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ORIGINAL ARTICLE

Is Brain MRI Essential for the Evaluation of Headache in Patients with Normal Neurological Examination?

Baş Ağrısında Nörolojik Muayenesi Normal Olan Hastalar İçin Beyin MRG Gerekli midir?

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ABSTRACT

Introduction: Headache is amongst the most common reasons for consulting a doctor. In addition to impairing the quality of life of the individual, there are societal as well as fiscal outcomes like workforce loss along with health expenditures. MRI findings of patients with headache were examined retrospectively through the relevant literature with a view to scrutinizing the necessity of the very procedure carried out, and the results were shared accordingly. Through our study we delved into the recent situation in our country and investigated whether MRI devices with advancing and novel technologies give dissimilar results with diffusion and susceptibility-weighted images in the MRI findings of patients who seek medical advice visiting a health institution with complaint of headache.
Materials and Methods: The study included 224 patients over the age of 18, who underwent brain MRI between January 2020 and December 2021 in our center, with normal findings on neurological examination and who had not undergone surgery. All abnormal appearances such as mass, metastasis, aneurysm, hydrocephalus, encephalitis, sinusitis, mastoiditis, otitis, which may cause secondary headache, were recorded in MR images.
Results: Of the 224 patients, 120 (53.57%) were male and 104 (46.43%) were female. The mean age was 39.45±12.55 years. None of the 224 examinations revealed mass suspicious for malignancy, aneurysm, encephalitis, or meningitis. Extraaxial mass lesion compatible with meningioma was detected in 3 patients (1.33%), arachnoid cyst in 3 patients (1.33%), and developmental venous anomaly in 2 patients (0.89%). There was paranasal sinus pathology in 145 patients (64.73%), mastoid pathology in 37 patients (16.52%), and middle ear pathology in 8 patients (3.57%). The remaining 66 patients had no MRI findings except ischemic-gliotic changes, enlarged perivascular distances, and physiological calcifications.
Conclusion: In studies designed according to CT and MRI examinations taken regardless of neurological examination and history, the rate of completely normal findings is quite high, as in our study. MRI scans conducted for these patients, who can indeed solely be diagnosed with examination or simpler imaging methods, lead to waste of time and money. In order to fix the said situation, we are of the opinion that the red flag practice should become widespread and nonessential examination requests should be supervised.

Keywords: Headache, cranial magnetic resonance imaging, neurologic examination

ÖZ

Amaç: Baş ağrısı toplumda en sık doktora başvurma sebeplerinden biridir. Kişinin hayat kalitesini bozması yanı sıra iş gücü kaybı ve sağlık harcamaları ile toplumsal ekonomik etkileri mevcuttur. Daha önce baş ağrılı hastalarda MRG bulguları yapılan işlemin gerekliliğin sorgulanması amacıyla retrospektif olarak incelenmiş ve elde edilen sonuçlar paylaşılmıştır. Ülkemizdeki son durumu gözlemlemek ve baş ağrısı şikayetiyle sağlık kurumuna gelen hastaların MRG bulgularında değişen ve yeni teknolojiye sahip MRG cihazlarının, difüzyon ve duyarlılık ağırlıklı görüntülerle birlikte farklı sonuçlar verip vermediğini araştırdık.
Gereç ve Yöntem: Çalışmaya merkezimizde Ocak 2020 – Aralık 2021 tarihleri arasında Beyin MRG tetkiki yapılan nörolojik muayenesi normal, operasyon geçirmemiş 18 yaş üzeri olan 224 hasta dahil edilmiştir. MR görüntülerinde sekonder baş ağrısına sebep olabilecek kitle, metastaz, anevrizma, hidrosefali, ensefalit, sinüzit, mastoidit, otit gibi normal dışı tüm görünümler kaydedildi.
Bulgular: 224 hastanın 120'si erkek (%53.57), 104'ü kadındı (%46.43). Ortalama yaş 39.45±12.55 idi 224 incelemenin hiç birisinde malignite şüphesi taşıyan kitle görünümü, anevrizma, ensefalit veya menenjit görülmedi. 3 hastada (%1.34) menenjiom ile uyumlu olabilecek ekstraaksiyal kitle lezyonu, 3 (%1.34) hastada araknoid kist, 2 hastada (%0,89) gelişimsel venöz anomali saptandı. 145 hastada (%64.73) paranazal sinüs enfeksiyonu, 37 hastada (%16.52) mastoidit, 8 hastada (%3.57) otit mevcuttu. Kalan 66 hastanın iskemik - gliotik değişiklikler, genişlemiş perivasküler mesafeler, fizyolojik kalsifikasyonlar dışında MRG bulgusu yoktu.
Sonuç: Nörolojik muayene ve hikayeye bakılmaksızın çekilen BT ve MRG incelemelerine göre dizayn edilen çalışmalarda intrakranial patoloji açısından tamamıyla normal hastaların oranı bizim çalışmamızda da olduğu gibi oldukça yüksektir. Sadece muayene veya daha basit görüntüleme yöntemleriyle tanısı konulabilecek bu hastalar için yapılan MRG incelemeleri zaman ve maddiyat kaybına yol açmaktadır. Bu durumu düzeltmek için öncelikle kırmızı bayrak uygulamasının yaygınlaşması, gereksiz tetkik istemlerinin denetlenmesi gerektiğini düşünüyoruz.

