

## Retrospektif Analysis of 1545 Patients: Neuroimaging in Headache

### Binbeşyüz kırkbeş Hastanın Retrospektif Analizi: Baş Ağrısında Nöroradyolojik Görüntüleme

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#### ABSTRACT

**Objective:** Neuroradiological imaging is also used to differentiate between primary and secondary headaches. The aim of this study was to evaluate retrospectively the significant abnormal neuroradiological imaging results and rates in the primary headache group. In addition, it was also planned to analysis the results of all headaches with imaging and discuss the imaging in the headache with the literature.

**Methods:** Medical records of headache patients of the neurology outpatient clinic at the tertiary care center were reviewed. Patients who required brain imaging and did not have any disease that could cause pathology in imaging were included. Neuroradiological images were grouped as brain computed tomography (CT), brain magnetic resonance imaging (MRI) and others. Results were normal, significant abnormal findings and others.

**Results:** Total 1545 patients were included. Primary headache 992, secondary headache 91, painful cranial neuropathies and other headaches were observed in 462 patients. Significant abnormal radiological findings were found to be 4.3% in primary headache, 14.3% in secondary headache, and 6.6% in painful cranial neuropathy and other headaches. Significant findings in primary headache were Arnold Chiari Malformation, sinus thrombosis, intracranial mass, choroid plexus xanthogranuloma, hydrocephalus, vascular malformation.

**Conclusion:** In this series, the rate of significant findings in neuroradiological imaging in primary headache is low. Secondary headaches require neuroimaging because of the presence of underlying life-threatening causes, although the rate of abnormal neuroradiological imaging is low. History, examination, and red flags in headache may lead to imaging, but patient and physician concerns may also increase imaging rates.

**Key Words:** Neurology, headache, primary headache, neuroimaging, computed tomography (CT), magnetic resonance imaging (MRI)

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#### ÖZET

**Amaç:** Nöroloji pratiğinde sık gözlenen baş ağrısının değerlendirilmesinde primer, sekonder ayrımında nöroradyolojik görüntüleme de kullanılmaktadır. Bu çalışmadaki primer baş ağrısı grubunda önemli anormal nöroradyolojik görüntüleme sonuç ve oranlarının retrospektif olarak değerlendirilmesi amaçlanmıştır. Ayrıca görüntülemenin literatür ile tartışılması da planlandı.

**Yöntem:** Üçüncü basamak sağlık merkezindeki nöroloji polikliniğinin bir yıl içindeki baş ağrısı hastalarının medikal kayıtları gözden geçirildi. Beyin görüntülemesi istenen ve görüntülemeye patoloji yaratabilecek hastalığı olmayan hastalar çalışmaya dahil edildi. Nöroradyolojik görüntülemeler beyin bilgisayarlı tomografi (BT), beyin manyetik rezonans görüntüleme (MRG) ve diğerleri olarak gruplandırıldı. Sonuçlar normal, önemli anormal bulgu ve diğerleri olarak değerlendirildi.

**Bulgular:** Toplam 1545 hasta çalışmaya alındı. Primer baş ağrısı 992, sekonder baş ağrısı 91, ağrılı kranial nöropatiler ve diğer baş ağrıları 462 hastada gözlemlendi. Primer baş ağrısında önemli anormal radyolojik bulgu %4.3, sekonder baş ağrısında %14.3, ağrılı kranial nöropati ve diğer baş ağrısında %6.6 oranında bulundu. Primer baş ağrısındaki önemli radyolojik bulgular Arnold Chiari malformasyonu, sinüs trombozu, intrakranial kitle, koroid pleksus ksantogranulomu, hidrosefali, vasküler malformasyon oldu.

**Sonuç:** Bu seride incelenen primer baş ağrılarındaki nöroradyolojik görüntülemeye önemli bulgu oranı düşüktür. Anormal bulgu oranı düşük olsa da sekonder baş ağrıları, altta yatan yaşamı tehdit eden nedenlerden ötürü nörogörüntüleme gerektirir. Baş ağrısında öykü, muayene ve kırmızı bayraklar görüntüleme konusunda yol gösterir ancak günümüzde hasta ve hekim kaygıları da görüntüleme oranlarını artırıyor olabilir.

**Anahtar Sözcükler:** Nöroloji, baş ağrısı, primer baş ağrısı, nöroradyolojik görüntüleme, bilgisayarlı tomografi (BT), manyetik rezonans görüntüleme (MRG)

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## INTRODUCTION

Headache is one of the most common symptoms that could impair an individual's quality of life. It is a common cause of presentation to physicians' offices and has a large share in health expenditures worldwide. The global prevalence of headache is unclear, and the prevalence of primary headache is greater. In 2010 global disease burden questionnaire, stress type headache and migraine are the second and third most common disorders worldwide, with migraine being also the seventh most common cause of disability (1). Although secondary headaches are rarer, they are of greater importance. Their etiologies may include life threatening conditions of central nervous system or other systems. Thus, evaluation of pain and decision making about the necessity of imaging studies are crucial for patients presenting to neurologist with headache. The aim of this study was to retrospectively evaluate neuroimaging rates and results in primary headache group. It is also planned to review the results of other headaches which have neuroimaging, which is important in the headache, and to discuss the imaging of headache with relevant literature.

