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Magnetic resonance imaging (MRI) findings in referred adult patients with headache

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Abstract

Background and objective: Since the beginning of the medical practice, headache was considered both a therapeutic and a diagnostic challenge. According to the ranking that was made by the global burden of diseases collaborative network for causes of disabilities, headache was considered the fourth for both males and females. The aim of the study was to evaluate the findings of MRI among headache patients.

Methods: A cross-sectional study was conducted from 1st of Nov. 2021 till the 1stof June 2022. A convenient sample was collected from referred patients to outpatient clinic in Rizgary Teaching Hospital. The cases were diagnosed by a specialist in internal medicine and then referred for further MRI evaluation. The data analyzed using IBM SPSS (statistical package of social science) version 25. The data was summarized by descriptive statistics. The measures of central tendency and dispersion were calculated. The mean of age differences was calculated by t-test. The associations between categorical variables were found by Chi-square test. The *P* value was considered significant if it was ≤ 0.05.

Results: Out of 150 patients, 70% were females and only 30% were males with male to female ratio of. 0.43:1.73.3% of females in primary group had normal MRI findings and 84.4% of males had abnormal findings in the secondary group. The difference was statistically significant (*P*-value <0.001). The mean age ± SD for males was 45.2 ± 9.3 and the mean age for females was 37± 9.8. The difference between means was significant (*P* = 0.018). In MRI findings 56% (84 out of 150) of patients were normal, followed by sinusitis (28%), (3.3%) cerebral tumor,0.6% had pituitary mass and 0.6% diagnosed as meningitis.

Conclusion: The low rate of positive findings in our study supports the need for an evidence-based guideline for neuroimaging in this health care setting. Future studies are recommended to investigate other physicians' reasons for using neuroimaging techniques as a routine investigation for headache patients.

Keywords: Secondary headache; MRI; Red flag; Cerebral tumors; Sinusitis.

Introduction

Since the beginning of the medical practice, headache was considered both a therapeutic and a diagnostic challenge. According to the ranking that was made by the global burden of diseases collaborative network for causes of disabilities, headache was considered the fourth for both males and females. In females it was ranked as the fifth cause of disability.[1,2] Headache impaired the quality of life. Chronic headache is considered a predisposing factor for other health conditions like depression.[3] Headache is not a single disease entity, it is considered a group of disorders; therefore, the prevalence varies from 8.1% for migraine[4] to 88% for tension type of headache.[5] Gender differences were reported in point prevalence between males (11%)[5] and

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females (22%). The international headache society classified headache based on underlying pathologies to primary and secondary.[6] The acute conditions are managed in the primary health care centers and do not need neuroimaging techniques. The secondary headache cases needed further investigations to diagnose the underlying pathological conditions.[7] Sinusitis and tumors caused secondary headache as studies showed.[8] Studies revealed absence of the classical presentation of brain tumor headache.[9] therefore, neuroimaging should be used in screening patients with headache.

There's no need for neuroimaging in cases of 1ry headache in According to the UK National Clinical Guideline Centre's guidelines.[10] in order to avoid unnecessary further interventions, insignificant findings that could be identified by neuroimaging.[11] Neuroimaging should be performed, for those suspected of an underlying disorder based on the presence of additional symptoms and signs that do not fit the clinical diagnosis of primary headache (e.g., atypical headache patterns, a history of seizures, and/or focal neurological symptoms or signs). Clinical guideline pertaining to neurophysiological tests and neuroimaging procedures for non-acute headache recommend magnetic resonance imaging (MRI) for autonomic nervous headache.[12] Therefore its necessary to evaluate MRI findings in patients with headache, and to find the efficacy of clinical presentation in diagnosis of secondary headache.

The aim of the study is to identify the MRI findings in patient with headache and to find the efficacy of clinical presentation in diagnosis of secondary headache.

Methods

Study design, sampling and time of study

A cross-sectional study was conducted from1st November 2021 till 1st of July 2022. A convenient sample consist of (150 patients) was collected from referred patients to outpatient department in Rizkary Teaching Hospital. The cases were diagnosed by a specialist then referred for further investigations by MRI. A special questionnaire was designed by the investigator and used for data collection. Then interviewed each case in a private room.

