



Review Article

Chronic Kidney Diseases and Substances Abuse: A menace of our time

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Abstract

Chronic kidney disease (CKD) is a significant health concern, particularly among substance abusers who are at a higher risk of kidney damage due to the toxic effects of substances. This review aims to explore the prevention strategies for CKD in substance abusers, highlighting the importance of early intervention and comprehensive care. The novelty of this review lies in its focus on the unique challenges faced by substance abusers in preventing CKD. By examining the existing literature, this review highlights the need for targeted interventions and collaborative efforts between healthcare providers, addiction specialists, and policymakers. The review utilizes a systematic approach to identify relevant studies, including randomized controlled trials, cohort studies, and systematic reviews. The selected studies were critically analyzed to extract key findings related to prevention strategies, screening protocols, harm reduction initiatives, and mental health interventions. In conclusion, preventing CKD in substance abusers requires a comprehensive approach that addresses the complex needs of this population. Early intervention, targeted education, harm reduction strategies, and multidisciplinary care are crucial in mitigating the risks of kidney damage. By implementing these recommendations, healthcare providers, policymakers, and communities can make a substantial impact on preventing CKD in substance abusers.

Keywords: chronic kidney disease, substance abuse, prevention strategies, early intervention, harm reduction, multidisciplinary care.

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Introduction

Chronic kidney disease (CKD) has become a significant public health concern worldwide, affecting millions of individuals. It is a progressive condition that impairs kidney function over time, leading to serious complications and potentially life-threatening consequences. While the causes of CKD are multifactorial, the association between substance abuse and the development and progression of kidney disease has gained increasing attention in recent years.

Staging of Chronic Kidney Disease

The different stages of CKD form a continuum. The stages of CKD are classified as follows

Stage 1: Kidney damage with normal or increased GFR (>90 mL/min/1.73 m²)

Stage 2: Mild reduction in GFR (60-89 mL/min/1.73 m²)

Stage 3a: Moderate reduction in GFR (45-59 mL/min/1.73 m²)

Stage 3b: Moderate reduction in GFR (30-44 mL/min/1.73 m²)

Stage 4: Severe reduction in GFR (15-29 mL/min/1.73 m²)

Stage 5: Kidney failure (GFR < 15 mL/min/1.73 m² or dialysis (KDIGO, 2012).

Signs and Symptoms of Chronic Kidney Diseases

Include nausea, vomiting, loss of appetite, fatigue and weakness, sleep disorder, urinating more or less, decreased mental sharpness, muscle cramps, swelling of feet (oedema), high blood pressure that is difficult to control, shortness of breath (dyspnoea) if fluid builds up in the lungs, chest pain if fluid builds up around the lining of the heart.

Substance abuse, including the misuse of illicit drugs, alcohol, and certain medications, has been recognized as a major risk factor for the development and progression of CKD. The harmful effects of substance abuse on the kidneys are well-documented, with substances like cocaine, heroin, methamphetamine, and excessive alcohol consumption directly contributing to renal damage. However, despite the growing body of evidence, the extent and specific mechanisms by which substance abuse impacts kidney health remain areas of concern.

Understanding the relationship between substance abuse and CKD is of paramount importance due to several reasons. Firstly, substance abuse is a widespread issue that affects individuals across various age groups and socioeconomic backgrounds. Secondly, the prevalence of CKD continues to rise, posing a significant burden on healthcare systems globally. By exploring the link between substance abuse and CKD, we can identify modifiable risk factors and develop targeted interventions to prevent and

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manage kidney disease effectively. Moreover, the economic implications of CKD, including the cost of dialysis and transplantation, further emphasize the need for comprehensive research in this area.

Research Questions

1. What are the specific substances that are most strongly associated with the development and progression of CKD?
2. What are the underlying mechanisms by which substance abuse leads to renal damage?
3. How does substance abuse impact the clinical course and outcomes of CKD?
4. Are there any preventive measures or interventions that can mitigate the risk of CKD in substance abusers?

