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Prevention of Chronic Kidney Failure

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Abstract: **Review Article**

Chronic kidney disease is a major public health problem due to its increasing prevalence, silent progression, and serious complications, particularly cardiovascular ones. Often diagnosed late, it can progress to an end-stage requiring dialysis or transplantation. Yet, a large proportion of cases are preventable through appropriate preventive measures. Early screening, targeting at-risk populations such as diabetics and those with hypertension, relies on creatinine and albuminuria levels. Primary, secondary, and tertiary prevention respectively prevent the onset, slow the progression, and limit the complications of the disease.

Keywords: Chronic Kidney Disease, Risk Factors, Screening, Prevention.

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I. INTRODUCTION

Chronic kidney disease is a major public health problem today due to its high prevalence, cardiovascular complications, and progression to end-stage renal disease. It is estimated that CKD will be the fifth leading cause of death worldwide by 2040 [1]. Its silent and prolonged progression makes it a particularly insidious disease, often diagnosed at an advanced stage when treatment options become burdensome and restrictive. However, in a large proportion of cases, its onset can be prevented and its progression slowed through simple and accessible measures. This article aims to present concrete ways to prevent chronic kidney disease, both at the individual and community levels.

II. METHODOLOGY

This article is based on a narrative review of the scientific literature on the prevention of chronic kidney disease. A literature search was conducted using recognized international databases, including PubMed, Google Scholar, and recommendations from learned societies such as KDIGO. Selected articles included clinical trials, observational studies, systematic reviews, and international guidelines. Particular attention was paid to epidemiological data and primary, secondary, and tertiary prevention strategies. The information was analyzed qualitatively to synthesize current knowledge and identify the most relevant prevention measures applicable to both clinical practice and public health. This approach aims to provide an educational and accessible document, suitable for healthcare professionals and decision-makers, particularly in resource-limited settings.

III. RISK FACTORS FOR CHRONIC KIDNEY FAILURE

CKD does not occur randomly; it is a consequence of common chronic diseases, especially hypertension and diabetes. In addition

to these factors, risky behaviors include an unbalanced diet, a sedentary lifestyle, self-medication, and exposure to nephrotoxic substances.

1. Associated Chronic Diseases

a) Diabetes Mellitus

Diabetes is the leading cause of CKD worldwide. Chronic hyperglycemia damages the small blood vessels in the kidneys, leading to diabetic nephropathy. This often progresses silently until it reaches an advanced stage. Nearly 40% of people with diabetes will develop some form of kidney damage if their blood sugar is not well controlled [2].

b) Hypertension

Hypertension is also a major cause of CKD. High blood pressure progressively damages the arteries supplying the kidneys, impairing their filtration capacity. Conversely, CKD often worsens hypertension, creating a vicious cycle [3].

2. Other Aggravating Factors

a) Family History

People with relatives suffering from kidney failure (especially end-stage renal disease) have an increased risk of developing the disease. Some forms are genetic in origin, such as autosomal dominant polycystic kidney disease [4].

b) Obesity and Metabolic Syndrome

Being overweight promotes diabetes and hypertension, and directly increases the risk of glomerulosclerosis [2].

c) Smoking

Smoking accelerates the decline in kidney function by increasing blood pressure, reducing renal blood flow, and promoting chronic inflammation [5].

d) Self-Medication and Nephrotoxic Substances

The misuse of nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen or certain traditional herbal remedies can impair kidney function. Drug-induced nephrotoxicity is an underestimated but common cause of CKD, particularly in low- and middle-income countries [6].

IV. EARLY SCREENING AND DIAGNOSIS OF CKD

One of the main challenges of chronic kidney disease is its silent nature in its early stages. The majority of patients remain asymptomatic until advanced stages. When diagnosed early, CKD can be slowed in its progression, or even stabilized. Screening for chronic kidney disease in the general population is not recommended. It should be primarily targeted at high-risk individuals, once or twice a year: These include diabetics (type 1 or 2); those with chronic hypertension; people over 60 years of age; obese patients or those with metabolic syndrome; people with a family history of kidney disease; and patients undergoing nephrotoxic treatments (NSAIDs, antiretrovirals, chemotherapy, etc.). The KDIGO and other learned societies recommend regular monitoring with creatinine testing and proteinuria screening in all these at-risk groups [7].

1. Recommended Screening Tests

Diagnosis relies on simple, accessible, and inexpensive tests:

a) Serum Creatinine Measurement

Creatinine is a waste product of muscle metabolism. Its level in the blood allows calculation of the glomerular filtration rate (GFR), which assesses the kidneys' ability to filter blood. An GFR < 60 mL/min/1.73 m² for more than 3 months indicates chronic kidney disease (CKD).

b) Urinalysis (dipstick or cytobacteriological examination)

Proteinuria, particularly albuminuria, is an early marker of kidney damage, especially in diabetics. It can precede a decrease in GFR.

c) Renal ultrasound (if necessary)

This allows for the assessment of kidney size and the presence of cysts or urinary obstructions, which can be either the cause or consequence of CKD.

