CRITICAL APPRAISAL

PRESENTER : DR NIK KHAIRIYAH BINTI RAJA MOHAMMED

LECTURER-IN-CHARGE : DR BAZLI MD YUSOFF

OVERVIEW

- Published in Q4 Journal with Impact Factor of 0.291.
- Title clearly described the study.
- Authors and institution clearly stated.
- Open assess in Springer Open and Research gate.

- Peer review was not stated.

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RESEARCH Open Access

The value of contrast-enhanced FLAIR magnetic resonance imaging in detecting meningeal abnormalities in suspected cases of meningitis compared to conventional contrast-enhanced T1WI sequences

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ABSTRACT

Abstract

Background: Early diagnosis of meningitis with magnetic resonance imaging (MRI) would be useful for appropriate and effective management, decrease morbidity and mortality, and provide better diagnosis and treatment. The objective of the current study is to compare the accuracy of contrast-enhanced FLAIR (CE-FLAIR) and contrast-enhanced T1WI (CE-T1WI) in the detection of meningeal abnormalities in suspected cases of meningitis.

Results: Out of 45 patients, 37 patients were confirmed to have meningitis on CSF analysis. Out of the 37 patients, 34 patients were positive on CE-FLAIR sequence and 27 were positive on CE-T1WI. The sensitivity of CE-FLAIR sequence was 91.9% and specificity 100%, while the sensitivity of CE-T1WI sequence was 73% and specificity 100%.

Conclusion: CE-FLAIR is more sensitive than CE-T1WI in diagnosis of meningitis. It is recommended to be used in any cases with clinically suspected meningitis.

Keywords: MRI T1 contrast, Contrast FLAIR, Meningitis

- Background, objectives, results and conclusion were concise and clearly written.

BACKGROUND

- One objective, clearly stated.
- Clearly written. Highlight the objectives.

Background

Meningitis is a serious disease worldwide. It can be a fatal disease if not properly managed [1]. Clinical and laboratory evaluation can establish the diagnosis of meningitis. Evaluation of cerebrospinal fluid (CSF) is the most critical component of meningitis diagnosis [2].

In the diagnosis of meningitis, computed tomography (CT) and MRI may have major roles, but MRI is much more reliable and should be considered as the first-line imaging modality in brain infections [1, 3].

Contrast-enhanced MRI (CE-MRI) is also superior to contrast-enhanced CT to locate the meningeal affection and its complications. MRI is also superior in detecting extra-axial fluid collections due to the lack of the skull bony artifacts. Contrast administration aids in recognizing the blood-brain barrier breakdown and helps in recognizing the disease process that may not be visible on CT [4].

The standard contrast-enhanced MR series is the contrast-enhanced T1WI (CET1WI). FLAIR is a special reverse pulse sequence that effectively voids CSF signals. Contrast-enhanced fluid-attenuated inversion recovery (CE-FLAIR) is a different MRI sequence. Both sequences are important imaging methods that can be used to diagnose meningitis and its complications such as empyema and abscess. The sensitivities determined in different studies are very variable, which may be due to varying degrees of inflammation and the etiology of meningitis [3].

Early diagnosis of meningitis with MRI would be useful for appropriate and effective management, decrease morbidity and mortality, and provide better diagnosis and treatment.

The objective of the current study was to compare the accuracy of contrast-enhanced T1WI (CE-T1WI) and contrast-enhanced FLAIR (CE-FLAIR) in detecting meningeal abnormalities in suspected cases of meningitis.

METHODOLOGY

Methods

Study design

This study was a prospective comparative study to compare CE-FLAIR and CE T1WI results of MRI sequences correlated with CSF analysis.

Sample size

Forty-five patients with clinically suspected meningitis were examined over a period of 2 years. It was a cross-sectional study of validation. The sampling technique used was nonprobability, purposeful type.

Inclusion criteria

Patients referred to the Radiology Department for contrast-enhanced brain MRI for clinically suspected meningitis were included in this current study.

Exclusion criteria

Every patient who had any contraindication to MRI or history of allergy to gadolinium was removed from the research.

Location

The study was carried out in the magnetic resonance section in the Radiology Department.

Equipment

In the present study, a 1.5 tesla (T) Siemens "Magnetom Avanto" was conducted from the vertex to the skull base.