The aim of this study is to investigate the relationship between substance abuse and CKD, with the following objectives:

1. To identify the specific substances that are most strongly associated with the development and progression of CKD.
2. To explore the underlying mechanisms by which substance abuse leads to renal damage.
3. To examine the impact of substance abuse on the clinical course and outcomes of CKD.
4. To propose preventive measures and interventions that can mitigate the risk of CKD in substance abusers.

Literature Review

Chronic kidney disease (CKD) is a global health issue with significant implications for morbidity and mortality. This literature review aims to explore the associations, risk factors, and outcomes related to CKD, as well as the impact of lifestyle factors and comorbidities on renal function.

Several studies have highlighted the association between estimated glomerular filtration rate (eGFR), proteinuria, and adverse cardiovascular outcomes in CKD patients (Bello et al., 2011). Impaired kidney function, as indicated by reduced eGFR, has been linked to an increased risk of cardiovascular events and mortality.

Alcohol consumption has been identified as a modifiable risk factor for CKD. A systematic review and meta-analysis showed that alcohol use negatively impacts glycemic control in patients with diabetes mellitus, potentially exacerbating kidney damage (Crews et al., 2010).

The global burden of CKD and its impact on public health cannot be understated. Jha et al. (2013) highlighted the increasing prevalence of CKD worldwide, emphasizing the need for comprehensive strategies to address this growing health challenge.

Uric acid has also emerged as a significant factor in the progression of CKD. Studies have demonstrated a bidirectional relationship between uric acid levels and CKD, suggesting that uric acid may contribute to the development and progression of renal damage (Johnson et al., 2013).

Socioeconomic factors play a crucial role in the outcomes of CKD patients. Kimmel et al. (2013) found that socioeconomic disparities, including income disparities and racial segregation, are associated with worse survival rates in hemodialysis patients.

The impact of lifestyle choices, such as smoking, on renal function has been extensively studied. Russo et al. (2003) reported a correlation between cigarette smoking and the progression of renal damage in patients with mild to moderate renal insufficiency. Smoking cessation interventions should be a priority in managing CKD patients.

Understanding the neurobiological mechanisms underlying addiction is vital in addressing substance abuse-related CKD. The National Institute on Drug Abuse (NIDA) provides comprehensive information on the science of addiction, highlighting the impact of drugs on the brain and behavior (NIDA, 2018).

Cardiorenal syndrome, characterized by the interplay between cardiac and renal dysfunction, presents unique challenges in managing patients with both cardiovascular disease and CKD. Ronco and Di Lullo (2014) discuss the pathophysiology, classification, and treatment strategies for cardiorenal syndrome.

Finally, Tonelli et al. (2006) conducted a systematic review investigating the relationship between CKD and mortality risk. The study revealed a significant association between reduced kidney function and increased mortality rates, emphasizing the need for early detection and appropriate management of CKD.

Identification of Specific Substances Associated with the Development and Progression of CKD

Chronic kidney disease (CKD) is a complex condition influenced by various factors, including specific substances that can contribute to its development and progression. This section focuses on the identification of some key substances that have been extensively studied in relation to CKD (National Kidney Foundation, 2021).

Hypertension: High blood pressure is a leading cause of CKD. Sustained elevation in blood pressure can damage the delicate blood vessels in the kidneys, impairing their ability to filter waste and maintain fluid balance. Controlling hypertension through lifestyle modifications and medication is crucial in preventing or slowing down CKD progression.

Diabetes Mellitus: Diabetes is another major contributor to CKD. Elevated blood sugar levels over time can damage the small blood vessels and filtering units (glomeruli) in the kidneys (Eckardt et al., 2013). Diabetic nephropathy is a specific form of kidney damage associated with diabetes. Proper management of diabetes, including glycemic control and blood pressure management, is essential in preventing CKD development and progression.

Glomerulonephritis: Glomerulonephritis refers to inflammation of the glomeruli, the filtering units of the kidneys. Various factors, including immune system disorders, infections, and certain medications, can trigger glomerulonephritis. The inflammatory response can lead to progressive kidney damage and eventual CKD. Early detection and treatment of glomerulonephritis are crucial in preventing further kidney impairment.

