IJBPAS, November, 2025, 14(11): 6059-6063

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

COMPARISON OF SIGNAL INTENSITIES OF WHITE MATTER AND GRAY MATTER IN T2W AND T2FLAIR AXIAL SEQUENCES IN PATIENTS UNDERGOES MRI BRAIN: SYSTEMATIC REVIEW STUDY

DESWAL M[1*] AND SARIN M[2]

1: Research Scholar, Radio-Imaging Technology, Department of Paramedical, Faculty of Allied Health Sciences, SGT University, Gurugram, Haryana, 122505

2: Professor, Department of Radio-Diagnosis, Faculty of Medicine and Health Sciences, SGT Medical College, Hospital & Research Institute, Gurugram, Haryana, 122505

***Corresponding Author: Mr. Mohit Deswal: E Mail: mohitdeswal.md.md@gmail.com**

Received 18th July 2024; Revised 25th Sept. 2024; Accepted 5th Nov. 2024; Available online 1st Nov. 2025

https://doi.org/10.31032/IJBPAS/2025/14.11.9580

ABSTRACT

Background: An MRI is a type of medical imaging that employs a magnet to recreate images of bodily tissues and assist in identifying abnormal and normal tissue. When describing most MRI sequences, we refer to the shade of grey of tissues or fluid with the word intensity. On T2-weighted images, tissues with a short T2 appear dark. T2-weighted pictures show bright tissues with a long T2. A procedure called "Fluid Attenuation Inversion Recovery" makes use of extended inversion times. As a result, the generated images lose signal from the cerebrospinal fluid. Thus, brain tissue in FLAIR images resembles T2 weighted images, with the CSF appearing black rather than light and the grey matter being brighter than the white matter.

Discussion/Conclusion: The review study concludes that signal strength is a critical factor in ruling out various diseases. Additionally, it was noted that the majority of experiments were conducted solely on MRI brains. This suggests that additional research might be conducted by varying the parts and sequences.

Keywords: MRI, T2, FLAIR, CSF, Hypo-intense, Hyper-intense

INTRODUCTION

History of MRI: MRI, as with all medical imaging techniques, is a relatively unique technique and, is a relatively new technology during the year of 1946. Dr. Felix Bloch, Stanford University & Edward Mills Purcell, Harvard University independently discovered the MR phenomena during this year and were later awarded the Nobel Prize in 1952. Until 1970s MRI was being used for chemical and physical analysis. Then in 1971 "Raymond Damadian" showed that nuclear magnetic relaxation times of tissues and tumors differed motivating scientists to use MRI to study disease, many scientists over the next 20 year developed MRI into the technology that we know and use today **[1]**. The emergence of superconductors was arguably one of these most fascinating breakthroughs. The powerful magnetic fields employed in MRIs are made possible by these superconductors. Owing to the several technologies needed, the first MRI examination of a human was not performed until 1977. Since then, the MRI procedure has accelerated due to faster computing. The greatest development in magnetic resonance imaging (MRI) was in 2003 when Paul C. Lauterbur and Peter Mansfield were awarded the Nobel Prize for their discoveries on the use of MRIs as a diagnostic tool **[2]**.

Basics of MRI: An MRI is a type of medical imaging that employs a magnet to recreate images of bodily tissues and assist in identifying abnormal and normal tissue. MRI is different from the other modalities of radiology department; it is used to assess soft tissue enhancement. MRI is formed by Magnetic Resonance Imaging that because its uses magnetic field to construct images of body tissue by sending RF pulse to specific part of body that energy get excite protons of tissue and these proton release energy to the surrounding that gets observed by RF coils **[3]**.

Signal Intensity: The following absolute phrases result from using the word "intensity" to describe the majority of MRI sequences, which refers to the gray scale of tissues or fluid:

- White signal at high intensity
- Grey is the intermediate signal intensity.
- Insufficient signal strength = dark

Frequently, we can use comparable phrases to describe the appearance:

- Hyperintense: surpasses the object being compared in brightness
- Isointense: maintains the same brightness level

- Hyperintense: falls short of the object being compared in brightness **[4]**.

T2W Image Characteristics: Tissues with lengthy T2 values generate the highest magnetization and appear brightest on an MRI image when the sequence is set to produce a T2-weighted image. T2 contrast is primarily produced via a T2-weighted sequence by down sampling the T1 contributions. Typically, a long echo time (TE) of 100–150 Ms and a long repetition time (TR) of 2000–6000 ms are used to accomplish this. On T2-weighted images, tissues with a short T2 appear dark. T2-weighted pictures show bright tissues with a long T2.

