

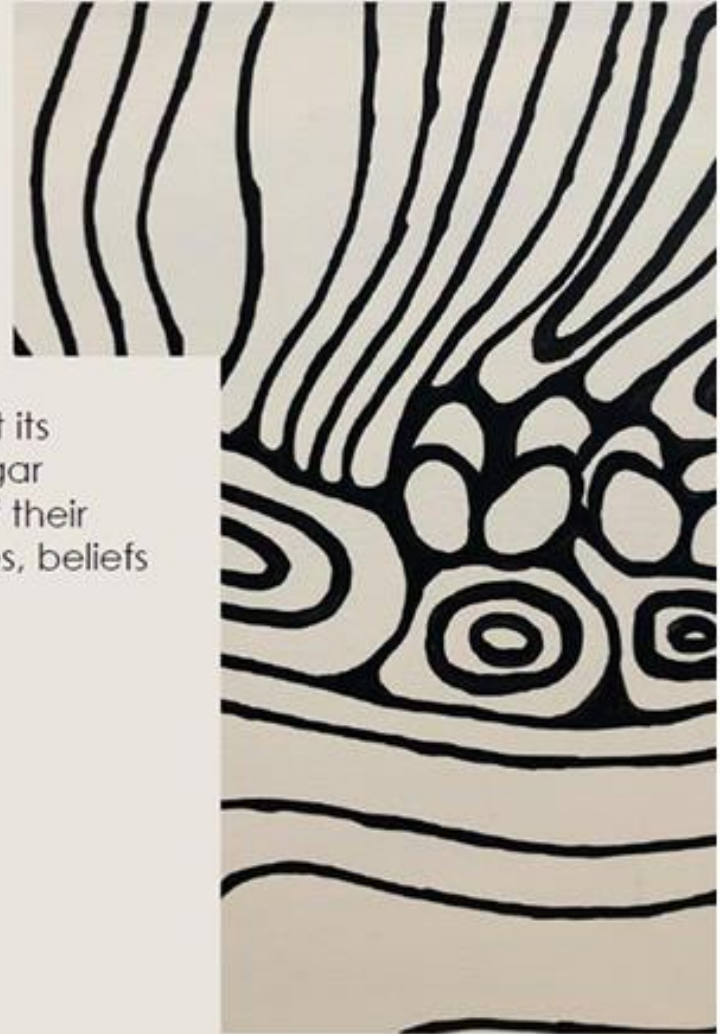
# DENT 3005: Introduction to Pharmacology

## **Renal and genitourinary drugs**

Dr Thuy Linh Truong  
[thuy.truong@uwa.edu.au](mailto:thuy.truong@uwa.edu.au)

# Acknowledgement of country

The University of Western Australia acknowledges that its campus is situated on Noongar land, and that Noongar people remain the spiritual and cultural custodians of their land, and continue to practise their values, languages, beliefs and knowledge.

