**Figure 12.25 Page: 169**

Parathyroid hormone and calcitonin: as calcium rises, the concentration of parathyroid hormone falls while that of calcitonin rises (antagonistic interaction)

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Point #3 We already have an idea about calcitonin, it is secreted from thyroid gland (parathyroid follicular cells, also called c-cells)

Point #2 Peptide hormone (protein hormone) the biological activity resides in the central region of the hormone, it means if only the central region remains, the hormone will still function.

Point #4 & 5calcitonin decreases calcium level by antagonism the action of pth on bone, calcitonin is also present in the nervous system (neuro-modulator)

Point #6 The major stimulus for calcitonin secretionis a rise from plasma calcium.

Point #7 The hypocalcuim action is caused by inhibition of both osteocytic ,osteolysis& osteoclastic bone resorption when these are stimulated by PTH.

Point #8 the action of calcitonin on phosphate is similar to the PTH.

Point #9 the importance of CT in humans is controversial

CT deficiency doesn’t lead to hypocalcaemia & CT hyper secretion doesn’t produce hypocalcaemia. It may be that abnormal CT secretion is easily compensated for the adjustment in PTH & vitamin D.

Why doesn't CT deficiency lead to hypocalcaemia& CT hyper secretion doesn’t produce hypocalcaemia? If calcitonin concentration differs & even if it was removed totally ,adjustment will occur to pth& vitamin D, nothing will happen to the calcium concentration.(prevention hormone: prevent the release of calcium from the bone),that’s why in medication dose not function that much.

Point #10 Is degraded within the liver & kidney.

**Figure 12.7 Page: 171**

As you see ,the function of calcitonin :

on the bone decreases the calcium release from the bone

in plasma decrease plasma calcitonin

on the kidney increases urine secretion of calcium & phosphate ,the result decrease plasma calcium level & plasma phosphate level.

Function of phosphate :

**Table 27-2 Page: 175**

1.part of the intracellular buffer system.

2.important constituent of a variety of macromolecules ,such as nucleic acids,phospholipids,metabolic intermediates and phosphoprotiens.

3.constituent of bone : how much of phosphate in the bone ?

Q) How much calcium in the bone ? 99%

**Figure 51-3 page: 174**

If phosphate level decreases what happens?

1-PTH decreases thus calcium and phosphate concentration is affected.

2- 1-alpha hydroxylase in the kidney is also affected it increases thus 1,25 increases so calcium as well as phosphate are reabsorbed in the intestines.

3-Ca & PO4 resorption in bone increases.

\*PTH is inhibited ,alpha hydroxylase is activated\*

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1-Calcium , phosphate& magnesium homeostasis are essential for health & life. A complex system acts to maintain normal body contents & extracellular fluid level of these minerals in the face of environmental & internal changes.

2-The key elements in the system are vitamin D ,PTH ,calcitonin & **other hormones**

Q) Which of these **other hormones** do you think are relatively important? Answer: GH, insulin & prolactin also plays a role.

3- GIT ,kidney ,skeleton, skin& liver are involved in homeostasis of calcium, phosphate &magnesium.

**Page: 179**

Rickets & poliomyelitis(viral disease) are diseases that affect children's limbs.

Rickets occurs mainly in children due to calcium or phosphate deficiency in the extracellular fluid, and also as lack of vitamin D which is stored in the liver & Adipose tissue.

Rickets appears in spring season because child loses the stored vitamin D during autumn & winter months.

Rickets is very rare nowadays because there are no kids that stay at home (indoors) all the time.

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Rickets in adults is called Osteomalacia.

Normal adults rarely have a serious dietary deficiency of vitamin D or calcium because large quantities of calcium are not needed for bone growth as in children.

However, serious deficiency of vitamin D and calcium occasionally occurs as a result of steatorrhea\*(failure to absorb fat), for vitamin D is fat-soluble, and calcium tends to form insoluble soaps with fat consequently, in steatorrhea both vitamin D & calcium tend to pass into the feces. Under these conditions an adult occasionally has such poor calcium and phosphate absorption that adult rickets can occur, though this almost never proceeds to the stage of tetany-but very often is a cause of severe bone disability.

\*Steatorrhea is a kind of severe diarrhea so there is no time to absorb vitamin D or calcium.

**Table 36.3 Page: 178**

Causes of osteomalacia&rickets:they are catabolized in 3 classes:

1-Inadequate availability of vitamin D

2-Defects in metabolic activation of vitamin D

3-Impaired action of l ,25- dihydroxycholecalciferol on target tissues.

The points mentioned above are mainly the general causes of rickets and osteomalacia.