Fluid Attenuation Inversion Recovery (FLAIR):

A procedure called "Fluid Attenuation Inversion Recovery" makes use of extended inversion times. As a result, the generated images lose signal from the cerebrospinal fluid. Thus, brain tissue in FLAIR images resembles T2 weighted images, with the CSF appearing black rather than light and the grey matter being brighter than the white matter.

The effectiveness of FLAIR sequences has been assessed in a variety of central nervous system disorders including

- Multiple sclerosis
- Infarction
- Subarachnoid hemorrhage
- Head Trauma and others.

Protocols to evaluate meningitis and other leptomeningeal illnesses have incorporated post-contrast FLAIR images **[5][6]**.

Routine MRI Brain protocol followed:

1. Localizer in 3 planes
2. T2_tse_tra
3. T2_flair_tra
4. T1_se_tra
5. T1_se_cor
6. T2_tse_sag
7. Dwi_epi3trace_tra

DISCUSSION

Several research and studies have been carried out in the past, and even now there are ongoing debate about the methods that we are using, which gives us the clear idea of the pathologies of the brain and how we need to move forward to improve the techniques and provide better quality of work. The data of the first research had a different approach as it came up with an alternative of the traditional methods that are being used in the MR imaging. The articles also put emphasis on the different approach that we can have about the pathologies. Several parameters influence signal intensity, including protein content, red blood cell hydration state, red blood cell shape and dimension, and hematocrit. Extrinsic parameters like MRI magnetic field intensity

and pulse sequences can affect clot formation and retraction, as well as the inflammatory response. The MRI signal pattern observed in parenchymal hematoma evolution does not apply with extra parenchymal or extra cranial hemorrhage. The hypo- intense and hyper-intense, the MRI evidence from parenchymal hematoma can be tricky to interpret, although it follows a predictable pattern as the clot degrades. In a further detailed study it was found that T1-weighted MR imaging reveals a variety of cerebral lesions that seem bright. Understanding the chemicals and physical qualities that cause T1 shortening aids in making accurate diagnoses and interpreting high-signal-intensity lesions on T1-weighted images. Several diseases have distinct clinical and imaging characteristics that enable accurate diagnosis. The study involving contrast based study revealed that CE-FLAIR imaging provides improved enhancement, lesion identification, and soft tissue contrast resolution over to the traditional CE-T1W sequence. T2-weighted images show hypo intense brain lesions due to shortened transverse relaxation time. This shortening is primarily caused by paramagnetic materials (contrary the media, blood, mineral chemicals, melanin), a lack of protons that are excited (air-containing areas, erratic and swift travel), a high degree of colloid material and protein levels (mucous- or protein-containing lesions), or a decrease in outside of cells fluid volume (highly cellular lesions). Understanding the location and shape of pathological alterations causing T2-hypointensity can help restrict the differential diagnosis and confirm the proper diagnosis based on an MRI. The studies have been done and some of the studies are still going on. The prior studies focus on the improvement yet there is still room for improvement in the study of the lesions of the brain and the studies can also help the next generations to understand and better visualize and diagnose different pathologies of the brain.

CONCLUSION

The review study concludes that signal strength is a critical factor in ruling out various diseases. Additionally, it was noted that the majority of experiments were conducted solely on MRI brains. This suggests that additional research might be conducted by varying the parts and sequences.

REFERENCES

[1] Ansorge R, Graves M. The physics and mathematics of MRI.

[2] Saranathan M, Worters P, Rettmann D, Winegar B, Becker J. Physics for clinicians: Fluid-attenuated inversion recovery (FLAIR) and double

inversion recovery (DIR) Imaging. Journal of Magnetic Resonance Imaging. 2017;46(6):1590-1600.

[3] Hanson L. Is quantum mechanics necessary for understanding magnetic resonance? Concepts Mag Reson Part A 2008;32a (5):329-40.

[4] Vézina L. MRI: Protocols to optimize lesion detection. Epilepsia. 2011; 52:25-27.

[5] MS J. Assessing Multiple Sclerosis Brain Plaques using Susceptibility-Weighted Imaging in Comparison with T2W and FLAIR. Clinical Radiology & Imaging Journal. 2018;2(2).

[6] Masutani S, Tachibana T, Tomozawa K. 317 Evaluation of the fast-FLAIR sequence in head MRI. Japanese Journal of Radiological Technology. 1995;51(10):1388.