ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP

DISSERTATION SUBMITTED TO

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI

In partial fulfilment of the requirements for the degree of

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Registration Number: 200120104012

DEPARTMENT OF GENERAL MEDICINE

TIRUNELVELI MEDICAL COLLEGE

TIRUNELVELI – 627011

MAY-2023

CERTIFICATE BY THE GUIDE

This is to certify that this dissertation titled **"ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP"** submitted by **Dr. A. MURUGSH RAJA** to the Tamilnadu Dr.M.G.R Medical university, Chennai in partial fulfillment of the requirement for the award of the MD degree (Branch I) in General Medicine during the academic period of 2020-2023 is an original bonafide research work carried out by him under my direct supervision and guidance. I forward this to the Tamil Nadu Dr.M.G.R. Medical University, Chennai, Tamil Nadu, India.

Date: Place: Tirunelveli	**Dr.G. RATHNAKUMAR, M.D,** **PROFESSOR OF GENERAL MEDICINE** Department of General Medicine, Tirunelveli Medical College, Tirunelveli-11

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This is to certify that the dissertation entitled **"ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP"**, is a record of work done by **Dr. A. MURUGESH RAJA,** in partial fulfilment for the award of the degree of Doctor of Medicine in GENERAL MEDICINE for the May 2023 examination by the Tamilnadu Dr.M.G.R. Medical University, Chennai. This is a bonafide original research work done by him in the department of GENERAL MEDICINE, Tirunelveli Medical College, under my guidance and supervision.

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I hereby certify that this dissertation entitled **"ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP"** is a record of work done by **Dr.A. MURUGESH RAJA**, in the Department of GENERAL MEDICINE, Tirunelveli Medical College, Tirunelveli, during his postgraduate degree course period from 2020- 2023. This work has not formed the basis for previous award of any degree.

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DECLARATION BY THE CANDIDATE

I solemnly declare that this dissertation titled **"ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP"** submitted by me for the degree of M.D., is the record work carried out by me during the period of 2020-2023 under the guidance of **Dr.ALAGESAN, M.D,D.M.,** Professor and Head of the Department, Department of General Medicine, Tirunelveli Medical College, Tirunelveli. The dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University, Chennai, towards the partial fulfilment of requirements for the award of M.D. (Branch I) General Medicine examination to be held in May 2023.

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Dear Dr.A.MURUGESH RAJA, MBBS, The Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during The IEC meeting held on 05.03.2021.

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1.	TIREC Application Form	☐
2.	Study Protocol	☐
3.	Department Research Committee Approval	☐
4.	Patient Information Document and Consent Form in English and Vernacular Language	☐
5.	Investigator's Brochure	☐
6.	Proposed Methods for Patient Accrual Proposed	☐
7.	Curriculum Vitae of The Principal Investigator	☐
8.	Insurance /Compensation Policy	☐
9.	Investigator's Agreement with Sponsor	☐
10.	Investigator's Undertaking	☐
11.	DCGI/DGFT approval	☐
12.	Clinical Trial Agreement (CTA)	☐
13.	Memorandum of Understanding (MOU)/Material Transfer Agreement (MTA)	☐
14.	Clinical Trials Registry-India (CTRI) Registration	☐

THE PROTOCOL IS APPROVED IN ITS PRESENTED FORM ON THE FOLLOWING CONDITIONS

1. The approval is valid for a period of 2 year/s or duration of project whichever is later
2. The date of commencement of study should be informed
3. A written request should be submitted 3weeks before for renewal / extension of The validity
4. An annual status report should be submitted.
5. The TIREC will monitor the study
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7. The PI should report to TIREC within 7 days of the occurrence of the SAE. If the SAE is Death, the Bioethics Cell should receive the SAE reporting form within 24 hours of the occurrence.
8. In the events of any protocol amendments, TIREC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in the original project. (Page no. Clause no. etc.)
   b. The PI must comment how proposed amendment will affect the ongoing trial. Alteration in the budgetary status, staff requirement should be clearly indicated and the revised budget form should be submitted.
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval. If the amendment demands a re-look at the toxicity or side effects to patients, the same should be documented.
   d. If there are any amendments in the trial design, these must be incorporated in the protocol, and other study documents. These revised documents should be submitted for approval of the IEC, only then can they be implemented.
   e. Approval for amendment changes must be obtained prior to implementation of changes.
   f. The amendment is unlikely to be approved by the IEC unless all the above information is provided.
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Member Secretary, TIREC
Tirunelveli Medical College, Tirunelveli – 627011
State of Tamilnadu, South India

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This is to certify that this dissertation work **"ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP"** of the candidate **Dr. a. MURUGESH RAJA** with registration Number **200120104012** for the award of **M.D.,** Degree in the branch of **GENERAL MEDICINE (Branch I).** I personally verified the urkund.com website for the purpose of plagiarism check. I checked the uploaded thesis file from introduction to conclusion page for plagiarism and the result showed **6 percentage** of plagiarism in the dissertation.

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ANALYTICAL STUDY ON RENAL FUNCTION OF CKD PATIENTS (STAGE 3 AND ABOVE) ON OP FOLLOWUP
INTRODUCTION

CONTENT

INTRODUCTION

Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function, present for>3 months, with implications for health. Kidney damage refers to a broad range of abnormalities observed during clinical assessment, which may be insensitive and non-specific for the cause of disease but may precede reduction in kidney function.

Markers of kidney damage are albuminuria (>30 mg/24 hours), urine sediment abnormalities, tubular disorders resulting in electrolyte abnormalities, abnormalities detected by histology, structural abnormalities detected by imaging or history of kidney transplantation.

GFR (glomerular filtration rate) is generally accepted as the best overall index of kidney function. Decreased GFR implies a GFR90ml/min/1.73m2), G2 (60-89ml/min/1.73m2), G3a (45-59ml/min/1.73m2), G3b (30-44ml/min/1.73m2), G4 (15-29ml/min/1.73m2) and G5 (300mg/24hr).

The clinical course is typically a progressive loss of nephron function ultimately leading to end stage renal disease (ESRD) characterized by hypertension, anemia, renal bone disease, nutritional impairment, neuropathy, impaired quality of life and reduced life expectancy ultimately needing some form of renal replacement therapy.

This puts a substantial burden on global health resources since all modalities of treatment are expensive. In a developing country like India only 3% to 5% of all patients with ESRD get some form of renal replacement therapy .

This study is taken up to analyse the course of Chronic Kidney Disease in patients getting admitted in a tertiary care centre.

AIM AND OBJECTIVE OF THE STUDY

The aim of the study is:

1. To follow-up CKD patients and estimate e-GFR

2. To arrive at statistical data on influence of co-morbidities (SHTN, DM) on rate of decline of e-GFR on the disease process.

3. To know their influence on rate of decline of e-GFR

REVIEW OF LITERATURE

Chronic kidney disease (CKD) includes a spectrum of different pathophysiologic process associated with abnormal renal function with a progressive decline in Glomerular Filtration Rate (GFR). The terminology Chronic Kidney Disease refers to the process of continuous significant irreversible reduction in nephron number . Accumulating evidence over the past decades indicates that identification of CKD in earlier stages and treating it adequately can prevent its progression and delay the downhill course & outcomes The term End Stage Renal Disease (ESRD) represents a stage of CKD characterized by accumulation of toxins, fluid, and electrolytes which are normally excreted by the kidneys & resulting in Uremic syndrome**.**

Clinically, CKD is characterized by abnormalities of kidney structure or function that are present for > 3 months and have implications for health of the patient.

Pathologically, CKD is defined as significant interstitial Fibrosis(>5%), tubular atrophy, and glomerulosclerosis.

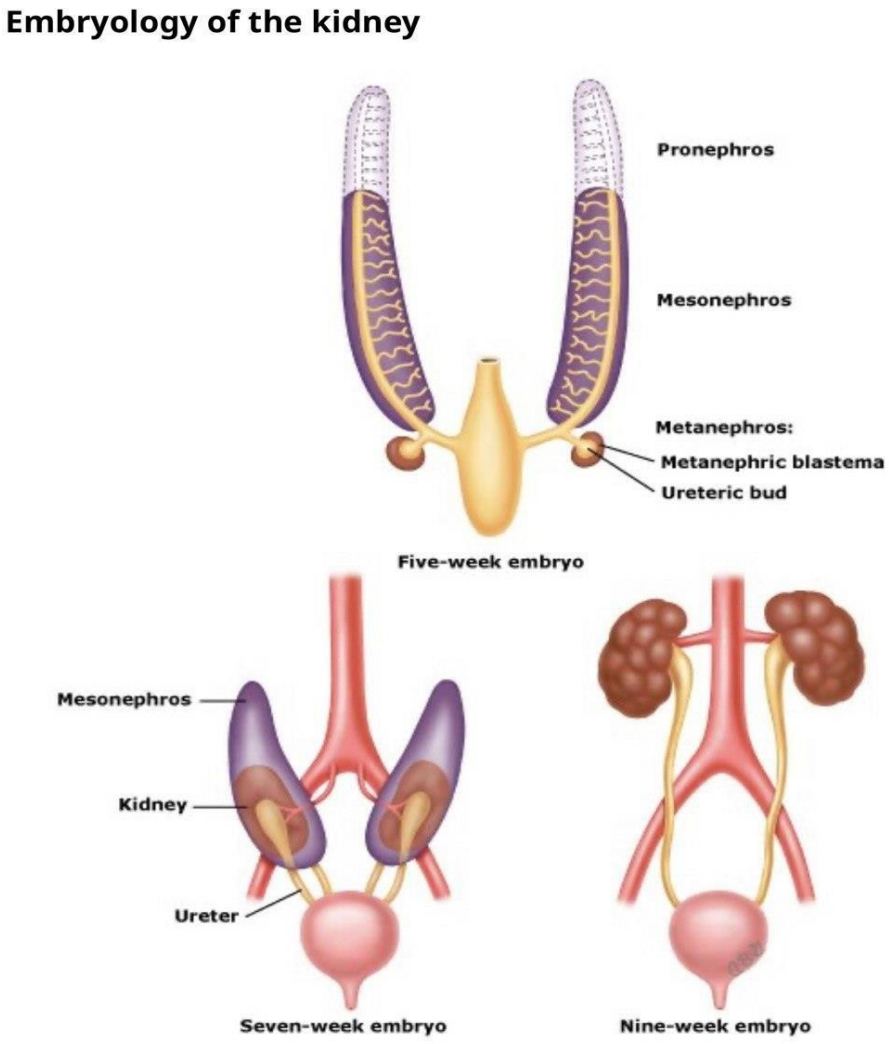
The term CKD can be defined with the embryologic development. Normally a baby with birth weight of 3Kg has **250,000 to 1.1 million** nephrons.There is increased chance of CKD if there are reduced no. of nephrons.

GFR = single nephron GFR. x number of nephrons.

In simple terms, a decrease in number of nephrons is termed as CKD.

EMBRYOLOGY

Normal embryologic development of the kidney takes three stages.



1) PRONEPHROS

A transient rudimentary, nonfunctioning,Pronephros begins in the fourth week of embryogenesis (Day 22) and disappears by end of the fourth week (Day 28). The so formed Pronephros degenerates during normal kidney development.

2) MESONEPHROS

Mesonephros is derived from the intermediate mesoderm by (Day 26) of embryogenesis. By fifth week of embryogenesis 20 paired tubules are produced, which produces small amounts of urine. The Mesonephros ultimately fuses with the cloaca and contributes to the formation of the urinary bladder. Additionally inmales, the genital system is develops from the mesonephric ducts and some tubules.

3) METANEPHROS

Metanephros, which is composed of the metanephric mesenchyme and ureteric bud epithelium (caudal portion of the mesonephric duct), is the last stage of kidney development and forms the permanent kidney beginning at the fifth week of embryonic age**.**

- ✓ Metanephros - 5 to 6 weeks of embryogenesis
- ✓ Begins functioning at 6 to 10 weeks
- ✓ Urine production beginning at 9 weeks of embryonic age.

The metanephros, initially positioned in the pelvis opposite to the sacral somites, migrates from its caudal position, reaching a permanent location in the lumbar region at the **8thweek** of embryogenesis.

Reciprocal interactions between the metanephros and the ureteric epithelium induce organogenesis, resulting in the formation of the nephrons and the collecting system.

The bladder develops from a separate& contiguous, structure called the urogenital sinus.

Renal development and CAKUT

CAKUT represents a broad range of disorders and are the result of abnormal renal developmental processes:

- Renal parenchymal malformation
- Anomalies of renal embryonic migration.
- Anomalies of urinary collecting system

Children with CAKUT are at risk for long-term CKD, which is thought to be due to glomerular hyperfiltration.

RENAL PARENCHYMAL MALFORMATIONS

- Renal hypoplasia
- Renal dysplasia / hypodysplasia
- Multicystic dysplasia
- Renal agenesis
- Renal tubular dysgenesis
- Genetic cystic diseases (ARPKD / ADPKD)
- Nephronophthisis.

ANOMALIES OF RENAL EMBRYONIC MIGRATION

- Renal ectopia - Pelvic kidney
- Fusion anomalies:
    - Horseshoe kidney.
    - Crossed fused kidneys

ANOMALIES OF URINARY COLLECTING SYSTEM

- Duplicated collecting systems

- Posterior urethral valves,

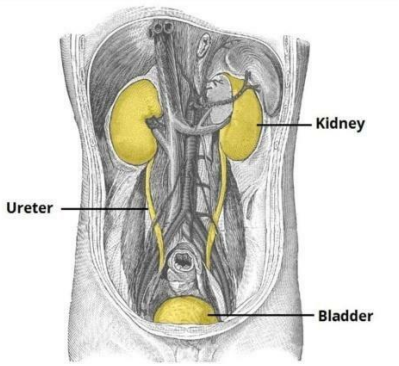
- Ureteropelvic junction obstruction.

ANATOMY

The kidneys are bilateral bean-shaped organs, located in the posterior abdomen. Their main function is filtering and excreting waste products of blood. They also play a major role in water and electrolyte balance of the body.

Urine is transported from the kidneys to the bladder by the ureters.

From the bladder, it leaves the body via the urethra thatopens out into the perineum in females and through the penis in the male.



ANATOMICAL POSITION

The kidneys lie in the abdomen retroperitoneally on either sides of vertebral column. They extend from T12 to L3 vertebra. The right kidney is situated slightly lower compared to the left due to the presence of liver. Each kidney is approximately three vertebrae in length.

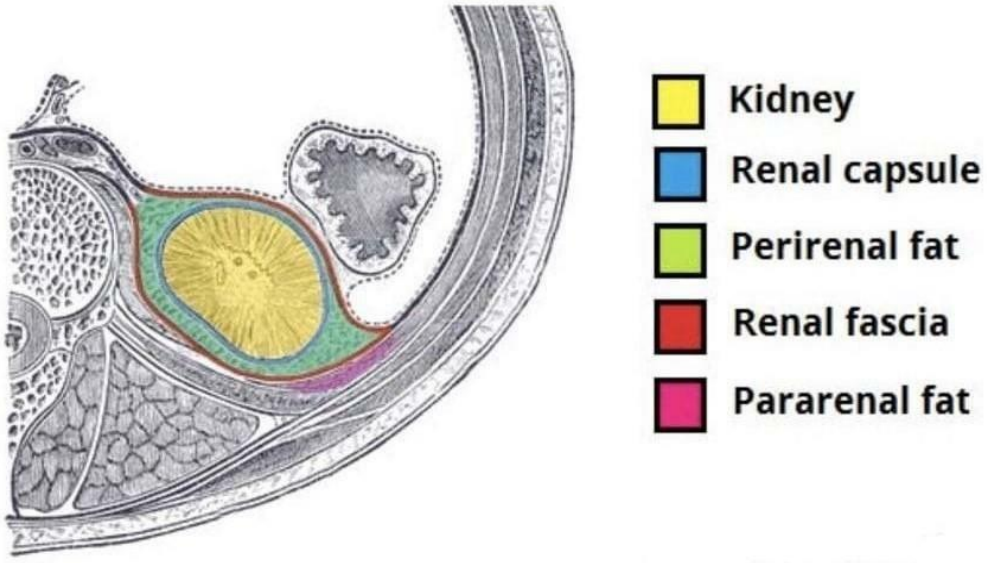
The adrenal glands are placed superior to the kidneys within a separate envelope of the renal fascia.

KIDNEY STRUCTURE

The kidneys are encased in complex layers of fascia and fat. They are arranged as follows (deep to superficial):

- Renal capsule – tough fibrous capsule.
- Perirenal fat – collection of extraperitoneal fat.
- Renal fascia (also known as Gerota's fascia or perirenal fascia) – encloses the kidneys and the suprarenal glands.
- Pararenal fat – mainly located on the posterolateral aspect of the kidney.

