EXCREATORY PRODUCT AND THEIR ELIMINATION

⊙ Ammonotelic: Organism excreting ammonia are known as Ammonotelic.

→ Process of excreating ammonia is called Ammonotelism.

→ Excreated by diffusion

eg: Bony fishes, aquatic amphibians and aquatic insect.

⊙ Ureotelic: Organism excrete Urea

eg: Mammals, terrestial amphibians and marine fishes.

→ Excreted Out by kidneys.

⊙ Uricotelic: Excrete Uric acid in form of pellet or paste with a minimum Loss of water and are Called Uricotelic.

⊙ Protonephridia or Flame Cells are excretory structure in platyhelminthes, rotifers, some annelids and Cephalochordate → Amphioxus.

→ Concerned with ionic and fluid Volume regulation i.e Osmoregulation.

⊙ Nephridia tubular excretory structure of Earthworm and other annelids.

→ Help to remove nitrogenous waste and in maintaing Osmoregulation.

⊙ Malpighian tubules excretory organ of insect [Cockroaches].

→ Help in removel of nitrogenous waste and Osmoregulation.

⊙ Antennal glands or green glands perform excretory function in Crustaceans like prawns.

HUMAN EXCRETORY SYSTEM

⊙ Consist a pair of Kidney and Ureters, a Urinary bladder and a Urethra.

⊙ Kidney : Bean shaped
→ situated b/w levels of last thoracic and third lumbar Vertebra Close to dorsal inner wall of abdominal Cavity.

→ Weight : 120 - 170 g

Hilum : through which Ureter, blood Vessel and nerves enter.

→ Inner Hilum is funnel shaped space Called renal pelvis with projection Called Calyces.

→ Inside Kidney are two Zones
Outer → Cortex
inner → Medulla
↓
Divide into medullary pyramids projecting into Calyces.

. Cortex extend b/w Medullary pyramids as renal Column Called Columns of Bertini.

⊙ Kidney has complex tubular functional Unit Nephrons.

