T2-FLAIR magnetic resonance imaging sequence

“T2-FLAIR” refers to a specific type of magnetic resonance imaging sequence used in medical imaging.

T2 Weighting: In MRI, different sequences are used to highlight different types of tissue based on their relaxation times. T2 weighting emphasizes the differences in T2 relaxation times between tissues. T2-weighted images are useful for visualizing fluid-filled structures and pathology, as fluids have long T2 relaxation times.

FLAIR: This stands for Fluid Attenuated Inversion Recovery. FLAIR is a special type of pulse sequence in MRI that suppresses the signal from fluids (such as cerebrospinal fluid) while maintaining the signal from other tissues. This is particularly useful for imaging lesions or abnormalities near fluid-filled spaces, as it helps to eliminate the bright signal from the cerebrospinal fluid and highlights abnormalities that might be adjacent to it.

Combining T2 weighting with FLAIR is particularly useful in neuroimaging, where it helps in visualizing structures in the brain and detecting abnormalities, especially those involving fluid-filled spaces. It's commonly used in the assessment of conditions such as multiple sclerosis, stroke, and brain tumors.

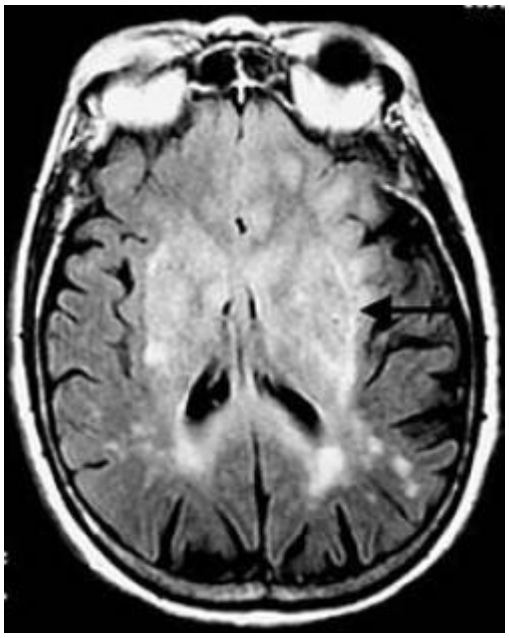
T2-FLAIR stands for T2-weighted-Fluid-Attenuated Inversion Recovery. Originally just called “FLAIR”, this technique was developed in the early 1990s by the Hammersmith research team led by Graeme Bydder, Joseph Hajnal, and Ian Young. Their original sequences used TI values of 2000-2500 to null signal from CSF, coupled with very long TRs (8000) and TEs (140) to create strong T2-weighting.

see T2-FLAIR mismatch sign

Is a special inversion recovery sequence with long T1 to remove the effects of fluid from the resulting images.

The T1 time of the FLAIR pulse sequence is adjusted to the relaxation time of the component that should be suppressed. For fluid suppression the inversion time (long T1) is set to the zero crossing point of fluid, resulting in the signal being 'erased'.

This type of sequence is particularly useful in the detection of subtle changes at the periphery of the hemispheres and in the periventricular region close to CSF.



Axial fluid-attenuated inversion recovery MRI image demonstrating tumor-related infiltration involving lenticular nucleus.

White matter hyperintensities (WMHs) are brain white matter lesions that are hyperintense on fluid-attenuated inversion recovery (FLAIR) magnetic resonance imaging (MRI) scans. Larger WMH volumes have been associated with Alzheimer's disease (AD) and with cognitive decline.

The usefulness of FLAIR sequences has been evaluated in diseases of the central nervous system such as:

infarction

multiple sclerosis

head injuries, and others

Increase in FLAIR signal of the fluid within the resection cavity is described as a highly specific and early sign for tumor recurrence in gliomas.

An increase in FLAIR signal of the fluid within the resection cavity might be a highly specific and early sign of local tumor recurrence/tumor progression also for brain metastases [1].

Single dose gadolinium (Gd) enhanced fluid-attenuated inversion recovery (FLAIR) is helpful for visualizing superficial parenchymal metastases.

Subarachnoid hemorrhage

Cerebral MRI may be proposed if the patient's clinical condition allows it. FLAIR imaging is more

sensitive than CT to demonstrate a subarachnoid hemorrhage and offers greater degrees of sensitivity for the diagnosis of restricted subarachnoid hemorrhage in cortical sulcus [2].

low-grade glioma

Fluid-attenuated inversion-recovery (FLAIR) imaging has established its utility in neuroimaging.

Bynevelt et al.propose this imaging sequence as a replacement for proton density image (PD) and T2-weighted spin-echo sequences in the follow-up of low-grade glioma.

Magnetic resonance imaging (MRI) with T2-weighted and Fluid Attenuated Inversion Recovery (FLAIR) images best delineates the extent of insular glioma infiltration, which can be limited to the insular lobe (Yasargil type 3a) or reach the perisylvian opercula (type 3b) and other paralimbic areas, namely the orbitofrontal and temporopolar regions (type 5), with or without involvement of core limbic structures [3].

MRI examinations of 18 patients with such tumours were reviewed by three neuroradiologists and a neurosurgeon. FLAIR was found to be superior for appreciation of the lesion (91% of studies) and for demonstration of its margin (92%). FLAIR was also better at showing different tumour components, particularly in regions difficult to demonstrate in some planes, such as the vertex in axial imaging. The sequence also defines the postoperative cavity, shows the least amount of susceptibility effect associated with surgical clips, and demonstrates local spread (to white matter tracts, subependymal and capsular) more distinctly.

FLAIR can replace PD and T2-weighted spin-echo imaging in radiological follow-up of low-grade glioma [4].

Lee et al. that measures of spatial diversity from point pattern analysis of intensity habitats from T1 post-contrast and T2 fluid-attenuated inversion recovery images are associated with both tumor subtype status and 12-month survival status and may therefore be useful indicators of patient prognosis, in addition to providing potential guidance for molecularly-targeted therapies in Glioblastoma multiforme [5].

http://www.intechopen.com/source/html/45292/media/fig1.png

A, B,C: Preoperative FLAIR MR images of a low-grade glioma infiltrating the left operculo-insular region and the fronto-orbital, including the perforated substance (white arrow), temporopolar and hyppocampal regions, type 5 B of Yasargil classification (Yasargil et al, 1992). D: Postoperative T1 gadolinium-weighted and E,F: Postoperative FLAIR MR images, showing the subtotal removal of the lesion. The boundaries of the resection are set based on anatomical (perforated substance, white arrow) as well as neurofunctional (subcallosal fasciculus, yellow arrow; inferior occipitofrontal fasciculus, green arrow; arcuate fasciculus, blue arrow) criteria.

A study supports the established association between extent of resection (EOR) and survival and presents additional data that pushing the boundary of a conventional 100% resection by the additional removal of a significant portion of the FLAIR abnormality region, when safely feasible, may result in the prolongation of survival without significant increases in overall or neurological

postoperative morbidity. Additional supportive evidence is warranted [6].

T2-FLAIR magnetic resonance imaging sequence for brain abscess

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