EXTERNAL COVERINGS OF KIDNEY



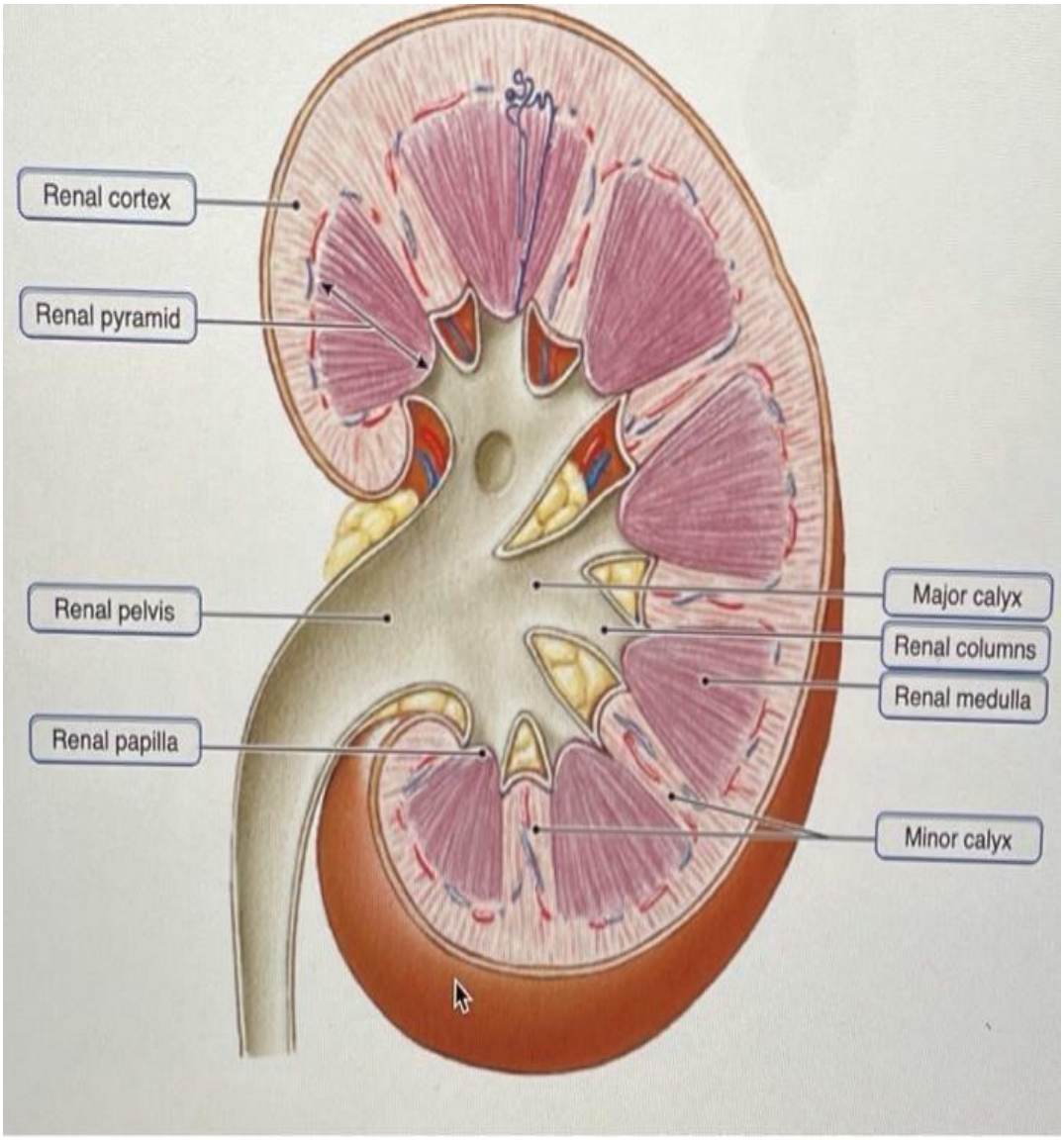
RENAL PARENCHYMA ANATOMY:

Renal parenchyma can be divided into–

- Outer cortex
- Inner medulla

The cortex extends into the medulla, dividing it into triangular Renal pyramids.The apex of the renal pyramid is the Renal papilla. Each renal papilla is associated with a Minor calyx, that collects urine from the pyramids. Several Minor calices merge to form a major calyx. Major calices end into the renal pelvis. From the renal pelvis, ureter emerges. The medial margin of each kidney is known as the

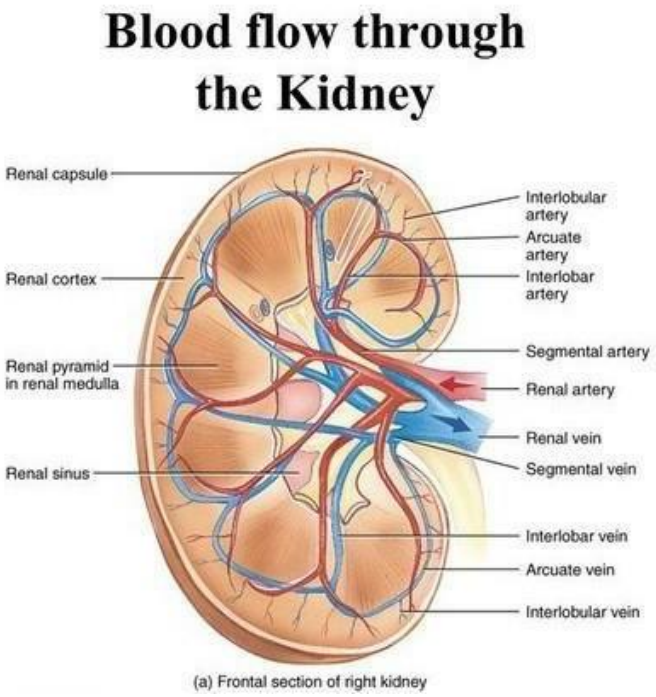
renal hilum. Hilum acts as a gateway for renal vessels and ureter to enter/exit the kidneys.



The internal structure of the kidney.

BLOOD SUPPLY

(b) Path of blood flow



(a) Frontal section of right kidney

The kidneys are supplied by Renal arteries, that arise directly from the abdominal aorta, distal to the origin ofSuperior mesenteric artery.

The Renal artery enters the kidney via the hilum.

At the hilum, Renal artery gives an anterior and a posterior division,supplying 75% and 25% of the renal blood supply,respectively.

Five segmental arteries arise from these two divisions.

The segmental branches of the renal undergo further divisions to form interlobar arteries.

These interlobar arteries undergo further subdivides and forms Arcuate arteries.

From the arcuate arteries, the interlobular arteries arise.

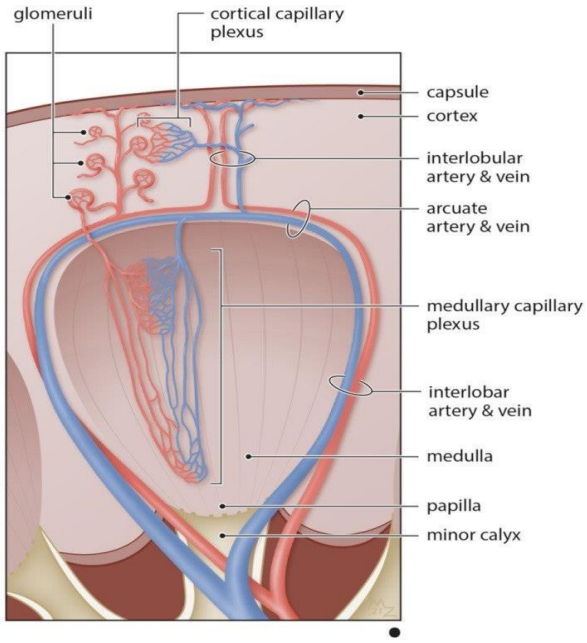
The interlobular arteries pass through the cortex and forms afferent arterioles.

The afferent arterioles form a capillary network called the glomerulus, where filtration occurs.

From the glomerulus, the capillaries join to form the efferent arterioles.

In the outer two-thirds of the renal cortex, the efferent arterioles form what is a known as a peritubular network, supplying the nephron tubules with oxygen and nutrients.

The inner third of the cortex and the medulla are supplied by long, straight arteries called vasa recta.



Venous Drainage

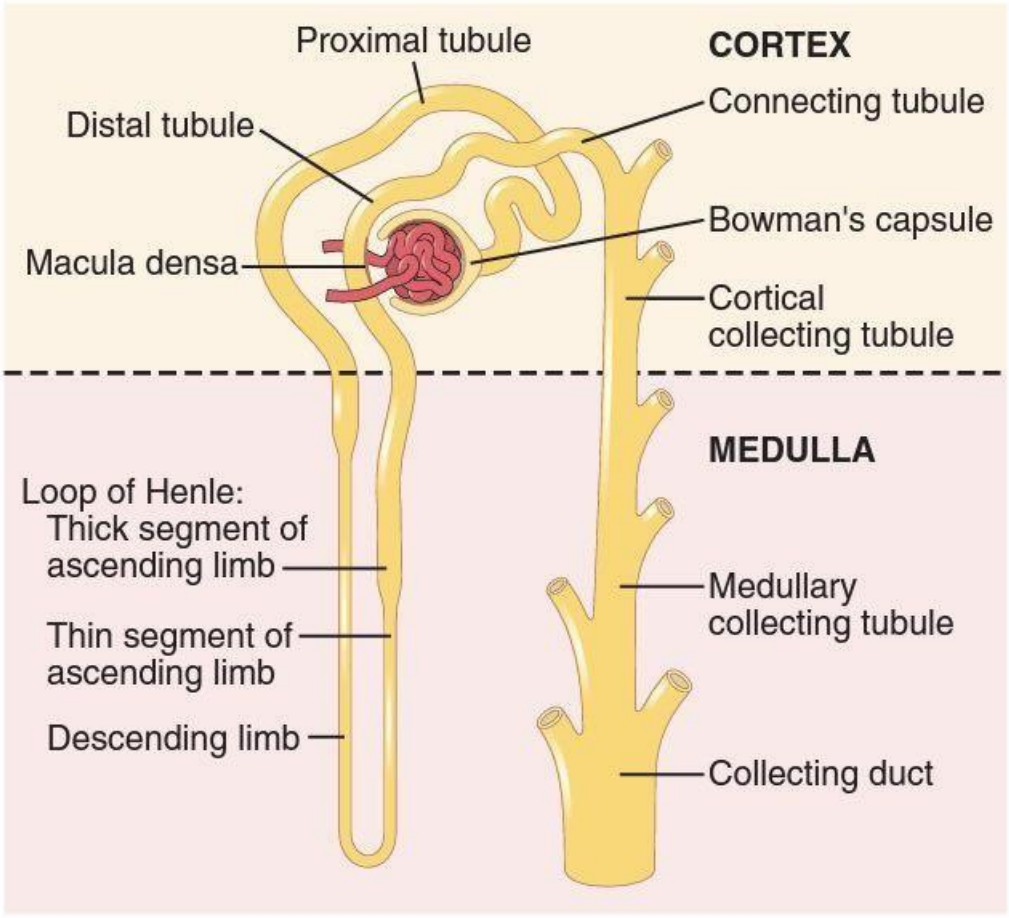
The venous drainage is by the left and right renal veins. They leave via the renal hilum anterior to the renal arteries, and empty directly into the inferior vena cava.

As the vena cava is lies slightly to the right, the left renal vein is longer. It travels anterior to Abdominal aorta below the origin ofSuperior mesenteric artery. The right renal artery is located posterior to the inferior vena cava.

Lymphatics

Lymphatics drain into the lateral aortic (or para-aortic) lymph nodes, that are located at the origin of renal arteries.

NEPHRON THE FUNCTIONAL UNIT



The human kidney contains around 800,000 to 1,000,000 nephrons, and each one is capable of forming urine. The kidneys cannot regenerate new nephrons. Hence, with renal injury, disease, or aging, the number of nephrons gradually decrease. Above 40 years of age, the number of functioning nephrons usually decreases by about 10% every 10 years.

PARTS OF A NEPHRON

(1) A tuft of glomerular capillaries called the glomerulus, through which fluid is filtered from the blood.

(2) A long tubule where the filtered fluid is converted into urine on the way to pelvis of the kidney.

The glomerulus contains a network of branching and anastomosing glomerular capillaries that are covered by epithelial cells.

The total glomerulus is encased in Bowman's capsule.

The fluids filtered from the glomerular capillaries flows into Bowman's capsule and then into the proximal tubule.

From the proximal tubule, fluid flows into the loop of Henle.

Each loop consists of a descending and an ascending limb. The walls of the descending limb and the lower end of the ascending limb are very thin and therefore are called the thin segment of the loop of Henle.

After the ascending limb of the loop, the wall becomes thicker, and is referred as the thick segment of the ascending limb.

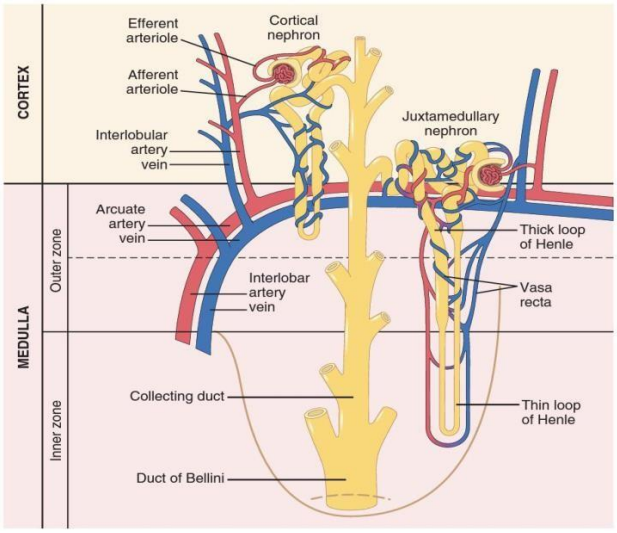
At the end of the thick ascending limb is a short segment, known as the macula densa that plays an important role in controlling nephron function in accordance to filtered Na+ load.

The fluid then enters the distal tubule. The distal tubule is followed by the connecting tubule and cortical collecting tubule, that leads to Cortical collecting duct.

The initial parts of 8 to 10 cortical collecting ducts join to form a single, larger collecting duct that runs downward into the medulla and becomes the medullary collecting duct.

The collecting ducts merge to form progressively larger ducts that eventually empty into the renal pelvis through the tips of the renal papillae.

CORTICAL & JUXTA MEDULLARY NEPHRONS



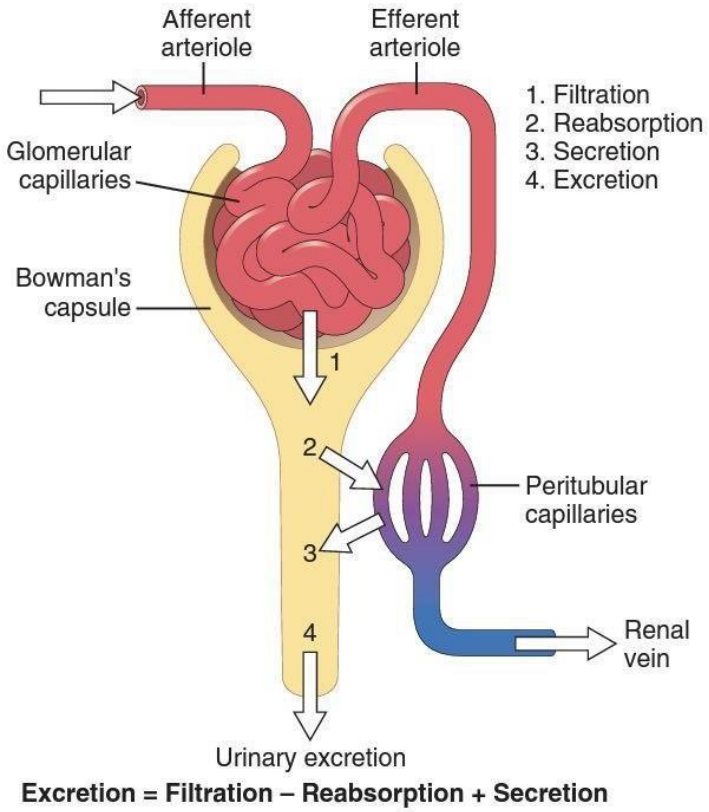
✓ Nephrons with glomeruli located in the outer cortex are called Cortical nephrons. They have short loops of Henle which can penetrate only a short distance into the medulla.

✓ Nephrons with glomeruli that lie deep in the renal cortex near the medulla are called Juxtamedullary nephrons. These nephrons have long loops of Henle that dips into the medulla.

In cortical nephrons, the entire tubular system is supplied by an extensive network of peritubular capillaries.

For the juxtamedullary nephrons, long efferent arterioles extend from the glomeruli down into the outer medulla and then divide into specialized peritubular capillaries called vasa recta, which extend downward into the medulla, lying side by side with the loops of Henle.

This specialized network of capillaries in the juxtameduullary nephrons play an essential role in counter current exchange and formation of a concentrated urine.



GLOMERULAR FILTRATION

Glomerular filtration is the first step in urine formation. It refers to filtration of large amounts of fluid through the glomerular capillaries into Bowman's capsule. About 180 liters are filtered daily of which only 1 litre is excreted per day. The rate of glomerular filtration depends on the rate of renal blood flow and the unique properties of the glomerular capillary membranes.

The glomerular capillaries are impermeable to proteins, so the filtered fluid, Glomerular filtrate is devoid of proteins. The concentrations of salts and organic molecules in the filtrate are similar to the concentrations in the plasma. Exception include low molecular substances like calcium and few fatty acids that are not filtered because they are bound to plasma protiens.

