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Vitamin A

Outlines:

- General biochemistry and types
- General functions
- Functions in the vision cycle
- Deficiency and diseases

When Vitamins were discovered they were called Vitamine (vital+amine) later they changed it because not all of vitamins had amines.

Vitamin

An organic chemical compound is called a vitamin when it cannot be synthesized in sufficient quantities by an organism, and must be obtained from the diet.

- **Essential**
- Noncaloric (*not a source of energy but they help in carbohydrates/fat/protein metabolism*)
- Required in very small amounts

Solubility:

Fat-Soluble Vitamins

A, K, E and D (أكيد)

Can't be excreted out by urine → more risk of intoxication (in overdose)

Water-Soluble Vitamins

- Ascorbic acid (vitamin C)
- Thiamin (vitamin B1)
- Riboflavin (vitamin B2)
- Niacin
- Pyridoxine (vitamin B6)
- Biotin
- Pantothenic acid
- Folate
- Cobalamin (vitamin B12)

Is excreted by urine (Rarely cause toxicity)

Vitamin A from **plants**

Provitamin



- Are **inactive** but can be converted into retinoids (**active**) when metabolized in the body
e.g: **Carotenoids** (**b-carotene**) (*Precursor of Vit A*) and cryptoxanthin

Vitamin A from **animal sources**

Preformed

Are metabolically active

Three preformed compounds (retinoids)

- RETINOL (*alcohol*) – is convertible to other forms of vit A
 - RETINAL or retinaldehyde – essential in **vision**
 - RETINOIC acid (*Carboxyl group*)– essential for **skin health and bone growth** (*can't change its form – it means that it can not be converted to Retinol or Retinal*)
- Can be converted to the other two forms

To remember >> Animals can walk so they are active. Plants can't walk so they are inactive.

Functions Of Vitamin A:

- Vision
- Gene transcription
- Immune function
- Embryonic development and reproduction
- Bone metabolism
- Skin Health
- Antioxidant activity

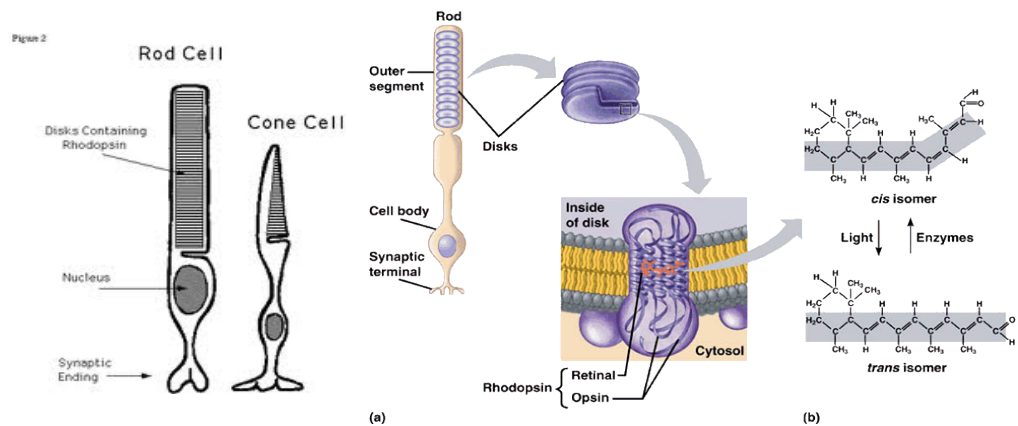
Vitamin A

- Essential role in vision (*retinal*) and normal cell differentiation (*retinoic Acid*)
- Deficiency most significant cause of **blindness in the developing world**
- Large doses over a **prolonged period of time** can produce intoxication and eventually lead to liver disease (it is called *Hypervitaminosis*)
- Excessive carotenoids (*inactive*) intake can result in yellowing of the skin, but appears to be harmless

