Targeted use of 1H-MRS is as accurate as histology in the diagnosis of glioblastoma multiforme.

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Introduction

For ^{1}H magnetic resonance spectroscopy (^{1}H-MRS) in brain tumour diagnosis to become better established in clinical use there is still a need for clear, well defined applications that have both high accuracy and added value. Glioblastoma multiforme (GBM) is the most common and aggressive primary brain tumour and current oncological practice requires histopathological confirmation prior to radiotherapy. Lesion proximity to eloquent cortex and white matter tracts or poor patient health may preclude debulking surgery, and stereotactic biopsy is performed for diagnosis. Biopsy is costly, subject to delays, has 1-2% mortality, 3-5% morbidity and is inconclusive in up to 10% of cases (1). We have evaluated the accuracy of ^{1}H MRS as a diagnostic tool for the subset of patients with GBM where biopsy could potentially be avoided.

Methods

89 patients were studied with single voxel 1H MRS at 1.5T with routine clinical CT and MR imaging also available. All data were independently analysed by 2 expert neuroradiologists, by 3 expert spectroscopists with reference to average tumour spectra (2), and the INTERPRET decision support system (DSS v2.0) for tumour diagnosis by ^{1}H MRS (3). Age, sex clinical symptoms and duration were available for neuroradiologists. Each expert was asked to grade the lesion as high or low and provide an absolute tumour diagnosis or the most likely differential diagnosis.

Results
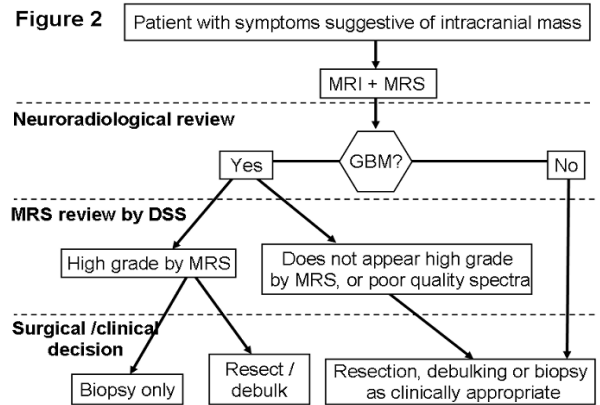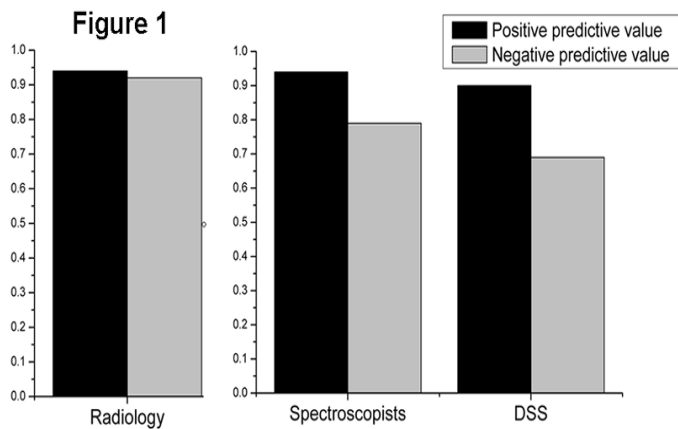
Of 89 cases with complete routine clinical CT/MR imaging and ^{1}H MRS, 8 had bad quality (uninterpretable) spectra and were excluded. Data from 81 patients were analysed by expert neuroradiologists and spectroscopists and by automated pattern recognition (DSS). Histological diagnoses were: 33 GBM, 15 grade II gliomas, 11 metastases, 9 grade III gliomas, 9 meningiomas, 3 lymphomas, 1 abscess. The positive and negative predictive values (PPVs and NPVs) for neuroradiologist diagnosis of GBM, and spectroscopists and DSS diagnoses of a high grade lesion are shown in Figure 1. 18 patients had stereotactic biopsy, 61 underwent debulking surgery and 2 patients had surveillance scans for presumed low grade glioma. Of 18 patients undergoing stereotactic biopsies, all 14 diagnosed as GBM by radiology and spectroscopy were confirmed as GBM by histopathology. Three cases that did not show agreement between radiology and spectroscopy were diagnosed by stereotactic biopsy as grade III astrocytoma, grade II astrocytomas and a lymphoma. Radiology and spectroscopy were in agreement of low grade glioma in the remaining case biopsied.

Discussion

The PPV and NPV for expert spectroscopists and the DSS were similar, and when combined with radiological diagnosis, automated pattern recognition by the DSS provided reliable diagnosis in the subset of patients undergoing stereotactic biopsy after a radiological diagnosis of GBM. This subset of patients was selected for biopsy on the basis of low Karnofsky score or lesion location. A combined neuroradiological opinion of GBM and spectroscopic opinion of a high grade lesion in this patient subset gave diagnosis of GBM with accuracy equal to histology. We therefore propose the decision tree protocol in Figure 2 to enable accurate non-invasive diagnosis in patients with brain tumours currently undergoing stereotactic biopsy simply for histological confirmation of a radiological opinion of GBM. It is in these patients assigned to biopsy only that a surgical procedure and treatment delay could potentially be avoided and ^{1}H MRS used to provide diagnosis and significant added value.

References 1) Ferreira MP et al. *Surg Neurol*. 2006; **65**: S1:27-1:32. 2) Tate AR et al. *NMR in Biomedicine*, 2006; **19:** 411-434. 3) http://azizu.uab.es/INTERPRET/int_Disc_Proto.shtml.