Drugs used On Urinary System.

Prepared by

Mrs Reshma V S

Department of pharmacology

BBCON

Syllabus – (Unit VI: Drugs used on Urinary System)

Pharmacology of commonly used:

- Diuretics.
- Antidiuretics.
- Urinary Antiseptics.
- Cholinergics & Anticholinergics.
- Acidifiers & Alkalanizers.

Composition, action, dosage, route, indications, contraindications, drug interactions, side effects, adverse, effects, toxicity & role of nurse.

Diuretics

DIURETICS

Diuretics (“water pills”) are the drugs which increase the urine out put (or) urine volume .

What is natreuretic agent ?

Any drug when introduce into the body increases the out put of sodium ie., loss of sodium in urine.

Therapeutic approaches

Diuretics are very effective in the treatment of conditions like:-

- ❑ Chronic heart failure
- ❑ Nephrotic syndrome
- ❑Chronic hepatic diseases
- ❑ Hypertension
- ❑Pregnancy associated edema
- ❑Cirrhosis of the liver.

NORMAL PHYSIOLOGY OF URINE FORMATION

Two important functions of the kidney are:-

1. To maintain a homeostatis balance of electrolytes and water.
2. To excrete water soluble end products of metabolites.

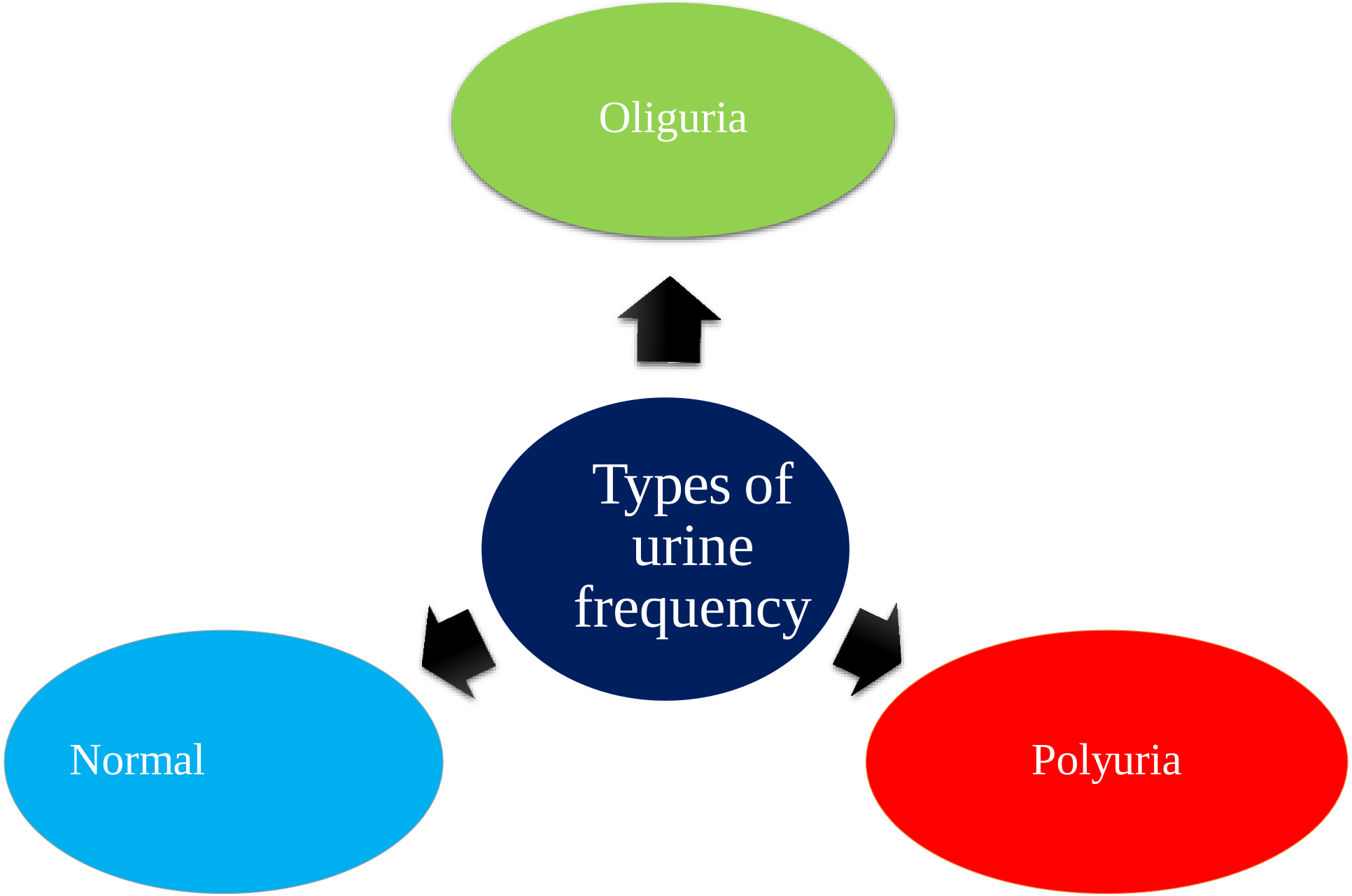
❖Each kidney contains approximately one million nephrons and is capable of forming urine independently.

