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Original Research Article

Role of MRI in the Evaluation of Chronic Headache: Spectrum of Intracranial Findings

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Abstract

Background: Chronic headache is a common clinical presentation and is usually associated with primary headache disorders. However, structural intracranial abnormalities may be detected in selected patients, particularly those with progressive or atypical symptoms or neurological abnormalities. MRI provides detailed evaluation of intracranial structures without ionizing radiation.

Objectives: To evaluate the role of MRI in patients presenting with chronic headache and determine the spectrum and frequency of intracranial findings detected on MRI.

Materials and Methods: A hospital-based observational study was conducted among 200 patients presenting with chronic headache who underwent MRI brain evaluation. Demographic and clinical characteristics, including headache pattern and associated neurological symptoms, were recorded. MRI findings were assessed and categorized according to the type of intracranial abnormality. The association between clinical features and abnormal MRI findings was also evaluated. Statistical significance was considered at $p<0.05$.

Results: The mean age of the study population was 38.7 ± 13.2 years, and females constituted 59% of patients. Recurrent headache was the most common presentation (72%), followed by progressive/increasing-frequency headache (29%) and visual symptoms (28%). MRI was normal in 132 (66%) patients, while abnormalities were detected in 68 (34%). Chronic ischemic/white-matter changes were the most frequent abnormality (10%), followed by sinus-related abnormalities (5%), arachnoid cysts (4%) and pituitary/sellar abnormalities (3%). Intracranial tumors and vascular abnormalities were each detected in 2.5% of patients. Abnormal MRI findings were significantly associated with neurological deficits ($p=0.012$) and progressive/increasing-frequency headache ($p=0.009$).

Conclusion: MRI demonstrated a broad spectrum of intracranial findings in patients with chronic headache, although most patients had no significant structural abnormality. Progressive headache and neurological deficits were associated with a higher frequency of abnormal MRI findings. MRI is therefore useful in appropriately selected patients with chronic headache, particularly when clinical features suggest a possible secondary intracranial cause.

Keywords: Chronic headache; magnetic resonance imaging; MRI brain; intracranial abnormalities; neuroimaging; headache.

Introduction

Headache is one of the most common neurological complaints encountered in clinical practice and may result from a wide range of primary and secondary disorders. Although most headaches are benign and do not require neuroimaging, the possibility of an underlying intracranial abnormality becomes important when the headache is progressive, atypical, or associated with neurological abnormalities or other clinical warning features. [1,2]

Chronic headache may present with recurrent or persistent pain and may be associated with nausea, vomiting, visual disturbances, dizziness, seizures or focal neurological deficits. Changes in the frequency, severity or character of headache, abnormal neurological examination, positional or exertional headache and other red-flag features may indicate a secondary cause and warrant further evaluation. [1,2]

Magnetic resonance imaging (MRI) has an important role in the evaluation of suspected intracranial causes of headache because of its excellent soft-tissue contrast and multiplanar imaging capability. MRI provides detailed visualization of the brain parenchyma, ventricular system, posterior fossa, sellar region and other intracranial structures. It can demonstrate a broad spectrum of abnormalities, including tumors, vascular lesions, hydrocephalus, cystic lesions and white-matter abnormalities. [1,3]

However, the diagnostic yield of neuroimaging is relatively low among patients with uncomplicated primary headache. A systematic review and meta-analysis reported that clinically significant abnormalities detected by neuroimaging were uncommon, supporting selective imaging in patients with appropriate clinical indications. [2] Similarly, the American Headache Society reported that clinically meaningful abnormalities requiring intervention were relatively rare in patients with migraine without atypical features or red flags. [3]

MRI may also demonstrate incidental intracranial findings that are unrelated to the patient's headache. Such findings may include benign cysts, vascular abnormalities, white-matter changes and other structural abnormalities. Distinguishing clinically relevant abnormalities from incidental findings is therefore an important aspect of MRI interpretation.

Therefore, evaluation of the spectrum of intracranial findings detected by MRI in patients with chronic headache may provide useful information regarding the frequency and nature of structural abnormalities and their relationship with clinical presentation. The present study was undertaken to evaluate the role of MRI in patients presenting with chronic headache and to determine the spectrum and frequency of intracranial findings detected on MRI.