Anahtar Kelimeler: Baş ağrısı, beyin manyetik rezonans görüntüleme, nörolojik muayene, sinüzit

Introduction

Headache is amongst the most common reasons for consulting a doctor (1,2). In addition to impairing the quality of life of the individual, there are societal as well as fiscal outcomes like workforce loss along with health expenditures (1). Magnetic resonance imaging (MRI) examination is accepted as the most sensitive method in the detection of intracranial pathologies (2). MRI examinations are also widely used in our country

(3). However, the contribution of cross-sectional imaging to the diagnosis in patients who apply to a health institution with headache complaints is controversial, and it has been reported that MRI examinations are not needed in most patients (4). MRI findings of patients with headache were examined retrospectively through the relevant literature with a view to scrutinizing the necessity of the very procedure carried out, and the results were shared accordingly (5). Through our study we delved into the recent situation in our country and investigated whether MRI devices with advancing and novel technologies give dissimilar results with diffusion and susceptibility-weighted images in the MRI findings of patients who seek medical advice visiting a health institution with complaint of headache.

Material and Method

This retrospective study was approved by the Ankara Medipol University Non-Interventional Clinical Research Ethics Committee (Date: 24.01.2022, Decision No: 78).

In the study, 224 patients over the age of 18 who underwent brain MRI in our center between January 2020 and December 2021, and were referred by the neurology outpatient clinic and whose neurological examination findings were stated as normal on the request paper, were evaluated (flowchart) (Figure 1).

Brain MRI examinations of the patients were evaluated retrospectively by a radiologist with 22 years of experience using an image archive and transmission system. MRI examinations were made with a 1.5 Tesla (Signa Explorer, GE Healthcare, USA) device. Routine sequences (transverse T1, T2, and FLAIR, sagittal T1, coronal T2, diffusion-weighted images, ADC map, susceptibility-weighted images) taken in our center were evaluated. Standard protocols for the sequences are given in Table 1.

All abnormal appearances such as mass, metastasis, aneurysm, hydrocephalus, encephalitis, mucosal thickening and fluid retention of paranasal sinuses, mastoid cells, middle ear cavities, which may cause secondary headache, were recorded in MR images.

Statistical analysis

Statistical analysis was performed using IBM SPSS v22 software. Results are presented as mean±standard deviation, percent (%) and number (n) unless otherwise stated.

Results

Out of the 224 patients, 120 (53.57%) were male and 104 (46.43%) were female. The mean age was 39.45±12.55 years (39.57±12.62 in males, 39.32±12.54 in females). None of the 224 examinations revealed suspicious mass for malignancy, aneurysm, encephalitis, or meningitis. Intracranial lesion was seen in 8 patients (3.57%). Extraaxial mass lesion compatible with meningioma was detected in 3 patients (1.33%), arachnoid cyst in 3 patients (1.33%), and developmental venous anomaly in 2 patients (0.89%). There was paranasal sinus pathology in 145 patients (64.73%), mastoid pathology in 37 patients (16.52%), and middle ear pathology in 8 patients (3.57%) (Figure 2-4). Paranasal sinus pathology finding was observed in one of the patients with meningioma and one of the patients with a developmental venous anomaly. In 23 of 37 patients with mastoid paranasal sinus pathology, signs in favor of sinusitis were observed at the same time, while both paranasal sinus pathology and middle ear pathology were found in 8 patients. The mean age and gender distribution of the cases are given in Tables 2 and 3. The remaining 66 patients had no MRI findings except ischemic-gliotic changes, enlarged perivascular distances, and physiological calcifications.