❖The nephrons are composed of glomerulus, proximal tubule, loop of henle, distal tubule.

- Approximately 1200 ml of blood per minute flows through both kidneys.
- Ions such as sodium, chloride,calcium are reabsorbed.
- Total amount of glucose, amino acids, vitamins, proteins are reabsorbed.
- If the urine contains above it represents the disorders.
- For example proteins such as albumin in higher amounts causes albuminaria.

GFR FORMATION

- ✓1 cardiac output -5 lit/min.
- ✓Out of that 20% goes to kidneys i.e.1 lit/min.
- ✓1 lit of blood of has 40%of cells and 60%of plasma.
- ✓600 ml of plasma is not entered into glomerulus only a part of plasma can enter into it and the rest pass through the efferent arteriole.
- ✓Only 20% can enter into glomerelus that is 120 ml.
- ✓This 120 ml/min (180L/day) makes glomerular filtrate (99%reabsorbed).
- ✓Urine output is about 1 – 1.5L/Day


Oliguria
Types of urine frequency
Normal
Polyuria

Classification of Diuretics

- **According to types:**

1. **<u>High ceiling (Loop Diuretics)</u>**
- Furosemide
- Torsemide.

2. **<u>Thiazide Diuretics</u>**.
- Chlorothiazide.
- Hydrochloride thiazide.
- Benzthiazide.

1. **<u>Osmotic Diuretics: Mannitol.</u>**
2. **<u>Carbonic Anhydrase inhibitors: Acetazolamide.</u>**
3. **<u>Potassium sparing Diuretics.</u>**
- Spironolactone.

Classification of Diuretics: contd.

- **According to Efficacy**:

