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Features of cerebral hemodynamics during treatment of Migraine paroxysm

Kalashnikov V Y
Department of Neurology, Neurosurgery and Psychiatry. Uzhhorod, National University, Uzhhorod, Ukraine

Abstract
Objective: To study the state of cerebral hemodynamics during drug-induced relief of migraine attacks in patients.
Materials and metods: Fifty-seven young patients with migraine were examined (32 patients with migraine without aura, 25 patients with migraine with aura). The time-averaged maximum blood flow velocity (TAMX) and resistance indices (RI) were measured in the internal carotid arteries (ICA), middle cerebral arteries (MCA), external carotid arteries (ECA), and vertebral arteries (VA). All patients were prescribed sumatriptan orally at a dose of 50 mg (1 tablet) during an attack.
Results: Increased TAMX values in the MCA and decreased RI values were noted in Group 1. In patients of Group 2, TAMX values in the MCA and VA and RI values in the MCA were increased. Asymmetry in flow velocity in the MCA and VA and a decrease in RI values in the ECA were also noted. Normalization of RI values in the ECA was observed with sumatriptan administration.
Conclusions: 1. Cerebral hemodynamics in the middle cerebral arteries during a migraine attack is characterized by a pattern of vasospasm in migraine without aura and a pattern of difficult perfusion in migraine with aura.
2. A characteristic feature of hemodynamics during a migraine attack is excessive blood filling of the external carotid arteries.
3. The positive effect of imigran during a migraine attack is manifested not only in the relief of pain, but also in the stabilization of cerebral hemodynamics in the form of optimization of blood flow in the ECA and normalization of peripheral resistance indices in the MCA.

Keywords: Migraine, cerebral hemodynamics, Doppler Sonography, sumatriptan

Introduction

Migraine is currently one of the most common types of primary headache, with a prevalence of 20-25% in the population. Diagnosis and differentiated treatment of migraine attacks are pressing issues in modern neurology [1, 2]. The method of Doppler Sonography (DS) of the main vessels of the head has long been successfully used to diagnose lesions of the extracranial and intracranial sections of the main arteries. Recently, a fairly large number of studies have been published devoted to the study of cerebral hemodynamic disorders in patients with migraine with and without aura, between attacks and during an attack [3, 6]. A substantial body of evidence supports the vascular hypothesis of migraine pathogenesis [6, 9]. In the "aura-phase migraine" model, the primary role is attributed to vasoconstriction in the intracranial vasculature, with subsequent vasodilation considered the cause of the headache phase [2, 7, 8, 10]. The goals of symptomatic treatment are to relieve the acute phase of migraine, reduce the intensity of associated symptoms, and shorten the duration of the attack. It is clinically appropriate to prescribe specific medications to such patients to control a migraine attack. This group of medications includes triptans, which are serotonin derivatives and selective 5-HT1 receptor agonists. Triptans act on 5-HT1 presynaptic receptors in the trigeminal nerve endings, preventing the release of neuroinflammatory peptides [2]. Triptans are also agonists of peripheral 5-HT1 receptors and, as a result of their action, cause constriction of dilated blood vessels [11]. In clinical practice, sumatriptan is the most frequently used medication in this group.

Objective: The aim of the study was to examine the state of cerebral hemodynamics during drug-induced relief of migraine attacks in patients with migraine.

Study design: Fifty-seven patients aged 20 to 35 years (9 men, 14 women) were examined.The patients were divided into two groups: Group 1 included 32 patients with migraine attacks without aura. Group 2 included 25 patients with migraine attacks with aura. The control group (CG) consisted of 20 subjects of the same gender and age.
Cerebral hemodynamics were studied using an Ultima - PA ultrasound scanner manufactured by RADMIR (Kharkiv, Ukraine). Time-averaged maximum blood flow velocity (TAMX) and resistance indices (RI) were measured in the internal carotid arteries (ICA), middle cerebral arteries (MCA), external carotid arteries (ECA), and vertebral arteries (VA). All patients were given sumatriptan orally at a dose of 50 mg (one tablet) during an attack.

Results and discussion

A study of TAMX velocity indicators in cerebral arteries revealed the following patterns. In patients of both groups, the TAMX and RI indices in the ICA did not differ from the norm, RI indices in the VA were also within the norm in both groups. In Group 1, blood flow indices in the MCA were slightly higher than those in the control group, while the RI values were below the norm. In patients of Group 2, a decrease in velocity indices in the MCA and VA was observed, with an increase in RI values in the MCA in this group. Also, in this group, the majority of patients (58.9%) had flow velocity asymmetries (25-30%) in the MCA and VA. Velocity parameters and RI indices in the ECA were reduced in both groups, which is probably due to their dilation during an attack. (Tables 1, 2).

Table 1: TAMX values (cm/s) in the main arteries in patients with migraine.

