



Research Article

Post contrast T2 -FLAIR sequence - can it be a predictor of disease activity in tuberculomas of brain – findings from a preliminary study

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Abstract

Aim: To assess the use of pre and post contrast T2 FLAIR images in brain scans in CNS tuberculomas as a predictor of disease activity.

Materials and Methods: T2 FLAIR pre and post contrast images and T1w post contrast images of clinically proven cases of tuberculomas in brain in various stages of antituberculous treatment were taken. The images were reviewed to particularly study the intensity and enhancement of the lesions.

Result: There was a clear difference in the enhancement of the rim of the tuberculoma in patients in different stages of antituberculosis treatment on T2 FLAIR images.

Conclusion: The results of the study are from a small sample. Our study was based on only six patients and hence is only a preliminary study. A study with a larger sample size is needed.

Keywords: Tuberculoma, T2 FLAIR, pre and post contrast images.

Introduction

T2-FLAIR stands for **T2-weighted-Fluid-Attenuated Inversion Recovery**. Originally just called "FLAIR", this technique was developed in the early 1990's 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.⁽³⁾

Fluid-attenuated inversion recovery (FLAIR) is a special inversion recovery pulse sequence with a long repetition time (TR) and echo time (TE), and an inversion time (TI) that effectively nulls signals

from the cerebrospinal fluid (CSF) The T2-FLAIR technique repeatedly proved itself by revealing a wide range of lesions, including cortical, periventricular, and meningeal diseases that were difficult to see on conventional images.⁽¹⁾

Due to the long TI (2000 -2500ms) in FLAIR sequences, the FLAIR images also show mild T1w effects. Some lesions may not be conspicuous with low doses of Gd on T1w post contrast sequences these may be better appreciated on T2 w FLAIR sequences.

Aim

The aim of the study is to assess the use of pre and post contrast FLAIR images in brain scans in CNS tuberculomas. Although T1w imaging is typically used in contrast imaging, our study was also to compare the enhancement of lesions on post contrast T2 FLAIR and T1w post contrast images.

Materials and Methods

The subjects were six clinically or microbiologically proven cases of CNS tuberculosis in different stages of treatment who underwent MR imaging as part of a larger study on CNS tuberculosis which was done in Government Medical College, Trivandrum after obtaining ethical committee clearance. In all cases basic pre contrast sequences included FLAIR sequence of brain. MR imaging was done on 1.5 Tesla scanner (Avanto; Siemens Medical Solution, Germany). After the basic sequences, contrast agent (gadobutrol [Gadovist]; Bayer Healthcare, Berlin, Germany) was administered as per the protocol at the standard dose of 0.1 mmol/kg of body weight. In our institution, contrast enhanced T1weighted images is the sequence routinely used in lesion detection at brain MRI. Routine post contrast multiplanar T1w images were taken as usual. Immediately after that axial FLAIR imaging was done.

Images of pre contrast FLAIR and post contrast FLAIR were compared to see the areas of altered signal intensities and contrast enhancement. Post contrast FLAIR images were compared with post contrast multi planar T1w images for assessment of lesion enhancement.

Results

Of the six cases, four patients had completed twelve months of anti tuberculosis treatment. One patient had completed four months of treatment and another patient was a case of relapse.

Two patients who had completed twelve months of antituberculous treatment had complete resolution of lesions with no enhancing lesions on post contrast FLAIR or post contrast T1w images.

The other two patients who had completed 12 months of ATT had multiple lesions in parenchyma which were hypointense on T2 FLAIR and of size less than 1 cm. On post contrast scans these lesions showed well defined ring enhancement on T1w images but no enhancement of the lesion was seen on post contrast FLAIR images. (Fig 1)

One patient who had disseminated miliary tubercles and tuberculous meningitis at the time of diagnosis showed multiple hypointense foci on FLAIR images in the parenchyma adjacent to bilateral Sylvian fissures. This patient had very tiny foci of hyperintensity scattered in the cerebral cortex seen only on FLAIR images with no visible enhancement on post contrast FLAIR or post contrast T1w images. (Fig 2) This patient was asymptomatic at the time of scan. These tiny foci of cortical hyperintensity on T2 FLAIR could represent gliosis or burned out tuberculous foci. We could not prove it by histopathology.

