ÖZGÜN ARAŞTIRMA ORIGINAL RESEARCH

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PEDIATRIC HEADACHES: DOES NEUROIMAGING CONTRIBUTE TO DIAGNOSIS?

ÇOCUKLUK ÇAĞI BAŞ AĞRILARI: NÖROGÖRÜNTÜLEMENİN TANIYA KATKISI VAR MI?

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Öz

Amaç

Baş ağrısı, çocukluk çağında sık görülen bir yakınmadır. Genellikle etiyolojide migren, gerilim tipi baş ağrısı gibi benign sebepler saptanmakla birlikte, altta yatan ciddi bir patolojiyi atlama endişesi ile hastalara kraniyal görüntüleme sıklıkla yapılmaktadır. Bu çalışmada, çocuklarda görülen baş ağrılarının etiyolojisini ve klinik özelliklerini değerlendirmek, görüntüleme yöntemlerinin tanıya olan katkısını belirlemek istedik.

Gereç ve Yöntem

Bu retrospektif çalışmaya, Süleyman Demirel Üniversitesi Tıp Fakültesi Çocuk Nörolojisi Polikliniği'ne, 2019-2022 yılları arasında, baş ağrısı yakınması ile başvuran hastalar dahil edildi. Baş ağrısı ile ilgili bilgiler (sıklık, süre, tipi, karakteri, şiddeti, lokalizasyonu, eşlik eden bulgular) alındı, kraniyal görüntüleme yapılan hastaların sonuçları kayıt edildi. Baş ağrıları, Uluslararası Baş Ağrısı Cemiyeti'nin kriterlerine göre sınıflandırıldı.

Bulgular

Yaşları 2-18 arasında değişen, % 64,5'i kız olan, 234 hasta dahil edildi. Yaş ortalaması 12,56 yıl idi. Hastaların % 68,4'ü birincil baş ağrısı tanısı aldı; gerilim tipi baş ağrısı % 46,2, migren % 31,2 ve diğer birincil baş ağrısı sebepleri % 22,5 oranlarında görüldü. İkincil baş ağrıları arasında %79,7 oranında kraniyum, boyun, gözler, kulaklar, burun, sinüsler, ağız ya da diğer yüz veya kraniyal yapıların bozukluklarına bağlı başağrısı görüldü ve en sık sebep sinüzit olarak belirlendi. Hastaların % 66,7'sine kraniyal görüntüleme yapıldı, % 51.9'u anormal saptandı. Anormal olarak değerlendirilen görüntüleme sonuçlarının %14,1'i tesadüfen saptanan, potansiyel klinik önemi olan serebral anormallikler; %10,3'ü tesadüfen saptanan, klinik önemi olmayan bulgulardı. Bu hastaların tedavileri görüntüleme sonucu ile değişmedi. %25'i de baş ağrısı ile ilişkili ekstraserebral anormallik olarak değerlendirildi. Sadece bir hastanın sonucu baş ağrısı ile ilişkilendirildi, sinus ven trombozu tanısı aldı ve tedavisi düzenlendi.

Sonuç

Bu çalışmada, çocukluk çağı baş ağrılarının büyük çoğunluğunun benign olduğu, etiyolojide ilk sırayı gerilim tipi baş ağrısı, enfeksiyon ve migrenin yer aldığı, görüntüleme yöntemlerinin tanıya katkısının az olduğu görüldü. Baş ağrısı ile başvuran hastalarda, ayrıntılı bir klinik değerlendirilme sonrasında etiyolojinin aydınlatılabileceği, görüntüleme yöntemlerinin seçilmiş vakalarda yararlı olabileceği sonucuna varıldı.

Anahtar Kelimeler: Baş ağrısı, Çocuk, Nörogörüntüleme

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Abstract

Objective
Headache is a common complaint in childhood. While the etiology is usually benign, such as migraine or tension-type headache, cranial imaging is often performed on patients to identify any missed or serious underlying pathology. In the present study we assess the etiology and clinical characteristics of headaches in children and establish the diagnostic contribution of imaging methods.