It may appear like Jaundice but sclera in this case is white

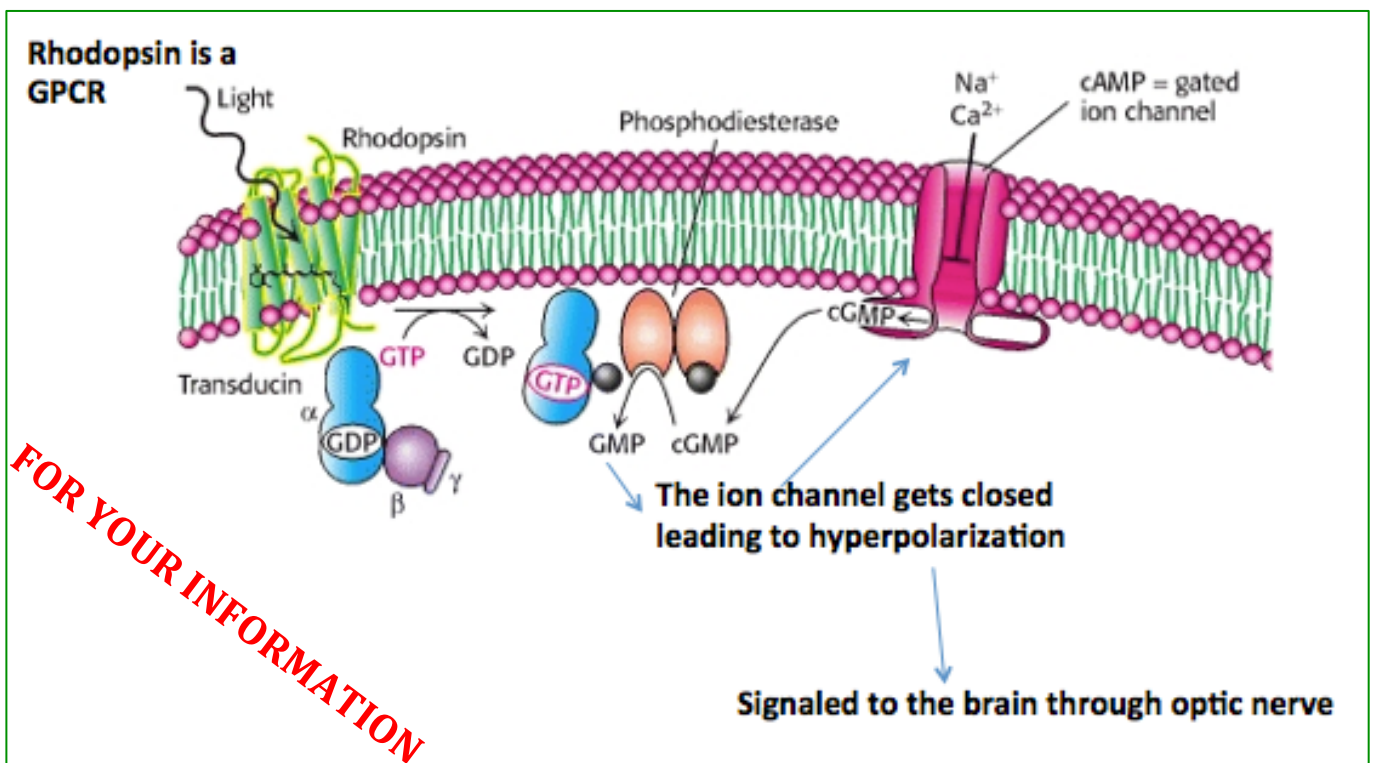
Role of Vitamin A in Vision

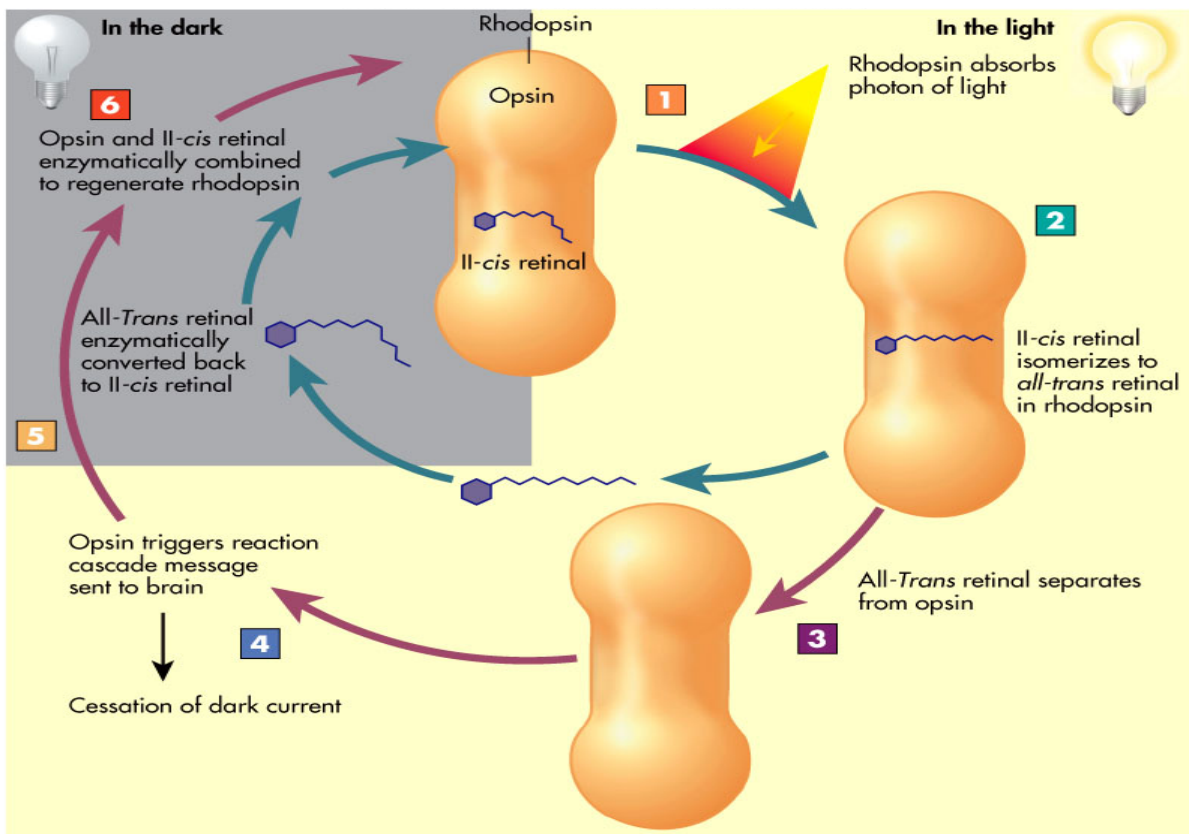
- Normal vision depends on the **retina** and on **adequate vitamin A**
- George Wald was awarded Nobel Prize in 1967, for identifying the role of vitamin A in vision
- **Retina is a light-sensitive layer of cells** at the back of the eye where an image is formed
- Retina consists of: **Rod and cone cells** (photosensitive cells)
- Vitamin A in the form of retinal binds to opsin proteins to make **rhodopsin** (in **rods**) and **iodopsin** (in **cones**)



