



Assessment Of the Functional State of The Kidneys in Metabolic Syndrome

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Abstract

The relevance of the problem is that the international congress on the metabolic syndrome (MSDA, 2017) finally defined it as a pandemic of the XXI century. The prevalence of MS in the adult population is 15-45%. According to WHO forecasts, by 2025 the number of people with MS in the world will reach 300 million people and the epidemic level reflects the main public health problem. The significance of the metabolic syndrome in the global spread of chronic kidney disease has led to numerous international studies that have demonstrated a close association of the pathogenetic platform of this syndrome.

KeyWords: arterial hypertension, insulin resistance, chronic kidney disease, microalbuminuria, glomerular filtration rate

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Introduction

The kidneys perform many functions, the main purpose of which is to maintain homeostasis. One of the most important mechanisms by which these functions are carried out is glomerular filtration (glomerular filtration rate - GFR). Filtration depends, firstly, on hemodynamic factors - hydrostatic and oncotic pressure in the afferent and efferent arterioles. The second important point is the area of the filtering surface, which is determined by the permeability of the glomeruli and their number. The latter, in turn, depends on height, body weight and metabolic rate. Glomerular filtration is a fairly stable value and is equal to 90-174 ml / min in men and 84-156 ml / min in women (20-29 years old), with age, filtration rates decrease. Normally, with age, filtration decreases by 1 ml / min per year after 30 years. Healthy kidneys are able to increase filtration in response to various long-term and short-term exposures. There are classical physiological situations with a prolonged increase in GFR and renal plasma flow rate: pregnancy, compensatory hypertrophy (including after organ loss), burn disease. A large number of studies have shown that the introduction of protein (both orally and in the form

of infusions), amino acids, dopamine also leads to an increase in GFR and plasma flow rate, but temporarily. [1,20].

Purpose of the study

Assessment of the functional state of the kidneys in metabolic syndrome.

Results and discussion

Metabolic syndrome (MS) is a combination of genetic, physiological, biochemical and clinical factors, the manifestation of which is the development of insulin resistance, dyslipidemia, visceral obesity, arterial hypertension, hypercoagulable state, endothelial dysfunction, hyperuricemia. The high relevance of the study of MS is due to its significant prevalence throughout the world. Approximately one in four or five adults (depending on country and ethnic group) has metabolic syndrome. With age, there is an increase in the incidence. The proportion of people with MS among the population older than 30 years is 10-20%, and in the USA -25%. The average prevalence in the world among men and women is 24%.

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If it was previously believed that MS is characteristic of older people, then in studies, conducted by the American Diabetes Association (American Diabetes Association), shows an increase in the incidence among young people aged 20–29 years. It is assumed that by 2025 the number of patients with this syndrome will be 300 million people. Therefore, the World Health Organization (WHO) considers MS a global epidemic [2, 4, 21].

The interest in the problem of MS and the recently significantly increased number of publications about it can be explained by the accumulation of new information about the patterns of its development and the growing attention of practicing physicians of various specialties of this pathology. Until recently, the association of MS with cardiovascular pathology and type 2 diabetes was most clearly seen. However, the conducted studies demonstrate the possibility of various manifestations of MS and the relevance of this condition for the adequate treatment of many diseases. In particular, it has been proven that MS has a negative impact not only on global cardiovascular risk, but also on kidney function. Thus, the incidence of chronic kidney disease (CKD) in patients with MS is 1.64 times higher than in patients without MS, while MS is a significant risk factor for the development of CKD for patients under the age of 60, and this relationship is linear. In a study by B. Isomaa et al., a threefold increase in the risk of developing coronary artery disease and/or stroke in patients with MS ($p < 0.001$) was noted, with microalbuminuria (MAU) making the greatest contribution to CV mortality (hazard ratio 2.80; $p < 0.002$) [5,19,22].