Material and Method
This retrospective study included patients who presented with headaches to the Pediatric Neurology Outpatient Clinic of Süleyman Demirel University Faculty of Medicine between 2019 and 2022. Headache information (frequency, duration, type, characteristics, intensity, localization, and accompanying findings) was obtained, and the cranial imaging results of patients were recorded. Headaches were classified according to the criteria established by the International Headache Society.

Results
The study included 234 patients aged 2–18 years with a mean age of 12.56 years, of which 64.5% were female. The diagnosis was primary headaches in 68.4% of the patients, with tension-type headaches in 46.2%, migraine in 31.2%, and other primary headache causes in 22.5%. Among the secondary headaches, disorders of the cranium, neck, eyes, ears, nose, sinuses, teeth or other cervical structures accounted for 79.7%, with the most common cause being sinusitis. Cranial imaging was performed on 66.7% of the patients, of which 51.9% were identified with abnormal findings. 14.1% of the imaging results evaluated as abnormal were incidentally detected cerebral abnormalities with potential clinical significance; 10.3% were findings that were found incidentally and had no clinical significance. The treatment of these patients did not change with the imaging result. Another 25% were evaluated as extracerebral abnormality associated with headache. Only one patient's outcome was associated with headache. The patient was diagnosed with sinus vein thrombosis and the treatment was arranged.

Conclusion
The majority of childhood headaches identified in the present study were found to be benign, with the leading causes being tension-type headache, infection and migraine, and imaging methods were found to be of little diagnostic benefit. It was concluded that a detailed clinical assessment of patients presenting with headaches could clarify the etiology, while imaging methods may be useful in selected cases.

Keywords: Child, Headache, Neuroimaging

Introduction

Headache is a common complaint among children. It is the primary cause of visits to pediatric neurologists. The etiology is usually benign, such as migraine or tension-type headache, while less common are serious organic conditions. Accordingly, every patient presenting with headaches should be evaluated in detail and secondary causes should be excluded (1-4). Physical and neurological examinations after taking a detailed history are usually sufficient to establish the cause of childhood headaches, and there is no obligatory test or imaging method required to confirm the diagnosis. An accurate definition and classification is the most important factor guiding patient management (5), although when history and examination findings are suggestive of a secondary cause, patients should be scheduled for neuroimaging after all necessary assessments.

Although cranial imaging has low diagnostic value in children with normal neurological examination findings, physicians may submit the patient to imaging, even if there is no indication, under family pressure/concern or out of fear of missing an underlying pathology.

In the present study we assess the etiology and clinical characteristics of headaches in pediatric patients and establish the diagnostic contribution of imaging methods.

Material and Method

Included in the study were all patients who presented with headaches to the Pediatric Neurology Outpatient Clinic of Süleyman Demirel University Faculty of Medicine between January 2019 and January 2022. The study was granted Ethics Committee approval (Süleyman Demirel University Faculty of Medicine Clinical Research Ethics Committee, 12.01.2022-25). Patients with incomplete records, with a known disease that could cause headaches or with a known structural intracranial disorder were excluded from the study. All patients presenting with headaches undergo a

systemic physical examination, including arterial blood pressure measurement, and a detailed neurological examination, including fundus examination, and the findings are recorded in the files. Data for the present study were collected from the patient files, including age and gender, frequency, and headache duration, type, characteristics, intensity and localization, as well as any accompanying symptoms and examination findings. Headache pain intensity was determined by numeric scale rating from 0 to 10. The cranial imaging results of the patients were recorded.

Headaches were classified according to the International Classification of Headache Disorders proposed by the Committee of the International Headache Society (5). Based on these criteria, all headaches were divided into two groups as primary or secondary. Primary headaches were then classified as migraine, tension-type, trigeminal autonomic cephalalgias, and other primary headache disorders; and secondary headaches were classified as headaches attributed to trauma or injury to the head and/or neck, headaches attributed to a non-vascular intracranial disorder, headaches attributed to infection, headaches attributed to cranial and/ or cervical vascular disorders, headaches attributed to a substance or its withdrawal, headaches attributed to disorder of homeostasis, headaches attributed to psychiatric disorders and headaches or facial pain attributed to disorders of the cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cervical structures.