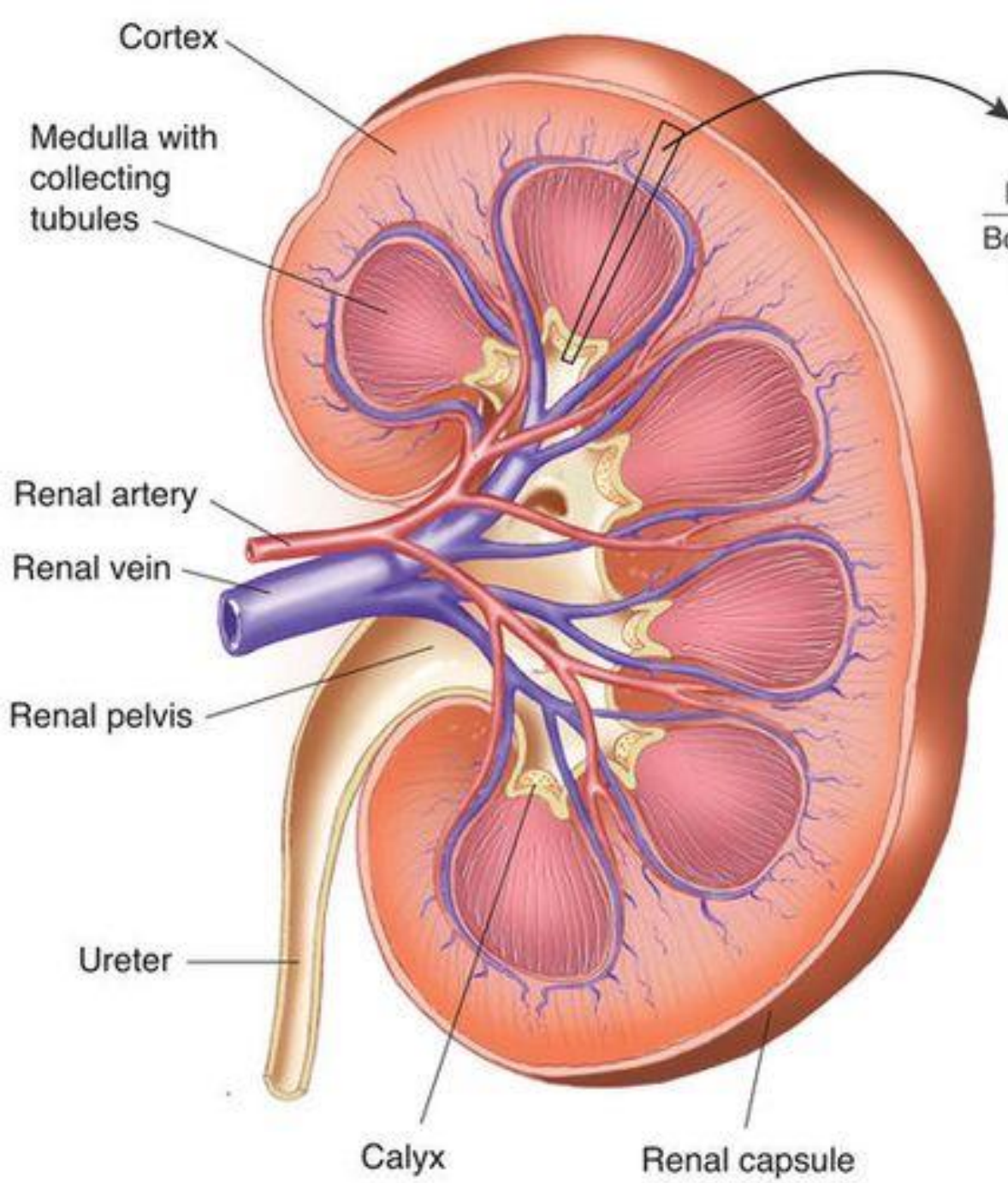


# Learning Outcomes

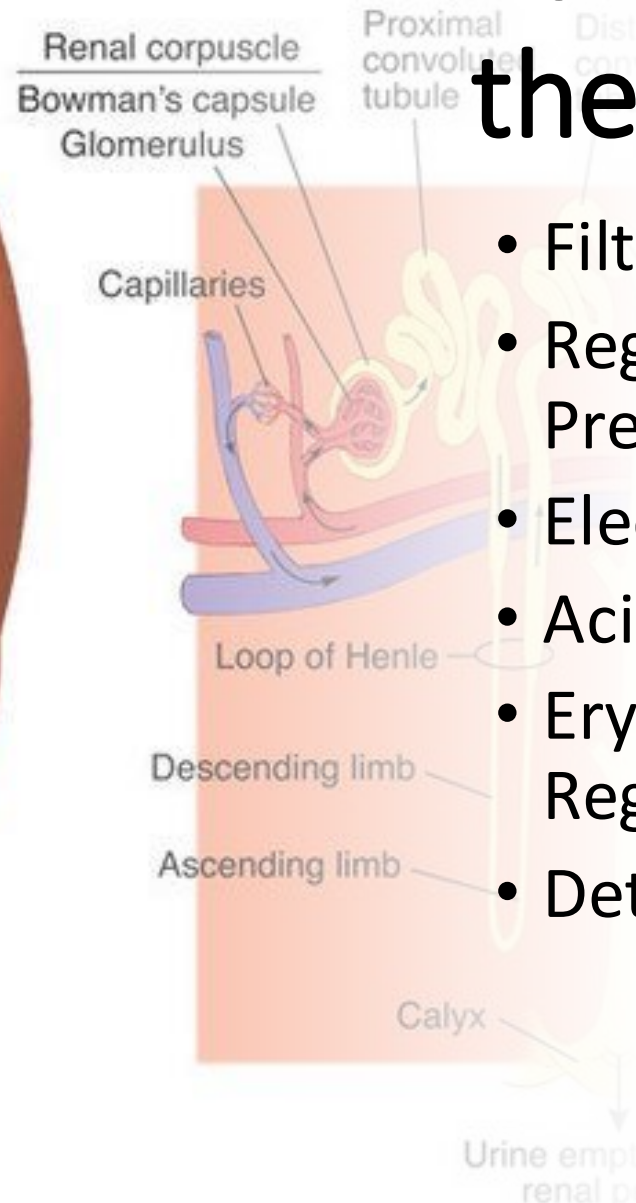
## Learning objectives

- 1) Understand the mechanism of diuretics
- 2) Broadly understand the function of the kidney and chronic kidney disease
- 3) Broadly understand BPH, drugs used and dental implication of these drugs
- 4) Recognise oral and dental side effects of diuretic drugs
- 5) Recognise dental implications of renal disease
- 6) Understand drugs interactions with dental medications
- 7) Applied knowledge to clinical scenarios





