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Kidney Condition in Patients with Myocardial Infarction

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Abstract: The connection between cardiac and renal pathology has long attracted the attention of both cardiologists and nephrologists. The kidneys, the glomeruli of which are part of the microcirculatory system of the body, affect the formation of cardiovascular pathology, at the same time they themselves are involved in the pathological process in various cardiovascular diseases (CVD). For heart and kidney diseases, there are a number of common risk factors (FR): arterial hypertension (AH), diabetes mellitus (DM), obesity, dyslipidemia, etc. In patients with hypertension, coronary heart disease (CHD), especially in combination with diabetes and chronic heart failure (CHF), renal dysfunction is quite common. At the same time, impaired renal function is an important independent factor in the development of such cardiovascular complications as myocardial infarction (MI), heart failure, fatal arrhythmias. Renal dysfunction is associated with a more frequent development of complications and death in patients with acute coronary syndrome, including during thrombolytic therapy, and a third of patients who have undergone MI are diagnosed with stage 3-5 CKD. CKD is recognized as the equivalent of coronary heart disease in terms of the risk of cardiovascular complications. The decrease in GFR in CHF is as significant as the value of the left ventricular ejection fraction or the functional class of CHF. Such a connection of damage to the cardiovascular system and kidneys allowed in 2008 to develop and adopt the concept of cardiorenal relationships, while five types of cardiorenal syndrome were identified depending on the type of lesion (acute or chronic) and the initiator organ: type 1 – acute heart failure leads to acute renal damage; type 2 – chronic cardiac insufficiency leads to chronic renal damage; type 3 – acute renal damage leads to acute myocardial dysfunction; type 4 – chronic kidney disease leads to CHF; type 5 – simultaneous kidney and heart damage in systemic diseases, including vasculitis, DM, amyloidosis, sepsis.

Keywords: chronic kidney disease, arterial hypertension, diabetes mellitus, acute coronary syndrome

Introduction

Numerous studies have shown a link between a decrease in glomerular filtration rate (gfr) and an increase in total and cardiovascular mortality, while even the earliest renal dysfunction is a risk factor for CVD and its complications. Since a decrease in eGFR is an independent FR of the development of CVD, and CVD is an independent FR of the development of CKD, we conducted a study aimed at identifying the relationship between the functional state of the kidneys and cardiovascular risk factors in patients with verified coronary atherosclerosis, including those who have suffered a myocardial infarction. Despite the decline in cardiovascular mortality in recent decades, cardiovasculardiseases (CVD) remain the main cause of morbidity, death and disability in both developed and developing countries. According to various population registers and studies, the prevalence of renal pathology is 20%. At the same time, the increase in the number of patients with renal pathology in recent years is due to their secondary lesions in the framework of arterial hypertension (AH) and diabetes mellitus (DM). Death due to CVD, It is 10-20 times more common among patients with chronic kidney disease than in the population, and the probability of developing cardiovascular complications is 25-100 times higher than the risk of ESRD. Heart and kidney diseases have common "traditional" risk factors: hypertension, diabetes, obesity and dyslipidemia. According to numerous prospective studies, even a slight decrease in kidney function is associated with an increased risk of CVD and death, regardless of other risk factors. It was shown that the prevalence of CVD in the population of patients with reduced the functional capacity of the kidneys is 64% higher than in individuals with preserved function. In clinical practice, it is permissible to use a 5-stage classification of CKD depending on the level