Table 1. Mean values used in routine brain MRI sequences

	TR (ms)	TE (ms)	FOV (mm^2)	Matrix	ST (mm)	SS (mm)
AXIAL T2	4540	88	20	256 x 256	5	0.5
AXIAL T1	500	12	20	256 x 256	5	0.5
AXIAL FLAIR	8800	110	20	256 x 192	5	0.5
DWI*	5800	130	28	256 x 192	5	1
ADC**	5800	130	20	256 x 192	5	1
SWI***	4325	25	20	256 x 256	3	0
SAGITAL T1	2500	15	24	256 x 192	5.5	1
CORONAL T2	4500	100	20	256 x 256	5.5	1

TR: Repetition time, TE: Echo time, FOV: Field of view, ST: Section thickness, SS: Slice Spacing *DWI: Diffusion-weighted images ** ADC: ADC map SWI: Susceptibility-weighted images

Table 2. Distribution of brain MRI findings in male and female patients

	FEMALES			MALES		
Brain MRI Findings	**Numbers of Persons**	**%**	**Mean of Age (min-max)**	**Numbers of Persons**	**%**	**Mean of Age (min-max)**
Normal	32	30.77	38.47(19-65)	34	28.33	39.4(25-57)
Just Sinus P.	50	48.08	39.58(18-65)	63	52.5	38.78(19-62)
Sinus and Mastoid P.	14	13.46	38(18-61)	9	7.5	38.88(29-52)
Mastoid and Middle Ear P.	1	0.96	49	–	–	–
Sinus, Mastoid, Middle Ear P.	4	3.85	39.75(28-54)	3	2.5	38.33(25-60)
Just Middle Ear P.	1	0.96	27	5	4.17	40.8(24-65)
Meningioma	1	0.96	56	2	1.67	57.5(50-65)
Vascular Malformation	1	0.96	53	1	0.83	48
Arachnoid Cyst	–	–	–	3	2.5	36(19-49)

%: Percentage, P: Pathology

Table 3. Distribution of brain MRI findings in all patients

Brain MRI Findings	Numbers of Persons	%	Mean of Age (min-max)
Normal	66	29,46	39.30(18-65)
Just Sinus Pathology	113	50.45	39.13(18-65)
Sinus and Mastoid Pathology	23	10.27	38.32(18-61)
Mastoid and Middle Ear Pathology	1	0,45	49(49-49)
Sinus, Mastoid, Middle Ear Pathology	7	3.13	39.14(25-60)
Just Mastoid Pathology	6	2.68	38,5(27-65)
Meningioma	3	1.34	58(50-65)
Vascular Malformation	2	0.89	50,5(48-53)
Arachnoid Cyst	3	1.34	36(19-49)

%: Percentage

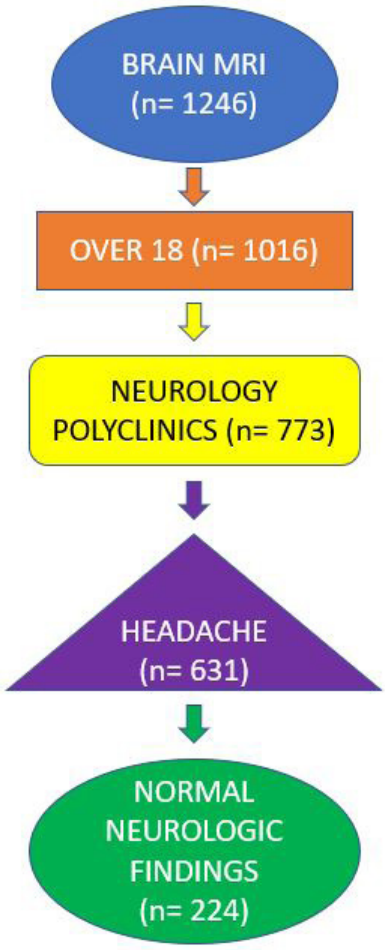

Figure 1. Flowchart used in patient selection.

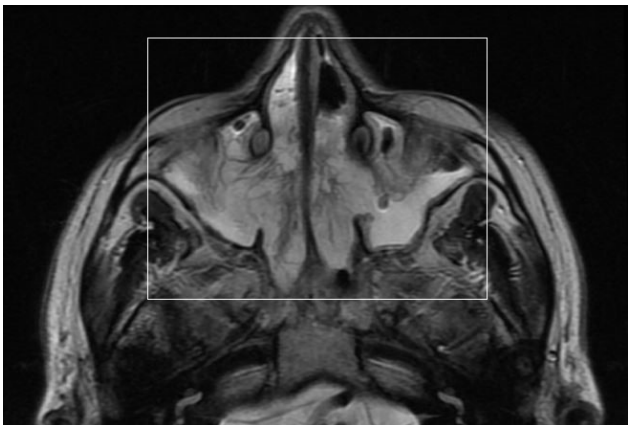

Figure 2. Transverse MR image (T2W). Inflammatory fluid and soft tissue intensities seemed in the bilateral maxillary sinus, in the marked area.