Examination method

After describing the aim, protocol, and risk-benefit ratio of the study and approval of the ethical committee, informed consent was obtained from all patients.

- Study design, sample size, inclusion and exclusion criteria were clearly explained.
- Only data collection time frame not clearly mentioned (time interval were clearly mentioned).
- MR protocol well-written.
- Experienced Radiologist involved, however, not stated whether general/neuroradiologist.

Contrast-enhanced MRI protocol

The CE-T1WI imaging parameters were TR: 500, TE: 8.9, FOV: 220 mm, slice thickness: 5 mm, slice interval: 1.5 mm, and acquisition time: 4 min. The CE-FLAIR imaging parameters were TR: 9000, TE: 90, TI: 2500, FOV: 220 mm, slice thickness: 5 mm, slice interval: 1.5 mm, and acquisition time: 2 min 15 s. Intravenous gadolinium contrast medium is administered to all patients (the patient's weight determined the dose) at a rate of 0.2 mL/s from a computer-controlled injector (Medrad).

Two experienced (more than 10-year experience) independent radiologists blinded to CSF results evaluated both MRI sequences (CE-FLAIR and CE-T1WI) through simple visual inspection with special emphasis to detect any meningeal abnormality. The exam was considered positive if the radiologist detected any abnormal meningeal enhancement.

CSF examination was done for all patients and was reported as positive or negative for diagnosing meningitis.

STATISTICAL ANALYSIS

- Only descriptive statistic was used.
- Specificity, sensitivity, negative and positive predictive values were compared with CSF analysis findings (diagnostic).

Statistical analysis

The data collected was analyzed and findings were obtained using the Statistical Package for Social Science (SPSS) windows package version 22.0. Descriptive analysis was conducted, i.e., frequencies and percentages for the continuous variables such as age for categorical variables such as gender, mean, and standard deviation. The significance level was considered if the P value < 0.05 was found. Sensitivity, specificity, and negative and positive predictive values were calculated by using CSF analysis as a standard of reference.

RESULTS

Results

Fifty patients with symptoms suspicious of meningitis during the recruitment period were sent for MRI examination. Five patients were removed from the study because 1 patient had metallic implants that were not MR compatible (cardiac pacemaker) and 4 patients were claustrophobic. Consequently, the total number of patients included in this study was 45, who were exposed to MRI for clinically suspected meningitis.

Of 45 patients, 28 (62.3%) were male patients and 17 (37.7%) were females. In males, the mean age ranged from 25 to 75 years was 36.0 ± 16.25 years. The mean age in females ranging from 10 to 75 years was 44.75 ± 12.68 years. Every patient was subjected to lumbar puncture for CSF analysis after the MRI exam to confirm the diagnosis. Among 45 patients, 37 patients (82.2%) had positive results with CSF and the remaining 8 patients (17.8%) had negative results.

Table 1 Results of MR in total cases ($n = 45$). CSF analysis was considered the gold standard (37 cases were positive and 8 cases were negative)

	CE-T1WI	CE-FLAIR
True positive	27	34
False positive	0	0
True negative	8	8
False negative	10	3

Table 2 Results of MR in total cases ($n = 45$). CSF analysis was considered the gold standard (37 cases were positive and 8 cases were negative)

	CE-T1WI	CE-FLAIR
Sensitivity	73%	91.9%
Specificity	100%	100%
PPV	100%	100%
NPV	44.4%	72.7%

- Both radiologist reported the same findings in all cases with no detected mismatching in their interpretation.

Discussion

MRI plays an important role in diagnosing intracranial infections. MRI study may show many abnormalities, including a variable degree of abnormal meningeal contrast enhancement. The standard contrast-enhanced magnetic resonance series at most institutions is CE-T1WI. On T1WI, however, meningeal enhancement is sometimes unnoticeable [5].

In detection of inflamed meninges, the CE-FLAIR sequence is superior to CE-T1WI. The meningeal disease can be visualized more effectively with CE-FLAIR images than it is in CE-T1WI because CE-FLAIR is more sensitive to lower contrast concentration as a result of its marked sensitivity to limited alteration of CSF composition [6, 7].

CE-FLAIR images also allow for more accurate differentiation between abnormal meningeal enhancement and the cortical veins [1]. CE-FLAIR demonstrates no enhancement of the cortical veins or normal meninges that can cause confusion with pathologically enhancing meninges on CE-T1WI.