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of GFR: high or optimal >90ml/min /1.73m^2, slightly reduced 60-89 ml/min/1.73m^2, moderately reduced 45-59 ml/min/1.73m^2, significantly reduced 30-44 ml/min/1.73m^2, sharply reduced 15-29 ml/min/1.73 m^2 , terminal renal failure. Chronic kidney disease (CKD) is a syndrome reflecting the progressive nature of chronic diseases kidney, which is based on the mechanisms of formation of nephrosclerosis. CKD is almost always asymptomatic in the early stages. The prevalence of CKD in the world is 12-18% and is comparable to such socially significant diseases as essential hypertension and diabetes mellitus, obesity and metabolic syndrome. It is known that the risk of cardiovascular mortality in patients with chronic kidney disease is 10-20% higher than in their peers without kidney damage. Large population studies have shown that even mild to moderate decline in kidney function correlates with increased morbidity and mortality from cardiovascular diseases. When conducting randomized trials of SOLVD, TRACE, SAVE, VALIANT revealed an association of decreased renal function with significantly higher cardiac mortality in patients with left ventricular systolic dysfunction. This connection It can be traced, despite the fact that patients with the most severe renal impairment were not included in the studies (one of the exclusion criteria in the selection of patients was an increase in creatinine levels of more than 2.5 mg/dl). In our study, kidney function was analyzed in patients in the acute period of myocardial infarction upon admission to the cardiac intensive care unit. It was revealed that 39.2% of patients hospitalized with acute myocardial infarction with ST segment elevation have kidney dysfunction, while only 22.9% of them had previously been diagnosed with kidney disease.

Materials And Methods

A simple cross-sectional observational study included 100 patients who had undergone MI more than 6 months ago, 86 (86%) of them men and 14 (14%) women. The average age of patients was 54 (51.0; 58.0) years. The patients were examined by the staff of the Department of Propaedeutics of Internal Diseases of Samsmu in Samarkand. Inclusion criteria: transferred by HIM with a stable course of coronary heart disease for three months preceding the point of inclusion in the study, in the presence of a stable sinus rhythm. Exclusion criteria: diagnosed kidney disease, mitral stenosis, valve insufficiency with regurgitation of the III degree, malignant neoplasms, severe DM, severe concomitant diseases in the acute phase, severe organ failure, acute diseases at the time of inclusion in the study. Instrumental diagnostic methods included ECG and echodopplercardiography (EchoCG). During the latter, the structural and functional parameters of the left ventricle (LV) were determined on the "May Lab 20" apparatus. The echocardiographic protocol included the calculation of LV myocardial mass (MMLH) and the MMLH index (MMLH). The presence of LV hypertrophy was judged by LVMI: with LVMI more than 115 g/m2 in men and more than 95 g/m2 in women.

All the examined patients were calculated the total cardiovascular risk (SSR) on the scales SCORE (risk of cardiovascular events with fatal outcome in the next 10 years) and Framingham (absolute risk of cardiovascular events in the next 10 years) at the time of occurrence of MI by analyzing medical documentation. High risk according to SCORE was determined at a score of ≥ 5%, according to the Framingham scale at a score of ≥ 20%.

In order to assess kidney function, a calculated method for determining GFR (gfr) using the formula CKD-EPI in ml/min/1.73m^2 was used.

The analysis of the obtained data was carried out using the MS Excel 7.0 spreadsheet editor and the STATISTICA 6.0 statistical program. Quantitative data at the preliminary stage of statistical analysis were evaluated for the normality of the distribution according to the Shapiro—Wilk criterion. Continuous variables are represented with a normal distribution in the form of an arithmetic mean (M± σ), with a distribution other than normal — in the form of median and interquartile intervals (Me, 25%; 75%). Nominal data are presented in the form of relative frequencies of the objects of study (n, %). The reliability of the differences in continuous data was evaluated using nonparametric criteria: for unrelated samples – the paired Mann—Whitney U-test, for related samples – the Wilcoxon signed-ranks test. To assess the differences in nominal data, the Fisher test was used in the analysis of unrelated samples and the McNemar's test criterion was used for related samples. The critical significance level of the null statistical hypothesis (p) was assumed to be 0.05; at $p<0.05$, the differences were considered statistically significant.

