MULTIPARAMETRIC MRI DIAGNOSIS OF SOFT TISSUE TUMORS.

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Abstract: The purpose of the study. To evaluate multiparametric MRI for differentiation of benign and malignant soft tissue tumors.

Material and methods: This is a retrospective study of 67 patients (average age 55 years; 18-82 years) with 35 benign and 32 malignant soft tissue tumors. The parameters were compared between benign and malignant tumors.

Keywords: IVIM-DWI, DCE-MRI, iAUC,

Introduction. In everyday practice, there are often problems that can distinguish benign soft tissue tumors from malignant ones. The signals of benign and malignant soft tissue tumors may overlap. Recently, diffusion-weighted imaging (DWI) has been used to evaluate soft tissue tumors. The calculation of the apparent diffusion coefficient (ADC) for the random movement of water in tissues may reflect the pathological status of the affected tissue. DWI based on the bi-exponential model of intravoxel incoherent motion (IVIM) by Le Bihan et al. allows to more accurately separate microcapillary perfusion from pure tissue diffusion (V e), as well as a semiquantitative parameter of the initial area under the time - signal intensity curve (iAUC). The values of these pharmacokinetic parameters for DCE-MRI have rarely been evaluated in soft tissue tumors.. Perfusion characteristics (pseudodiffusion coefficient, D *) and their volume fraction (perfusion fraction, f) can be obtained simultaneously. IVIM-DWI applies the possibility of differentiation of benign and malignant soft tissue tumors. Dynamic contrast MRI (DCE) is reported to be very useful for the characteristics

of soft tissue tumors. The application of the Tofts pharmacokinetic model 17 , DCE-MRI can obtain three main quantitative parameters: the transfer constant (K trans), the rate constant (K ep) and the extracellular extracellular volume fraction

The results obtained

The final diagnosis was established on the basis of histopathology, among the cases included 35 benign and 32 malignant formations. Detailed demographic and histopathological information for the two groups is described in Table 1. The agreement between the IVIM-DWI observers was considered excellent for ADC and D (ICC = 0.95–0.98), for D* and f (ICC = 0.58–0.65). For DCE-MRI between observers for K trans, Kep and iAUC were considered good (ICC = 0.72–0.74), and for V e - bad (ICC = 0.38).

Benign group n = 35, malignant group n = 32 p value

Age (years) 53 ± 16

Schwannoma (8), undifferentiated sarcoma (8), Hemangioma (6), Synovial sarcoma (4), angioleiomyoma (4), myxoid liposarcoma (3) fibromatosis (4), myxofibrosarcoma (3), nodular fasciitis (3), lymphoma (3) fibroma (2),epithelioidemangioendothelioma (2), glomus tumor (2)leiomyosarcoma (2), tenosynovial giant cell tumor (2)angiosarcoma (1) myxoma (2) and fibromyxoid sarcoma (1), neurofibroma (1), myeloid sarcoma (1), neuroma (1), extra-skeletal mesenchymalchondrosarcoma (1), malignant melanoma (1)

Malignant tumor of the peripheral nerve sheath (1) also malignant solitary fibrous tumor (1)