The MRI scan of the patient who had completed four months of treatment and had shown clinical improvement showed multiple lesions in parenchyma hypointense on T2 FLAIR images. Some of these lesions on post contrast T2 FLAIR images showed ring enhancement as well as seen on T1w images. Other lesions showed enhancement only on T1w post contrast images. (Fig 3)

The MRI of the patient who presented with relapse showed ring enhancement of the lesions on post contrast T1w and T2 FLAIR as well. Such a ring enhancement of the lesions was seen in the post contrast T1w and T2 FLAIR images. (Fig 4)

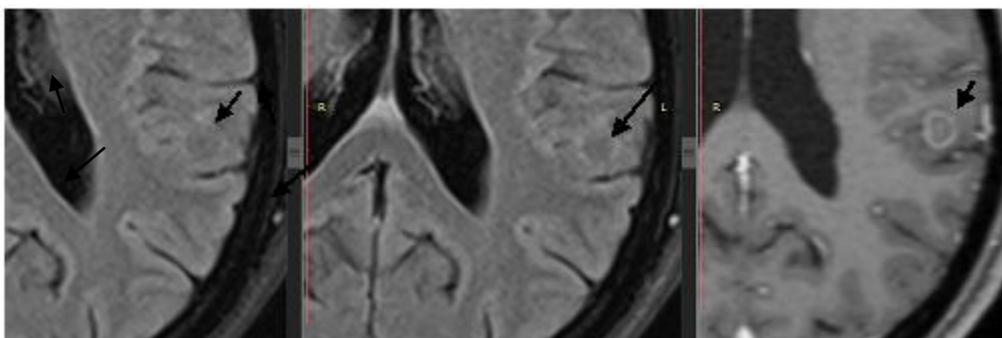


Fig 1 Pre contrast FLAIR, post contrast FLAIR and post contrast T1w axial images.

A hypointense lesion –tuberculoma is seen on precontrast T2 FLAIR, with very minimal peripheral enhancement at the rim on post contrast FLAIR images. On T1w post contrast images the lesion is seen as well defined rim enhancing lesion .This patient had completed 12 months of antituberculosis treatment and was asymptomatic.

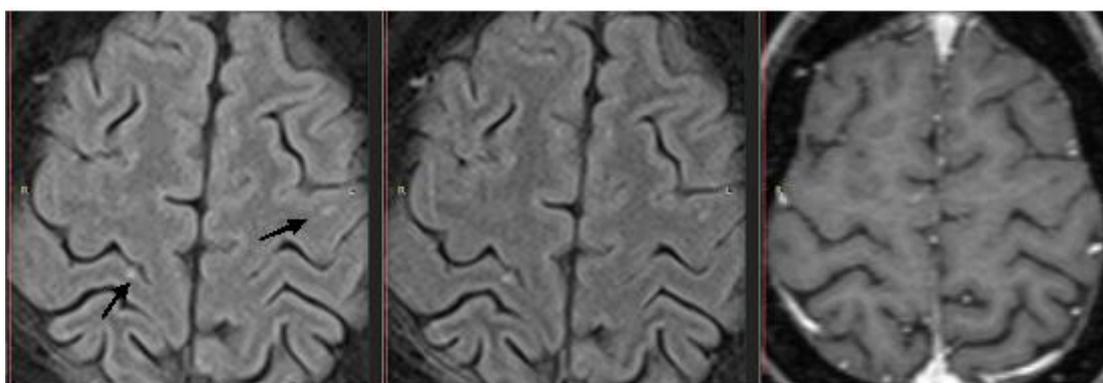


Fig 2. Pre contrast T2 FLAIR, post contrast T2 FLAIR and Post contrast T1w axial images. Tiny hyperintensities are seen in grey matter and subcortical white matter which do not show enhancement on post contrast images.

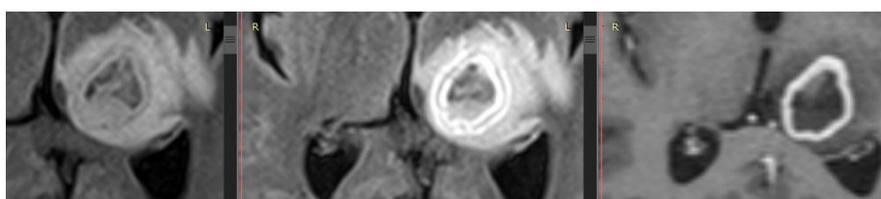


Fig 3: Pre contrast T2FLAIR ,post contrast T2 FLAIR and post contrast T1w axial images On post contrast T2 FLAIR , the rim of the lesion is seen to enhance with a double ring .On post contrast T1w FLAIR, well defined enhancement of the rim is seen. This was a a biopsy proven case of CNS tuberculoma with relapse.