Filtration fraction = GFR / Renal plasma flow

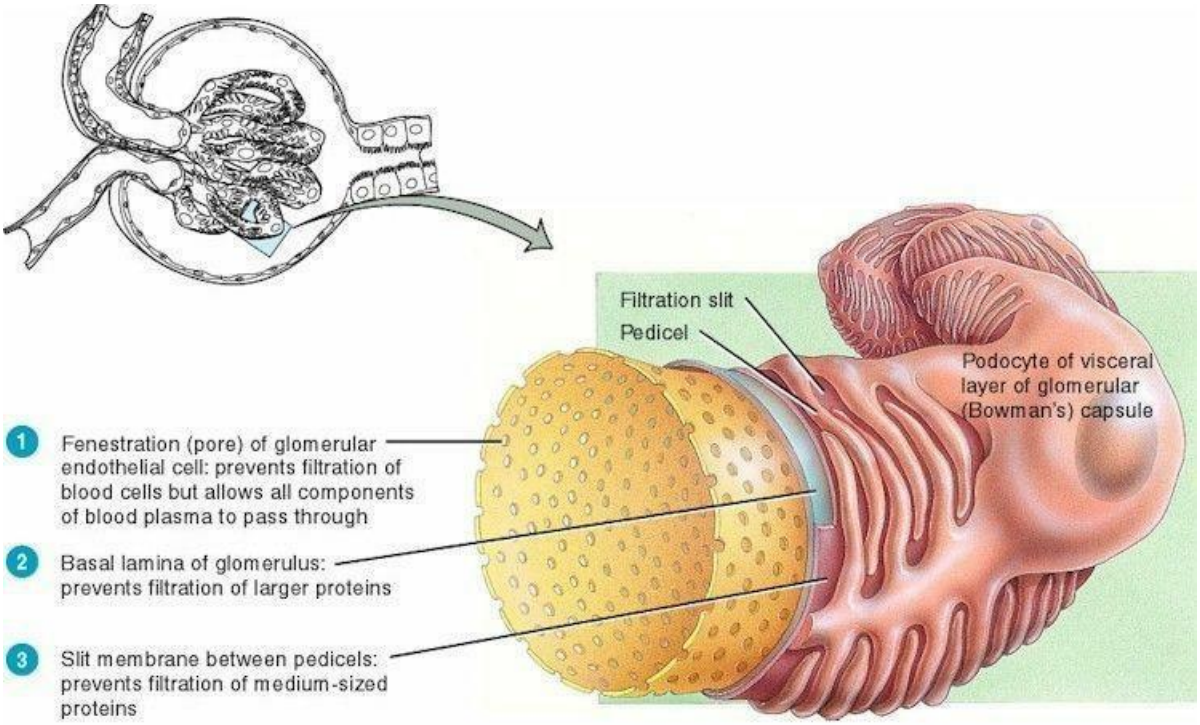
FILTRATION BARRIER:

The glomerular capillary membrane has three layers:

(1) The capillary endothelium

(2) The basement membrane

(3) Epithelial cell (podocytes) layer surrounding the outer surface of the capillary basement membrane.



- The glomerular capillary membrane is partly due to highly fenestrated capillary endothelium. Although the fenestrations are relatively large, endothelial cell proteins are richly endowed with negative charges that hinder the passage of plasma proteins.
- The second layer, basement membrane consists of a meshwork of collagen and proteoglycan fibrillae. The basement prevents filtration of plasma proteins, because of strong negative electrical charges associated with the proteoglycans.
- The epithelial cells that line the outer surface of the glomerulus have long footlike processes (podocytes). The foot processes are separated by gaps called *slit pores*. The epithelial cells, also have negative charges, providing additional restriction to filtration of plasma proteins.

Hence negatively charged large molecules are filtered less easily than positively charged molecules of equal size.

GFR DETERMINANTS:

(1) Sum of the hydrostatic and colloid osmotic forces across the glomerular membrane (Net filtration pressure).

(2) Glomerular filtration coefficient (Kf).

$$GFR = Kf \times \text{Net filtration pressure.}$$

The net filtration pressure represents the sum of the hydrostatic and colloid osmotic forces that either favor or oppose filtration across the glomerular capillaries.

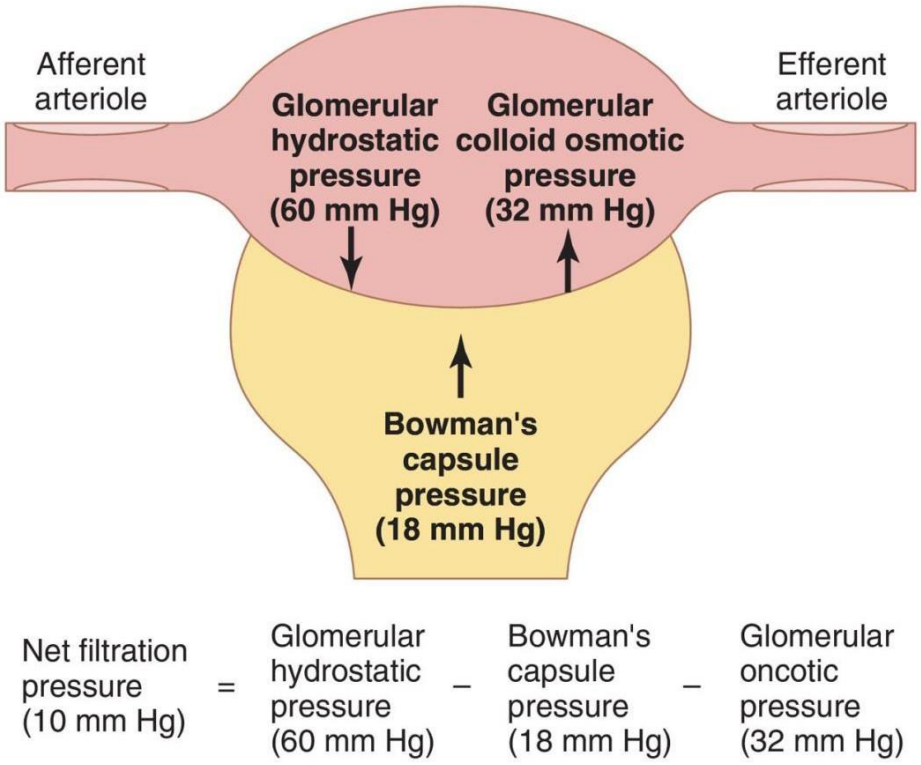
(1) Hydrostatic pressure inside the glomerular capillaries (PG), which promotes filtration

(2) Hydrostatic pressure in Bowman's capsule (PB), which opposes filtration

(3) Colloidal osmotic pressure of glomerular capillary plasma proteins (πG), which oppose filtration

(4) Colloidal osmotic pressure of proteins in Bowman's capsule (πB), which promotes filtration.

Under normal conditions, the protein in the glomerular filtrate is so low that (πB) can be equated to zero.



FILTRATION COEFFICIENT

The Kf cannot be measured directly, but it is estimated experimentally by dividing the rate of glomerular filtration by net filtration pressure:

Kf = GFR / Net filtration pressure

Normally, the total GFR for both kidneys is about 125 ml/min and the net filtration pressure is 10 mm Hg, the normal Kf about 12.5 ml/min/ mm Hg of filtration pressure.

Some diseases lower Kf by reducing the number of functional glomerular capillaries, and thereby reducing the surface area for filtration or by increasing the thickness of the glomerular capillary membrane and reducing its hydraulic conductivity. In case of chronic uncontrolled hypertension and diabetes mellitus, there is gradual decrease in Kf due to increase in the thickness of glomerular capillary basement membrane and, eventually, by damaging the capillaries leading to loss of capillary function and fall in GFR.

INCREASED (PB) DECREASES GFR

Changes in Bowman's capsule pressure is not the primary means for regulating GFR, but in pathological states associated with obstruction of the urinary tract, Bowman's capsule pressure can increase markedly, causing severe reduction of GFR. For example, precipitation of calcium or of uric acid may leading to stones that lodge in the urinary tract, often in the ureter, thereby obstructing outflow of the urinary tract and raising Bowman's capsule pressure. This causes hydronephrosis & reduces GFR subsequently.

INCREASED (π_G) DECREASES GFR

Factors that influence the glomerular capillary colloidal osmotic pressure are

(1) Arterial plasma colloid osmotic pressure

(2) Fraction of plasma filtered by the glomerular capillaries.

Increase in the arterial plasma colloid osmotic pressure raises the glomerular capillary colloid osmotic pressure, which in turn decreases the GFR.

Increase in the filtration fraction, leads to concentration of plasma proteins and raises the glomerular colloid osmotic pressure, thereby decreasing GFR. i.e, as the blood passes from the afferent arteriole through the glomerular capillaries to the efferent arterioles, the plasma protein concentration increases by around 20 percent. The reason for this increase is that about one fifth of the fluid in the capillaries filter into Bowman's capsule, thereby concentrating the glomerular plasma proteins that are not filtered. Assuming that the normal colloid osmotic pressure of plasma entering the glomerular capillaries is 28 mmHg, this value usually rises to about 36 mm Hg by the time the blood reaches the efferent end of the capillaries. Therefore, the average colloid osmotic pressure of the glomerular capillary plasma proteins is midway between 28 and 36 mmHg.

INCREASED (PG), INCREASES GFR

Changes in glomerular hydrostatic pressure serve as the primary means for physiological regulation of GFR. Increase in glomerular hydrostatic pressure raise the GFR, whereas decrease in glomerular hydrostatic pressure reduce the GFR.

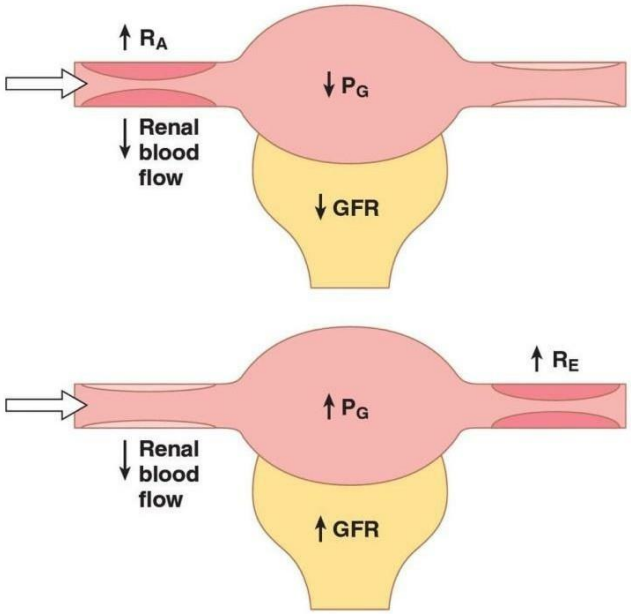
Glomerular hydrostatic pressure is determined by three factors:

(1) arterial pressure

(2) afferent arteriolar resistance

(3) efferent arteriolar resistance.

- Increased arterial pressure tends to raise glomerular hydrostatic pressure and tends to increase the GFR.
- Increased resistance of afferent arterioles reduces glomerular hydrostatic pressure and decreases the GFR.
- Efferent arteriolar constriction has a biphasic effect on GFR. At moderate levels of constriction, there is a slight increase in GFR, but with severe constriction, there is a decrease in GFR. As efferent constriction becomes severe and as plasma protein concentration increases, there is a rapid, nonlinear increase in colloid osmotic pressure caused by the Donnan effect, causing decrease in GFR.



SUMMARY OF FACTORS INFLUENCING GFR

Physical Determinants*	Physiological/Pathophysiological Causes
$\downarrow K_f \rightarrow \downarrow GFR$	Renal disease, diabetes mellitus, hypertension
$\uparrow P_B \rightarrow \downarrow GFR$	Urinary tract obstruction (e.g., kidney stones)
$\uparrow \pi_G \rightarrow \downarrow GFR$	↓ Renal blood flow, increased plasma proteins
$\downarrow P_G \rightarrow \downarrow GFR$	
$\downarrow A_P \rightarrow \downarrow P_G$	↓ Arterial pressure (has only a small effect because of autoregulation)
$\downarrow R_E \rightarrow \downarrow P_G$	↓ Angiotensin II (drugs that block angiotensin II formation)
$\uparrow R_A \rightarrow \downarrow P_G$	↑ Sympathetic activity, vasoconstrictor hormones (e.g., norepinephrine, endothelin)

TUBULAR REABSORPTION

Unlike glomerular filtration, which is nonselective (i.e, all plasma solutes are filtered except, plasma proteins and protein bound substances), tubular reabsorption is highly selective. Substances, such as glucose and amino acids, are completely reabsorbed by the tubules, and their urinary excretion rate is zero. Plasma ions, such as sodium, chloride, and bicarbonate, are also highly reabsorbed, but their rates of reabsorption and urinary excretion varies, depending on the needs of the body. Metabolic waste products like urea and creatinine, are poorly reabsorbed by the tubules and are excreted in large amounts. Therefore, by controlling reabsorption of different substances, the kidneys regulate excretion of solutes, which is essential for precise control of the body fluid composition.

REABSORPTION MECHANISMS

For reabsorption of solutes & solvents they should be transported

(1) across the tubular epithelial membranes into the renal interstitial fluid

(2) through the peritubular capillary membrane back into the blood.

Reabsorption across the tubular epithelium into the interstitial fluid includes either active or passive transport mechanisms.

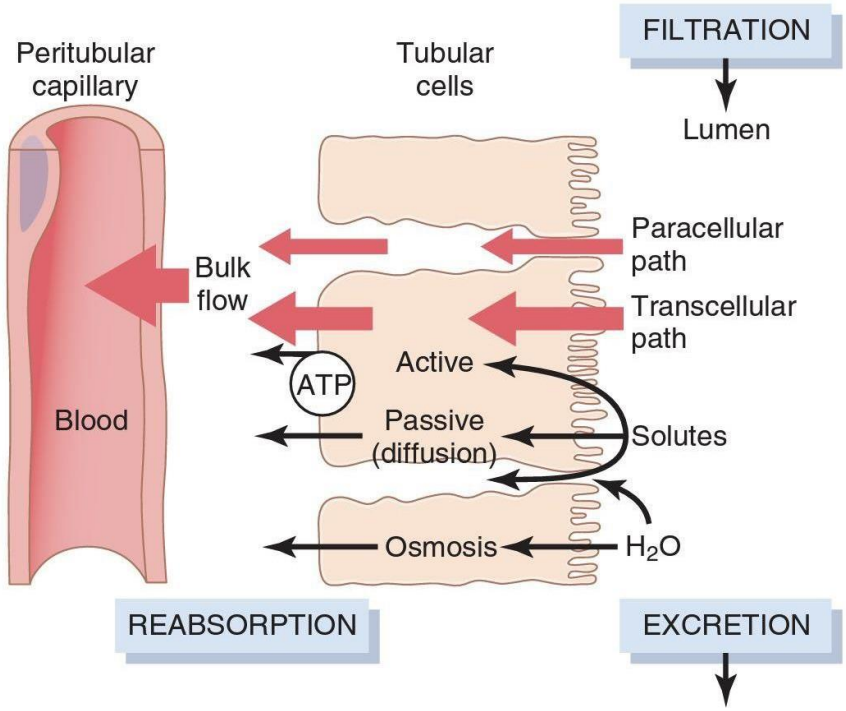
For instance, water and solutes can be transported via

✓ Transcellular route (through the cell membranes).

or

✓ Paracellular route (through spaces between cell junctions).

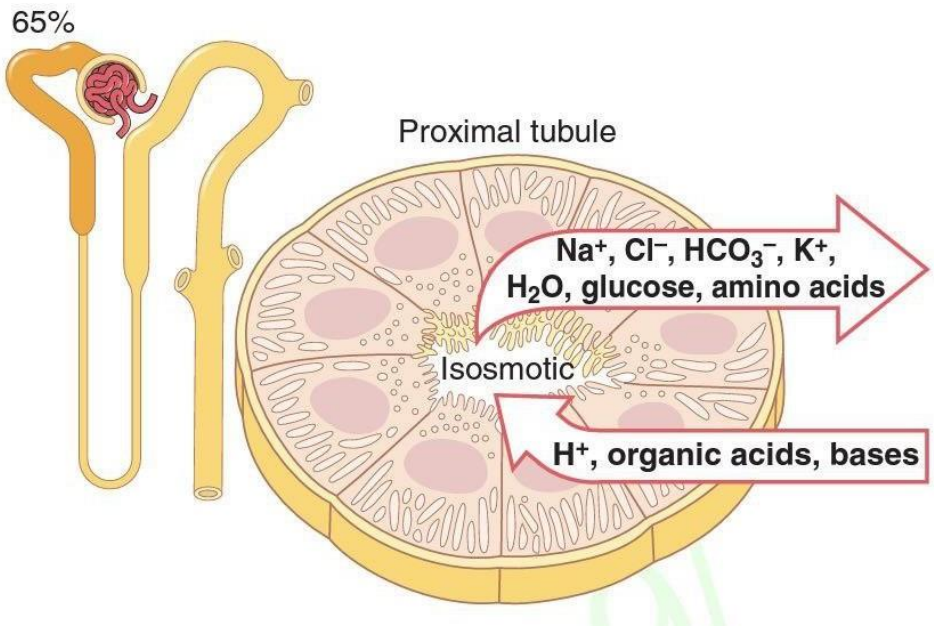
After absorption, water and solutes are transported through the peritubular capillary walls into the blood by ultrafiltration (bulk flow), mediated by hydrostatic and colloid osmotic forces. The peritubular capillaries provides net reabsorptive force that moves fluid and solutes from the interstitium into the blood.

