

Protein-Energy Malnutrition (PEM)

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Protein-Energy Malnutrition (PEM)



Protein-Energy Malnutrition (PEM)

- PEM manifests as a range of clinical syndromes,
- all resulting from a dietary intake of protein and calories that is inadequate to meet the body's needs.
- The two ends of the spectrum of syndromes are known as **marasmus** and **kwashiorkor**.

Protein-Energy Malnutrition (PEM) Contd.

There are two protein compartments in the body.

- **The somatic compartment:** proteins in skeletal muscles, and
 - **The visceral compartment:** protein stores in the visceral organs, primarily the liver.
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- **The somatic compartment** is affected more severely in **marasmus** and
 - **The visceral compartment** is depleted more severely in **kwashiorkor**.

Protein-Energy Malnutrition (PEM) Contd.

- The most common victims of PEM worldwide are children.
- A child whose weight falls to less than 80% of normal is considered malnourished.

Protein-Energy Malnutrition (PEM) Contd.

- The diagnosis of PEM is obvious in its most severe forms.
- Helpful parameters are fat stores, muscle mass, and serum proteins.

Protein-Energy Malnutrition (PEM) Contd.

- **Measurement of loss of fat:** measured skinfold thickness (which includes skin and subcutaneous tissue) is reduced.
- **Measurement of loss of somatic protein compartment:** reduction in muscle mass is reflected by reduced circumference of the midarm.
- **Measurement of levels of serum proteins (visceral protein compartment):** serum albumin, transferrin, and others proteins are reduced.

Marasmus

- Marasmus is the term used to denote a deficiency of calories from all sources.
- a deficiency of all elements of the diet



Marasmus

A child is considered to have marasmus when weight level falls to 60% of normal for sex, height, and age.

- A marasmic child suffers growth retardation and loss of muscle mass.
- It is due to catabolism and depletion of the somatic protein compartment.
- Serum albumin levels are either normal or only slightly reduced.



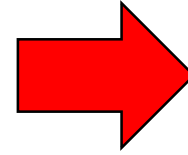
Marasmus Contd.

- Subcutaneous fat is also mobilized and used as fuel.
- Extremities are emaciated & head appears too large for the body.
- Anemia
- Multivitamin deficiencies
- Immune deficiency.



Marasmus Contd.

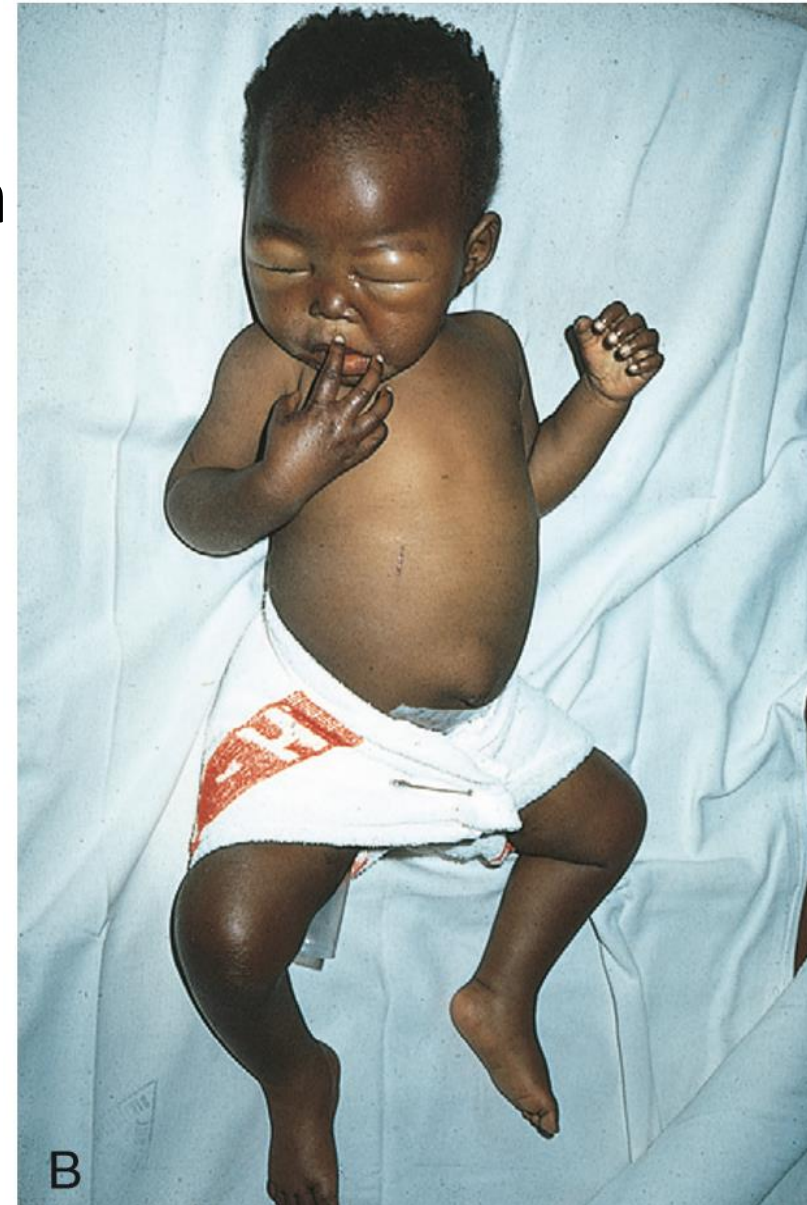
- Loss of muscle mass and subcutaneous fat;
- the head appears to be too large for the emaciated body.