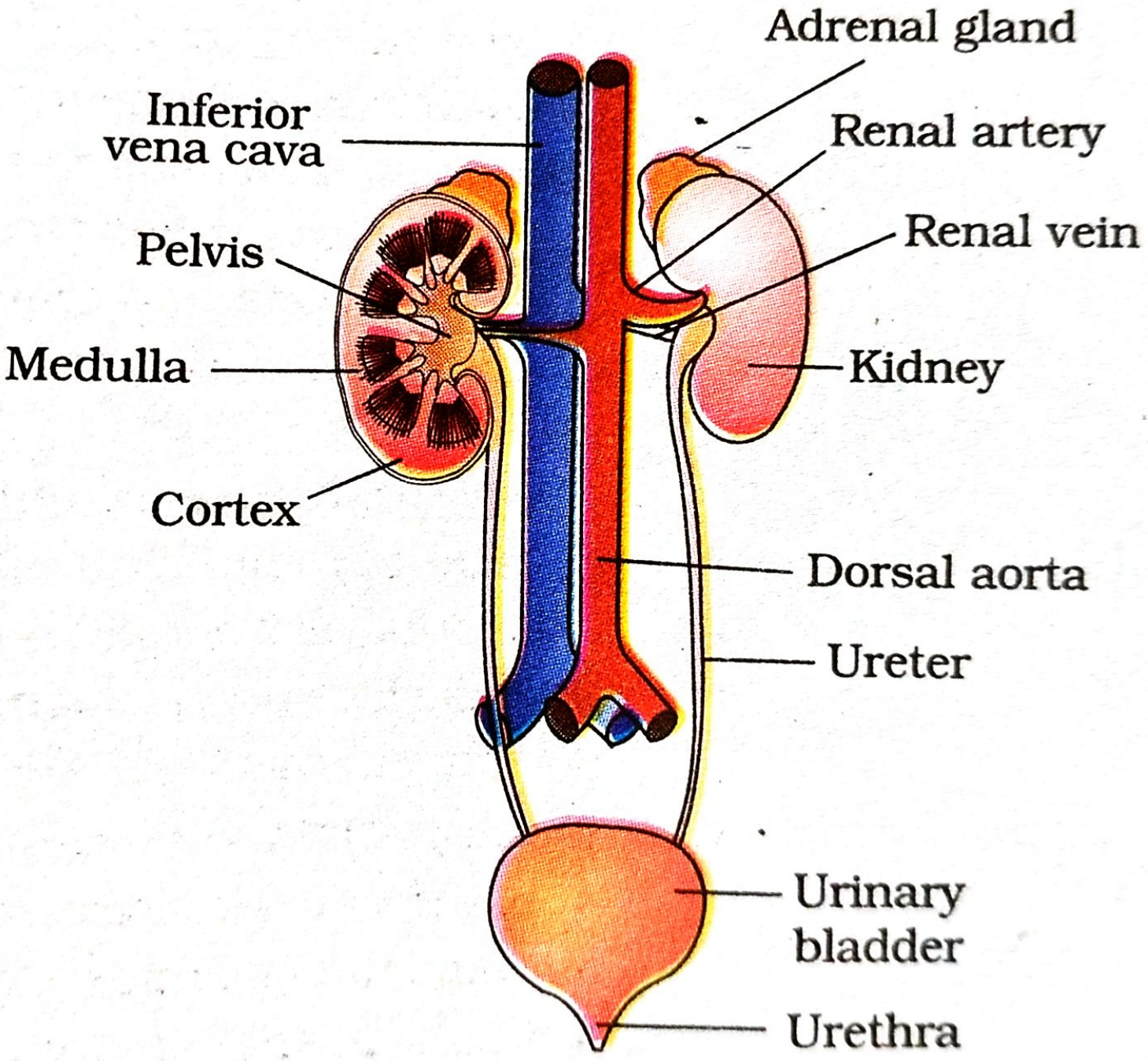

Figure 19.1 Human Urinary system

⊙ Nephrons has two parts:

1. Glomerules: Tuft of Capillaries formed b
   afferent arteriole → a fine branch
   of renal artery.

   → Blood from glomerulus is carried
   away by efferent arteriole.

2. Renal tubule: Begins as walled double-walled
   cup like structure called
   Bowman's Capsule.
   ↓
   Enclose glomerules.

   Glomerules + Bowman's Capsule = Malpighian
   body.

→ Tubule continues further to form a highly
Coiled network Proximal Convoluted tubule.

→ Henle's loop: Hairpin shaped
   → has Ascending and descending
   limb

→ Ascending limb continue as another highly
Coiled tubule called Distal Convoluted
tubule.
   ↳ Open into Collecting Duct.

