DIFFERENTIATING TUMOUR VS. PSEUDOTUMOURAL DISEASE VS. NORMAL BRAIN WITH SV 1H-MRS

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Purpose: In many cases, reliable differentiation of neoplasic from nonneoplasic brain masses is difficult or impossible with conventional MR imaging [i]. The purpose of the study was to differentiate tumors from pseudotumoral disease and from normal brain with SV ^{1}H-MRS at short and long TE.

Methods: Inclusion criteria for tumors and pseudotumors were: 1) presence of an untreated solid non-necrotic brain mass suggesting a brain tumor, 2) diagnosis of pseudotumoral disease or glial tumor grades II or III of the WHO confidently established, 3) to have spectra available obtained at both short and long TE, and 4) the spectra to be of good quality at visual inspection. The diagnosis of pseudotumoral disease was based on clinical and imaging follow-up. Clinically, patients had an acute to subacute onset of signs or symptoms involving a focal neurological deficit mimicking the findings of an intracranial neoplasm. Imaging follow-up ranged between 2 and 77 months, and showed reduction or resolution of the mass. The diagnosis of brain tumor was considered to be confidently established when a sample of the tumor could be evaluated and the pathologist could establish a single diagnosis. Normal volunteers were selected from retrospective cases of the INTERPRET database acquired at the same institution [ii]. SV ^{1}H-MRS was performed in all cases with the same Philips MR unit. A volume of interest (VOI) between (1.5 cm)^3 and (2 cm)^3 was placed following criteria previously approved at the institution for performing ^{1}H-MRS in brain tumors. VOI size and location for tumors and pseudotumors were determined with the aim of positioning the largest possible voxel within the tumoral area, with minimal contamination from the surrounding nontumoral tissue. Two spectra were acquired from the same VOI for each case: 1) Short TE (2000/30/96-192) (TR/TE/averages); and 2) Long TE (2000/136/128-256). Spectra were automatically processed with the INTERPRET data manipulation software [available at http://azizu.uab.es/INTERPRET/downloads.html, ii]. Spectra at each TE were analyzed with Linear Discriminant Analysis using SPSS 15.0, using stepwise variable selection, in the 4.05 – 0.01 ppm range.

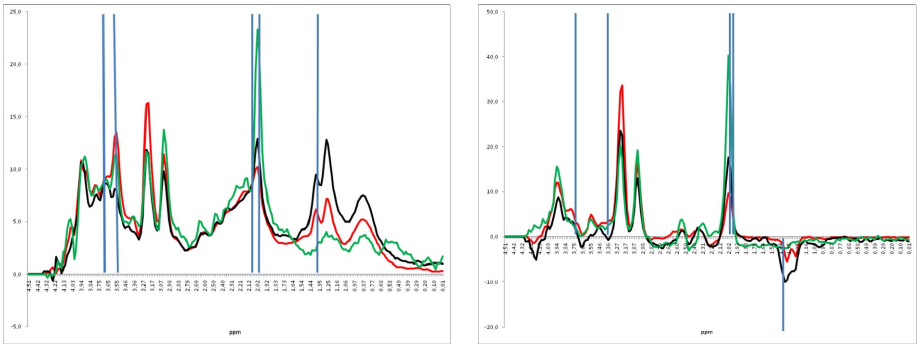

Figure 1 : Left, short TE. Right, long TE. Red, mean spectrum of tumor; Black, mean spectrum of pseudotumoural disease; Green, mean spectrum of normal brain. Vertical blue lines: Variables selected for classification at each TE

Results: Forty-six tumors, twelve pseudotumoral and 5 normal volunteer cases satisfied inclusion criteria. Mean spectra with standard deviations, as well as the variables used by the discriminant functions are shown in Figure 1. Classification results are shown on Figure 2 and Table 1. At short TE, 95.2% of cases were correctly classified and 90.5% at the leave-one-out crossvalidation. At long TE, 96.8% of cases were correctly classified and 93.7% at the leave-one-out crossvalidation.

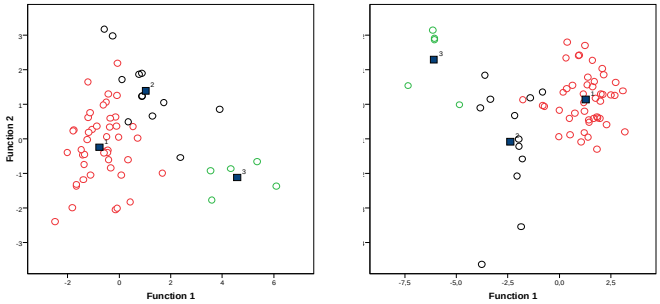

Figure 2: Latent space of cases. Left, short TE. Right, long TE. Red, tumor, Black, pseudotumor, Green, nomal brain. Function 1 and 2 are the two discriminant functions obtained by each 3-class classifier.

Number of cases		Predicted group		
		Tumor	Pseudotumoral	Normal brain
Short TE	Tumor	44	1	1
	Pseudotumoral	2	8	2
	Normal brain	0	0	5
Long TE	Tumor	45	1	0
	Pseudotumoral	1	10	1
	Normal brain	0	1	4

Table 1: Confusion matrix with classification results after the leave-one-out crossvalidation of initial classification

Conclusions: Both short and long TE SV ^{1}H-MRS give similar results with respect to classification accuracy. If these preliminary classification results can be validated with the help of an independent test set, a similar classifier may be integrated in a graphical decision-support system for clinical use.

References:[i]: *Mastrostefano R, Occhipinti E, Bigotti G, et al. Neurosurgery 1987;21:244–246.* [ii]: *Tate AR, Underwood J, Acosta D, et al. NMR Biomed 2006;19:411–434.*