

MRI as the Primary and Only Imaging Modality for Stroke Diagnosis in a Tier 3 Town in North India

Jai Inder Singh Dhillon, M.D.¹; Yatin Sharma B.Sc.²; Rishi Awasthi Ph.D.²

¹Bibi Kaulan Ji Bhalai Kendra Trust, Amritsar, Punjab, India

²Siemens Healthineers, Gurugram, Haryana, India

Stroke is a leading cause of death and disability worldwide and in India. According to an Indian Council of Medical Research (ICMR) press release [1], stroke could lead to nearly 10 million deaths annually by 2050, primarily in low- and middle-income countries (LMICs). Almost 80% of stroke cases are caused by obstruction of cerebral arteries leading to reduced blood supply to the brain tissue. Various studies of stroke patients demonstrate that treatment (such as mechanical thrombectomy) can improve functional outcomes if done within a few hours of stroke onset. The key is a diagnosis based solely on diffusion-weighted (DWI) and FLAIR MR imaging [2–5].

In this article, we showcase the use of our new MAGNETOM Free.Star 0.55T MRI scanner (Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China) in symptomatic acute ischemic stroke patients at Bibi Kaulan Ji Charitable Hospital, Amritsar, India. The aim of Bibi Kaulan Ji Charitable Hospital is to serve everyone in society, but especially those who cannot afford to access quality healthcare. The hospital therefore provides its services at about 30% of the cost charged by other hospitals in the region. Since accurate and timely diagnosis is key to successful treatment, and since MRI is one of the most important diagnostic tools, the hospital's trust was looking

for a scanner which does not compromise diagnostic outcomes and is also easy to operate and manage. The management decided on a MAGNETOM Free.Star scanner, after seeing its capabilities in terms of resolution and image quality during a live demonstration before the purchase. Given that it is a lower-field scanner, one of the biggest concerns was about the quality of DWI, which is the most important sequence for stroke detection. To our surprise, the standout feature on our MAGNETOM Free.Star is the quality of DWI. In particular, its ability to minimize distortion artifacts helps to pick up lesions even in difficult regions like the skull base and temporal lobe.

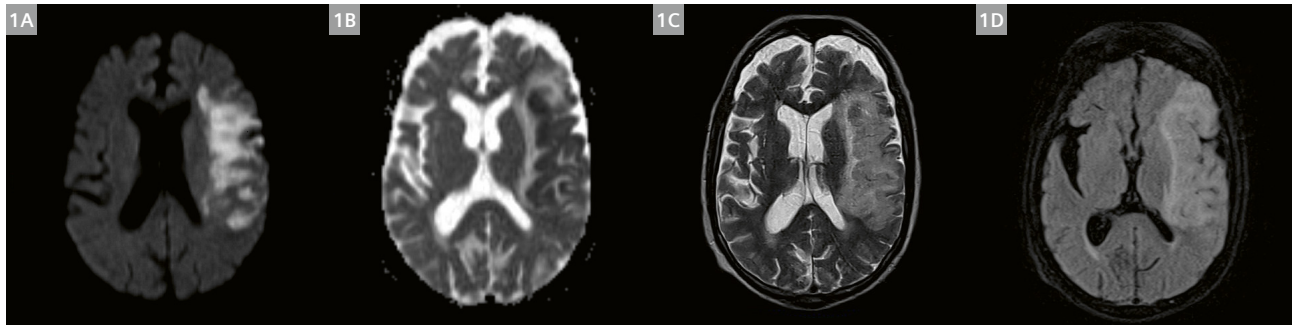
Generally, computed tomography (CT) is the first modality used in stroke, as it is easily available and offers a simple workflow and fast imaging capabilities. However, in our hospital, we prefer to use MRI in patients with suspected acute stroke. In fact, we image stroke patients exclusively with MRI for two specific reasons:

1. MRI can detect acute stroke in the first few hours of onset [6].
2. MRI can predict the age of hemorrhage [7–9].

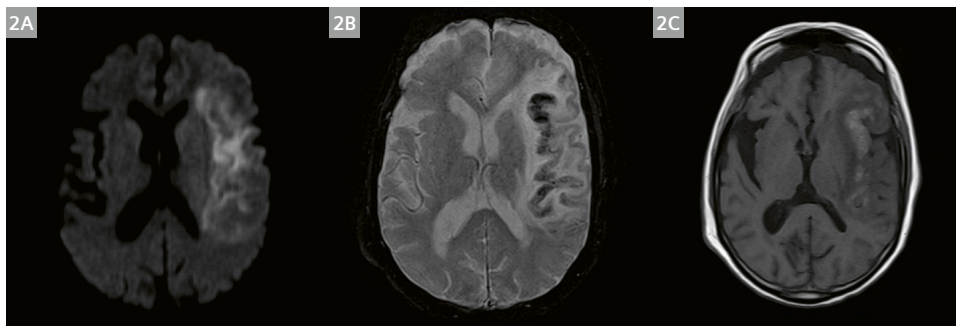
The following are a selection of stroke cases diagnosed at our hospital:

Case 1

An 86-year-old male patient who presented with right-side weakness and semiconsciousness. An MRI brain scan was suggested. It revealed a large subacute infarct in the left middle cerebral artery (MCA) territory with mild midline shift toward the right side. Images show significant restriction on DWI and low apparent diffusion coefficient (ADC) (Figs. 1A–1D). After one week, the patients' symptoms persisted. A follow-up scan was performed and revealed hemorrhagic transformation of the infarct, with blooming on gradient echo (GRE) images (Figs. 2A–2C).



