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Features of Prevalence Criteria for Diagnosis and Assessment of Renal Function in Chronic Kidney Disease with Various Etiology

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Abstract The article presents the results of an analysis of scientific sources of foreign researchers in recent years on the study of chronic kidney disease. Prevalence, diagnostic criteria, markers of kidney damage, and assessments of kidney function in individuals with chronic kidney disease are described. The effectiveness of using laboratory markers for diagnosis and prognosis of the outcome of a given nosological condition is presented.

Keywords Chronic kidney disease, Glomerular filtration rate, Criteria for chronic kidney disease, Markers of damage

1. Introduction

In the 21st century, the world community is faced with a global problem of chronic non-communicable diseases associated with high treatment costs, loss of ability to work, severe complications and mortality. One of the main ones is kidney disease. The problem of chronic kidney disease (CKD) is socially significant, which has a high prevalence, mortality, and at the terminal stage requires highly costly methods of replacement therapy - dialysis, kidney transplantation [14,19]. According to the US National Center for Health Statistics, more than 3.9 million adults have been diagnosed with kidney disease in this country (2% of the adult population). Mortality due to renal failure was the 8th leading cause of death. These data indicate that kidney disease is a major health problem and that understanding the mechanisms leading to kidney disease is an important endeavor that can have a large potential impact on health [15,22,31]. According to the World Health Report and Global Burden Disease (GBD), kidney and urinary tract diseases lead to the death of 850 thousand people every year. They rank 12th as a cause of death and 17th as a cause of permanent disability. However, the true incidence of CKD is not fully assessed [19,31]. In the Russian Federation, about 14 million people suffer from CKD; kidney disease ranks 11th as a direct cause of death, and 17th as a cause of disability [10]. In 2017, 697.5 million cases of CKD at all stages were registered among the population of the Russian Federation, with a global prevalence of 9.1%. The average age and gender incidence rate in the Russian Federation for stage IV CKD is 47% higher than the global one and exceeds the rates in the USA, China and a number of European countries [16]. Dudko M.Yu., Kotenko O.N. [7] conducted a study to assess the prevalence of CKD among the adult population of Moscow. The authors found a high prevalence of CKD among the population of this city. At the same time, an analysis of the prevalence of CKD by stage showed a high proportion of early stages of CKD with significantly lower detection rates of late stages. In the Kyrgyz Republic in 2018, a total of 172.9 cases of acute and chronic glomerulonephritis (GLN) were registered per 100 thousand population, 52.9 cases per 100 thousand population were newly identified. The authors came to the conclusion that timely diagnosis and comprehensive support for patients suffering from HFN can significantly improve the prognosis of the outcome of these diseases [2].

The same studies were conducted in Tajikistan in the period 2011-2017, on various diseases of the kidneys and urinary tract in the adult population aged 18-90 years. The prevalence of CKD was 18.7-21.9 cases per 100 thousand population. The high prevalence of CKD in Tajikistan dictates a revision of some tasks of nephrological care [1].

Vyalkova A.A. [5] provides the results of an analysis of large-scale studies (Accomplish, advance, altitude, carress-hf, ontarget, roadmap), where it was confirmed that CKD has a high prevalence (10-15%) and occupies one of the leading places in the overall mortality structure and morbidity of the population. In these studies, CKD is defined as a supra-nosological concept characterized by structural kidney damage and/or decline in kidney function for 3 months or more, regardless of the nosological diagnosis of chronic kidney disease.

It has been established that markers of kidney damage should be considered changes identified during clinical, laboratory and instrumental examination: increased albuminuria

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/proteinuria, erythrocyturia, cylindruria, leukocyturia, changes in the electrolyte composition of blood and urine, kidney abnormalities, cysts, hydronephrosis, changes in the size and shape of the kidneys and other. CKD is established even in the absence of any markers of renal damage, but a decrease in glomerular filtration rate (GFR) of less than 60 ml/min/1.73 m2 has been detected, which also persists for 3 or more months [8,22].

The criterion for decreased renal function is a GFR level below 90 ml/min/1.73 m2. To assess kidney function by GFR in adults, informative and accessible methods are used: the Cockcroft-Gault formula, which reflects GFR in the early stages of CKD, and the MDRD formula, which more accurately reflects function in stages 3-5 of CKD. Another method for calculating GFR for CKD is represented by CKD-EPI [19,31].

Other formulas for calculating GFR according to Schwartz are given: GFR = k x body length (cm) x 80 / plasma creatinine (μmol/l), where k = 0.55 (in children from 2 to 12 years), k = 0.55 (for girls from 13 to 18 years old), k = 0.77 (for boys from 13 to 18 years old). Formula for calculating GFR according to Barrat: for young children: GFR = 0.55 x body length (cm) / plasma creatinine (mg%); for older children: GFR = 0.45 x body length (cm) / plasma creatinine (mg%) [5].

