



Assessment of Cranial Imaging Findings in Patients with Migraines

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Abstract

Objective: The findings from cranial magnetic resonance imaging (MRI) in patients with migraines were assessed to document the type, frequency, and pathological characteristics of the detected lesions.

Methods: A total of 105 migraine patients (79 female, 26 male; mean age: 34.04 ± 11.93 years) presenting with headaches and normal neurological findings who had undergone a cranial MRI examination were included. The diagnosis of migraine was based on the revised criteria of the International Headache Society. Of the participants, 23 and 82 had migraines with and without aura, respectively. The clinical characteristics, cranial imaging indications, and MRI results were recorded and evaluated. Chi-square and independent t-tests were used for statistical comparisons. A p-level of less than 0.05 was considered statistically significant.

Results: The mean duration of illness was 7.02 ± 6.2 years. The average monthly number of migraine episodes was 6.61 ± 1.73 . Fifty-three patients had normal cranial MRIs, while 52 were found to have lesions, most of which were of a benign character.

Conclusion: In this retrospective study of MRIs in patients with migraine, coincidental structural lesions comprised the majority of the findings in MRI. In patients presenting with severe headaches, cranial imaging appears to be necessary to exclude other organic causes and to detect other treatable pathological conditions, even if the clinical findings are suggestive of a migraine attack. Detection and treatment of coexisting pathological conditions might not only help alleviate the chronic headaches, but might also reduce the frequency of migraine episodes.

Keywords: Migraine, imaging, MRI

Introduction

According to the International Headache Society (IHS) criteria, a migraine is an episodic headache disorder with a pulsating quality characterized by a unilateral location, nausea and/or vomiting, and photophobia and phonophobia accompanied by varying combinations of gastrointestinal and autonomic alterations. Migraine subtypes include those with or without aura, periodic syndromes during childhood, retinal migraines, migraine complications, and probable migraines (1-3). A migraine is considered to be a multifactorial condition with a genetic component. The underlying pathophysiological process is thought to involve the hyperexcitability of the cerebral cortex, although the exact mechanism responsible for this condition remains to be elucidated. In this regard, a multitude of neuroradiological imaging studies have been performed to shed some light on the pathophysiology of migraines. Decreased cranial blood flow has been documented during the aura and early stage of the headache in studies where perfusion MRI was used. In recent years, integrated neurovascular theory has gained more widespread acceptance as an explanation for this condition (4). The diagnosis of migraine is also based on a patient's history. Physical examinations, neurological examinations, and laboratory and imaging studies generally give normal results, and MRI is helpful in excluding other secondary causes of headache. Several imaging studies involving patients with migraines have emphasized the association with ischemic and/or demyelinating white matter lesions (5,6). In this study, we aimed to classify lesion types, rates, and pathological lesions detected in patients with migraine.

Material and Methods

This retrospective study was undertaken with a total of 105 migraine patients (79 female, 26 male; mean age: 34.04 ± 11.93 years) who had attended our outpatient unit with the complaint of headaches. They had normal neurological examination findings and had undergone a cranial MRI. Patients who were included were between 20 and 55 years of age, had been diagnosed with a migraine with or without aura according to the IHS criteria, had a disease history of at least two years, and were experiencing at least six migraine episodes per month. Those with a history of substance abuse or significant comorbid conditions were excluded.

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Table 1. Clinical and demographic characteristics of the patients

Characteristic	Female	SD	Male	SD	Total	SD
Sex	79(7.3%)		26(24.7%)		105	
Age	34.10±	±11.20	33.88	±14.05	34.04	±11.93
Duration of illness	6.91	±5.55	7.48	±6.80	7.02	±6.20
Frequency of episodes	6.66	±1.84	6.48	±1.39	6.61	±1.73
Presence of aura	19(24.4%)		4 (14.8%)		23(21.9%)	
Refractory to treatment	42(53.1%)		12 (46.1%)		54(52%)	
Partial response to treatment	37(46.9%)		14 (53.8%)		51(48%)	

Table 2. Cranial MRI Results

Cranial MRI Results	CASES (n)	Percent (%)
Normal	53	50.4%
Intracranial benign lesion	19	18.09%
Extracranial benign lesion	27	25.7%
Structural pathological lesion	6	5.7%
Total	105	100%

MRI: magnetic resonance imaging

In addition to systemic and neurological examinations of the patients, sociodemographic data were recorded. Patients with chronic comorbid diseases such as diabetes mellitus, hypertension, hyperlipidemia, history of smoking and alcohol use, and central nervous system diseases like stroke or demyelinating disease were excluded from the study.

Demographic data, treatment response, presence of aura, duration of disease, and frequency of episodes were recorded in the sociodemographic information form.

The demographic characteristics, cranial MRI indications, and MRI results were examined.