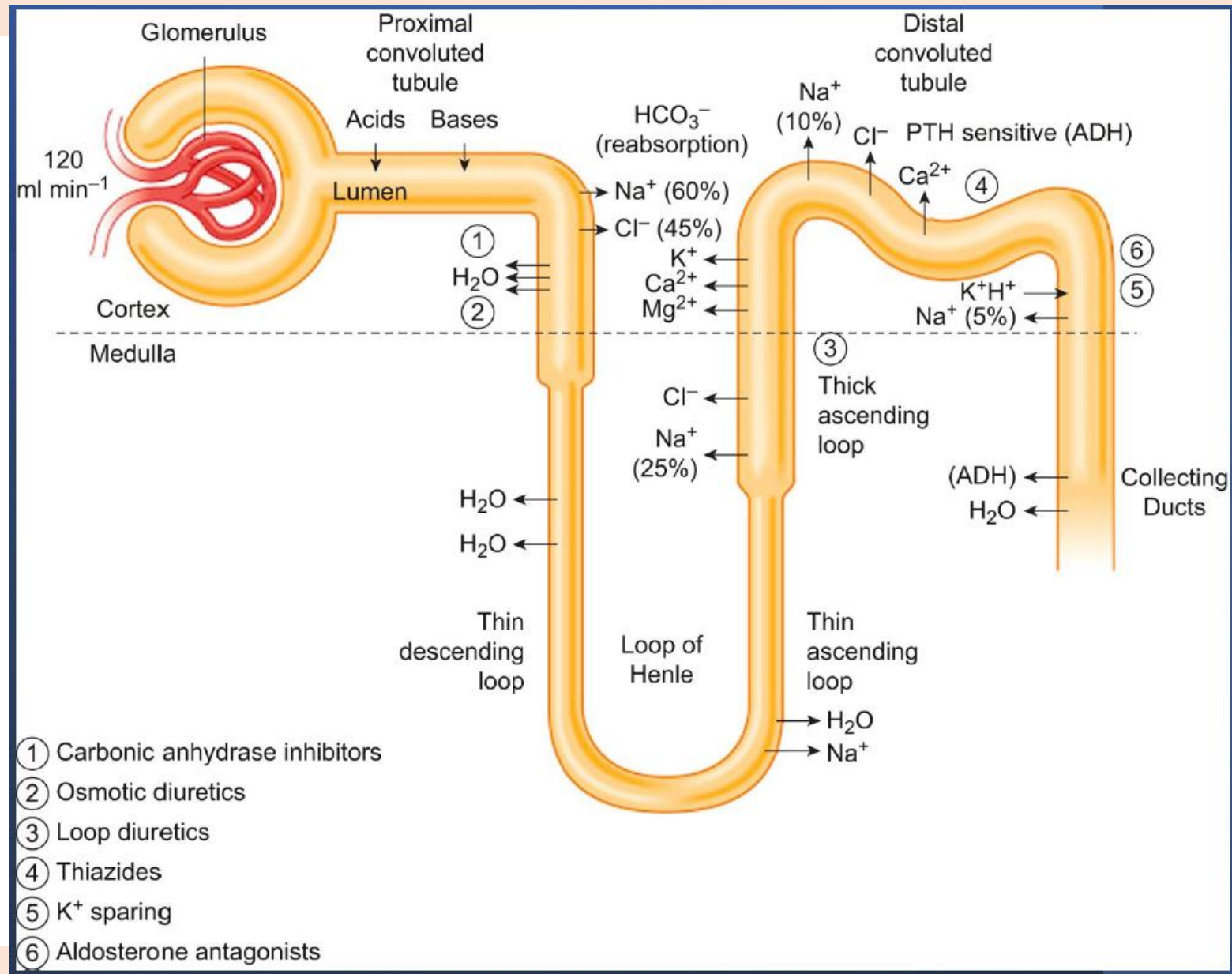
Kidney



Single Nephron

# Functions of the kidney

- Filtration of Blood
- Regulation of Blood Pressure
- Electrolyte Balance
- Acid-Base Balance
- Erythropoiesis Regulation
- Detoxification



# Diuretics

## Classes of diuretics – Mechanism and sites of action

| Medication  | Mechanism of Action   | Site of Action                |
|---|---|-------------------------------|
| <b>Loop diuretics</b> (e.g. frusemide, bumetanide)                                | Inhibit $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ symport (NKCC2)         | Thick ascending loop of Henle |
| <b>Thiazide diuretics</b> (e.g. hydrochlorothiazide, indapamide)                  | Inhibit $\text{Na}^+/\text{Cl}^-$ symport                             | Distal convoluted tubule      |
| <b>Potassium-sparing diuretics</b> (aldosterone antagonists, e.g. spironolactone) | Aldosterone antagonists   | Collecting duct               |
| <b>Pteridine derivatives</b> (e.g. amiloride)                                     | Inhibit $\text{Na}^+$ entry through epithelial sodium channels (ENaC) | Collecting duct               |
| <b>Carbonic anhydrase inhibitors</b> (e.g. acetazolamide)                         | Inhibit carbonic anhydrase  | Proximal convoluted tubule    |
| <b>Osmotic diuretics</b> (e.g. mannitol)  | Increase in tubular fluid osmolality                                  | Proximal convoluted tubule    |

## Thiazide & related anti-diuretics

- **MOA:** inhibit reabsorption of Na & Cl
- **Dental implications**
  - NSAIDs: may reduce renal function

## Potassium sparing diuretics

- **MOA:** inhibit reabsorption of Na in the distal tubule
- **Dental implications**
  - NSAIDs: may increase risk for hyperkalemia & reduce renal function
  - Dry mouth

| Generic name        | Brand Name |
|---------------------|------------|
| Hydrochlorothiazide | Dithiazide |
| Chlorthalidone      | Hygroton   |
| Indapamide          | Natrilix   |

| Generic name | Brand Name                               |
|--------------|--|
| Amiloride    | Kaluril                                  |
| Triamterene  | Only available w/<br>hydrochlorothiazide |

## Aldosterone antagonists

- **MOA:** antagonize Aldosterone → inhibit Na absorption in distal tubule
- **Dental implications**
  - Orthostatic hypotension & drug interaction w/ NSAIDS