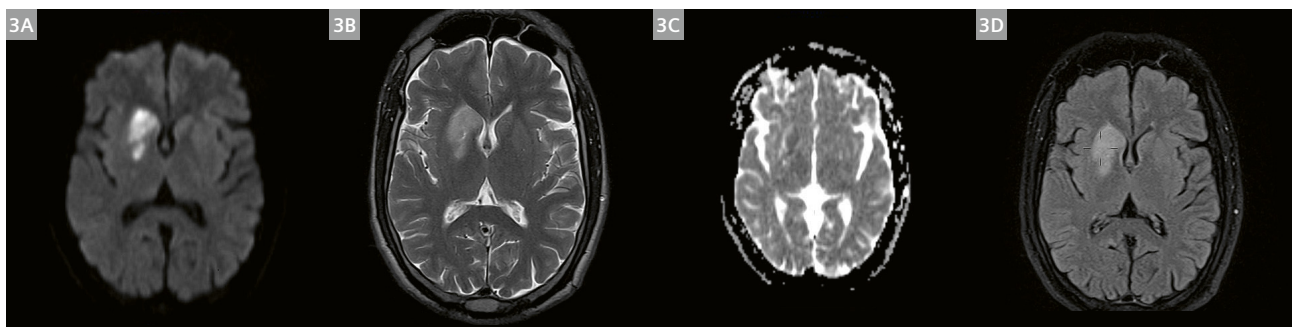
1 (1A) DWI, (1B) ADC map, (1C) T2-weighted image, (1D) FLAIR.



2 (2A) DWI, (2B) GRE, (2C) T1-weighted image.

Case 2

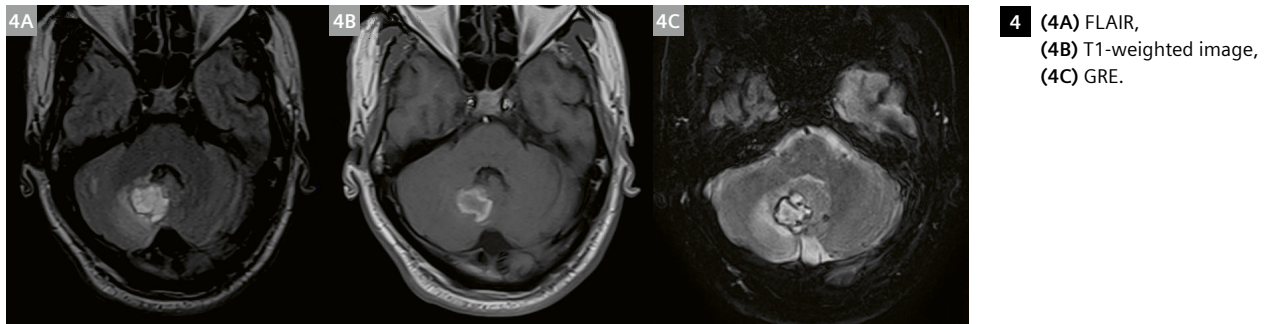
A 48-year-old male patient presented at the emergency department with left-side weakness. An MRI brain scan was performed and revealed an acute non-hemorrhagic infarct in the right basal ganglia showing hyperintense signal on T2-weighted images and restriction on DWI (Figs. 3A–3D).



3 (3A) DWI, (3B) T2-weighted image, (3C) ADC map, (3D) FLAIR.

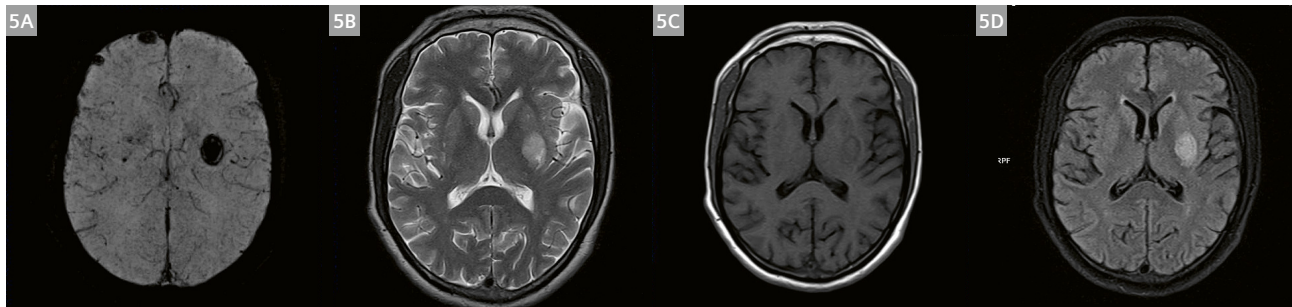
Case 3

A 42-year-old male patient presented with difficulty walking and high blood pressure, which had lasted 6–7 days. An MRI brain scan revealed subacute hemorrhage in the right cerebellar hemisphere with peripheral T1 hyperintensity and blooming on GRE images with mild surrounding edema (Figs. 4A–4C). Age of hemorrhage was consistent with duration of symptoms.