Inclusion and Exclusion criteria

Inclusion criteria involve all adult patients presented with headache as chief complain, Exclusion criteria include patient less than 18 years.[13] Patient presented with headache associated recent head trauma, aneurysm coil or clips, known history of brain tumor, past surgical history, past cerebral ischemia.

Method and equipment

The MRI images were reviewed by the investigator and a specialist in radiology. After collecting data including age, gender, red flag signs and associated symptoms.[14] the cases were classified according to MRI findings to (normal MRI) and (abnormal MRI).[6] The MRI machine was SIEMENSMAGNETUM AVANTO system ,1.5 Tesla.

Data analysis

The data analyzed using the Statistical Package for Social Sciences (SPSS program Version 25). The data was summarized by descriptive statistics. The measures of central tendency and dispersion were calculated. Mean differences were calculated by t-test. The associations between categorical variables were tested by the Chi-square test of association. The *P* value was considered significant if it was ≤ 0.05.

Ethical consideration

Informed verbal consent was taken from each patient and confidentiality was assured. The study was approved by ethical committee of college of medicine in Hawler Medical University.

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Results

In Table 1and Figure 1, the majority (70%) of the patients (with headache) were female and only 30% were males with male to female ratio of 0.43:1,26.6% of females had abnormal MRI findings compared with 84.4% of males. (*P* <0.001).

Table 2 showed statistically significant differences between the mean age of headache patients. The mean age ± SD for males was 45.2 ± 9.3 and the mean age for females was 37± 9.8. The result was significant (*P* = 0.018).

Table 1 Distribution of the studied sample by gender and MRI findings

Gender	No (%) *	No (%) ** (Normal MRI)	No (%) ** (Abnormal MRI)	*P* value
Male	45 (30)	7 (15.55)	38 (84.44)	
Female	105 (70)	77 (73.33)	28 (26.67)	< 0.001
Total	150 (100)	84 (56.0)	66 (44.0)	

*column percent, ** row percent

Table 2 Distribution of the studied sample by mean, median and standard deviation

Gender	Mean age	Median (Min-Max)	Standard deviation	*P* value (Two sample t- test).
Age overall	38.9	35 (21-62)	9.6	0.018
Males	45.2	42 (21-61)	9.3	
Females	37	35 (22-62)	9.8	

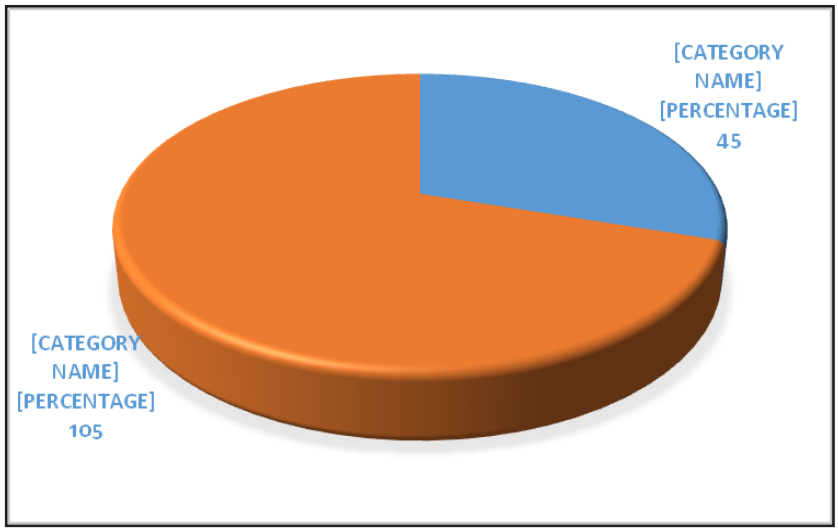

Figure 1 Frequency and Percentage of the Sample by gender

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Fifty six present of the studied sample had normal MRI findings and 44% had abnormal MRI findings as shown in Figure 2.