## Loop diuretics

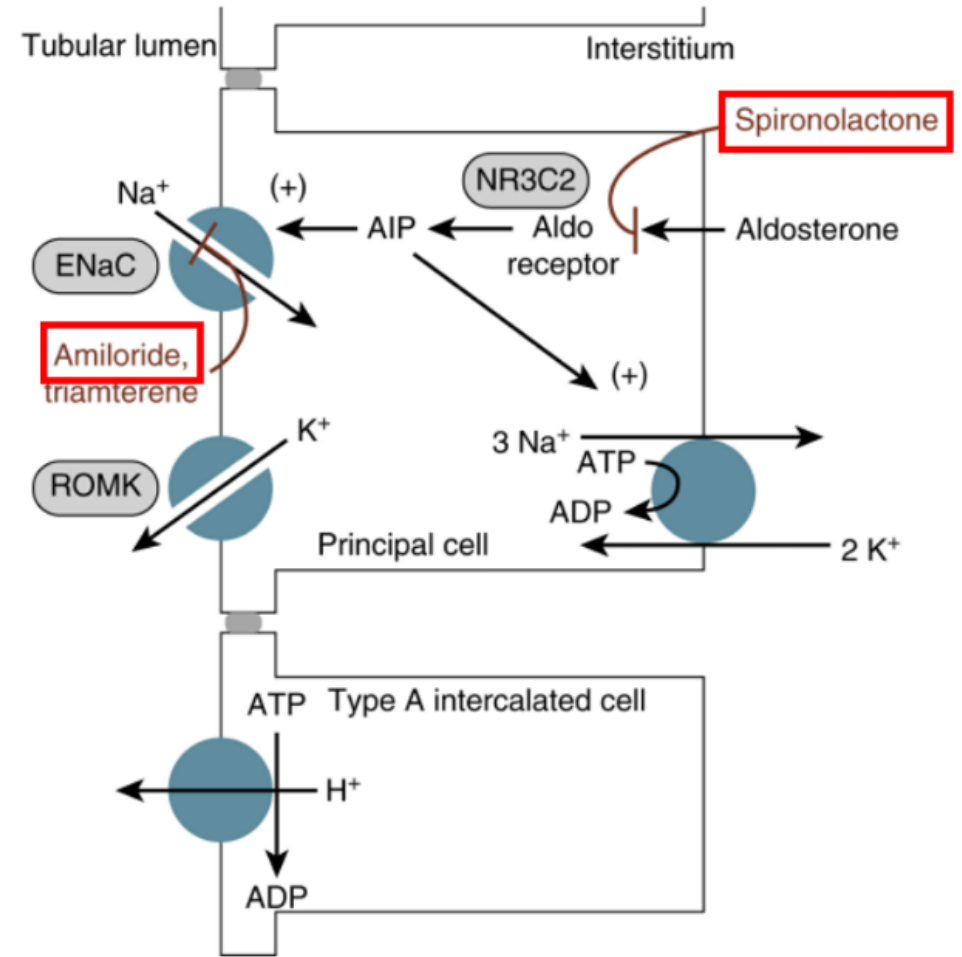
- **MOA:** inhibit reabsorption of Na & Cl in ascending limb of loop of Henle
- **Dental implications**
  - Orthostatic hypotension & drug interaction w/ NSAIDS


| Generic name | Brand Name              |
|--------------|-------------------------|
| Eplerenone   | Inspra                  |
| Spirolactone | Aldactone,<br>Spiractin |

| Generic name    | Brand Name  |
|-----------------|-------------|
| Bumetanide      | Burinex     |
| Ethacrynic acid | Edecrin     |
| Frusemide       | Lasix, Urex |

# Potassium sparing effect

- *Retention of K while promoting the excretion of sodium and water*
  - *Prevent potassium loss*
- AIP – Aldosterone-induced protein
- ROMK - Renal outer medullary potassium channel
- NR3C2 - Nuclear hormone receptor
- Both Amiloride and Spironolactone lead to mild natriuresis with a K<sup>+</sup> sparing effect
- Adverse effect = Hyperkalemia





## Diuretics Dental implications

- **K<sup>+</sup> imbalance**
  - Hypo and Hyperkalemia → More prominent in thiazide and loop diuretics
- **Cardiac precautions e.g. Local anesthetic w/ adrenaline**
  - Ensure safe delivery of LA
- **Triple whammy:** consider other drugs w/ adverse renal effects (NSAIDs)
- **Dry mouth (Xerostomia)**
  - Dental caries
  - Difficult swallowing (Dysphagia)
  - Taste alteration (Dysgeusia)

