

Drug	Effects & Metabolism	Clinical uses & Contraindications	ADRs & abnormalities
<b>1-Parathyroid Hormone</b>	<b>1-Bones</b> Mobilization of $\text{Ca}^{2+}$ and $\text{PO}_4^{3-}$ from bone, by stimulating osteoclasts (increase Ca levels) <b>2-Kidneys:</b> <ul style="list-style-type: none"> <li>↑ <math>\text{Ca}^{2+}</math> reabsorption</li> <li>↑ formation of calcitriol (1,25-dihydroxycholecalciferol) which is the active form of vitamin D</li> </ul> <b>3-GIT:</b> ↑ absorption of $\text{Ca}^{2+}$ (effect mediated via stimulation of the enzyme responsible for converting vitamin D to its active form)	Treatment of <b>severe osteoporosis</b> - Cases failed to respond to other medications (not 1 <sup>st</sup> line)	
<b>2-Teriparatide</b> ✓ Synthetic polypeptide PTH analogue. <b>Bone forming drug: it acts mainly on osteoblast: increase bone formation and density.</b> ✓ Given, once / daily / subcutaneous injection ✓ Affect calcium homeostasis	Used to treat severe cases osteoporosis in people who have a risk of getting fracture (increase bone mass & strength) ✓ <b>Should not be used by people with increased risk for bone tumors (osteosarcoma)</b> - because it has high incident of forming bone tumor - including : - People with <b>Paget's disease</b> of bone. (Elevated serum <b>alkaline phosphatase</b> ) - People who had radiation treatment involving bones. - Elevated serum <b>alkaline phosphatase</b>		<ul style="list-style-type: none"> <li>Diarrhea, heart burn, nausea</li> <li>headache, leg cramps</li> <li>Hypotension when standing can occur.</li> <li>Elevated serum calcium can occur in some cases can lead to kidney stones</li> </ul>
<b>3-Vitamin D</b> <ul style="list-style-type: none"> <li>Refers to cholecalciferol (vitamin D3) &amp; ergocalciferol (vitamin D2).</li> <li>Vitamin D2 is the prescription form of vitamin D &amp; is also used as food additive.</li> <li>Vitamin D3 is usually for vitamin D-fortified milk &amp; foods &amp; also available in drug combination products.</li> </ul>	<ul style="list-style-type: none"> <li><b>Bone:</b> Activation of osteoblast cells</li> <li><b>Kidney:</b> Increased reabsorption of <math>\text{Ca}^{2+}</math> &amp; <math>\text{PO}_4</math>.</li> <li><b>GIT:</b> Increased absorption of <math>\text{Ca}^{2+}</math></li> </ul> <p>The initial transformation of D3 occurs in liver to 25-(OH)D3 (calcifediol)  In the kidney: <b>parathyroid hormone</b> stimulates the formation of active form of vitamin D (calcitriol) {1,25-(OH)<sub>2</sub> D3}</p>	<b>Sources of Vitamin D</b> Diet : ✓ <b>D2</b> milk, egg yolk, fish oils ✓ <b>Sunshine:</b> Cholecalciferol (D3) : Generated in the skin from <b>7-dehydrocholesterol</b> by the action of ultraviolet radiation (sunshine).	✓ <b>A deficiency of Vitamin D in adults causes Osteomalacia. In children it is called Rickets.</b>
<b>4-Calcitonin</b> <ul style="list-style-type: none"> <li>Produced by the parafollicular cells (C cells) of the thyroid gland. It is released when there is an elevated level of <math>\text{Ca}^{2+}</math> in the blood.</li> <li>calcitonin salmon: synthetic form given by nasal spray</li> </ul>	<ul style="list-style-type: none"> <li><b>Bone:</b> Decrease bone resorption by inhibiting osteoclast activity</li> <li><b>Kidney:</b> Decreases reabsorption of <math>\text{Ca}^{2+}</math> &amp; <math>\text{PO}_4</math>, thus increasing their excretion</li> </ul>	<ul style="list-style-type: none"> <li>Osteoporosis</li> <li>Hypercalcemia</li> </ul>	<ul style="list-style-type: none"> <li>Nausea</li> <li>local inflammation (injection)</li> <li><b>Flushing of face &amp; hands</b></li> <li>Nasal irritation (Nasal spray)</li> </ul>

## Summary

- The principal factors involved in calcium metabolism & bone remodeling are: **parathyroid hormone ( PTH), teriparatide, calcitonin, and vitamin D** . And they are targeting **bone, kidney, and intestine**.
- **Parathyroid hormone** is released from the parathyroid gland in response to **low plasma  $\text{Ca}^{2+}$  level**. It causes mobilization of  $\text{Ca}^{2+}$  and  $\text{PO}_4^{3-}$  from bone, it stimulates osteoclast cells to increase the outward flux of calcium , increase  $\text{Ca}^{2+}$  reabsorption and formation of **calcitriol** in the kidney, and increase absorption of  $\text{Ca}^{2+}$  from GIT in order to restore **serum calcium level**.
  - **Daily , intermittent administration of PTH for 1 to 2 hours / day leads to a net stimulation of bone formation , while continuous exposure to elevated PTH leads to bone resorption.**
  - **It used in Treatment of** severe osteoporosis - Cases failed to response to other medications.
- **Teriparatide** : Synthetic polypeptide PTH analogue
  - **Used to treat osteoporosis in people who have a risk of getting fracture ( increase bone mass & strength )**
  - **Side effects** : Diarrhea, heart burn, nausea , headache, leg cramps ,hypotension when standing can occur, **and kidney stones due to elevated serum calcium.**
  - **Should not be used by people with increased risk for bone tumors (osteosarcoma)** e.g :people with **Paget's disease** or who had radiation treatment involving bones.
- **Vitamin D** : Refers to cholecalciferol ( vitamin D3) & ergocalciferol ( vitamin D2) .
  - The initial transformation of D3 occurs **in liver** to  $25\text{-(OH)D}_3$  ( calcifediol ) . **In the kidney:** parathyroid hormone stimulates the formation of active form of vitamin D (calcitriol) {  $1,25\text{-(OH)}_2\text{D}_3$  }
  - **It Activates osteoblast cells**, increases **reabsorption of  $\text{Ca}^{2+}$  &  $\text{PO}_4$**  from **the kidney**, and Increases absorption of  $\text{Ca}^{2+}$  in GIT
- **Calcitonin** produced **by the parafollicular cells (C cells)** of the thyroid gland . It is released when there is an **elevated level of  $\text{Ca}^{2+}$**  in the blood. **Calcitonin salmon** : synthetic form given by nasal spray
  - It decreases bone resorption by **inhibiting osteoclast activity** , and decreases reabsorption of  $\text{Ca}^{2+}$  &  $\text{PO}_4$  from the kidney , thus increasing their excretion
  - Used in **Osteoporosis and hypercalcemia**
  - **Its common SE is flushing of face & hands**