In Table 3, out of 150 patients evaluated, 45% of normal findings cases were in the age group 30-39, followed by 27.4% in the age group 40-49. In abnormal MRI findings, 33% were in age group 30-39 and 28.7% in age group 40-49. The Chi-square test was significant (*P* = 0.03).

(Table 4, Image 3 and 4) In regard to MRI findings 56% (84 out of 150) of patients assessed had normal findings, followed by sinusitis (28%), (3.3%) diagnosed with cerebral tumor, 0.6% had a pituitary mass and 0.6% diagnosed as meningitis.

Table 3 Distribution of age by MRI findings

Age	No (%)	Primary (Normal MRI)	Secondary (Abnormal MRI)	*P* value
20-29	22 (14.66)	13 (15.47)	9 (13.63)	0.030
30-39	60 (40)	38 (45.23)	22 (33.33)	
40-49	42 (28)	23 (27.4)	19 (28.78)	
50-59	20 (13.33)	9 (10.71)	11 (16.66)	
60-69	6 (4)	1 (1.19)	5 (7.57)	
Total	150	84 (100.0)	66 (100.0)	

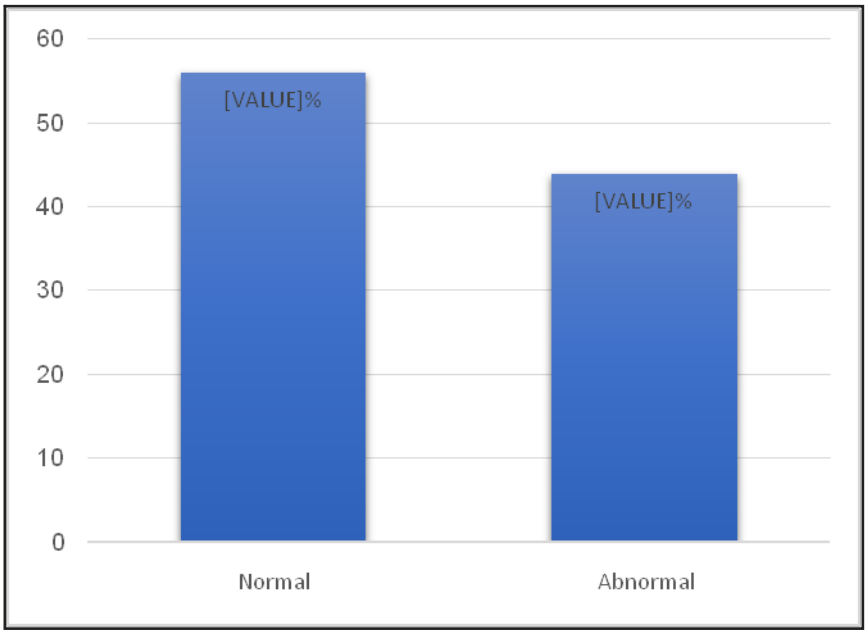

Figure 2 Distribution of the studied sample by normal and abnormal MRI findings

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Table 4 Illustrated various findings in MRI among patients presented with headache.

MRI findings	No (%)
Normal findings	84 (56)
Para nasal sinuses related findings	42 (28)
Demyelination	3 (2)
Empty Sella	2 (1.3)
Pituitary mass	1 (0.6)
Cerebral tumor	5 (3.3)
Post fossa mass	2 (1.3)
Deep WT matter ischemia	6 (4)
Cerebral atrophy	3 (2)
Meningitis	1 (0.6)
Venous hypoplasia	1 (0.6)
Total	150