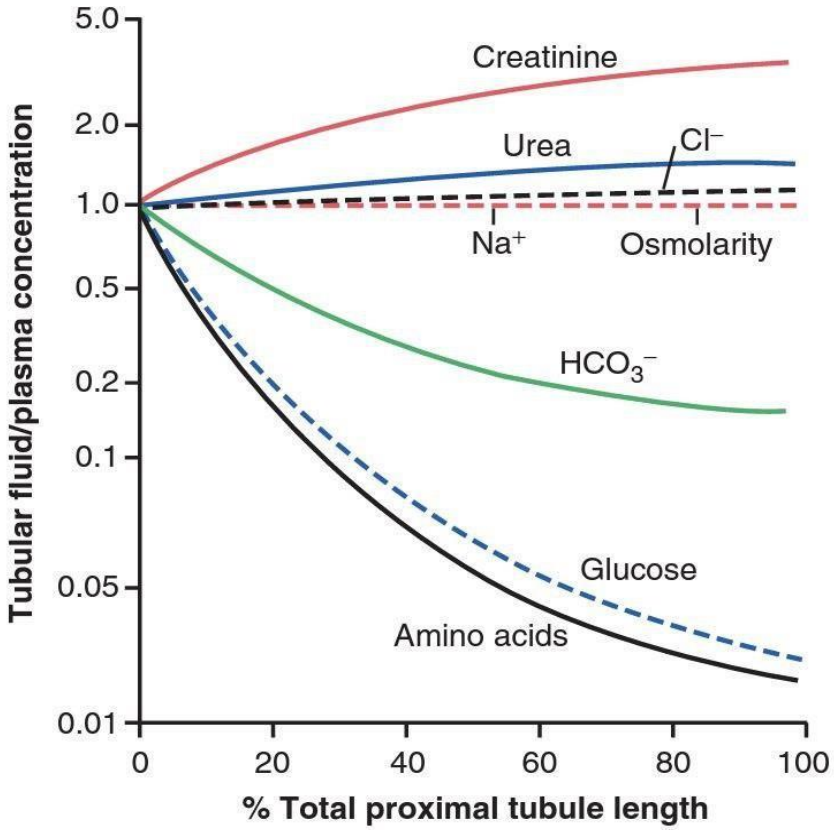


AT PROXIMAL TUBULE

The proximal tubules reabsorb about 65 percent of the filtered sodium, chloride, bicarbonate, and potassium and all the filtered glucose and amino acids.

They also secrete organic acids, bases, and hydrogen ions into the tubular lumen.





Changes in concentrations of different substances in tubular fluid along the proximal convoluted tubule relative to the concentrations of these substances in the plasma and in the glomerular filtrate. A value of 1.0 indicates that the concentration of the substance in the tubular fluid is the same as the concentration in the plasma. Values below 1.0 indicate that the substance is reabsorbed more avidly than water, whereas values above 1.0 indicate that the substance is reabsorbed to a lesser extent than water or is secreted into the tubules.

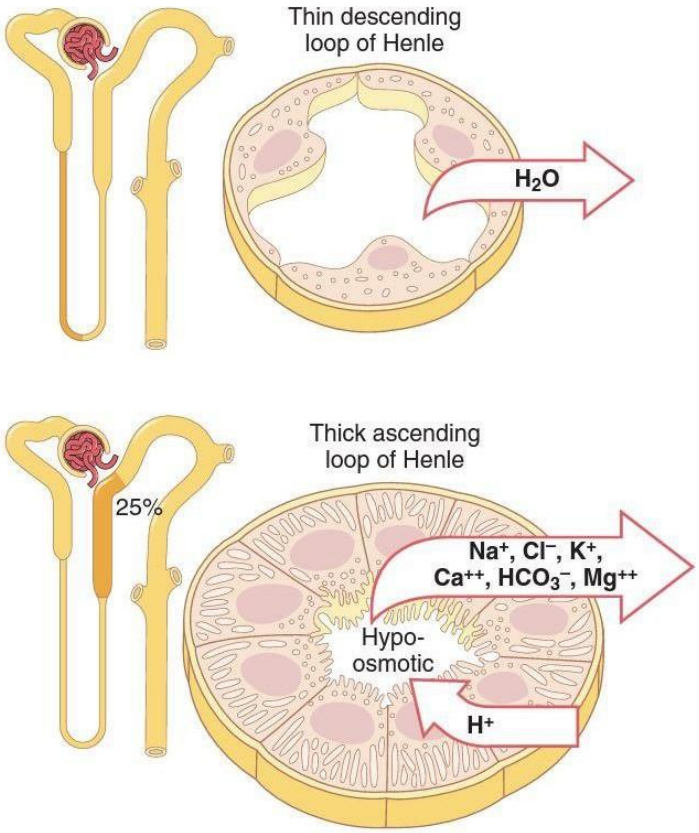
AT LOOP OF HENLE

20% of filtered water is reabsorbed in the loop of Henle, and majority of this occurs in thin descending limb.

The ascending limb, both thin and thick portions, are virtually impermeable to water, that concentrates the urine.

The thick segment of the loop of Henle, plays role in active reabsorption of sodium, chloride, and potassium. About 25 percent of the filtered Sodium, chloride, and potassium are reabsorbed in the loop of Henle, mostly in the thick ascending limb.

Significant amounts of Calcium, Bicarbonate, and Magnesium, are also reabsorbed in the thick ascending loop of Henle.



AT EARLY DISTAL TUBULE

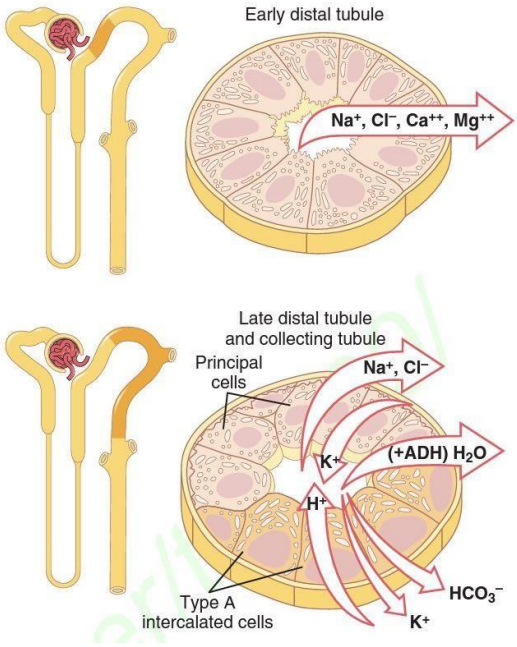
This segment is permeable to most of the ions, including sodium, potassium, and chloride, but is virtually impermeable to water and urea. Hence it is referred as the diluting segment.

5% of the filtered sodium chloride is reabsorbed in the early distal tubule. The sodium-chloride co-transporter pump moves sodium chloride from the tubular lumen into the cell. Chloride diffuses out into the renal interstitial fluid through chloride channels in the basolateral membrane.

AT LATE DISTAL TUBULE & CORTICAL COLLECTING TUBULE

The late distal tubule and Cortical collecting tubule have similar functional characteristics. Anatomically, they are composed of two distinct cell types, the principal cells and intercalated cells.

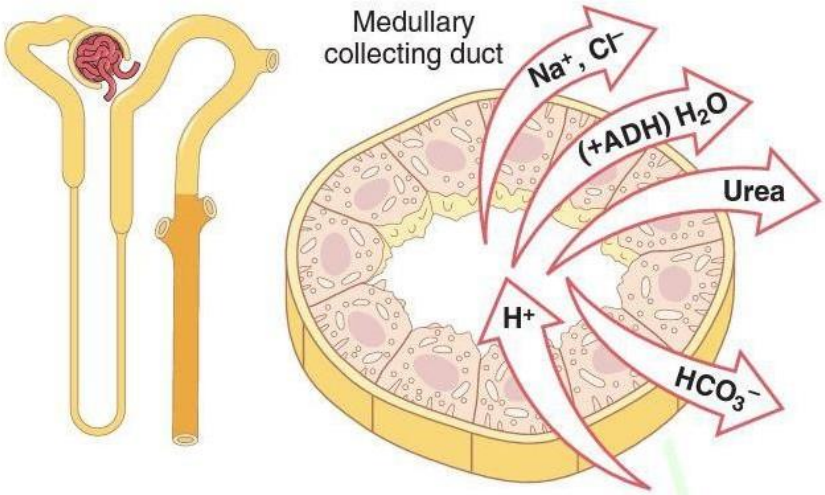
- ✓ The principal cells reabsorb sodium and water from the lumen and secrete potassium ions into the lumen.
- ✓ The type A intercalated cells reabsorb potassium ions and secrete hydrogen ions into the tubular lumen.
- ✓ Type B intercalated cells have H+ and HCO_3- transporters. They secrete HCO_3- into the lumen and absorb H+ ions.



AT MEDULLARY COLLECTING DUCT

- The permeability of the medullary collecting duct to water is under influence of ADH. With high ADH levels, water is avidly reabsorbed into the medullary interstitium, thereby decreasing the urine volume and the urine is concentrated with solutes.
- The medullary collecting duct has special urea transporters facilitating, urea diffusion across the luminal and basolateral membranes. T herefore, some of the tubular urea is reabsorbed into the medullary interstitium. This helps in raising the medullary osmolality and contributes to the kidneys' ability to form concentrated urine.
- The medullary collecting duct is capable of secreting hydrogen ions against a large concentration gradient.

Thus, the medullary collecting duct also plays a key role in regulating acid-base balance.

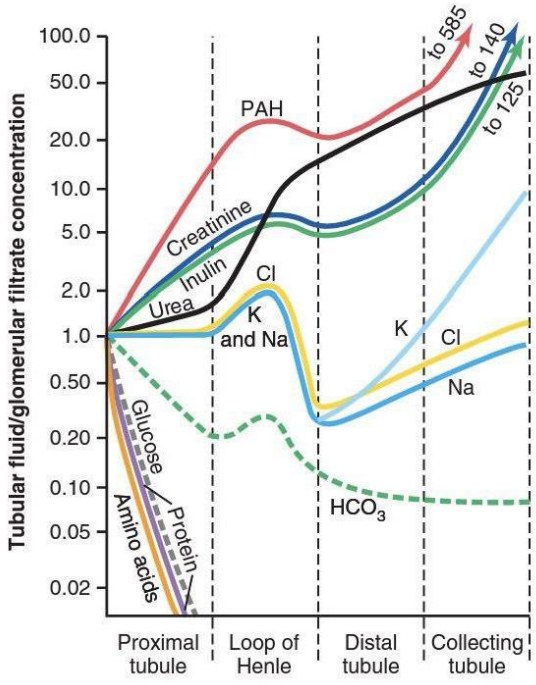


Cellular ultrastructure and transport characteristics of the medullary collecting duct. The medullary collecting ducts actively reabsorb sodium and secrete hydrogen ions and are permeable to urea, which is reabsorbed in these tubular segments. The reabsorption of water in medullary collecting ducts is controlled by the concentration of antidiuretic hormone.

FILTRATION, REABSORPTION & EXCRETION OF DIFFERENT SUBSTANCES

	Amount Filtered	Amount Reabsorbed	Amount Excreted	% of Filtered Load Reabsorbed
Glucose (g/day)	180	180	0	100
Bicarbonate (mEq/day)	4320	4318	2	>99.9
Sodium (mEq/day)	25,560	25,410	150	99.4
Chloride (mEq/day)	19,440	19,260	180	99.1
Potassium (mEq/day)	756	664	92	87.8
Urea (g/day)	46.8	23.4	23.4	50
Creatinine (g/day)	1.8	0	1.8	0

SUMMARY OF DIFFERENT SOLUTES IN DIFFERENT SEGMENTS



Changes in average concentrations of different substances at different points in the tubular system relative to the concentration of that substance in the plasma and in the glomerular filtrate. A value of 1.0 indicates that the concentration of the substance in the tubular fluid is the same as the concentration of that substance in the plasma. Values below 1.0 indicate that the substance is reabsorbed more avidly than water, whereas values above 1.0 indicate that the substance is reabsorbed to a lesser extent than water or is secreted into the tubules.

KDIGO CRITERIA FOR CKD

Kidney Disease: Improving Global Outcomes (KDIGO) defines CKD as either of the following for > 3 months

- Glomerular filtration rate (GFR) < 60 mL/minute/1.73 m2
- Kidney damage as evidenced by ≥ 1 of

  -albuminuria

  -urine sediment abnormalities

  -electrolyte or other abnormalities due to tubular disorders

  -abnormal histology

  -abnormal structure detected by imaging

- History of kidney transplant

STAGING OF CKD

CKD is staged based on GFR and Albuminuria , where

-GFR is the marker of renal excretory function

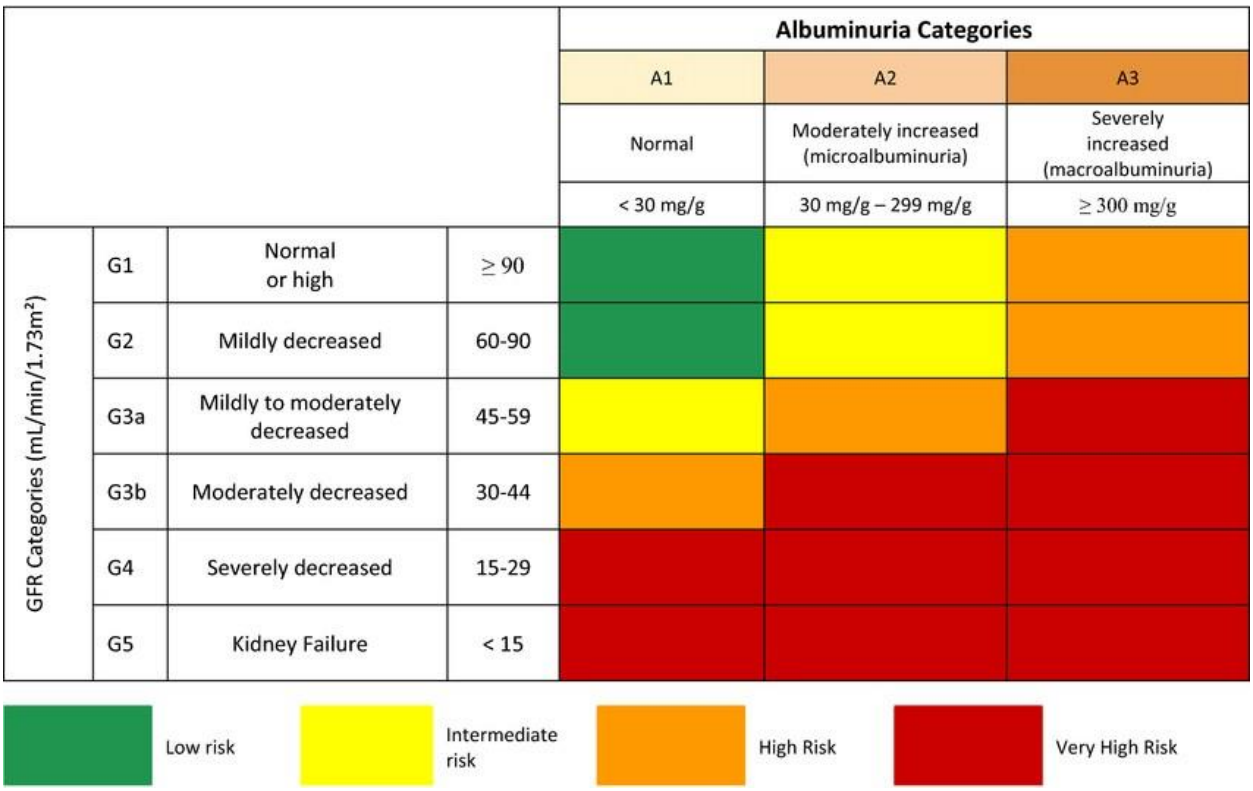
-Albuminuria is the indicator of renal barrier dysfunction (Glomerular injury)

GFR categories

- G1 - GFR > 90 mL/minute/1.73 m2 (normal or high)
- G2 - GFR 60-89 mL/minute/1.73 m2 (mildly decreased compared to young adult level)
- G3a - GFR 45-59 mL/minute/1.73 m2 (mild-to-moderately decreased)
- G3b - GFR 30-44 mL/minute/1.73 m2 (moderate-to-severely decreased)
- G4 - GFR 15-29 mL/minute/1.73 m2 (severely decreased)
- G5 - GFR < 15 mL/minute/1.73 m2 (kidney failure)

Albuminuria categories

- A1 - albumin excretion rate (AER) < 30 mg/24 hours, albumin to creatinine ratio (ACR) < 30 mg/g (3 mg/mmol) (normal to mildly increased)
- A2 - AER 30-300 mg/24 hours, ACR 30-300 mg/g (3-30 mg/mmol) (moderately increased compared to young adult level)
- A3 - AER > 300 mg/24 hours, ACR > 300 mg/g (30 mg/mmol) (severely increased [including nephrotic syndrome])



The screening test for CKD is the measurement of serum creatinine. However, it considered insensitive, since it is influenced by influenced by several factors such as sex, age, body mass, and diet. Also creatinine concentration increases when as much as 50% of the nephron mass had been wiped off. Hence the concept of eGFR was deviced.