Cranial imaging results were first classified as normal or abnormal, and the abnormal results were then further classified under five headings: 1) cerebral abnormalities relevant to headache 2) incidental cerebral abnormalities with potential clinical significance 3) incidental cerebral abnormalities without clinical significance 4) extracerebral abnormalities relevant to headache and 5) incidental extra-cerebral abnormalities.

The patients were divided into two groups according to age: Group 1 aged ≤10 years, and Group 2 aged >10 years.

Statistical Analysis

The statistical analyses in the study were performed using IBM SPSS Statistics (Version 20.0. Armonk, NY: IBM Corp.). Descriptive values were presented as frequency (percentage) and mean±SD (median; Q1-Q3). Patient characteristics were compared between those who underwent and who did not undergo cranial imaging. A Chi-square test with Monte Carlo simulation was used to assess the relationship between categorical variables. Since the quantitative measurements were not normally distributed, the two independent groups were compared with a Mann-Whitney U test. A p-value of < 0.05 was considered statistically significant for all analyses.

Results

The study included 234 patients aged 2–18 years with complaints of headaches. The mean age was 12.56±3.7 years (median age: 13 years). Female and male patients accounted for 64.5% and 35.5% of the study sample, respectively. The patients described their headaches mostly as throbbing (50.9%). Headaches had persisted for more than one year in 33.3% of the patients; the mean pain score was 6.15±1.96, the frequency of headache attacks was mostly 2–4/week (47.4%); the duration of headache attacks was mostly 1 hour or 1–3 hours (~59%); and the localization of headache was mostly in the frontal region (39.7%). The distribution of the headache characteristics of the patients is presented in Table 1. Of the patients, 78.6% reported headache relief with analgesics. The rate of patients diagnosed with primary headaches was 68.4%, with the most common cause of primary headaches being tension-type headache (46.2%) and the second most common cause being migraine (31.2%). The rate of secondary headaches was 31.6%, with the most common cause being headache or facial pain attributed to disorders of the cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cervical structures (79.1%). These patients were most frequently diagnosed with sinusitis (Table 2). Nearly half of the patients had no accompanying symptoms, while the most common co-complaints included nausea and dizziness (Table 3).

Cranial imaging was performed in 66.7% of the patients, with abnormal findings revealed in 51.9%.

Based on the abnormal cerebral findings considered to be associated with headaches, only one patient was diagnosed with venous sinus thrombosis (0.6%). Incidental cerebral abnormalities with potential clinical significance, such as arachnoid cysts and Chiari type 1 malformation, were identified in 14.1% (Table 4). For the sole patient diagnosed with venous sinus thrombosis, the treatment plan was changed after cranial imaging findings, while the follow-up and treatment of other patients continued as planned.

There was no significant difference in the demographic or clinical characteristics of the patients who underwent and those who did not undergo neuroimaging. The

Table 1 Distribution of headache features

Features		n(%)
Characteristic of headache	Throbbing	119 (50,9)
	Can not be described	70 (29,9)
	Squeezing	21 (9,0)
	Stabbing	15 (6,4)
	Non- specific	9 (3,8)
Duration of headache	<1 month	34 (14,5)
	1-3 months	51 (21,8)
	3-6 months	21 (9,0)
	6 months-1 year	50 (21,4)
	>1 year	78 (33,3)
Headache frequency	1/week	47 (20,1)
	2-4/week	111 (47,4)
	>4/week	37 (15,8)
	1/month	23 (9,8)
	>1/month	16 (6,8)
Duration of headache attack	< 30 minutes	46 (19,7)
	< 1 hour	68 (29,1)
	1-3 hours	70 (29,9)
	< 24 hours	40 (17,1)
	>24 hours	10 (4,3)
Localization	Frontal	93 (39,7)
	Frontoparietal	35 (15,0)
	Temporal	9 (3,8)
	Temporoparietal	23 (9,8)
	Occipital	26 (11,1)
	Can not be localized	48 (20,5)

two groups of patients had the same median age. The mean pain score was slightly higher in patients who underwent cranial imaging, although there was no significant difference between the groups.

