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MAGNETIC RESONANCE IMAGING – WHAT IMPORTANT FINDINGS CAN IT SHOW IN CHILDREN WITH HEADACHE?

BADANIE MR – JAKIE ISTOTNE PATOLOGIE MOŻNA W NIM WYKAZAĆ U DZIECI Z BÓLAMI GŁOWY?

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Abstract

Introduction: *Even though it is not justified to perform computed tomography (CT) and magnetic resonance imaging (MRI) in children with headaches only, these examinations are still performed. As a continuation of a previous work from our centre concerning the value of neuroimaging in the diagnostics of headaches in children, the material was collected from consecutive years and significant neurological abnormalities detected by MRI in those cases are presented.*

Material and methods: *1000 MR examinations, performed in the years 2007-2012 due to headaches were analysed. In 400 cases MR angiography was performed as an addition to brain scan. The examinations were performed with use of GE Signa HDxt 1.5T scanner according to the routine protocol.*

Results: *Negative results – no abnormalities – were obtained in 457 children (45.7%). Positive results (in 543 children, 54.3%) were divided into mild (not influencing patient management) and significant (requiring more diagnostic procedures or therapeutic intervention). Significant ear, nose and throat changes were excluded. The percentage of significant neuroradiological changes in the analysed material was 5.6%. Among these there were: brain tumours in 4 children (0.4%), aneurysms in 2 (0.2%), Chiari I malformation in 5 (0.5%), isolated internal hydrocephalus in 6 (0.6%), postischemic scar in 11 (1.1%), hypoplasia of intra- or extracranial arteries in 6 (0.6%), non-specific T2-hyperintense lesions requiring further investigation in 18 (1.8%), cavernous haemangioma in 3 (0.3%), capillary haemangioma in 1 (0.1%).*

Conclusion: *Rarity of clinically relevant changes in the brain causes that neuroimaging studies should not be routinely carried out in the diagnosis of patients reporting headaches only. If, however, the decision is made to perform them, magnetic resonance imaging should be a method of choice.*

Key words: magnetic resonance imaging (MRI), brain, headache, children

Streszczenie

Wprowadzenie: *Mimo braku uzasadnienia dla wykonywania kosztochłonnych badań (tomografii komputerowej – TK i rezonansu magnetycznego – MR) u dzieci zgłaszających jedynie bóle głowy, są one ciągle wykonywane. Kontynuując pracę z naszego ośrodka, dotyczącą wartości badań neuroobrazowych w diagnostyce bólów głowy u dzieci zebrano materiał z kolejnych lat i przedstawiono istotne neurologicznie nieprawidłowości stwierdzone w badaniu MR w tych przypadkach.*

Materiał i metody: *Przeanalizowano 1000 badań MR, wykonanych w latach 2007-2012 z powodu bólów głowy u dzieci. W 400 przypadkach dodatkowo wykonano angiografię MR. Badania wykonano aparatem GE HDxt Signa o natężeniu pola magnetycznego 1,5 T według rutynowego protokołu.*

Wyniki: *Ujemne wyniki – brak odchyleń od stanu prawidłowego – uzyskano u 457 dzieci (45,7%). Dodatnie (stwierdzone u 543 dzieci, 54,3%) podzielono na łagodne (niezmieniające postępowania z pacjentem) i istotne (wymagające rozszerzenia diagnostyki/interwencji terapeutycznej). Z analizy wyłączono istotne zmiany laryngologiczne. Odsetek zmian istotnych z zakresu neuroradiologii wyniósł w analizowanym materiale 5,6%. Były to: guzy mózgu u 4 dzieci (0,4%), tętniak u 2 (0,2%), zespół Chiari'ego I u 5 (0,5%), izolowane wodogłowie wewnętrzne u 6 (0,6%), blizna poudarowa u 11 (1,1%), hipoplazja tętnic*

dogłowowych i wewnątrzczaszkowych u 6 (0,6%), niespecyficzne ogniska hiperintensywne w obrazach T2-zależnych wymagające dalszej diagnostyki u 18 (1,8%), naczyniak jamisty u 3 (0,3%), naczyniak włośniczkowy u 1 (0,1%).

Wnioski: *Rzadkość występowania istotnych klinicznie zmian w mózgu powoduje, że badania neuroobrazowe nie powinny być rutynowo stosowane w diagnostyce pacjentów zgłaszających jedynie bóle głowy. Jeżeli podejmuje się jednak decyzję o ich wykonaniu, to należy wybrać metodę rezonansu magnetycznego.*

Słowa kluczowe: rezonans magnetyczny (MR), mózg, bóle głowy, dzieci

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INTRODUCTION

The studies conducted so far indicate that cost-intensive studies (computed tomography – CT and magnetic resonance imaging - MRI) are not justified in children presenting with headache only (1-5). However, pressure from parents and perhaps the fear of medico-legal implications are the reasons why they are still made. In the department of diagnostic imaging of the big paediatric centre referrals for brain MRI and MR angiography (MRA) because of headaches are a daily reality. This would require a separate analysis, but it seems even that referrals with a diagnosis of "headaches" are the most common referrals. Continuing the work from our centre, on the value of neuroimaging in the diagnosis of headache in children (2) the author has collected material from the next years and presented significant abnormalities detected by MRI in these cases.

MATERIAL AND METHODS

1000 MR examinations performed in 2007-2012 because of headaches in children have been analysed. In 400 cases, referrals to the structural study of the brain were accompanied by a referral for MR angiography. All the examinations were performed with use of GE Signa HDxt scanner with a field strength of 1.5T according to the routine protocol: SE sequence, T1-weighted images (T1-WI), axial projection, FSPGR sequence, 3D/T1-WI, sagittal projection, FSE sequence, T2-WI, axial and coronal projection, FLAIR sequence, axial projection, GRE sequence, T2*-WI, axial projection, DWI sequence. MRA was performed using SPGR/3D/TOF sequence.