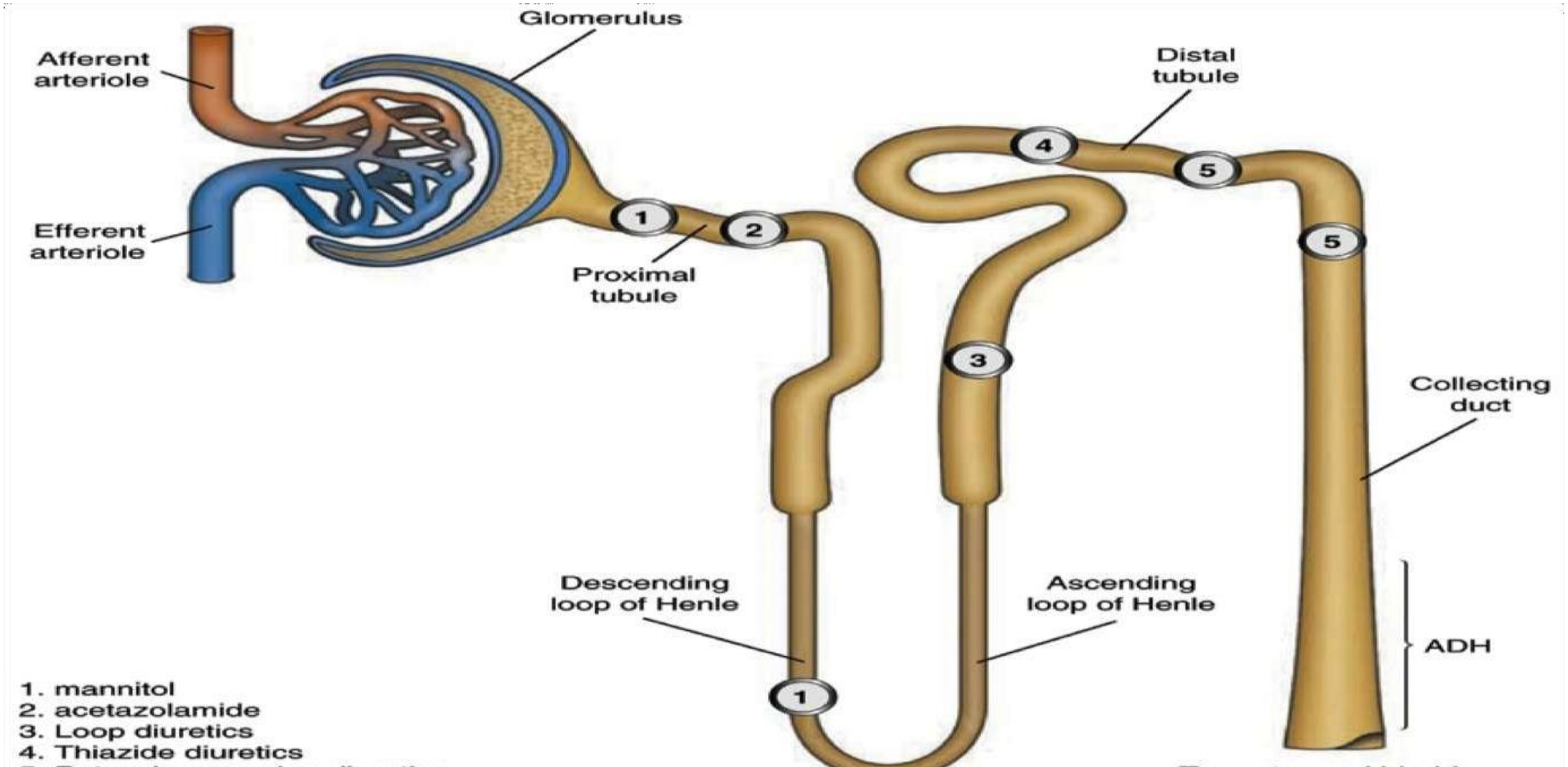
1. High efficacy diuretics: Loop Diuretics.
2. Medium efficacy diuretics: Thiazide Diuretics
3. Weak diuretics:

