cápsula (LCT) y la cuantificación del mapa del coeficiente de difusión aparente (ADC) en la predicción de la extensión extracapsular (EEC) microscópica en pacientes con cáncer de próstata candidatos a prostatectomía radical.
Método: Se realizó un estudio retrospectivo de prueba diagnóstica con curvas receptor-operador (ROC) evaluando el rendimiento diagnóstico del valor de ADC y LCT como predictores de EEC microscópica en 92 pacientes con cáncer de próstata de moderado y alto riesgo, entre mayo de 2011 y diciembre de 2013.
Resultados: El punto de corte óptimo para el valor del mapa de ADC fue de 0,87 $\times$ 10^{-3} mm^2/s, con un área bajo la curva ROC del 72% (intervalo de confianza del 95% [IC95%]: 57-86%), una sensibilidad del 83% y una especificidad del 61%. Para la LCT, el punto de corte óptimo fue de 17,5 mm, con un área bajo la curva ROC del 74% (IC95%: 61-87%), una sensibilidad del 91% y una especificidad del 57%. Empleando ambos criterios, el rendimiento diagnóstico mejoró con un área bajo la curva ROC del 77% (IC95%: 62-92%), una sensibilidad del 77% y una especificidad del 61%. Se calculó un modelo de regresión logística y se obtuvo un área bajo la curva ROC del 82% (IC95%: 73-93%).
Conclusiones: El uso de criterios cuantitativos mejora la exactitud diagnóstica de la resonancia magnética multiparamétrica en la estadificación del cáncer de próstata. Se encontró que los valores de ADC y de LCT son predictores de EEC microscópica, y que se obtienen mejores resultados si se usan de manera conjunta.

Introduction

Prostate cancer is the second most common type of cancer in males worldwide (15 per cent) and the fifth cause of cancer mortality among this population (6.6 per cent).[1] In Colombia, the panorama is not any different and it is the second most common cause of cancer in men, with an incidence of 46.5 per 100,000 inhabitants and a mortality rate of 12.6 per 100,000 inhabitants.[2]

Both choosing treatment and the prognosis of patients with prostate cancer depend on the presence of extracapsular spread (ECS). For the cases of localized prostate cancer, the radical prostatectomy is the treatment of choice, with high rates of survival.[3]

Patients with localized prostate cancer undergo clinical staging of the risks based upon what decisions are made when it comes to management (radical prostatectomy with or without adjuvant therapy), ECS risk prediction and possible chemical relapse after the prostatectomy–reported in up to 15–40 per cent of the cases.[4–7] This staging is performed based on the prostate-specific antigen (PSA), rectal examination, and Gleason grading group.[8] Gleason's grading system is based on the sum of the two (2) most prevalent patterns of growth of biopsied tissue, and this score is used to make a five (5) group-grade classification (1: $\leq$6; 2: 3 + 4 = 7; 3: 4 + 3 = 7; 4: 8; and 5: 9 and 10), where group-grade 1 is low risk, while groups-grades 4 through 5 are high risk.[9,10]

Unfortunately, with the use of these clinical parameters we find a 59 per cent substaging,[11] with presence of microscopic ECS in 20–50 per cent of the surgical pieces initially classified as localized prostate cancer.[12,13] This is why it is recommended to perform one wide surgical resection including the neurovascular bundle that may lead to erectile dysfunction as a possible complication.[14] This is the reason why determining the ECS is essential to be able to achieve better surgical outcomes with a lower comorbidity rate and better oncological outomes.[15]

The multiparametric magnetic resonance imaging (mp-MRI) is the best imaging modality for the tumor staging of this neoplasm. It uses anatomical sequences (T1 and T2-weighted images) and functional sequences (diffusion and dynamics after the administration of contrast). For the diagnosis of ECS we normally use T2-weighted imaging conventional criteria[16,17]; this is how, in the year 2011, the European Society of Urogenital Radiology established the PI-RADS criteria and determined the score for the prediction of extracapsular involvement (1–5 points) using T2-weighted sequences. These criteria assess the following parameters: capsular contact (1 point); capsular irregularity (3 points); neurovascular bundle thickening (4 points); bulging or capsular loss (4 points); and overt extracapsular spread (5 points). Scores $\geq$4 regard the presence of ECS as likely.[8] In 2015, the PI-RADS criteria (versión 2) were updated, no changes to these ECS criteria were made, but the DWI sequences-appararent diffusion coefficient (ADC) map and tumor contact length (TCL) with the capsule were mentioned as important factors in the prediction of ECS.[18]

In the medical literature we found great variability in the values of sensitivity and specificity when using these conventional criteria (T2-weighted sequences). One meta-