RESULTS

The division of the results into negative and positive was consistently maintained. Negative results – no deviation from the normal condition – were found in 457 children (45.7%). Positive (reported in 543 children, 54.3%) were divided into mild (not changing the management) and significant (requiring further diagnostics or therapeutic intervention). Due to the lack of data on the management of patients with lesions in the paranasal sinuses, mastoid processes and tonsils, significant ENT changes which led to treatment in this area, were not included in this study. According to the purpose of the study, table I shows only the significant neuroradiological changes. Their prevalence stood at 5.6% of the analyzed material. The types of pathology found are shown in Table I.

DISCUSSION

Computed tomography is based on ionizing radiation. The risk of death from cancer induced by ionizing radiation during CT scans is significantly higher in the paediatric population than in adults. According to *Brenner et al*, in the U.S. up to 170 deaths a year are caused by tumours induced by head CT performed in children who were below 15 years of age at the time of examination. The risk of cancer caused by CT of the head performed in a one-year-old child is 1:1500 (6). For this reason, currently this method is not used in the diagnostic process in case of isolated headaches and is replaced by MRI. Computed tomography remains the method of choice in the diagnosis of post-traumatic lesions. The choice of method is also affected by higher resolution of magnetic resonance imaging. Lower resolution of CT makes it necessary to repeat the study after contrast medium administration, doubling the dose of radiation, and adding the problem of potential risk associated with the use of iodinated contrast media.

MRI does not expose to ionizing radiation. However, a much longer duration of the study, during which the child should be fixed in order to avoid motion artifacts, which may even make it impossible to assess the images, is a factor that hinders its performance, since small children and those who do not cooperate, require an aesthesia during the study. The referring physician is obliged to inform the parents about it. The study must be performed on an empty stomach, a score of peripheral blood counts and serum creatinine levels must be assessed. Infection on the day of MRI may result in withdrawal of anesthesia.

According to different authors in children with headache neuroimaging does not reveal evidence of any deviation from the normal condition in 41% (2) up to 95% of the cases (3). Such a large difference is due to different classification of the changes: some authors include anatomical variants in changes, while others treat them as normal findings; benign changes are also variously classified. The same is true for the more important

Table I. Clinically significant lesions in the analysed material.
Tabela I. Istotne klinicznie zmiany w analizowanym materiale.

Kind of lesion *Patologia*	Number of patients	% *Odsetek*
Cerebral tumour *Guz mózgu*	4	0.4
Aneurysm *Tętniak*	2	0.2
Chiari I malformation *Zespół Chiari'ego I*	5	0.5
Isolated internal hydrocephalus *Izolowane wodogłowie wewnętrzne*	6	0.6
Postischemic scar *Blizna poudarowa*	11	1.1
Hypoplastic intra- or extracranial arteries *Hipoplazja tętnic dogłowowych i wewnątrzczaszkowych*	6	0.6
Non-specific T2-hyperintense lesions requiring further investigation *Niespecyficzne ogniska hiperintensywne w obrazach T2-zależnych wymagające dalszej diagnostyki*	18	1.8
Cavernous haemangioma *Naczyniak jamisty*	3	0.3
Capillary haemangioma *Naczyniak włośniczkowy*	1	0.1
	56	5.6

percentage of significant changes which is as follows: according to *Duczkowska et al* it is just over 2% (2.4%), according to *Schwedt et al* – up 9.5% (2, 4). However, if the changes that *Duczkowska et al* treat as benign are not taken into account, this percentage is reduced to 5.4%. A similar percentage of significant changes was found in this study – 5.6%.It should be noted that the weakness of this study is the lack of knowledge of the management of patients with laryngological findings. Taking into account the different degrees of severity of these changes one can conclude that in some patients they did not change the management, but in some these findings resulted in antibiotic treatment, sinus puncture, ear drainage or tonsils resection. For this reason, they should be classified as significant changes (changing the patient's management, requiring treatment) which would significantly increase their percentage. However, this work is neuroradiological and only neuroradiological findings are included. Besides, ENT changes do not require MRI of the head for the diagnosis which is mainly clinical.

Considering the neuroradiological findings one should answer the question, if they can alter the diagnosis and treatment of the patient and if these changes may be a cause of headaches.

Many of the changes considered as benign are incidental findings during the examination and are not related to headaches. One should include developmental variations in this category, such as asymmetry of the lateral ventricles, cavum septi pellucidi, cavum Verge, mega cisterna magna, anatomical variants of the cerebral arteries. Among the latter the most common are: posterior communicating artery hypoplasia or fetal configuration of the circle of Willis (7).

It is more difficult to determine whether there is a relationship between headaches and hypoplasia of one of the vertebral arteries in a child, in whom other intracerebral vessels are normal (fig. 1). In the analysed material there were 5 children (0.5%) with hypoplastic right vertebral artery, which is often narrower than the left one. The vertebrobasilar system provides about 30% of arterial blood to the brain, and the internal carotid arteries (ICA) – about 70% (8). Therefore, hypoplasia of one of the major vessels supplying the brain – ICA – does not raise such concerns. In our material there was one case of such a lesion (0,1%) (fig. 2), that is observed threefold more frequently on the left side than on the right (9). It may be clinically silent if the collateral circulation had been formed but it may carry serious consequences in the older age if it is not diagnosed: e.g. in case of endarterectomy, carotid ligation or transsphenoidal surgery. Besides as much as one-third of patients with ICA hypoplasia have intracranial aneurysms as well (10).

In two cases (0.2%), MRI and MRA revealed the presence of an aneurysm: in bifurcation of the right ICA in a 15-year-old girl (fig. 3) and in the middle cerebral artery bifurcation of a 16-year-old girl (fig. 4). Cerebral aneurysms are extremely rare in children, and if present, they are usually found in this location, with a slight female predominance (11). The cases in the analysed material are therefore consistent with the data from literature, and their relationship with headache is unquestionable.