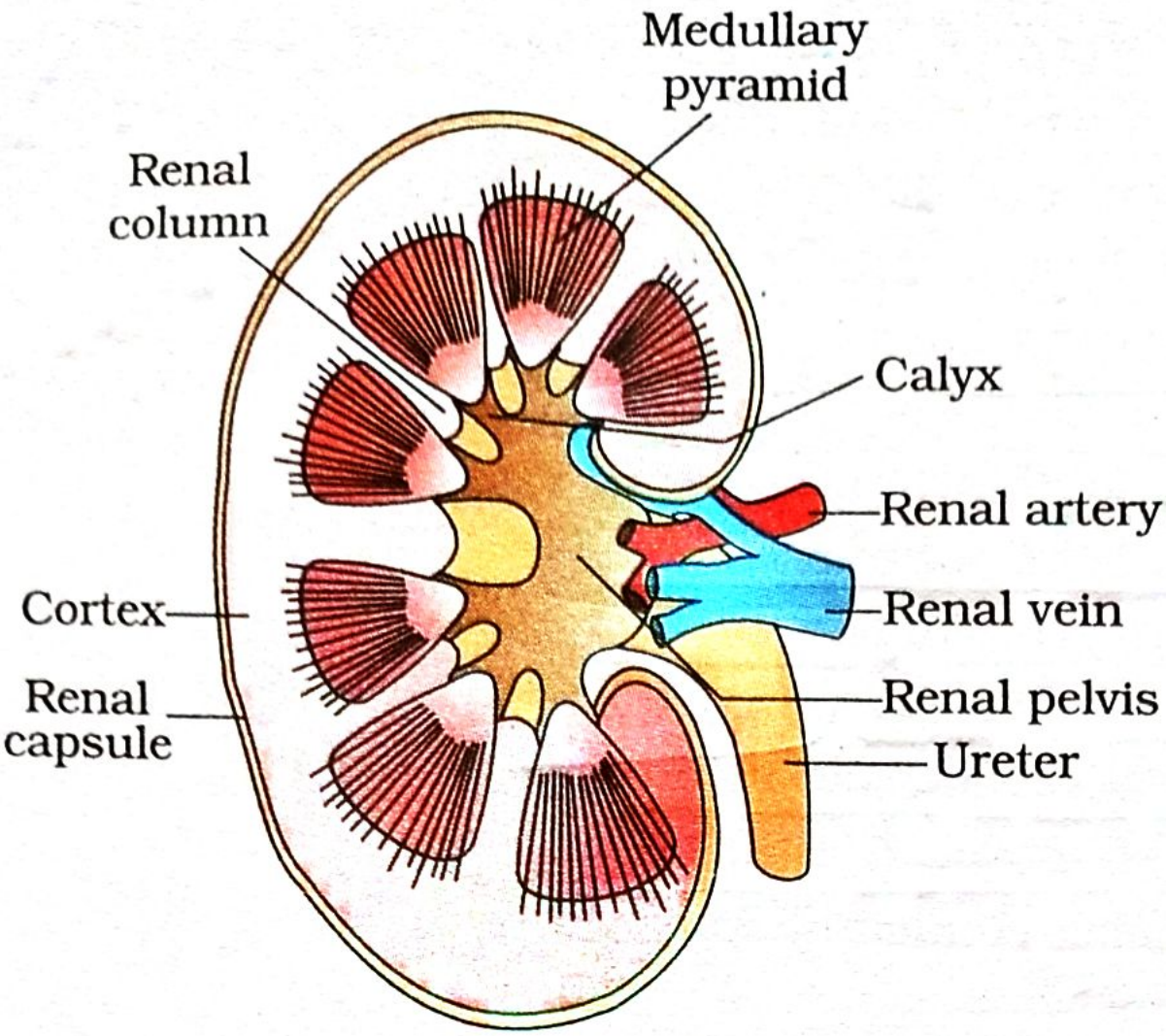

Figure 19.2 Longitudinal section (Diagrammatic) of Kidney

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⊙ Malpighian Corpuscle, PCT and DCT of nephron situated in Cortical region of kidney.

⊙ Henle's loop dips into Medulla.

* Cortical nephron: Nephron in which Henle's loop is too short and extend very little into medulla.

* Juxta medullary nephrons: In which Henle's loop is too-long and runs deep in medulla.

⊙ Peritubular Capillaries: Efferent arteriole forms a Capillary network around renal tube.

→ Vasa recta: Minute Vessel of Capillary network around Henle's loop which runs parallel.

URINE FORMATION

→ include three main process
1. glomerular filtration
2. Reabsorption.
3. Secretion.

