# Hypocalcemia

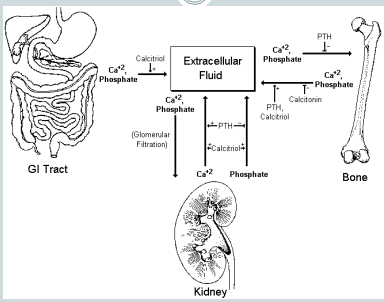
## Normal value

- Serum calcium

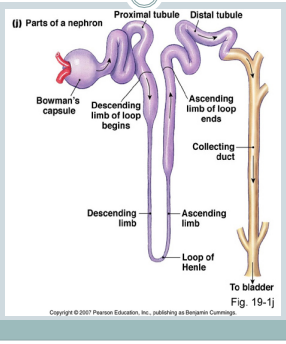
| | Total mg/dl | Ionized mg/dl |
|---|---|---|
| Cord blood | 9.0 ~ 11.5 | 5.0 ~ 6.0 |
| New born (1st 24 hrs) | 9.0 ~ 10.6 | 4.3 ~ 5.1 |
| 24~ 48 hrs | 7.0 ~12.0 | 4.0 ~4.7 |
| Child | 8.8 ~10.8 | 4.8 ~4.92 |
| There after | 8.4 ~10.2 | 4.8 ~4.92 |

## Physiologic functions

- Blood coagulation
- Cellular communication
- Exocytosis / endocytosis
- Muscles contraction
- Neuromuscular transmission

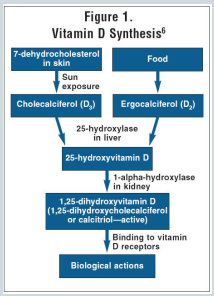


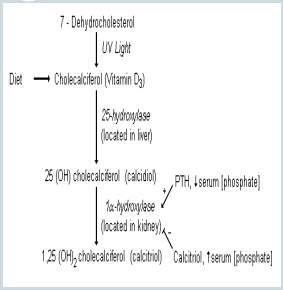

## Nephron – a functional unit of kidney




## Influencing factors in Calcium and Phosphate Balance

- Calcitriol (1,25 dihydroxycholecalciferol - active form of vitamin D3)
- Parathyroid hormone (PTH)




- 1,25(OH)2D increases intestinal calcium absorption and helps maintain normal serum calcium levels.
- When dietary calcium is low and, therefore, intestinal calcium absorption is low, 1,25(OH)2D also binds to osteoblasts, thereby increasing osteoclast activity and causing the release of skeletal calcium

## Role of Calcitriol

- Stimulates GI absorption of both calcium and phosphate
- Stimulates renal reabsorption of both calcium and phosphate
- Stimulates bone resorption

Net effect of calcitriol → ↑ serum calcium
↑ serum phosphate

## Role of PTH

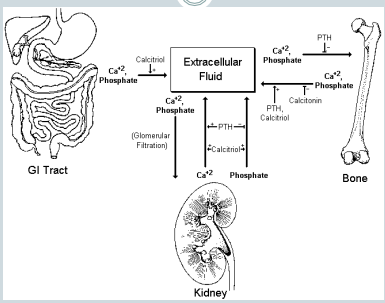
- Stimulates renal reabsorption of calcium
- Inhibits renal reabsorption of phosphate
- Stimulates bone resorption
- Inhibits bone formation and mineralization
- Stimulates synthesis of calcitriol

Net effect of PTH → ↑ serum calcium
↓ serum phosphate

## Regulation of PTH

- Low serum [Ca+2] -> Increased PTH secretion
- High serum [Ca+2] -> Decreased PTH secretion

## Overview of Calcium-Phosphate Regulation

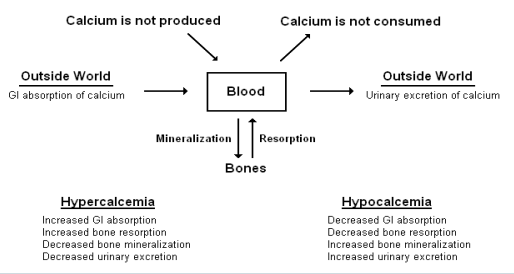


## Different Forms of Calcium

- Calcium in the plasma:
- 45% in ionized form (the physiologically active form)
- 45% bound to proteins (predominantly albumin)
- 10% complexed with anions (citrate, sulfate, phosphate)

- To estimate the physiologic levels of ionized calcium in states of hypoalbuminemia:
- [Ca+2]Corrected = [Ca+2]Measured + [ 0.8 x (decrease in albumin concentration below normal in g/dl)]