Currently, in the diagnosis of CKD, to determine the prognosis and rate of its progression during therapy, great importance is attached to the assessment of albuminuria/ proteinuria. At the London KDIGO conference in 2009, the previous gradations of albuminuria were retained: <30; 30-299; > 300 mg albumin/g urine creatinine. To assess urinary albumin excretion, instead of normo-, micro-, macroalbuminuria/proteinuria, the following are proposed: “optimal” level (<10 mg/g), “highly normal” (10-29 mg/g), “high” (30-299 mg/g). d), “very high” (300-1999 mg/g) and “nephrotic” (>2000 mg/g) and their use to predict the risk of general and cardiovascular mortality. In 2007, in ICD-10, the term “chronic renal failure” was replaced by “CKD” (code N18) and each stage was assigned the corresponding codes: C1 - N18.1; C2 - N18.2; C3a and C3b - N18.3; C4 - N18.4; C5 - N18.5. To indicate the etiology of CKD, in addition to these codes, appropriate disease codes should be used; code N18.9 denotes cases of CKD with unspecified stage [18].

The classification of CKD is given by NRF/KDOQI (National Kidney Foundation/Kidney Disease Outcomes Quality Initiative, 2002): risk group - GFR (ml/min/1.73 m2) >90, in the presence of CKD risk factors; signs of nephropathy, normal or increased GFR - >90; signs of nephropathy (slight decrease in GFR) - 60-89; moderate decrease in GFR (conservative stage) - 30-59; severe decrease in GFR (pre-dialysis stage) - 15-29; extremely severe decline (dialysis stage) - ESRD - >15 [26].

The criteria for CKD have been established: the presence of structural kidney disorders, identified according to imaging and/or morphological studies; functional kidney disorders, detected by changes in kidney function parameters in urine and/or blood tests. To determine the stage of CKD, tubular function and GFR are assessed using Schwartz calculations [5].

The concept of 5-stage CKD was formulated by experts from the National Kidney Foundation/Kidney Disease Outcomes Quality Initiative in the USA in 2002 and received recognition from the global medical community [27]. In 2012, improved recommendations for the diagnosis, classification, and treatment of CKD depending on the level of GFR and albuminuria were published [26].

According to Shutov A.M. [23] the fundamental difference between the concept of CKD and chronic renal failure is the inclusion in this category of patients, including those with a normal functional state of the kidneys. Two main reasons served as the basis for the emergence of the concept of CKD: the presence of common mechanisms of progression of nephropathy and the high cardiovascular morbidity and mortality of patients with CKD. In his opinion, for the first time in the world a generally accepted classification has appeared that allows one to look at a patient with CKD from a unified perspective.

As a result of research by English authors Wall NA et al. [30] found that significant renal impairment (eGFR <60 ml/min/1.73 m2, CKD stage G3-5) was found in 6% of the UK population, and its prevalence increased markedly with age, affecting more than 30% of people aged 75 years and older. According to the authors, a decrease in eGFR or an increase in albuminuria is associated with mortality independent of all causes and progression to severe CKD - end-stage renal disease (ESRD), for which the annual mortality rate exceeds 10%.

Analysis of the results of large population studies (HOPE, PREVEND, LIFE) revealed a direct relationship between a decrease in GFR, albuminuria and cardiovascular morbidity (CVD). About 40-80% of patients with CKD at the pre-dialysis stage had CVD. Death from CVD in dialysis patients occurred in 40-50% of cases, which is 10-20 times higher than in the general population. As the stages of CKD progress, the severity and frequency of cardiovascular disorders increases [11,26].

According to Weber BR et al. [29] hemodynamically significant stenosis of the renal arteries, designated by the term “ischemic kidney disease,” is one of the leading causes of irreversible deterioration of kidney function in the elderly and often remains unrecognized until ESRD. It can be accelerated in these patients by commonly used elderly medications and diagnostic interventions.

It is clear that ischemic kidney disease is predominantly characteristic of patients with widespread atherosclerosis. In case of ischemic kidney disease, it is reasonable to eliminate iatrogenic factors that aggravate renal dysfunction - non-steroidal anti-inflammatory drugs, loop diuretics in large doses that cause relative hypovolemia, but primarily ACE inhibitors and angiotensin II receptor blockers. They are often prescribed without proper monitoring to elderly patients with arterial hypertension [25].

CKD, which is characterized by a persistent decrease in GFR and, therefore, is associated with the greatest

deterioration in long-term prognosis, is more common among the elderly [20].

Treating an elderly patient with CKD poses significant challenges. They are the first group to avoid polypharmacy. A special problem for them remains disturbances in nutritional status, which often occur in this age group and with preserved renal function, but always significantly increase as CKD progresses. The term "protein-energy malnutrition" is also used to refer to the malnutrition syndrome in elderly patients with CKD. Currently, successful experience has been accumulated in the use of medicinal preparations of keto analogues of amino acids for the prevention and correction of protein-energy deficiency in patients with CKD. In an economic analysis by Italian researcher Scalone L. et al. (2010) have proven that the use of a low-protein diet with the prescription of keto analogues of amino acids allows one to safely delay the start of dialysis by an average of 1 year and leads to savings of 30 thousand euros per elderly patient with CKD over 3 years [21].

