

~~2nd~~Biochemistry caseSAPNA
PAGE NO.
DATE: / / 20① Kwashiorkor -Condition - 2-3 year child

Low serum Albumin (N.R = 3.4-5.0 gm%)

Low serum total Protein (N.R = 6-8 gm%)

Hypoalbuminemia, edema, diarrhoea

Treatment -

- ① Balanced diet with good quality of Protein
- ② Vitamin & Iron Supplement to correct Anaemia
- ③ Frequent oral feeding & Mineral supplement

② Marasmus -Conditions - Children 1 yr. or less than 1 yr.
deficiency of calories.Manifestation - (प्रतीकरण)

Serum albumin is Normal

Hb is Less than Normal.

Muscle Wasting, Weight loss, Weakness

Wrinkled skin

No edema.

No Fatty liver

Treatment -Nutrition rich in calories, Protein, Vitamin.

③ Gout - (Nucleic Acid Metabolism)

Condition - Pain & swelling in joints

↑ blood uric acid - (N.R - 3.0-7.0 mg%)

disorder of purine catabolism.

Hyperuricemia

Reasons - ① Hyperactivity of PRPP synthase & PRPP
Amido transferase

② Deficiency of HGPRTase

Treatment -

① Allopurinol competitively inhibit xanthine oxidase,
thus reduce uric acid formation.

② colchicine & NSAIDs like Indomethacin.

③ Reduce intake of dietary protein like
meat, liver, tea, coffee, Sea Foods

④ Avoid Alcohol & High Protein diet

⑤ Consume Plenty of H_2O .

④ Lesch Nyhan Syndrome -

Condition - Biting fingers, lip,

Joint Pain

Neurological symptoms

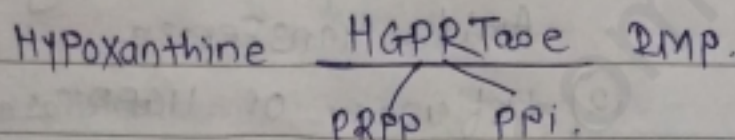
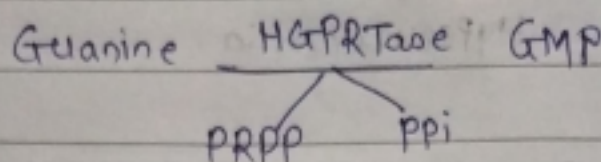
Increased serum uric acid level.

Reason - deficiency of Hypoxanthine Guanine

Phosphoribosyl Transferase (HGPRTase)

2) X-linked recessive disorder (Only Male affected)

concerned (संबंधित) pathway -



⑤ Sickle cell Anaemia

Condition - Crescent shaped RBCs

Electrophoresis - Hbs Band.

Slightly Anemic (Low Haemoglobin).

Reasons -

- ① Glutamic acid replaced by Valine at 6th Position of β -chain of HbA.

Lab. Test -

- ① Sickle Test.
- ② Demonstration of sickled RBC in smear.
- ③ Haemoglobin electrophoresis.

Factors - $\downarrow$ O_2 Tension, $\uparrow$ CO_2 concentration.

$\downarrow$ PH (Acidosis) $\uparrow$ 2,3 BPG Concentration

Manifestation -

- ① Hemolytic anaemia
- ② Tissue damage & Pain in bone (chest, Abd.)
- ③ ↑ed susceptibility to Infection i.e. Malaria
- ④ Premature death.

⑥ Metabolic Acidosis -

condition - • Untreated diabetic mellitus lead to excessive production of keto acid.

- low - serum Bicarbonate, pH, PCO_2
- Fall in cardiac output, so BP ↓
- deep sighing respiration - Kussmaul's breath

$$\frac{NaHCO_3}{H_2CO_3} = \frac{20}{1}$$

Treatment -

- ① Insulin administration
- ② Na Bicarbonate to Neutralise acids
- ③ In renal failure - dialysis

Metabolic Acidosis - ↓ Bicarbonate (HCO_3^-)

Respiratory Acidosis - ↑ Carbonic acid (H_2CO_3)

Metabolic Alkalosis - ↑ Bicarbonate (HCO_3^-)

Respiratory Alkalosis - ↓ carbonic acid (H_2CO_3)