## Overview of Calcium Balance




## Etiologies of Hypocalcemia

Decreased GI Absorption
- Poor dietary intake of calcium
- Impaired absorption of calcium
  - Vitamin D deficiency
    - Poor dietary intake of vitamin D
    - Malabsorption syndromes
  - Decreased conversion of vit. D to calcitriol
    - Liver failure
    - Renal failure
    - Low PTH
    - Hyperphosphatemia

Decreased Bone Resorption/Increased Mineralization
- Low PTH (hypoparathyroidism)
- PTH resistance (pseudohypoparathyroidism)
- Vitamin D deficiency / low calcitriol
- Hungry bones syndrome
- Osteoblastic metastases

Increased Urinary Excretion
- Low PTH
  - thyroidectomy
  - Autoimmune hypoparathyroidism
- PTH resistance
- Vitamin D deficiency / low calcitriol

## Hypocalcemia

- Serum calcium < 8 mg/dl or
- Ionized calcium < 4 mg/dl

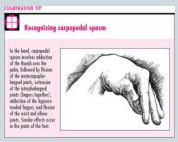
## Causes ( O P Ghai)

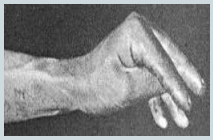
- Vit D deficiency
  - Malnutrition
  - Malabsorption
  - Abnormal metabolism
  - Prolong phenytoin therapy
- Increase losses
  - Idiopathic hypercalciuria
  - Renal tubular acidosis
  - Frusemide therapy
  - Prolonged corticosteroid therapy

- Metabolic
  - Hypoparathyroidism (Low PTH)
  - Pseudohypoparathyroidism (PTH resistance )
  - Hypomagnesemia
  - hyperphosphatemia
- Others
  - Hypoproteinemia
  - Acute pancreatitis
  - Prematurity
  - IDM
  - High phosphate milk ingestion

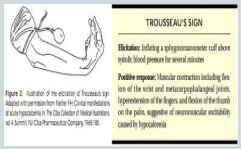
## Clinical features

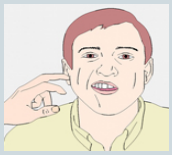
- Tetany ( a classic manifestation)
  - Carpopedal spasms – wrist flexed, fingers extended, thumbs adducted over palms / feet extended and adducted, toes planter flexed
  - Laryngospasm – spasmodic closure of the vocal cord producing expiratory stridor
  - Seizures – brief and recurrent, usually generalized
- Jitteriness
- Paresthesias – perioral, hands and feet



- Trousseau sign
  - A blood pressure cuff is inflated slightly above the systolic pressure for more than 3 minutes; carpopedal spasm occurs if hypocalcemia is present as a result of ischemia of motor nerves
- Chvostek sign
- Tapping the facial nerve anterior to the external auditory meatus elicits a twitch of the upper lip or entire mouth
- ECG
  - Prolong QT interval, prolong ST interval, peaked T wave, heart block



## Management

- Symptomatic hypocalcaemia
  - 100 – 200 mg / kg calcium gluconate (1 – 2 ml / kg of 10% calcium gluconate; 9 – 18 mg of elemental calcium) in 5 – 10 mins under cardiac monitoring (can be repeated every 8 to 6 hours)
- Calcium supplementation
  - Calcium carbonate, calcium gluconate, calcium glubionate – 50 mg/kg/day in 3 - 4 divided doses

- In certain situations like
  - Pancreatitis – complete correction of hypocalcaemia should be avoided because resolution of primary problem will release Ca from complexed calcium
  - Hypocalcaemia with acidemia – first correct hypocalcaemia if possible because acidemia increases ionized calcium concentration by displacing calcium from albumin. Correction of acidemia will decrease ionized calcium.

## Hypercalcaemia

- Causes
  - Parathormone excess
    - Parathyroid adenoma
    - Parathyroid hyperplasia
    - Transient neonatel hyperparathyroidism
  - Vit D excess; hypervitaminosis A
  - Sarcoidosis
  - William' s syndrome
  - Subcutaneous fat necrosis
  - Thyrotoxicosis
  - Prolonged immobilization

## Clinical features

- Urinary stones with colic and hematuria
- Nephrocalcinosis – deposition of Ca in renal parenchyma
- Bony changes – fractures, deformity etc
- Severe hypercalcaemia - coma

## Management

- Forced saline diuresis with frusemide or peritoneal dialysis
- Biphosphonates – modality of treatment in children
- Pamidronate and etidronate – in hypercalcaemia due to maligancy, immobilization and hyperparathyroidism
- Surgical