Kwashiorkor

Kwashiorkor is a form of malnutrition in children caused by a diet deficient in protein alone.

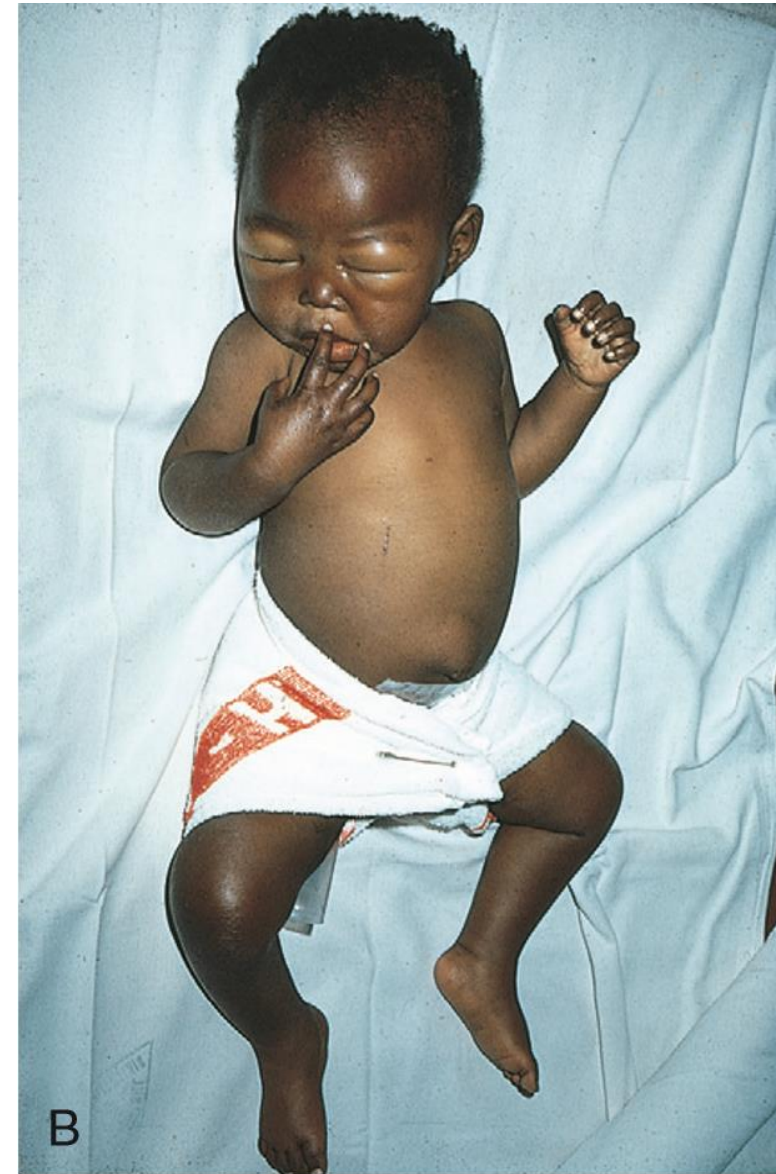
- In kwashiorkor, severe loss of the visceral protein compartment, and the resultant hypoalbuminemia gives rise to generalized or dependent edema.
- Relative sparing of subcutaneous fat and muscle mass.



