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The Role of Arterial Hypertension in The Progression of Chronic Kidney Disease

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Abstract: Chronic kidney disease (CKD) is a major medical and social problem associated with a high risk of cardiovascular complications, disability, and mortality. Arterial hypertension is one of the most important factors contributing to the onset and progression of CKD. Persistent elevation of blood pressure leads to renal microvascular damage, glomerular hypertension, nephrosclerosis, albuminuria, and progressive decline in glomerular filtration rate. At the same time, impaired renal function contributes to sodium and fluid retention, activation of the renin–angiotensin–aldosterone system, and further elevation of blood pressure. This creates a vicious pathogenetic circle that accelerates the progression of renal dysfunction. The aim of this article is to evaluate the role of arterial hypertension in the progression of chronic kidney disease and to analyze the clinical and functional indicators associated with an unfavorable prognosis. The review highlights the prognostic importance of blood pressure level, estimated glomerular filtration rate, albuminuria, cardiovascular comorbidity, and duration of hypertension in patients with CKD.

Key words: Chronic kidney disease, arterial hypertension, glomerular filtration rate, albuminuria, renal dysfunction, cardiovascular risk, nephroprotection, disease progression.

INTRODUCTION

Significance of the Study

The significance of this study is determined by the high prevalence of chronic kidney disease and arterial hypertension, as well as their close pathogenetic relationship. Arterial hypertension is one of the main modifiable risk factors for the progression of chronic kidney disease. Persistent elevation of blood pressure contributes to renal microvascular damage, increased intraglomerular pressure, albuminuria, nephrosclerosis, and a gradual decline in glomerular filtration rate. In patients with chronic kidney disease, hypertension often has a more severe and resistant course due to sodium and fluid retention, activation of the renin–angiotensin–aldosterone system, endothelial dysfunction, and increased vascular stiffness. As a result, a vicious circle develops: impaired renal function aggravates arterial

hypertension, while elevated blood pressure further accelerates kidney damage. The clinical importance of this issue is associated with the increased risk of cardiovascular complications, progression to end-stage renal disease, and the need for renal replacement therapy. Therefore, timely diagnosis, regular blood pressure monitoring, and adequate antihypertensive treatment are essential for slowing the progression of chronic kidney disease and improving long-term patient outcomes.

Aim of the Study

To assess the influence of arterial hypertension on the progression of chronic kidney disease by analyzing blood pressure levels, glomerular filtration rate, albuminuria, and other clinical and functional parameters in patients with CKD.

METHODS

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The study included 120 individuals: 25 practically healthy subjects in the control group and 95 patients with stage 4 chronic kidney disease. All participants underwent a comprehensive clinical and laboratory examination, including assessment of blood pressure, renal function, complete blood count, and biochemical blood parameters such as serum creatinine, urea, hemoglobin, albumin, and electrolytes. Concomitant diseases were also analyzed. During the follow-up period, adverse clinical outcomes and their association with identified risk factors were assessed. Statistical analysis was performed using Statistica 6.0. The results were expressed as $M \pm SD$. Differences were considered statistically significant at $p < 0.05$.

RESULTS

The study included 120 individuals, of whom 25 were practically healthy subjects and 95 were patients with stage 4 chronic kidney disease. In patients with CKD, arterial hypertension was considered one of the main clinical factors influencing the progression of renal dysfunction. Comparative analysis showed that patients with stage 4 CKD differed significantly from the control group in the main clinical and laboratory parameters. In the CKD group, higher blood pressure values, increased serum creatinine and urea levels, decreased estimated glomerular filtration rate, lower hemoglobin levels, and reduced serum albumin were observed. These changes indicated a pronounced impairment of renal function and the presence of systemic metabolic disorders typical for advanced CKD. When analyzing patients with CKD depending on the severity of arterial hypertension, it was found that higher systolic and diastolic blood pressure levels were associated with more unfavorable renal function parameters. Patients with uncontrolled arterial hypertension had more pronounced elevation of serum creatinine and urea, lower glomerular filtration rate, and more frequent anemia compared with patients with better blood pressure control. A relationship was also observed between arterial hypertension and the development of adverse clinical outcomes during the follow-up period. Patients with elevated blood pressure more

often demonstrated progression of renal dysfunction, worsening of general clinical condition, electrolyte imbalance, and signs of cardiovascular complications. The combination of arterial hypertension with anemia, hypoalbuminemia, and reduced glomerular filtration rate was associated with a more severe course of chronic kidney disease. Thus, the obtained results indicate that arterial hypertension in patients with stage 4 chronic kidney disease is not only a concomitant condition, but also an important factor associated with disease progression. Persistent elevation of blood pressure contributes to further deterioration of renal function and increases the risk of unfavorable clinical outcomes.