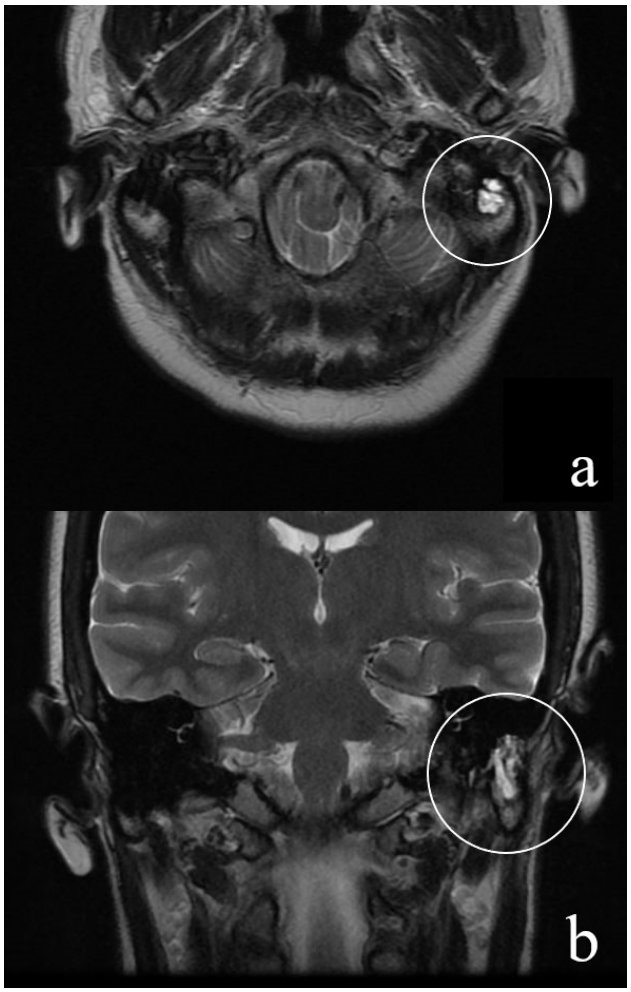

Figure 3. a-Transverse, b-coronal MR image (T2W). Inflammatory fluid and soft tissue intensities seemed in the left mastoid sinus, in the marked area (same patient).

Figure 4. Transverse MR image (T1W with contrast). The right temporal extra-axial mass lesion was observed in the marked area (meningioma?).

Discussion

Headache is the most common medical symptom in the community and one of the most common reasons for applying to the neurology service (6, 7). More than 90% of the total population has experienced headache at least once in their life (8). One-third of the admissions to the neurology outpatient clinic are just headaches. Headache is present in 2/3 of the total applications (8).

The diagnosis of the patient with headache is primarily based on anamnesis and neurological examination findings (6). Headache is primarily categorized as primary and secondary. 90% of all headaches are primary headaches (1, 8). Primary headaches are substantially common, and most of them are caused by migraine. (9). The most common causes of secondary headaches are acute or chronic sinusitis, ear infections, brain tumors, intracranial pressure changes, systemic and intracranial infections, intracranial vascular pathologies, head traumas, psychiatric, endocrine, ischemic pathologies, and hypertension (8,10).

The clinician should only suspect secondary headache by the presence of one of the red flags. A red flag warning indicates a secondary headache and should be well known (8). Red flags for headaches are appearing headaches in the morning, unexplained headaches that begin over the age of 50, and headaches with changes in cognitive function or personality (11). It has been stated that brain imaging should be considered if the headache occurs before the age of 10, after the age of 50, with exercise, after head trauma, accompanied by systemic findings such as fever, and not respond to painkillers (12).

The presence of many causes of headache is a situation that frightens the clinician (6). Above all, doctors who do not have enough experience in headaches unnecessarily turn to brain MR imaging to find the cause of the pain. It is unnecessary for imaging in classical episodic and tension headaches (7).