# Chronic kidney disease

- **Chronic Kidney Disease (CKD)** is a progressive condition
- **Risk factors:** diabetes, Hypertension, History of kidney disease
- **Drug therapy**
  - Anti-hypertensives
  - Diuretics
  - Phosphate binders
  - Vitamin D
  - Erythropoietin injection and iron

# Chronic kidney disease

**Table 1 - Relationship between glomerular filtration rate and stage of chronic kidney disease\***

| Kidney function stage | eGFR (mL/min/1.73 m <sup>2</sup> ) |
|-----------------------|------------------------------------|
| 1                     | ≥90                                |
| 2                     | 60–89                              |
| 3a                    | 45–59                              |
| 3b                    | 30–44                              |
| 4                     | 15–29                              |
| 5                     | <15 or on dialysis                 |



## Renal disease Dental implications

- **Compromised kidney function**
  - Impaired drug metabolism, bleeding risks, susceptible to infections
- **Altered drug clearance**
  - Prolonged effect/toxicity
- **Altered platelet function**
  - Bleeding risks: monitor use of NSAIDs
- **Weakened immune response**
  - Educate OH and preventative dental tx
- **Renal osteodystrophy**
  - Weakened bones: jaw?

## Renal disease Dental implications

- If patients are taking high doses of corticosteroids for a long duration of time [i.e. *polymyalgia rheumatica*]
  - Schedule the dental session in the morning
- Try to avoid nephrotoxic medications → If necessary → Dose / Frequency adjust
  - **NSAID** - Can cause bleeding tendencies
  - **Aspirin** - Increases platelet dysfunction
- LA, paracetamol, codeine

# Benign prostatic hyperplasia

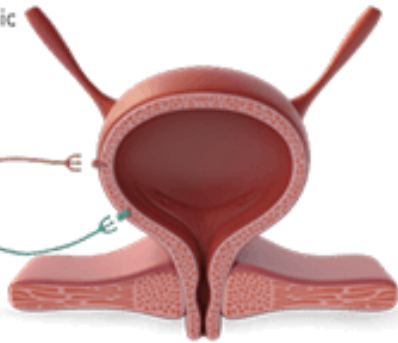
- Non-cancerous enlargement of the prostate gland
- The prostate surrounds the urethra, and as it enlarges → compress the urethra → urinary symptoms
- Driven by hormonal changes
  - Increase in dihydrotestosterone (DHT) levels → LUTS
    - Frequent urination (especially at night)
    - Difficulty starting urination
    - Weak urine stream
    - Incomplete bladder emptying
    - Urgency to urinate
- $\alpha$ 1-adrenoceptor antagonists
  - Smooth muscle relaxation → urinate

# Incontinence

- **Neurogenic Bladder:** this condition refers to bladder dysfunction that results from a neurological impairment. It can affect bladder control and the ability to store or void urine properly
- **Incontinence:** this is the inability to control urination, leading to involuntary leakage of urine
- **Oxybutynin:** muscarinic receptor antagonist, reduce involuntary contractions of bladder muscle [Anticholinergic effect - Dry mouth]

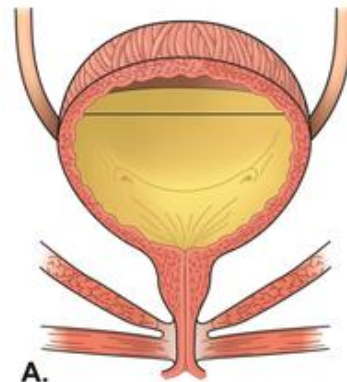
**M<sub>3</sub> (muscarinic) receptor**  
Activating the muscarinic receptors contracts the bladder detrusor muscle to mediate bladder emptying<sup>2</sup>

**Beta-3 receptor**  
Activating the beta-3 adrenergic receptors relaxes the bladder detrusor muscle to increase capacity<sup>1-3</sup>



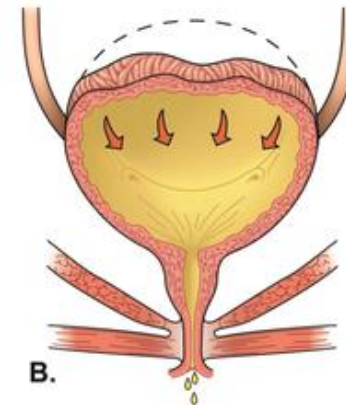
For illustrative purposes only.