DISCUSSION

- Well-explained.
- Other studies were mentioned as reference.

AUTHOR	TITLE	PUBLICATION	CONCLUSION
Mubasher et al.	Comparison of gadolinium based T1 weighted and flair MR sequences for the assessment of leptomeningeal enhancement in meningoencephalitis.	Int J Radiol 5(1):163–171; 2018	Sensitivity of CE-FLAIR 95.3%. Sensitivity of CE-T1WI 76.7%.
Azad et al.	Qualitative and quantitative comparison of contrast-enhanced fluid-attenuated inversion recovery, magnetization transfer spin echo, and fat-saturation T1-weighted sequences in infectious meningitis.	Korean J Radiol 18(6):973; 2017	CE-FLAIR improved sensitivity, diagnostic accuracy and better correlation with CSF as compared to CE-T1WI.
Allesandra et al.	Contrast-enhanced FLAIR in the early diagnosis of infectious meningitis.	Neuroradiology 47(8):591–598; 2005	100% in CE-FLAIR while 50% in CE-T1WI.
Parmar et al.	Contrast-enhanced flair imaging in the evaluation of infectious leptomeningeal diseases.	Eur J Radiol 58(1):89–95; 2006	CE-FLAIR has equal sensitivity but higher specificity as compared to CE-T1WI.
Falzone et al.	Contrast enhanced fluid-attenuated inversion recovery vs. contrast-enhanced spin echo T1- weighted brain imaging.	Vet Radiol Ultrasound 49(4):333–338; 2008	Dominance of CE-FLAIR compared to CE-T1WI in the identification of brain lesions.
Ercan et. al	Diagnostic value of contrast-enhanced fluid-attenuated inversion recovery MR imaging of intracranial metastases.	Am J Neuroradiol 25(5):761–765; 2004	CE-FLAIR imaging is a valuable adjunct to CE-T1WI.

CONCLUSION

Conclusion

MRI imaging of meningitis, CE-FLAIR sequence, is more accurate than the CET1WI sequence. Therefore, in suspected cases of meningitis, CE-FLAIR should be applied as a regular sequence for non-invasive diagnosis.

- Concise.
- Answer the objectives.

LIMITATIONS

- Not mentioned.

- Single center study.
- Small sample size.

SUGGESTIONS

- Not mentioned.

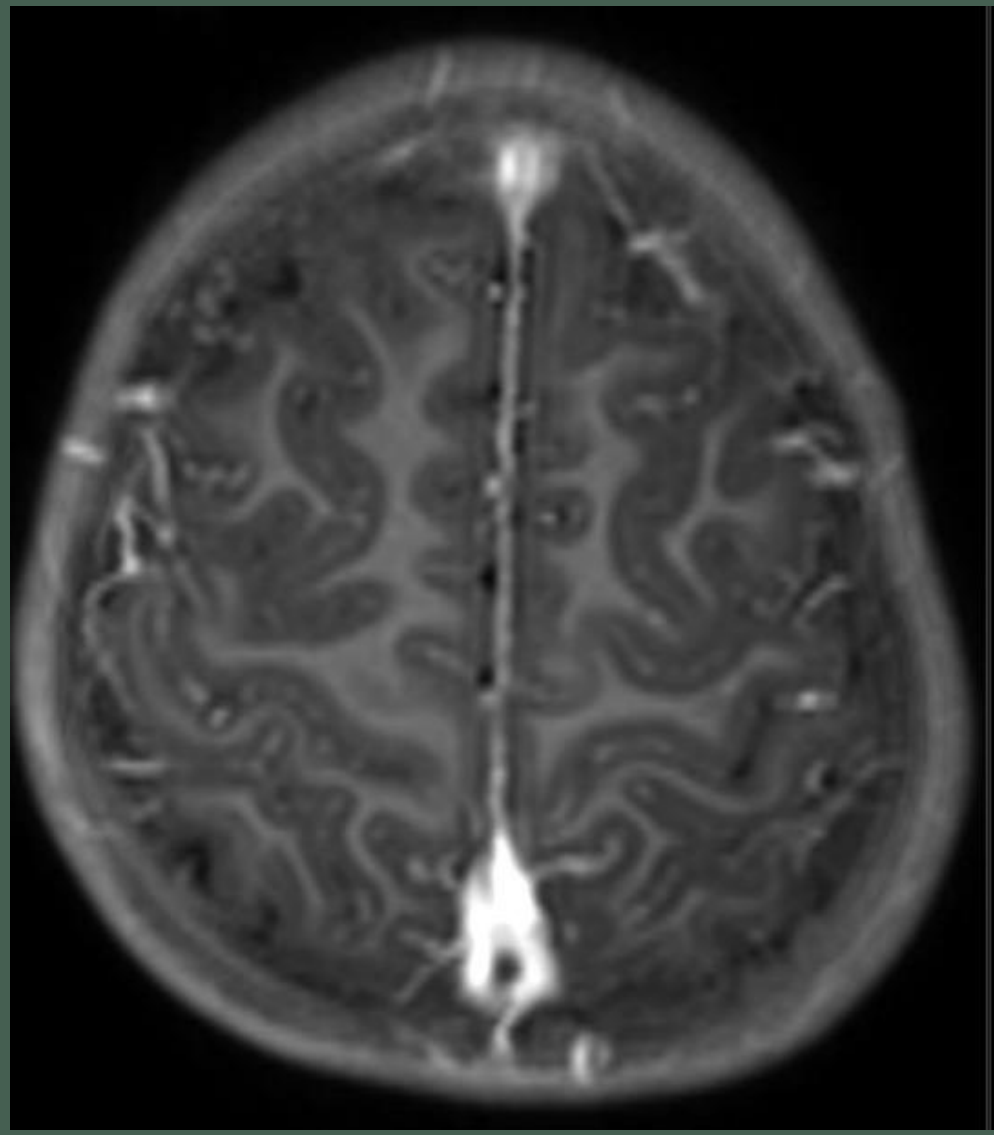
- Necessitation of further study with higher sample size.
- Use variables statistical analysis.