V. PREVENTION OF CHRONIC KIDNEY FAILURE

Once considered an inevitable and irreversible process, the progression of CKD can now be controlled in a large number of cases. Thanks to the decisive progress made in recent years in identifying the causal mechanism of the various nephropathies and the mechanisms of their progression to tubulointerstitial fibrosis, targeted pharmacological treatments can influence these processes, provided that preventive therapeutic intervention is initiated early enough, at a stage where reversibility is still possible.

1. Methods of Preventing End-Stage Renal Failure

Prevention theoretically involves three levels:

Primary prevention consists of preventing the development of kidney damage in conditions known to lead to it, for example, diabetes, hypertension, acquired nephropathies and uropathies, and many hereditary diseases. When kidney disease has already led to a reduction in the eGFR, the goal of treatment is to stop, or at least slow, the progression to ESF by acting on the general mechanisms of worsening: this is referred to as secondary prevention. Finally, the prevention of major complications of CKD, particularly cardiovascular disease, constitutes tertiary prevention [8].

a) Primary Prevention

Primary prevention is based primarily on adopting healthy lifestyles, limiting environmental or drug-related risk factors, and controlling chronic diseases. These simple and accessible measures can significantly reduce the incidence of CKD at both the individual and collective levels.

Adopting a Kidney-Friendly Lifestyle

Balanced Diet

A healthy diet, low in salt, saturated fats, and refined sugar, and rich in fruits, vegetables, and fiber, helps prevent diabetes, hypertension, and obesity, the main risk factors for chronic kidney disease (CKD). Excessive consumption of animal protein can also overload the kidneys.

Regular Physical Activity

Physical exercise reduces the risk of type 2 diabetes, hypertension, and metabolic syndrome, thus helping to preserve kidney health.

Smoking Cessation

Smoking promotes the progression of CKD, even in non-diabetic individuals. Quitting smoking slows the decline in glomerular filtration rate (GFR) and improves the response to antihypertensive treatments.

Avoiding Nephrotoxic Substances

The misuse or prolonged use of certain medications, such as non-steroidal anti-inflammatory drugs (NSAIDs), iodinated contrast agents (without prior precautions), certain antibiotics (aminoglycosides), or toxic medicinal plants, should be limited or medically supervised.

Chronic Disease Management

Hereditary Diseases

Hereditary diseases are particularly well-suited to primary prevention when it is possible to address the consequences of the genetic abnormality, especially in the case of an enzyme deficiency for which replacement therapy exists. Early recognition of the disease in family members of an affected individual allows for the screening of at-risk individuals and their preventive treatment. The main hereditary kidney diseases amenable to preventive treatment are: Polycystic kidney disease and other cystic kidney diseases; as well as autosomal dominant polycystic kidney disease, which is the most prevalent. Each child of an affected parent has a 50% chance of inheriting the disease. Other hereditary diseases include: Alport syndrome; primary hyperoxaluria; hereditary hyperuricemia; hereditary tubulopathies; cystinosis; Fabry disease; Congenital Nephrotic Syndromes.

Glomerular Nephropathies and Systemic Diseases

Many acquired kidney diseases are now amenable to effective treatment. Primary prevention is possible in certain types of glomerulonephritis. Indeed, thanks to the immediate antibiotic treatment of pharyngeal infections, often caused by streptococcus, acute post-infectious glomerulonephritis has significantly decreased in frequency, and membranoproliferative glomerulonephritis has practically disappeared in all industrialized countries, with the exception of forms linked to the hepatitis C virus. Nephropathies associated with HIV infection have been regressing since the widespread use of triple therapy. Primary glomerular nephropathies are increasingly amenable to active treatment, although it is not always possible to address the underlying cause of the disease. In nephropathies associated with severe and persistent nephrotic syndrome, such as corticosteroid-dependent or corticosteroid-resistant idiopathic nephrosis, membranous glomerulonephritis, or focal segmental glomerular glomerulosclerosis, treatment with high-dose corticosteroids combined with immunomodulators often leads to stable remission of nephrotic syndrome and prevents or slows progression to renal failure [9].