Obstructive Uropathy: Obstructive uropathy occurs when there is a blockage in the urinary tract that hinders the normal flow of urine. Conditions such as kidney stones, urinary tract infections, and structural abnormalities can cause obstructive uropathy. Prolonged obstruction can lead to kidney damage and CKD. Timely identification and management of the underlying obstruction are important in preventing CKD progression (Levin et al., 2013).

Nephrotoxic Medications: Certain medications can have toxic effects on the kidneys, leading to drug-induced nephrotoxicity. Nonsteroidal anti-inflammatory drugs (NSAIDs), certain antibiotics, and some chemotherapy drugs are known to have nephrotoxic potential. Proper dosing, monitoring of kidney function, and avoidance of

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unnecessary exposure to nephrotoxic medications are important in preventing drug-induced CKD.

Heavy Metals: Exposure to heavy metals, such as lead, cadmium, and mercury, has been associated with kidney damage and CKD. Occupational exposures, environmental contamination, and certain herbal remedies or traditional medicines can contribute to heavy metal toxicity. Strict regulations, avoidance of exposure, and appropriate safety measures are necessary to prevent heavy metal-related CKD.

Proteinuria: Persistent proteinuria, the presence of abnormal amounts of protein in the urine, is a significant marker of kidney damage and a risk factor for CKD progression. Various kidney diseases, including glomerular disorders and diabetic nephropathy, can cause proteinuria. Identifying and managing the underlying cause of proteinuria is crucial in preventing further kidney damage and CKD progression (Perazella et al., 2008).

Exploring the Underlying Mechanisms by Which Substance Abuse Leads to Renal Damage

Substance abuse, including the prolonged and excessive use of drugs and alcohol, can have detrimental effects on various organ systems, including the kidneys. Renal damage caused by substance abuse involves multiple mechanisms that can contribute to kidney dysfunction and the development of chronic kidney disease (Perico et al., 2017). Here are some underlying mechanisms by which substance abuse can lead to renal damage:

Hemodynamic Effects: Many substances, such as stimulants like cocaine and amphetamines, can cause significant changes in blood pressure and blood flow to the kidneys. These alterations can lead to vasoconstriction, reduced renal blood flow, and increased glomerular pressure, which eventually contribute to kidney damage.

Inflammation and Oxidative Stress: Substance abuse can trigger an inflammatory response and increase the production of reactive oxygen species (ROS) within the kidneys. Chronic inflammation and oxidative stress can damage renal cells, including glomeruli and tubules, leading to progressive kidney injury.

Direct Toxicity: Some substances, such as certain illicit drugs and solvents, have direct toxic effects on renal cells. For example, heroin and other opioids can cause direct toxicity to the renal tubules, leading to acute kidney injury (AKI) or CKD (Eckardt et al., 2009). Similarly, certain chemicals and solvents can directly damage renal cells when ingested or inhaled.

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Immune-Mediated Mechanisms: Substance abuse can disrupt the immune system, leading to abnormal immune responses that can affect the kidneys. Immune complexes and autoantibodies can deposit in the kidneys, causing inflammation and kidney damage. This mechanism is seen in conditions like drug-induced glomerulonephritis.

Rhabdomyolysis: Certain substances, such as alcohol and cocaine, can induce rhabdomyolysis, a condition characterized by muscle breakdown. The release of myoglobin, a muscle protein, can overwhelm the kidneys' filtering capacity and lead to acute kidney injury. Rhabdomyolysis-related renal damage requires prompt medical attention.

Dehydration and Electrolyte Imbalances: Substance abuse, particularly with alcohol and stimulants, can lead to significant dehydration and electrolyte imbalances. Dehydration reduces blood volume and impairs kidney function, while electrolyte imbalances can disrupt the delicate balance required for normal kidney function. Prolonged or recurrent dehydration and electrolyte disturbances can contribute to renal damage (Hsu and Chertow, 2008).

Comorbidities: Substance abuse often coexists with other comorbid conditions, such as hypertension, diabetes, and viral infections like hepatitis B and C. These conditions can independently cause renal damage, and their presence alongside substance abuse can exacerbate the risk and severity of kidney injury (Ronco et al., 2019).