Fig. 1. A 15-year-old girl with headaches, without neurological signs and symptoms. MR angiography, arterial phase. Right vertebral artery hypoplasia, only left VA and basal artery are visible.

Ryc. 1. 15-letnia dziewczynka z bólami głowy, bez objawów neurologicznych. Badanie angio-MR w fazie tętniczej. Hipoplazja prawej tętnicy kręgowej, widoczna jest tylko lewa tętnica kręgowa i tętnica podstawna.

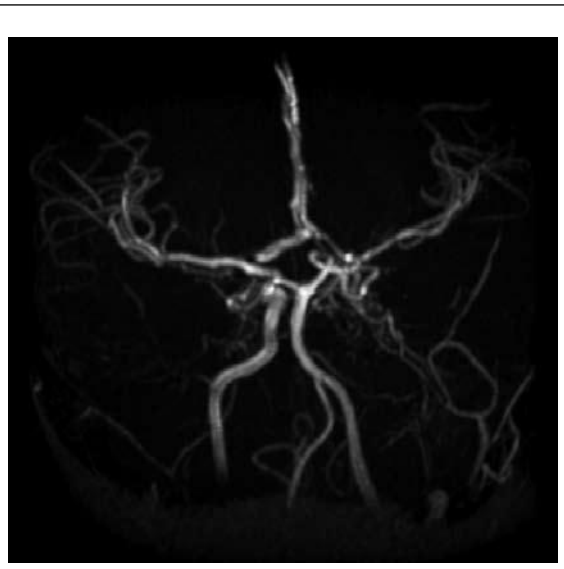

Fig. 2. A 13-year-old boy with headaches, without neurological signs and symptoms. MR angiography, arterial phase. Left internal carotid artery hypoplasia, a network of abnormal vessels is visible in its vicinity, reflecting most likely collateral circulation.

Ryc. 2. 13-letni chłopiec z bólami głowy, bez objawów neurologicznych. Badanie angio-MR w fazie tętniczej. Hipoplazja lewej tętnicy szyjnej wewnętrznej, widoczna jest siateczka nieprawidłowych naczyń w jej miejscu, najpewniej krążenie oboczne.

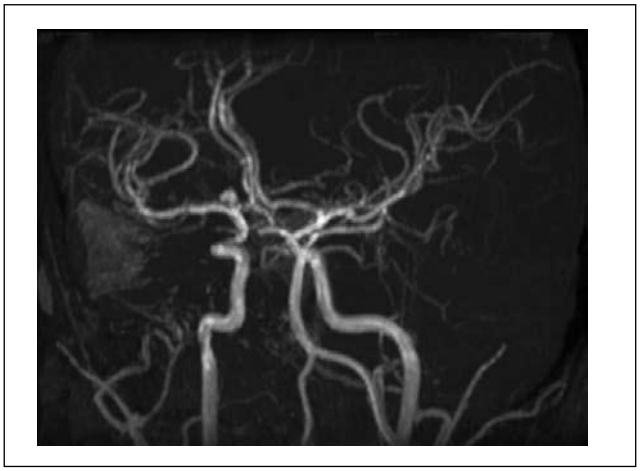

Fig. 3. A 15-year-old girl with headaches, without neurological signs and symptoms. MR angiography, arterial phase. An aneurysm in the right internal carotid artery bifurcation.

Ryc. 3. 15-letnia dziewczynka z bólami głowy, bez objawów neurologicznych. Badanie angio-MR w fazie tętniczej. Tętniak w rozwidleniu prawej tętnicy szyjnej wewnętrznej.

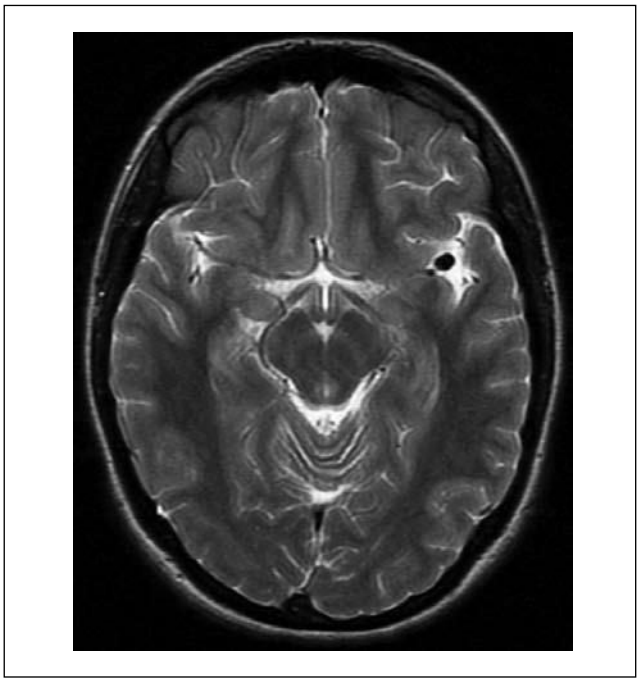

Fig. 4. A 16-year-old girl with headaches, without neurological signs and symptoms. MRI, FSE/T2-weighted image, axial plane. An aneurysm in the left middle cerebral artery bifurcation.

Ryc. 4. 16-letnia dziewczynka z bólami głowy, bez objawów neurologicznych. Badanie MR, obraz FSE/T2-zależny, projekcja poprzeczna. Tętniak w miejscu podziału lewej tętnicy środkowej mózgu.

In three cases (0.3%) MRI revealed cavernous haemangioma. These changes are often clinically silent, and only discovered incidentally and observed. Some of them, however, require neurosurgical treatment (12). In one case (0.1%) we found a different lesion with clear contrast enhancement and classified it as capillary haemangioma (fig. 5). Intracerebral capillary haemangioma is a rare finding and usually surgery is the treatment of choice (13).