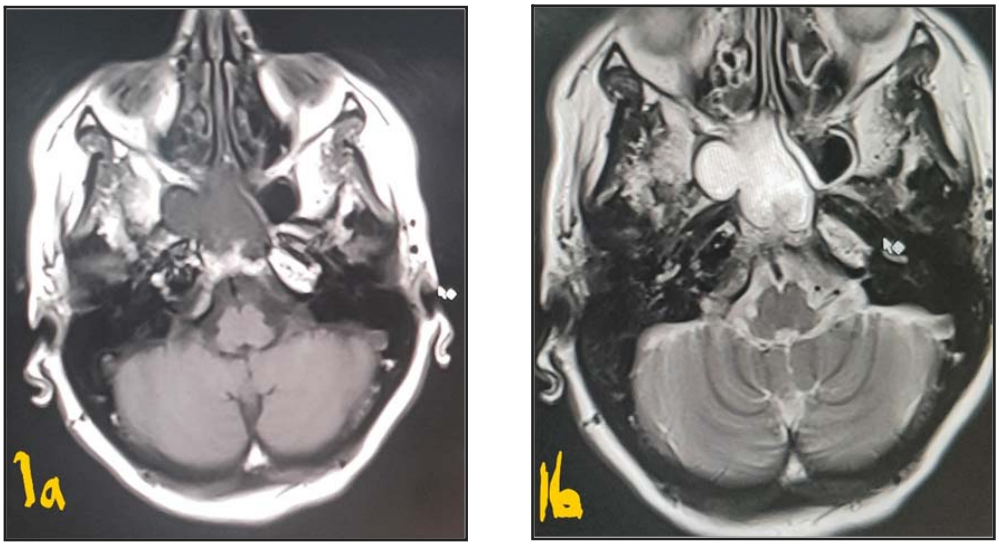

Image 1 Axial plane MRI through the sphenoid sinus (a. T1 and b. T2) both show cystic lobulated lesion occupied RT sphenoid sinus, features of sphenoid sinus mucocele.

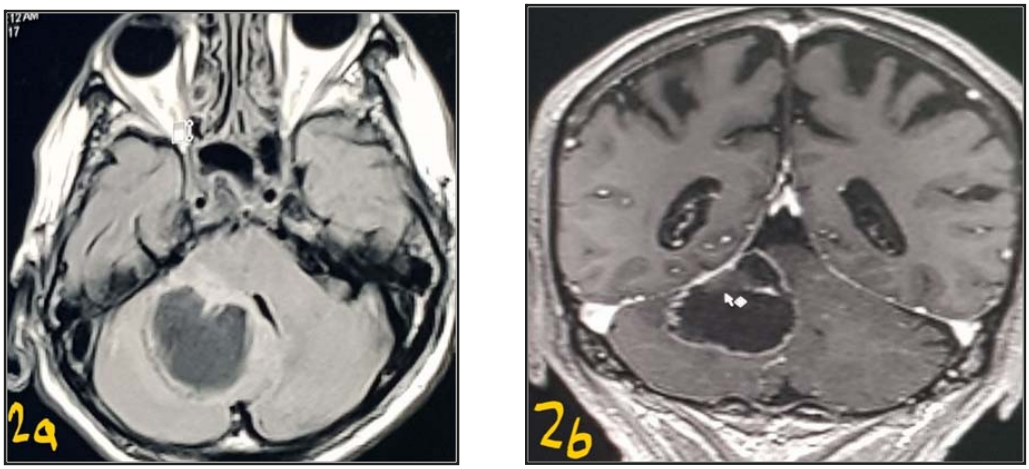

Image 2 (a) T1WI Axial plane MRI through the posterior fossa shows well defined, low signal intensity cystic lesion seen in left cerebellar hemisphere, (b) Coronal T1WI post contrast shows enhanced mural nodule, features of hemangioblastoma.

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Table 5 and Figure 3 shows that 43.9% (29 out of 66) of headache cases had nasal symptoms, 6.1% presented with blurred vision, 3% had weakness and 1.5% with speech problem. In Table 5, Figure 4, 37.9% had no sign or symptoms but actually they had an abnormal MRI finding.

