Thiamin

- CVS module First year MBBS

Lec by

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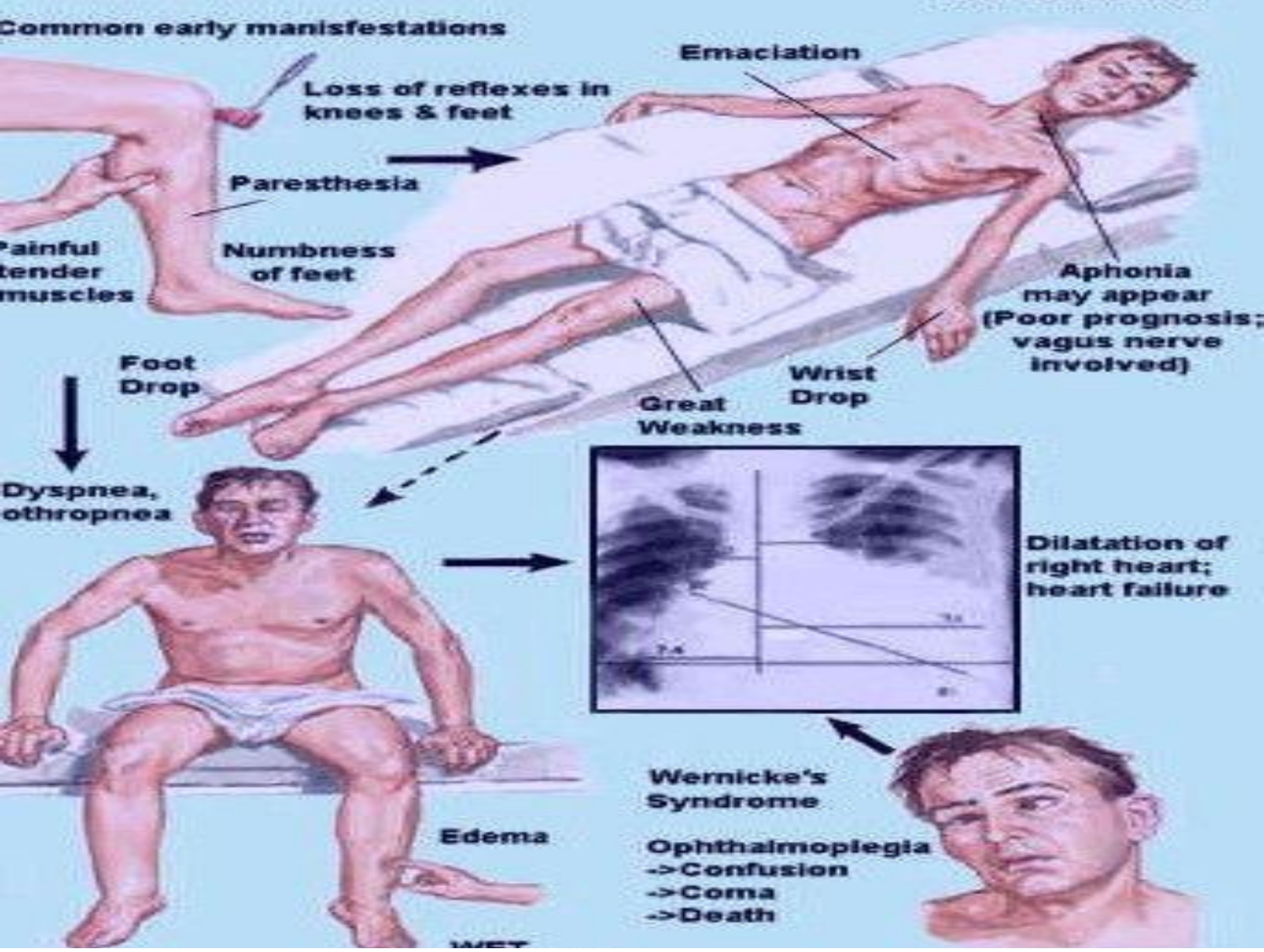
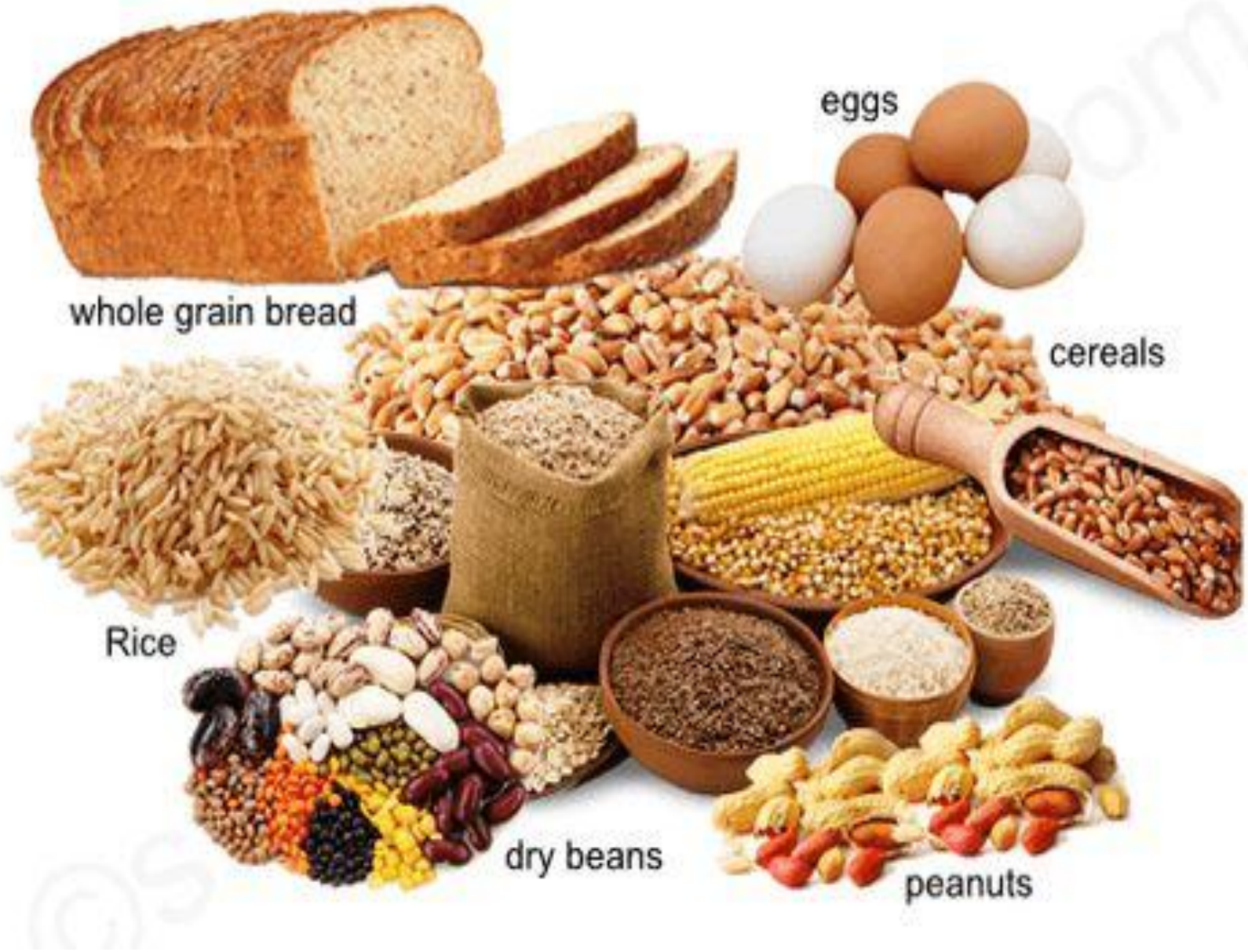
Biochemistry department