Obesity, according to WHO, is abnormal or excessive body fat that can be harmful to health [6]. Obesity has become a worldwide epidemic and is predicted to increase by 40% in the next decade. The rising prevalence of obesity has an impact on the risk of developing diabetes, cardiovascular disease, and chronic kidney disease (CKD). A high body mass index is one of the most significant risk factors for CKD. In obese individuals, compensatory hyperfiltration develops in response to an increase in the metabolic demands of excess body weight. An increase in intraglomerular pressure can lead to kidney damage and increase the risk of developing CKD in the long term. In recent years, the incidence of obesity-associated glomerulopathy has increased 10-fold. In addition, it has been shown that obesity is a risk factor for nephrolithiasis and a number of malignant neoplasms, including kidney cancer. This

year, the World Kidney Day Initiative is putting forward an educational program that explains the dangerous consequences of obesity and its relationship with kidney disease, and promotes healthy lifestyles and lifestyle interventions as an accessible basis for preventing the adverse effects of obesity [7]. In obesity already in the early stages of excessive accumulation of adipose tissue in the body, significant changes occur in target organs, primarily in the kidneys, which are one of the first to take on a compensatory function with increasing body weight. Consequently, the search for biomarkers or risk factors for early renal damage in children with obesity and metabolic syndrome will ensure the formation in clinical practice of a risk group for nephropathy or its pre-nosological diagnosis in order to prevent or resolve the issue of the advisability of drug correction [8]. And insulin resistance is a condition accompanied by a decrease in the sensitivity of peripheral tissues to the action of endogenous or exogenous insulin. Insulin resistance is an important pathophysiological factor in metabolic syndrome [9]. Recent years have been marked by a dramatic increase in the number of patients with diabetes mellitus (DM) and chronic kidney disease (CKD) in the world. These two big medical problems are closely interrelated, as diabetes has taken a leading position among the causes of kidney disease. Diabetology and nephrology are very expensive healthcare sectors. The burden of economic costs allocated to provide renal replacement therapy to patients with DM continues to grow. In this regard, the expediency of a renoprotection program in the early stages of diabetic nephropathy (DN), which can prevent or slow down the development of end-stage renal disease, becomes more and more obvious [10].

Diabetic nephropathy is a late complication of diabetes mellitus (DM), which usually develops in patients with its long decompensated course. Diabetic nephropathy is characterized by a special form of glomerular damage by diabetic glomerulosclerosis. The most common is its nodular (or nodular) form, which until recently was considered pathognomonic for DM [11].

The patient, 45 years old, a nurse, belongs to the category of "heavy smokers" (smoking index is 29 pack/years). Since childhood, livedo has been determined on the skin of the lower extremities. In the obstetric anamnesis - a miscarriage at a short gestational age. For more than ten years he has been suffering from Raynaud's syndrome. In 2001,



chronic obstructive pulmonary disease was diagnosed, which was regarded as the result of prolonged smoking. During this period, the examination of the pathology of the kidneys was not revealed. In 2006, for the first time, the appearance of edema of the legs and face was noted. Since March 2007 - moderate arterial hypertension, at the same time for the first time detected: proteinuria more than 4 g / l, microhematuria, a moderate increase in creatinine levels (up to 1.6 mg / dl). Didn't receive therapy. In July 2007, she was examined for the first time in the clinic. EAT. Tareeva. Arterial hypertension with a maximum rise in blood pressure up to 180/110 mm Hg, moderately pronounced nephrotic syndrome (proteinuria 2.5 g/day, albumin 31 g/l), and minimal erythrocyturia were revealed. The blood creatinine level remained normal, but the glomerular filtration rate was 49 ml/min. At the same time, on the basis of the first discovered hyperglycemia (blood glucose level of 20 mmol/l), DM2 was diagnosed. The nature of kidney damage was unclear. The possibility of developing diabetic nephropathy seemed unlikely due to a short history of diabetes. Changes in the kidney tissue found in heavy smokers, to which the presented patient belongs, are nonspecific and may resemble the histological signs of other nephropathies, one way or another associated with damage to the endothelium, including diabetic glomerulosclerosis and thrombotic microangiopathy. The development of nodular and global glomerulosclerosis, tubulointerstitial fibrosis and arteriosclerosis in the observed patient with a relatively short (about one and a half years) history of nephropathy, apparently, can be explained by a combination of several factors acting in the same direction (DM, prothrombotic state due to a combination of acquired and hereditary thrombophilia, persistent smoking), and it is extremely difficult to single out the main one in this situation [12].