Table 5 The distribution of the studied sample by MRI findings with associated symptoms and 'Red flag' signs

MRI findings	Associated signs and symptoms								
	No signs No. (%)	Nasal symptom No. (%)	Blurred vision No. (%)	Dizziness No. (%)	Weakness No. (%)	Speech difficulty No. (%)	Confusion No. (%)	Numb-ness No. (%)	Total No. (%)
Para nasal sinuses related findings	13 (30.95)	29 (69.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	42 (63.63)
Demyelination	2 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (50)	4 (6.1)
Empty Sella	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (3.03)
Pituitary mass	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.51)
Cerebral tumor	0 (0)	0 (0)	3 (60)	2 (40)	0 (0)	0 (0)	0 (0)	0 (0)	5 (7.57)
Post fossa mass	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	0 (0)	2 (3.03)
Deep WT matter ischemia	6 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (9.09)
Cerebral atrophy	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	0 (0)	2 (3)
Meningitis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (1.51)
Venous hypoplasia	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.51)
Total	25 (37.9)	29 (43.9)	4 (6.1)	2 (3)	2 (3)	1 (1.5)	1 (1.5)	2 (3)	66 (100)

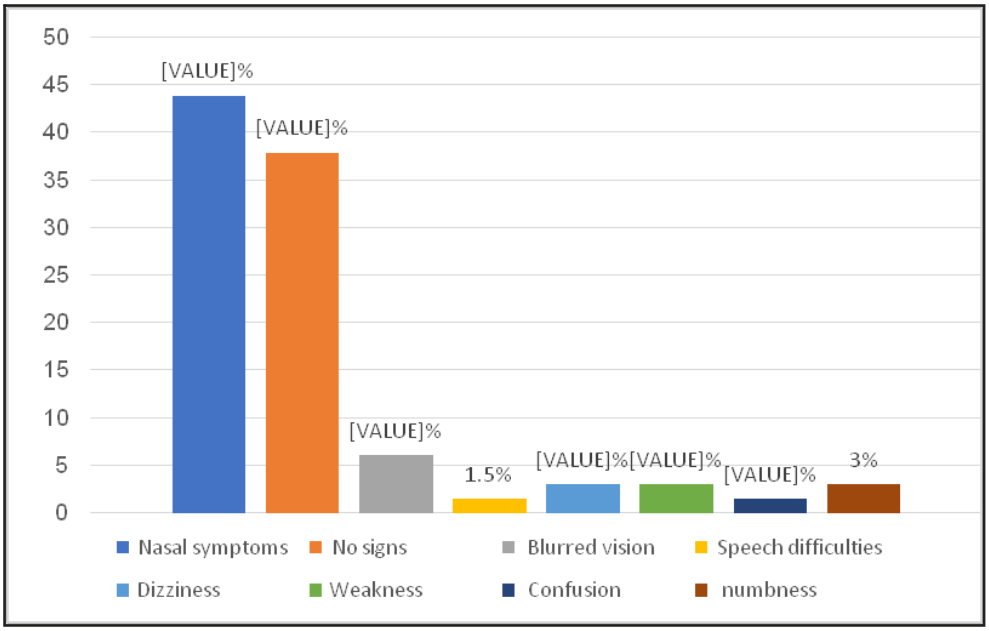

Figure 3 The signs and symptoms among secondary cases of headache

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Table 6 shows the frequency of cases, true positive, true negative, false positive and false negative (98, 40, 2, 10) respectively.
The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI in detecting pathological causes of headache were 90.7%, 95.2%, 98%, 80% and 92% respectively as illustrated in Table 7.

Table 6 The true positive, true negative value, false positive and false negative cases

Clinical	Gold standard is MRI		Total
	Positive	Negative	
Positive	98	2	108
Negative	10	40	42
	100	50	150

Table 7 The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of clinical presentation in detecting pathological causes of headache

	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Clinical Diagnosis	90.7%	95.2%	98%	80%	92%