بسم الله الرحمن الرحيم


Common early manisfestations
Loss of reflexes in knees & feet
Paresthesia
Painful tender muscles
Numbness of feet
Emaciation
Aphonia may appear (Poor prognosis; vagus nerve involved)
Wrist Drop
Great Weakness
Foot Drop
Dyspnea, othropnea
Edema
Dilatation of right heart; heart failure
Wernicke's Syndrome
Ophthalmoplegia
->Confusion
->Coma
->Death


eggs
whole grain bread
cereals
Rice
dry beans
peanuts


B1

Objectives

- How discovered ?
- Chemical structure
- Dietary sources and RDA
- Biochemical functions
- Deficiency manifestation
- Hyper vitaminosis

How discovered?

- In 1900-Eijkman produced beri-beri in chicken by feeding them polished rice.
- In 1910 a Japanese scientist Umetaro Suzuki first isolated this vitamin and named as thiamine
- Adolf Winduas – elucidated the structure

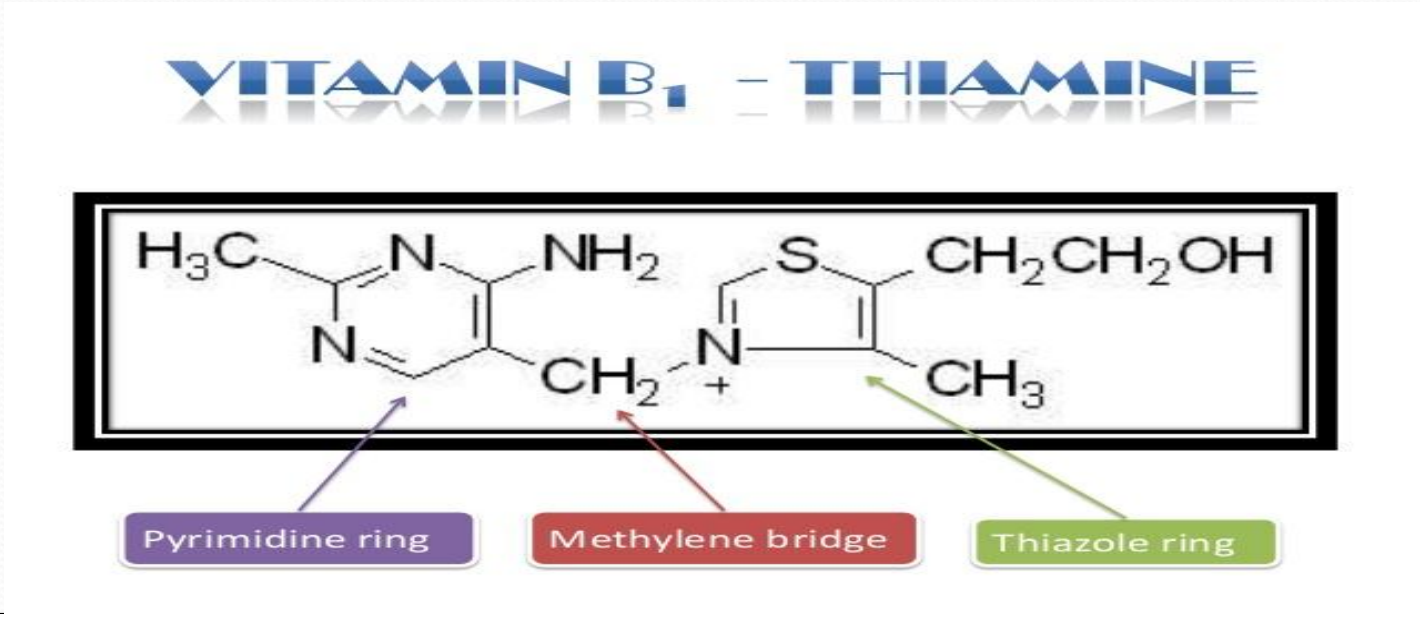
Eijkman

Umetaro Suzuki

Vitamin B_1 (Thiamine)

