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Advanced Imaging of Brain Tumors

-Dr. Shilpa Sankhe

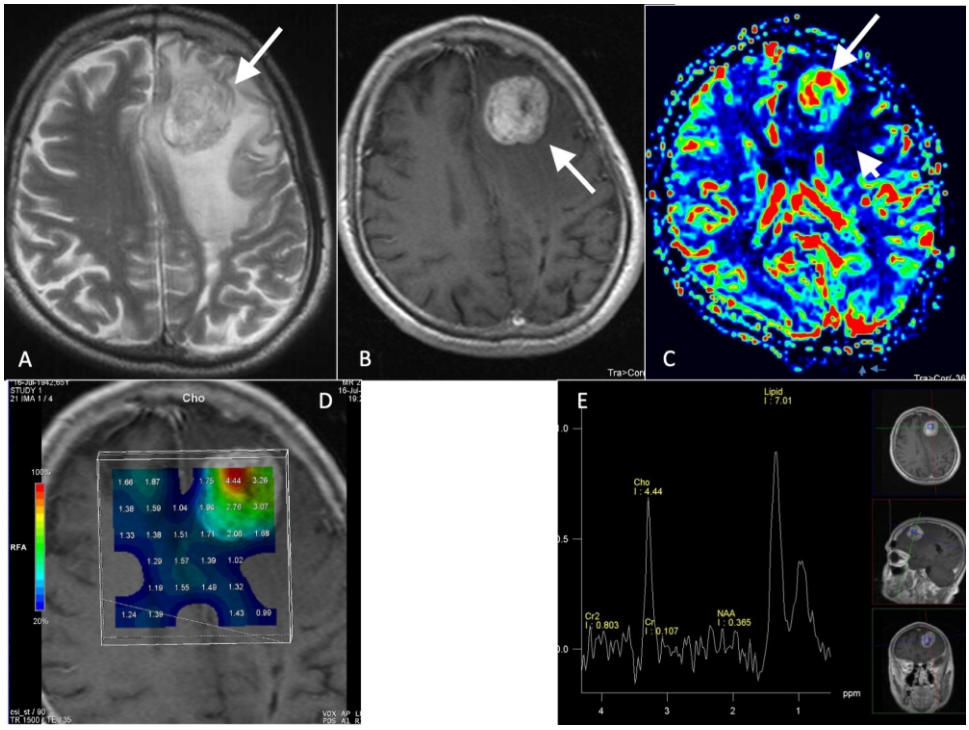

Fig. 1 (A-E): Left frontal solitary enhancing lesion noted on axial T2W (arrow in A) and axial post-contrast T1W (arrow in B) images. Diagnostic dilemma: glioblastoma multiforme (GBM) v/s metastasis. MR perfusion (C) reveals increased perfusion (arrow) with surrounding marked hypoperfusion (arrowhead) confirming vasogenic edema and not infiltrative tumor, virtually ruling out GBM. MR spectroscopy (D) with metabolite mapping shows high choline within the tumor with absent choline in surrounding vasogenic edema ruling out infiltrative tumor. Spectral map (E) reveals lipid lactate peak with absent NAA and high choline suggestive of metastatic lesion.

Conventional MRI is useful for initial assessment, but can present limitations when evaluating tumor extent, predicting grade, and assessing treatment response.

In addition to T1, T2 and post contrast imaging perfusion, MR spectroscopy, diffusion tensor imaging (DTI) and functional imaging are used for diagnosis and problem solving.

Perfusion (Fig. 1)

Relative cerebral blood volume (rCBV) is considered a marker of angiogenesis. rCBV may be helpful in distinguishing high-grade from low-grade gliomas and differentiation of tumor from pseudoprogression.

MR Spectroscopy (MRS) (Fig. 1)

MRS provides insight into the metabolic profile of brain. NAA is a neuronal marker, Cr a marker for cellular metabolism, and Cho a marker for cell membrane turnover. The MRS profile of gliomas shows elevated Cho and decreased NAA. High-grade gliomas have been found to have higher Cho-NAA and Cho-Cr ratios than lower grade gliomas. MRS is also useful in differentiating progression from pseudoprogression from radiation necrosis.

DTI (Fig. 2)

The use of DTI tractography can contribute substantially to preoperative planning by confirmation of integrity and location of displaced white matter (WM) tracts.

