

Biexponential study in Diffusion Weighted Imaging of liver tumours

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Objective. Intravoxel incoherent motion (IVIM)-based Diffusion Weighted (DW) imaging (1,2) allows to distinguish both pure molecular diffusion and microcirculation and to evaluate the perfusion contribution in the diffusion measurements (3). The aim of this project was to prospectively evaluate a DW magnetic resonance (MR) imaging sequence combined with parallel acquisition to allow the calculation of pure molecular-based (D) and perfusion related (D^* , f) diffusion parameters based on IVIM theory, in liver lesions according to their enhancement behaviour on 3D gradient-echo contrast-enhanced MR sequences.

Materials and methods. This study was IRB approved and informed consent was obtained. 99 liver tumors in 56 patients were evaluated with DW-MR and conventional sequences. Lesions were classified in hypervascular lesions (n=63) with strong enhancement on arterial-phase, intermediate lesions (n=30) with minimal enhancement on arterial-phase, and non hypervascular lesions (n=6) with no lesion enhancement at any phase. All scans were obtained on a 1.5T fully body system (Philips Medical Systems, The Netherlands). Free breathing echoplanar sequence with 11 b factors (0, 10, 20, 30, 40, 50, 75, 100, 150, 300, 500 s/mm^2) was performed. The mean D, D^* and the fraction f values were measured by a biexponential model and compared in the three groups. Means were compared by using the Student t test.

Results. Hypervascular liver lesions had significantly greater D^* and f values than intermediate and non hypervascular lesions (72.9 ± 36.6 vs 60.2 ± 14.5 vs 57.8 ± 9.2 10^{-3} mm^2/sec , 28.2 ± 12.7 % vs 25.7 ± 7.6 % vs 20.6 ± 8.8 %, respectively (Figure 1). A typical example of D, D^* and f maps is shown in figure 2 underlying the importance of microperfusion contribution in diffusion measurements.

Conclusion. We have shown for the first time that D^* and f values can reflect liver lesions perfusion. These parameters obtained with a biexponential approach might be useful for the characterization of liver lesions and the assessment of tumour response.

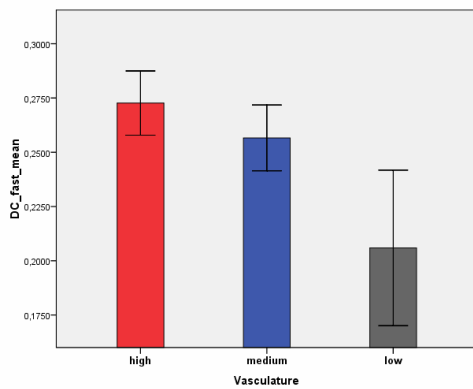
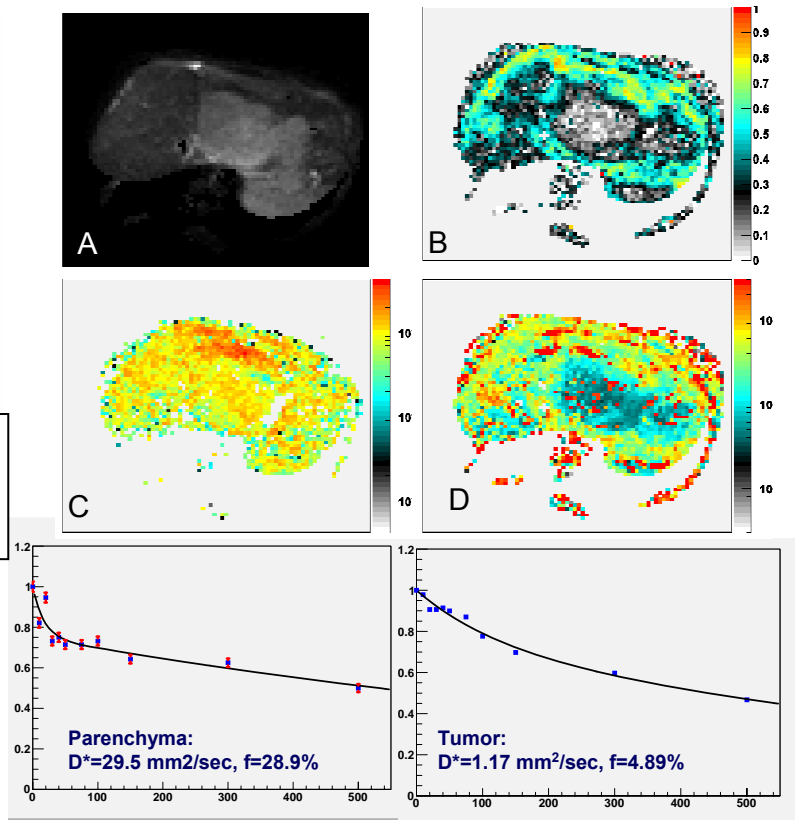


Figure 1: Significant decrease of the f fraction of the diffusion linked to the microcirculation related to the tumour vasculature

Figure 2: example of the high sensitivity of D^* and f in a cholangiocarcinoma. (A): native DW image, (B): fraction f of diffusion related to the microcirculation, (C): pure diffusion coefficient D; (D) perfusion related diffusion D^* ; (E): biexponential decay measured in healthy parenchyma; (F): biexponential decay measured in tumour.



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