Composed of pyrimidine ring and a thiazole ring held by a methylene bridge.

Thiamine (vitamin B_1) was the first of the water-soluble B-vitamin family to be discovered.

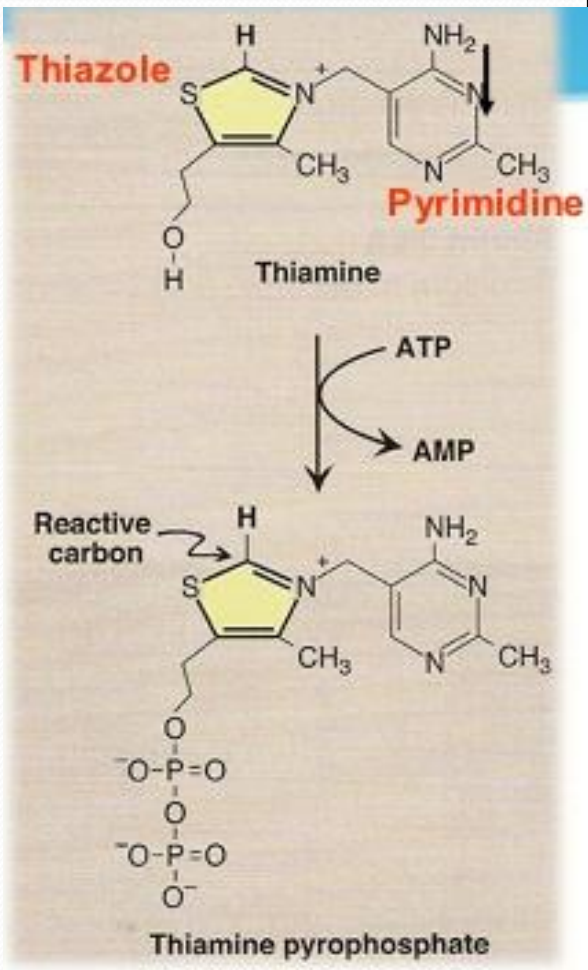


The Active form

- Active form:
- Thiamin pyrophosphate

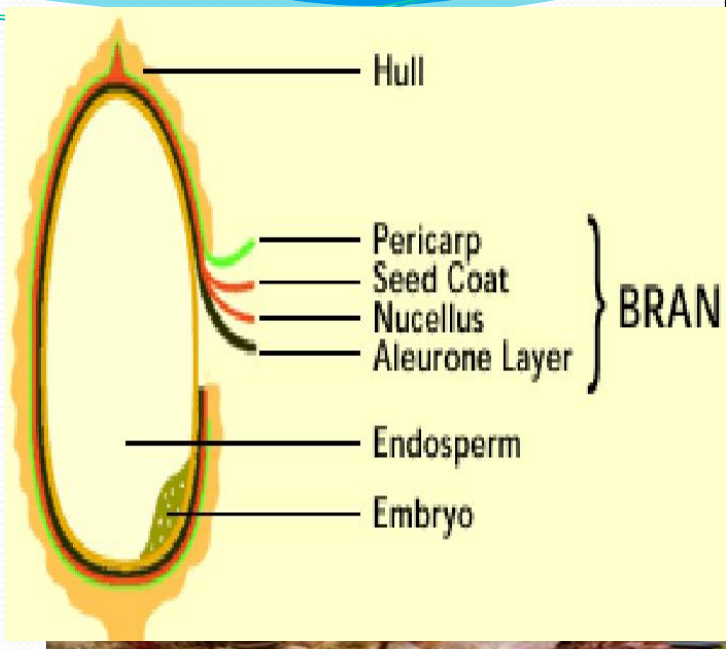
- Active co-enzyme form is formed by addition of two phosphate groups, with the help of ATP.
- Reaction is catalyzed by enzyme
- Thiamin pyrophosphate transferase

- Activation occurs mainly in liver



Thiamine sources

- Cereals
- Potato
- Oil seeds
- Nuts
- Yeasts
- Meat
- Fish
- Egg
- Milk
- RDA—1.2—1.5mg/day



Required Daily Amount

- The daily requirements are based on the number of calories in diet.

  It is about 0.5 mg/1000 calories.

  Average 1.5 mg/ day for 3000 calories.

- Daily requirement increase with high carbohydrate intake and for hard worker or athletes.

Stability

- **Thiamine is destroyed by prolonged heat.**
- **Avoid sulfite preservatives as it breaks Vitamin B_1.**
- **Vitamin B_1 is stable in acid, unstable in aqueous solutions of PH more than 5.**
- **It is readily oxidized by exposure to the atmospheric oxygen or by oxidizing agents to thiochrome (blue fluorescence), used for the quantitative fluoremetric assay.**

Absorption and transport

- Absorbed from both large and small intestine.
- The capacity of human intestine to absorb vitamin is limited to 5mg per day.