	ICA	MCA	ECA	VA
CG	43.1 ± 6.2	61.6 ± 5.1	36.9 ± 6.7	36.7 ± 4.6
Group 1	44.1 ± 6.4	65.7 ± 6.1	20.6 ± 7.2 *	40.1 ± 6.1
Group 2	44.1 ± 7.1	48.4 ± 6.3*	21.7 ± 4.8 *	23.8 ± 5.3 *

* $p < 0.05$

Table 2: RI values in the main arteries in patients with migraine.

	ICA	MCA	ECA	VA
CG	0.61 ± 5.1	0.69 ± 4.1	0.77 ± 6.1	0.67 ±4.4
Group 1	0.62 ± 6.9	0.52 ± 5.5 *	0.62 ± 5.2 *	0.68 ±5.6
Group 2	0.61 ± 5.7	0.84 ± 4.3 *	0.61 ± 4.8 *	0.69 ± 5.3

* $p < 0.05$

With normal baseline data, TAMX and RI parameters remained virtually unchanged with sumatriptan administration . The greatest effect of sumatriptan was observed in the ECA, where a trend toward normalization of these parameters was observed, although ultimately TAMX and RI values did not reach the normative values. Normalization of RI values in the MCA was also observed: a decrease in Group 1 and an increase in Group 2, while TAMX values changed only slightly, consistent with the concept of sumatriptan having no significant effect on cerebral blood flow (Figs. 1 and 2).

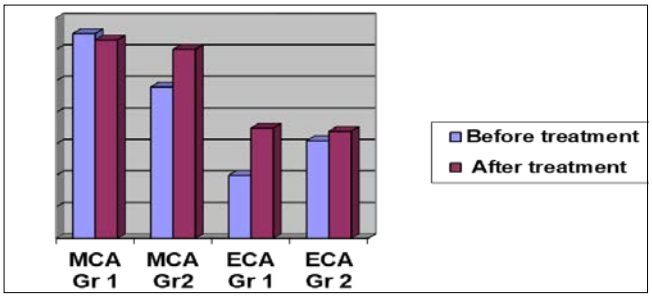

Fig 1: Dynamics of TAMX indices in the MCA and ECA in patients with migraine during treatment with sumatriptan.

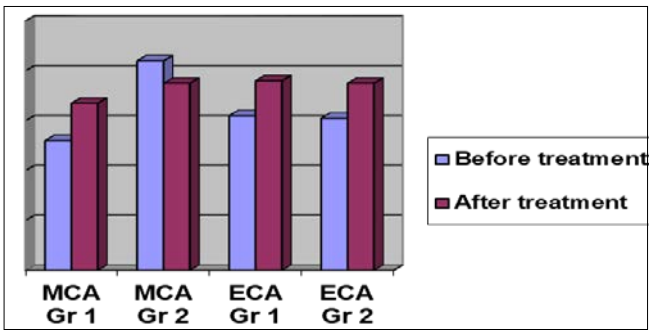

Fig 2: Dynamics of RI indices in the MCA and ECA in patients with migraine during treatment with sumatriptan.

Conclusions

1. Cerebral hemodynamics in the middle cerebral arteries during a migraine attack is characterized by a pattern of vasospasm in migraine without aura and a pattern of difficult perfusion in migraine with aura.
2. A characteristic feature of hemodynamics during a migraine attack is excessive blood filling of the external carotid arteries.
3. The positive effect of sumatriptan during a migraine attack is manifested not only in the relief of pain, but also in the stabilization of cerebral hemodynamics in the form of optimization of blood flow in the ECA and normalization of peripheral resistance indices in the MCA.

Conflict of interest

The author of the manuscript consciously declare that there is no actual or potential conflict of interest regarding the results of this work with pharmaceutical companies, biomedical device manufacturers, other organizations whose products, services, financial support may be related to the subject of the materials provided, or who sponsored the research conducted.

Compliance with ethical standards

The author of the manuscript consciously certify that the study was conducted using data from primary medical records and included clinical observations of patients. The study was conducted in accordance with the ethical standards of the Declaration of Helsinki of the World Medical Association on the ethical principles of conducting scientific medical research involving human subjects, the European Society Directive 86/609 on the participation of humans in biomedical research, as well as the Order of the Ministry of Health of Ukraine No 690 of September 23, 2009. Informed consent to participate in the study was obtained from all participants after providing them with clear, complete and accessible information about the purpose, design and methodology of the study, its potential risks, expected benefits and possible alternatives. All participants confirmed their voluntary participation by signing an informed consent document. Participants had the right to refuse participation at any time without giving reasons. In accordance with confidentiality regulations, all data was collected anonymously and processed in compliance with applicable data protection legislation. All information was used exclusively for this study and was summarized for further analysis of the results.

Primary data and materials

The author of the manuscript consciously declare that the work uses the results of their own clinical studies, which were systematized and analyzed by the authors. Primary data include generalized patient indicators, laboratory results, protocols and obtained quantitative characteristics. All materials are stored in the archive of the research group and can be provided upon reasonable request to the corresponding author, taking into account the requirements of confidentiality and ethical norms.

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