⑦ Hyperthyroidism -

Condition -

Swelling in Neck

Elevated T_3 & T_4

Low TSH

Sweating, Loss of wt., Palpitation

Lab. -

↑ total and free T_3 & T_4

↓ TSH (Thyroid Stimulating Hormone)

↓ TBG (Thyroxine Binding Globin)

↑ Radioactive Iodine Uptake

↑ BMR

Causes -

- Enlarged Thyroid Gland (Exophthalmic Goiter)
- Weight Loss
- ↑ BMR, Uncouples oxidative Phosphorylation, Block ATP Synthesis, High Consumption of O_2 , Liberates Heat

Manifestation - (प्रतीक 20)

↑ HR, Tremors, Anxiety, Loss of wt, ↑ Appetite, Sweating, Nervousness, Irritability, ↑ BMR, ↑ T_3 & T_4 , ↓ TSH.

Treatment -

Surgical Removal

Radioactive Iodine Therapy

Drug like Carbimazole

⑧ Hypothyroidism-

condition- Enlarge thyroid Gland!
decreased T_3 & T_4
Increased TSH.

Manifestation-

Cretinism (children) - Poor Physical, Mental, sex. growth

Myxoedema (adult) - Baggy eyes, Mental & Physical slowing, Puffy face.

Low pulse rate, Gain wt, sensitivity to cold, Dry skin
sluggish behaviour, ↓ Appetite

Lab. -

↓ total & Free T_3 & T_4

↑ TSH

↓ Radioactive iodine uptake

Treatment -

Administration of Thyroxine

① Fatty liver

Condition - serum cholesterol & serum TG levels

Anorexia

Causes -

- ① Excessive mobilization of fat from Adipose tissue
eg. diabetic mellitus & starvation
- ② excessive intake of calories
- ③ Impaired mobilisation of fat due to
 - ✓ Deficiency of EFA
 - ✓ Deficiency of Lipotropic factor
- ④ Alcoholism
- ⑤ Drugs like CCl₄, Chloroform, orotic acid, Puromycin, yellow Phosphorus, Arsenic.
- ⑥ Deficiency of essential amino acid, Antioxidant (Vit E, Se)
- ⑦ endocrine factor eg. Insulin, ACTH, Thyroid H.