- Transported bound to albumin.
- Phosphorylation occur in tissues.

- Stored in liver, kidney, heart.
- Excess is excreted in urine.

Mainly required for carbohydrate metabolism.

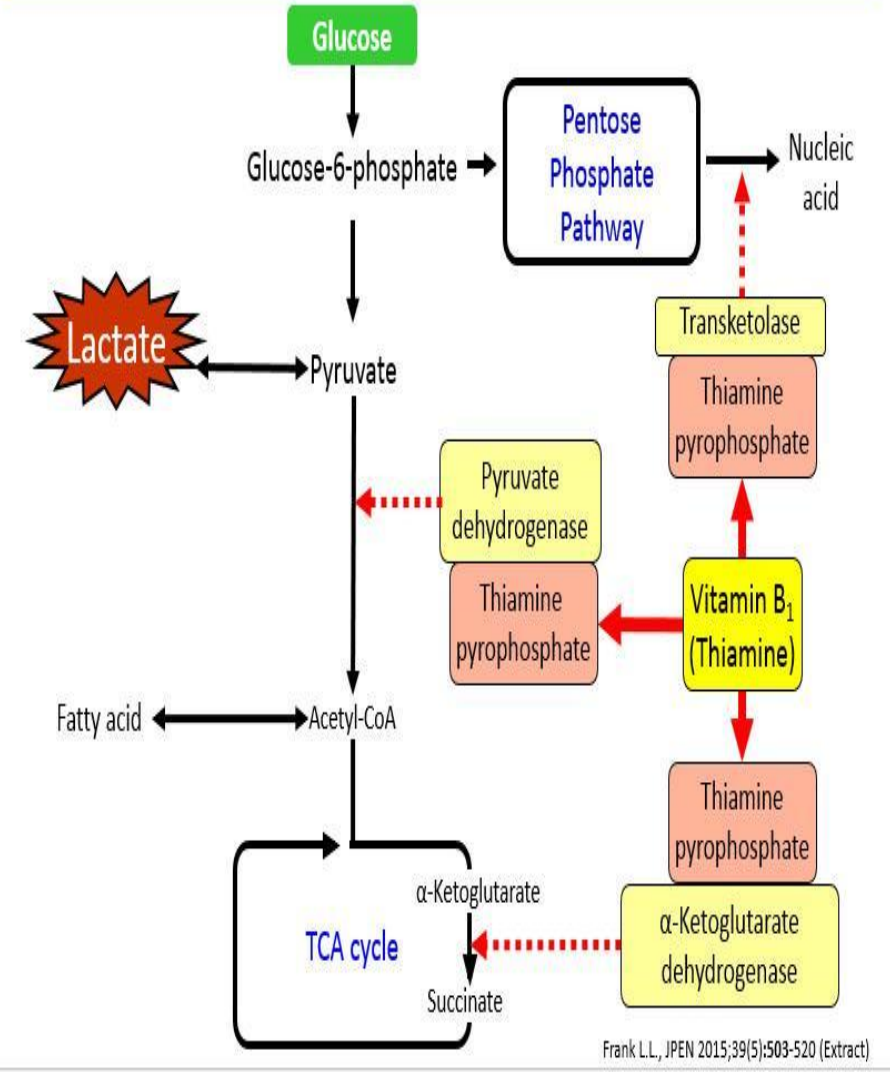
Thiamine pyrophosphate (TPP) is a coenzyme for:

α-ketoglutarate dehydrogenase.

pyruvate dehydrogenase.

These enzymes function in the metabolism of carbohydrates.