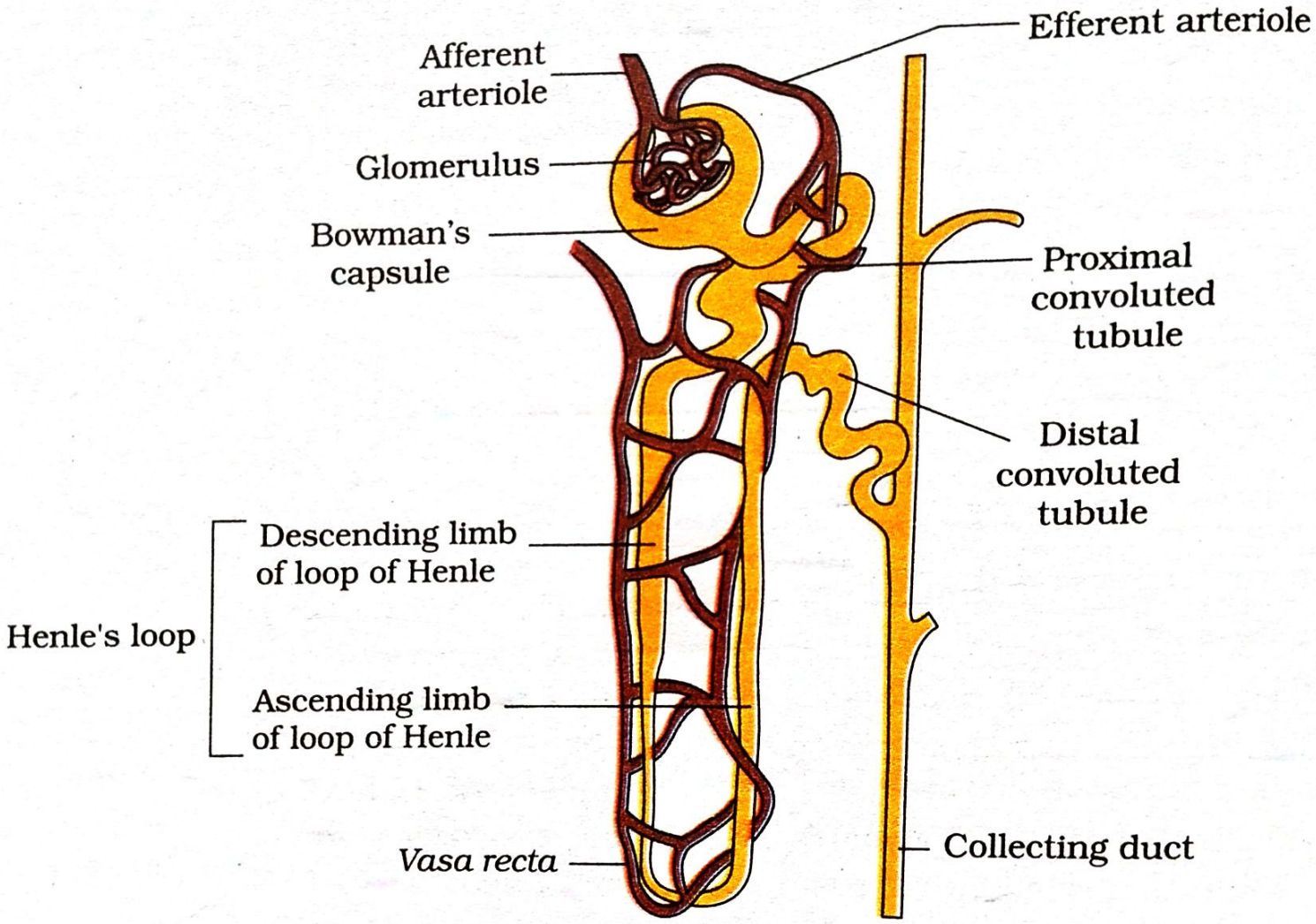

Figure 19.3 A diagrammatic representation of a nephron showing blood vessels, duct and tubule

1. Glomerular filtration:

→ Filtration of blood by glomerulus.
→ Average → 1100 - 1200 ml blood per minute
→ Glomerular Capillary blood Pressure Cause ~~blood~~ filtration of blood by 3 layers.
a. Endothelium of glomerular blood Vessel
b. Epithelium of Bowman's Capsule
c. Basement membrane b/w two layers.

→ Epithelial Cells of Bowmans Capsule Called podocytes are arranged in an intricate manner to leave minute space Called Slit poses.

→ All Constituent of plasma Except protein pass onto lumen of Bowman's Capsule
→ It is Considered as process of Ultra filtration.

⊙ Glomerular filtration rate: Amount of filtrate formed by kidney per minute.
Average → 125 ml/minute i.e 180L per day.

⊙ Juxta glomerular apparatus [JGA]

→ Sensitive ~~Organ~~ region formed by Cellular modification is DCT and afferent arteriole at location of their Contact.

→ fall in GFR activate JG Cell to release renin which can stimulate glomerular blood flow and GFR back to normal.

2. Reabsorption

→ Filtrate has to be reabsorbed by renal tube.

→ perform by epithelial cells of nephron by active or passive machanism.

Glucose, amino acid, Na^+ → actively
Nitrogenous waste → passive.

⊙ Tubular cell secrete substance like H^+ and K^+ and ammonia into filtrate.

Help in maintenance of ionic and acid base balance of body.

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FUNCTION OF THE TUBULES

1. Proximal Convoluted Tubule [PCT]:

→ Lined by Cuboidal brush border epithelium which increase surface area for reabsorption.

→ Essential nutrient, electrolytes and water reabsorbed.

→ Help to maintain pH and ionic balance of body fluids

2. Henle's Loop: Minimum Reabsorption.

→ Maintain high Osmolarity of medullary interstitial fluid.

→ Descending limb is permeable to water but impermeable to electrolytes.

→ Ascending limb is impermeable to water but allow transport of electrolyte actively or passively.

3. Distal Convoluted Tubule [DCT]: Conditional reabsorption of Na^+ and water.

→ Capable of reabsorption of HCO_3^- and selective secreation of H^+ and K^+ and NH_3 to maintain pH and Na-K balance in blood.