ESTIMATION OF GFR (eGFR) :

The eGFR has been accepted as better renal function marker than serum creatinine in CKD patients. eGFR can be calculated using different equations including the Cockroft-Gault / MDRD / CKD - EPI equations.

1) COCKCROFT – GAULT EQUATION:

eGFR = (140 - age) x weight / serum Cr x 72 x (0.85 for females)

2) MODIFICATION OF DIET IN RENAL DISEASE (MDRD) EQUATION:

eGFR = 175* $(S.Cr)^{-1.17^4}$ * $(Age - 0.203)^{-0.203}$ * 0.742(in females)

3) CKD – EPI Creatinine EQUATION:

For MALES:

If SCr<0.9 : 141 x (SCr/0.9)-0. 411 × 0.993Age

If SCr>0.9 : 141 x (SCr/0.9) -1.209 x 0.993Age

FOR FEMALES:

If SCr<0.7 (for female): 144 x (SCr/0.7)-0.329 × 0.993Age

If SCr> 0.7 (for female): 144 x (SCr/0:9)-1.209 × 0.993Age

The CKD-EPI (creatinine) equation was developed by Levey et al in 2009.This equation was validated by Inker et al (2012) and found to be more accurate than the MDRD Equation. The sensitivity and specificity of estimated GFR <60 mL/min/1.73 m2 were 91% and 87%, respectively, using the CKD-EPI equation and 95% and 82%, respectively, using the MDRD Equation. In our study we use the most accurate CKD – EPI equation for calculating eGFR of our patients.

RISK FACTORS FOR CKD:

1) Older age

2) Diabetics - type I or type 2

3)Poorly controlled hypertension

4)Microalbuminuria or Proteinuria

5)Acute kidney injury

6)Obstructive uropathy

7)Metabolic syndrome (overweight or obesity)

8)Smoking

9) Prolonged exposure to nephrotoxic drugs (Nonsteroidal anti-inflammatory drugs (NSAIDs) / cocaine / heroin)

10) Black race with APOL1 homozygous gene variant

11) Monogenic kidney disease (including autosomal dominant polycystic kidney disease, podocytopathies causing steroid-resistant nephrotic syndrome, Fabry disease, Alport syndrome, and atypical hemolytic-uremic syndrome)

12) Congenital abnormalities (including congenital anomalies of kidney and urinary tract and vesico-ureteric reflux)

13) Malignancy

14)Renal transplant

COMMON ETIOLOGIES OF CKD:

1. Diabetes mellitus (type I and type II);
2. Hypertension
3. Cystic kidney disease
4. Tubulointerstitial or obstructive kidney disease
5. Vasculitis (Lupus/ANCA vasculitis etc.)
6. Glomerulonephritis

OTHER CAUSES

1. Multiple myeloma

2. Infections such asPyelonephritis, HIV, hepatitis, malaria.

3. Multiple episodes of acute kidney injury

4. Prolonged use of nephrotoxic medications such as herbs, agricultural chemicals, heavy metals, or radiation

5.Genetic diseases like Fabry's disease / Alport syndrome / Hemolytic Uremic syndrome /Podocytopathies causing steroid resistant nephritic syndrome.

CKD ACCORDING TO SITE OF INJURY

GLOMERULAR	TUBULO INTERSTITIAL	VASCULAR	POSTRENAL
1)Diabetes mellitus	1)Autoimmune diseases	1)Hypertension	1)Nephrolithiasis
2)Autoimmune disease	2)Sarcoidosis-related	2)Atherosclerosis	2)Benign Prostatic Hyperplasia (BPH)

3)Systemic infection	3)Acute interstitial nephritis	3)Vasculitis	
4)Medications	4)Myeloma	4)Ischemia	
5)Neoplasia	5)Proton pump inhibitors	5)Thrombotic microangiopathy	
6)Membrano proliferative glomerulonephritis (MPGN)	6)Chronic tubulointerstitial nephritis	6)Renal artery stenosis	
7)Focal segmental glomerulosclerosis (FSGS)	7)UTI/ Pyelonephritis/ Systemic infections		
8)Membranous nephropathy (MN)	8)Primary hyperoxaluria		

PATHOGENESIS OF CKD

CKD is usually indicative of ongoing loss in number of nephrons

Mechanisms leading to CKD include:

1) Nephron loss, that occurs due to kidney injury / aging / kidney donation.

2) Nephron hypertrophy, occurring secondary to increased glomerular filtration and glomerular hypertension.

3) Impaired glomerular filtration function.

4) Fibrosis, that occurs secondary to inflammation resulting from infiltration of immune cells, albuminuria, and glucosuria.

Features of fibrosis include

- Glomerulosclerosis

  Characterised by:

  i) Endothelial dysfunction and damage ,

  ii) Proliferation of smooth muscle cells and mesangial cells,

  iii) Destruction of podocytes lining glomerular basement membrane

- Tubular atrophy
- Interstitial fibrosis and scarring (associated with proteinuria and decreased glomerular filtration rate)

FACTORS ASSOCIATED WITH PATHOGENESIS OF CKD

1) Hypertension

2)Diabetes - associated with glomerular hyperfiltration

3) Obesity - associated with glomerular hyperfiltration / proteinuria / nephron loss / systemic inflammation / focal segmental glomerulosclerosis

4)Low birthweight - associated with reduced number of nephrons at birth

5) Pregnancy - associated with glomerular hyperfiltration& hypertrophy/ proteinuria / arterial hypertension (preeclampsia)

6) Ageing - associated with decreased glomerular number & filtration / glomerulosclerosis / nephron atrophy / interstitial fibrosis / decreased podocyte density

7) Acute kidney injury - associated with nephron loss

8) Congenital abnormalities - associated with increased nephrocalcinosis and/or cystic degeneration (in some patients with metabolic storage disease).

Management of Patients With CKD

Reducing Risk of Cardiovascular Disease

A major component of CKD management is reduction of cardiovascular risk. It is recommended that patients aged 50 years or older with CKD be treated with a low- to moderate-dose statin regardless of low-density lipoprotein cholesterol level.(1-3) Smoking cessation should also be encouraged.(4)

Both the Eighth Joint National Committee (JNC 8) and Kidney Disease: Improving Global Outcomes (KDIGO) guidelines have recommended goal systolic and diastolic blood pressures of less than 140 mm Hg and less than 90 mm Hg, respectively, among adults with CKD based on expert opinion.(5) The KDIGO guidelines further recommend that adults with urine ACR of at least 30 mg per 24 hours (or equivalent) have systolic and diastolic blood pressures maintained below 130 mm Hg and 80 mm Hg, respectively.

More recently, the Systolic Blood Pressure Intervention Trial (SPRINT) demonstrated that among individuals with increased risk of cardiovascular disease but without diabetes, more intensive blood pressure control (goal systolic blood

pressure 300 to 5000 mg/24 hours) taking ACE-I or ARB therapy, those randomized to canagliflozin had a 30% lower risk (43.2 vs 61.2 events per 1000 patient-years) of developing the primary composite renal outcome (doubling of serum creatinine, ESKD, or death from a renal or cardiovascular cause) compared with those randomized to placebo.(6) Prior trials have also suggested cardiovascular benefit with this class of medications, which may extend to patients with CKD who have lower levels of albuminuria.(7,8)

Nephrotoxins

All patients with CKD should be counseled to avoid nephrotoxins. Although a complete list is beyond the scope of this review, a few warrant mentioning. Routine administration of NSAIDs in CKD is not recommended, especially among individuals who are taking ACE-I or ARB therapy.(9)

Herbal remedies are not regulated by the US Food and Drug Administration, and some (such as those containing aristolochic acid or anthraquinones) have been reported to cause a myriad of kidney abnormalities, including acute tubular necrosis, acute or chronic interstitial nephritis, nephrolithiasis, rhabdomyolysis, hypokalemia, and Fanconi syndrome.(10)

Phosphate-based bowel preparations (both oral and enema formulations) are readily available over the counter and can lead to acute phosphate nephropathy.(11,12)

Proton pump inhibitors are widely used and have been associated with acute interstitial nephritis in case reports and incident CKD in population-based studies.(13-15) In the population-based Atherosclerosis Risk in Communities cohort, the incidence of CKD was 14.2 events in those taking proton pump inhibitors and 10.7 per 1000 events in people who did not take them.

Uniform discontinuation of proton pump inhibitors in CKD is not necessary. However, indications for use should be addressed at each primary care visit. Drug Dosing Adjustments in drug dosing are frequently required in patients with CKD. Of note, the traditional Cockcroft-Gault equation often poorly reflects measured GFR, whereas estimation of GFR using the CKD-EPI equation likely correlates better with drug clearance by the kidneys.(16,17)

Common medications that require dose reductions include most antibiotics, direct oral anticoagulants, gabapentin and pregabalin, oral hypoglycemic agents, insulin, chemotherapeutic agents, and opiates, among others.(18)

In general, use of medications with low likelihood of benefit should be minimized because patients with CKD are at high risk of adverse drug events.(19–22).

Gadolinium-based contrast agents are contraindicated in individuals with acute kidney injury, eGFR less than 30 mL/min/1.73 m2 , or ESKD given the risk of nephrogenic systemic fibrosis, a painful and debilitating disorder characterized by marked fibrosis of the skin and occasionally other organs.(23,24)

Newer macrocyclic chelate formulations (eg, gadoteridol, gadobutrol, or gadoterate) are much less likely to cause nephrogenic systemic fibrosis, but the best prevention may still be to avoid gadolinium altogether. If administration of gadolinium is deemed essential, the patient must be counseled on the potential risk of nephrogenic systemic fibrosis and a nephrologist may be consulted for consideration of postexposure hemodialysis.

Dietary Management

Dietary management to prevent CKD progression is controversial since large trials have had equivocal results. (25-27) For example, the MDRD study evaluated 2 levels of protein restriction in 840 patients, finding that a low-protein diet compared with usual protein intake resulted in slower GFR decline only after the initial 4 months, and that a very low-protein diet compared with a low-protein diet was not significantly associated with slower GFR decline. Both levels of protein restriction appeared to have benefit in the subgroup with proteinuria greater than 3 g per day, although this group was small. Other, smaller trials have suggested a

benefit of protein restriction in the prevention of CKD progression or ESKD.(28-30).

The KDIGO guidelines recommend that protein intake be reduced to less than 0.8 g/kg per day (with proper education) in adults with CKD stages G4-G5 and to less than 1.3 g/kg per day in other adult patients with CKD at risk of progression. The possible benefits of dietary protein restriction must be balanced with the concern of precipitating malnutrition and/or protein wasting syndrome. Lower dietary acid loads (eg, more fruits and vegetables and less meats, eggs, and cheeses) may also help protect against kidney injury.(31,32) Low-sodium diets (generally 5 mL/min/1.73 m2). In persons without CKD, even small changes in serum creatinine (eg, from 0.7 mg/dL to 1.2 mg/dL) reflect large declines in eGFR, and primary care clinicians should attempt to identify reversible causes.

INDICATIONS FOR KIDNEY BIOPSY

This may include but are not limited to unexplained persistent or increasing albuminuria, presence of cellular casts or dysmorphic red blood cells on urine sediment, and unexplained or rapid decline in GFR.

Specific thresholds vary depending on patient characteristics and by institution. Patients with polycystic kidney disease, certain types of glomerulonephritis, and

nephrotic-range albuminuria are at particularly high risk of progressing to ESKD.(33)

Referral to nephrology is important for planning kidney replacement therapy and transplant evaluation. The decision to begin kidney replacement therapy is based on the presence of symptoms and not solely on level of GFR.108 Urgent indications include encephalopathy, pericarditis, and pleuritis due to severe uremia.(34) Otherwise, initiation of dialysis should be individualized and considered when patients have uremic signs or symptoms (eg, nausea, vomiting, poor appetite, metallic taste, pericardial rub or effusion, asterixis, or altered mental status), electrolyte abnormalities (eg, hyperkalemia or metabolic acidosis), or volume overload (eg, pulmonary or lower extremity edema) refractory to medical management. A shared decision-making approach is best. Patients should be educated about treatment options and actively contribute to decision-making. Early education should include information on the potential complications of CKD as well as the different modalities of kidney replacement therapy. Kidney transplantation is considered the optimal therapy for ESKD, with living donor kidney transplantations performed before or shortly after dialysis initiation having the best outcomes(35,36).

MATERIALS AND METHODS

STUDY POPULATION : CKD patients attending OP at General Medicine and Nephrology department, TVMCH

STUDY DESIGN : Analytical Cross sectional study

SAMPLE SIZE: Number of patients enrolled during initial 6 months of the study period

STUDY PERIOD: 18 months

INCLUSION CRITERIA :

All patients of GFR ≤ 59mL/min/1.73m² fulfilling KDIGO guidelines for CKD

KDIGO CRITERIA FOR CKD

Either One Of The Following For >3 Months

1) MARKERS OF KIDNEY DAMAGE

Albuminuria AER ≥ 30 mg/24 hr

ACR ≥ 30 mg/mmol

Renal structural & echogenic abnormalities in USG

Histologically proven chronic changes

Electrolyte abnormalities of tubular disorder

Urine sediment abnormalities

2) DECREASED GFR

GFR ≤ 60 mL/min/1.73 m²

EXCLUSION CRITERIA :

- Known Liver Disorders
- Known Rheumatological Disorders
- HIV Patients
- Malignancy
- Pregnancy
- Chronic bed ridden patients

DEMOGRAPHIC VARIABLES :

- Age
- Sex
- Occupation
- Smoking and Alcohol history

EXAMINATION :

- Vital parameters
- Blood investigations

STUDY VARIABLES:

- S.Uric acid
- S.Creatinine
- Sr.Electrolytes
- HbA1C (in diabetics)
- Liver Function Test
- Complete Blood Count , ESR
- Spot urine Protein creatinine ratio
- Urine Albumin ,Sugar , Deposits
- Urine Culture and Sensitivity (if needed)
- Ultrasonography of abdomen and pelvis

These were plotted in an excel masterchart and statistical analysis was done.

RESULTS

Table 1: Distribution of Study Participants based on Age and Gender

S.no	Variables	Categories	Frequency (n)	Percentage (%)
1.	Age (in years)	< 20	1	0.7
		21 – 30	6	4.4
		31 – 40	23	16.9
		41 – 50	45	33.1
		51 – 60	37	27.2
		> 60	24	17.6
2.	Gender	Male	71	52.2
		Female	65	47.8

The table 1 and figure 1 shows the Age Distribution among the Patients.

It was observed that 33.2% of the patients belonged to41-50 years age-group, 27.2% of them were in 51-60years age group and 17.6% above 60 years age group.

Figure 1: Distribution of Study Participants based on Age

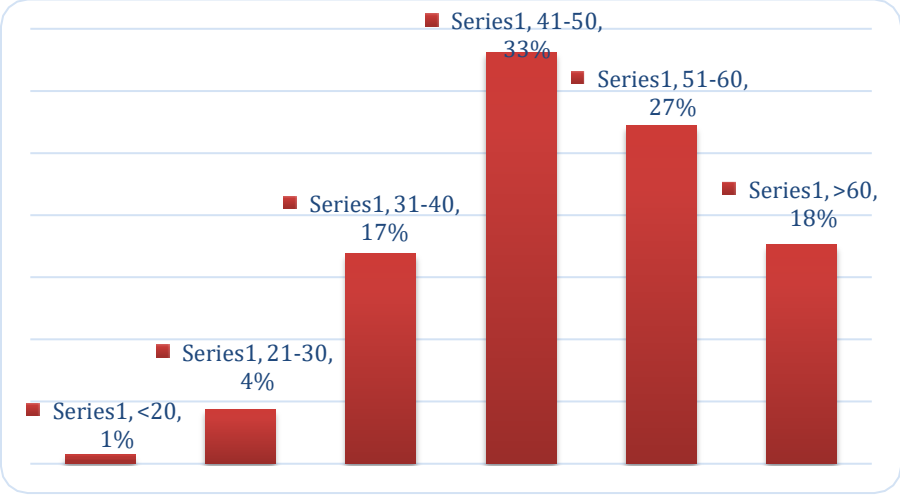


Figure2: Distribution of Study Participants based on Gender

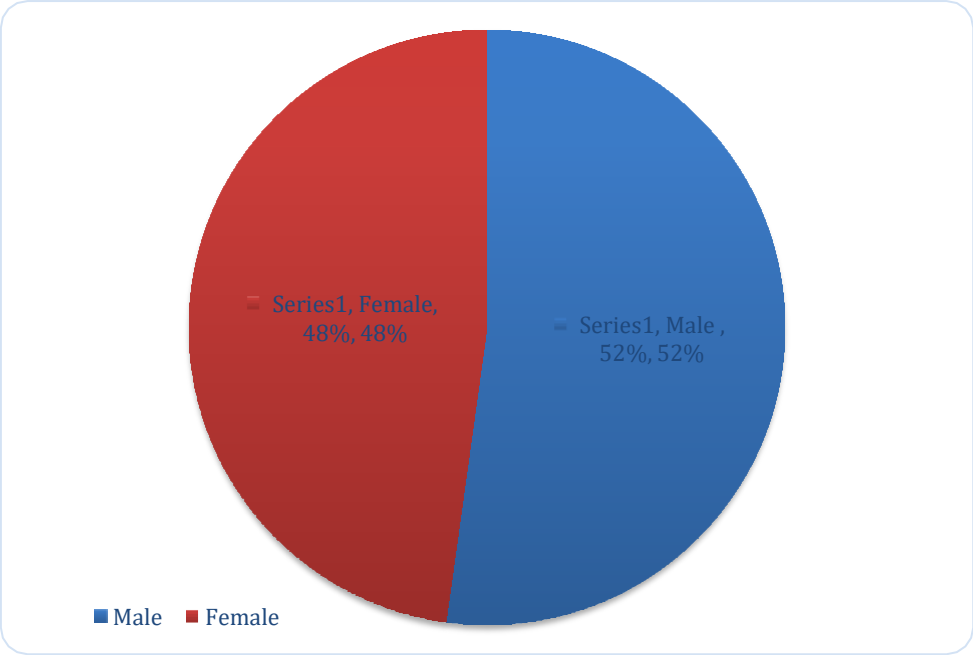


Table 1 and Figure 2 shows the gender distribution of the patients.

