A COMPARATIVE ANALYSIS OF MRI PERFUSION PARAMETERS IN YOUNG PATIENTS WITH VARIOUS METABOLIC SYNDROME PHENOTYPES

Shahboz Abdusodikovich Bobojonov, Akmal Akhmatzhanovich Gaibiev
SAMARKAND MEDICAL UNIVERSITY

Relevance. In recent years, there has been an increase in the incidence of metabolic syndrome among young people: according to epidemiological studies, the prevalence of metabolic syndrome in the 18-40 age group reaches 5-10% and continues to increase due to a sedentary lifestyle and unbalanced diet (1). Metabolic syndrome is accompanied by microcirculatory disorders and endothelial dysfunction, which in the preclinical stages manifest as changes in cerebral blood flow. Early diagnosis of such disorders is critical for preventing cognitive and vascular complications (2).

MRI perfusion allows for the quantitative assessment of cerebral blood flow (CBF), blood volume distribution (CBV), and contrast transit time (MTT) with high spatial and temporal resolution. MRI perfusion is recognized as an effective tool for identifying areas of hypoperfusion in acute and chronic conditions (3). Despite some studies on the use of CT perfusion in vascular and neurodegenerative disorders, there are no data on how CTP parameters vary depending on the predominant metabolic syndrome phenotype (hypertensive, dyslipidemic, insulin resistant) specifically in young patients (4,5).

Comparative analysis of CBF, CBV, TTP and MTT between these groups will allow us to identify early markers of subclinical cerebral hypoperfusion and justify the need for targeted preventive and therapeutic strategies.

Material and methods of the study. A comprehensive examination of 118 young patients with MS was conducted, 57 men (48.3%) and 61 women (51.7%). The patients' ages fell within the following range: young age according to the WHO, 2023 - 18-44 years (mean age 29.6 ± 9.2 years). The duration of the disease at the beginning of the patient examination, according to the anamnesis and analysis of medical records, ranged from 5 to 11 years, averaging 6.1 ± 5.2 years.

In our study, we identified three metabolic syndrome phenotypes:

1. Hypertensive phenotype (CO+ AG) - patients with this metabolic syndrome phenotype, in addition to central obesity (CO), had a predominant symptom of arterial hypertension (AH).

2. Dyslipidemic phenotype (CO+DL) - this phenotype is characterized by CO and lipid metabolism disorders, including severe dyslipidemia (DL).

3. Insulin-resistant phenotype (CO+IR) - this phenotype is primarily characterized by CO and severe insulin resistance (IR), which leads to carbohydrate metabolism disorders.

Therefore, all patients studied were divided into three groups based on their metabolic syndrome phenotype.

Group I (CO+AG) included 41 patients (34.7), average age 36.4+4.8 years, including 25 men (61.0%) and 16 women (39.0%) (here and below the percentage is calculated based on the number of patients in a given group), the m/f ratio (male/female) was 1.6:1.0. Group II (CO+DL) included 32 patients with an average age of 28.6+5.3 years, including 15 men (46.9%) and 17 women (53.1%) (the gender ratio m/f was 0.9:1.0). Group III (CO+IR) included 45 patients aged 24.6+7.1, including 17 men (37.8%) and 58 women (62.2%) (the gender index m/f was 0.6:1.0). The control group (CG) included 20 patients, 10 men and 10 women, average age 25.1±6.4 years.

To study cerebral perfusion, we chose the non-contrast ASL perfusion (Arterial Spin Labeling, ASL) method, which allows us to measure cerebral blood flow (CBF), because this method has a number of important advantages, especially in comparison with contrast methods (for example, DSC-MRI or PET)

Results. In the control group, the average CBF was 55.0 ± 5.2 ml/100 g/min. Even in patients with arterial hypertension (phenotype I), a significant decrease in cortical blood flow to 52.1 ± 6.4 ($p = 0.04$) was observed. In the dyslipidemic phenotype (II), cortical CBF decreased even more significantly (48.3 ± 7.1; $p = 0.002$), and in insulin resistance (phenotype III), it decreased to 44.5 ± 8.0 ($p < 0.001$), reflecting progressive cerebral hypoperfusion.

In patients with MS phenotype III, a significant decrease in cerebral blood flow (CBF) and blood volume (CBV) is observed ($p < 0.001$), indicating severe microcirculatory dysfunction. Groups I and II phenotypes demonstrate intermediate values between the control and III phenotypes, with statistically significant deviations

from the norm ($p < 0.05$) observed in Group II, reflecting increasing cerebral ischemia. Cortical areas are more sensitive to perfusion changes (greater reduction in CBF) than subcortical areas, consistent with the distribution of metabolic loads in the brain.

Conclusion. MRI perfusion at the structural and functional levels (macro- and microcirculation) is an informative method for diagnosing and stratifying the degree of cerebral dysfunction in metabolic syndrome.

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