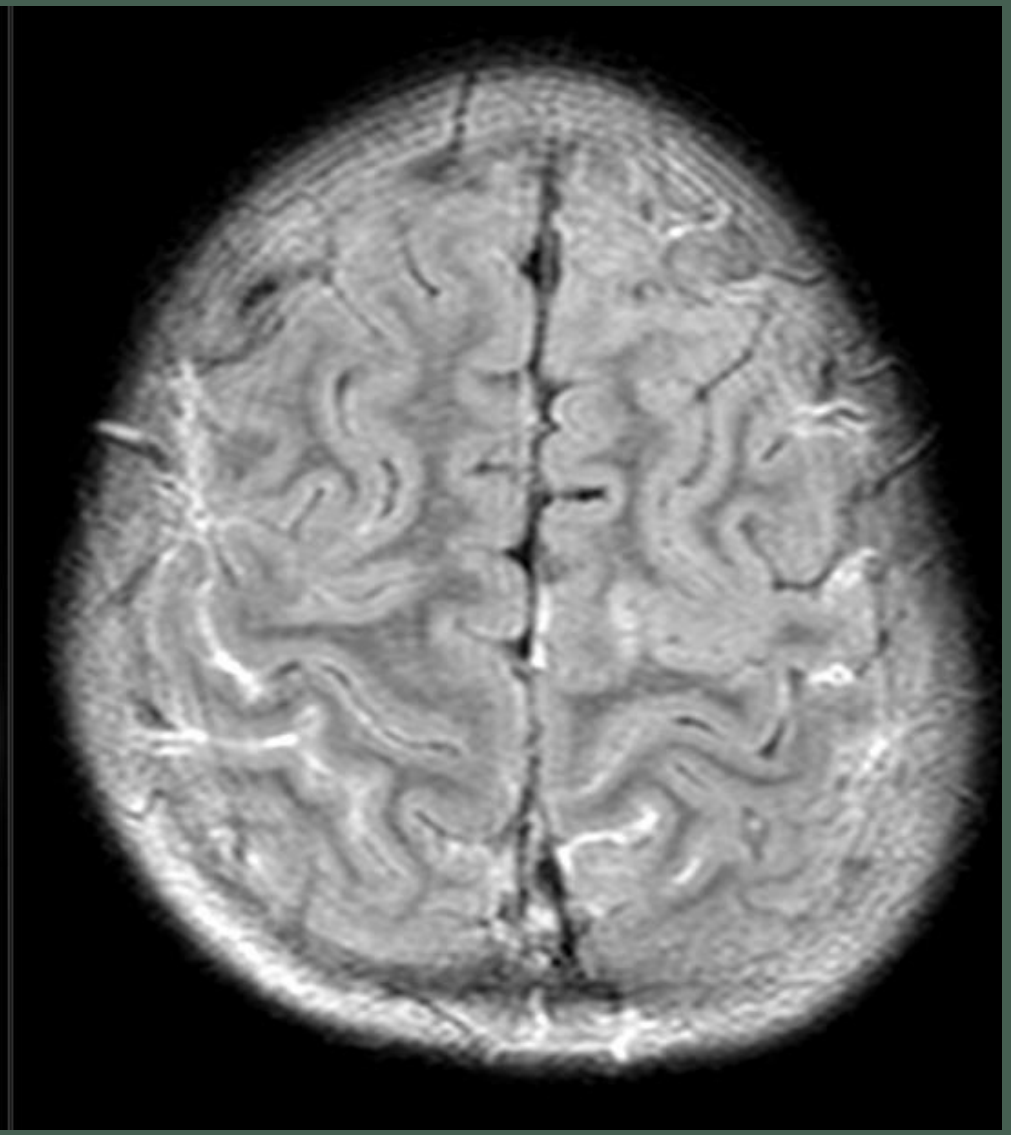
OVERALL

- Good study.
- Can be applied in our center as a routine sequence in detecting meningeal abnormalities.