DISCUSSION

The results of the present study confirm the important role of arterial hypertension in the progression of chronic kidney disease. In patients with stage 4 CKD, elevated blood pressure was associated with more pronounced impairment of renal function, higher levels of serum creatinine and urea, lower estimated glomerular filtration rate, anemia, hypoalbuminemia, and electrolyte disturbances. These findings indicate that arterial hypertension is not only a common concomitant condition in CKD, but also an important factor contributing to the worsening of renal dysfunction. The obtained data are consistent with the results of studies conducted in Uzbekistan. Karimov, Daminov, and Kayumov emphasized that chronic kidney disease represents an important medical and social problem, while arterial hypertension, diabetes mellitus, and cardiovascular disorders are among the main risk factors for its development and progression [1]. Rasulev, Daminov, and Tursunbayev also noted the epidemiological significance of CKD in the Republic of Uzbekistan and its close association with cardiovascular risk [2]. The NDT abstract by Rasulev et al. specifically describes CKD as a global health problem and assesses epidemiological characteristics of CKD development in Uzbekistan.

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The pathogenetic relationship between arterial hypertension and CKD is bidirectional. On the one hand, persistent elevation of blood pressure leads to increased intraglomerular pressure, damage to the renal microvasculature, endothelial dysfunction, and progressive nephrosclerosis. These processes contribute to a gradual decrease in glomerular filtration rate and progression of renal failure. On the other hand, impaired kidney function promotes sodium and fluid retention, activation of the renin-angiotensin-aldosterone system, increased vascular stiffness, and further elevation of blood pressure. As a result, a vicious circle develops in which arterial hypertension accelerates CKD progression, while CKD aggravates hypertension. According to KDIGO recommendations, prognosis in CKD should be assessed using glomerular filtration rate and albuminuria categories, since these indicators reflect the severity of kidney damage and the risk of progression [7]. The KDIGO 2024 guideline reinforces diagnosis, risk prediction, and management approaches for CKD, while the KDIGO blood pressure guideline focuses on blood pressure management in patients with CKD [7, 8]. In this regard, the combination of arterial hypertension with reduced GFR and albuminuria should be considered an unfavorable prognostic sign. In the present study, patients with stage 4 CKD and arterial hypertension demonstrated a more severe clinical course. This was manifested by a greater degree of renal dysfunction and more frequent metabolic disorders. Similar observations are presented in international studies, where reduced eGFR and increased albuminuria were shown to be independent predictors of all-cause and cardiovascular mortality [14]. Matsushita et al. reported that eGFR below 60 mL/min/1.73 m² and elevated albumin-to-creatinine ratio are independent predictors of mortality risk, supporting the prognostic value of renal functional markers [14]. Cardiovascular complications are particularly important in patients with advanced CKD. Sharapov and Daminov showed that cardiovascular diseases are common among dialysis patients in Uzbekistan and remain one of the key problems in this category of patients [3]. The authors also noted that more than half of deaths among

patients with end-stage renal disease are due to cardiovascular causes [3]. These data support the need for early identification and correction of arterial hypertension before the development of terminal renal failure. The findings of Sharapov, Daminov, Yarygina, and Dyagilev also confirm the high clinical significance of cardiovascular pathology in patients with stage 5 CKD receiving programmed hemodialysis [4]. In addition, Yuldashova and Daminov studied clinical manifestations of stage V CKD on dialysis and the features of symptomatic intradialytic hypotension, which also reflects the importance of hemodynamic disorders in advanced renal dysfunction [5]. These studies indicate that blood pressure disorders in CKD may manifest not only as persistent hypertension, but also as hemodynamic instability in later stages of the disease. The role of hemodynamic instability is also supported by Muminov and Kosimova, who analyzed the pathogenesis of intradialytic hemodynamic instability [6]. This is important because patients with advanced CKD often have impaired vascular regulation, reduced adaptive capacity of the cardiovascular system, and increased sensitivity to changes in circulating blood volume. Therefore, adequate blood pressure control in CKD should be individualized, taking into account not only the level of arterial pressure but also the stage of CKD, comorbidities, anemia, albumin level, electrolyte status, and cardiovascular risk. The results of the present study also correspond to international concepts of CKD progression. Large epidemiological and meta-analytic studies have shown that CKD is associated with a high global burden and increased risk of adverse outcomes [12, 13, 15]. The global burden analysis published in *The Lancet* reported CKD as a major contributor to morbidity and mortality worldwide [12]. These data emphasize the need for early diagnosis, regular monitoring, and prevention of modifiable risk factors, especially arterial hypertension. Thus, the discussion of the obtained results confirms that arterial hypertension is one of the most significant modifiable predictors of CKD progression. In patients with stage 4 CKD, persistent elevation of blood pressure is associated with

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deterioration of kidney function, metabolic disorders, anemia, hypoalbuminemia, and increased cardiovascular risk. Early detection of arterial hypertension, adequate antihypertensive therapy, monitoring of GFR and albuminuria, and correction of associated disorders may slow CKD progression and improve long-term prognosis.

CONCLUSIONS

Arterial hypertension is one of the key clinical factors associated with the progression of stage 4 chronic kidney disease. Persistent elevation of blood pressure contributes to further deterioration of renal function and a decrease in estimated glomerular filtration rate.

Patients with chronic kidney disease and uncontrolled arterial hypertension demonstrate more pronounced laboratory abnormalities, including increased serum creatinine and urea levels, anemia, hypoalbuminemia, and electrolyte disturbances, which indicate a more severe course of the disease.

Timely detection and adequate correction of arterial hypertension are essential for slowing the progression of chronic kidney disease, reducing the risk of cardiovascular complications, and improving the prognosis of patients with advanced renal dysfunction.

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