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Results And Discussion

When assessing the functional state of the kidneys in patients who underwent MI, it was revealed that 12 (12%) patients with eGFR of more than 90 ml/min/1.73 m2 had proteinuria, which corresponds to the 1st stage of CKD. 59 (59%) patients have eGFR of less than 90 ml/min1.73 m^2, with at the same time, in 19 of them (19%), a decrease in eGFR in the range from 60 to 89 ml/min / 1.73 m^2 was combined with proteinuria, which corresponds to the 2nd stage of CKD, in 5 (5%) patients eGFR was in the range from 30 to 59 ml/min / 1.73 m^2, which corresponds to 3-th stage of CKD. There was no decrease in eGFR of less than 30 ml/min/1.73 m^2 corresponding to the 4th-5th stages of CKD in the examined group of patients.

When determining eGFR in patients with various FR CVD and signs of target organ damage, it was found that in patients who underwent MI, in the presence of hypertension, dyslipidemia, LV hypertrophy and proteinuria, eGFR was statistically significantly lower than in their absence. In the presence of obesity/overweight, smoking and diabetes, the differences did not reach statistical significance, but had a similar trend (Table 1).

When analyzing the effect of the degree of hypertension on the severity of renal dysfunction, it was found that in patients who underwent MI, the eGFR value did not depend on the degree of hypertension (p=0.38), i.e., the factor aggravating renal dysfunction is the presence of hypertension itself, and not its degree.

All the examined patients had angina pectoris of functional classes I–III and CHF corresponding to functional classes I–III according to the NYHA classification. When calculating GFR in patients, depending on the functional class of angina pectoris and CHF, a decrease in eGFR was revealed as the severity of angina pectoris and CHF increased.

Table 1
Glomerular filtration rate in patients with myocardial infarction with various risk factors and signs of target organ damage (ml/min/1.73m^2)

Risk factors and signs of target organ damage	Yes	No	Statistical significance of differences (p)
Arterial hypertension	**82,4 ±15,4 (n=88)**	**85,3 ±19,0 (n=12)**	**0,04**
Dyslipidemia	**81,8 ±16,1 (n=74)**	**85,6 ±14,4 (n=26)**	**0,02**
Obesity/ overweight	**82,5 ±15,7 (n=84)**	**84,0 ±15,7 (n=16)**	**0,19**
Diabetes mellitus	**81,7 ±14,5 (n=14)**	**83,0 ±16,1 (n=86)**	**0,37**
Smoking	**82,3 ±16,3 (n=62)**	**83,4 ±14,8 (n=38)**	**0,37**
LV hypertrophy	**78,6 ±14,4 (n=32)**	**83,6 ±15,9 (n=68)**	**0,02**
Proteinuria	**79,9 ±15,8 (n=38)**	**84,0 ±15,3 (n=62)**	**0,04**

When distributing patients into subgroups of high and low/moderate risk of SS events on the SCORE and Framingham scales, it was revealed that in high-risk patients on the SCORE scale, eGFR was statistically significantly lower than in the low/moderate risk group. The Framingham risk analysis revealed a similar trend indicating a lower eGFR in the group of high-risk patients.

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Table 2
Glomerular filtration rate in patients with myocardial infarction, depending on the total cardiovascular risk (ml/min/1.73 m^2)

	High risk	Low and moderate risk	statistical significance of differences (p)
score	**78,9 ±16,0 (n=58)**	**90,0 ±13,7 (n=42)**	**0,0002**
Framingham	**81,0 ±16,3 (n=35)**	**85,1 ±15,7 (n=65)**	**0,07**

The presence of a lower eGFR level in patients with high SSR is confirmed by the data of numerous prospective studies indicating an increase in the risk of CVD and death as renal function decreases. This position is confirmed by the presence of an average strength of a statistically significant relationship between the total SSR and eGFR: for the SCORE scale – r = -0.33, p<0.001; for the Framingham scale – r= -0.27, p<0.001.

