IDENTIFICATION OF ABSCESS CAUSING MICROORGANISMS BY IN VIVO MRS

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Introduction

Identification of microorganisms causing an infection is essential for optimal therapy. Current diagnostic methods are time consuming, invasive and require isolation of microorganisms from affected tissue or body fluids. Radiological methods used in routine diagnosis of cerebral mass lesions are unable to distinguish with certainty between different types of lesion (e.g. tumour, bacterial or fungal abscess). Glioblastoma multiforme remains part of the differential diagnosis on imaging. Initial results suggest that distinction between glioblastoma and abscess is possible using Magnetic Resonance Spectroscopy (MRS) [1, 2]. However, identification of abscess causing microorganisms has not been addressed.

Aim and Methods

It was our aim to test the ability of *in vivo* MR Spectroscopy to distinguish between tumours and infective mass lesions as well as determine the microbial etiology of infective lesions. Single voxel MR spectra of infective cerebral mass lesions in humans were acquired on 1.5 Tesla MR scanners (Siemens Vision and GE Signa Horizon LX) at five Australian hospitals. MR spectra were acquired from 34 patients with focal brain infections and 35 patients with glioblastoma over five years. Voxels were placed at the center of the lesion, avoiding surrounding brain tissue. Short (20 or 35ms) and long echo time (135ms) MR spectra were acquired. Correlation with microbiological findings and *ex vivo* MRS of pus/ biopsy samples was performed in all cases.

Results and Discussion

MR spectra of all tumours showed an increased choline-to-creatine (3.2:3.0 ppm) resonance ratio (mean 2.5 ± 0.8). Necrosis was indicated by the presence of lipid resonances. MR spectra of patients with focal fungal or bacterial infections showed in all cases intensive lipid signals due to the presence of activated/apoptotic white blood cells. An increase in amino acid signal intensity was observed in 25% of focal infections. Intense signals of bacterial metabolites were present in abscesses. The metabolite profile correlated with bacteria identified in the pus (eg, lactate from aeorphilic cocci like *Streptococcus milleri*, acetate and succinate from anaerobic bacteria). Certain organic acids were specific for particular microbial taxa (eg, propionate for *Propionibacterium* spp. and butyrate for *Fusobacterium* spp.). MR spectra from patients with abscess caused by the same microorganisms were identical. MR diagnosis made *in vivo* was confirmed by *ex vivo* MRS analysis of biopsy and pus samples. It was possible to classify abscess according to groups of microorganisms (e.g., anaerobe, aerobe, fungal, tuberculoma, sterile). Figure 1 illustrates the diversity of abscess due to the diversity of causing microorganisms.

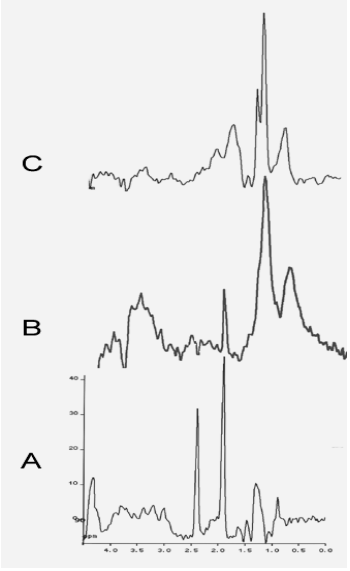

Figure 1: MR spectra of patients with cerebral abscess (VOI= 6-10cm^3, TE=20ms). Infections were caused by (A) *Streptococcus millerii*, *Peptostreptococcus* spp. and *Fusobacterium nucleatum* (B) *Streptococcus milleri* and *Bacteroides fragilis* and (C) *Staphylococcus aureus.*

Conclusion:

MRS is able to distinguish between tumours and infective mass lesions *in vivo* based on relative metabolite intensities. Classification of microorganisms causing infections is possible based on marker metabolites.

References:

[1] S Grand, G Passaro, A Ziegler et al. Radiology 213: 785-793 (1999).
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