4. Collecting Duct: Extends from Cortex of kidney to inner part of medulla.

→ Large amount of water reabsorbed to produce a Concentrated Urine.

→ allow passage of small amounts of Urea into medullary interstitium.

→ Maintain pH and ionic balance of ~~body~~ blood.

MECHANISM OF CONCENTRATION OF FILTRATE

⊙ Mammals have ability to produce a Concentrated Urine.
↳ Henle's Loop and Vasa recta play significant role.

* Counter Current mechanism

1. Flow of filtrate in two limbs of Henle's as well as in Vasa recta is in opposite direction and thus form a Counter Current.

2. Counter Current in them help in maintaing and increasing Osmolarity towar inner medullary interstitium

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3. This gradient is Caused by Nacl and Urea.

4. Nacl is transported by ascending limb of Henle's loop which is exchanged with desending limb of Vasa recta.

Nacl is returned to interstitium by ascending portion of Vasa recta.

5. Similarly Small amount of Urea enter thin segment of ascending limb of Henle's loop which is transported back to interstitium by Collecting tube.

REGULATION OF KIDNEY FUNCTION

- Involve Hypothalamus, JGA and to a Certain extent Heart.

- Osmoreceptors activate by change in body fluid and ionic Concentration.

Excessive loss of body fluid activate receptors which stimulate hypothalamus to release Antidiuretic hormone [ADH] or Vasopressin from Neurohypophysis.

⊙ ADH facilitates water reabsorption from tubule preventing diuresis.

⊙ Increase in body fluid volume switch off Osmoreceptors and suppress ADH release.

⊙ ADH also affect kidney function by cause an increase in blood pressure which in turn increase glomerular blood flow and thereby GFR.

* Renin - Angiotensin Mechanism

⊙ Fall in Glomerular blood flow/ glomerular blood pressure / GFR can activate the JG cells to releases Renin

↓

Convert Angiotensinogen to Angiotensin I and to Anginotensin II.

⊙ Angionotensin II increase glomerular blood pressure and thereby GFR.

→ also activate adrenal Cortex to release Aldosterone

↳ Cause reabsorption of Na^+ and water. This lead to increase blood pressure and GFR.

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⊙ Increase in blood flow to atria of heart can cause release of Atrial Natriuretic Factor [ANF]
↳ Cause Vasodilation [dilation of blood vessel]. and decrease the blood pressure.

MICTURITION

⊙ The process of release of Urine is called Micturition.
→ Neural mechanism causing it called Micturition reflex.

⊙ Urine formed by nephron carried to Urinary bladder and is stored till voluntary signal given by CNS.

→ Signal is initiated by stretching of Urinary bladder.
→ Stretch receptors send signal to CNS.
→ CNS pass on motor messages to initiate contraction of smooth muscles of bladder and relaxation of Urethral Sphicter causing release of Urine.
↓
1 to 1.5 L/day
Yellow Coloured
acidic [pH - 6]

→ Presence of Glucose [Glycosuria] and ketones

bodies [ketonuria] in Urine are idicative of diabetes mellitus.

* Role Of Other Organ In Excretion.

⊙ Lung remove large amount of CO_2 and significant amount of water.

⊙ Liver : Secreate bile Containing bilirubin, bilivesdine, Cholestrol, degraded steroid hormone, Vitamins and drugs.

⊙ Sweat : produce by sweat gland Contain Nacl small amount of Urea, Lactic acid etc.

→ function is to facilitates Cooling effect on body surface.

⊙ Sebaceous gland eliminate substance like sterols, hydrocarbons and waxes through sebum.

This secreation provide protective Oily Covering for skin.

Disorders Of Excretory System

1. Uremia: Malfunctions of kidneys lead to accumulation of Urea in blood.

→ Urea Can be removed by a process Called Hemodialysis

↓

→ Blood drained from artery is pumped into dialysing Unit after adding Heparin.

→ Unit Contain a Coiled Cellophone tube surrounded by fluid having same Composition as plasma.

→ Porous Cellophane membrane of tube allow passage of molecule ~~base~~ based on Concentration gradient. thereby clearing the blood.

→ Cleared blood is pumped back to body through Vein after adding anti-heparin.

2. Renal failure: Kidney transplantation is ultimate method Correction of Kidney failure.

3. Renal Calculi: Stone or insoluble mass of Crystallised salt form within Kidney.

4. Crlomerulonephritis: Inflammation of glomeruli of kidney.