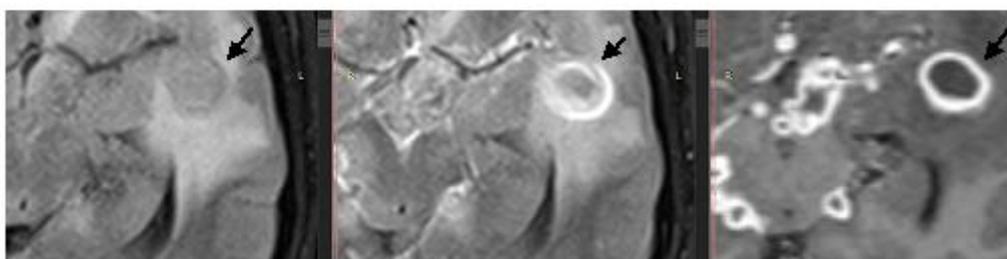


Fig 4 – Pre contrast T2 FLAIR, Post contrast T2 FLAIR and post contrast T1w images: Rim enhancement is seen on both T2 FLAIR and T1w post contrast images this patient is on ATT for past 4 months. Clinically has improved.

Discussion

Contrast enhancement (CE) in the CNS is the result of a combination of 3 processes: for intra-axial brain lesions, the blood brain barrier (BBB) must be disrupted for Gd to enter the extracellular space; for extra-axial lesions, enhancement is observed in lesions with relatively high vascularity; and for leptomeningeal regions, contrast leakage occurs from vessels into the CSF. Understanding the normally enhancing structures on CE - FLAIR imaging from review of literature can provide a reference point for routine interpretation⁽²⁾. In previous reports in children, the choroid plexus, pituitary infundibulum, and cavernous sinus showed relatively intense enhancement, and the pituitary gland, pineal gland and nasal mucosa/ turbinates are mildly enhanced. However, unlike CE-T1WI, FLAIR enhancement in the pineal gland, pituitary gland and nasal mucosa/turbinates can be difficult to recognize, or show subtle changes due to intrinsic T2 prolongation on pre-contrast FLAIR images.

On CE-FLAIR imaging, most blood vessels do not show enhancement, probably due to a T2 effect of the FLAIR sequence. Additionally, the degree of enhancement in normal intracranial structures on CE-FLAIR imaging appears less intense than that on CE-T1WI, probably because of a mild T1 effect of FLAIR imaging.

Among our patients contrast enhancement of lesions on FLAIR images and T1w multiplanar images were not similar. In patients who had completed 12 months of treatment and who were clinically asymptomatic following antituberculous treatment the lesions on FLAIR images did not show ring enhancement of lesions. But these lesions showed smooth ring enhancement on T1w images.

Conclusion

A well defined ring enhancement of lesions on post contrast FLAIR images only in patients who are clinically symptomatic and with less than six months of ATT raises the possibility of making it a marker sequence to assess activity of tuberculomas. Our study was based on only six patients and hence is only a preliminary study. A study with a larger sample size is needed.

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References

1. Importance of Contrast-Enhanced Fluid-Attenuated Inversion Recovery Magnetic Resonance Imaging in Various Intracranial Pathologic Conditions Korean J Radiol 2016;17(1):127-141.
2. Post-contrast FLAIR MR Imaging of the Brain in Children: Normal and Abnormal Intracranial Enhancement Pediatr Radiol. 2003 Dec;33(12):843-9.doi: 10.1007/s00247-003-1057-8. Epub 2003 Oct 10.
3. Normal Findings on Brain Fluid-Attenuated Inversion Recovery MR Images at 3T M. Neema Z.D. Guss J.M. Stankiewicz A. Arora B.C. Healy R. Bakshi AJNR Am J Neuroradiol 30:911–16 , May 2009 , www.ajnr.org