The study was approved by the Istanbul training and research Hospital Human Ethics Committee.

A detailed, written informed consent form was obtained from each subject before initiating the study.

Conventional MRI of all cases was performed on a 1.5 T super conduction MRI machine (Signa HDxt., GE Medical Systems, Milwaukee, WI, USA) using a HRBRAIN coil. The imaging protocol included routine axial and coronal FSE T1AG (TR/TE/NEX=620 ms/8.5 ms/2) and axial and coronal FSE T2AG (TR/TE/NEX=2750 ms/100 ms/2), and the matrix size was set to 512x512.

The statistical analyses were performed using Statistical Package for Social Sciences 21.0 (IBM Corp.; Armonk, NY, USA) software. The data were checked for whether they conformed to a normal distribution. If the data had a normal distribution, Student's independent t-test was used; if not, the Mann-Whitney U-test was used. The chi-square test was used for comparison between the groups in terms of numbers. A p-level of less than 0.05 was considered statistically significant.

Results

Of the overall study population, 26 (24.7%) were male and 79 (75.3%) were female. The patients had mean ages of 33.8 ± 14.05 and 34.10 ± 11.20 years for males and females, respectively. The mean age of the overall population was 34.04 ± 11.93 years. Twenty-three (21.1%) and 72 (78.9%) patients were diagnosed with migraine with and without aura, respectively. The average duration of the disease history was 7.02 ± 6.20 years, and the average number of migraine episodes per month was 6.61 ± 1.73 . Fifty-two percent of the cases were refractory to medical treatment, while 48% had partial responses (Table 1).

Sixty (57.1%) of the patients were using both antidepressants and triptans during the attack. Twenty (19.04%) of the patients were using only triptans during the attack. Twenty-five (23.8%) of the patients were not taking any medication during the attack.

In the majority of cases, MRIs were performed to exclude organic causes for headaches in patients experiencing chronic headaches that were poorly controlled despite medical treatment.

Cranial MRIs were normal in 50.4% of the patients (n=53), while 18.09% were found to have several intracranial benign conditions, including meningioma, schwannoma, lipoma, empty sella, arachnoid cyst, epidermoid cyst, Chiari malformation, and small areas of encephalomalacia. Furthermore, 25.71% of the patients had benign extracranial conditions such as mastoiditis, sinusitis, and retention cysts. In 5.7%, migraines were accompanied by structural lesions (demyelinating disorder in 2%, obstructive vascular disease in 2%, intraparenchymal bleeding in 1%, and arteriovenous malformation in 1% (Table 2) (GRAPHIC).

The most frequently observed MRI finding was sinus infection, which was seen in 20% of the patients. Of the cases with sinusitis, the most frequent site of involvement was the maxillary sinus (63%) followed by the ethmoidal sinus (22%), frontal sinus (11%), and sphenoid sinus (4%).

Patients with benign intracranial, benign extracranial, or structural pathological lesions were comparable to those without such lesions in terms of gender, age, and the presence or absence of aura ($p < 0.05$). However, there was a significant association between the presence of aura and extracranial benign lesions ($p < 0.05$). Intracranial benign or structural lesions did not show any association with aura ($p = 0.18$ and $p = 0.28$, respectively).

Discussion

A migraine is a syndrome characterized by a typical headache that triggered by external or internal stimuli and is associated with adverse effects on the patient's quality of life. The female to male ratio is 3:1, with a peak incidence during the 3rd or 4th decade of life; however, migraines can occur in any age group (3). Consistent with these numbers, 75.3% of our patients were female with a mean age of 34.04 ± 11.93 years.

Migraine headaches can severely restrict the activities of daily living. Aura preceding the migraine episode might manifest itself with visual, auditory, or speech disturbances and is present in approximately one third of migraine patients. Although rare occurrences of aura associated with sensory and motor deficits have been reported, the most frequent symptoms are of a visual nature (7). In this regard, our results are in line with the reported figures, and 22% of our patients had migraines with aura, mostly associated with visual disturbances. Our results only showed a correlation between the presence of aura and extracranial benign lesions, which in our opinion might be due to the fact that acute inflammation of the sinuses can sometimes induce or mimic aura itself.

Although history-taking in patients with headaches might sometimes yield clues, certain pathological conditions, such as space-occupying lesions, are usually only detected coincidentally in imaging studies performed following complaints involving more severe pain during the early hours of the day. The differential diagnosis of severe headaches, including migraines, should include other possible underlying organic pathological conditions such as ischemic events, intracranial bleeding, tumors, nervous system infections, sinus infections, and vascular anomalies. Exclusion of secondary causes is essential for proper diagnosis and effective treatment. Therefore, in patients with chronic headaches, at least one imaging study should be performed during the patient's follow-up. Furthermore, neuroimaging should be repeated under certain conditions. These conditions include the detection of pathological signs during the neurological examinations, atypical headaches, changes in headache patterns, resistance to treatment, electroencephalogram or cranial X-ray abnormalities, or the presence of extracranial neoplastic lesions. In our study, cranial MRI results were assessed in a group of patients who had attended our unit with headache complaints and were diagnosed with migraines.