Majority of the patients were males (52%) and remaining (48%) were females.

Table 2: Distribution of Study Participants based on Diabetic Status

S.no	Variables	Categories	Frequency (n)	Percentage (%)
1.	Diabetic status	Yes	82	60.3
		No	54	39.7
2.	Duration (n=82)	< 5 years	31	37.8
		5-10 years	34	41.4
		>10 years	17	20.7
3.	Compliance (n=82)	Good	27	32.9
		Poor	55	67.1

Table 2 and Figure 3 shows the distribution of diabetic status of the patients. 82 (60.3%) had diabetes.

Among 82 patients, 41.4% had diabetes for 5-10 years and 37.8% had for less than 5 years. Only 32.9% had good compliance to medications.

Table 3: Distribution of Study Participants based on Hypertensive status

S.no	Variables	Categories	Frequency (n)	Percentage (%)
1.	Hypertension status	Yes	76	55.9
		No	60	44.1
2.	Duration (n=76)	< 1 year	9	11.8
		2-5 years	32	42.1
		5-10 years	20	26.3
		>10 years	15	19.7
3.	Compliance (n=76)	Good	28	26.8
		Poor	48	63.2

Table 3 and figure 3 shows the distribution of hypertensive status of the patients.

76 (55.9%) had hypertension. Among 76 patients, 42.1% had hypertension for 2-5 years and 26.3% had between 5-10 years. Only 26.8% had good compliance to medications.

Table 4: Distribution of Study Participants based on other comorbidities

S.no	Variables	Frequency (n)	Percentage (%)
1.	Dyslipidemia	14	10.3
2.	Primary renal disease	27	19.9
3.	Cardiovascular disease	21	15.4

Table 4 and figure 3 shows the distribution of other co-morbidities of the patients. 10.3%. had dyslipidemia, 19.9% had primary renal disease and 15.4% had cardiovascular disease.

Figure3: Distribution of Study Participants based on comorbidities

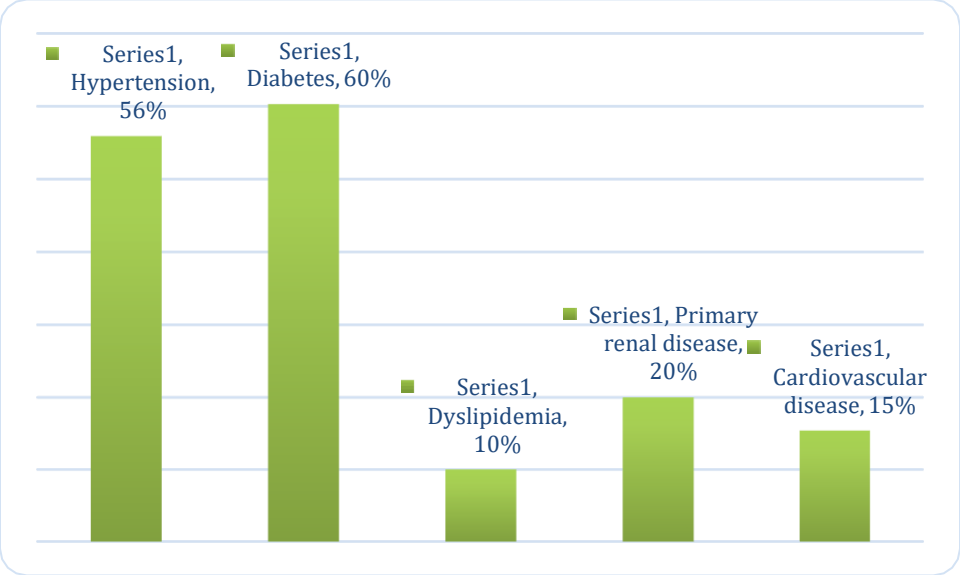


Table 5: Distribution of Study Participants based on Risk factors

S.no	Variables	Frequency (n)	Percentage (%)
1.	Family history	5	3.7
2.	Smoking	16	11.8
3.	Alcohol	17	12.5

Table 5 shows the distribution of risk factors status of the patients.

12.5% had the habit of drinking alcohol, 11.8% had the habit of smoking and 3.7% had family history of renal disease.

Table 6: Distribution of Study Participants based on Etiology

S.no	Variables	Frequency (n)	Percentage (%)
1.	Kidney disease	25	18.4
2.	Hypertension	24	17.6
3.	Diabetes Mellitus	23	16.9
4.	Diabetes+CAD	7	5.1
5.	Diabetes+Hypertension	25	18.4
6.	DM+HTN+ADPKD	1	0.7
7.	DM+HTN+FAM	1	0.7
8.	DM+HTN+CAD	9	6.6
9.	DM+HTN+Dyslipidemia	1	0.7
10	Died or Loss to follow up	20	14.7

Table 6 and figure 4 shows the distribution of etiological factors.

18.4% had kidney disease as an etiology, for 17.6%, hypertension was an etiological factor, 16.9% had diabetes as an etiology and 18.4% had both diabetes and hypertension as an etiology.

Figure 4: Distribution of Study Participants based on Etiology

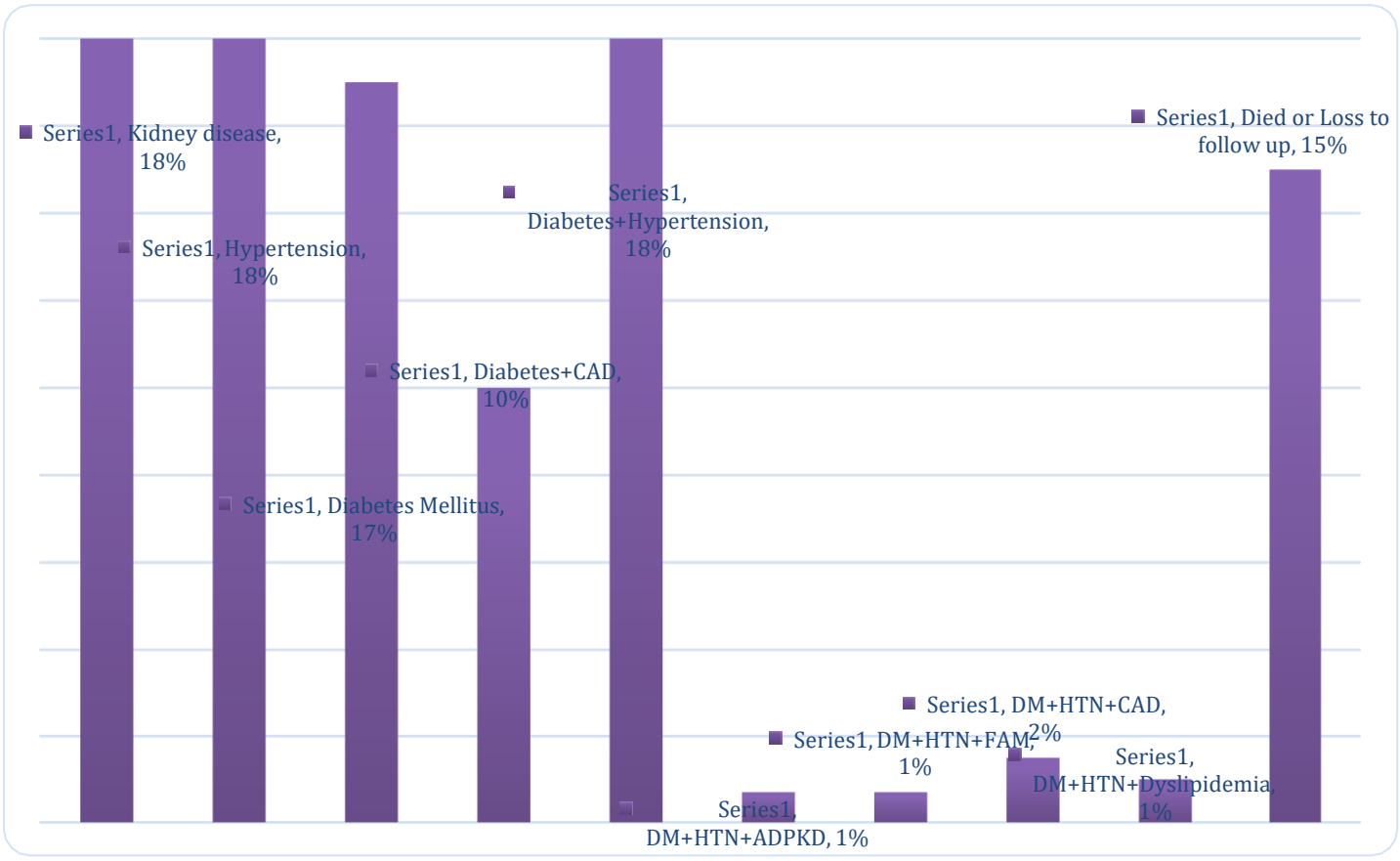


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Table 7: Comparison of e-GFR among the patients during the treatment

EGFR	Mean	Standard Deviation	95% Confidence Interval	F	p value
1st Visit	28.54	12.88	26.16-30.91	466.9	< **0.001**
2nd Visit	27.35	13.78	24.85-29.84		
3rd Visit	27.09	13.54	24.24-29.71		
4th Visit	26.53	13.95	26.83-29.23		

Table 7 shows the mean e-GFR values among patients during the course of treatment.

Mean (SD) EGFR among patients at the 1st visit was 28.54 (12.8), at the 2nd visit 27.35 (13.78) and at the 3rd visit was 27.09 (13.54) and at 4th visit was 26.53 (13.9). The difference between these was statistically significant (Repeated measures ANOVA test, p value < 0.001)

Table 8: Comparison of serum creatinine among the patients during the treatment

Serum Creatinine	Mean	Standard Deviation	95% Confidence Interval	F	p value
1st Visit	2.89	1.44	2.61-3.17	321.8	**< 0.001**
2nd Visit	3.11	1.69	2.79-3.44		
3rd Visit	3.27	1.97	2.89-3.65		
4th Visit	3.48	2.26	3.04-3.91		

Table 8 shows the mean serum creatinine values among patients during the course of treatment. Mean (SD) serum creatinine among patients at the 1st visit was 2.89 (1.44), at the 2nd visit3.11 (1.69) and at the 3rd visit was 3.27 (1.97) and at 4th visit was 3.48 (2.26). The difference between these was statistically significant (Repeated measures ANOVA test, p value < 0.001)

Table 9: Association between e-GFR and its influencing factors

S.no	Variables	EGFR		p value
		n	Mean (SD)	
1.	**Age** < 20 21-30 31-40 41-50 51-60 >60	 1 6 23 45 37 24	 31 (8.6) 32.8 (12) 33.7 (15.6) 26.2 (14.6) 25.1 (11.6) 19.4 (10.8)	**0.04**
2.	**Gender** Male Female	 71 65	 26.6 (14.6) 26.5 (13.1)	0.94
3.	**Diabetes** **Yes** **No**	 82 54	 22.3 (13.9) 29.9 (12.1)	**0.05**
4.	**Hypertension** **Yes** **No**	 76 60	 22.6 (14) 30.6 (12.6)	**0.003**
5.	**Dyslipidemia** **Yes** **No**	 14 122	 13.6 (9.5) 27.9 (13.6)	**0.002**
6.	**Primary Renal disease** Yes No	 27 109	 29.7 (13.8) 25.5 (13.9)	0.17
	Cardiovascular disease **Yes** **No**	 21 115	 24.2 (9.8) 26.9 (14.5)	0.5
7.	**Smoking** **Yes** **No**	 16 120	 21.5 (10.8) 27.2 (14.1)	0.17
8.	**Alcohol** **Yes** **No**	 17 119	 19.8 (11.2) 27.6 (14)	**0.05**
9.	**Family history** **Yes** **No**	 5 131	 19.7 (12.2) 26.8 (13.9)	0.31

Table 9 shows the association of eGFR with its influencing factors.

There was statistically significant association of eGFR values with the age of the patients, diabetes status hypertensive status, dyslipidemia and drinking alcohol.

Age: The mean e GFR was 33.7 in 31-40 years of patients and 32.8 in 21-30 years of patients and 26.2 in 41-50 years patients the difference was statically significant ($p = 0.05$).

Diabetes: The mean eGFR among the diabetic patients 22.3 and in non-diabetic was 29.9 and the difference was statically significant ($p < 0.05$).

Hypertension: The mean eGFR among the hypertensive patients 22.6 and in non-hypertensives was 30.6 and the difference was statically significant ($p < 0.05$).

Dyslipidemia: The mean eGFR among patients with dyslipidemia was 13.6 and those with no alteration in lipid levels showed 27.9 and the difference was statically significant ($p < 0.05$).

Alcohol: The mean eGFR among patients who drink alcohol was 19.8 and for those who don’t drink was 27.6 and the difference was statically significant ($p < 0.05$).

Table 10: Association between eGFR decline status and its influencing factors

S.no	Variables	eGFR decline		p value
		Non-Progression of eGFR	**Rapid Progression of eGFR**	
1.	**Age** 21-30 31-40 41-50 51-60 >60	 0 1 (11.1) 1 (11.1) 1 (11.1) 6 (66.7)	 4 (7.4) 11 (20.4) 19 (35.2) 15 (27.8) 5 (9.3)	**0.001**
2.	**Gender** Male Female	 5 (55.6) 4 (44.4)	 28 (51.9) 26 (48.1)	0.563
3.	**Diabetes** **Yes** **No**	 7 (77.8) 2 (22.2)	 21 (38.8) 33 (61.2)	**<0.05**
4.	**Diabetic treatment compliance** **Not applicable** **Good** **Poor**	 2 (22.2) 1 (11.1) 6 (66.7)	 33 (61.2) 0 21 (38.8)	**<0.05**
5.	**Hypertension** **Yes** **No**	 8 (88.9) 1 (11.1)	 23 (42.6) 31 (57.4)	**0.012**
6.	**Hypertension treatment compliance** **Not applicable** **Good** **Poor**	 2 (22.2) 1 (11.1) 6 (66.7)	 34 (63) 0 20 (37)	**0.007**
7.	**Dyslipidemia** **Yes** **No**	 1 (11.1) 8 (88.9)	 8 (14.8) 46 (85.2)	0.62
8.	**Primary Renal disease**			

	Yes No	1 (11.1) 8 (88.9)	18 (33.3) 36 (66.7)	0.172
9.	**Cardiovascular disease** **Yes** **No**	 0 9 (100)	 9 (16.7) 45 (83.3)	 0.22
10.	**Smoking** **Yes** **No**	 3 (33.3) 6 (66.7)	 4 (7.4) 50 (92.6)	 **0.05**
11.	**Alcohol** **Yes** **No**	 1 (11.1) 8 (88.9)	 5 (9.3) 49 (90.7)	 0.62

Table 10 shows the association of eGFR decline status with its influencing factors.

Among 136 patients, for 63 patients the eGFR has declined. There was statistically significant association of eGFR values with the age of the patients, diabetic status and its treatment compliance hypertensive status and its treatment compliance, dyslipidemia and smoking.

Age: Non-progression of eGFR was more among the patients aged above 60 years (66.7%) and rapid progression was more among 41-50 years of the patients (35.2%) and the difference was statically significant ($p = 0.05$).

Diabetes: Non-progression of eGFR was more among diabetes (77.8%) whereas rapid progression was more among non-diabetic (61.2%) and the difference was statically significant ($p < 0.05$).

Diabetes treatment compliance: Non-progression was more among diabetic patients whose treatment compliance was poor (66.7%) and the difference was statically significant ($p < 0.05$).

Hypertension:: Non-progression of e-GFR was more among hypertensive (88.9%) whereas rapid progression was more among non-hypertensive (57.4%) and the difference was statically significant ($p < 0.05$).

Hypertension treatment compliance: Non-progression was more among hypertensive patients whose treatment compliance was poor (66.7%) and the difference was statically significant ($p < 0.05$).

Smoking: 11.1% of the smokers had slow progression and 9.3% of the smokers had rapid progression and the difference was statically significant ($p < 0.05$).

Age: Non-progression of e-GFR was more among the patients aged above 60 years (71.4%) and rapid progression was more among 41-50 years of the patients (50%) and the difference was statically significant ($p <0.05$).

Cardiovascular disease: 42.9% of the patients with cardiovascular disease risk had non-progression of e-GFR whereas rapid progression was more among patients with non-cardiac risk (50%) and the difference was statically significant ($p < 0.05$).

DISCUSSION

Chronic kidney disease represents the entire spectrum of disease that occurs following initiation of kidney damage.