Based on the results of her research, Daminova M.A. [6] concludes that the definition and stage classification of CKD in children is currently no different from that in adults. It is currently known that the development of CKD in children is facilitated by genetic, endogenous, demographic (gender, age) and a complex of exogenous factors. Due to the fact that in childhood it is possible to reverse the development of chronic kidney damage and restore organ function, early detection and timely treatment are an important prerequisite for preventing or preventing its unfavorable outcome.

The same author [6] in another work emphasizes that in nephrology there are 4 groups of risk factors that influence the development and course of CKD in children: factors influencing the development of CKD: risk factors that initiate CKD: risk factors that lead to the progression of CKD: risk factors for end-stage CKD.

The concept of risk factors has become widespread in epidemiological research. The effect of risk factors on the body is individual, and the likelihood of developing a disease depends on the adaptive capabilities of the body. Each individual responds to the action of certain risk factors by changing the functional state of his body. What is common to all is the development of a nonspecific adaptation reaction with the formation of certain prenosological conditions. A feature of the concept of risk factors in prenosological diagnosis is that the intensity of any risk factor can be studied in relation to various functional states. Risk factors for the development of maladjustment are also risk factors for diseases. Diseases arise through the transition of prenosological states to premorbid, and then to nosological. The connection between risk factors and disease is carried out through functional states, reflecting stress and overstrain of regulatory mechanisms with subsequent disruption of homeostasis and compensation. At the current level of development of medicine, it is possible to identify factors that can provoke the development of diseases of the urinary system [13].

Seema Sharma et al. [28] conducted a study to identify risk factors for CKD and evaluate the impact of counseling on quality of life in 52 patients with CKD. A validated QOL questionnaire was administered. The authors found that arterial hypertension was the cause of CKD in 48.1% of patients, diabetes in 7.6%, hypertension along with diabetes in 32.7%, glomerulonephritis in 5.8%, immunological causes in 5.8% of patients. There were statistically significant improvements in social functioning, emotional, mental and self-esteem parameters, indicating the impact of counseling. The authors concluded that clinical pharmacist counseling was helpful in improving quality of life in the patients studied.

The same studies to study the quality of life in patients with CKD were conducted by Vasilyeva I.A., Dobronravov V.A. [4]. The authors used the SF-36 questionnaire for this purpose. They found that the progression of CKD is accompanied by a decrease in indicators of the physical component of quality of life. There was no significant deterioration in psychosocial indicators as renal function decreased.

Along with the issues of prevalence, classification, pathogenesis, medical and social research, the laboratory parameters of CKD, which had pathogenetic and diagnostic aspects of these supra-nosological conditions, were also analyzed.

The authors [3] assessed the relationship between serum concentrations of angiopoietin-like proteins types 3 and 4 (APLP types 3 and 4) with the development of renal dysfunction in 158 patients aged 21-80 years with rheumatoid arthritis against the background of metabolic changes with a disease duration of 9 years. Negative correlations of moderate strength were revealed between the calculated GFR values using the CKD-EPI formula and the levels of APPB3 and APPB4. It has been established that the content of APPB4 in patients with rheumatoid arthritis is directly influenced by two factors - renal dysfunction and the presence of metabolic syndrome.

Another study [11] proved that impaired renal function is strongly associated with the prognosis of the development of heart failure in patients with left ventricular systolic dysfunction, unfavorable course of coronary artery disease, and arterial hypertension. The close relationships between changes in the kidneys and organs of the cardiovascular system have led to the conclusion that there is a clinical and pathogenetic commonality - the "cardiorenal continuum".

Sibireva O.F. et al. [17] patented an invention, the essence of which is that the prognosis of the nature of the progressive course of CKD is determined using blood coagulation characteristics: activated partial thromboplastin time (APTT), prothrombin time (PT), thrombin time (TT), antithrombin III level (ATIII), von Willebrand factor (VWF), endothelin-1 (E-1), D-dimer. With aPTT ranging from 28 to 35 seconds, PT from 12 to 15 seconds, TV from 9 to 13 seconds, ATIII level from 29 to 70%, EF level from 105 to 115%, E-1 not more than 0.32 fmol /ml and D-dimer from 245 to 520 ng FEE/ml predict slow progression of CKD. With the same values of APTT, PT, TV, ATIII level, and EF level more than 115%, E-1 more than 0.32 fmol/ml, D-dimer more than 620 ng FEE/ml, accelerated progression of CKD is predicted.

The use of the claimed method allows to increase the accuracy and reliability of the diagnosis of CKD.

2. Conclusions

Thus, an analysis of the literature of foreign researchers showed the importance of the problem of CKD for different segments of the world's population. A classification is proposed, criteria and markers for diagnosing CKD are defined, and the effectiveness of some tests for diagnosing this supranosolological condition is shown. In the next part of our review, we considered it necessary to provide an analysis of the scientific sources of domestic researchers on the problem of CKD in humans.

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