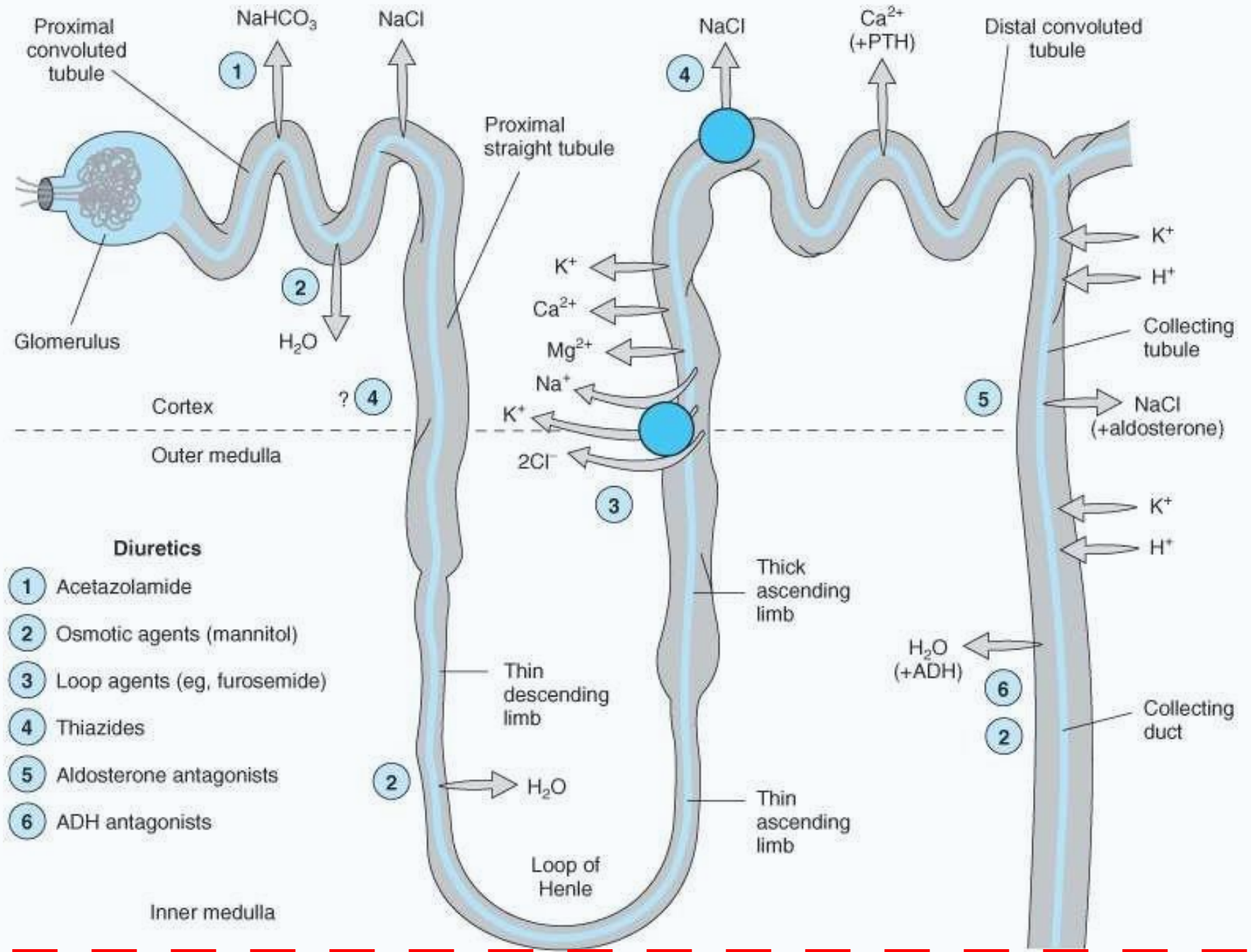
❖Carbonic Anhydrase inhibitors

❖Osmotic Diuretics.

❖Potassium sparing Diuretics.

Classification of Diuretics




Proximal convoluted tubule
$NaHCO_3$
NaCl
1
Glomerulus
2
H_2O
Proximal straight tubule
NaCl
4
Ca^{2+} (+PTH)
Distal convoluted tubule
K^+
H^+
Collecting tubule
K^+
Ca^{2+}
Mg^{2+}
Na^+
K^+
$2Cl^-$
3
? 4
Cortex
Outer medulla
5
NaCl (+aldosterone)
K^+
H^+
Thick ascending limb
H_2O (+ADH)
6
2
Collecting duct
Thin descending limb
2
H_2O
Thin ascending limb
Loop of Henle
Inner medulla
Diuretics
1 Acetazolamide
2 Osmotic agents (mannitol)
3 Loop agents (eg, furosemide)
4 Thiazides
5 Aldosterone antagonists
6 ADH antagonists

Diuretics

- **Mechanism of Action**:

1. **Loop Diuretics**: They show their action by reducing absorption of sodium at the level of loop of Henle. Eg. Furosemide, Torsemide.
2. **Potassium sparing**: Drug which antagonised the effect of aldosterone, Eg. Spironolactone.
3. **Thiazide**: They inhibit reabsorption of sodium & Chloride ions from distal convoluted tubules, Eg. Chlorothiazide.
4. **Osmotic**: It inhibits reabsorption of water and sodium. Eg. Mannitol.
5. **Carbonic Anhydrase inhibitor**: They suppress the activity of Carbonic Anhydrase, Eg.Acetazolamide.