Test -

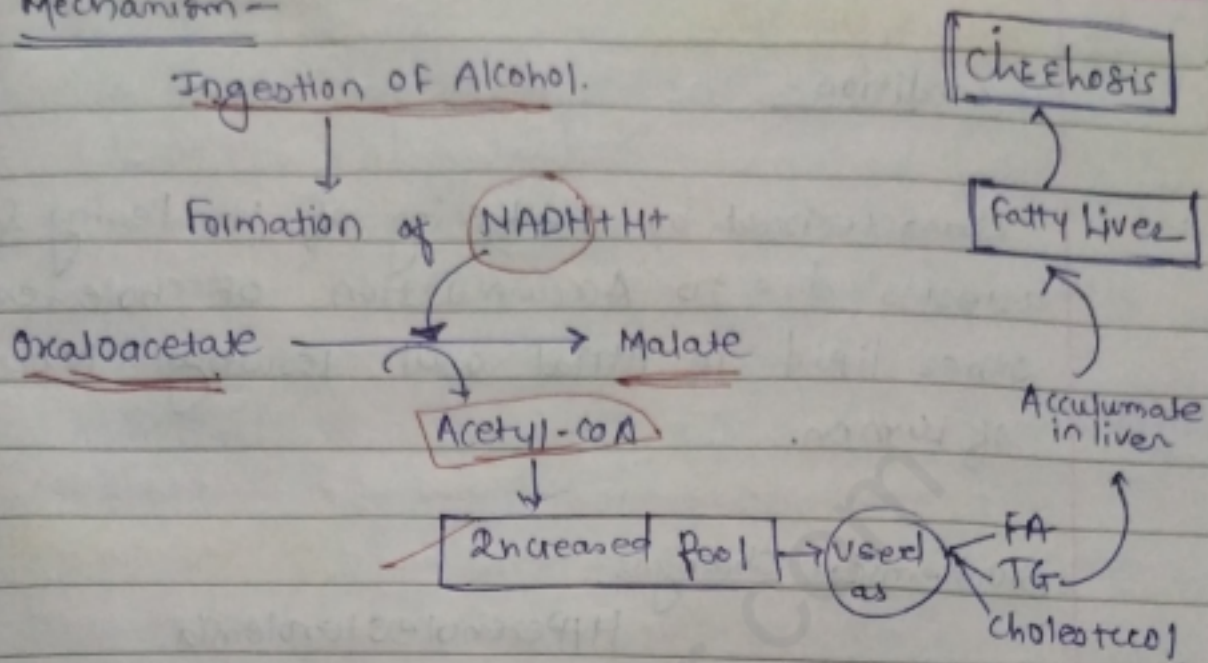
① Liver Function Test -

↑ serum bilirubin
↑ SGPT
↑ SGOT
↑ LDH
↑ ALP

② Lipid profile -

↑ s. cholesterol
↑ LDL cholesterol
↑ T.G
↑ HDL cholesterol

Mechanism -



Factor that Prevent Fatty Liver -

- ① Choline
- ② Methionine & betaine
- ③ Lecithin
- ④ casein.
- ⑤ Antioxidant like vit.E & selenium
- ⑥ Vit. B12 & folic acid.
- ⑦ Omega-3-fatty acid. - (esterification of cholesterol)

Treatment -

Stoppage of Alcohol.
Weight Control
Control of diabetes
Hyperlipidemia

Nutritional Support

(10)

Atherosclerosis -Condition -

characterized by thickening & Hardening of arteries due to Accumulation of cholesterol & other lipid in Arterial wall resulting in Narrowing of lumen.

Biochemical changes -

Hypercholesterolemia

↑ LDL

↓ HDL

Risk factor -Hypercholesterolemia $> 200 \text{ mg\%}$ ↑ LDL cholesterol $> 150 \text{ mg\%}$

obesity

smoking

High consumption of fat

Hypertension

Stress

Lack of Physical exercise

Treatment -

- Drug - Lovastatin, simvastatin. Inhibit cholesterol synthesis by inhibiting HMG-CoA reductase.

- Diet
- PUFA (veg. oil & fish oil)
- Green leafy vegetable
- Avoid sucrose
- Garlic oil contain Allyl thiosulfinate which
↓ cholesterol, LDL, ↑ HDL
- Antioxidant Like Vit-E, Vit-C & β -Carotene.

11) Ketoacidosis -

Ketone Bodies are

- Acetoacetate
- β -OH butyrate
- Acetone

Explanation -

Acetoacetate & β -OH-Butyrate - strong Acid

↓
depletes Alkali reserve

↓
Causes → Metabolic Acidosis

In ketosis:

- electrolyte imbalance & dehydration bec^z Ketone Body, Na⁺, Glucose, are lost in urine

(12) Myocardial Infarction (MI) -

- Nicotine causes Transient constriction of Coronary & Carotid artery. It also decrease HDL & causes Accumulation of (CO) that causes endothelial cell Injury.

Risk Factor -

- Hypercholesteremia $> 200 \text{ mg\%}$
- $\uparrow$ Serum T.G $> 150 \text{ mg\%}$
- $\uparrow$ LDL $> 150 \text{ mg\%}$
- $\downarrow$ HDL $< 35 \text{ mg\%}$
- LDL: HDL ratio > 3.5
- Hypertension
- Smoking
- Diabetes mellitus
- sedentary life
- obesity
- Alcoholism

Prevention -

- Physical exercise
- Consumption of PUFA
- Fibre diet $\downarrow$ cholesterol absorption
- No Smoking
- Moderate Alcohol Consumption.
- Antioxidant. Vit E, Vit. C, β -carotene.
- Garlic & Fenugreek seed - $\downarrow$ cholesterol.

13) Diabetic ketoacidosis - (DM + ketoacidosis)

Condition - deep breathing with Fruity odour
Excessive thirst
Polyuria with ketone bodies

Biochemical Investigation -

1] Urine -

Benedict Test - to detect sugar in urine

(purple Ring) Rothera's Test - to detect K.B in urine

2] Blood -

Blood sugar estimation - for degree of Hyperglycemia

Blood Ketone Body - for severity of ketoacidosis

Blood Urea - May be raised.