Normal



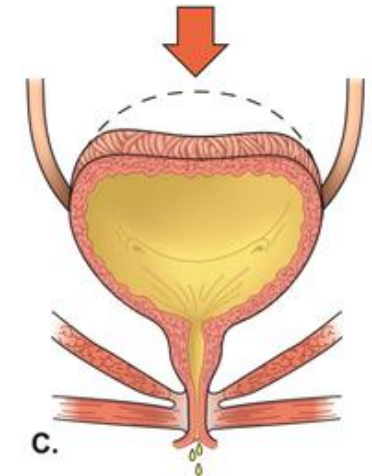
A. The bladder stays relaxed and the urethra stays contracted and closed until the patient is ready to void.

Urgency Incontinence



B. Bladder muscle contracts before the patient is ready to void.

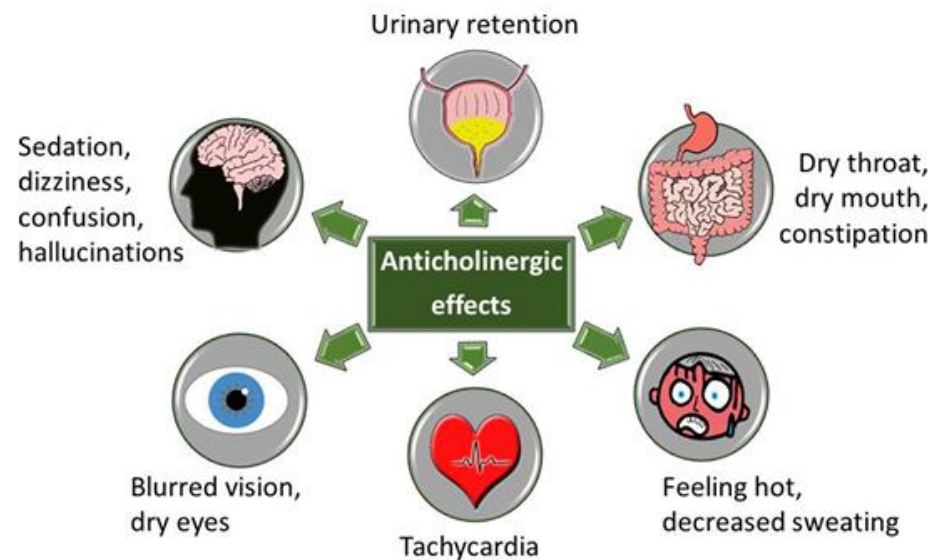
Stress Incontinence

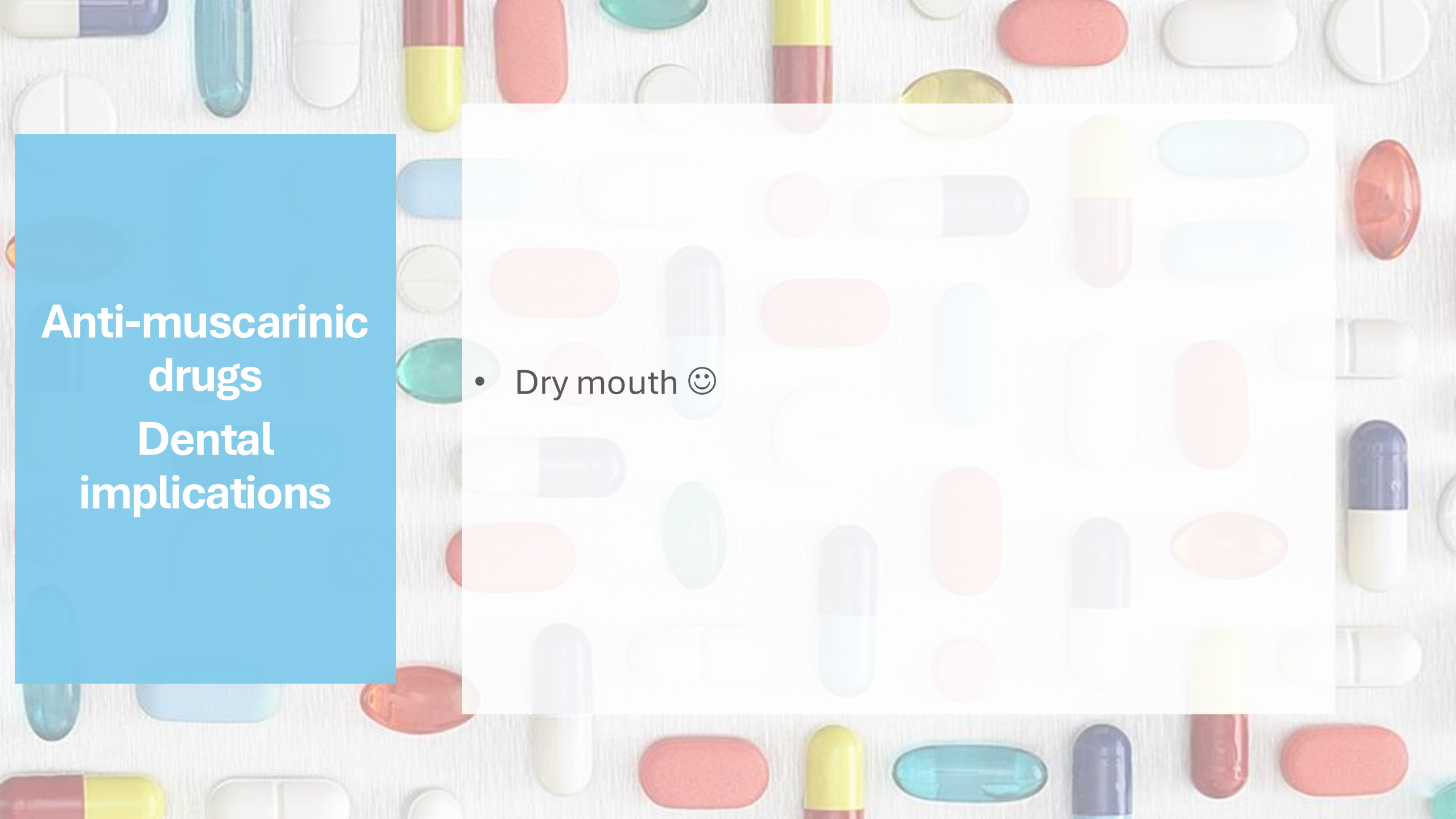


C. Urethra is too weak to stay closed during increased intra-abdominal pressure.

# Anti-muscarinic medications

- Competitive antagonists of acetylcholine at muscarinic receptors – reduction in parasympathetic activity
- Dental relevance = Dose-dependent effect → Salivary secretion is reduced
- Symptoms
  - Unpleasant dryness
  - Difficulty swallowing
- Examples
  - Oxybutynin
  - Atropine
  - Scopolamine
  - Ipratropium
  - Benztropine





# Anti-muscarinic drugs Dental implications

- Dry mouth 😊

## References

- Ritter JM, Flower RJ, Henderson G, Loke YK, MacEwan D, Robinson E, editors. *Rang & Dale's pharmacology*. 10th ed. Edinburgh: Elsevier; 2023
- Australian Medicines Handbook Online [Internet]. Adelaide (AU): Australian Medicines Handbook Pty Ltd;2000. Cardiovascular, Genitourinary; [updated 2025; cited 2025]. Available from: UWA Onesearch
- Pharmaceutical Society of Australia. *Australian Pharmaceutical Formulary and Handbook: A Guide to Best Practice*. 25th ed. Canberra: Pharmaceutical Society of Australia; 2021
- Ali K. *Clinical dental pharmacology*. 1st ed. Oxford: Wiley-Blackwell; 2023
- Bullock S, Manias E. *Fundamentals of pharmacology*. 8th ed. Frenchs Forest, NSW: Pearson Australia; 2017
- MIMS Australia. *eMIMSElite: Consumer medicine information, specific clinical monograph* [Internet]. Sydney: MIMS Australia; [updated 2025; cited 2025 Apr 17]. Available from: UWA Onesearch