National Kidney foundation defined CKD as

1) Kidney damage for ≥3 months as defined by structural or functional abnormalities of the kidney, with or without decreased GFR or

2) GFR <60ml/min/1.73m2 for ≥ 3 months with or without kidney damage.

The GFR is considered the best measure of overall kidney function. A GFR <60ml/min/1.73m2 represents loss of one half or more of adult level normal kidney function. The normal GFR varies according to patient age, sex and body mass index.

This study was conducted in a Tertiary care Hospital in Southern TamilNadu.

This study was done to analyse the clinical profile of the CKD patients coming to the nephrology OPD.

Demography

Male gender has been recognized as an important factor in the development of CKD. In our study, of the 136 patients with CKD, 52% were males which was concordant with the CKD registry of India report where males constituted 68% of the total CKD patients and CMC Vellore study where 62% were males, probably reflects the faster decline in GFR in males as compared to females due to hormonal influence.

Because of the documented age related decline in GFR, the prevalence of CKD increases with age. This was seen in our study too with a majority of patients in the age group of 41-60 years contributing to about 60% . The mean age in the CKD registry of India report was 48.3±16.6 years and CMC Vellore study was 38.2±14.5 years.

Etiology

Among the etiological factors has a contributing to CKD, diabetes was the most common cause of CKD (50%) which was discordant with the CMC Vellore study where CGN was the diagnosis in 70.5%. Kidney disease (18.4%), hypertensive nephrosclerosis (17.6%) were the other common causes of CKD in our study. Thus the epidemic of non-communicable diseases like diabetes and hypertension in developing countries, continue to be the most common cause of CKD.

Comorbid illness

In this study, 76 (55.9%) had hypertension. Among 76 patients, 42.1% had hypertension for 2-5 years and 26.3% had between 5-10 years. Only 26.8% had good compliance to medications. Longstanding hypertension has been associated with Chronic Kidney disease. Regular follow up of hypertensive patients is thus essential to overcome the complications of CKD.

In this study 18.4% had kidney disease as an etiology ; for 17.6%, hypertension was an etiological factor; 16.9% had diabetes as an etiology and 18.4% had both diabetes and hypertension as an etiology.

In this study, 10.3% had dyslipidemia, 19.9% had primary renal disease and 15.4% had cardiovascular disease as comorbid illness.

Habits:

In this study, 12.5% had the habit of drinking alcohol, 11.8% had the habit of smoking and 3.7% had family history of renal disease. This is consistent with the CKD registry of India report, where cigarette smoking was prevalent in 32%, alcohol consumption in 6.4%.

FACTORS INFLUENCING PROGRESS OF CKD

Age:

Non-progression of e GFR was more among the patients aged above 60 years (71.4%) and rapid progression was more among 41-50 years of the patients (50%) and the difference was statically significant ($p < 0.05$). Thus age is a significant risk factor in decline in e GFR.

Cardiovascular disease and CKD:

42.9% of the patients with cardiovascular disease risk had non-progression of e GFR whereas rapid progression was more among patients with non-cardiac risk (50%) and the difference was statically significant ($p < 0.05$). Thus Cardiovascular disease is a significant risk factor in the non progression of e GFR.

In a study by Sarmad Said et al.,(38) the conclusion was that among patients with ACS who also have CKD, the mortality is increased twofold compared to patients with ACS and normal kidney function.

Effect of Smoking and Alcoholism in CKD:

11.1% of the smokers had slow progression and 9.3% of the smokers had rapid progression and the difference was statically significant ($p < 0.05$). Thus it shows that smoking has a significant association with progression of CKD.

42.9% of the alcoholics had slow progression and 7.7% of the alcoholics had rapid progression and the difference was statically significant ($p < 0.05$). This study shows that alcohol is associated with progression of CKD. This is consistent with the CKD registry of India report which shows significant association of smoking and alcoholism.

In a nationwide cross-sectional survey by Ayako Matsumoto et al.,(37) the findings were that in both smokers and nonsmokers, alcohol consumption was inversely associated with the risk of CKD. Mild to moderate alcohol consumption might be associated with a lower risk of CKD (proteinuria and eGFR), especially among nonsmokers. This result is in contrast with our study.

CONCLUSION

The factors affecting the estimated Glomerular Filtration rate in patients with Chronic Kidney Disease were

- Age
- Diabetic status and its treatment compliance
- Hypertensive status and its treatment compliance
- Dyslipidemia
- Cardiovascular status
- Smoking
- Alcoholism

Although there are many risk factors and varied etiology for Chronic Kidney Disease, Diabetes and Hypertension are the two major chronic non communicable diseases that results in the progression of CKD.

Management of Diabetes and hypertension by improved patient compliance plays a significant role in delaying the progression of Chronic Kidney Disease.

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ANNEXURES

PROFORMA

NAME :

AGE / SEX :

Co- MORBIDITIES :

DM -

SHTN -

CAD -

S.UREA :

S.CREATININE :

e-GFR :

ANNUAL e-GFR TREND :

HbA1C (in diabetics) **:**

USG abdomen :

CONSENT FORM

Format for Informed Consent Form for Parent / Guardian of the Subjects

Informed Consent form to participate in a research study

Study Title:

Study Number: _____

Subject's Initials: _____ **Subject's Name:** _____

Date of Birth / Age: _____

(i) I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions. [ ]

(ii) I understand that my son / daughter's participation in the study is voluntary and that he/she is free to withdraw at any time, without giving any reason, without his/her medical care or legal rights being affected. [ ]

(iii) I understand that the Ethics Committee and the regulatory authorities will not need my permission to look at my son / daughter's health records both in respect of the current study and any further research that may be conducted in relation to it, even if he/she withdraws from the trial. I agree to this access. However, I understand that my son / daughter identity will not be revealed in any information released to third parties or published. [ ]

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). [ ]

(v) I agree for the participation of my son/daughter in the above study. [ ]

Signature (or Thumb impression) of the Subject's parent /Legally Acceptable Guardian
Date: _____/_____/_____
Signatory's Name: _____
Signature: _____
Or
Representative: _____
Date: _____/_____/_____
Signatory's Name: _____

Signature or thumb impression of the Witness: _____
Date: _____/_____/_____
Name & Address of the Witness: _____

15.1.3 CONSENT FROM IN LOCAL LANGUAGE

நோயாளிகளுக்கு அறிவிப்பு மற்றும் ஒப்புதல் படிவம்
(மருத்துவ ஆய்வில் பங்கேற்பத்திற்கு)

ஆய்வு செய்யப்படும் தலைப்பு:
பங்கு பெறுவரின் பெயர்:
பங்கு பெறுவரின் வயது:

		பங்கு பெறுவர் இதனை ✓ குறிக்கவும்
1.	நான் மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்களை படித்து புரிந்து கொண்டேன். என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டுள்ளது என அறிந்து கொண்டேன்.	☐
2.	நான் இவ்வாய்வில் தன்னிச்சையாக தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும், எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.	☐
3.	இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்காள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.	☐
4.	இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக் கொள்ள மறுக்க மாட்டேன்.	☐
5.	இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக் கொள்கிறேன் எனக்கு கொடுக்கப்பட்ட அறிவுரைகளின் படி நடந்து கொள்வதுடன், ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ, அல்லது எதிர்பாராத, வழக்கத்திற்கு மாறான நோய்குறி தென்பட்டாலோ உடனே இதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்கிறேன்.	☐

பங்கேற்பவரின் கையொப்பம் / ..... இடம் .....
கட்டைவிரல் ரேகை
பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....
ஆய்வாளரின் கையொப்பம் /..... இடம் .....
ஆய்வாளரின் பெயர் .....
மையம் .....
கல்வியறிவு இல்லாதவற்கு (கைரேகை வைத்தவர்களுக்கு) இது அவசியம் தேவை
சாட்சியின் கையொப்பம் /..... இடம் .....
பெயர் மற்றும் விலாசம் .....

Ser.	Patients	Age	Sex	Diabetes Stat	Dura	Rx	co	Hypertension Stat	Dura	Rx	compliance	Dysl	Prim	Card	Fa	Sm	Alcohol	1st visit(baseline Crea	egfr	Urea	2nd visit Crea	egfr	Urea	3rd visit Crea	egfr	Urea	4th visit Crea	egfr	Annual egfr variation	ckd etio
1	Avudaiyappan	58y	M	N				N				N	Chr.	N	N	N	N	1.8	43		2	38		1.9	40		1.9	40	3 down	Chr Interstitial Nephritis
2	Francis	28y	M	N				N				N	Chr	N	N	N	N	2	46		2.1	43		2	46		2.2	41	5 down	cin
3	Siva	32y	M	N				N				N	Chr	N	N	N	N	2.6	33		3.2	25		3.2	25		2.9	29	4 down	cin
4	Devairakkam	57y	M	N				N				N	ADP	N	N	N	Y	4.9	13		4.5	15		4.9	13		5	13	no change	ADPKD
5	Pon Esakki	32y	M	N				N				N	IgA	N	N	N	N	2.3	38		2.5	34		2.4	36		2.6	33	5 down	IgA N
6	Nallakannu	45y	M	N				N				N	IgAN	N	N	N	N	1.8	47		1.6	54		1.9	44		1.5	58	11 up	IgA
7	Poolpandi	58y	M	N				N				N	MG	N	N	N	N	1.8	43		1.9	40		1.9	40		2.1	36	7 down	mgn
8	Rajappan	60y	M	N				N				N	MG	N	N	N	N	1.7	46		1.9	40		1.8	43		2	38	8 down	mgn
9	Mayandi	30y	M	N				N				N	ADP	N	N	N	N	1.9	48		2.1	43		2	45		2.1	43	5 down	adpkd
10	Shenbagaraj	38y	M	Y	2y		good	N				N	ANCA vas	N	N	N		6	12		8	8		12	5		12	5	7 down onMHD	ANCA vasculitis+DM
11	Raman	38y	M	N				N					IgAN	N	N	N	N	4.1	18		5	14		5.4	13		6.1	11	7 down onMHD	IgA
12	Manikandan	24y	M	N				N				N	IgA	N	N	N	N	3	29		3.6	23		4.1	20		5.9	13	13 down on MHD	IgA N

Ser.	Patients	Age	Sex	Diabetes Stat	Dura	Rx	co	Hypertension Stat	Dura	Rx	compliance	Dysl	Prim	Card	Fa	Sm	Alcohol	1st visit(baseline Crea	egfr	Urea	2nd visit Crea	egfr	Urea	3rd visit Crea	egfr	Urea	4th visit Crea	egfr	Annual egfr	ckd etio
13	Boologa Pandi	70y	M	N				Y	5y			N	N	N	N	Y	N	2.3	30		2.4	28		2.3	30		2.4	28	2 down	htn good
14	Paulpandi	65y	M	N				Y	20y	Good		N	N	N	N	N	Y	3.3	20		3.7	17		3.5	19		3.2	21	1 up	htn good
15	Manivasagam	65y	M	N				Y	7y	good		N	N	N	N	Y	N	3	22		3.2	21		3.2	21		3.2	21	1 down	htn good
16	Gurusamy	72y	M	N				Y	5y	good		N	N	N	N	N	N	2.3	29		2.1	33		2.2	31		2.2	31	2 up	htn good
17	Subburaj	66y	M	N				Y	4y	Good		N	N	N	N	Y	N	3.1	21		2.9	23		3.2	21		3	22	1 up	htn good
18	Esakkimuthu	45y	M	N				Y	5y	Good		N	N	N	N	Y	Y	2.5	31		2.4	33		2.5	31		2.3	35	4 up	htn good
19	Marimuthu	44y	M	N				Y	3y	Good		N	N	N	N	N	N	2.6	30		2.9	27		2.5	32		2.4	33	3 up	htn good
20	Idhaya Vijay	44y	M	N				Y	5y	Good		N	Y(ADN		N	Y	Y	5.7	12		5.5	12		5.8	12		5.7	12	no change on MHD	htn good
21	Arumugam	47y	M	N				Y	5y	Good		N	N	N	N	N	N	2.1	38		2.2	36		2	41		1.9	43	5 up	htn good
22	Arasan	57y	M	N				Y	7y	Poor		N	N	N	N	Y	Y	3.8	18		4.1	16		4	17		4.2	16	2 down	htn poor
23	Dharmalingam	50y	M	N				Y	10y	Poor		N	N	N	N	Y	Y	3.4	21		3.9	18		3.8	18		4.4	15	6 down	htn poor
24	Anand	43y	M	N				Y	10y	Poor		N	N	N	N	N	N	5.5	12		5.8	12		7	9		7.8	8	4 down on MHD	htn poor
25	Arumugam	50y	M	N				Y	20y	Poor		N	N	N	N	N	N	6.9	9		7.8	8		8.2	7		9	7	2 down on MHD	htn poor
26	Parvathinathan	45y	M	N				Y	4y	Poor		N	N	N	N	N	N	1.8	47		1.8	47		1.9	44		2.2	37	10 down	htn poor
27	Velusamy	58y	M	N				Y	12y	Poor		N	N	N	N	N	N	4.2	16		5	13		5.4	12		6	10	6 down	htn poor
	Guruvayoorapp	72y	M	N				Y	5y	poor		N	N	N	N	N	N	2.3	29		2.1	33							LOST FOLLOW UP	
	Arumugaraj	47y	M	N				Y	5y	Poor		N	N	N	N	N	N	2.1	38										LOST FOLLOW UP	

HTN

Ser.	Patients	Age	Sex	Diabetes Stat	Dura	Rx	co	Hypertension Stat	Dura	Rx	compliance	Dysl	Prim	Card	Fa	Sm	Alcohol	1st visit(baseline Crea	egfr	Urea	2nd visit Crea	egfr	Urea	3rd visit Crea	egfr	Urea	4th visit Crea	egfr	Annual egfr	ckd etio
28	Subbupandiyan	48y	M	Y	6y		Good	N				N	N	N	N	N	N	2.6	29		2.5	31		2.6	29		2.4	32	3 up	dm good
29	Manikavasagam	45y	M	Y	3y		good	N				N	N	N	N	N	N	1.9	44		2	41		1.7	50		1.7	50	6 up	dm good
30	Thangapandian	31y	M	Y	4y		good	N				N	N	N	N	N	N	1.7	55		1.6	59		1.8	51		1.6	59	4 up	dm good
31	Arumugam	72y	M	Y	20y		Good	N				N	N	N	N	N	Y	3.8	16		3.7	17		3.7	17		3.6	17	1 up	dm good
32	Arumugam	55y	M	Y	5y		good	N				N	N	N	N	N	N	1.9	41		1.8	44		1.7	47		1.8	44	3 up	dm good
33	Gopal	74y	M	Y	6y		Poor	N				Y	N	N	N	N	N	1.9	37		1.8	39		2.2	31		2.2	31	6 down	dm poor
34	Selvan	59y	M	Y	6y		Poor	N				N	N	N	Y	N	N	1.9	40		2.4	30		2.1	36		2.2	34	6 down	dm poor
35	Mahalingam	45y	M	Y	11y		Poor	N				N	N	N	N	N	N	2.1	39		2.4	33		2.5	31		2.8	27	12 down	dm poor
36	Abdul Kadhar	63y	M	Y	20y		Poor	N				Y	N	N	N	N	N	7.1	8		7.5	8		7.4	8		8	7	1 down on MHD	dm poor
37	Kali	56y	M	Y	10y		poor	N				Y	N	N	N	N	N	5.1	13		5.5	11		5.5	11		6	10	3 down on MHD	dm poor
38	Raja	49y	M	Y	16y		poor	N				Y	N	N	N	N	N	8	8		12	5							HD from 2nd visit	dm poor
39	Mydeen Pitchai	52y	M	Y	9y		poor	N				Y	N	N	N	N	N	7.5	8		9	6		13	4				HD from 3rd visit	dm poor
40	Selvan	66y	M	Y	10y		poor	N				Y	N	N	N	N	N	6.4	9		7.8	9		10	5				HD from 3rd visit	dm poor
	Manikavel	45y	M	Y	3y			N				N	N	N	N	N	N	1.9	44										LOST FOLLOW UP	
	Kaliyappan	56y	M	Y	10y		poor	N				N	N	N	N	N	N	5.1	13		5.5	11							DIED DUE TO COVID / SEPSIS / MODS / DM POOR	