Enzymes in which thiamine serves as a cofactor in carbohydrate metabolism

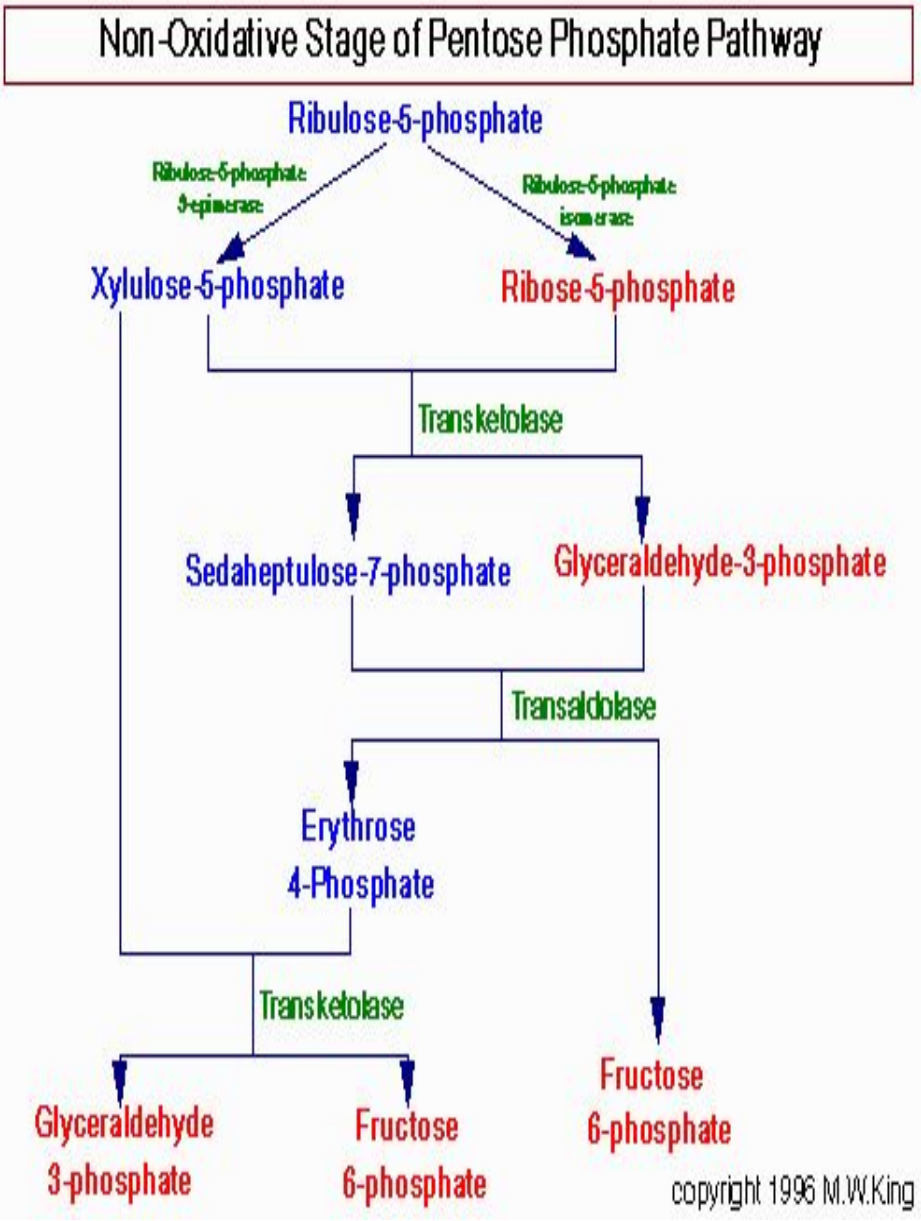


Transketolase.

Transketolase functions in:

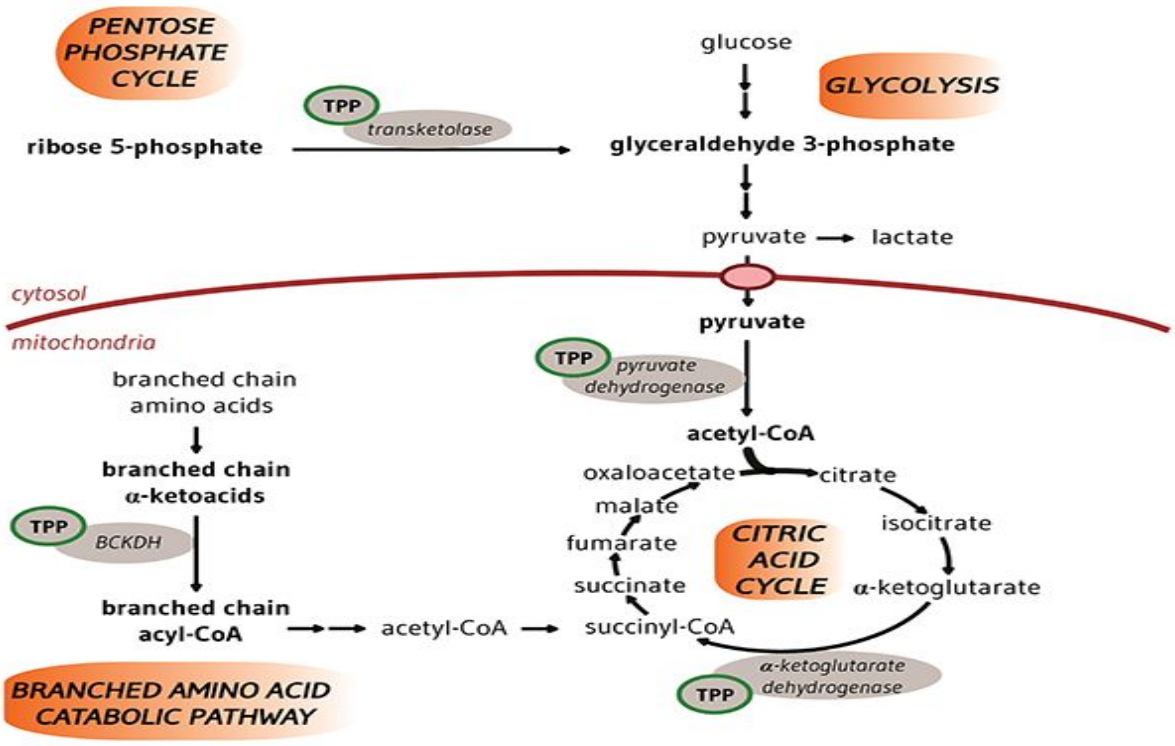
The pentose phosphate pathway to synthesize NADPH.

The pentose sugars deoxyribose and ribose involved in nucleic acids biosynthesis.



