Section: Radio Diagnosis

Original Research Article

DIAGNOSTIC CONCORDANCE BETWEEN FULL VERSUS LIMITED MRI BRAIN PROTOCOLS IN PATIENTS WITH ACUTE-ONSET NEUROLOGICAL SYMPTOMS: AN OBSERVATIONAL STUDY

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ABSTRACT

Background: Rapid neuroimaging is essential in patients presenting with acute-onset neurological symptoms. While full-protocol brain MRI provides comprehensive diagnostic information, abbreviated protocols may reduce acquisition time and improve workflow efficiency. This study evaluated the diagnostic concordance and performance of a limited MRI brain protocol compared with a full protocol in acute neurological presentations.

Materials and Methods: This prospective observational cross-sectional study with retrospective image review included 100 patients presenting within seven days of onset of neurological symptoms. All patients underwent full-protocol brain MRI. A simulated limited protocol comprising diffusion-weighted imaging (DWI), fluid-attenuated inversion recovery (FLAIR), gradient echo (GRE), and axial T2-weighted sequences was independently reviewed. The full protocol served as the reference standard. Sensitivity, specificity, and concordance rates were calculated.

Results: The study population included 57 males and 43 females, with the highest representation in the 51–60-year age group (17%). Hemiparesis was the most common clinical presentation (24%). On full-protocol MRI, infarction was the predominant diagnosis (26%), followed by demyelination (18%), infection (15%), tumor (13%), cerebral atrophy (12%), hydrocephalus (10%), and hemorrhage (6%). The limited protocol detected 91% of cases concordantly, with 9% discordance. Missed diagnoses included subtle enhancing demyelinating lesions (n=2), infectious lesions (n=2), tumors (n=2), small cortical infarct (n=1), atrophy with hydrocephalus (n=1), and venous sinus thrombosis (n=1). DWI demonstrated sensitivity of 96% and specificity of 92%, FLAIR 88% and 85%, T2-weighted imaging 86% and 80%, and GRE 90% and 95%, respectively.

Conclusion: The limited MRI protocol demonstrated high concordance and diagnostic accuracy in acute neurological conditions, supporting its role as a rapid screening tool. However, comprehensive imaging remains necessary in selected cases for optimal lesion characterization.

Keywords: Acute neurological symptoms; Brain MRI; Limited MRI protocol; Diagnostic concordance; Diffusion-weighted imaging; Neuroimaging.

INTRODUCTION

Magnetic resonance imaging (MRI) has become an indispensable tool in the evaluation of patients with acute neurological symptoms, offering superior soft-tissue contrast and the ability to detect a spectrum of intracranial pathologies including infarction, hemorrhage, demyelination, infection, and neoplasms.[1] In emergency settings, rapid and accurate imaging is essential for timely diagnosis and

appropriate management, particularly when distinguishing stroke and other time-sensitive conditions from mimics.[2] Traditional full-protocol brain MRI typically includes a comprehensive set of sequences, which increases acquisition time and may be limited by patient tolerance, scanner availability, and motion artefacts, particularly in acute/emergency scenarios.[3]

Recent research has investigated abbreviated or limited MRI protocols designed to streamline imaging by focusing on a targeted set of sequences with high diagnostic utility, such as diffusion-weighted imaging (DWI), fluid-attenuated inversion recovery (FLAIR), gradient echo (GRE), and T2-weighted imaging. These sequences have been shown to reliably detect major pathologies in acute neurological presentations while potentially reducing scan time and resource utilization.[1,3] For example, ultrafast MRI protocols integrating a limited combination of essential sequences have demonstrated high concordance with standard protocols in identifying critical intracranial lesions, with sensitivities and specificities approaching those of comprehensive imaging in some cohorts.[1,4]

Despite promising findings, there remains variability in the diagnostic performance of limited protocols across different clinical conditions, and certain subtle or contrast-enhanced abnormalities may be under-detected without full sequence acquisition.[5] Furthermore, the relative contributions of individual sequences such as DWI for infarction and GRE for hemorrhagic detection support the rationale for targeted protocol design in acute settings.