In some cases it is difficult to assess the significance of the MRI findings. This statement concerns the arachnoid cysts and pineal cysts. The experience of the radiologists is that follow-up studies do not show their progression and the need for neurosurgical intervention and therefore they are classified as benign, but neurosurgeons still refer patients for check-ups. Similarly, venous angiomas are not an indication for intervention: neither of the interventional radiologist nor of the neurosurgeon. Based on 22 years of personal neuroradiological experience and on literature data these three types of lesions were omitted and not included in the significant changes (14-16). However it is difficult to determine whether the headaches in these patients may be related to their presence.

Most of nonspecific T2-hyperintense lesions are included in the group of benign changes. They are attributed to, among others, hypoxia in the past, usually in the perinatal period, if they are unambiguous on MRI and they are then considered as not requiring follow-up studies. Headaches by themselves lead – in an undetermined mechanism, probably ischemic – to the formation of hyperintense lesions in individuals who suffer from them. So far it has not been explained finally, whether the cause is vascular spasm or emboli (17). However, some hyperintense foci - for various reasons – raise concern, require further evaluation and follow-up examinations to assess their dynamics. There were 18 such cases (1.8%) in the analysed material. In the most serious of them, detected changes most probably reflected acute disseminated encephalomyelitis (ADEM) (fig. 6). MR appearance of this disease is fairly typical if it stays in agreement with the clinical picture, which includes symptoms of multifocal damage to the central nervous system, monophasic course, usually after infection (18). However, isolated headache as the first symptom of the disease is a very atypical clinical picture.

It happens that the lesions detected by neuroimaging remain unexplained despite extensive diagnostics and the passage of time, and their causal relationship with the headaches that made a doctor perform neuroimaging studies also remains unclear (fig. 7).

It is difficult to determine whether the headaches are associated with a history of previous (e.g. *in utero)* ischemic incident. If the postischemic scar is diagnosed in a child with headache (and there is no history of head injury that would justify the scar), further diagnostic process of the cardiovascular system is necessary (fig. 8). In the analysed material there were 11 such cases (1.1%).

In some cases, significant changes are detected in children referred to MRI due to headaches which require further diagnostics, neurosurgical consultation and/or follow-up studies. Among these changes there is tonsillar

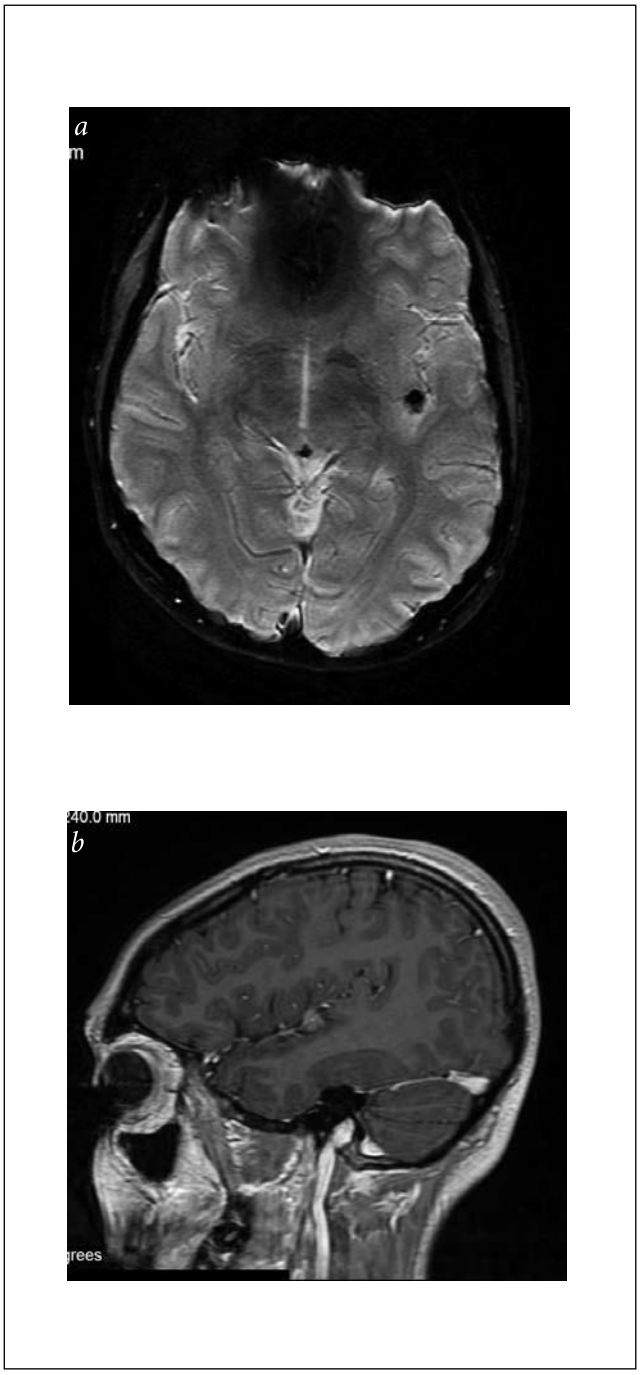

Fig. 5. Fig. 4. An 18-year-old girl with headaches, without neurological signs and symptoms. Capillary haemangioma.
a. MRI, SWI sequence, axial plane. Hypointense lesion in the posterior insular cortex on the left side.
b. MRI, FSE/T1-weighted image, sagittal plane. Contrast enhancement of the haemangioma and the feeding artery after gadolinium administration.

Ryc. 5. 18-letnia dziewczynka z bólami głowy, bez objawów neurologicznych. Naczyniak włośniczkowy.
a. Badanie MR, sekwencja SWI, projekcja poprzeczna. Ubogosygnałowe ognisko w korze tylnej części lewej wyspy.
b. Badanie MR, obraz FSE/T1-zależny po podaniu gadolinu, projekcja strzałkowa. Wzmocnienie kontrastowe zmiany i doprowadzającego naczynia.

