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Review Article

Chronic Kidney Disease and Maintenance of Hemodialysis

Rama*, Bobburi Tejaswi, Mohammed Mansoor Ali, Anusha Patil
Department of Pharmacy, Mallareddy Institute of Pharmaceutical Sciences, Hyderabad, India

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ABSTRACT

Introduction: Chronic Kidney Disease (CKD) or Chronic Renal Disorder (CRD) is associated with abnormal structural and functional of kidney and its main unit nephrons which lead to the abnormal urine output and impaired excretory function. CKD is also associated with hypertension, diabetes, obesity and other renal disorders. So after crossing the stages the renal failure reaches to End Stage Renal Disorder (ESRD) which is fifth stage in CKD according to the National Kidney Foundation (NKF). Dialysis in the patient individual is done in the end stage i.e. when kidney lost its function about 80%-90% and when the GFR rate <15 ml/min. In CKD the maintenance of hemodialysis is done by some medications like antiplatelet (heparin), erythropoietin stimulating agents, and iron drugs and sometimes if the patient is hypertension ACE inhibitors are used.

Keywords: Chronic kidney disease, Hemodialysis, Maintenance, Diabetes, Hypertension, Heparin, Erythropoietin stimulating agents, Iron drugs

***Correspondence:** Rama, Department of Pharmacy, Mallareddy Institute of Pharmaceutical Sciences, Hyderabad, India, E-mail: rama2078@gmail.com

INTRODUCTION

Chronic kidney disease (CKD) is defined by persistent urine abnormalities, structural abnormalities or impaired excretory renal function implicational a loss of functional nephrons (Levin A, *et al.*, 2013). CKD is associated to age-related renal function decline accelerated in hypertension, diabetes, obesity and first renal disorders. The bulk of patients suffering with CKD are in danger of accelerated disorder and death (Hill NR, *et al.*, 2016).

Chronic kidney disease (CKD) or chronic renal disorder (CRD) may be a condition during which an individual has damaged kidneys or reduced kidney function for quite 3 months. During this point, the kidneys cannot properly filter waste out of the blood. If not detected and treated early, chronic kidney disease can cause many health problems and even cause renal failure and early death (Tozawa M, *et al.*, 2002).

CKD can start at any age, but the probabilities of developing it increase as people grow old. It is commonest among adults aged 70 years or older. Once an individual has CKD, it always gets worse over time and lasts for the remainder of the person's life. Kidney failure-also called end-stage renal disease-is the ultimate stage of CKD, when the kidneys pack up completely (Rama M, *et al.*, 2012).

If discovered within the early stages, CKD are often treated. People can make lifestyle changes to hamper the disease's progress and stop or delay renal failure. The only treatments for an individual with renal failure are dialysis or a kidney transplant. Hemodialysis, the most common form of treatment, uses a machine to clean waste, salt, and fluid from a person's blood when the kidney 1 are not healthy enough to do it on their own (Parker K, *et al.*, 2019).

Chronic kidney disease is defined and characterized by decreased kidney function shown by glomerular filtration rate less than 60 ml/min per 1.73 m2 or markers of kidney damage or both for at least 3 months duration. Both estimated glomerular filtration rate (GFR) and Albuminuria are strong bold risk factors for all cause and cardiovascular disease (CVD) mortality. And progression to end stage renal disease (ESRD) (Webster AC, *et al.*, 2017; Go AS, *et al.*, 2004; Gansevoort RT, *et al.*, 2011). Diabetes and HTN are the major cause of CKD. It is a diseased state condition associated with premature mortality, increased healthcare expenditures, and decreased quality of life (Chukwuonye II, *et al.*, 2019).

LITERATURE REVIEW

Prevalence

Chronic kidney disease is a serious public health issue with a universal prevalence of 13.4% and a mortality rate of 1.2 million (approx.) per year. To understand the aetiology of CKD, the physical and chemical causative factors such as soil, water, food, heat stress, pesticides, and environmental samples have been analyzed by different research groups, but failed to provide the clues about the exact causative factors (Xie Y, *et al.*, 2018).

