OPUS Ultra-Fast MRI

Jankharia Imaging

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BRAIN TUMORS

PERFUSION MRI COMBINED WITH MR SPECTROSCOPY PROVIDE CLINICALLY RELEVANT PHYSIOLOGIC INFORMATION IN BRAIN TUMORS

Functional evaluation of brain tumors has, until now, been the domain of nuclear medicine. Nuclear medicine methods rely on the uptake or metabolism of a radioactive tracer to identify high grade recurrent tumor components. They generally have poorer spatial resolution and are less sensitive for the detection of small (<1.5cm diameter) lesions. The sensitivity-to-specificity ratio of FDG-PET and T1-SPECT in detecting postradiation treatment related changes and glioma recurrence, have been reported to be as low as 81.40% and 69.40% with significant false-negative and false-positive examinations. New PET techniques (methionine, tyrosine and choline labeled PET) are potentially more accurate but costly.

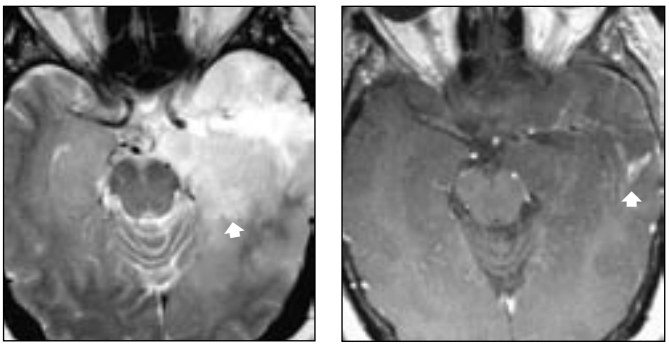
Functional evaluation of brain tumors can be carried out more practically by advanced magnetic resonance imaging techniques. **MR perfusion imaging derived cerebral blood volume (CBV) maps and proton MR spectroscopy (MRS) can be combined effectively in the functional assessment of brain tumors**. **CBV** reflects the microscopic, capillary level flow in tumors. **Areas of maximum CBV in tumors have been correlated histologically with high mitotic activity and vascularity**. Proton MR spectroscopy - derived **choline** signals serve as an index of phospholipid turnover and cellular density. Choline is significantly increased in all gliomas. The choline signal in the solid portions of gliomas is higher in grade 3 and 4, than in grade 2 astrocytomas. Choline is relatively diminished in areas of necrosis. Multivoxel MRS provides metabolic information on the rate of growth, and on the extent of infiltration in astrocytomas. The intratumoral regions with highest choline can be defined and are optimal sites for tissue biopsy. The ideal site to biopsy a heterogenous glioma would be areas of highest choline and highest CBV (as opposed to areas of contrast enhancement, which do not necessarily reflect the most aggressive foci of the tumor).

Indications for MRS and MR perfusion in tumor evaluation:

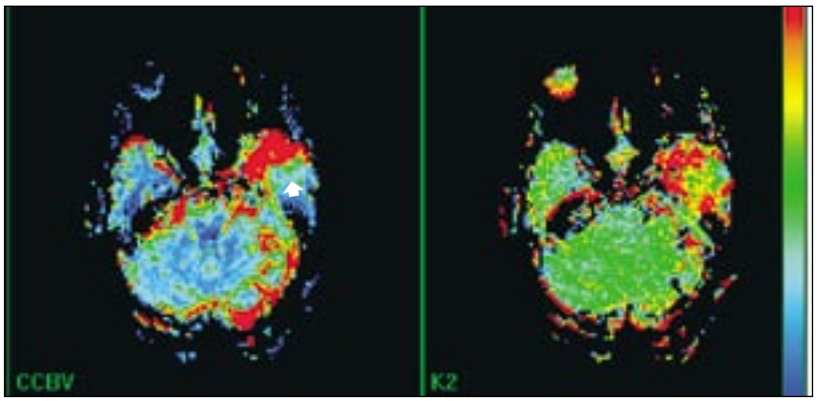
1. The preoperative grading of gliomas
2. Localization of aggressive foci in gliomas ("targeted" stereotactic biopsy)
3. Distinguishing treatment induced changes from recurrent glioma
4. Determining prognosis and response to treatment.