Fig. 6. An 8-year-old boy with headaches which were attributed by the mother to stress after parents' divorce. MRI, FLAIR sequence, coronal plane. Two hyperintense cortical-subcortical lesions in both cerebral hemispheres – ADEM.

Ryc. 6. 8-letni chłopiec z bólami głowy wiązanymi przez matkę ze stresem dziecka po rozwodzie rodziców. Badanie MR, sekwencja FLAIR, projekcja czołowa. Dwa korowo-podkorowe ogniska hiperintensywne w obu półkulach mózgu – ADEM.

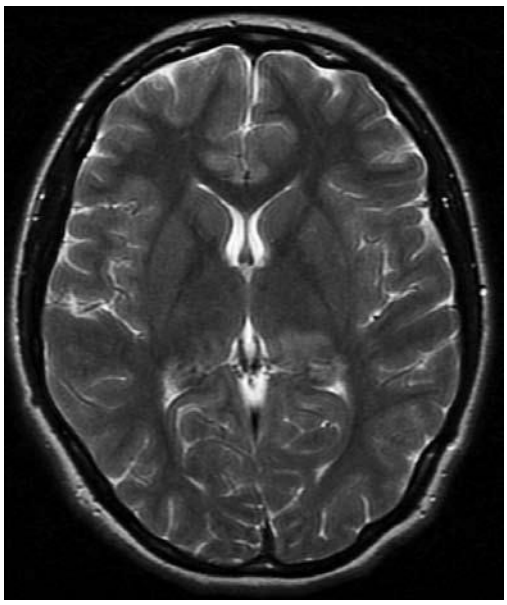

Fig. 7. A 17-year-old girl with headaches, without neurological signs and symptoms. At least third follow-up MRI study, FSE/T2-weighted image, axial plane. Stable lesions in both thalami, more extensive on the left side, that have been followed without progression for 8 years.

Ryc. 7. 17-letnia dziewczynka z bólami głowy, bez objawów neurologicznych. Kolejne (co najmniej trzecie) kontrolne badanie MR, obraz FSE/T2-zależny, projekcja poprzeczna. Stabilne w czasie zmiany w obu wzgórzach, bardziej nasilone po stronie lewej, obserwowane bez progresji od 8 lat.

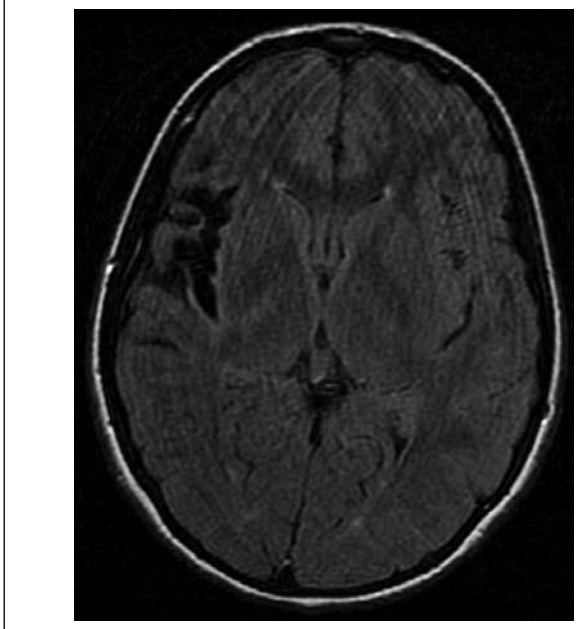

Fig. 8. A 13-year-old girl with headaches, without neurological signs and symptoms, without other known diseases, with no history of perinatal problems. MRI, FLAIR sequence, axial plane. A scar is seen in the right fronto-temporal region with fluid and glia elements.

Ryc. 8. Dziewczynka 13-letnia z bólami głowy, bez objawów neurologicznych, bez znanych innych schorzeń, z nieobciążonym wywiadem okołoporodowym. Badanie MR, sekwencja FLAIR, płaszczyzna poprzeczna. W prawej okolicy czołowo-skroniowej widoczna jest płynowa blizna z dyskretnymi elementami gliozy widocznymi na obwodzie w postaci pasemek wzmożonego sygnału.

ectopia. It is considered as pathologic if they are located more than 6 mm below the foramen magnum (fig. 9). This condition requires spinal MRI to rule out Chiari II malformation, and neurosurgical consultation, especially if tonsillar ectopia is accompanied by hydrocephalus. In our material there were 5 cases (0.5%) of Chiari I malformation in which there is no myelomeningocoele. This malformation can be treated by neurosurgical decompression of the cranio-cervical junction, but the neurosurgeon may decide about conservative management with periodic follow-up MRI (19).

It is similar in case of isolated hydrocephalus or hydrocephalus caused by pathological intracranial mass. In the analysed material there were 6 cases of isolated ventriculomegaly (0.6%) and two tumours causing hydrocephalus (0.2%) – benign tectal masses (BTM) (fig. 10).The management of these tumours differs depending on symptoms they cause and dynamics of their growth: from observation by means of MRI by ventriculo-peritoneal shunt in case of active hydrocephalus, as in the cases described, to radio-and chemotherapy (20).