The overall pooled prevalence of CKD among Indian adults was 10.2%. As per high quality studies, highest prevalence was 17.2% found among participants of SEEK (Screening and Early Evaluation of Kidney Disease) study and lowest prevalence was 4.2% found among ≥ 20 years old adult residing in Delhi (Singh NP, *et al.*, 2009).

Etiology

They are many causes for chronic kidney disease (CKD, 2019) *(Table 1)*.

Table 1: GFR rate values with the severity and stages of CKD (Garland JS, 2014)

S.no	Stage	Severity	GFR rate (ml/min)
1	Stage 1	Normal	>90
2	Stage 2	Mild CKD	60-89
3	Stage 3A	Moderate CKD	45-59
4	Stage 3B	Moderate CKD	30-44
5	Stage 4	Severe CKD	15-29
6	Stage 5	End stage CKD	<15

- **Diabetes:** Chronic kidney disease correlated with diabetes. Uncontrolled diabetes may lead to increase blood sugar levels. And affecting the kidneys.
- **Hypertension:** Increased blood pressure may damage the

parts of kidney leading to damage.

• **Blocked urine flow:** Block urine may lead to increase the pressure on kidneys.

• **Chemical substances:** Intoxication of chemicals may lead to damage of kidneys.

Signs and symptoms

• Decreased urine output

• Blood in urine

• Edema

• Fatigue

• Hypertension

• Nausea

• Vomiting

• Muscle cramps

• Protein in urea

Men tended to report fewer symptoms than women and Southern Asian patients often described experiencing symptoms with a greater severity. Older patients found musculoskeletal symptoms more intrusive whereas younger patients found reduced concentration more intrusive (Stephanie AB, *et al.*, 2017).

Risk factors

CRD is a health problem, which could lead to end-stage renal disease (ESRD) and increased cardiovascular morbidity and mortality (Kazancioğlu R, 2013) *(Figure 1)*.

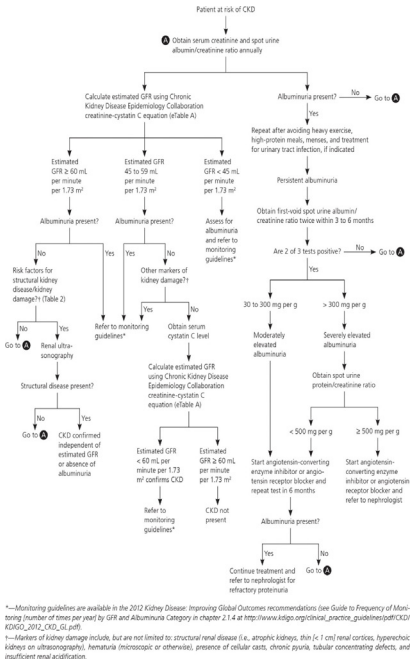

Figure 1: Assessment of chronic kidney disease based on the GFR rate and the albumin results which are assessed to approach the treatment guidelines (Gaitonde DY, 2017)

• Genetics, family history

• Gender

• Ethnicity

• Age

• Low birth weight

• Obesity

• Low socio economic status.

• Smoking

• Nephrotoxins

• Acute kidney injury

• Diabetes mellitus

• Hypertension.

Cause of CKD

Cause of CKD can be based on presence or absence of systemic disease, determining the cause may differentiate the patient either has systemic condition or localized condition in the kidney such as glomerular disease (National Kidney Foundation Inc, 2021) *(Table 2)*.

Table 2: Causes of CKD

Disease	Examples of systemic disease affecting the kidney	Example of primary kidney disease
Glomerular disease	Diabetes, systemic autoimmune disease, systemic infections, drugs, neoplasia	Diffuse glomerulonephritis, focal and segmental glomerulosclerosis.
Tubulointerstitial diseases	SID, sarcoidosis, drugs, urate, environmental toxins.	Urinary tract infections, stones, obstruction.
Vascular diseases	Atherosclerosis, hypertension, Ischemia, micro angiopathy.	ANCA-associated renal limited vasculitis, fibromuscular dysplasia
Cystic and congenital disease	Polycystic kidney disease, alport's syndrome, fabry's disease.	Renal dysplasia, medullary cystic disease.