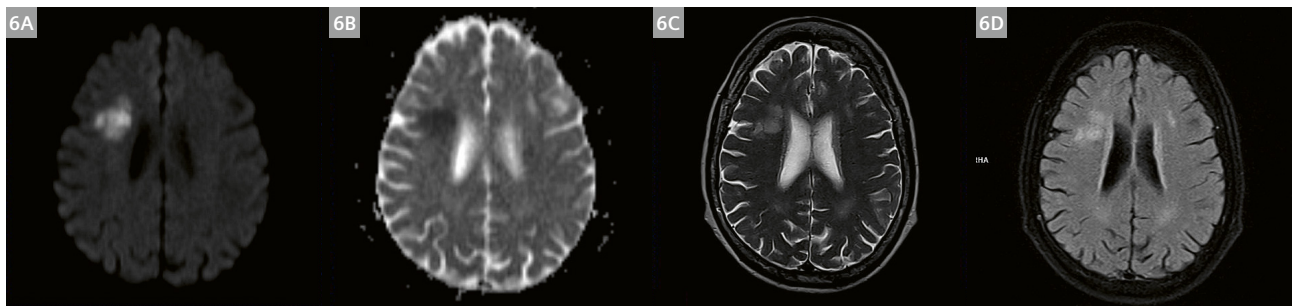
Case 4

A 42-year-old male patient presented with sudden right-side weakness. The MRI brain scan shows hyperacute hemorrhage in the left lentiform nucleus, with blooming on GRE images, isointensity on T1-weighted images, and hyperintensity on T2-weighted images (Figs. 5A–5D).



Case 5

A 75-year-old female patient presented with slurring of speech and left-side weakness. An MRI brain scan was performed, revealing an acute non-hemorrhagic infarct in the right corona radiata with restriction on diffusion-weighted images (Figs. 6A–6D).



Conclusion

In our current practice at Bibi Kaulan Ji Charitable Hospital with our MAGNETOM Free.Star scanner, we use MRI as a primary diagnostic modality (in fact, the only imaging modality) in cases of suspected acute ischemia. The case reports presented here show that we are able to make diagnoses with excellent image quality at the required resolution to detect complex pathologies, including stroke.

References

- 1 Indian Council of Medical Research. Stroke Deaths are on the rise: Report from World Stroke Organization and the Lancet Neurology Commission. Oct. 10, 2023. Accessed on March 18, 2024. Available from: https://main.icmr.nic.in/sites/default/files/press_realease_files/Stroke_Press_Release_Draft_V3.pdf
- 2 Yang SH, Liu R. Four Decades of Ischemic Penumbra and Its Implication for Ischemic Stroke. *Transl Stroke Res.* 2021;12(6):937–945.
- 3 Lapchak PA. Critical early thrombolytic and endovascular reperfusion therapy for acute ischemic stroke victims: a call for adjunct neuroprotection. *Transl Stroke Res.* 2015;6(5):345–354.
- 4 Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, et al. Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/ American Stroke Association. *Stroke.* 2019;50(12):e344–e418.
- 5 Berkhemer OA, Fransen PS, Beumer D, van den Berg LA, Lingsma HF, Yoo AJ, et al. A randomized trial of intraarterial treatment for acute ischemic stroke. *N Engl J Med.* 2015;372(1):11–20.
- 6 Kakkar P, Kakkar T, Patankar T, Saha S. Current approaches and advances in the imaging of stroke. *Dis Model Mech.* 2021;14(12):dmm048785.
- 7 Atlas SW, Thulborn KR. Intracranial Hemorrhage. In: *Magnetic resonance imaging of the brain and spine.* Lippincott Williams & Wilkins, Philadelphia. 2002;773–832.
- 8 Wintermark M, Maeder P, Reichhart M, Schnyder P, Bogousslavsky J, Meuli R. MR pattern of hyperacute cerebral hemorrhage. *J Magn Reson Imaging.* 2002;15(6):705–709.
- 9 Korbakis G, Prabhakaran S, John S, Garg R, Connors JJ, Bleck TP, et al. MRI Detection of Cerebral Infarction in Subarachnoid Hemorrhage. *Neurocrit Care.* 2016;24(3):428–435.



Contact

Jai Inder Singh Dhillon, M.D.
Bibi Kaulan Ji Charitable Hospital
Tarn Taran Road, New Krishna Nagar,
Guru Amar Dass Nagar
Amritsar, Punjab
India
jsdhillon712@gmail.com