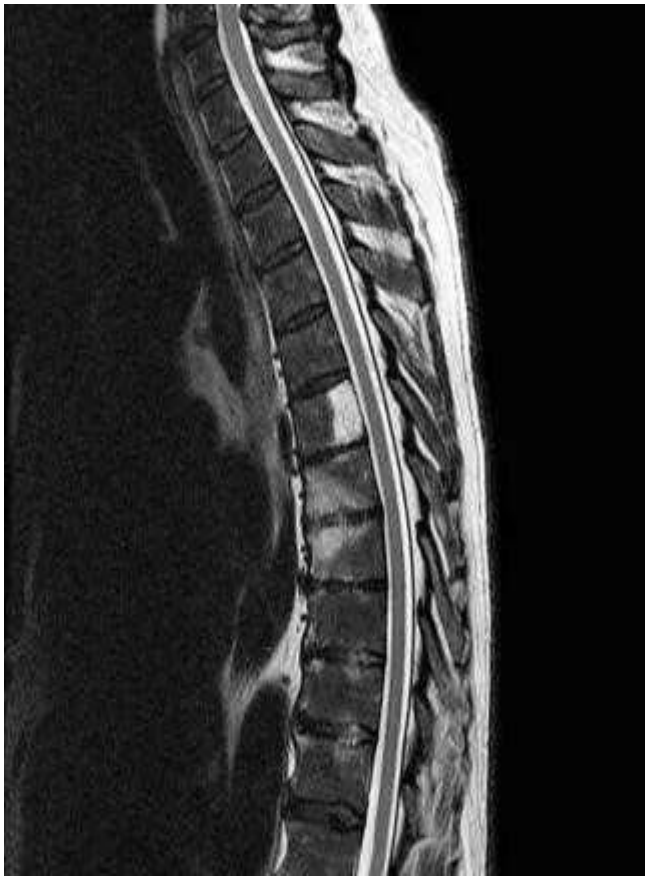

Figure 1. A 50-year-old man with myeloid sarcoma. A, Weighted image of TSE T 1 with axial fat suppression and contrast enhancement shows an increasing mass of 2.5 cm (arrows) along the radial nerve in the elbow, simulating a suture. B The mass demonstrates a high signal with a hypointensive area (arrow) at a DVI oo value of b 800 s / mm2 . C, obstructed water diffusion (arrows) on the ADC map. IVIM-DWI parameters and DCE-MRI parameters suggest a qualitative soft tissue tumor. This case was pathologically confirmed as myeloid sarcoma. D. Results of quantitative multiparametric MRI. ADC, apparent diffusion coefficient; DCE-MRI, magnetic resonance imaging with dynamic contrast; DWI, diffusion-weighted imaging; IVIM-DWI, intravoxel visualization of incoherent motion, diffusionweighted; TSE, turbo spin echo.

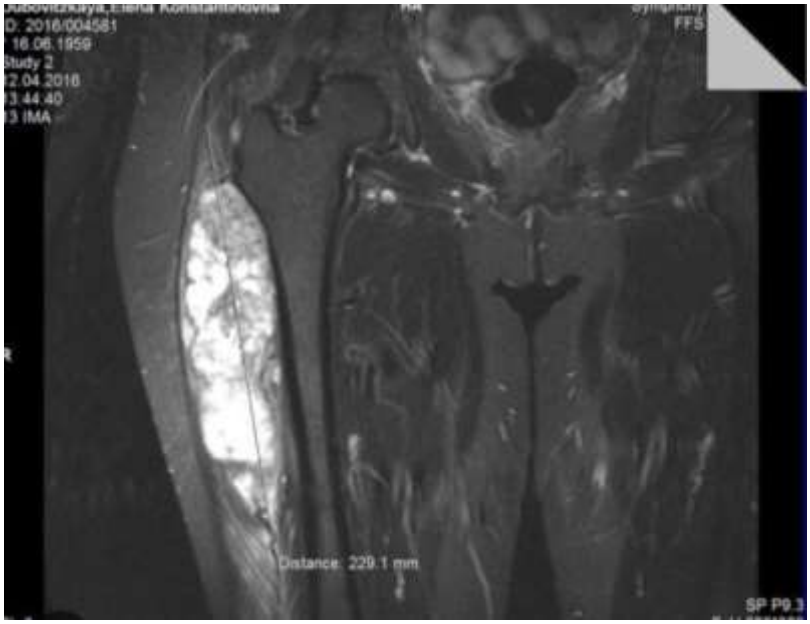

Figure 2.

A woman, 71 years old, has a myxoma. A, Weighted image of TSE T 1 with axial fat suppression and contrast enhancement shows 4 cm of inhomogeneously increasing mass (arrows) in the proximal thigh. B: The bright signal is not displayed on the DVI oo value b 800 s / mm2 . C, the mass is hyperintensive (arrows) on the ADC map. IVIM-DWI parameters and DCE-MRI parameters suggest a benign soft tissue tumor. The formation was pathologically confirmed as a myxoma.

Results of quantitative multiparametric MRI.ADC, apparent diffusion coefficient; DCE-MRI, magnetic resonance imaging with dynamic contrast; DWI, diffusion-weighted imaging; IVIM-DWI, intravoxel visualization of incoherent motion, diffusion-weighted; TSE, turbo spin echo.