Treatment

The National Kidney Foundation has published a classification system based on GFR as well as urinary and anatomic abnormalities to intensify the identification and management of chronic kidney disease (Levey AS, *et al.*, 2002).

Guidelines for the treatment of HTN with chronic kidney disease

Patients without DM: Proteinuric CKD patients-ACE Inhibitors should be included, when there is intolerance to ACE Inhibitors then in that case ARBs should be included.

BP Target: <130/80 mm Hg.

Non proteinuric CKD patients-anti hypertensive agents include-

• ACE inhibitors

• ARBS

• Beta blockers (age limit 60 or less)

• Long acting CCB

Patients with DM: Antihypertensive agents-ACE inhibitor or angiotensin-receptor blocker.

BP target: <130/80 mm Hg.

Patients with large-vessel renal vascular disease

Renovascular hypertension is treated in the same manner as for non-diabetic, non proteinuric chronic kidney disease. There is a risk of ARF with use of ACE Inhibitors and ARBS, so caution should be taken.

Guidelines for the treatment of diabetes in patients with chronic renal disorder

Use of metformin in type 2 diabetes mellitus: Metformin is mostly used in type 2 DM in either stages of CKD stage-1, stage-2 or stage-3. Metformin is stopped when there is increase in illness and a particular care should be taken while administering the drugs ACE inhibitors, ARBs, NSAIDs, CCBs, Beta Blockers or diuretics.

Guidelines for lifestyle management for patients with chronic kidney disease

Smoking cessation: Smoking should not be encouraged because it increases the risk of developing CKD, end-stage renal disease, and cardiovascular disease.

Weight reduction and dietary protein control: Protein-controlled diet: 0.80-1.0 g/kg/d

Dietary protein restriction of <0.70 g/kg/day.

Alcohol intake: It increases blood pressure. Healthy individuals should limit their consumption of alcohol to 2 drinks per day, and should not exceed more than 14 drinks per week for men and 9 drinks per week for women.

DISCUSSION

Hemodialysis

It is a process in which the blood is filtered or purified in the persons whose kidneys are improper in function. This type of dialysis achieves the extracorporeal removal of waste products like creatinine and urea. Hemodialysis is the choice of renal replacement therapy patients who need dialysis acutely and for many patients as maintenance therapy (Hakim RM and Lazarus JM, 1995; Lee KY, 2017).

There are three sorts of hemodialysis: Conventional hemodialysis, daily hemodialysis and nocturnal hemodialysis.

Conventional hemodialysis: Another process which will be utilized in hemodialysis is convection. In convection, hydrostatic pressure is used to push water through the membrane. Alongside the water, this pressure drags toxins and waste molecules through the semi-permeable membrane.

Daily hemodialysis: In dialysis, patients use a machine to artificially do what healthy kidneys should eliminate waste and unwanted water from the blood. Standard dialysis involves three treatments hebdomadally, while frequent dialysis involves treatment once a day.

Nocturnal hemodialysis: Nocturnal dialysis may be a slower, longer hemodialysis treatment that takes place in the dark while you sleep. This longer treatment is for 6 to eight hours, 3 times or more every week. Nocturnal dialysis reception or at a dialysis center that features a nocturnal dialysis program.

Procedure

First you will need to do minor surgery to create direct access to your blood stream, this can be done in few ways (Leslee SH, 2011).

- Fistula (also referred to as arteriovenous fistula or AV fistula).
- Graft (arteriovenous graft or AV graft)
- Catheter (central venous catheter)

An AV fistula is located in your arm, and if necessary it can be placed in the leg. With an AV fistula, blood flows from the artery into the vein directly by increasing the blood pressure and amount of blood flow through the vein. The veins are enlarged due to the increased flow and pressure.