CASE REPORT :

A middle-aged lady had a known left temporal lobe astrocytoma, grade 2, excised 2 years ago. Radiotherapy was given postoperatively. Follow up MRI 2 yrs after treatment shows a new area of T2 hyperintensity around the treated tumor site. Is this recurrence? What treatment should be offered?

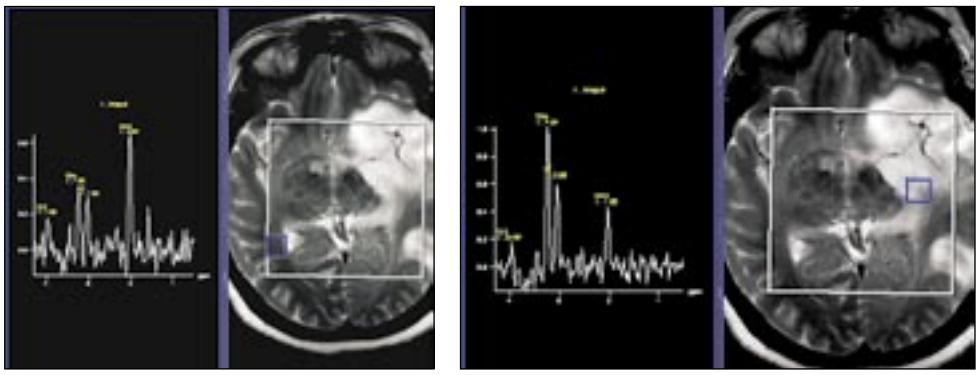


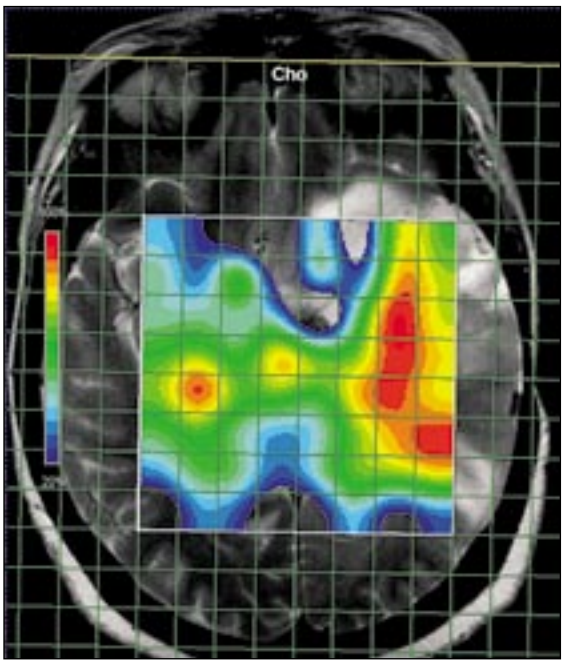
Follow up MRI done 2 yrs after excision and RT of a left temporal glioma (grade 2) Diffuse T2 hyperintense signal around the excision bed (arrow) with a small area of contrast enhancement representing breakdown of the blood-brain-barrier (arrowhead).



Area of hyperperfusion (red color on corrected CBV map and K2 permeability map) in the left temporal pole (arrow, not corresponding to area of enhancement. Normalized rCBV ratios (compared with contralateral white matter) are greater than 2. This represents a focus of anaplastic transformation in the anterior temporal area.

Multivoxel Proton MRS of the left temporal lobe abnormality and the normal right TL for comparison. Voxel placed in area of hyperintensity shows elevated choline/creatine ratio and reduced NAA/creatine ratio. Compared with the normal side, the total value of the choline in the tumor is elevated (compare I = integral *or quantity)*





COLOR MAP OF THE DISTRIBUTION OF CHOLINE
obtained from the multivoxel MRS examination.
Scale on left shows that red areas have highest choline values.
These should be targetted for stereotactic biopsy if required as they represent sites with highest rates of cellular proliferation

Functional MRI
with MRS and MR perfusion
clearly shows
recurrence in the left temporal lobe
with multiple foci of high grade tumor

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