Kwashiorkor Contd.

Less severe forms of kwashiorkor are seen in

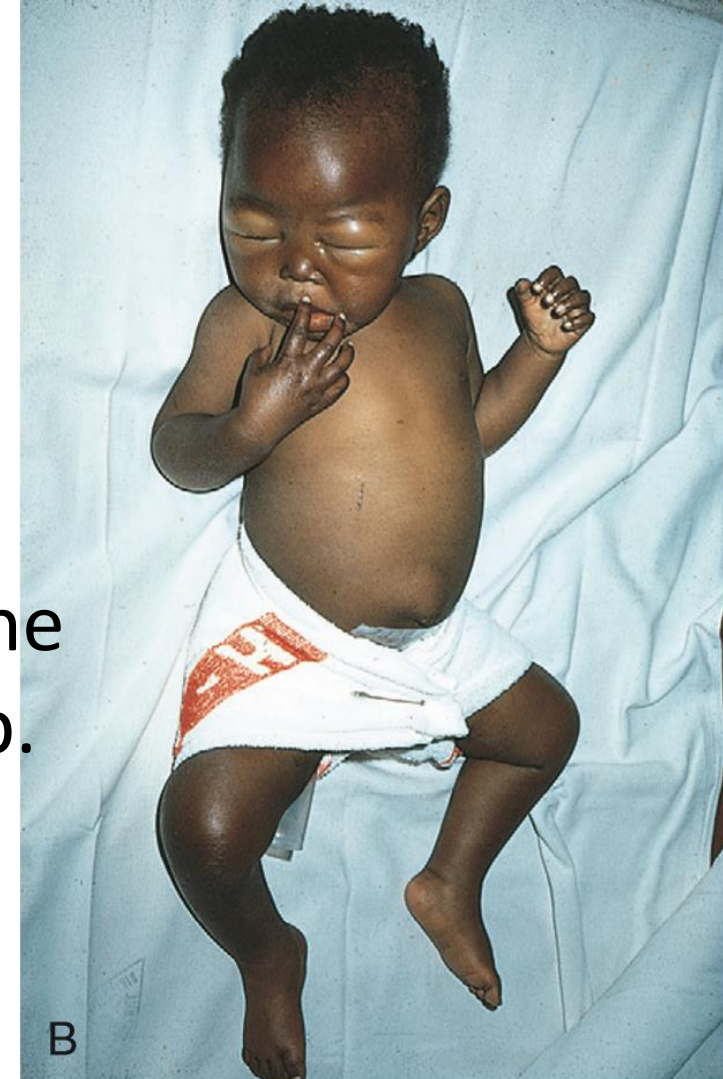
- Chronic diarrhea
- Protein-losing enteropathies,
- Nephrotic syndrome,
- Extensive burns.
- Rare cases of kwashiorkor resulting from fad diets or replacement of milk by rice-based beverages



Kwashiorkor Contd.

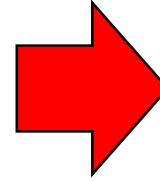
Children with kwashiorkor have characteristic of

- Skin lesions with alternating zones of hyperpigmentation, desquamation, and hypopigmentation, giving a “flaky paint” appearance.
- Hair changes include loss of color or alternating bands of pale and darker color, straightening, fine texture, and loss of firm attachment to the scalp.
- Other features are fatty liver (resulting from reduced synthesis of the carrier protein component of lipoproteins)

