1. Introduction

Chronic kidney disease (CKD) is a pathological condition characterized by a gradual and persistent deterioration in kidney function. Chronic kidney disease (CKD) can arise for a multitude of reasons, including diabetes, hypertension, autoimmune disorders, and hereditary predispositions. An essential element in the care of CKD is the regulation of blood pressure, as unregulated blood pressure can expedite kidney deterioration and heighten the likelihood of cardiovascular problems. In 2021, Kidney Disease: Improving Global Outcomes (KDIGO) issued revised guidelines, including updated recommendations for the management of chronic renal disease and the control of blood pressure. The 2021 KDIGO Guidelines utilize current research and comprehensive scientific evidence to provide the most favorable blood pressure goals for those suffering from chronic kidney disease. The primary objective is to decelerate the advancement of renal impairment, mitigate problems linked to chronic kidney disease, and enhance the patient's quality of life. The 2021 KDIGO guidelines ground the blood pressure target recommendations for patients with chronic kidney disease (CKD) in a thorough evaluation of the extent of kidney damage, cardiovascular risk, and individual patient characteristics. The 2021 KDIGO guidelines recommend tailoring blood pressure control in patients with CKD to each individual rather than following a standardized method.

Furthermore, it is crucial to comprehend the successive phases of chronic renal disease, which encompass different levels of kidney impairment and deterioration in function. The phases of chronic renal disease are organized based on the glomerular filtration rate (GFR), which measures the kidney's ability to remove waste from the bloodstream. The progression of CKD begins in the initial phases, during...
which the damage may not manifest noticeable symptoms, and advances to the later stages, characterized by a substantial decline in renal function, necessitating the need for kidney function replacement. The objective of this study is to provide a comprehensive analysis of the blood pressure targets recommended by KDIGO 2021 for individuals diagnosed with chronic kidney disease. In addition, we shall elucidate the progression of chronic kidney disease from its initial phases to its ultimate stages, along with the elements that impact its development. Acquiring a more comprehensive understanding of the KDIGO guidelines and the progression of CKD will enable the treatment and administration of chronic kidney disease to be executed with greater efficacy, thereby mitigating the adverse effects on patient well-being.

2021 KDIGO guidelines for blood pressure targets

KDIGO 2021 offers precise guidelines for blood pressure targets, taking into account the extent of kidney damage, cardiovascular risk, and other accompanying medical conditions in individuals with chronic kidney disease (CKD). Establishing suitable blood pressure targets is crucial, as it might impact the advancement of diseases and the likelihood of problems in individuals with CKD. The glomerular filtration rate (GFR) is a crucial factor in establishing blood pressure target guidelines for individuals with chronic kidney disease (CKD). GFR is an indicator of renal function, namely the efficiency of the kidneys in removing waste and byproducts from the bloodstream. The recommendations for blood pressure targets may differ depending on the glomerular filtration rate (GFR). This is crucial for optimizing the management of chronic kidney disease (CKD) and minimizing the risk of complications. The glomerular filtration rate (GFR) serves as an indicator of the extent of kidney impairment and influences the body’s regulation of blood pressure, hydration, and electrolyte balance.2,3

During the initial phases of chronic kidney disease, the glomerular filtration rate (GFR) may remain relatively elevated, and kidney function may not be significantly compromised. During this phase, patients may exhibit a greater degree of renal reserve, indicating that the body is still capable of effectively regulating water and electrolyte equilibrium. Consequently, blood pressure targets may prioritize the regulation of elevated blood pressure in order to avert more harm to the kidneys and mitigate the likelihood of problems. During the advanced phases of chronic kidney disease, there is a substantial decline in glomerular filtration rate (GFR) and reduced kidney function. Individuals in this phase may have an elevated susceptibility to issues such as edema (accumulation of fluid in the body), imbalances in electrolyte levels, and increased cardiovascular hazards. Thus, during this phase, it may be advisable to set lower blood pressure goals in order to promote optimal fluid and electrolyte equilibrium and alleviate strain on the cardiovascular system.3

Individuals suffering from chronic kidney disease (CKD) are at an elevated risk of experiencing cardiovascular complications, such as coronary artery disease, cerebrovascular accidents, and peripheral vascular disease. Cardiovascular-renal syndrome refers to the intimate association between kidney illness and cardiovascular risk. Various factors contribute to this heightened risk, including persistent inflammation, endothelial dysfunction, elevated blood pressure, and compromised electrolyte metabolism. Lowering blood pressure targets for patients with a higher cardiovascular risk is recommended because effective blood pressure management can reduce the likelihood of experiencing such consequences. Hypertension can result in vascular damage and exacerbate cardiac problems. Regulating blood pressure can lower the likelihood of harm to the cardiovascular system. Hypertension is a significant contributing factor to the occurrence of stroke. Maintaining blood pressure within the normal range can decrease the likelihood of experiencing a stroke. Regulating blood pressure can also contribute to the preservation of optimal renal function and mitigate the risk of additional harm to the kidneys. Therefore, regulating blood pressure can diminish the likelihood of experiencing kidney issues. Elevated blood pressure imposes an additional load on the heart and circulatory system. Reducing blood pressure alleviates this load.4


In essence, the KDIGO 2021 guidelines for blood pressure targets in patients with CKD can be succinctly defined as: (1) If the glomerular filtration rate (GFR) is equal to or greater than 30 mL/min/1.73 m², the recommended target blood pressure is less than 140/90 mmHg. (2) If the glomerular filtration rate (GFR) is less than 30 mL/min/1.73 m², the recommended target blood pressure is also less than 140/90 mmHg. However, it is important to carefully examine the dangers of renal hypoperfusion.