According to the previous report, it is stated that 66% of the patients admitted to the clinic with the complaint of headache had at least one cross-sectional examination (13). In 1994, the quality standards subcommittee of American Academy of Neurology; did not authorize MRI and Computed Tomography (CT) to be fulfilled on patients without seizures, visual aura, or focal neurological signs (13,14). The United States headache consortium has a similar decision (15).

CT has a considerably lower efficiency than MRI in investigating the cause of headaches. We can exclude significant abnormalities only with MRI (2).

Arslan and Adıbelli detected an intracranial mass of 6.1% between the ages of 36 and 60 in the CT examinations of patients admitted with the complaint of headache. This rate is alarming when we know that the sensitivity of CT is low in diagnosis. Therefore, it has been explicit that cross-sectional imaging methods can be applied, especially in advanced age groups and women, since the rate of intracranial mass detection is high (16).

According to a study that interpreted similar studies between 1950 and 2008 with the meta-analysis, the method determined 0.7% neoplastic brain tumors and 2% non-neoplastic pathology (just like in our case, subtle gliotic changes and micro-bleeding findings were ignored) from the data of 19.559 patients without neurological symptoms (17).

In the study of Clark et al., in the MR images of patients with headache and suspected intracranial pathology; only 5.5% of the pathologies described as 'important' were detected, and these 'important' pathologies were named as pituitary adenoma, arachnoid cyst, arteriovenous malformation, ischemic stroke, and tumor (18).

Tushima and Endo reported significant pathology in only two (0.7%) of 306 patients with normal neurological examinations, one being subdural hematoma and the other pituitary adenoma (2).

It is known that 60% of patients with headaches worry that they have severe disease, including a brain tumor, and 2/3 of these patients maintain the same concern even if their brain MRI results are well (19).

Considering the data in the literature, brain MRI is not required for diagnosis in most patients. Only in some patients may it be necessary to rule out secondary headaches (4). A good anamnesis and systemic physical and neurological examination are sufficient for childhood headaches. Neuroimaging should not be part of a routine examination (4,20).

Despite all these, it has been said that a significant intracranial pathology can not cause any other symptoms other than headache (21).

The COVID-19 epidemic, which affected the whole world, once and again revealed the importance of countries' health investments. Especially by referring patients with negative RT-PCR (Reverse Transcription Polymerase Chain Reaction) test to CT with clinical suspicion, it has been demonstrated to contribute to the early initiation of the treatment needed by many patients and the effectiveness of the treatment (22). While accepting the contribution of radiological methods to the diagnosis, there are also studies showing that CT is not necessary (23).

In the number of MRI scans per thousand people, Turkey ranks first among OECD countries with 186.4. This number means that each device takes in the mean of 45 shots per day (3). As a result of excessive shooting of the devices, the image quality decreases. The situation not only makes the diagnosis difficult but also increases the workload of radiologists. This result causes lots of time to spend on poor-quality images. Therefore, it increases the possibility of harming the patient rather than benefiting them. As an expert opinion Tuncay Hazırolan, President of the Turkish Society of Radiology, states that 120 of 150 MR-CT scans are unnecessary. He articulates that the patient-physician relationship has turned into a patient-examination relationship (24).

It is seen that the characteristics of patients who apply to primary care physicians and neurology specialists with headache complaints are similar, and these patients can be evaluated in primary health center. For the health system to function efficiently, it is necessary to apply to the family doctor first with the complaint of headache and avoid unnecessary further examinations (8).

The rate of healthy intracranial findings; varies between 60.9% and 92.9% in studies designed according to CT and MRI examinations, regardless of neurological examination and history (1,16,17,25-27). This rate was 96.4% in our study. This result is significant data on the unnecessariness of shootings in our country. In addition, paranasal sinus, middle ear and mastoid cell pathologies are seen as common causes of secondary headache in our study. This result emphasizes that secondary headache etiology can determine with a very high percentage without the need for brain MRI examination, and the possibility of intracranial pathology can be excluded.

There were some limitations of our study. The major limitation of this study is the uncertainty of the scope and content of the neurological examination. In addition, its retrospective nature and relatively low study population are other limitations. Further studies can be planned prospectively, if possible, multicenter and in direct cooperation of the neurology department.

Conclusion

As our study shows, we think that brain MRI may be largely unnecessary in individuals with a completely normal neurological examination. MRI scans conducted for these patients, who can indeed solely be diagnosed with examination or simpler imaging methods, lead to waste of time and money. In order to fix the said situation, we are of the opinion that the red flag practice should become widespread and nonessential examination requests should be supervised.

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