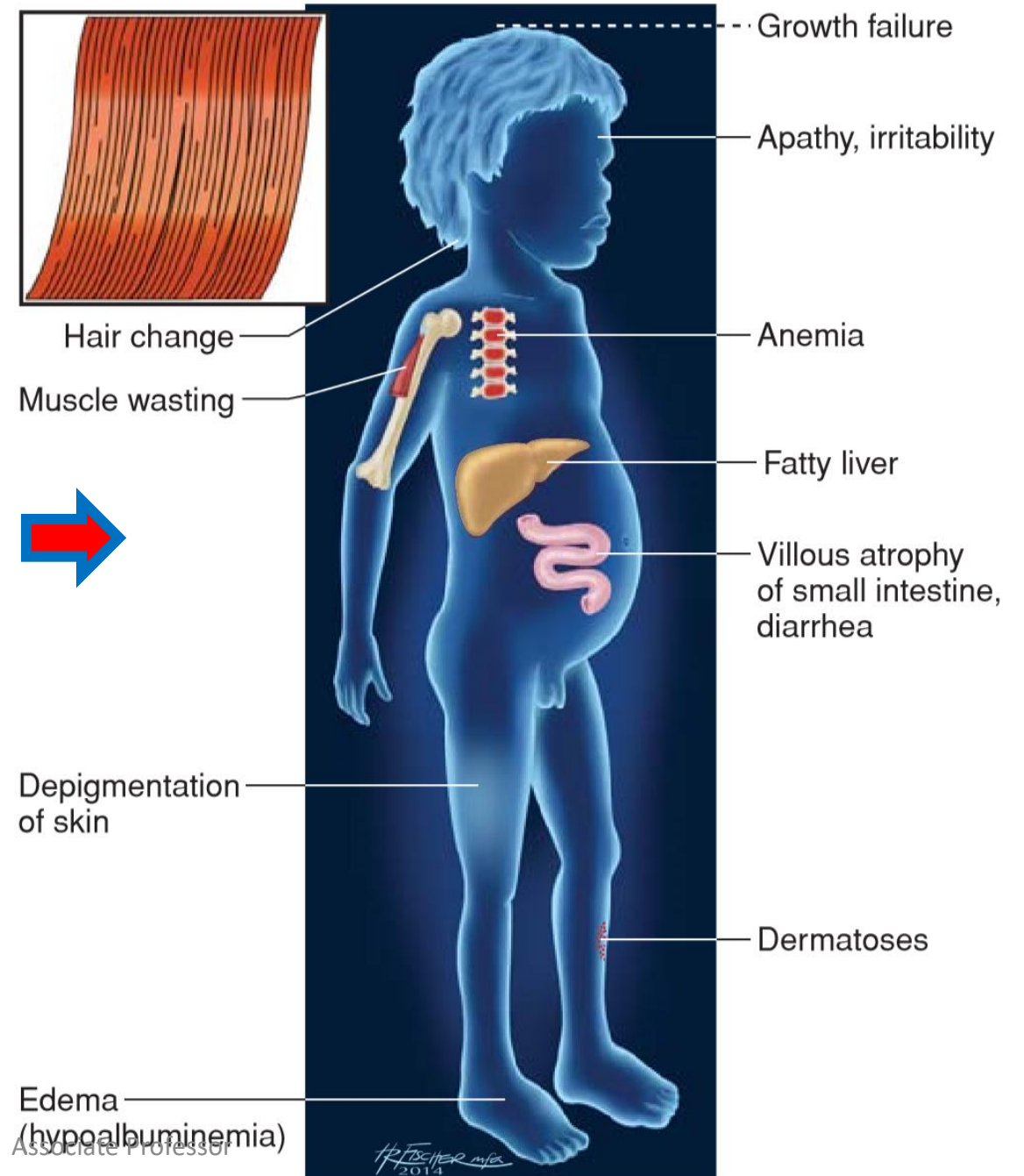
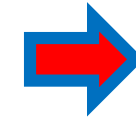


Kwashiorkor Contd.

- The infant shows generalized edema, seen as ascites and
- puffiness of the face, hands, and legs.



Complications of kwashiorkor.



Vitamin Deficiencies

Vitamin A

Vitamin A is the name given to a group of related compounds that include

- retinol (vitamin A alcohol),
- retinal (vitamin A aldehyde) and
- retinoic acid (vitamin A acid)