Indication & Uses:

1. **Loop Diuretics:** Edema, Acute pulmonary edema (Acute LVF, M.I), Cerebral edema, Hypertension, Hypercalcemia & Renal calcium stone.
2. **Thiazide:** Mild to moderate edema (Cardiac failure, Nephrotic syndrome), HTN, Diabetes insipidus, Hypercalciuria/ Calcium stone, Premenstrual tenses.
3. **Osmotic:** Acute renal failure during prolonged surgery or trauma to prevent or treat increase ICP, Glaucoma.
4. **Carbonic Anhydrase inhibitor:** Glaucoma, Epilepsy, Acute motion sickness, periodic paralysis.
5. **Potassium sparing:** Hyperaldosteronism, HTN, CHF, edema, combine with furosemide, thiazide to reduce potassium loss produce by these agents.

Drug Examples & Doses:

S. no.	Drugs	Doses
1	Furosemide	20-80mg
2	Torsemide	5-10mg orally or IV OD
3	Chlorothiazide	500 – 1000mg PO or IV OD or Bid.
4	Hydrochlorothiazide	25-50mg OD
5	Benzthiazide	25mg
6	Mannitol.	50 to 100gm IV
7	Acetazolamide	125-250mg orally IV
8	Spironolactone	25 to 200mg/day in 1 or 2 divided doses.
9	Amiloride	5-10mg OD

Contraindication & Precautions

- **Osmotic**: Intracranial bleeding, CHF, Urinary tract obstruction, Pulmonary congestion, edema,
- **Loop:** Hyponatremia, Severe sodium and water depletion, Hypokalaemia, Renal failure, Addison's disease.
- **Potassium:** Anuria, Hyperkalaemia, Acute or progressive renal insufficiency.
- **Thiazide:** severe renal impairment, severe hepatic impairment, hypersensitivity, pregnancy & lactation.
- **Carbonic Anhydrase:** Pregnancy & lactation, hepatic insufficiency, severe pulmonary congestion.

Adverse effect

- **Thiazide:** Hypokalaemia, metabolic alkalosis, hyponatremia, Dehydration, Hypotension, Hypercholesterolemia, Hyperuricemia, Azotemia (in renal disease patient)
- **Loop:** Hypokalaemia, metabolic alkalosis, Hyperuricemia, Hypomagnesemia, Dehydration (Hypovolemia), Hypotension, Ototoxicity (Dose related hearing loss)
- **Osmotic**: Electrolyte imbalance, increase circulatory load and may cause congestive heart failure.
- **Potassium:** Hyperkalaemia, metabolic acidosis, Gynecomastia, (aldosterone antagonist), Gastric problems including peptic ulcer.
- **Carbonic Anhydrase:** Hypokalaemia, metabolic acidosis, skin rash.

Drug interactions:

1. Simultaneously use of spironolactone and digoxin increases the risks of digoxin toxicity.
2. Spironolactone effects may decrease with salicylates use.
3. Salicylates may cause carbonic anhydrase inhibitor toxicity.
4. These drugs may cause lithium toxicity by decreasing excretion of lithium.
5. Use of digoxin may cause additive hypokalaemia, these increasing the risk of digoxin toxicity and arrthymias.
6. Anticoagulants effect may increases with the use of these drugs simultaneously.
7. Risk of ototoxicity may occurs when use with aminoglycosides.

Nursing Responsibilities.

- Monitor urine output, blood pressure, hrly check for electrolyte imbalance.
- Obtain vital signs.
- Monitor laboratory values sply. Potassium, sodium (diuretics can cause electrolyte imbalance)
- Observe for changes in level of consciousness, dizziness, fatigue, and postural hypotension because reduction in blood volume due to diuretic therapy may produce changes in level of consciousness or syncope.
- Observe for sign of hypersensitivity reaction.
- Monitor hearing and vision (Loop diuretic are ototoxic)

Contd.

- Instruct patient to:

1. Immediately report any severe shortness of breath, profound fatigue, edema in extremities, potential sign of heart failure, or pul. oedema.
2. Avoid excessive heat which contributes to fluid loss through perspiration.
3. Consume adequate amount of plain water.
4. Stop medication if severe hypotension exists.
5. Immediately report any change in consciousness, specially felling faint.
6. Change position slowly.
7. Receiving loop or thiazide diuretic to eat food high in potassium.

Contd.

1.Receiving potassium – sparing diuretic to avoid foods high in potassium.

2.To consult which health care provider before using vitamin/minerals supplements or electrolyte fortified sports drinks.

