Calcitonin

Source: light (C, parafollicular) cells of the thyroid

Secretion: regulated by plasma $[Ca^{2+}]$; increase in $[Ca^{2+}]$ stimulates release

Actions
- Receptors present in kidneys, bones, etc.
- Promotes calcification of osseous tissue by inhibiting osteoclasts
- Inhibits gastric motility and gastrin secretion
- Inhibits intestinal absorption of Ca and phosphate
- Inhibits renal 1α-hydroxylase activity

Vitamin D_3 (cholecalciferol)

Sources: (i) food, (ii) synthesised in skin from 7-dehydrocholesterol

Chemistry
- Vitamin D and its derivatives are steroids
- Vitamin D hydroxylated at C_{25} in the liver (calcidiol): t½ = 15 h
- 25-OHD_3 hydroxylated at C_1 in kidney → 1,25-$(OH)_2D_3$ (calcitriol): t½ = 15 d
- 1α-hydroxylase activated by parathormone

Actions
- Stimulates Ca^{2+} and phospate absorption from intestine
- Promotes reabsorption of Ca^{2+} and phosphate from renal tubules
- Normal concentrations of the vitamin promotes calcification
- High doses of the vitamin stimulates bone resorption

Clinical conditions
- Avitaminosis D
  - rickets in children, osteomalacia in adults
  - plasma calcium and phosphate levels are ↓
  - newly-formed osteoid tissue fails to calcify
  - skeletal malformation, pain, muscle weakness
- Hypervitaminosis D
  - cause: therapeutic and biosynthetic excesses
  - characterised by hypercalcaemia, hyperphosphataemia, anorexia, calcification of soft tissues, etc.

Bone physiology

Definition of bone: living, calcified osteoid tissue

Functions of bones
- Support the body and act as levers for muscles
- Protect vital organs: brain, heart, etc.
- Involved in maintaining acid-base balance
- Help to maintain calcium homeostasis

Embryology
- Bone formation: intramembranous and endochondral mechanisms
- Linear growth of long bones occurs at epiphysial cartilage

Structure
- Organic material
  - collagen: rich in hydroxyproline
  - ground substance: hyaluronic acid, etc.
  - osteoblasts synthesise collagen, matrix, etc.
  - osteocytes (resting osteoblasts) cause osteolysis
  - osteoclasts degrade bone; activated by PTH
- Inorganic material
  - hydroxyapatite (98 %) and $CaHPO_4$ (2 %)
  - $CaHPO_4$ readily exchangeable
  - other minerals: Na, Mg, K, etc.

Bone formation: promoted by GH, vitamin D, calcitonin, PTH, T_3 and T_4, insulin, etc.

Osteoporosis
- Definition: loss of bone while mineral to matrix ratio is maintained
- Causes
  - idiopathic type: most common, e.g. post menopausal type
  - secondary type: caused by excess corticoid hormones, etc.
- Plasma Ca, Pi, and alkaline phosphatase levels normal
- Clinical history: spontaneous fractures and morbidity
- Prevention: physical activity, oestrogen, and adequate Ca-intake delay onset