Vitamin A

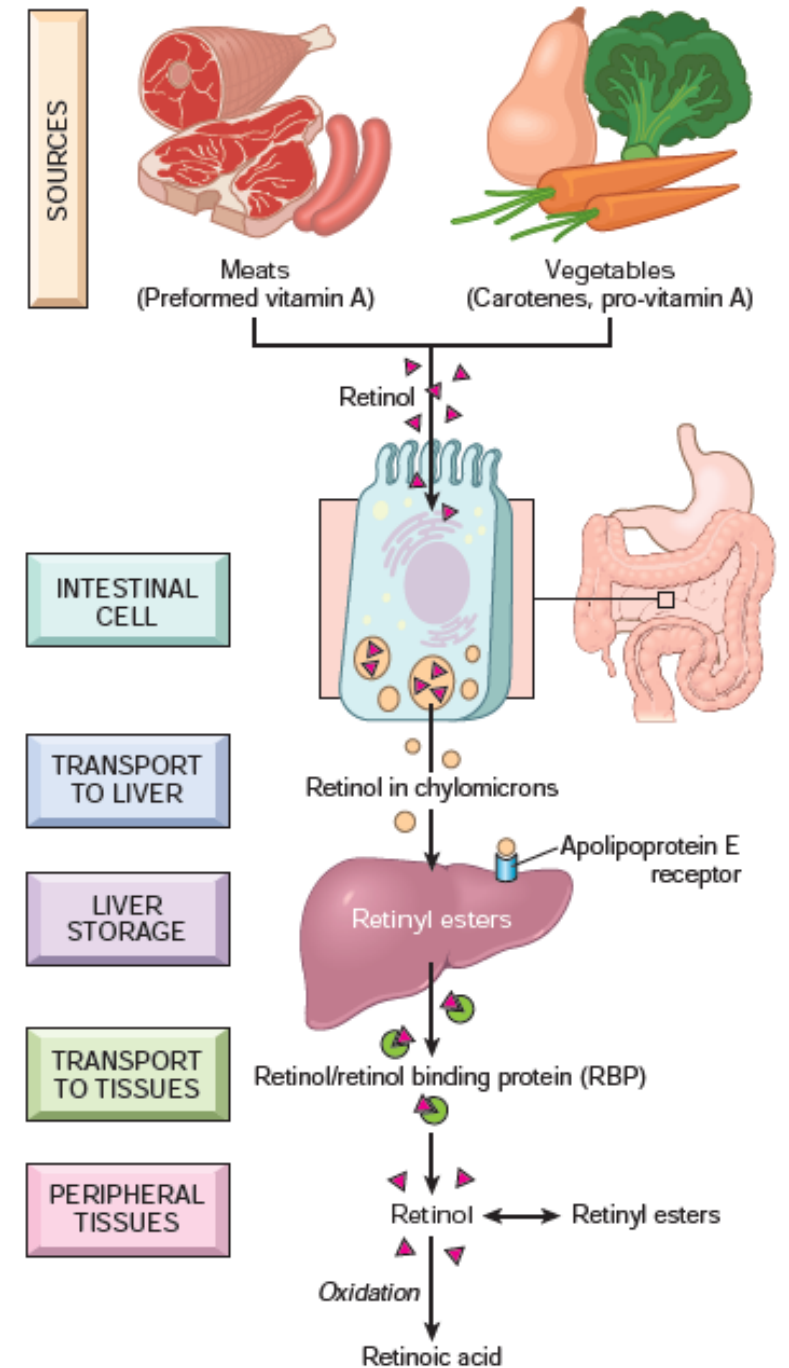
The major functions of **vitamin A** are

- maintenance of normal vision,
- regulation of cell growth and differentiation,
- regulation of lipid metabolism and host resistance to infections.

Source of **vitamin A**

- **Animal source:** liver, fish, eggs, milk, and butter.
- **Plants source:** Yellow and leafy green vegetables such as carrots, squash, and spinach.

Metabolism of Vitamin A



Vitamin A Deficiency

In eye

- An earliest manifestations of vitamin A deficiency is ***night blindness***.
- Persistent deficiency gives rise to *epithelial metaplasia* and *keratinization*, causes ***xerophthalmia*** (dry eye) and ***xerosis conjunctivae*** (dryness of the conjunctiva).
- This is followed by a buildup of keratin debris in small opaque plaques (***Bitot spots***) that progresses to erosion of the roughened corneal surface (Corneal ulcer).
- Softening and destruction of the cornea (***keratomalacia***), and **blindness**.

Vitamin A Deficiency Contd.

In respiratory tract:

- Squamous metaplasia.
- Loss of the mucociliary epithelium of the airways predisposes to secondary pulmonary infections.

In urinary tract:

- Squamous metaplasia.
- Desquamation of keratin debris in the urinary tract predisposes to renal and urinary bladder stones.

Vitamin A Deficiency Contd.