3. To report any changes in hearing or vision.

Antidiuretics

Antidiuretics

- **Introduction:** An antidiuretics are the agent that reduce urine volume, opposing diuresis.
- **Mechanism of Action:** Reduces urine flow by acting reabsorption of water by kidney tubules
- **Indication & Uses:**

1. Cranial Diabetes insipidus.
2. Primary nocturnal enuresis (bed wetting)
3. Nocturia associated with multiple sclerosis.

Drug Examples & Doses:

S. no.	Drugs	Doses
1	Antidiuretic Hormone (Vasopressin)	5-10units IM/ SC
2	Desmopressin	100-400mcg orally 1-4mcg IV.

Contd

- **Contraindication & Precautions:** Hypersensitivity, impaired renal function, with ongoing diuretic treatment, Caution in CV disease, edema, hypertension, cystic fibrosis, fluid and electrolyte imbalance, pregnancy and lactation.

- **Adverse effect:** Nasal irritation, Rhinitis, Abdominal cramps, Urge defecate, fluid retention, congestion, Ulceration, nausea, pallor, Backache in females (due to uterine contraction)

Nursing Responsibilities.

- Monitor electrolyte imbalance.
- Monitor vital signs and B.P. regularly.
- Observe for sign of hypersensitivity reactions.
- Monitor laboratory values.
- Stop medication if hypertension exists.

Urinary Antiseptics

Urinary Antiseptics

- **Introduction**: Drugs used for urinary tract infects which kill or inhibit the growth of microorganism.
- **Mechanism of Action:** There are bacteriostatic drug. They inhibit the growth of different species of bacteria in urine.
- **Indication & Uses:**

1. Sulphonamide are used to treat infection causes by susceptible organism in urinary tract.
2. Methenamine is used to prevent recurrent urinary tract infection

- **Adverse effects**: Fever, Rash, Crystalluria, Nausea, Vomiting, Photosensitivity reaction, Stevens Johnson's syndrome

Drug Examples & Doses:

S. no.	Drugs	Doses
Sulphonamides		
1	Cotrimoxazole	Co-Trimoxazole (Trimethoprim/Sulfamethonazole) 80mg+400mg
2	Sulfadiazine	500-1000mg
3	Sulfamethoxazole	1-2gm orally every 6hrly.
Miscellaneous		
4	Flouroquinolones	Ciprofoxacin – 250-500mg, Levofloxacin 250-500mg
5	Methenamine	1gm orally
6	Nalidic acid	Nalidixic Acid 500mg
7	Nitrofurantoin	50-100 mg orally.

Contd

- **Contraindication & Precautions:**

1. Contraindicated in pregnant and breast feeding women, children younger than age 2yr.
2. History of Stevens Johnson syndrome.
3. Hypersensitive patients with sulphonamides.
4. Cautiously use in patient with mild to moderate renal or hepatic disorders, severe allergies, blood Dyscrasias urinary obstruction.

- **Drug interaction:**
- Sulphonamides may increase the effect of oral hypoglycemics.
- It may decrease the effectiveness of hormonal contraceptives.
- Increase risk of bleeding in patient who are taking anticoagulants.

Nursing Responsibilities.

- Assess the sign and symptoms of urinary tract infections.
- Advice to patient for intake of fluid 2000 – 3000 ml/day to reduce Crystalluria.
- Teach the patient proper hygiene measures to reduce the risk of reinfection.
- Monitor the patient urinary elimination patterns.
- Instruct to women who are taking oral conceptives to use an alternative method such as barrier method during the entire course of therapy.

Assignment: Role of Cholinergics & Anticholinergics in Urinary system.

Acidifiers & Alkalanizers

Urinary acidifiers & alkalanizers

Acidic	Alkaline	pH immaterial	
Nitrofurantoin	Cotrimoxazole	Chloramphenicol	
Methanamine	Aminoglycosides	Ampicillin	

Assignment

- **Explain in detail**: Urinary acidifiers & alkalanizers (Acidifiers Sodium citrate, potassium citrate, tartaric acid & Alkalanizers Sodium bicarbonate, acetazolamide)
- **Explain in detail**: Nitrofurantoin, Cotrimoxazole & Chloramphenicol.

Thanks.