An assessment of the two age groups, being those aged≤10 years and those aged >10 years, revealed a significant gender difference between the groups (p=0.004). While 28.2% of the patients were younger than 10 years of age and the distribution of boys and girls was equal, 71.8% of the patients were older than 10 years and 70.2% of these patients were female. The mean age was 7.68±2.28 years in Group 1 compared with 14.49±1.99 years in Group 2.

The types of headache also differed significantly between the age groups (p<0.001), with higher rates of throbbing and tightening headaches in Group 1. There was no significant difference in the headache duration, attack frequency, attack duration and localization between the different age groups. Symptoms accompanying headaches did not differ

Table 2 Etiological distribution of patients with primary and secondary headache

Headache type	Classification	n (%)
Primary (n=160)(68.4%)	Tension-type headache	74 (46.2)
	Migraine	50 (31.2)
	Other primary headache disorders	36 (22.5)
Secondary (n=74)(31.6%)	Headaches or facial pain attributed to disorder of cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cervical structures	59 (79.7)
	Headaches attributed non-vascular intracranial disorder	2 (2.7)
	Headaches attributed to disorder of homeostasis	9 (12.2)
	Headaches attributed to cranial/cervical vascular disorder	1 (1.3)
	Headaches attributed to trauma/injury to the head/neck	3 (4.0)
Total		234(100)

Table 3 Symptoms accompanying headache

	n (%)
None	117 (42,3)
Nausea	63 (22,8)
Vertigo	44 (15,9)
Photophobia	19 (6,8)
Phonophobia	12 (4,3)
Vomiting	11 (3,9)
Vision loss	9 (3,2)
Numbness	1 (0,36)

significantly between the age groups, although the rates of nausea, vomiting, dizziness and phonophobia were slightly higher in Group 2, and the rate of vision loss was higher in Group 1. The rate of response to analgesics was higher in Group 1 (p=0.031). While Group 2 had predominantly primary headaches, Group 1 had a significantly higher rate of secondary headaches (p=0.021). Among the primary headaches, migraine accounted for a higher rate in the older age group, while the rate of tension-type headaches was higher in the younger age group (Table 5). The neuroimaging results of the two age groups did not differ significantly, although mean pain score was significantly higher in Group 2 (p<0.001).

When the patient characteristics were compared between those diagnosed with primary and secondary headaches, primary headaches were significantly more common in females (72.8%) (p<0.001). Mean age (p=0.003) and mean pain score (p=0.015) were significantly higher in those with primary headaches. The rate of patients who had suffered headaches for more than one year (41.1%) was significantly higher in those with primary headaches (p=0.006). Attacks

Table 4 Neuroimaging classification results

	n (%)
Normal	75 (48.1)
Cerebral abnormalities relevant to headache Sinus venous thrombosis	1 (0.6)
Incidental cerebral abnormalities with potential clinical significance Arachnoid cyst Chiary type 1 malformation Pineal gland cyst Arteriovenous malformation Choroid plexus papilloma Mega cysterna magna	22 (14.1)
Incidental cerebral anormalities without clinical significance White matter hyperintesities Old ischemic infarcts	16 (10.3)
Extracerebral abnormalities relevant to headache Sinusitis Mastoiditis	39 (25.0)
Incidental extra-cerebral abnormalities Adenoid vegetation Mucosal retention in sinuses	3 (1.9)
Total	156 (100)

lasting in excess of 24 hours were observed only in the patient group with primary headaches (p=0.012). The rate of headaches localized to the occipital region was significantly higher in patients with secondary headaches (20.5%) (p=0.036). The number of patients undergoing neuroimaging was not different between patients with primary and secondary headaches.

Discussion

The majority of headache complaint can be attributed to functional disorders such as migraine and tension-type headache, while a small proportion have a more serious underlying organic cause. Various studies reported different rates of migraine (7-55%) and tension-type headaches (29-77%) as the most common causes (3, 4, 6). Our study identified tension-type headache (31.6%), headache or facial pain attributed to disorders of the cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cervical structures (25.2%), and migraine (21.4%) as the most common of all headache types. After classification as primary or secondary headaches, the rate of primary headaches was 68.4%, and the most common type of primary headache was tension-type (46.2%), followed by migraine (31.2%). Secondary headaches were identified in 31.6% of the patients, with the most common cause being headaches or facial pain attributed to disorders of the cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cervical structures (79.7%), and the most common diagnosis being sinusitis. Previous studies in literature also identify the majority of secondary headaches as benign, self-limiting, and developing usually after upper respiratory tract infections. Serious causes are very rare (1-3, 7).