In skin:

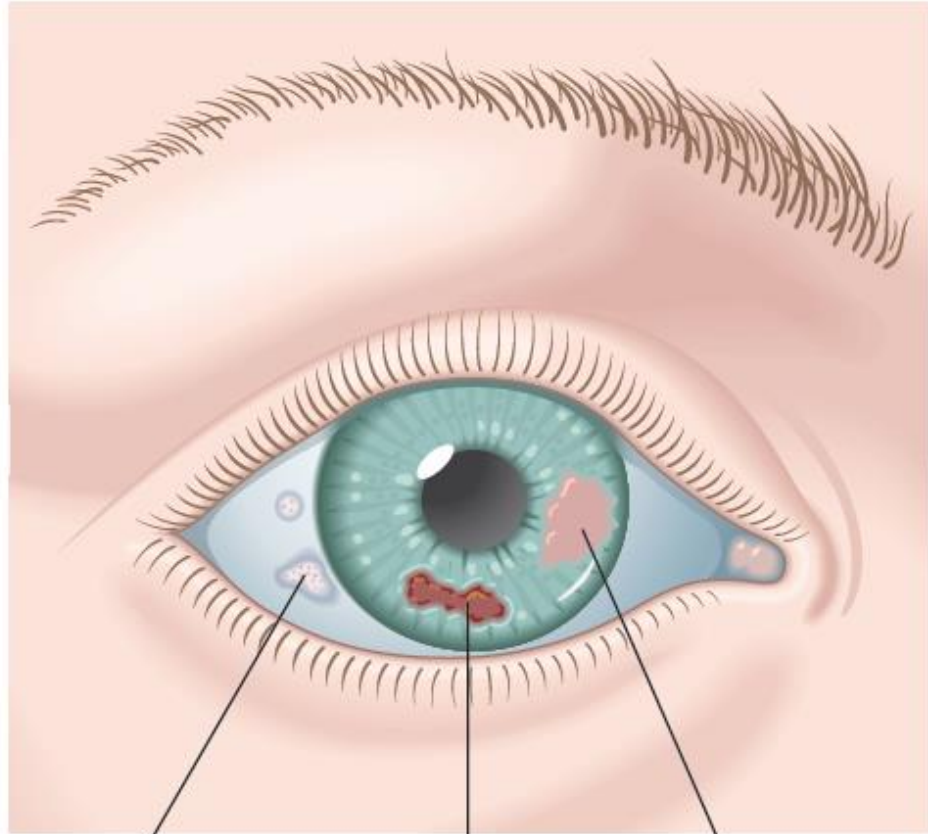
- Hyperplasia and *hyperkeratinization of the epidermis* with plugging of the ducts of the adnexal glands may produce follicular or papular dermatosis.

Others:

- Immune deficiency,
- Infections such as measles, pneumonia,
- infectious diarrhea.

Vitamin A Deficiency

EYE CHANGES

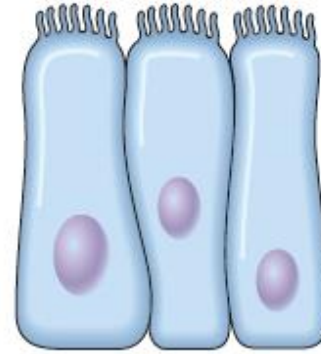


Bitot spots

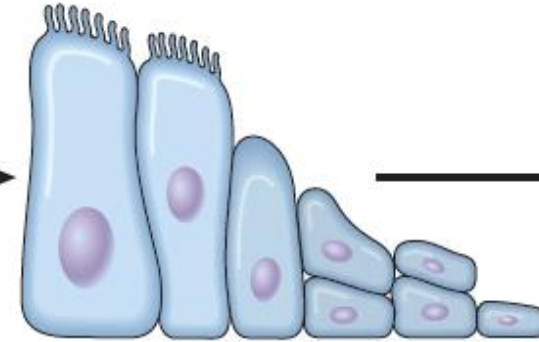
Corneal ulcer

Keratomalacia

CELL DIFFERENTIATION



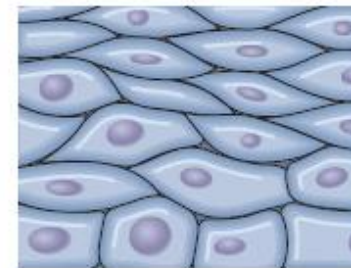
Normal



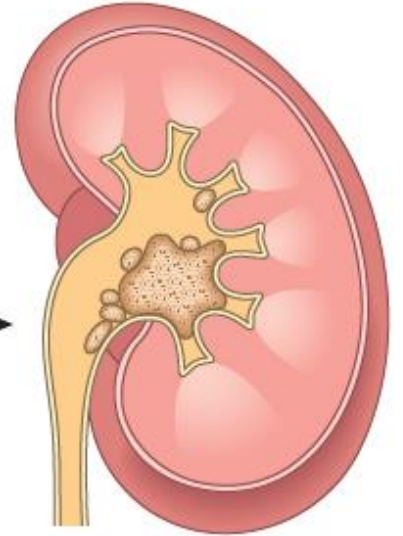
Transition



Epithelial
metaplasia



Advanced metaplasia



Increased cancer?