The AV fistula is placed in the forearm or upper arm. Vein are made larger and stronger because of AV fistula that causes extra pressure and extra blood to flow because larger vein provides easy, reliable access to blood vessels.

An AV fistula is how patients are connected to a dialyzer. A nurse or technician starts treatment by inserting two needles into the AV fistula. One needle removes the blood and sends it to the dialyzer, where it is filtered. The second needle allows the blood to be returned safely in to the body.

An arteriovenous (AV) graft may be a sort of access used for hemodialysis. The graft is typically placed within the arm, but could also be placed within the leg if necessary.

An AV graft is the connection of a vein and an artery that utilizes a graft with is hallow and synthetic. One end of the tube is connected to an artery and therefore the other end of the tube is connected to a vein. This connection leads to blood flowing from the high flow, high artery through the graft and into the low flow, low vein. As a result the blood flow through the graft provides a flow which will deliver enough blood to supply an adequate hemodialysis treatment.

The quite difference between an AV graft and an AV fistula. Both are of hemodialysis access. A abbreviate for artery and therefore the V for vein. Therefore, it's some quite connection between and artery and a vein. The machine needs faster flow than a vein, but not as fast as an artery.

An AV fistula may be a direct connection between the patient's artery and one among their nearby veins. This is often absolutely the BEST access a patient can have because it's all their own tissue. The fistula resists clotting and infection.

An AV graft (sometimes called a bridge graft) is an indirect connection between the artery and vein, most ordinarily a plastic tube is employed, but donated cadaver arteries or veins also can be used.

Taking care of your fistula or graft

- An important thing to recollect is that the AV fistula or graft is that the patient's lifeline and thus must be protected.
- Keep the heal your access area clean
- AVoid sleeping on your access arm
- Protect your arm from injury
- Request vital sign measurements and blood draws be taken from your non-access arm
- Wear loose clothing and jewellery over the access

A central venous catheter (CVC) may be a sort of access used for hemodialysis. Tunneled CVCs are placed under the skin and into an outsized central vein, preferably the interior jugular veins. CVCs are meant to be used for a brief period of your time until a more permanent sort of dialysis access has been established.

Tunneled CVC's are placed under the skin and meant to be used for an extended duration of your time vs. non-tunneled, which are designed to be temporary.

During hemodialysis, you'll sit or lie back in a chair or bed. A tech will place two needles in your arm where the fistula or graft is found. A pump within the hemodialysis machine slowly draws out your blood, and then sends it through another machine called a dialyzer. Complete procedure is been explained in the following flowchart *(Figure 2)*.

This works sort of a kidney and filters out extra salt, waste, and fluid. Your cleaned blood is shipped back to your body through the second needle in your arm. Or, if there's a catheter, blood comes out of 1 port then is returned *via* a second port. Dialysis begins at a blood flow rate of 50 to 100 ml/min, and is gradually increased to 300 ml/min, to give maximal clearance.

Figure 2: Procedure of haemodialysis in a simple pattern (Fox CS, 2012)

CONCLUSIONS

Complications

1. Anemia: A condition in which the blood doesn't have enough healthy red blood cells (Song JH, 2018). Anaemia results from a lack of red blood cells or dysfunctional red blood cells in the body. This leads to reduced oxygen flow to the body's organs. Symptoms may include fatigue, skin pallor, and shortness of breath, light-headedness, dizziness or a fast heartbeat.

2. Infections (especially AIDS, hepatitis B)

3. Thrombosis: Thrombosis is where the blood clots in the blood vessels in blocks the flow of the blood properly and in some cases it returns back to the heart.

4. Hypertension: Hypertension is where the blood pressure raises higher than that of normal value 120/80 mm Hg.

5. Air embolism

6. Bleeding (due to use of systemic anticoagulant)

Due to us of anticoagulants then we can observe the internal bleeding.

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