Materials and Methods:

Study Design and Setting

A hospital-based observational study was conducted in the **Department of Radiodiagnosis at a tertiary care hospital** to evaluate MRI findings in patients presenting with chronic headache.

Study Population

A total of **200 consecutive patients** presenting with chronic or recurrent headache and referred for MRI brain evaluation were included in the study.

Inclusion Criteria

Patients were included if they:

- Presented with chronic or recurrent headache.
- Were referred for MRI brain evaluation.
- Had adequate clinical and imaging records available for analysis.

Exclusion Criteria

Patients were excluded if they:

- Presented with acute traumatic brain injury.
- Had acute thunderclap headache as the primary presentation.
- Had a previously diagnosed intracranial malignancy under active treatment.
- Had incomplete clinical or MRI records.
- Were unable to undergo MRI examination.

Clinical Assessment

Relevant clinical details were recorded using a structured proforma. Data included **age, sex, duration and pattern of headache, frequency of headache, site of pain and associated symptoms** such as nausea, vomiting, visual disturbances, dizziness and seizures. Neurological examination findings, including the presence of focal neurological deficits, were also documented.

Particular attention was given to **progressive headache, change in headache pattern, positional symptoms and associated neurological manifestations**, as these features may indicate an underlying secondary intracranial cause.

MRI Examination

MRI of the brain was performed using a standard brain MRI protocol. The examination included **T1-weighted, T2-weighted and FLAIR sequences**. Diffusion-weighted imaging and susceptibility-weighted/gradient-echo sequences were obtained when indicated. Contrast-enhanced MRI was performed in patients requiring further characterization of suspected lesions.

The brain parenchyma, ventricular system, posterior fossa, sellar region, meninges and other intracranial structures were systematically evaluated.

Evaluation of MRI Findings

MRI examinations were categorized as **normal or abnormal**. Abnormal findings were further classified into:

- Chronic ischemic/white-matter changes
- Vascular abnormalities
- Neoplastic lesions
- Cystic lesions
- Pituitary/sellar abnormalities
- Hydrocephalus
- Inflammatory/infective lesions
- Sinus-related abnormalities
- Other structural abnormalities

The relationship between clinical characteristics and abnormal MRI findings was assessed.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS 19.0. Continuous variables were expressed as **mean ± standard deviation**, while categorical variables were presented as **frequency and percentage**. Associations between categorical variables were assessed using the **Chi-square test**. Continuous variables were compared using the **independent-samples t-test**. A **p-value <0.05** was considered statistically significant.

Results:

A total of **200 patients** presenting with chronic headache were included in the study. The mean age of the study population was **38.7 ± 13.2 years**, with a female predominance.

Among the 200 patients, **118 (59%) were females** and **82 (41%) were males**. The largest proportion of patients belonged to the **31–40 years** age group (31%). (Table 1)

Table 1. Demographic characteristics of the study population

Demographic characteristic	Number (n)	Percentage (%)
Age group		
18–30 years	52	26
31–40 years	62	31
41–50 years	46	23
>50 years	40	20
Sex		
Male	82	41
Female	118	59
Total	**200**	**100**

Mean age: 38.7 ± 13.2 years.

Recurrent headache was reported by **144 (72%)** patients. Progressive or increasing-frequency headache was present in 58 (29%), while visual symptoms, nausea/vomiting and dizziness were reported in 28%, 24% and 22% of patients, respectively. (Table 2)

Table 2. Clinical characteristics of patients

Clinical feature	Number (n)	Percentage (%)
Recurrent headache	144	72
Progressive/increasing frequency	58	29
Visual symptoms	56	28
Nausea/vomiting	48	24
Dizziness	44	22
Positional component	30	15
Seizures	18	9
Neurological deficit	20	10

.MRI examination was **normal in 132 (66%) patients**, whereas **68 (34%) patients** demonstrated one or more intracranial abnormalities. (Table 3)

Table 3. Overall MRI findings

MRI finding	Number (n)	Percentage (%)
Normal MRI	132	66
Abnormal MRI	68	34
Total	**200**	**100**

Chronic ischemic/white-matter changes were the most common abnormality, observed in 20 (10%) patients. Sinus-related abnormalities were seen in 10 (5%), while arachnoid cysts were identified in 8 (4%). Intracranial tumors and vascular abnormalities were each detected in 2.5% of patients. (Table 4)