Vitamin A Toxicity.

Acute:

- Headache, dizziness, vomiting, stupor, and blurred vision, symptoms that may be confused with those of a brain tumor (*pseudotumor cerebri*).

Chronic:

- Weight loss, anorexia, nausea, vomiting, and bone and joint pain.
- Retinoic acid stimulates osteoclast production and activity, leading to increased bone resorption and high risk of fractures.

Vitamin D

Function of the fat-soluble vitamin:

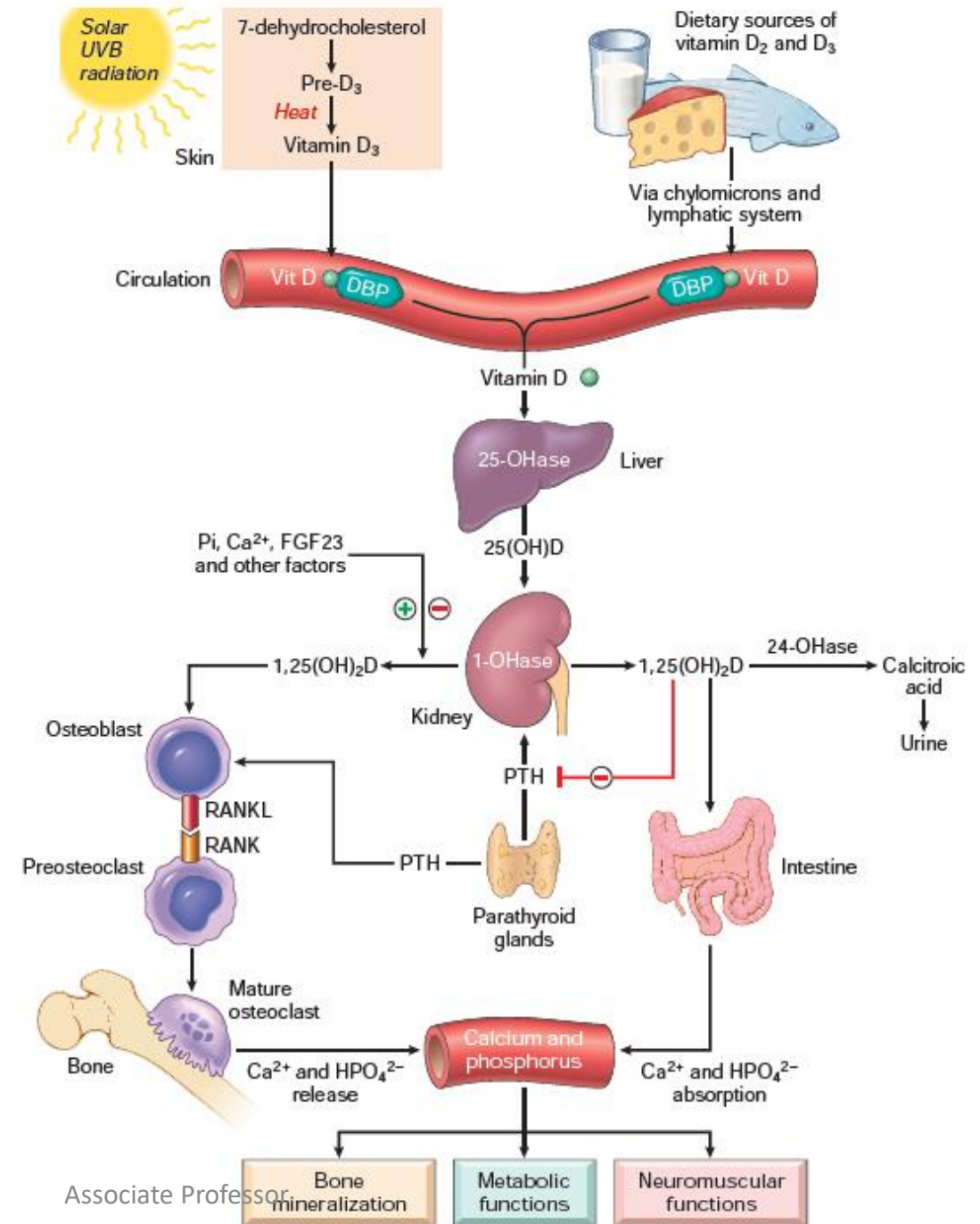
- Maintenance of plasma levels of calcium and phosphorus
- Which support metabolic functions of bone mineralization, and neuromuscular transmission.