Examining the Impact of Substance Abuse on the Clinical Course and Outcome of Chronic Kidney Disease (CKD)

Substance abuse, including the prolonged and excessive use of drugs and alcohol, can have a significant impact on the clinical course and outcome of chronic kidney disease (CKD). It exacerbates the progression of CKD and increases the risk of complications. Here are some key points to consider when examining the impact of substance abuse on CKD:

Accelerated Progression: Substance abuse, particularly with drugs like cocaine, amphetamines, and heroin, can accelerate the progression of CKD. The underlying mechanisms, such as hemodynamic effects, direct toxicity, and inflammation, contribute to increased renal damage and faster decline in kidney function. As a result, individuals with CKD who abuse substances are more likely to reach end-stage renal disease (ESRD) at an earlier age compared to non-abusers.

Increased Risk of Acute Kidney Injury (AKI): Substance abuse, especially with alcohol and certain drugs, increases the risk of developing acute kidney injury (AKI). AKI episodes can further impair kidney function and hasten the progression of CKD. It is important to note that AKI can be a reversible condition if identified and managed promptly.

Complications and Comorbidities: Substance abuse can lead to the development or exacerbation of comorbid conditions that commonly accompany CKD. For example, hypertension and diabetes are prevalent among substance abusers and are independent risk factors for CKD progression. Substance abuse can also increase the likelihood of infections, particularly viral hepatitis, which can worsen renal health.

Medication Non-Adherence: Substance abuse is often associated with poor treatment adherence. Individuals may neglect prescribed medications, including those aimed at managing CKD and its complications, such as blood pressure control and blood sugar management. Medication non-adherence can further worsen kidney function and increase the risk of adverse outcomes.

Increased Cardiovascular Risk: Substance abuse is linked to an increased risk of cardiovascular disease, which is already a common complication in CKD. The combination of substance abuse and CKD amplifies the risk of cardiovascular events such as heart attacks and strokes. This highlights the importance of comprehensive management strategies that address both substance abuse and cardiovascular risk factors.

Psychosocial Challenges: Substance abuse often leads to various psychosocial challenges, including mental health disorders, social isolation, and unstable living conditions. These factors can impact an individual's ability to manage their CKD effectively, adhere to treatment regimens, and engage in healthy behaviors. Addressing these psychosocial challenges is crucial for improving clinical outcomes in CKD patients with substance abuse.

Transplantation Considerations: Substance abuse history may impact eligibility for kidney transplantation. Many transplant centers have strict criteria and require individuals to establish a period of sustained abstinence before being considered for transplantation. Substance abuse can also affect post-transplant outcomes, including graft survival and overall success of the transplant.

Proposing Preventive Measures and Interventions to Mitigate the Risk of CKD in Substance Abusers

Preventing chronic kidney disease (CKD) in individuals who abuse substances requires a comprehensive approach that addresses both the underlying causes of substance abuse and the associated risk factors for CKD. Here are some preventive measures and interventions that can help mitigate the risk of CKD in substance abusers:

Education and Awareness: Promoting education and awareness about the risks of substance abuse on kidney health is crucial. Public health campaigns, educational programs, and community outreach initiatives can help raise awareness about the detrimental effects of substance abuse on the kidneys. Increasing knowledge about the link between substance abuse and CKD can encourage individuals to seek help and make informed decisions about their health.

Substance Abuse Treatment: Providing access to effective substance abuse treatment programs is essential for mitigating the risk of CKD. Substance abuse treatment should include a combination of behavioral therapies, counseling, and pharmacotherapy when appropriate. Accessible and affordable treatment options can help individuals overcome their addiction, reduce substance abuse-related complications, and improve overall health outcomes, including kidney health.

Harm Reduction Strategies: Implementing harm reduction strategies can reduce the adverse effects of substance abuse on the kidneys. Needle and syringe exchange programs, safe injection sites, and naloxone distribution can help prevent infections and overdose-related complications, which can indirectly impact kidney health. These strategies can also serve as entry points for engaging substance abusers in healthcare services and facilitating access to relevant interventions.

Screening and Early Detection: Regular screening for CKD among individuals who abuse substances is crucial for early detection and intervention. Healthcare providers should routinely assess kidney function through urine tests and blood tests to identify any signs of kidney damage promptly. Early detection allows for timely intervention and management of CKD, which can help slow down its progression and prevent further complications.