Conclusion

In our study, in patients with verified coronary atherosclerosis, including those who have undergone IT, the occurrence of cardiovascular risk factors was established depending on the functional state of the kidneys. It was revealed that more than a third of patients who have undergone MI have signs of renal dysfunction in the form of CKD stage 1-3, while the presence of CVD in them exacerbates the severity of renal dysfunction. The functional state of the kidneys worsens with an increase in the severity of angina and CHF. The results obtained are consistent with the data of other researchers.

Assessment of the functional state of the kidneys in patients with CVD, including those who have undergone MI, is important for risk stratification, as well as the choice of preventive and therapeutic measures. Methods for assessing kidney function in patients with cardiorenal pathology are reflected in national interdisciplinary clinical guidelines. To date, the CKD-EPI formula has been recognized as optimal for calculating GFR, since its results are closely comparable to the determination of GFR by the clearance method (mTc-DTPA clearance method), including in persons with preserved kidney function. In patients with CVD, it is also recommended to determine albumin or the albumin/creatinine ratio in the morning portion of urine and to conduct imaging studies of the kidneys to clarify renal damage. If kidney dysfunction is detected in a patient with CVD, it is necessary to prescribe nephroprotective therapy – a set of measures aimed at preserving kidney function or inhibiting the rate of its decline, which will reduce the mortality of these patients primarily from cardiovascular complications, since their risk increases sharply at each stage of CKD and long before terminal chronic renal failure, and the probability of the development of cardiovascular complications in the presence of CKD is 25-100 times higher than the risk of developing terminal chronic renal failure. Against the background of nephroprotective therapy, the following targets should be achieved:

1) maximum reduction of albuminuria /proteinuria (≥ 1.5 times), ideally – up to normoalbuminuria – less than 10 mg / day.;

2) dynamics of GFR reduction – less than 2 ml/min/1.73 m^2;

3) target blood pressure < 140/90 mmHg; in the presence of proteinuria, or albuminuria more than 300 mg /day, or albumin/creatinine ratio >30 mg /mmol, target systolic blood pressure < 130 mmHg; in patients with diabetes, target diastolic blood pressure < 85 mmHg should be avoided lowering blood pressure below 120/80 mmHg.;

4) blood lipid spectrum targets: LDL cholesterol < 2.5 mmol/l in patients with GFR from 30 to 60 ml/min, and <1.8 mmol/l with GFR less than 30 ml/min;

5) for patients with diabetes mellitus – albuminuria less than 30 mg / day. and the level of glycated hemoglobin < 7%.

The main factor in the progression of nephropathies, including in patients with CVD, is intraclubular hypertension, which inevitably occurs both with high blood pressure and with a decrease in the number of functioning nephrons due to increased load on the active glomeruli. The pressure in the glomerulus depends

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not only on the systemic BP, but also on the difference in diameter between the afferent and efferent arterioles. Intraclubular hypertension is aggravated by hyperglycemia and obesity, which cause vasodilation of the afferent arteriole, as well as prolonged intake of high-protein foods even with a normal amount of active nephrons. The main pathogenetic factors of intraclubular hypertension are activation of the renin-angiotensin-aldosterone system (RAAS) and constriction of the efferent arteriole under the action of angiotensin II. Therefore, the main strategy of nephroprotection should be considered the blockade of RAAS, especially if the patient has albuminuria / proteinuria. Drugs from the ACE / sartan group dilate the efferent arteriole, leading to a decrease in pressure inside the renal glomerulus. However, when prescribing these drugs, it should be remembered that it is necessary to monitor the level of potassium and creatinine in the blood with the calculation of GFR: with the initial appointment 7-10 days after the start of treatment, and then less often depending on the level of blood pressure, eGFR, plasma potassium levels, as well as concomitant diseases and taking nephrotoxic drugs. To date, the main directions of nephro- and cardioprotection coincide. However, when choosing doses and tactics of using drugs with dual nephro- and cardioprotective effects, the tasks of nephroprotection (maximum reduction of albuminuria/proteinuria and slowing the decrease in GFR) are paramount.

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