Table 4. Spectrum of intracranial MRI abnormalities

MRI abnormality	Number (n)	Percentage (%)
Chronic ischemic/white-matter changes	20	10
Sinus-related abnormalities	10	5
Arachnoid cyst	8	4
Pituitary/sellar abnormality	6	3
Intracranial tumor	5	2.5
Vascular abnormality	5	2.5
Hydrocephalus	4	2
Inflammatory/infective lesion	3	1.5
Other structural abnormalities	7	3.5
Total abnormal findings	**68**	**34**

Abnormal MRI findings were present in **12 (60%)** patients with neurological deficits compared with **56 (31.1%)** patients without neurological deficits. This difference was statistically significant (**p=0.012**). (Table 5)

Table 5. Association between neurological findings and abnormal MRI

Neurological findings	Abnormal MRI	Normal MRI	Total	p-value
Present	12 (60%)	8 (40%)	20	**0.012**
Absent	56 (31.1%)	124 (68.9%)	180	
Total	**68 (34%)**	**132 (66%)**	**200**	

.Abnormal MRI findings were detected in **28 (48.3%)** patients with progressive or increasing-frequency headache compared with **40 (28.2%)** patients without this feature. The difference was statistically significant (**p=0.009**). (Table 6)

Table 6. MRI findings according to headache pattern

Headache pattern	Abnormal MRI	Normal MRI	Total	p-value
Progressive/increasing frequency	28 (48.3%)	30 (51.7%)	58	**0.009**
No progressive feature	40 (28.2%)	102 (71.8%)	142	
Total	**68 (34%)**	**132 (66%)**	**200**	

Discussion:

The present study evaluated the spectrum of MRI findings in 200 patients with chronic headache. The mean age was 38.7 ± 13.2 years, with a female predominance (59%). Headache is a common neurological complaint, and although most cases are primary headache disorders, neuroimaging becomes particularly relevant when atypical or progressive features or neurological abnormalities are present. [6,7]

MRI was normal in 66% of patients, while abnormalities were identified in 34%. This indicates that a substantial proportion of patients with chronic headache have no demonstrable structural intracranial lesion. A systematic review and meta-analysis by Jang et al. reported that clinically significant abnormalities on neuroimaging were relatively uncommon and emphasized the importance of appropriate clinical selection for imaging. [7]

The commonest abnormality in our study was chronic ischemic/white-matter change (10%). Nonspecific white-matter abnormalities and chronic vascular changes may be encountered during brain MRI, although their clinical significance varies and they should not automatically be considered the cause of headache. Evidence-based recommendations emphasize interpretation of imaging findings in conjunction with the clinical presentation. [6,8]

Sinus-related abnormalities (5%) and arachnoid cysts (4%) were other relatively frequent findings in the present study. Such findings may be incidental and should not necessarily be considered the cause of headache. Incidental findings on brain MRI are well documented, with Morris et al. reporting both neoplastic and non-neoplastic incidental abnormalities in individuals undergoing brain MRI. [9]

Intracranial tumors were detected in 2.5% of our patients, while vascular abnormalities were identified in another 2.5%. Although these findings were less frequent than nonspecific or chronic changes, their detection may be clinically important because some lesions require further evaluation or treatment. [9,10]

Patients with neurological deficits had a significantly higher frequency of abnormal MRI findings than those without neurological deficits (60% vs. 31.1%, p=0.012). This supports the importance of

neurological examination when selecting patients with chronic headache for imaging. The ACR Appropriateness Criteria identify neurological abnormalities and other red-flag features as important considerations for neuroimaging. [6]

Similarly, patients with progressive or increasing-frequency headache had significantly more abnormal MRI findings than those without this feature (48.3% vs. 28.2%, p=0.009). A change in headache frequency, severity or clinical characteristics is recognized as a feature that may warrant neuroimaging. [6,8]

Conclusion:

MRI demonstrated a broad spectrum of intracranial findings in patients presenting with chronic headache, although the majority (66%) had no significant structural abnormality. Chronic ischemic/white-matter changes were the most frequent finding, followed by sinus-related abnormalities and arachnoid cysts. Progressive headache and neurological deficits were significantly associated with abnormal MRI findings. MRI therefore has an important role in the evaluation of appropriately selected patients with chronic headache, particularly when clinical features suggest a possible secondary intracranial cause

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