Besides, in the analysed group of patients there was yet another case of tumour of benign morphology on

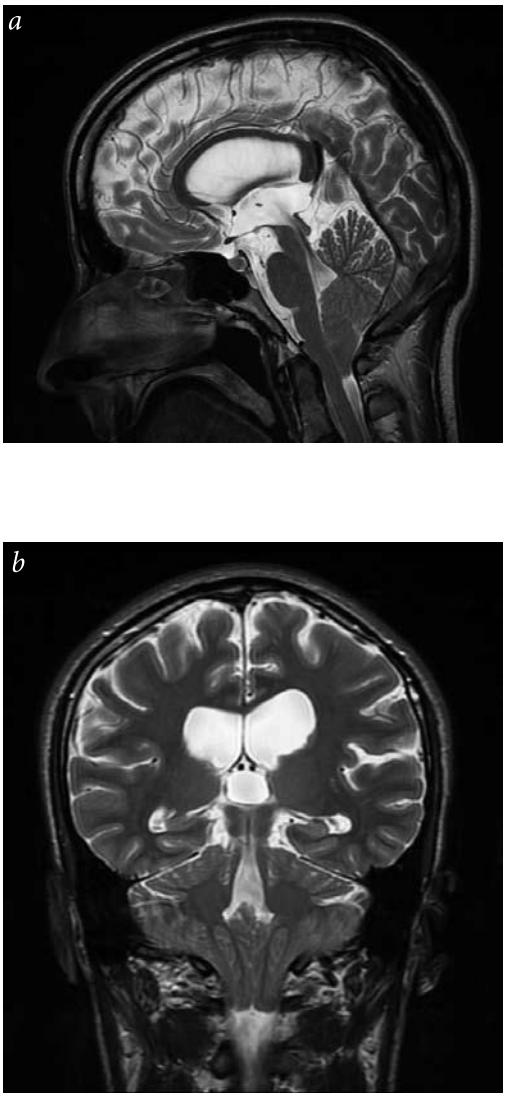

Fig. 9. An 11-year-old boy with headaches, without neurological signs and symptoms. MRI study, FSE/T2-weighted images. Tonsillar ectopia with depth of 11 mm is seen in the sagittal plane (a). Non-active supratentorial ventriculomegaly is observed in the coronal projection (b).

Ryc. 9 Chłopiec 14-letni z bólami głowy, bez odchyleń od stanu prawidłowego w badaniu neurologicznym. Badanie MR, obrazy FSE/T2-zależne. W płaszczyźnie strzałkowej widoczne jest wgłobienie migdałków móżdżku na ok. 11 mm w głąb kanału kręgowego (a). W płaszczyźnie czołowej (b) stwierdza się poszerzenie układu komorowego nadnamiotowego, bez cech przesiękania płynu mózgowo-rdzeniowego do tkanki mózgu.

Fig. 10. A 20-year-old man at the moment of this follow-up examination of the benign midbrain tegmental tumor, which was diagnosed at the age of 16 on MRI study performed because of headaches. The tumour was then accompanied by active hydrocephalus. Ventriculo-peritoneal shunt was implanted. The tumour is followed on MRI and does not show progression.
a. FLAIR sequence, axial plane. Hyperintense tumour mass as a cause of the third ventricle's dilatation. No oedema of the surrounding tissue is seen.
b. FSE/T2-weighted image in the sagittal plane shows shows how the tumour prevents the outflow of cerebrospinal fluid from the ventricular system, causing obstruction of the cerebral aqueduct.

Ryc. 10. Mężczyzna 20-letni w chwili, kolejnego badania kontrolnego łagodnego guza nakrywki śródmózgowia, stwierdzonego w wieku lat 16 w badaniu MR wykonanym z powodu bólów głowy. Wówczas rozpoznano guz j.w., z wodogłowiem i cechami przesiękania płynu mózgowo-rdzeniowego. Założono zastawkę komorowo-otrzewnową. Guz jest jedynie kontrolowany w badaniu MR i nie wykazuje cech progresji.
a. Sekwencja FLAIR, płaszczyzna poprzeczna. Hiperintensywna (jasna) w porównaniu z tkanką mózgu masa guza powoduje poszerzenie komory III. Nie stwierdza się obrzęku otaczającej tkanki.
b. Obraz FSE/T2-zależny, w projekcji strzałkowej pokazuje, w jaki sposób guz uniemożliwia odpływ płynu mózgowo-rdzeniowego z układu komorowego, powodując niedrożność wodociągu mózgu.

MRI without the widening of the ventricular system (fig. 11). At the time of writing this paper I still have no information about the treatment of this patient.

The above considerations apply to otherwise healthy children with headaches who do not show any neurological symptoms. As already mentioned, the results of the analyses do not support the need for neuroimaging in these children. In contrast, the problem of headache should be treated differently in children with a family history (e.g. brain tumour in the family – fig. 12) or with a known malignancy, even if, according to the standards it is considered cured. In these latter patients headache, especially if absent earlier, stronger, or of a different nature, may indicate a recurrence (fig. 13) or metastatic spread of a primary tumour (fig. 14).

Headaches can also be attributed to the extracerebral changes. These include sinusitis, inflammatory changes of the ears, hypertrophied adenoid tonsil and palatine tonsils (fig. 15). The face is in the field of view of brain MRI, so the radiologist should always report the changes seen in this localisation, which in most cases eliminates the need for the diagnostic X-ray methods. MRI cannot be

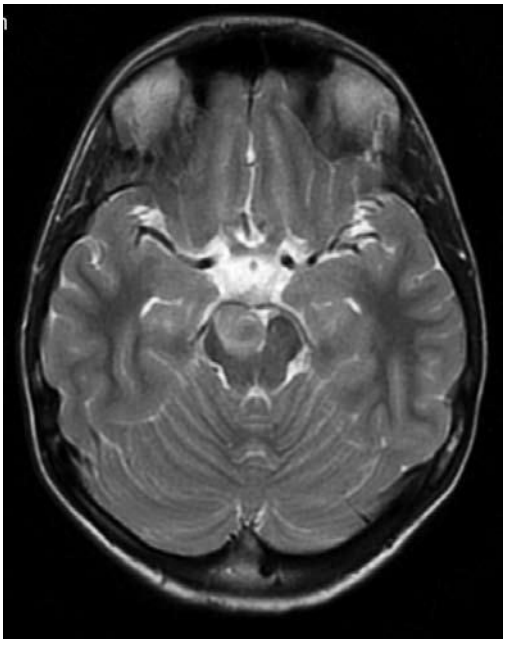

Fig. 11. A 12-year-old boy with headaches, without neurological signs and symptoms. MRI, FSE/T2-weighted image, axial plane. Pathological mass in the right cerebral peduncle without oedema of the surrounding tissue, with only trace of contrast enhancement (not shown). Lesion's morphology suggests a benign, slowly growing tumour.