Given these considerations, systematic evaluation of limited MRI protocols against the full protocol reference standard is necessary to define their clinical utility and limitations in patients presenting with acute-onset neurological symptoms. This study therefore aims to compare diagnostic concordance and performance metrics between limited and full MRI brain protocols in a prospective cohort.

MATERIALS AND METHODS

Study Design: This investigation was conducted as a prospective observational cross-sectional study with retrospective image analysis. The objective was to compare the diagnostic performance of a limited-sequence MRI brain protocol with that of a comprehensive full brain MRI protocol in patients presenting with acute-onset neurological symptoms of less than seven days' duration.

Study Setting: The study was carried out in the Department of Radiology at Sir Takhatsinhji General Hospital (PMSSY Building) and Sahyog MRI Center. Both centers are equipped with advanced neuroimaging facilities, including a Siemens MAGNETOM Vida 3T system and a GE WPRO 1.5T MRI Scanner, enabling acquisition of high-resolution brain images suitable for detailed structural evaluation.

Study Duration: The study period extended from 2023 to 2025, encompassing patient enrollment, image acquisition, image review, and statistical analysis.

Study Population: The study population included patients who underwent a complete brain MRI examination for evaluation of acute neurological complaints of less than one week's duration. Only those with complete radiological documentation and accessible DICOM image datasets were considered eligible for review.

Sample Size: A total of 100 patients were included in the analysis. The sample size was determined based on feasibility, availability of eligible cases during the study period, and reference to comparable sample sizes reported in similar radiological studies. A formal statistical power calculation was not performed.

Inclusion Criteria

Patients fulfilling all of the following criteria were included:

- Individuals of any age or gender presenting with newly developed neurological symptoms of less than seven days' duration
- Patients who underwent a full brain MRI protocol during the study period
- Availability of MRI requisition forms, finalized radiology reports, and complete DICOM image datasets
- Documented informed consent permitting use of anonymized imaging and clinical data for research purposes

Exclusion Criteria

Patients were excluded under the following conditions:

- MRI studies performed using dedicated protocols (e.g., pituitary, orbital, or internal auditory canal protocols)
- Normal MRI brain examinations without detectable pathology
- Known or suspected congenital brain anomalies
- History of previously diagnosed chronic neurological disorders
- History of traumatic brain injury or traumatic intracranial hemorrhage
- MRI performed more than seven days after symptom onset
- Repeat MRI performed for the same clinical episode
- Incomplete clinical or imaging data
- Refusal to participate

Data Collection: Demographic details, clinical indications, MRI requisition forms, finalized radiological reports, and complete imaging datasets were retrieved from the MRI console workstation and institutional archives.

Image Review and Group Allocation: Each case underwent dual analysis under two protocol conditions:

- **Group A (Full Protocol):** Included all sequences routinely performed in the institutional standard brain MRI protocol.

- **Group B (Limited Protocol):** Simulated evaluation restricted to diffusion-weighted imaging (DWI), fluid-attenuated inversion recovery (FLAIR), gradient echo (GRE), and axial T2-weighted images.

Rationale for Limited Protocol Selection: The selected sequences were chosen based on their established diagnostic utility in acute neurological conditions:

- **DWI:** Detection of acute ischemic infarction and certain infectious lesions
- **FLAIR:** Identification of edema, inflammatory processes, and subacute infarcts
- **GRE:** Detection of hemorrhage and susceptibility-related abnormalities
- **Axial T2-weighted imaging:** Characterization of lesion morphology and associated edema

Blinded Image Interpretation: Two qualified radiologists independently reviewed the imaging datasets in separate sessions. Interpretations of the full protocol and limited protocol were conducted independently. Both reviewers were blinded to clinical details and to each other's findings to minimize interpretive bias.

Data Analysis: Data were compiled and analyzed using Microsoft Excel 2021. The full MRI protocol served as the reference standard for comparison. The following statistical parameters were calculated for the limited protocol:

- Sensitivity
- Specificity
- Positive predictive value (PPV)
- Negative predictive value (NPV)

Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Ethical clearance was obtained from the Institutional Ethics Committee prior to initiation of the study. No personally identifiable information was included in the dataset. As the study involved analysis of pre-existing clinical and imaging records without additional patient intervention, the associated risk was minimal. All data were anonymized in accordance with institutional and data protection guidelines before statistical evaluation.