OUR CENTRE EXPERIENCE

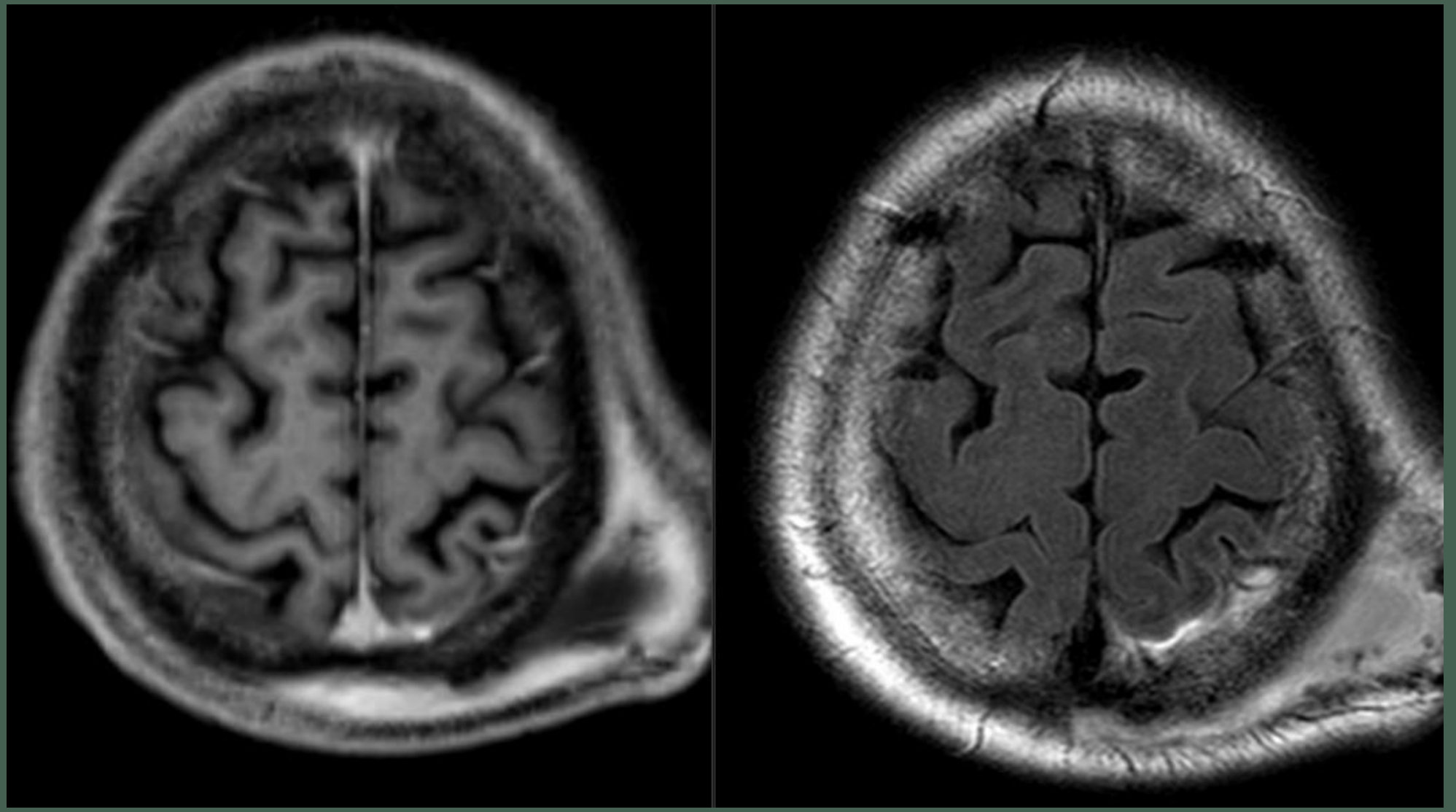
- Treated as SSST with meningitis.
- Parents not consented for LP.
- MR features of meningitis.