## METHODS

In this retrospective and cross-sectional study, electronic medical records of our neurology outpatient clinic were reviewed by four neurologists between July 2016 and July 2017. Patients with headache were enrolled who have main diagnosis of headache and brain neuroimaging (CT, MRI and other brain studies (MRI/CT venography-angiography, diffusion, or their combinations with brain CT/MRI) was performed. Patients with a known intracranial neoplasm, vascular lesion or seizure disorder were excluded. All MRI studies had done with 1.5 Tesla and two detector computed tomography had used. The results of imaging studies were reviewed by radiologist and neurologist from written report and image archive systems. The main diagnosis of headache was determined with pain history and international classification of disease (ICD) code. Age, gender, headache diagnosis, type and result of neuroimaging and neurological examination findings of all patients were recorded. The results of neuroradiological imaging were categorized according to McCrory et al. in the US Headache Consortium as follows: normal (normal, T2 hyperintensity of migraine), important abnormalities and others, i.e. unimportant findings (sinusitis, ischemic gliotic focus, lacunar infarction, meningioma, arachnoid cysts, demyelinating plaques) (2). Important abnormalities included tumors, hydrocephalus, vascular malformations (aneurysm, arteriovenous malformation, cavernoma, venous angioma) and Arnold-Chiari malformation (ACM), intracerebral and extracerebral hemorrhage, acute and subacute ischemia, and sinus thrombosis. Headache was categorized by (ICHD)-3 beta as primary, secondary, painful cranial neuropathies, and other headache disorders. Other headaches were non-specific headaches of primary headaches which did not meet the diagnostic criteria and excluded the secondary causes. In the primary headache it was known headache class but unexpected age was requested in the presence of a change in the character of pain, in the presence of unresponsiveness to treatment, in secondary headaches and in others in the presence of a red flag and history that did not meet the primary headaches (3). Imaging findings were assessed by subgroups in the primary headache category. The study was approved by our university's clinical research ethic committee (02.06.2018-03/01).

## Statistical analysis

The statistical analyses were performed with SPSS 21 (SPSS Inc, Chicago, Ill, USA) software package. Quantitative variables were expressed as percentage, mean, and standard deviation. Data distribution was assessed with the normality test, with non-normally distributed variables being compared with Mann Whitney-U test. p value of less than 0.05 was considered statistically significant.

## RESULTS

In this study, medical records of 2980 patients who have headache were reviewed. Total 1545 patients were included according to inclusion and exclusion criterias. There were 1113 women (72.03%) and 432 men (27.9%) in study group. The mean age was 42.8 (range 16-90) years. There is not significant difference in mean age between female and male patients (42.53±16, 43.69±17 p=0.264).

Primary headache was the most common type of headache (991 patients, 64.2%), followed by painful cranial neuropathies and other headaches (462 patients, 29.9%) and secondary headache (91 patient, 5.9%). The primary headache subtypes were migraine (345 patients, 34.8%), tension type headache (TTH) (528 patients, 53.2%), migraine with TTH (108 patients, 10.9%), trigeminal autonomic headache (4 patients, 4%), and other primary headaches (stabbing headache, 7 patients, 7%) (Table 1). Neurological examination was pathological (papillary edema) only three cases in primary headache group. In painful cranial neuropathy and other headaches, neurological examination was normal but neurological examination findings could not be achieved in secondary headaches.

Table 1. Groups of headache

Headache group	n (%)
Primary headaches	992 (64.2)
Painful cranial neuropathies and other headaches	462 (29.9)
Secondary headaches	91 (5.9)
Total	1545

The rates of neuroimaging studies are given on Table 2. The most frequent imaging method was MRI (828, 53.6%) in the study group. The important radiological finding was found 4.3% in primary headache, 14.3% in secondary headache, and 6.6% in painful cranial neuropathy and other headaches. Abnormal imaging findings in primary headache subgroup were present 2% in migraine, 1.6% in TTH, 0.6% in combined migraine and TTH, and 0.1% in trigeminal autonomic headache (Table 3). Normal radiological imaging findings were present 86.4% in primary headache and 9.3% in other findings.

Table 2. The types of neuroimaging

Neuroimaging study	n (%)
Brain MRI	828 (53.6)
Brain CT	598 (38.7)
Others	119 (7.7)
Total	1545

MRI, Magnetic rezonans imaging; CT, Computerize tomography

Table 3. Significant neuroimaging abnormalities in patients with primary headache

Primary headache subtypes	Neuroimaging findings (n)			Total
	Normal	Significant abnormalities	Other	
Migraine	300	20	25	345
TTH	454	16	58	528
Mikst (migraine +TTH)	93	6	9	108
TOH	3	1	0	4
Other primary headache	7	0	0	7
Total	857	43	92	992

TTH, Tension type headache; TOH, Trigeminal autonomic headache

## DISCUSSION

History, neurological and systemic examinations are important tools to make an accurate diagnosis of headache, a complaint commonly observed in the neurology practice.