Ryc. 11. 12-letni z bólami głowy, bez objawów neurologicznych. Badanie MR, obraz FSE/T2-zależny, projekcja poprzeczna. Patologiczna masa zajmująca częściowo prawy konar mózgu, bez cech obrzęku otaczającej tkanki mózgu, ze śladowym jedynie wzmocnieniem kontrastowym (tu niepokazane). Morfologia zmiany wskazuje na łagodny, wolno rosnący guz.

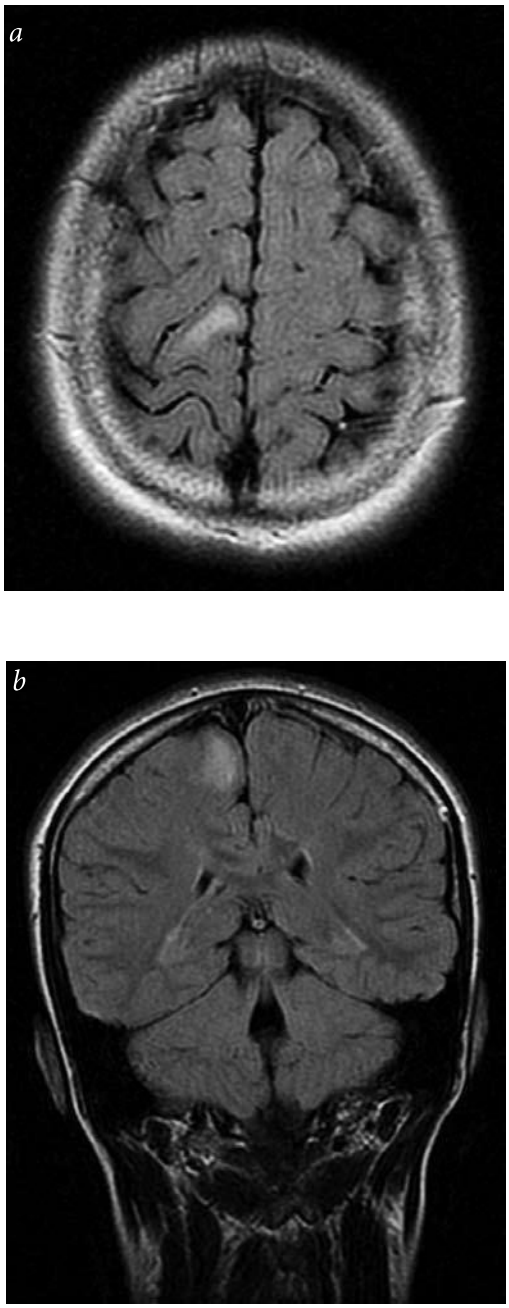

Fig. 12. A 13-year-old girl with headaches, without neurological signs and symptoms. The girl's father died of brain tumour (unknown pathological diagnosis) at the age of 27. MRI, FLAIR sequence in axial (a) and coronal (b) planes shows a hyperintense, subcortical lesion widening the cortical gyrus. MRI is suggestive of highly differentiated glioma.

Ryc. 12. 13-letnia dziewczynka z bólami głowy, bez objawów neurologicznych. Z wywiadów wiadomo, że ojciec dziewczynki zmarł w wieku 27 lat z powodu guza mózgu (brak danych o rozpoznaniu histopatologicznym). Badanie MR, sekwencja FLAIR w projekcji poprzecznej (a) i czołowej (b) wykazuje obecność podkorowo położonej zmiany o nieprawidłowo wzmożonym (hiperintensywnym) sygnale, poszerzającej zakręt. Po podaniu gadolinu nie uzyskano wzmocnienia kontrastowego tej zmiany. Obraz MR wskazuje na wysoko zróżnicowany glejak jednozawojowy.

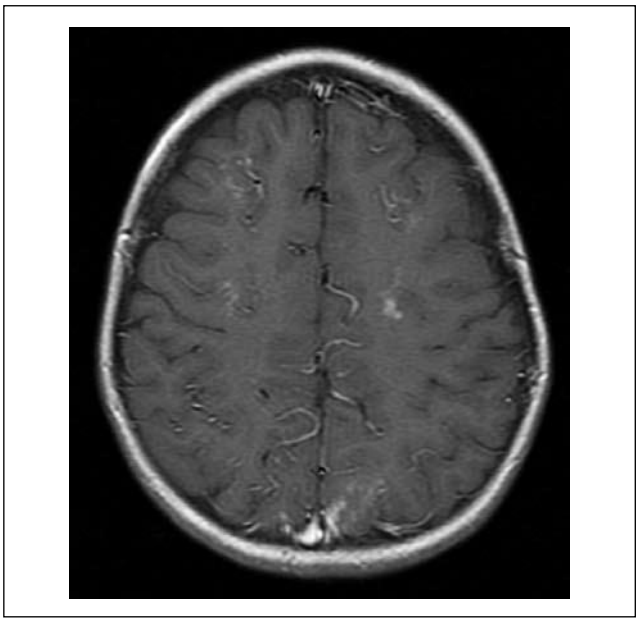

Fig. 13. A 4-year-old-boy with severe headache for a few days before examination, without neurological signs and symptoms. He has a history of acute lymphoblastic leukaemia. CT scan one day before MRI – normal. MRI, SE/T1-weighted image after gadolinium administration. Contrast enhancement within the cortical grooves and parenchymal. MRI indicates leukaemic infiltration (recurrence) or neuroinfection.