RESULTS

A total of 100 patients presenting with acute-onset neurological symptoms were included in the study. The age distribution demonstrated that the majority of patients were between 31 and 60 years of age, accounting for 46% of the study population. The highest proportion of cases was observed in the 51–60 year age group (17%), followed by 41–50 years (15%) and 31–40 years (14%). Pediatric patients (0–10 years) constituted 7% of cases, while individuals older than 70 years comprised 12% of the cohort. There was a male predominance, with 57% males and 43% females, resulting in a male-to-female ratio of approximately 1.3:1 [Table 1].

Regarding clinical presentation, hemiparesis or hemiplegia was the most frequent symptom, reported in 24% of patients. Altered sensorium or loss of consciousness accounted for 16% of cases, while seizures were noted in 14%. Headache was present in 12% of patients, and fever associated with neurological signs was observed in 11%. Visual disturbances such as diplopia were reported in 8% of cases, whereas gait disturbances or ataxia accounted for 6%. Cognitive decline or memory impairment was documented in 5% of patients. Miscellaneous symptoms, including vertigo and speech abnormalities, constituted 4% of the study population [Table 2].

MRI findings using the full protocol sequences identified infarction as the most common diagnosis, seen in 26% of patients. Demyelinating lesions were detected in 18%, and infectious etiologies accounted for 15% of cases. Intracranial tumours were diagnosed in 13% of patients. Cerebral atrophy was observed in 12%, hydrocephalus in 10%, and hemorrhagic lesions in 6% of cases [Table 3].

When limited protocol sequences were applied, infarction was detected in 25% of patients, demyelination in 16%, infection in 13%, tumours in 10%, cerebral atrophy in 11%, hydrocephalus in 10%, and hemorrhage in 6%. Overall, the limited protocol demonstrated concordant findings in 91% of cases when compared with the full protocol. However, 9% of cases showed discordance [Table 4].

Analysis of the missed cases revealed that nine diagnoses identified on the full protocol were not detected using the limited protocol. These included two cases of demyelination characterized by small enhancing plaques and juxtacortical lesions, two infectious cases with ring-enhancing abscesses or leptomeningeal enhancement, and two tumours with enhancing margins or necrotic cores requiring contrast-enhanced sequences or spectroscopy. One small cortical infarct was not visualized on standard diffusion-weighted imaging and required higher b-value DWI and MR angiographic correlation. One case of subtle callosal thinning with periventricular seepage suggestive of atrophy with hydrocephalus required high-resolution 3D T1 and FLAIR sagittal imaging. Additionally, one case of venous sinus thrombosis involving the left transverse sinus required MR venography for definitive detection [Table 5].

Overall concordance between the full (Group A) and limited (Group B) MRI protocols was observed in 91% of cases, while 9% were discordant [Table 6].

The diagnostic performance of individual limited protocol sequences demonstrated high sensitivity and specificity across major pathologies. Diffusion-weighted imaging showed a sensitivity of 96% and specificity of 92%, particularly for acute infarction and infectious lesions. FLAIR imaging demonstrated a sensitivity of 88% and specificity of 85%, especially for demyelinating lesions and subacute

infarcts. T2-weighted imaging showed a sensitivity of 86% and specificity of 80% for detecting edema and lesion extent in tumours and hydrocephalus. Gradient echo sequences exhibited a sensitivity of 90% and specificity of 95% for hemorrhagic lesions and calcifications [Table 7].

Table 1: Age and Gender-Wise Distribution of Patients

Age Group (Years)	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
0–10	4	7.0	3	6.4	7	7.0
11–20	5	8.8	4	8.5	9	9.0
21–30	7	12.3	6	12.8	13	13.0
31–40	8	14.0	6	12.8	14	14.0
41–50	9	15.8	6	12.8	15	15.0
51–60	10	17.5	7	14.9	17	17.0
61–70	7	12.3	6	12.8	13	13.0
>70	7	12.3	5	10.6	12	12.0
Total	57	100.0	43	100.0	100	100.0