Individuals with elevated levels of proteinuria: (1) For patients with high levels of protein in their urine (proteinuria) and a glomerular filtration rate (GFR) of 30 mL/min/1.73 m² or higher, the recommended target blood pressure is less than 130/80 mmHg. (2) Patients who have high levels of protein in their urine (proteinuria) and a glomerular filtration rate (GFR) below 30 mL/min/1.73 m² should aim for a target blood pressure below 130/80 mmHg. However, it is important to carefully assess the possibility of reduced blood flow to the kidneys (renal hypoperfusion).

The 2021 KDIGO guidelines acknowledge the significance of incorporating patients in the decision-making process for managing blood pressure in individuals with chronic kidney disease (CKD). This approach embodies the tenets of patient-centered care, which upholds patient preferences, values, and priorities in their treatment. Every individual patient possesses unique preferences and values when it comes to the treatment and management of blood pressure. Engaging patients enables them to actively partake in decisions that impact their well-being and fosters a greater sense of involvement in their healthcare. Patients frequently possess a heightened comprehension of their medical condition, firsthand knowledge of symptoms, and awareness of medication adverse effects. Engaging patients in discussions can facilitate doctors' comprehension of these factors and enable them to develop a more tailored treatment strategy. When determining blood pressure targets, it is important to carefully analyze the trade-off between the advantages and disadvantages. Patients possess a deep understanding of how certain symptoms or side effects can affect their overall quality of life. Active engagement of the patient allows for modification of treatment plans to maximize advantages while minimizing potential hazards. Every patient possesses distinct characteristics and qualities. Various factors, including age, lifestyle, concomitant health conditions, and personal preferences, can impact the most effective strategy for managing blood pressure and overall chronic kidney disease (CKD).

**Chronic kidney disease progression**

Chronic kidney disease (CKD) progresses through stages characterized by a gradual decrease in kidney function and progressively worsening organ damage. The GFR scale assesses the extent of renal impairment and quantifies the kidneys' efficiency in eliminating waste and byproducts from the bloodstream.

**Initial stage (G1–G2)**

The glomerular filtration rate (GFR) remains within the normal range at this stage, with just a little decline. The renal function is largely intact, and patients may not manifest overt symptoms associated with renal illness at this stage. Existence of Risk Factors or Indications of Kidney Impairment: Despite the GFR remaining within the normal range or experiencing only a minor decrease, there are risk factors or initial indications that suggest the possibility of renal impairment. These indicators may encompass the existence of proteinuria (abnormally high levels of protein in the urine), elevated creatinine levels in blood tests, or other laboratory findings that suggest possible compromised kidney function. Despite the presence of potential indications of harm, kidney function remained within normal parameters. This indicates that the kidneys are still capable of performing their functions efficiently, despite the initial alteration in their state. During this phase, the implementation of preventative measures and risk management strategies becomes crucial. At this stage, healthcare providers should counsel and direct patients on preserving kidney health, managing risk factors such as hypertension or diabetes, and adopting a wholesome lifestyle to decelerate the advancement of renal disease. By providing diligent care and therapy throughout the initial phases, it is feasible to avert additional harm to the kidneys and diminish the
likelihood of difficulties in the advanced stages of CKD.7,8

**Stage 2 (G3a-G3b)**
During this stage, there is a more substantial decrease in the glomerular filtration rate (GFR) compared to the preceding stage. This decline signifies a more significant impact on renal function. Stage G3a is characterized by a glomerular filtration rate (GFR) ranging from 45–59 mL/min/1.73 m², whereas stage G3b is characterized by a GFR ranging from 30–44 mL/min/1.73 m². A significant loss in kidney function can result in early symptoms such as heightened fatigue, elevated blood pressure, and potentially other issues, including reduced urine production or electrolyte imbalances. During this phase, the management of renal disease becomes increasingly rigorous. Patients may require increased frequency of testing and monitoring, as well as particular recommendations for dietary choices, medications, and the management of risk factors such as hypertension. During stages G3a–G3b, it is crucial to implement measures to halt the progression of kidney function deterioration and mitigate potential consequences. This entails collaborating closely with the healthcare team to devise suitable treatment techniques and lifestyle modifications. Implementing suitable interventions at this stage can effectively decelerate the advancement of renal disease, uphold patient welfare, and diminish the likelihood of problems in subsequent stages. Hence, prompt identification of symptoms and intervention are imperative in the management of chronic renal disease.7,8