Tubulointerstitial nephropathies

Benign prostatic hyperplasia (BPH) is the most common acquired cause of urinary tract obstruction, developing in nearly 30% of men over 65. It must be distinguished from prostate cancer, which presents with the same symptoms. Kidney stones are an increasingly rare cause of kidney failure, thanks to more effective management of idiopathic forms and better identification of secondary forms due to a treatable cause (such as primary hyperparathyroidism) as well as hereditary kidney stone diseases, most of which are now amenable to specific treatments that prevent or significantly reduce stone formation and kidney infiltration by crystals. The frequency of infected kidney stones, the most common cause of end-stage renal disease (ESRD) of lithiasic origin, has considerably decreased in all industrialized countries thanks to advances in the detection and treatment of urinary tract infections. Sufficiently prolonged treatment of acute pyelonephritis caused by urease-producing bacteria, such as Proteus, particularly during pregnancy, is an essential preventive measure. Uric acid stones are particularly common in the elderly, especially men. They can progress to the formation of obstructive stones. It responds to a very simple and effective treatment by regular urine alkalinization, but now requires investigation for metabolic syndrome or type 2 diabetes [10]. Prolonged and high-dose use of analgesics or non-steroidal anti-inflammatory drugs (NSAIDs), including aspirin, can lead to progressive chronic interstitial nephritis. Discontinuing the offending medications and replacing them with molecules that are not renally toxic most often leads to a reversal and then stabilization of renal insufficiency.

Hypertensive and Diabetic Nephropathies

The diseases mentioned above are relatively rare and occur in barely one in 1,000 people in the general population. This is very different with regard to kidney damage secondary to hypertension or diabetes, very common diseases affecting millions of people. Primary prevention relies on the appropriate treatment of hypertension and diabetes.

Diabetes

Strict blood glucose control helps reduce the risk of developing diabetic nephropathy. Patients should have regular microalbumin monitoring. Considerable progress has been made in recent years in the prevention and treatment of diabetic nephropathy, thanks to optimized blood glucose control and early treatment with angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) and statins.

Hypertension

Controlling blood pressure (< 130/80 mmHg) is essential to protect the kidneys. Angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) are recommended.

b) Secondary Prevention

In patients with diagnosed CKD (stages 1 to 3), several interventions are recommended to slow the decline in kidney function:

Regular monitoring of kidney function

Regular checkups (every 3 to 6 months depending on the stage) are essential to monitor changes in eGFR, albuminuria, calcium-phosphate balance, serum potassium, etc.

Optimization of treatments

The use of renin-angiotensin system inhibitors (ACE inhibitors or ARBs) can reduce proteinuria and slow the progression of CKD, particularly in diabetic or hypertensive patients.

Adapted diet

A low-salt, moderate-protein diet, and monitoring of phosphorus and potassium intake based on blood tests are recommended. Dietitians play a fundamental role in patient education.

c) Tertiary Prevention

In patients at stages 4 or 5, the goal is to anticipate complications and prepare for renal replacement therapy:

Management of Metabolic Complications

Correction of anemia (erythropoietin, iron); prevention of calcium and phosphate disorders and bone abnormalities (vitamin D, phosphate binders); monitoring of blood potassium (hyperkalemia).

Preparation for Renal Replacement Therapy

From stage 4 onward, joint follow-up by a nephrologist and the dialysis team is necessary to inform the patient and guide them toward choosing a treatment strategy: peritoneal dialysis, hemodialysis, or registration on the kidney transplant waiting list.

VI. DISCUSSION

The analyzed data confirm that chronic kidney disease is a multifactorial condition, the prevention of which relies primarily on controlling modifiable risk factors, particularly diabetes and hypertension. The high prevalence of these conditions in the general population largely explains the increase in the incidence of CKD worldwide [2, 3]. One of the major findings is the frequent diagnostic delay, linked to the often asymptomatic nature of the disease. This underscores the importance of targeted screening in at-risk populations, as recommended by learned societies, notably the KDIGO guidelines [7]. The implementation of simple screening strategies, based on creatinine measurement and albuminuria testing, appears to be a cost-effective measure, particularly in low- and middle-income countries [7]. Furthermore, primary prevention measures, based on lifestyle modifications, remain insufficiently implemented despite their proven effectiveness in reducing the incidence of associated chronic diseases [2]. Patient education and community interventions play a key role in promoting behaviors that support kidney health. Therapeutically, recent advances, particularly the use of renin-angiotensin system inhibitors, have significantly improved the prognosis of patients with chronic kidney disease (CKD) by reducing proteinuria and slowing the decline in glomerular filtration rate (GFR) [2, 7]. However, access to these treatments remains unequal depending on socioeconomic background, which limits their impact at the population level. Finally, tertiary prevention, focused on reducing cardiovascular complications and preparing for renal replacement therapy, requires multidisciplinary and proactive management [8]. In this context, strengthening health

systems, training professionals, and raising public awareness appear essential to reducing the long-term burden of CKD.

VII. CONCLUSION

Chronic kidney disease (CKD) is a growing public health problem with significant human, social, and economic consequences. Its silent nature in the early stages often leads to underdiagnosis and delayed treatment. However, effective preventive measures exist.

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