DM

Ser.	Patients	Age	Sex	Diabetes Stat	Dura	Rx	co	Hypertension Stat	Dura	Rx	compliance	Dysl	Prim	Card	Fa	Sm	Alcohol	1st visit(baseline Crea	egfr	Urea	2nd visit Crea	egfr	Urea	3rd visit Crea	egfr	Urea	4th visit Crea	egfr	Annual egfr	ckd etio
41	Varatharaj	45y	M	Y	5y		Good	Y	5y	Good		N	N	N	N	N	N	1.8	47		2.1	39		1.8	47		1.8	47	no change	dm+ht good
42	Petchimuthu	40y	M	Y	2y		Good	Y	4y	Good		N	N	N	N	N	N	2.1	40		2	42		1.9	45		1.9	45	5 up	dm+ht good
43	Petchiappan	31y	M	Y	3y		Good	Y	1y	Good		N	N	N	N	N	N	2.1	42		2	45		1.9	48		2	45	3 up	dm+ht good
44	Sreenivasan	75y	M	Y	6y		Good	Y	13y	Good		N	N	N	N	Y	Y	1.8	39		2	34		1.7	42		1.8	39	no change	dm+ht good
45	Perumal	49y	M	Y	2y		Good	Y	4y	Good		N	N	N	N	Y	Y	2.4	32		2.5	31		2.1	38		2.2	36	4 up	dm+ht good
46	Subburaj	66y	M	Y	10		Poor	Y	20	Poor		N	N	N	N	Y	Y	2.5	28		3.1	21		3.2	21		3.5	18	10 down	dm+htn poor
47	Gnanasekar	50y	M	Y	15y		Poor	Y	15y	Poor		Y	N	N	N	Y	Y	5.3	12		6.8	9		7.3	8		10	6	6 down on MHD	dm+htn poor
48	Saravanan	40y	M	Y	10y		Poor	Y	7y	Poor		N	N	N	Y	N	N	3.8	20		4	18		4.5	16		5	14	6 down on MHD	dm+htn poor
49	Narayanan	63y	M	Y	17y		poor	Y	2y	poor		N	N	N	N	N	Y	4.8	13		5.8	10		6	10		7.9	7	8 down on MHD	dm+htn poor
50	Abdul Rahman	42y	M	Y	8y		poor	Y	3y	poor		N	N	N	N	N	N	4.5	16		6.8	10		7.1	9		8	8	8 down on MHD	dm+htn poor
51	Karuppasamy	45y	M	Y	10y		poor	Y	6y	poor		Y	N	N	N	Y	Y	4.6	15		5.2	13		6	11		6.4	10	5 down on MHD	dm+htn poor
52	Ponnusamy	70y	M	Y	21y		poor	Y	5M	poor		Y	N	N	N	N	N	6.1	9		7	8		8.1	7		8.6	6	3 down on MHD	dm+htn poor
53	Ramakrishnan	52y	M	Y	5y		Poor	Y	4y	Poor		N	N	N	N	Y	Y	5.3	12		7	9		11	5				HD from 3rd visit	dm+htn poor
54	Velmurugan	56y	M	Y	10y		Poor	Y	6M	Poor		N	N	N	N	Y	Y	6.2	10		11	5							HD from 2nd visit	dm+htn poor
55	Amirthavel	60y	M	N	13y		poor	Y	2Y	Poor		N	N	N	N	Y	N	7.2	8		11	5							HD from 2nd visit	dm+htn poor
56	Karuppasamy	56y	M	Y	10y		Poor	Y	10y	Poor		N	N	N	N	N	N	6.8	9		15	3							HD from 2nd visit	dm+htn poor
	Gnanagururaj	50y	M	Y	15y		Poor	Y	15y	Poor		Y	N	N	N	Y	Y	5.3	12		6.8	9							DIED DUE TO COVID PNEUMONIA / SEPSIS / DM + HTN POOR	
57	Kanas	64y	M	Y	12y		Good	N				N	N	Y(CA	N	N	Y	2.3	31		2.5	28		2.3	31		2.2	33	2 up	dm+cad good
58	Mariappan	52y	M	Y	5y		Good	N				N	N	Y	N	N	N	2	39		2.1	37		1.9	42		1.9	42	3 up	dm+cad good
59	Antony	47y	M	Y	7y		Poor	N				N	N	Y(HF	N	N	N	2.2	36		2.4	33		2.3	34		2.5	31	5 down	dm+cad poor
60	Mariappan	52y	M	Y	5y		Good	Y	3y	good		N	N	Y	N	N	N	2.5	30		2.6	29		2.3	33		2.4	32	2 up	dm+sht+cad good
61	Palani	53y	M	Y	9y		Good	Y	6y	good		N	N	Y	N	N	N	2.4	31		2.5	30		2.5	30		2.4	31	no change	dm+sht+cad good
62	Kalyanasundara	60y	M	Y	8y		Poor	Y	6y	poor		N	N	Y	N	N	N	3.2	21		3.4	20		4.2	15		4.6	14	7 down	dm+sht+cad poor
63	Easwaran	56y	M	Y	8y		Poor	Y	5y	poor		N	N	Y	N	N	N	2.7	27		2.8	26		3.3	21		3.5	20	7 down	dm+htn+cad poor
64	Sundaram	46y	M	Y	12y		Poor	Y	3M	poor		N	N	Y	N	N	N	6	11		9.8	6		12	5				HD from 3rd visit	dm+sht+cad poor
	Selvam	66y	M	Y	10y		poor	Y	3Y	Poor		N	N	Y	N	N	N	6.4	9										DIED DUE TO COVID PNEUMONIA / DM + SHT + CAD POOR	
	Saravana kuma	40y	M	Y	10y		Poor	Y	7y	Poor		N	N	N	Y	N	N	3.8	20		4	18							DIED DUE TO COVID PNEUMONIA / DM + HTN + CAD POOR	

Ser	Patients	Age	Sex	Diabetes Sta	Dura	Rx com	Hypertension Sta	Durat	Rx compliance	Dysl	Prima	Cardi	Fam	Smo	Alcohol	1st visit(baseline) Crea	egfr	2nd visit Crea	egfr	3rd visit Crea	egfr	4th visit Crea	egfr	Annual egfr variation	ckd etio	
1	Santhanamari	18y	F	N			N			N	Y(Lup	N	N	N	N	2.5	28	2	36	2	36	2.3	31	3 up	lupus	
2	Sudha	44y	F	N			N			N	Y(Lup	N	N	N	N	2.3	26	2.1	29	2.2	28	2.1	29	3 up	lupus	
3	Poolthai	39y	F	N			N			N	Y(Lup	N	N	N	N	1.4	49	1.3	54	1.4	49	1.4	49	no change	lupus	
4	Kokila	42y	F	N			N			N	Y(Lup	N	N	N	N	1.9	33	1.6	41	1.8	36	1.8	36	3 up	lupus	
5	Mariyam	36y	F	N			N			N	Y(Lup	N	N	N	N	1.8	37	1.9	35	1.8	37	2	33	4 down	lupus	
6	Seethalakshmi	36y	F	N			N			N	Y(Lup	N	N	N	N	1.8	37	1.7	40	1.9	35	1.7	40	3 up	lupus	
7	Valliyammal	45y	F	N			N			N	Y(ADP	N	N	N	N	3.4	16	3.1	18	4	13	4.1	13	3 down	adpkd	
8	Mayil	32y	F	N			N			N	Y(ADP	N	N	N	N	1.9	36	1.8	38	2	33	1.9	36	3 down	adpkd	
9	Santhanalakshm	48y	F	N			N			N	Y(ADP	N	N	N	N	2.1	29	2.6	22	2.3	26	2.6	22	7 down	adpkd	
10	Pushpalatha	40y	F	N			N			N	Y(MG	N	N	N	N	1.4	49	1.5	45	1.3	53	1.5	45	4 down	mgn	RY RENAL DI
11	Rajammal	60y	F	N			N			N	Y(MG	N	N	N	N	1.4	43	1.6	37	1.6	37	1.6	37	6 down	mgn	
12	Freda	28y	F	N			N			N	Y(Cin)	N	N	N	N	2	34	2.1	32	2	34	2.2	31	3 down	cin	
13	Parameshwari	32y	F	N			N			N	Y(Chr	N	N	N	N	2.6	24	3.2	19	3.2	19	2.9	21	3 down	cin	

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14	Kanagalakshmi	35y	F	Y	1y	Good	N			N	N	N	N	N	N	1.5	46	1.4	50	1.6	43	1.4	50	4 up	dm good	
15	Thangapushpam	58y	F	Y	9y	Good	N			N	N	N	N	N	N	2.5	22	2.2	25	2.3	24	2.2	25	3 up	dm good	
16	Pappammal	70y	F	Y	20y	Good	N			Y	N	N	N	N	N	1.8	30	1.7	32	1.9	28	1.8	30	no change	dm good	
17	Karthika	44y	F	Y	5y	Good	N			N	N	N	N	N	N	2.4	25	2.3	26	2.1	29	2.2	28	3 up	dm good	DM
18	Jeyanthi	43y	F	Y	5y	Good	N			N	N	N	N	N	N	1.7	38	1.8	35	1.6	41	1.6	41	3 up	dm good	
19	Sneha	34y	F	Y	4y	Poor	N			N	N	N	N	N	N	2.1	31	2.3	28	2.5	25	2.4	27	4 down	dm poor	
20	Dhanalakshmi	40y	F	Y	4y	Poor	N			N	N	N	N	N	N	1.8	36	1.9	34	2.1	30	2.1	30	6 down	dm poor	
21	Selvi	59y	F	Y	6y	Poor	N			N	N	N	Y	N	N	1.9	30	2.4	23	2.1	27	2.2	25	5 down	dm poor	
22	Malliga	45y	F	Y	5y	Poor	N			N	N	N	N	N	N	2.1	29	2	31	2.3	26	2.4	25	4 down	dm poor	
23	Kaliammal	70y	F	Y	10y	poor	N			Y	N	Y	N	N	N	3	16	3.5	13	4.6	10	6	7	10 down on MHD)	dm poor	
	Lakshmi	35y	F	Y	2Y	Poor	N			N	N	N	N	N	N	1.5	46	LOST FOLLOW UP (ALT MEDICATIONS)								
	Fathima	28y	F	Y	4Y	Poor	N			N	N	N	N	N	N	2	34	2.1	32	LOST FOLLOW UP (ALT MEDICATIONS)						
	Arumugavadivu	50y	F	Y	4Y	Poor	Y			N	N	N	N	N	N	4.5	11	5.3	9	DIED DUE TO COVID PNEUMONIA / DM POOR						

Ser	Patients	Age	Sex	Diabetes Sta	Dura	Rx com	Hypertension Sta	Durat	Rx compliance	Dysl	Prima	Cardi	Fam	Smo	Alcohol	1st visit(baseline) Crea	egfr	2nd visit Crea	egfr	3rd visit Crea	egfr	4th visit Crea	egfr	Annual egfr	ckd etio	
24	Nargis Nagoor B	29y	F	N			Y	2y	Good	N	N	N	N	N	N	2.1	32	1.9	36	2	34	1.9	36	4 up	htn good	
25	Guruvammal	56y	F	N			Y	7y	Good	N	N	N	N	N	N	1.6	38	1.5	41	1.6	38	1.5	41	3 up	htn good	
26	Antonyammal	50y	F	N			Y	7y	Good	N	N	N	N	N	N	1.6	39	1.5	42	1.7	36	1.5	42	3 up	htn good	
27	Subbamal	60y	F	N			Y	10y	Poor	N	N	N	N	N	N	2.5	21	3.6	14	3.5	14	3.6	14	7 down	htn poor	
28	Viji	62y	F	N			Y	20y	Poor	N	N	N	N	N	N	2.6	20	2.7	19	3	17	2.9	18	2 down	htn poor	HTN
29	Parvathi Banu	45y	F	N			Y	4y	Poor	N	N	N	N	N	N	1.7	37	1.8	35	1.9	33	2.2	27	10 down	htn poor	
30	Velammal	58y	F	N			Y	12y	Poor	N	N	N	N	N	N	4.2	12	5	9	5.4	9	6	8	3 down	htn poor	
31	Anandi	43y	F	N			Y	12y	Poor	N	N	N	N	N	N	5.8	9	6.5	8	6.8	7	7.5	6	3 down on MHD	htn poor	
32	Arumugam	50y	F	N			Y	20y	Poor	N	N	N	N	N	N	4.5	11	5.3	9	6	8	6.8	7	4 down on MHD	htn poor	
	Gayathri	56y	F	N			Y	3y		N	N	N	N	N	N	1.6	38	1.5	41	LOST FOLLOW UP						
	Vijaya	60y	F	N			Y	2y		N	N	N	N	N	N	2.5	21	3.6	14	LOST FOLLOW UP						

Ser	Patients	Age	Sex	Diabetes Sta	Dura	Rx com	Hypertension Sta	Durat	Rx compliance	Dysl	Prima	Cardi	Fam	Smo	Alcohol	1st visit(baseline) Crea	egfr	2nd visit Crea	egfr	3rd visit Crea	egfr	4th visit Crea	egfr	Annual egfr	ckd etio	
33	Sumithra	45y	F	Y	5y	Good	Y	5y	Good	N	N	N	N	N	N	1.5	44	1.4	47	1.4	47	1.4	47	3 up	dm+ht good	
34	Pushpalatha	40y	F	Y	6y	Good	Y	6y	Good	N	N	N	N	N	N	1.6	42	1.5	45	1.4	49	1.5	45	3 up	dm+htn good	
35	Petchiammal	31y	F	Y	3y	Good	Y	1y	Good	N	N	N	N	N	N	1.5	46	1.6	43	1.4	50	1.4	50	4 up	dm+htn good	
36	Lakshmi	48y	F	Y	4y	Poor	Y	4y		N	N	N	N	N	N	1.6	40	1.7	37	1.7	37	1.8	34	6 down	dm+sht poor	
37	Beer Fathima	42y	F	Y	13y	Poor	Y	15y	Poor	N	N	N	N	N	N	3.4	17	4.3	13	4.1	13	4.2	13	4 down	dm+htn poor	DM + HTN
38	Muthulakshmi	51y	F	Y	15y	Poor	Y	10y	Poor	Y	N	N	N	N	N	2.7	21	2.5	23	3.3	16	3.1	18	3 down	dm+htn+lipid poor	
39	Manimegalai	42y	F	Y	20y	Poor	N	17y	Poor	N	N	N	Y	N	N	7.5	6	6.8	7	7.9	6	8	6	no change on MHD	dm+htn poor+fam	
40	Mayil	61y	F	Y	18y	Poor	Y	10y	Poor	N	N	N	N	N	N	5.7	8	6.5	7	6.3	7	6.7	7	1 down on MHD	dm+ht poor	
41	Chandrakumari	38y	F	Y	4y	Poor	Y	2y	Poor	N	ADPK	N	N	N	N	6.2	8	6.6	8	6.9	7	7.5	7	1 down on MHD	dm+htn poor +adpkd	
42	Ramalakshmi	65y	F	Y	10y	Poor	Y	15y	Poor	N	N	N	N	N	N	5.5	8	5.8	8	5.7	8	6.3	7	1 down on MHD	dm+ht poor	
43	Subbulakshmi	52y	F	Y	13y	Poor	Y	6M	Poor	N	N	N	N	N	N	10	4	15	3					HD from 2nd visit	dm+ht poor	
44	Amirtham	56y	F	Y	21y	Poor	Y	5M	Poor	N	N	N	N	N	N	8.8	5	11	4					HD from 2nd visit	dm+ht poor	
	Sushmitha	45y	F	Y	3y		Y	1y		N	N	N	N	N	N	1.5	44					LOST FOLLOW UP				
	Pushpa	40y	F	Y	2y		Y	2y		N	N	N	N	N	N	1.6	42	1.5	45			LOST FOLLOW UP				
	Mymoon	42y	F	Y	10y		Y	10y		N	N	N	N	N	N	3.4	17	4.3	13			LOST FOLLOW UP				
	Ramathal	65y	F	Y	8y	Poor	Y	2y	Poor	N	N	N	N	N	N	5.5	8	DIED DUE TO COVID PNEUMONIA / DM + HTN POOR								
	Ananthammal	43y	F	N	7y	Poor	Y	12y	Poor	N	N	N	N	N	N	5.8	9	DIED DUE TO SEPSIS / DM + HTN POOR								

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45	Mary	52y	F	Y	5y	Good	Y	3y		N	N	Y	N	N	N	2.5	23	2.6	22	2.3	25	2.4	24	1 up	dm+sht+cad good	
46	Palammal	53y	F	Y	6y	Good	Y	6y		N	N	Y	N	N	N	2.4	24	2.5	22	2.5	22	2.4	24	no change	dm+sht+cad good	
47	Kaliyammal	60y	F	Y	8y	Poor	Y	6y		N	N	Y	N	N	N	3.2	16	3.4	15	4.2	12	4.6	10	6 down	dm+sht+cad poor	
48	Easwari	56y	F	Y	8y	Poor	Y	5y		N	N	Y	N	N	N	2.7	20	2.8	19	3.3	16	3.5	15	5 down	dm+htn+cad poor	
	Jayanthi	60y	F	Y	8y	Poor	Y	6y		N	N	Y	N	N	N	3.2	16	3.4	15	DIED DUE TO COVID PNEUMONIA /DM + HTN + CAD						
	Chandra	66y	F	Y	4y	Poor	Y	2y	Poor	N	N	Y	N	N	N	6.2	8	DIED DUE TO COVID PNEUMONIA / DM + HTN + CAD								
49	Begum	50y	F	Y	5y	Poor	N			N	N	Y	N	N	N	1.6	39	1.6	39	1.7	36	1.8	34	5 down	dm+cad poor	
50	Charulatha	49y	F	Y	7y	Poor	N			N	N	Y	N	N	N	2.5	23	2.8	20	2.9	19	3.1	18	5 down	dm+cad poor	
51	Jesu Antony	47y	F	Y	5y	Poor	N			N	N	Y	N	N	N	2.2	27	2.4	24	2.3	26	2.5	23	4 down	dm+cad poor	
52	Marithai	52y	F	Y	7y	Good	N			N	N	Y	N	N	N	1.9	31	1.7	36	1.9	31	1.8	33	2 up	dm+cad good	
	Kalithai	70y	F	Y	10y	poor	N			N	N	Y	N	N	N	3	16	3.5	13	DIED DUE TO CARDIAC MI / DM+ CAD POOR						