While headaches can occur at any age, the prevalence increases at the age of 12–14, being more common in females. Before 12 years of age, the prevalence of headache is similar among males and females (8). In the present study, the mean age was 12.56 years, and the frequency of headaches did not differ significantly between the male and female patients up to the age of 10, while the female rate was higher among patients over 10 years of age.

Indications for neuroimaging include acute severe headache, abnormal neurological examination findings, changes in headache characteristics and symptoms suggestive of increased intracranial

pressure, although imaging planning is carried out during the initial assessment in clinical practice (8, 9). This can often be attributed to worry of missing serious disease and family pressure.

The increased frequency of imaging has resulted in an increasing rate of detection of abnormal incidental findings that are unrelated to headaches. Different studies have reported a cranial imaging rate of 35–85% in patients with headaches (2-4, 6). In the present study, 66.7% of the patients underwent imaging, and the rate of abnormal findings was 51.9%. Previous studies have reported abnormal finding rates of 9–52.8% (3, 10, 11). Patients with headaches who undergo cranial imaging may have several abnormal findings that may or may not be related to headaches. Although the rates of abnormal imaging findings reported in the present study and other studies are high, the rate of abnormalities related to headaches is low. Cerebral abnormalities related to headaches were detected in only one (0.6%) of the 156 patients in the present study, and medical treatment was planned accordingly. Other findings considered abnormal were incidental findings that were unrelated to headaches. Yılmaz et al. performed cranial imaging on 72.2% of 449 patients, and found abnormalities relevant to headache in only 0.6% (3). Similarly, the imaging findings of 133 patients with headaches were evaluated, and abnormalities related to the headaches were identified only in 3.8% (12). A previous study involving 2,086 patients reported a secondary headache rate of 30% and a serious cause rate of only 3.6% (brain tumor, intracranial infections or vascular disorder) among the sample (1). Another study reported that the imaging findings were pathological in 3.7% of migraine patients and in 16.6% of patients with chronic headaches who had normal neurological examination findings, although none required surgical interventions (13). Abnormalities were identified on 17.7% of the neuroimaging scans performed in another group of patients who presented with idiopathic recurrent headache, but most of these abnormalities were unrelated to the pathogenesis of headache (14). The abnormalities in the secondary headaches reported in the literature are mostly arachnoid cysts, pineal cysts, hyperintense white matter lesions, developmental abnormalities, Chiari malformations and vascular anomalies (10, 14, 15).

Moreover, an assessment of the cranial imaging findings of 225 healthy asymptomatic pediatric patients revealed abnormalities in 21% of the total, of whom 36% were followed up, and 2% (cerebellar tonsillar lesion in 1 patient) required emergency interventions (16).

In the present study, imaging was performed on the vast majority of cases, and pathological findings were detected by imaging methods in 51.9%. That said, concurring with the studies mentioned above, the majority of these abnormalities were not considered to be directly related to the patient's headache, and so were not decisive in treatment planning.

Conclusion

It was found in the present study that the majority of childhood headaches were benign, the leading causes were tension-type headache, infection and migraine, and imaging methods had a little diagnostic contribution. Despite the high rate of abnormal imaging findings, they offer little to the follow-up of headaches. The etiology of the headache can be clarified through a detailed clinical assessment of patients presenting with headaches, with imaging methods being useful only in selected cases.

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Conflict of Interest Statement
The author has no conflicts of interest to declare.

Ethical Approval
The study was conducted in line with the principles of the Helsinki Declaration and approved by the Ethics Committee (Süleyman Demirel University Faculty of Medicine Clinical Research Ethics Committee, 12.01.2022-25).

Consent to Participate and Publish
Written informed consent to participate and publish was obtained from all individual participants included in the study.

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Availability of Data and Materials
Data are available on request due to privacy or other restrictions.

Authors Contributions
MA: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Validation; Visualization; Writing-original draft.

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