Ryc. 13. 4-letni chłopiec z silnymi bólami głowy od kilku dni przed badaniem, bez odchyleń od stanu prawidłowego w badaniu neurologicznym. W wywiadach ostra białaczka limfoblastyczna. Badanie TK wykonane w przeddzień badania MR – wynik prawidłowy. Badanie MR, obraz SE/T1-zależny po podaniu środka kontrastowego. Wzmocnienie kontrastowe opony miękkiej w rzucie rowków sklepistości mózgu, ale również śródmiąższowe. Obraz wskazuje na naciek białaczkowy (wznowę) lub zapalny (neuroinfekcję).

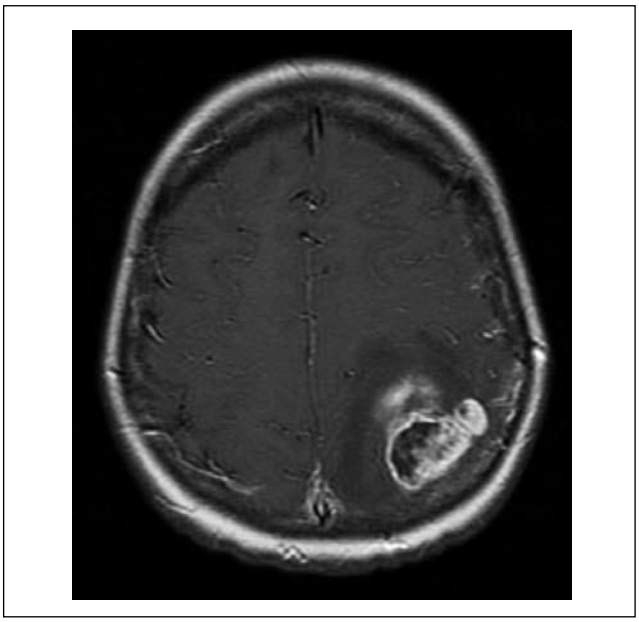

Fig. 14. An 18-year-old girl with malignant mesenchymoma of the pelvis and lung metastases. Very severe headache of sudden onset on the day of the examination. MRI, SE/T1-weighted image after gadolinium administration. MRI diagnosis – brain metastasis. Strong contrast enhancement of the lesion, the surrounding oedema is not enhanced.

Ryc. 14. 18-letnia dziewczynka z rozpoznanym i leczonym mesenchymoma malignum miednicy, z przerzutami do płuc. Bardzo silny ból głowy o nagłym początku. Badanie MR wykonane w dniu wystąpienia bólu, obraz SE/T1-zależny po dożylnym podaniu środka kontrastowego. Rozpoznanie na podstawie badania MR – przerzut. Silne wzmocnienie kontrastowe przerzutu, otaczająca strefa obrzęku pozostaje niewzmocniona.

used to assess the bony walls of the sinuses, but swollen, thickened, inflamed mucosa is very clearly visible, especially on T2-weighted images, in which it displays a strong signal. The same applies to inflammatory changes in the mastoid processes. If they contain air, they display signal void - are completely black on T2-weighted images. Inflammatory changes, as in paranasal sinuses, are T2-hyperintense (bright) (fig. 16).

CONCLUSIONS

Rarity of clinically relevant changes in the brains of patients with headaches only is the reason why the neuroimaging studies should not be routinely used in their diagnostics. If, however, one makes a decision to perform neuroimaging, MRI should be a method of choice.

Fig. 15. A 15-year-old girl with headaches, without neurological signs and symptoms. Brain MRI – normal. FSE/T2-weighted image in the sagittal plane shows adenotonsillar hypertrophy, virtually closing the airways.

Ryc. 15. 15-letnia dziewczynka z bólami głowy, bez odchyleń od stanu prawidłowego w badaniu neurologicznym. Badanie MR mózgu bez zmian patologicznych. W obrazie FSE/T2-zależnym w płaszczyźnie strzałkowej uwidoczniono przerośnięty migdałek gardłowy, praktycznie zamykający światło dróg oddechowych.

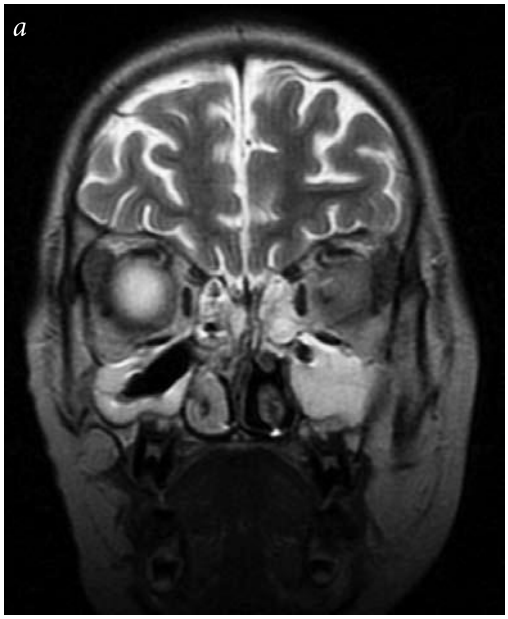

Fig. 16. A 7-year-old girl with headaches, without neurological signs and symptoms. MRI, FSE/T2-weighted images. Inflammatory changes almost completely filling both ethmoid and left maxillary sinuses are found in the coronal plane (a). In the axial projection (b) one can also see inflammatory changes in the mastoid processes, more extensive on the left side.

Ryc. 16. 7-letnia dziewczynka z bólami głowy, bez neurologicznych objawów ogniskowych. Obrazy FSE/T2-zależne. W płaszczyźnie czołowej (a) widoczne są zmiany zapalne wypełniające niemal całkowicie komórki sitowia obustronnie oraz lewą zatokę szczękową. Znaczne przyścienne zgrubienia śluzówki są widoczne w prawej zatoce szczękowej. Pogrubiałe małżowiny w prawej jamie nosa. W płaszczyźnie poprzecznej (b) poza zajęciem zatok stwierdzono również zmiany zapalne w wyrostkach sutkowatych: nasilone po stronie lewej, śladowo widoczne po prawej.

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