**Page: 180**

Osteoporosis is a very serious, important & dangerous disease , the most common diseases in adults ,the most common of all bone diseases in adults and especially in old age.It is different disease from osteomalacia and rickets, for it results from diminished organic matrix rather than abnormal bone calcification. usually, in osteoporosis the osteoblastic activity in the bone is less than normal, and consequently the rate of bone deposition is depressed(pathological conditions in liver ,kidney or thyroid & parathyroid glands)so it’s a problem in deposition of organic materials in the bone.

**Page: 181**

1. Lack of physical stress the bones because of on inactivity.

🡪women above age of 30 are advised to be active

2) Malnutrition to the extent that sufficient protein matrix cannot be formed.

3) Lack of vitamin C (very important)

4) Postmenopausal lack of estrogen secretion.

5) Old age, in which many of the protein anabolic functions are poor.

6) Cushing's disease.

7) Acromegaly.

\*Strategies to prevent the development of osteoporosis begin in pre meno-puase(age of 40's) :  
 1) high calcium intake

1. Consistent of weight bearing exercises.

both are widely recommended & very important.

\*One of our beloved professor's relatives got a hip bone fracture (commonest) while playing tennis ,he was overweight & may had osteoporosis.

\*Pharmacological agents are now available for preventing or at least retarding the development of osteoporosis or for treating the disease once it had been established.

In general these drugs go into different classes:

1. Antiresoptive drugs similar to the action of calcitonin (drugs that work to decrease the release of calcium from the bone),but it doesn’t function that much.
2. Drugs that stimulate bone formation, the most common drug that is useful is estrogen.

Estrogen has many advantages for osteoporosis & for the look of females.

Calcitonin is generally offered for women who can't or unwilling to get estrogen but doesn’t function that much.

Another class of drugs is 3) Phosphonates they are becoming popular,these drugs are powerful inhibiter to bone reabsorption but some of the first agents discovered are found to impair mineralization (prevent it), but now they found new phosphonate drugs that are against reabsorption but do not prevent mineralization.

\*Vitamin D is one of the drugs that can stimulate bone formation,often given as 1,25 combined with calcium.

\*PTH is recently available as an injectable treatment for osteoporosis that stimulates osteoblastic formation & increase bone mass.

PTH increases the activity of the bone (release & formation of bone).

**Figure 37.1 Page: 182**

PANCREAS IS VERY IMPORTANT GLAND.

PANCRASE has endocrine & exocrine functions.

Its enzymes are the most important,they affect protein ,carbohydrate & fat ,the only enzymes that affect all food contents.

Pancrease has a sinus,Hormone secretion.

There is a coordination between hormone & enzyme secretion specially insulin &glucagon

The enzymes & hormones are activated by nutrients & gastrointestinal hormones.

Hormones & substrates are released into portal vein then transferred into the liver. In the liver the substrates are affected by the hormones ,after that transferred to the peripheral tissues to feed back the release of the hormones.

**Table 19-1** **Page:184**

These are major cell types in the islets of Langerhans .

Langerhans islets are 2% of the volume of pancreas.

F cells secrete pancreatic polypeptide some books call them PP cells.

A cells(20%) secrete Glucagon

B cells(75%) secrete proinsulin ,insulin & amylin.

D cells secrete somatostatin

Epsolin cells secrete ghrelin (first of discoveries of stomach cells)

**Figure 34.1 Page 183**Pre clinical data indicate that amylin act as a new endocrine hormone that complement the action of insulin in post cardial glucose homeostasis ,several mechanisms include suppression of post cardial glucagon secretion & slower the rate at which nutrients are delivered to the small intestine ,that’s for amylin.

Ghrelin also stimulates a peptide contributed to the mass & growth.(from stomach & pancreas has the same function).

**Figure78.2 Page:186**

\*B cells secrete 1)proinsulin (insulin connected to c-peptide),2)insulin& 3)c-peptide.

\*The activity of pro insulin is 10% of insulin which is very low.

\*c-peptide has no activity.

\*proinsulin has 2 chains: alpha 21a.a & beta 30a.a,the active is B chain ,it has very short half life 6 minutes.

\*Alpha & beta chains are connected via disulfide bridges.

\*Insulin is first secreted into the liver as well as c-peptide.

\*All these products are secreted first into the liver.

\*The liver retains 50-60% of insulin, the remain is released into the blood but it doesn’t retain the c-peptide.

\*If we want to estimate the production of insulin from b cells ,we estimate the concentration of c-peptide because the amount of c-peptide is equal to the amount of insulin,but insulin 50-60% of it is retained while c-peptide is not.

