Entropy of T2-weighted Imaging and Apparent Diffusion Coefficient of Uterine Leiomyoma in Prediction of Leiomyoma Volume Reduction Following Uterine Artery Embolization

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Introduction:

Uterine artery embolization (UAE) has become an alternative option for symptomatic leiomyomas[1]. Many recent studies have investigated the role of MRI features of leiomyomas before UAE for prediction of leiomyoma volume reduction (VR) following UAE[2, 3, 4]. However, many of the results were contradictory and there is lack of a consensus on which is the most reliable feature to predict the outcome after embolization[2, 3, 4]. In this work, we for the first time employed entropy of T2-weighted imaging as the morphological parameter, together with apparent diffusion coefficient (ADC) as the functional parameter, to determine their utility for predicting the leiomyoma VR after UAE.

Materials and Methods:

In this prospective study, 11 patients (age range 29 to 56 years; mean 42 years) with symptomatic uterine leiomyomas who underwent pelvic MRI including diffusion weighted imaging (DWI) before and 6 months after UAE were included. Pre-UAE and post-UAE MRI was all obtained on a 3.0 T system (HDxt; GE healthcare) equipped with a phased-array pelvic coil. Imaging sequences include fast spin-echo T2-weighted imaging, axial DWI using a single-shot spin-echo echo-planar sequence (b-values = 0, 1000 s/mm^2) and axial contrast-enhanced T1-weighted imaging using a 3D volumetric interpolated technique (LAVA) prior to and after administration of intravenous Gd-DTPA contrast.

The volumes of each leiomyoma before and after UAE were determined using software ITK-SNAP on contrast-enhanced T1-weighted images, and the percentage change in volume was calculated. Entropy of T2-weighted imaging and ADC before UAE were assessed using the following equations: $ADC = - \ln(Sb/S0)/b$, where b is the diffusion-sensitizing factor (b-value), and Sb and S0 the signal intensity at a non-zero b-value and zero b-value, respectively; $Entropy = \sum i(- pi)(\log(pi))$, where pi represents the probability of signal intensity (SI) i in the image and is calculated by dividing the pixel number of each SI by the total pixel number.

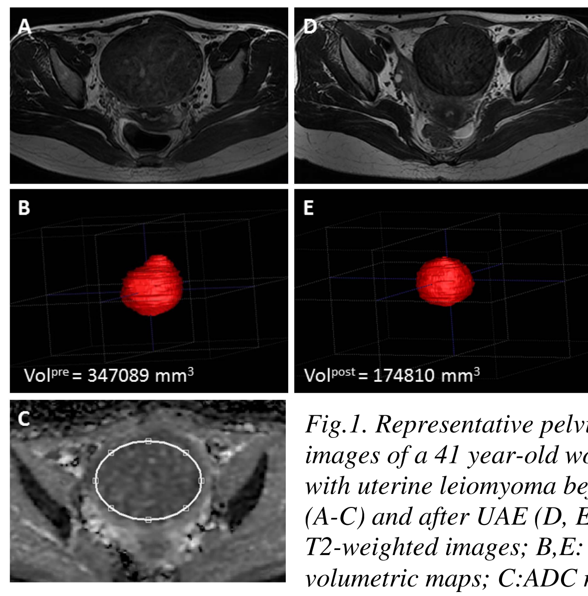

Fig.1. Representative pelvic images of a 41 year-old women with uterine leiomyoma before (A-C) and after UAE (D, E).A,D: T2-weighted images; B,E: 3D volumetric maps; C:ADC map

Results:

A total number of 16 leiomyomas larger than 2 cm in diameter were evaluated. The mean leiomyoma volume before UAE was 72.6 cm^3 (range 7.3–347.1 cm^3), while the mean volume 6 month after UAE was 34.6 cm^3 (range 1.5–174.8 cm^3), resulting in a mean leiomyoma VR of 58.9% (range 25.8%–95.0%). The mean ADC of leiomyomas was 1.37×10^{-3} mm^2/s (range 1.05×10^{-3}–2.32×10^{-3} mm^2/s) and the mean entropy of T2-weighted imaging was 5.36 (range 4.62–5.91) before UAE. ADC and entropy were significantly correlated with VR (Pearson correlation $r = 0.61$, $P = 0.012$; $r = 0.73$, $P = 0.001$). On multiple regression analysis, a combination of ADC and entropy constituted the best model for determining leiomyoma VR using the Akaike information criterion. For predicting ≥ 50% VR, receiver operating characteristic (ROC) curve analysis showed that the cutoff value of ADC was 1.39 × 10^{-3} mm^2/s (sensitivity 45.5%, specificity 80.0%) and the cutoff value of entropy was 5.15 (sensitivity 90.9%, specificity 60.0%).

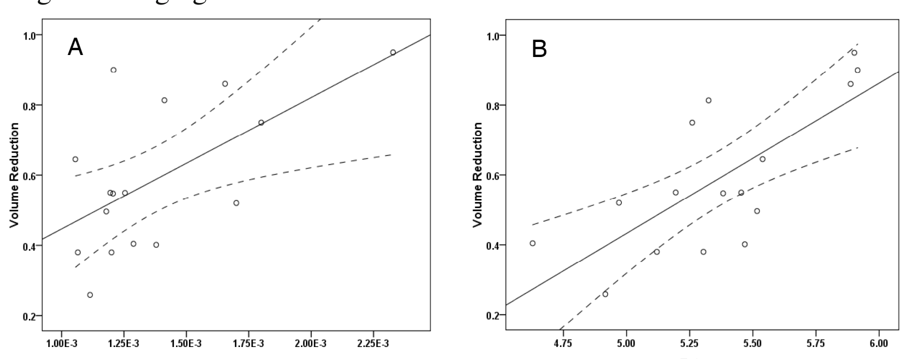

Fig.2. Relationships between ADC (A), entropy (B) and VR, respectively

Conclusion:

Entropy of T2-weighted imaging and ADC of leiomyomas were significantly correlated with VR after UAE. A combination of entropy and ADC may have predictive value for VR after UAE.

References:
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