Vitamin D Contd.

Source of vitamin D

- **The major source of vitamin D for humans is its endogenous synthesis**
 - from a precursor, 7-dehydrocholesterol, in a photochemical reaction that requires solar or artificial UV light.
- **Animal source:** liver, fish, eggs, milk, and butter.
- **Plants source:** No

Metabolism of Vitamin D



Vitamin D Contd.

Deficiency of vitamin D:

- *Rickets* (in children whose epiphyses have not already closed),
- *Osteomalacia* (in adults), and
- *Hypocalcemic tetany*.



Deficiency of vitamin D can be prevented by a diet high in fish oils (Cod liver oil)

Vitamin C (Ascorbic Acid)

Vitamin C is a water-soluble vitamin.

Source of vitamin C

- Ascorbic acid is not synthesized endogenously.
- It is present in milk and some animal products (liver, fish) and is abundant in a variety of fruits and vegetables.

Vitamin C (Ascorbic Acid)

Deficiency of vitamin C:

Scurvy:

- bone disease in growing children and
- hemorrhages and healing defects in both children and adults.

VITAMIN C DEFICIENCY

IMPAIRED COLLAGEN FORMATION

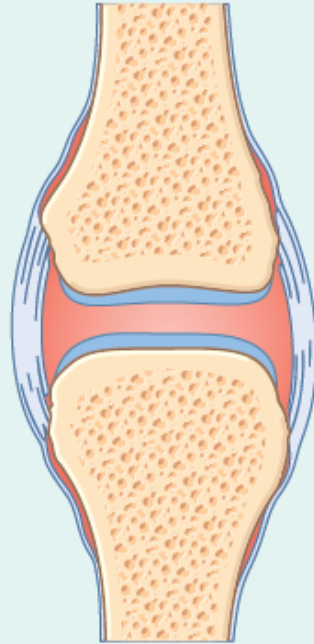
Poor vessel support results in bleeding tendency



Gums

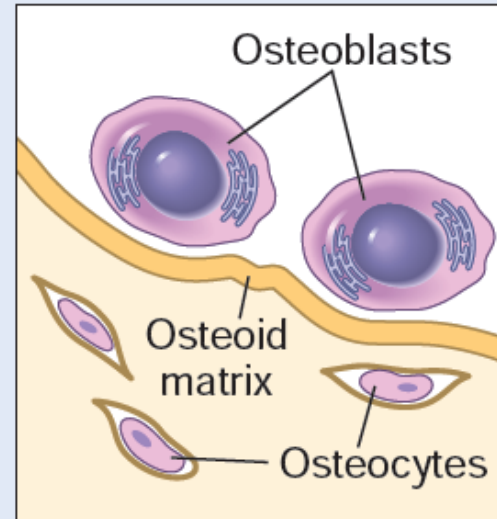


Skin

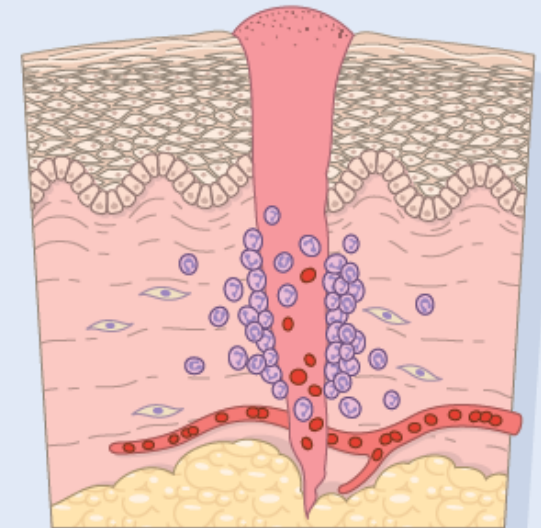


Periosteum and joints

Other effects



Inadequate synthesis of osteoid



Impaired wound healing

SAQ of Nutritional & Environmental Pathology

1. What are the dietary sources of vitamin A?
2. What are the clinical manifestations of vitamin A deficiency?
3. Write short note on:
 - Protein energy malnutrition.
 - Deficiency of zinc.
 - Kwashiorkor
 - Beriberi
 - Environmental pollution.
 - Effects of UV radiation.