Neuroradiological imaging serves to differentiate primary headaches from secondary ones. In addition, some conditions may require neuroradiological imaging for follow-up of primary headaches (3,4).

This study examined imaging data of large patient group who were diagnosed as having primary headache (migraine, stress, trigeminal autonomic headache and other primary headaches). It revealed a prevalence of 4.3% for important abnormal radiological findings. Studies in the literature assessing brain CT findings in chronic headaches (with unknown main diagnosis) have revealed a prevalence of 0-3% for important radiological findings (5,6,7,8,9). While a review of brain MRI findings in chronic headaches by Wang et al demonstrated that the prevalence was 3.7% in the migraine, TTH, mixed, atypical headache group, the prospective study of Tsushima et al (where headache subgroups were undefined) a corresponding figure of 0.7% was reported (10,11). Another study by Sempere et al assessing brain CT and MR findings in a greater number of patients with headache reported a prevalence of 1.2% (12).

Although differences between prevalence numbers reported by previous studies may result from the differences related to population size and methodology, the reported prevalences are generally low. Our study also demonstrated a low prevalence for important radiological findings, albeit somewhat higher than those reported in the literature. This may have stemmed from a greater rate of MRI examination than CT examination. The important radiological findings were ACM Type I, sinus thrombosis, intracranial mass, choroid plexus xanthogranuloma, hydrocephalus, vascular malformation (aneurysms, cavernoma). ACM Type I refers to the herniation of cerebellar tonsils through foramen magnum for 3 to 5 mm downwards; it is controversial if it is a true cause of headache (13,14). In our study, 19 cases in the primary headache group had incidental ACM Type I, of which 10 were diagnosed with migraine. Other incidental findings were choroid plexus xanthogranuloma, vascular malformation (aneurysm, cavernoma), and hydrocephalus. An intracranial mass (schwannoma, paraganglioma and occipital mass) was observed in two migraine patients and one TTH. Prior clinical studies have reported that isolated headache is rare, occurring rather with other symptoms. Moreover, stress type headache was the most common headache type followed by migraine type headache in primary and secondary metastatic tumors (15). Sinus thrombosis was detected in three patients (two migraines, one TTH) who were found to have papillary edema in neurological examination.

White matter hyperintensity on T2-weighted MRI images in migraine has been shown by many studies. These changes may be observed in migraine both with and without aura and in the absence of risk factors. Furthermore, these lesions have a higher rate in the migraine patients than the healthy controls (16). As T2 hyperintensities in the white matter were unimportant and would not alter the outcome in the migraine patients, they were included in the normal imaging findings.

Our study found a rate of 6.6% for the important radiological findings (subacute ischemia, ACM, venous angioma) among the group of painful cranial neuropathy and other headaches. Painful cranial neuropathies are characterized by pain in the cranial or cervical nerve distribution, and the most common ones are trigeminal, postherpetic, and occipital varieties (17). The ones in our patient group were seven trigeminal neuralgia cases which were idiopathic. Radiological findings were in other nonspecific headaches.

The retrospective analysis revealed that there were 91 secondary headache cases, which had a rate of important radiological findings of 14.3%. Apart from neuroradiologically diagnosable secondary headaches such as subarachnoid bleeding, cerebral venous thrombosis that are mentioned in IHS, some secondary causes are with normal neuroradiological imaging such as medication overuse. This affects the results.

This study raises the question of whether more than necessary neuroradiological imaging is required in primary headaches. In this reviewed patient series, psychiatric comorbidities that may accompany primary headache, particularly migraine, TTH, or both, may also lead to misinterpretation of red flag signs and other follow-up parameters due to treatment resistance secondary to drug abuse. Hence, neurological examination is of great importance in these conditions. In migraine neuroimaging is not recommended if its diagnostic criteria are fully met, neurological and systemic examination are normal, and the course is stable (18). It was proved that the same recommendation also applies to other primary headaches (19). As is known, red flags are recommended in clinical practice to question secondary and potential life-threatening conditions. Orange flags are the other recommended danger signs in headache (20). In

2003 the SNOOP4 (systemic symptoms/signs and disease, neurologic symptoms or signs, onset sudden or onset after the age of 40 years, and change of headache pattern) list including the red flag signs recommended for clinical practice was revised as the SNOOP10 list by adding orange flag signs to it (21). Nowadays, however, the rate of ordering radiological imaging tests for headache has been progressively increasing. Headache being the primary symptom, patient's and physician's concerns about headache, better access to neurologists, and repeated visits are the reasons of this increase (22,23,24).

In summary, the rates of important radiological signs are low in primary headache and most are incidental. Clinician should review diagnosis criteria, red flags, neurologic examination and follow-up of patients with primary headache. Secondary headaches require neuroimaging because of the presence of underlying life-threatening causes, although the rate of abnormal neuroradiological imaging is low.

#### Conflict of interest

No conflict of interest was declared by the authors.

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