Advanced Imaging of Brain Tumors

At a glance:

- Advanced MRI techniques help in differentiating neoplastic from non-neoplastic lesions in the brain.
- These are MR perfusion, MRI spectroscopy, diffusion tensor imaging (DTI) and functional imaging, among others.
- They also help in the grading of tumours, selecting biopsy targets particularly in non-enhancing lesions, planning surgery and radiation therapy and assessing treatment response.

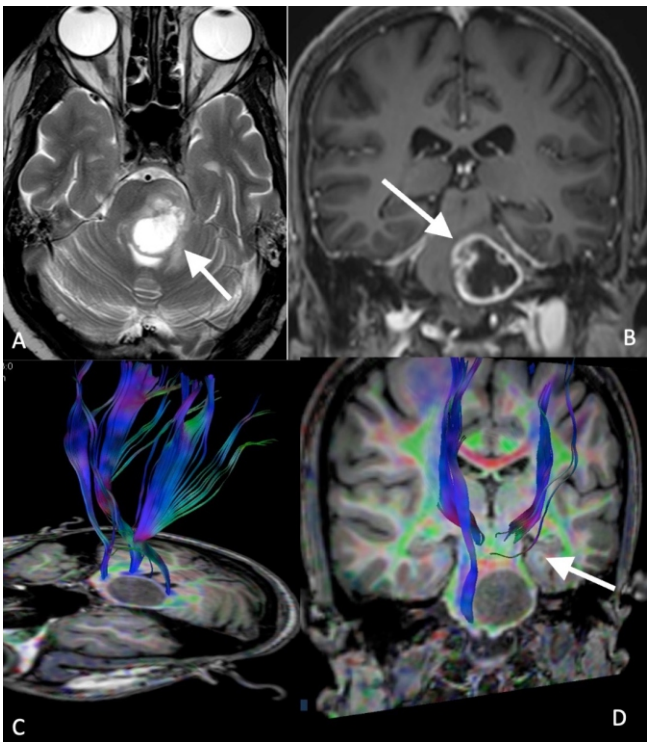

Fig. 2 (A-D): Pontine glioma. Axial T2W (arrow in A) and coronal post-contrast T1W (arrow in B) images show a peripherally enhancing pontine glioma. DTI (C, D) reveals complete absence of the left corticopontine tract (arrow in D) suggesting destruction in keeping with high grade glioma. Histopathology revealed GBM..

If preoperative imaging demonstrates that a WM tract is intact but displaced by tumor to a new location, surgical approach can be adapted to preserve the displaced tract during resection.

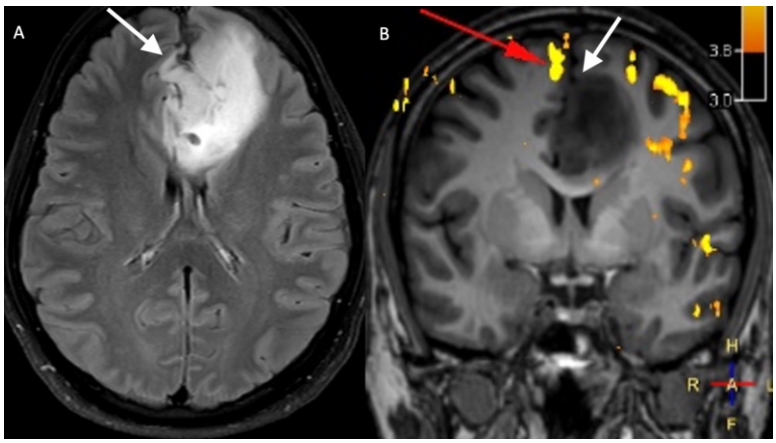

Fig. 3 (A, B): Left frontal glioma. Axial T2W image shows the left frontal tumor (arrow). A functional MRI (B) was performed for motor mapping prior to surgery. The coronal BOLD image (B) shows that the foot activation area (red arrow) abuts the tumor (white arrow). The surgeon approached from the lateral aspect.

Functional

Functional MRI (fMRI) utilizes relative changes in the blood oxygen level dependent (BOLD) signal to infer brain activity and has been used for preoperative planning in order to identify the relationship of eloquent functional cortex to brain tumors. The distance from the tumor to functional area depicted on task-based fMRI has been shown to be related to the degree of postoperative loss of function with a small margin (< 1 cm) predicting a poorer neurologic outcome

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