In a study by Demirkiran et al. (8), only 25% of the patients diagnosed with migraines were found to have undergone a previous cranial imaging. In that retrospective study involving 202 patients with migraines, 78.8% of the cases had normal imaging findings compared with 19.2% who had benign abnormalities. In another study involving 78 patients with migraines or tension headaches, no pathological conditions associated with headaches could be detected in CT (computed tomography) imaging, in which 61.5% of the subjects had normal findings and 38.5% had intracranial benign structural lesions with no accompanying symptoms (9). In a meta-analysis by Frishberg, pathological lesions were detected in 0.4% of 897 migraine patients, and these results are similar to figures reported by Sudlow who reported pathological lesions in 0.2% of 1,086 cases

with migraines (10, 11). In our study, 1% of the patients had another underlying structural pathological lesion. Detection of a higher rate of patients with these abnormalities in our study might be due to the facts that only patients who had undergone MRI imaging were included in the study and that the sample size was relatively small.

Some recent studies have reported that migraines might actually represent an initial sign of multiple sclerosis and venous sinus thrombosis that might manifest itself clinically as a migraine episode (12, 13). Of our patients, 5.7% had structural pathologic lesions coexistent with migraines. During the follow-up period after the acute presentation, these patients continued to meet the diagnostic criteria for migraines. The subject with demyelinating disorder did not exhibit any increase in the number of plaques. The intracranial benign lesions observed in 18.09% of the represented coincidental findings did not alter the course of the treatment.

Due to a possible diagnostic confusion between migraine and otologic or rhinogenic pain, patients with a possible diagnosis of migraine are assessed both by neurologists and ear, nose, and throat specialists. Mastoiditis and sinusitis are common causes of otologic and rhinogenic cephalgia that are frequently confused with migraines. In our group of migraine patients who had cranial MRI examinations, there were no conditions that necessitated a change in the treatment algorithm or that required another approach other than migraine treatment.

Cerebral perfusion studies in migraine patients have shown the development of aura during hypoperfusion, while headaches were found to occur during hyperperfusion. Also, T2 and fluid-attenuated inversion recovery (FLAIR) images in MRI among patients with migraines showed periventricular, subcortical, and infratentorial hyperintense lesions in the deep white matter that were considered to be associated with hypoperfusion (5, 6). Compared with the general population, an increased frequency of demyelinating lesions of the white matter in MRI images obtained from migraine patients has also been reported in many studies (5, 6). In our patient group, 3% had demyelinating lesions in the subcortical white matter.

Identification and treatment of concomitant pathological conditions might offer a complete cure or might decrease the frequency of migraine attacks. In patients presenting with chronic headaches, performing cranial imaging might assist in the differential diagnosis from other organic causes of headache. Moreover, the identification of treatable causes of headaches seems necessary, even if the clinical signs suggest a migraine diagnosis. Accordingly, secondary causes of headaches were excluded in our patient group for those who presented with severe clinical signs suggestive of a migraine. Furthermore, imaging studies were found to play an important role in the exclusion of otologic and rhinogenic causes of cephalgia, cystic and tumoral lesions, and vascular pathological lesions. Detection of sinusitis in 20% (mostly maxillary) and mastoiditis in 6% of our subjects and their subsequent management underscore the significance of detecting treatable causes of severe headaches. Therefore, from a cost-effectiveness point of view, performing cranial imaging before reaching a definitive diagnosis followed by appropriate management appears to be a more reasonable approach. This is particularly so when

one considers the cost of antidepressants, antimigraine medications, anti-inflammatory agents, and gastric acid blockers along with the significant loss of productivity associated with this condition. Our major limitations are post-treatment migraine evaluation of the cases diagnosed with sinusitis and mastoiditis and failure to detect any relevant correlation between clinical migraine and some other pathologies.

Conclusion

In conclusion, in this retrospective study of MRI imaging in patients with migraine, coincidental structural lesions comprised the majority of the findings in MRI. In patients presenting with severe headaches, cranial imaging appears to be necessary to exclude other organic causes and to detect other treatable pathological conditions, even if the clinical findings are suggestive of a migraine attack. Detection and treatment of coexistent pathological conditions might not only help alleviate the chronic headaches, but might also reduce the frequency of migraine episodes. The clinician should always bear in mind that the above-listed pathological conditions might coexist within a single patient with migraines.

Ethics Committee Approval: Ethics committee approval was received for this study from Istanbul Training and Research Hospital's Human Ethics Committee.

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

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