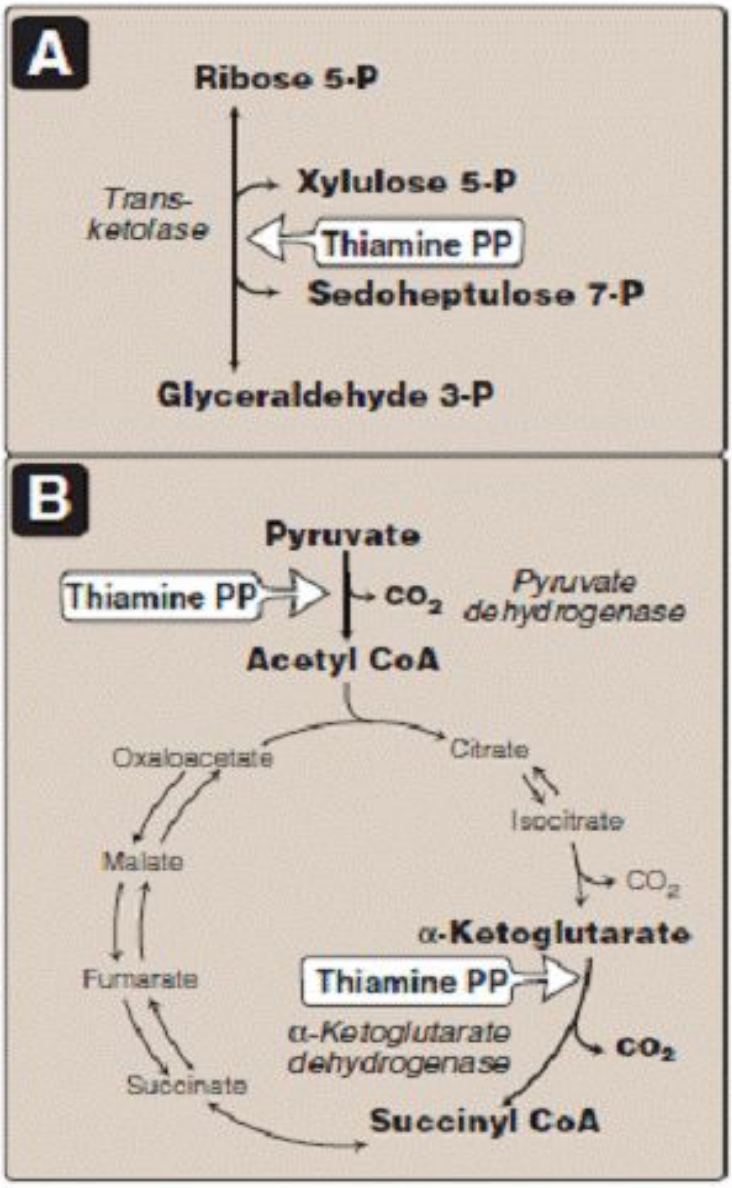
The branched chain alpha-keto acid dehydrogenase,

Catalysis the oxidative decarboxylation of branched chain amino acids to the respective keto acids.



- Thamin is precursor for synthesis of acetylcholine (neurotransmitters) and lipids including myelin, therefore necessary for normal functioning of nervous system.

- Plays an important role in nerve impulse transmission.



Risk Factors for Deficiency

- The leading risk factor for thiamine deficiency is alcoholism. Alcohol acts directly to destroy thiamine and increases it's excretion.
- Liver cirrhosis, malabsorption syndromes, diabetes, kidney disease, or hyper metabolic conditions also have increased susceptibility to B_1 deficiency.
- The elderly peoples with poor nutritional status and difficulties with absorption.
- Others with nutritionally inadequate diets, or an increased need as a result of stress, illness, or surgery may benefit from additional vitamin B_1 intake.
- Use of tobacco, or products like carbonate and citrate food additives can impair thiamine absorption.

Deficiency disease

Beri -beri

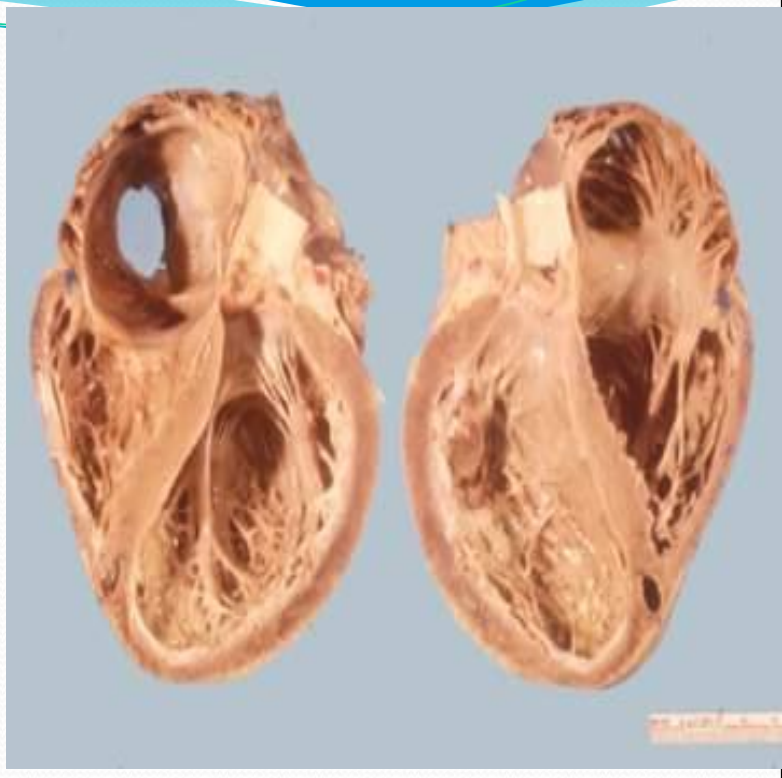
- Early symptoms
- Weakness
- Constipation
- Mental depression
- Peripheral neuropathy

- Types of Beri-beri

- Dry beri-beri
- Neurological manifestation result in peripheral neuritis.
- Muscles become progressively wasted.
- Degeneration and demyelination of both motor and sensory nerves leads to complete paralysis.