Table 2: Distribution of Cases by Clinical Presentation

Clinical Presentation	Number of Cases (n)	Percentage (%)
Hemiparesis / Hemiplegia	24	24.0%
Altered Sensorium / LOC	16	16.0%
Seizures	14	14.0%
Headache	12	12.0%
Fever with Neurological Signs	11	11.0%
Visual Disturbance / Diplopia	8	8.0%
Gait Disturbance / Ataxia	6	6.0%
Cognitive Decline / Memory Loss	5	5.0%
Others (Vertigo, Speech Abnormalities, etc.)	4	4.0%
Total	100	100.0%

Table 3: MRI Findings Using Full Protocol Sequences

Diagnosis Category	Number of Cases (n)	Percentage (%)
Infarction	26	26.0
Demyelination (e.g., MS, ADEM, etc.)	18	18.0
Infection (e.g., abscess, encephalitis, TB)	15	15.0
Tumour (e.g., glioma, metastases, lymphoma)	13	13.0
Cerebral Atrophy	12	12.0
Hydrocephalus (communicating or obstructive)	10	10.0
Hemorrhage (intraparenchymal, SAH, IVH)	6	6.0

Table 4: MRI Findings Using Limited Protocol Sequences (n = 100)

Diagnosis Category	Lesions Detected on Limited Protocol (n)	Percentage (%)
Infarction	25	25.0%
Demyelination	16	16.0%
Infection	13	13.0%
Tumour	10	10.0%
Cerebral Atrophy	11	11.0%
Hydrocephalus	10	10.0%
Hemorrhage	6	6.0%
Total Detected (Concordant)	91	91.0%
Missed / Discordant Cases	9	9.0%

Table 5: Cases Missed by Limited Protocol but Detected by Full Protocol (n = 9)

Diagnosis Category	Number of Missed Cases (n)	Examples of Missed Findings	Sequence Required for Detection
Demyelination	2	Tiny enhancing plaques, juxtacortical lesions	T1 post- contrast
Infection	2	Ring-enhancing abscess, leptomeningeal enhancement	T1 post- contrast, DWI refinement
Tumour	2	Enhancing margin, necrotic core	T1 post- contrast, MRS
Infarction	1	Small cortical infarct not seen on DWI (b - 1000)	High b value DWI MRA
Atrophy with Hydrocephalus	1	Subtle callosal thinning, periventricular seepage	3D T1, FLAIR sagittal
Venous Sinus Thrombosis	1	Thrombus in left transverse sinus	MRV
Total	9		

Table 6: Concordance Between Full (Group A) and Limited Group B) MRI Protocols (n = 100)

Category	Number of Cases (n)	Percentage (%)
Concordant	91	91.0%
Discordant	9	9.0%

Table 7: Diagnostic Performance of Limited Protocol Sequences Based on Study Data

Sequence	Plane(s)	Clinical Utility Based on Study	Common Diagnoses Identified	Sensitivity (%)	Specificity (%)
DWI	Axial	Primary tool for detecting acute infarcts and abscesses	Infarction, infection	96	92
FLAIR	Axial	Best for demyelination and subacute infarcts	Demyelinatio, gliosis	88	85
T2W	Axial	Identifies edema and lesion extent in tumors, infections	Tumours, hydrocephalus	86	80
GRE	Axial	Highly sensitive to hemorrhagic components and calcifications	Hemorrhage, calcified lesions	90	95

Representative images given below (Figure 1-3)