**Stage 3 (G3b-G4)**
During this stage, there is a more substantial decrease in the glomerular filtration rate (GFR) compared to the preceding stage. This decline signifies a progressive deterioration in renal function. Stage G3b is characterized by a glomerular filtration rate (GFR) ranging from 30 to 44 mL/min/1.73 m², whereas stage G4 is characterized by a GFR ranging from 15 to 29 mL/min/1.73 m². Further deterioration in kidney function can exacerbate the manifestation of symptoms. Patients may have heightened fatigue, challenging blood pressure management, electrolyte imbalances, anemia, and other complications associated with reduced renal function. Individuals in this phase are more susceptible to cardiovascular issues, such as coronary artery disease, cerebrovascular accidents, and other vascular disorders. This is because the kidneys play a crucial role in regulating fluid, electrolyte, and blood pressure equilibrium. During phases G3b–G4, the therapy of renal disease becomes increasingly rigorous. Patients can benefit from receiving more specialized treatment in terms of dietary recommendations, drug prescriptions, and the handling of potential problems. At this juncture, the physician may do a comprehensive assessment to detect any complications and additional health issues that may occur as a result of reduced kidney function. This requires a strong partnership between the patient and the healthcare team, with frequent and open communication. During stages G3b–G4, the objective is to decelerate the advancement of the disease, effectively handle symptoms and consequences, and minimize the likelihood of cardiovascular problems. Patients must adhere to treatment instructions provided by the medical team and implement measures to preserve overall health and the residual functionality of the kidneys.7–9

**Stage 4 (G4)**
During stage G4, there is a substantial decline in glomerular filtration rate (GFR). The individual’s renal function was significantly impaired, with a glomerular filtration rate (GFR) falling within the range of 15–29 mL/min/1.73 m². These findings indicate a severe restriction in the kidney’s capacity to eliminate waste from the bloodstream. During this period, a high level of medical care is necessary. Patients may necessitate the administration of medical interventions to address potential health consequences, including anemia, electrolyte imbalances, and cardiovascular issues. Patients in stage G4 require vigilant supervision by the healthcare team due to the significant likelihood of problems. Furthermore, patients should also begin contemplating kidney replacement alternatives, such
as dialysis or transplantation. Due to a significant impairment in kidney function, the patient may be advised to contemplate the possibility of undergoing dialysis or kidney transplantation. The decision to choose this alternative will depend on a comprehensive assessment of the patient's condition and other relevant considerations. Patients in stage G4 must adequately prepare themselves both physically and psychologically for more rigorous therapy and potential significant alterations to their daily routine, depending on the selected kidney replacement alternative. Stage G4 is a pivotal phase in the advancement of CKD due to the heightened vulnerability of patients to severe consequences, necessitating meticulous supervision and treatment. Openly communicating with the healthcare team, following their instructions, and taking appropriate actions are crucial for minimizing adverse effects on health and quality of life.\textsuperscript{9}

\textbf{Stage 5 (G5)}

In stage G5, the kidneys significantly reduce or completely lose the glomerular filtration rate (GFR). This suggests that the kidneys are nearing a point where they are no longer capable of effectively filtering and cleaning the blood. Stage G5 is the final stage of renal failure. This is the stage at which renal function is inadequate to sustain a normal life, necessitating the patient to undergo kidney replacement therapy in order to survive. Patients in stage G5 should contemplate kidney function replacement alternatives, typically encompassing dialysis or kidney transplantation. Dialysis is the procedure of purifying the blood by eliminating waste and waste products through a specialized machine, whereas kidney transplantation is the surgical placement of a healthy kidney from a compatible donor. Patients at stage G5 must undertake further preparations for the imminent restoration of kidney function. This entails meticulous monitoring, comprehensive assessment, and strategic coordination with the healthcare team. Renewal of renal function has a substantial influence on the patient's quality of life. Patients should anticipate modifications in their daily regimen, dietary habits, and medical treatment. Nevertheless, the restoration of kidney function can also offer renewed optimism and enable patients to have an improved quality of life. Stage G5 represents a crucial juncture in the progression of chronic renal disease, where the need for kidney function replacement becomes not only essential but potentially obligatory in order to save the patient's life and well-being. Effective collaboration with the healthcare team, a comprehensive understanding of kidney replacement choices, and thorough planning are essential to successfully navigating this significant transition.\textsuperscript{8,9}

\section*{2. Conclusion}

Assessing the extent of kidney damage, cardiovascular risk, and individual patient characteristics mostly determine the blood pressure target recommendations for patients with chronic kidney disease (CKD) in the 2021 KDIGO guidelines. These suggestions suggest that the management of blood pressure in individuals with CKD should not be standardized but rather tailored to the specific needs of each person.

\section*{3. References}

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