Benign group Malignant group the value of p. Threshold values Sensitivity (%) and specificity (%) accuracy (%) - AUC - area under the curve; DCE-MRI, magnetic resonance imaging with dynamic contrast; IVIM DWI, intravoxel visualization of incoherent motion, diffusion-weighted.

Among the parameters of DCE-MRI, K trans (209 ± 160 min -1 x 10 3), K ep

(737 ± 488 min -1 x 10 3) and iAUC (23 ± 14%) in malignant tumors were significantly higher than in benign tumors (92 ± 67 min -1 x 10 3, 311 ± 230 min -1 x

10 3 and 12 ± 9%, respectively; p <0.001 for all), while V e (32 ± 17%) in malignant tumors was significantly lower than in benign tumors (44 ± 28%, p = 0.043) (Table 2). ROC analysis showed that K-trans has the highest sensitivity of 81% (specificity 77%, cutoff> 110 min -1 x10 3, indicating malignancy) with an AUC of 0.792 with statistical significance (p <0.001). K er showed the highest AUC 0817 with statistical significance (p <0.001), while a value greater than 368 min -1 × 10 3 indicates malignancy (78% sensitivity and 71% specificity). IAUC also showed an AUC of 0.771 with statistical significance (p <0.001), with a value of more than 14% indicating malignancy (sensitivity 72% and specificity 69%).

Subgroup analysis of myxoid soft tissue tumors. There were no significant differences in IVIM-DWI for differentiation of benign and malignant myxoid soft tissue tumors.

AUC - area under the curve; DCE-MRI, magnetic resonance imaging with dynamic contrast; IVIM DWI, intravoxel visualization of incoherent motion, diffusion-weighted

Of the parameters of DCE-MRI, K trans (122 ± 73 min -1 x 10 3) and iAUC

(17 ± 12%) in malignant myxoid soft tissue tumors were significantly higher than in benign myxoid soft tissue tumors (63 ± 37 min - 1 × 10 3 and 8 ± 5%, respectively; p = 0.035 and 0.037). ROC analysis showed that K ep has the highest sensitivity of

87% (specificity 63%, cutoff > 220 min -1×10 3, indicating malignancy) with an AUC of 0.750 with statistical significance (p= 0.001). The best specificity was

achieved with iAUC (specificity 90%, sensitivity 62%, threshold> 14% indicating malignancy) with AUC 0.761 with statistical significance (p = 0.001)

Subgroup analysis of non-myxoid soft tissue tumors. ADC (979 ± 300 mm2/s) and D (938 ± 296 mm2/s) in malignant non-myxoid soft tissue tumors were significantly lower than in benign non-myxoid soft tissue tumors (1,365 ± 238 mm2/s and 1,294 ± 249 mm2/s, respectively; p <0.001). ROC analysis showed that ADC and

D showed the highest sensitivity of 87% (specificity 73 and 79%, threshold values ≤1261 mm2/s and ≤1183 mm2/s, indicating malignancy, respectively) with AUC

0.835 and 0.831 with statistical significance (p = 0.001)

K trans (238 ± 172 min -1 x 10 3), K ep (832 ± 510 min -1 x 10 3) and iAUC (26 ± 15%) in malignant non-myxoid soft tissue tumors were significantly higher than in benign non-myxoid tumors. myxoid soft tissue tumors (105 ± 72 min -1 · 10 3 , 333 ± 207 min -1 · 10 3 and 14 ± 10%, respectively; p = 0.001, <0.001 and 0.002). ROC analysis showed that K trans, K ep and iAUC showed the same sensitivity of

87% (specificity 66%, 66% and 62%, threshold values > 110 min -1 x 103 ,> 358 min -1 x10 3 and > 12% indicating malignancy, respectively) with AUC 0.798, 0.855 and 0.766 with statistical significance (p <0.001 for all).

IVIM-DWI parameters were analyzed using step–by-step multidimensional logistic regression analysis, and D (OR, 0.998; 95% CI, 0.997-0.999) was an independent factor for predicting malignancy. DCE-MRI with multivariate logistic regression analysis showed that K ep (OR, 1,004; 95% CI, 1,001–1,006) and iAUC (OR, 1,064; 95% CI, 1,001–1,131) were independent factors for predicting malignancy.

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