Wet beri-beri

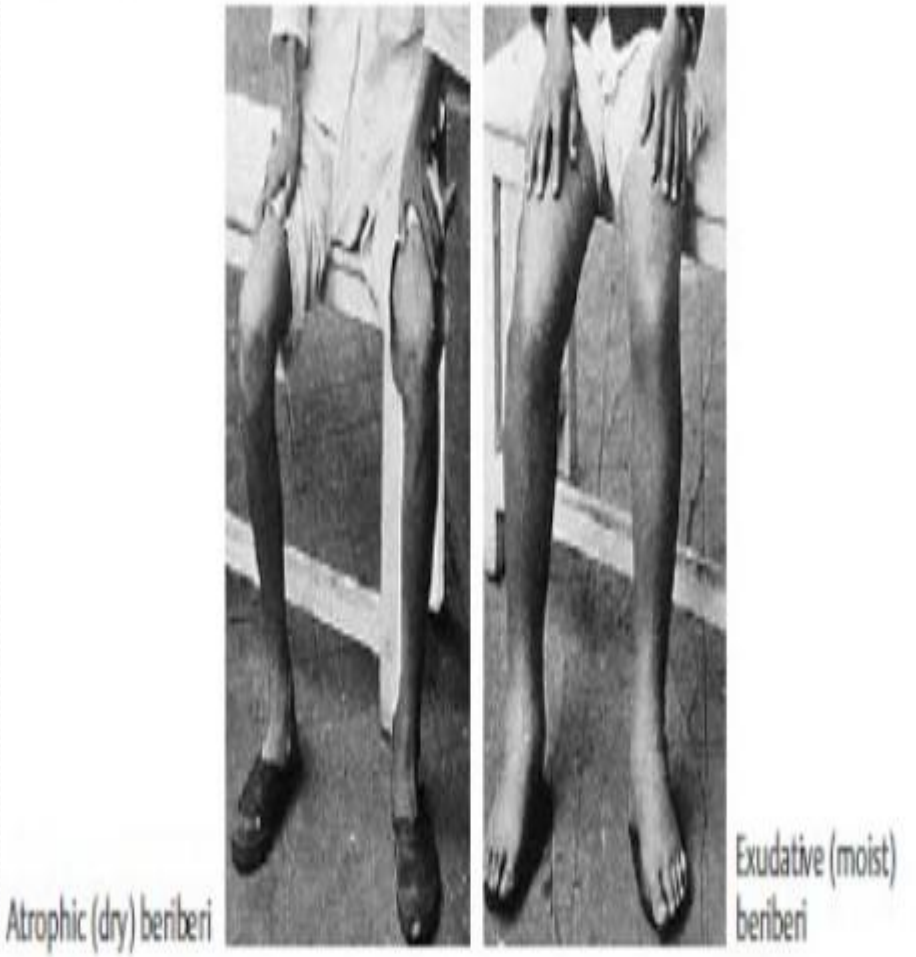
- Associated with peripheral vasodilatation, leading to more rapid arteriovenous shunting of blood, cardiac failure, peripheral edema.
- Cardiac failure due to weakness of heart muscle.
- As a result of decreased release of metabolic energy in tissues local vasodilatation may occur.