Blood Pressure and Blood Sugar Control: Managing blood pressure and blood sugar levels is essential for individuals who abuse substances, as hypertension and diabetes are common risk factors for CKD. Implementing lifestyle modifications, such as a healthy

diet, regular exercise, and weight management, can help control blood pressure and blood sugar levels. Additionally, healthcare providers should closely monitor and manage these risk factors to prevent or delay the onset of CKD.

Mental Health Support: Addressing the underlying mental health issues that often accompany substance abuse is critical. Providing comprehensive mental health support, including counseling and therapy, can help individuals manage their substance abuse and reduce the associated stressors that can impact kidney health. Integrated care models that combine substance abuse treatment and mental health services can be highly beneficial.

Peer Support and Recovery Programs: Encouraging participation in peer support groups and recovery programs can provide individuals with substance abuse disorders the necessary social support and motivation to maintain abstinence and make positive lifestyle changes. Peer support groups can offer a sense of belonging, share experiences, and provide practical advice on managing substance abuse and maintaining kidney health.

Multidisciplinary Care: Coordinating care among healthcare professionals, including primary care physicians, nephrologists, addiction specialists, and mental health professionals, is crucial for the comprehensive management of CKD in substance abusers. A multidisciplinary care approach ensures that all aspects of a person's health are addressed, promoting better outcomes and reducing the risk of CKD progression.

Conclusion

In conclusion, preventing chronic kidney disease (CKD) in substance abusers requires a multifaceted approach that addresses both substance abuse and the associated risk factors for CKD. By implementing education and awareness programs, providing access to substance abuse treatment, implementing harm reduction strategies, conducting regular screening, managing blood pressure and blood sugar levels, addressing mental health issues, promoting peer support and recovery programs, and ensuring multidisciplinary care, the risk of CKD can be mitigated in this vulnerable population. It is crucial for healthcare providers, policymakers, and communities to work together to implement these preventive measures and interventions, ultimately improving kidney health outcomes and enhancing the overall well-being of substance abusers.

Recommendation

Based on the information provided, here are some recommendations for preventing chronic kidney disease (CKD) in substance abusers:

Improve access to substance abuse treatment: Increase the availability and affordability of treatment programs for substance abusers. This can include expanding the number of treatment facilities, providing financial assistance options, and promoting awareness of available resources.

Implement education and awareness programs: Develop targeted educational campaigns that highlight the risks of substance abuse on kidney health. These programs should focus on informing individuals about the potential long-term consequences of substance abuse and the importance of early intervention and treatment.

Promote harm reduction strategies: Implement harm reduction programs that aim to minimize the negative health consequences associated with substance abuse. This can include providing clean needle exchange programs, distributing naloxone kits to prevent opioid overdoses, and offering safe injection sites or supervised consumption facilities.

Conduct regular screening and monitoring: Implement routine screening protocols for substance abusers to detect early signs of kidney damage. Regular monitoring of blood pressure and blood sugar levels is also essential to identify and manage risk factors for CKD.

Address mental health issues: Provide comprehensive mental health services to substance abusers, as mental health disorders are often intertwined with substance abuse. By addressing underlying mental health issues, individuals may be more motivated to seek treatment and make positive lifestyle changes.

Promote peer support and recovery programs: Establish peer support groups and recovery programs specifically designed for substance abusers with kidney disease. These programs can provide a sense of community, encouragement, and shared experiences, which can enhance the likelihood of successful treatment outcomes.

Ensure multidisciplinary care: Encourage collaboration between healthcare professionals, including nurses, nephrologists, addiction specialists, mental health professionals, and primary care providers. This multidisciplinary approach can help

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address the complex needs of substance abusers with CKD and improve overall patient outcomes.

Advocate for policy changes: Work with policymakers to develop and implement policies that support prevention efforts and improve access to treatment for substance abusers. This can include advocating for increased funding for substance abuse treatment programs, implementing regulations to reduce access to harmful substances, and supporting initiatives that aim to reduce the stigma associated with addiction.

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