OUR CENTRE EXPERIENCE

- Treated for scalp tuberculosis.
- MR features of tuberculous meningitis.



FLAIR POST CONTRAST
-CLINCAL USE-

CE FLAIR

- Parenchymal lesion
- Leptomeningeal lesion
- Pachymeningeal lesion
- Cranial nerve lesion
- HARM
- Diabetic retinopathy
- Hyperglycemic-induced seizure
- Gd encephalopathy

OTHER JOURNALS

AUTHOR	TITLE	PUBLICATION	CONCLUSION
Ajit Mahale et al	Postcontrast Fluid-Attenuated Inversion Recovery (FLAIR) Sequence MR Imaging in Detecting Intracranial Pathology.	Hindawi Radiology Research and Practice; 2020	Delayed postcontrast T2 FLAIR was better in detection of meningeal enhancement in infectious meningitis and in meningitis carcinomatosis than T1 MTC images. In delayed postcontrast T2 FLAIR images, intra-axial parenchyma lesions appeared more conspicuous or similar to T1 MTC images. Delayed postcontrast T1 FLAIR images provided better anatomic delineation of intra-axial lesions.
Pascal Sati et al	FLAIR*: A combined MR Contrast Technique for Visualizing White Matter Lesions and Parenchymal Veins	RSNA; 2012	High-isotropic-resolution FLAIR* images obtained at 3.0 T yield high contrast for WM lesions and parenchymal veins, making it well suited to investigate the relationship between WM abnormalities and veins in a clinical setting.
Tara S. Davis et al	Comparison of T1-Post and FLAIR-Post MRI for identification of traumatic meningeal enhancement in traumatic brain injury patients	PLOS ONE; 2020	Conspicuity of traumatic meningeal enhancement (TME) is higher on post-contrast FLAIR MRI than on post-contrast T1WI. TME as seen on post-contrast FLAIR MRI can aid in the identification of patients with TBI.

LEARNING POINT/TAKE HOME MESSAGE

- In suspected leptomeningeal abnormalities, it is advisable to add CE-FLAIR for better delineation of pathologic leptomeningeal enhancement.
- CE-FLAIR can be use as adjunct to CE-T1WI, particularly in detecting subtle findings of leptomeningeal abnormalities, particularly in patient who contraindicated/refused LP.

REFERENCES

- The value of contrast-enhanced FLAIR magnetic resonance imaging in detecting meningeal abnormalities in suspected cases of meningitis compared to conventional contrast-enhanced T1WI sequence; Egyptian Journal of Radiology and Nuclear Medicine 2020; Kamr et al.
- Importance of contrast-enhanced fluid- attenuated inversion recovery magnetic resonance imaging in various intracranial pathologic conditions. Korean J Radiol 17(1):127–141; 2016; Lee EK et al.


Mochchakkeram
Kiitos
Dank Je
Terma Kasih
Merci
Spasibo
Salamat
Kia Ora
Obrigado
Ua Tsaug Rau Koj
Merci
Mochchakkeram
Grazie
Grazie
Multumesc
Cam on ban
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Merci
Thank You
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Thank You
Matur Nuv
Merci
Thank You
Chokrane