Vision Cycle:

- It is the process where light impacting on the photosensitive cells of the retina is converted into an electrical signal to the optic nerve
- The nerve impulse generated by the optic nerve is conveyed to the brain where it can be interpreted as vision.





Role of Vitamin A in Vision

- When stimulated by light vitamin A changes (or isomerizes) from its bent 'cis' form to a straighter 'trans' form and detaches from opsin
- The opsin molecule changes shape, which sends a signal to the brain and an image is formed
- Most retinal released in this process is quickly converted to trans-Retinal and then to cis-Retinal, to begin another cycle

trans-Retinal → trans-Retinol → cis-Retinol → cis-Retinal

Dark Adaptation time

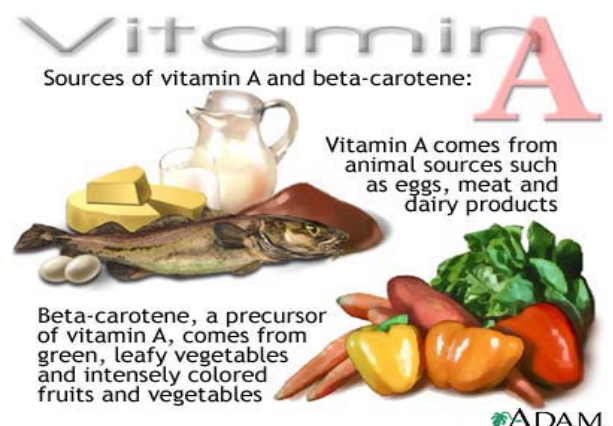
- Bright light **depletes stores of rhodopsin in rods**
- A sudden shift from bright lights to dimly lit area causes difficulty in seeing
- Rhodopsin is synthesized in few minutes and vision is improved
- This time is called the dark adaptation time
- **Dark adaptation time is increased in vitamin A deficiency**

Recommended Dietary Allowance (RDA)

- *Vitamin A for Adults*
- Women: 700 µg or 2,330 IU
- Men: 900 µg or 3,000 IU
- Upper Limit Men or Women: 3,000 µg or 10,000 IU

Vitamin A Deficiency and Diseases

- **Night blindness or Nyctalopia** - patient cannot see in low light or near darkness conditions
- **Xerophthalmia** - dryness of the conjunctiva and cornea
- **Bitot's spots**- localized increased thickness of conjunctiva
- **Keratomalacia** – prolonged xerophthalmia leads to drying and clouding of cornea
- **Blindness** (in sever deficiency)



MCQ:

Which of the following vitamins is water-soluble?

1. Vitamin A
2. Vitamin K
3. Vitamin C
4. Vitamin D

Which of the following is an active form of vitamin A?

1. Carotenoids
2. B-carotene
3. Cryptoxanthin
4. Retinoic acid

Which of the following statements about Vitamin A is true?

1. Vitamin A deficiency decreases Dark Adaptation time
2. Prolonged xerophthalmia leads to drying and clouding of cornea
3. Large doses of carotenoids over a prolonged period of time can produce intoxication
4. Darkness depletes stores of rhodopsin in rods

Which one of the following Vitamin A forms is a component of the visual pigment "Rhodopsin"?

1. 11-cis Retinol
2. Retinoic acid
3. 11 –cis Retinal
4. All-trans Retinal

Answers:

- 3
- 4
- 2
- 3

Done by:

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