Discussion

In this study the number of females (n=105,70%) were more than the number of males (n=45,30%) (Figure 1). This result was consistent to other studies done earlier.[4,5] Young and his colleagues conducted a study to assess the neuroimaging utilization pattern among patients with headache, 65% were females.[15] A study was conducted in Chinese liberation army hospital by Wang among primary headache patients (n=1070) with healthy controls (n=1070), the number of females (n=725,67.8%) was more than males.[15]
In current study, corresponding to the gender distribution by MRI findings. The presence of normal MRI was 73% in females and 15.5% in males with statistically significant difference ($P \leq 0.05$) (Table 1). This result agrees with the study conducted among hospital health workers in Nigeria, 133 participants included in the study, the headache was more prevalent among females (88.7%) than males (87.3%).[17] Females were more exposed to neuroimaging techniques than males. This could be explained by the fact that females are more anxious about headaches than males or may be due to physiological hormonal changes.
In the current study, the mean age ±SD for male was 45.2±9.3 and the mean age for female was 37±9.8. The result was statically significant (Table 2). A higher mean age (46.5 years) was reported in Young and his colleagues' study.[15]
In Wang study the sample size was large 1070 and in Ukamaka and Adaorah[18] study it was 126 patients only. These variations could be due to the sample size of these studies and the settings. Another explanation it could be due to presence of an older population in these studies.
In our study, corresponding to the age distribution by MRI findings, a larger number of patients were in the age group 30-39 and 40-49 (40% vs 28%) respectively, 45.23%were in normal and 33.33% in the abnormal for group 30-39.

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In 40-49 age group, 27.4% of patients had normal results and 28.78% had abnormal results. This result is significant. Ukamaka and Adaorah[18] reported 39.9 ± 13.7 years with the majority in the 45-54 age range.

In the current study, the normal MRI findings were equal to 56% of the studied sample and abnormal finding were 44%. The most common abnormal MRI findings include sinusitis that consistence with result that reported by Ukamaka and Adaorah.[18]

Other MRI findings distributions in this study is agreement with study of Ogolodom et al.[19] Our result was contrary to that reported by Atci[20] study, in which cerebral infarction was more common followed by sinusitis.

The cerebral tumor was reported in (n=5, out of 66) 7.57% of patients only. In the study of USA among children with headache only 2(0.7%) had intracranial lesions as Cain and his colleagues[21] revealed.

In this study 43.9% among headache cases had nasal symptoms, 6.1% presented with blurred vision, 3% had weakness and 1.5% with speech problem. 37%.[9] had no sign or symptoms. This study is agreeing with Young et al[15] study (Table 5, Figure 3).

A retrospective study conducted in China [22] among 762 patients, to assess the accuracy of MRI in the diagnosis of brain tumors. The overall sensitivity and positive predictive value were 72% and 90% respectively. The current study reported a higher figure for sensitivity 90.7 %, PPV 98% (Table 7). The accuracy of MRI in diagnosing brain lesions was satisfactory.

Some investigators in a Western country [23] reported 10.5% abnormal findings (461 out of 4404) among patients with chronic headache. According to Simpson[23] most of patients with chronic headache had normal findings after doing the scan, this was explained by absence of underlying medical conditions. They concluded that routine investigation with scan for all headache cases should not be recommended. Neuroimaging can be used in patients with chronic headache if they had warning signs. These warning criteria are focal neurological symptoms, sudden onset, change in character, age older than fifty years and not responding to analgesics. Neuroimaging was not necessary for primary headache cases.[23]

This study had many limitations, it was a cross sectional study; therefore, it cannot establish a cause effect relation-ship. The study results cannot be generalization to the whole population because these findings limited to a single healthcare setting. However, despite all these limitations, this study provided a baseline data on importance of MRI in diagnosing pathological headache.

Conclusion

The current study investigated the findings of MRI among referred headache cases. Female predominance was noted in this study. The majority of MRI findings were normal. This was followed by sinusitis and other paranasal sinus problems that represented the most common abnormal MRI findings in this study. MRI is an examination of choice for assessment of headache cases. Patients with headache need to be evaluated clinically before being sent for MRI. Evidence-based guidelines for neuroimaging are needed. Further studies with a larger sample size are advised. An assessment of the type of headache and MRI findings is advised.

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Competing interests

The authors declare that they have no competing interests.

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