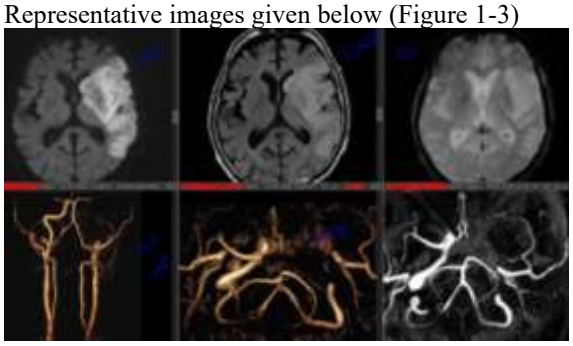

Figure 1: Infarct with left ICA and MCA occlusion

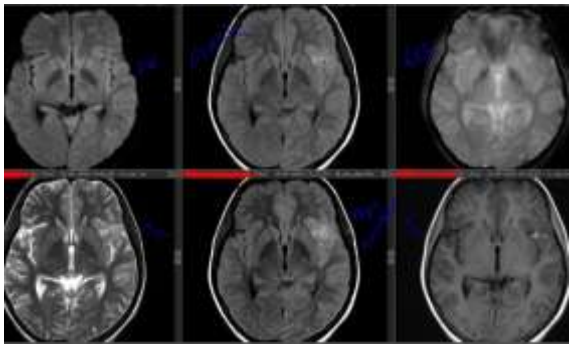

Figure 2: Meningitis with tuberculoma in left sylvian fissure.

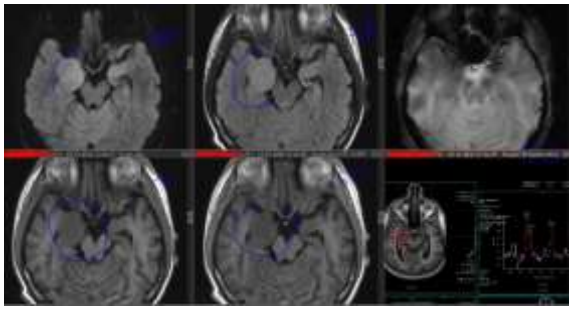

Figure 3: Right medial temporal low grade Glioma

DISCUSSION

In this study, the limited MRI protocol demonstrated a high overall concordance with the full MRI protocol for detecting major intracranial abnormalities in patients with acute neurological presentations. The 91% concordance rate observed aligns with evolving evidence that abbreviated MRI protocols can serve as effective initial diagnostic tools in emergent settings, providing clinically actionable information while potentially reducing total scan time and patient burden.[6] Focused abbreviated protocols have been highlighted in the literature as practical approaches to streamline MRI in emergency imaging, particularly when rapid decision-making is required.[7,8]

The sequence-specific diagnostic performance in our cohort — with DWI showing high sensitivity for acute infarcts and GRE exhibiting strong specificity for hemorrhagic components — parallels findings from recent ultrafast brain MRI studies that report comparable diagnostic accuracy between targeted imaging sequences and more comprehensive protocols.[9,10] These reports emphasize that sequences like DWI and FLAIR remain central to the early detection of acute ischemic events and other critical pathologies.[11] However, while abbreviated MRI protocols facilitate rapid evaluation, they may lack certain sequences critical for detecting subtler or contrast-dependent lesions. In our analysis, a minority of discordant cases included demyelinating plaques, ring-enhancing infections, and venous sinus thromboses, which were not readily visualized on the limited sequence set, underscoring the limitations of abbreviated protocols for comprehensive lesion characterization. Contrast-enhanced imaging and specialized sequences, often omitted in abbreviated protocols, remain indispensable for these findings.[12,13]

The practical implication of these results suggests that while limited MRI protocols can effectively serve as initial screening tools in acute neurological settings, full-protocol MRI retains value when clinical suspicion persists or when advanced structural and contrast-based detail is required. Future studies may focus on optimizing abbreviated protocols or integrating adaptive imaging strategies guided by real-time findings to achieve a balance between rapid acquisition and comprehensive diagnostic coverage.

CONCLUSION

In patients presenting with acute-onset neurological symptoms of less than seven days' duration, the limited MRI brain protocol demonstrated high diagnostic concordance (91%) with the full protocol, along with strong sensitivity and specificity across major pathological categories. Diffusion-weighted imaging showed excellent performance for acute infarction, while GRE sequences reliably identified hemorrhagic lesions. However, a small but clinically

relevant proportion of cases (9%) were missed by the limited protocol, particularly subtle enhancing demyelinating plaques, small cortical infarcts, ring-enhancing infections, tumors requiring contrast evaluation, and venous sinus thrombosis that required advanced sequences such as post-contrast imaging, MR venography, or high-resolution 3D acquisitions. These findings indicate that although a limited-sequence MRI approach may serve as a rapid and resource-efficient screening tool in acute neurological settings, comprehensive MRI remains essential when clinical suspicion persists or when detailed lesion characterization is required.

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