The vascular endothelium is a heterogeneous structure with diverse functions, being an active metabolic system. Endothelial cells mediate inflammatory and immune processes, regulate leukocyte adhesion, vascular permeability and tone, participate in the hemostasis system, and stimulate angiogenesis processes. Endothelial dysfunction may be the initiating factor of individual disorders, but more often it is a universal link in the pathogenesis of many diseases.

Currently, there are 4 typical forms of endothelial dysfunction: 1) vasomotor; 2) hemostatic; 3)

adhesive; 4) angiogenic [13].

In accordance with modern concepts, endothelial dysfunction is a pathological condition of the endothelium, which is based on a violation of the production of endothelial factors, in which the endothelium is not able to provide hemorheological balance of blood and leads to dysfunction of both organs and systems [14,23,24]. The features of endothelial function, metabolic factors such as insulin resistance, dyslipidemia were studied in 67 patients with arterial hypertension in combination with obesity. Studies have shown that in patients with arterial hypertension in the presence of metabolic disorders, a decrease in endothelium-dependent vasodilation, an increase in microalbuminuria in daily urine, and von Willebrand factor are highly significant, which determines the development of endothelial dysfunction. In general, in AH patients with metabolic factors, moderate disturbances in the nitrogen excretion function of the kidneys and microalbuminuria in daily urine were revealed. High levels of blood pressure, obesity with IR equally often lead to a deterioration in the functional state of the kidneys, where MA becomes an indicator of endothelial dysfunction and a predictor of disease progression with an unfavorable prognosis. In AH patients with metabolic disorders such as insulin, MA resistance is combined with cardiac remodeling, regardless of blood pressure levels, which requires optimization of treatment for this category of patients. This confirms the hypothesis that MAs become an early marker of vascular damage and reflects the presence of a general vascular lesion [15,25].

To date, arterial hypertension (AH) remains the leading cause of persistent deterioration in kidney function in the general population. Diagnosis of kidney damage in AH is very important, since the identification of initial signs of hypertensive nephropathy makes it possible to formulate the principles of early, effective and safe treatment of patients with cardiorenal pathology and slows down the progression of AH [16]. The features of changes in the structural and functional parameters of the kidneys in patients with isolated AH and in those with AH in combination with comorbid pathology were revealed in the form of a statistically significant increase in the width and thickness of the kidneys, the proportion of patients with an uneven contour of the kidneys, structural disturbances and changes in the echogenicity of the parenchyma, a decrease in tubular and glomerular



function of the kidneys in the combination of hypertension with metabolic disorders. The noted changes in the structure of the kidneys occur in parallel with the violation of the tubular and glomerular function of the kidneys when the components of MS or type 2 diabetes are attached to AG [17].

Significantly higher incidence of spastic hemodynamic type of microcirculation in patients with «isolated» AH in comparison with patients with AH and comorbid pathology is caused by spasm of arterioles, slowing of blood flow, increased erythrocyte aggregation, and reduced hemoperfusion [18].

Conclusions

1. There is a strong relationship between MS and CKD.
2. Patients with metabolic syndrome are 2.5 times more likely to have a high risk of chronic kidney disease and 2 times more likely to be at risk of microalbuminuria.
3. Risk factors for CKD in MS are: insulin resistance, obesity, dyslipidemia, high blood pressure, reactive oxygen species, inflammatory cytokines, increased activity of coagulation factors, inhibition of the fibrinolytic system.
4. Smoking induces increased platelet aggregation, which in combination with damage to endothelial cells can cause activation of intraglomerular blood coagulation with the development of microthrombosis.
5. There are correlations between the structural and functional state of the kidneys and endothelial dysfunction confirm the progression of damage to the kidneys and endothelium in the combination of hypertension with MS or type 2 diabetes.

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