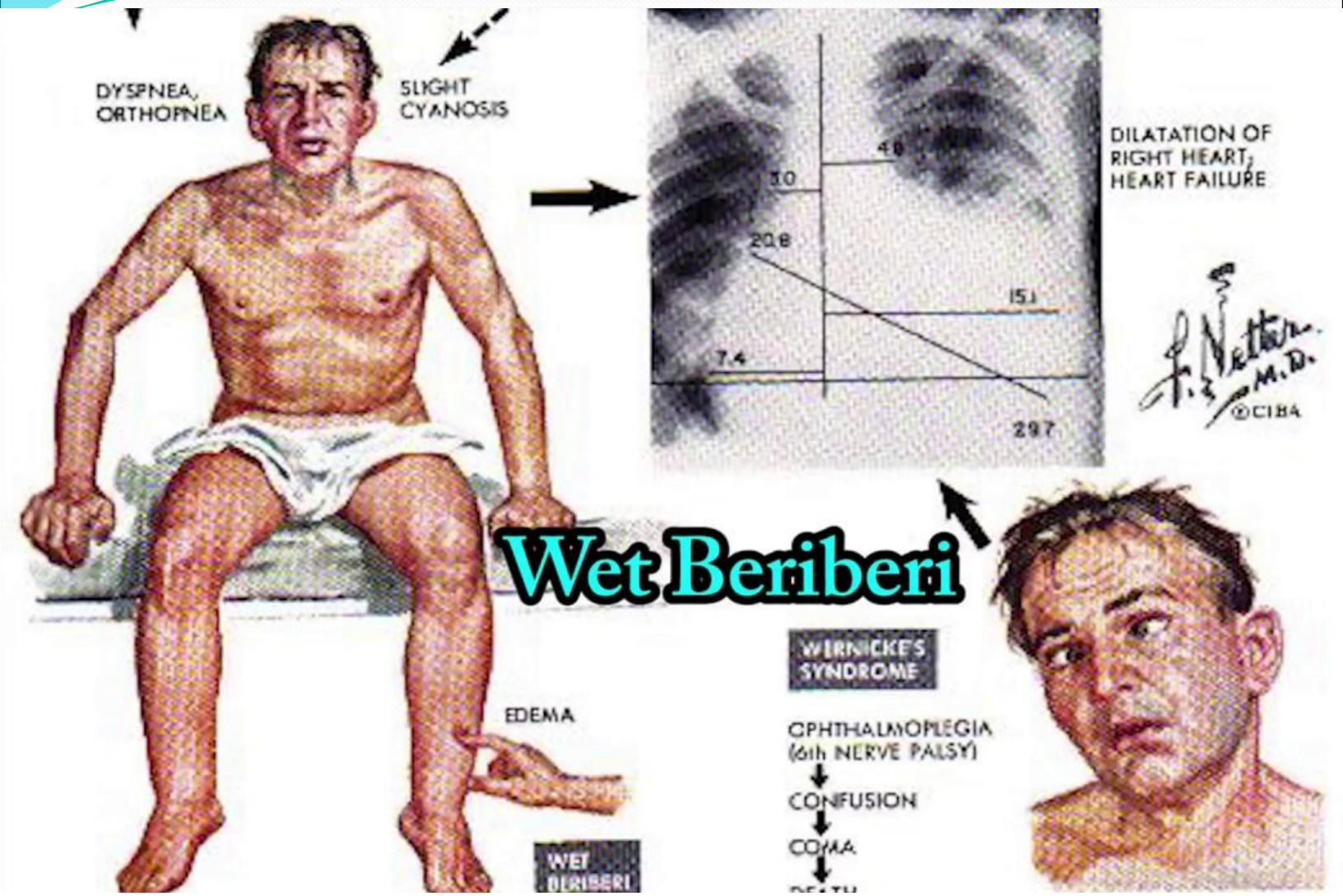


Dilated cardiomyopathy Due to peripheral dilation of arterioles

- Wet beri-beri

- Cardiac involvement with edema of face, legs trunk and serous cavities.




DYSPNEA, ORTHOPNEA
SLIGHT CYANOSIS
DILATATION OF RIGHT HEART; HEART FAILURE
Wet Beriberi
EDEMA
WET BERIBERI
WERNICKE'S SYNDROME
OPHTHALMOPLEGIA (6th NERVE PALSY)
CONFUSION
COMA
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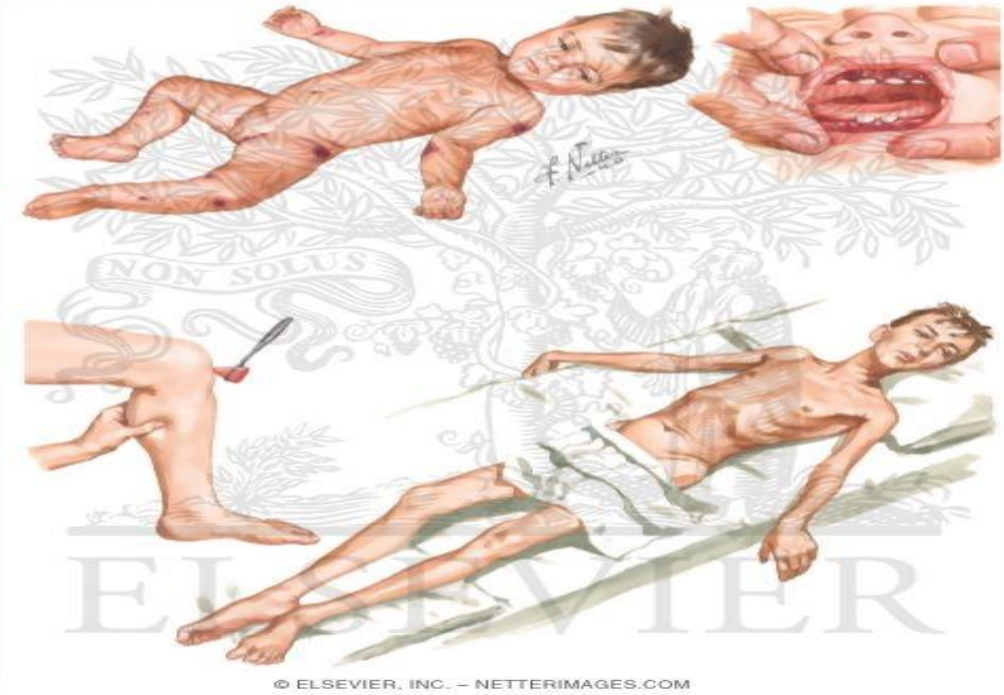
Infantile beri-beri

- Occur in babies born to thiamin deficient mothers.
- Restlessness, sleeplessness and bouts of screaming due to cardiac failure.



Wernicke –Korsakoff syndrome

- Mostly seen in chronic alcoholics.
- Body demand of thiamine increases in alcoholics.
- Characterized by
- Confusion
- Dementia
- Apathy
- Nystagmus
- Cerebellar ataxia

Nervous disorders

- Common because nervous system is entirely depend on glucose for its energy requirements and there is mental depression.
- Pyruvate accumulate in tissues, excreted in urine.
- Cross blood brain barrier ,accumulate in brain, cause polyneuritis.
- Nerve impulse transmission decrease.
- Activity of transketolase decreases in RBCs.

Diagnostic tests for Thiamin

- Erytherocyte transketolase activity test.
- Meaurement of Pyruvate, lactate and alpha ketogluterate levels in blood.

Therapeutic uses

- Neuritis of pregnancy
- Alcoholic neuritis
- Wernicke's encephalopathy
- Inborn errors of metabolism

References

- Chatterjea
- Jaypee
- Satyanaryn


Thank you!