3] Plasma electrolyte -

K - Normal (or) $\uparrow$

HCO_3^- - $\downarrow$

Na - Usually $\downarrow$

H^+ - $\uparrow$

P - Usually $\uparrow$

Metabolic changes -

a) Hyperglycemia & Glycosuria

b) ketoacidosis

c) electrolyte imbalance

d) Dehydration

Blood Glucose 7250 mg/100ml
BSL - Blood sugar level
PAGE NO. _____
DATE: / / 20

Treatment-

- 1) I/V of Insulin.
- 2) Isotonic solⁿ & NaHCO₃ to maintain pH & fluid level
- 3) fluid replacement using Isotonic saline
- 4) electrolyte A.S.N.
- 5) Intramuscular enjection of Antiketogenic substance

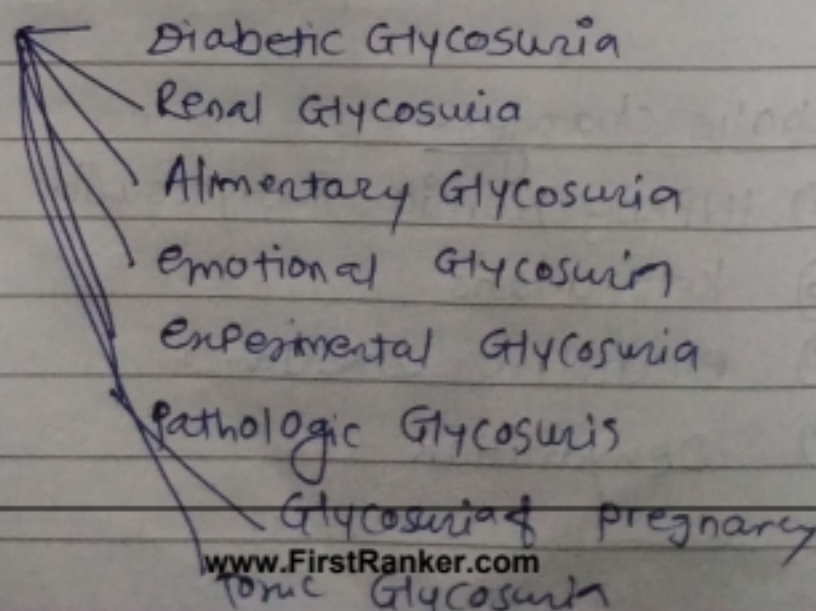
14) Diabetes Mellitus-

Condition- Glycosuria, Polyuria, loss of wt, Polydipsia
Polyphagia, Polyuria

Biochemical Test-

- Urine Benedict Test
- Blood Sugar - Fasting, PP, GTT
- Lipid Profile - (Serum cholesterol, T.G & HDL)
- HbA_{1c}.

Glycosuria



★ Type-I/Insulin dependent diabetes Mellitus -

• Lack of insulin due to obstruction of pancreatic beta cell due to -

• Viral infection • Autoimmune disorder

Onset - (अवधि)

at about 14 yr of age (Juvenile)

Symptoms - (Hyperglycemia with Glycosuria & ketoacidosis)

- Polyuria (Frequent Urination)
- Polydipsia (excessive Thirst)
- Polyphagia (excessive Hunger)
- Loss of weight, weakness, Tiredness
- NOT obese

Treatment -

Administration of exogenous Insulin is required

★ Type-II/ Non-Insulin dependent diabetes Mellitus -

• decreased sensitivity of target cell to insulin
(Inadequate insulin receptor)

Onset -

After age 40 years (Adult onset diabetes)

Symptoms -

Similar with Type-I but ketoacidosis is

Absent

Treatment -

- diet control.
- exercise
- weight reduction
- drug that increases insulin sensitivity -
Thiazolidinediones & Metformin.

Blood Glucose estimation -

- ✓ GOD-POD
- ✓ Folin-Hu method

15) diabetes insipidus -

Condition - urine Benedict - -ve

Blood Glucose Level - Normal.

Specific Gravity - less than Normal.

Polyuria, Polydipsia.

causes -

① Lack of Antidiuretic H (ADH) / vasopressin.

② Deficient action of ADH on its Target cell

lab.

① - Fluid & food are withheld for 24 Hours

② Body wt, plasma, urine osmolarity measured

16

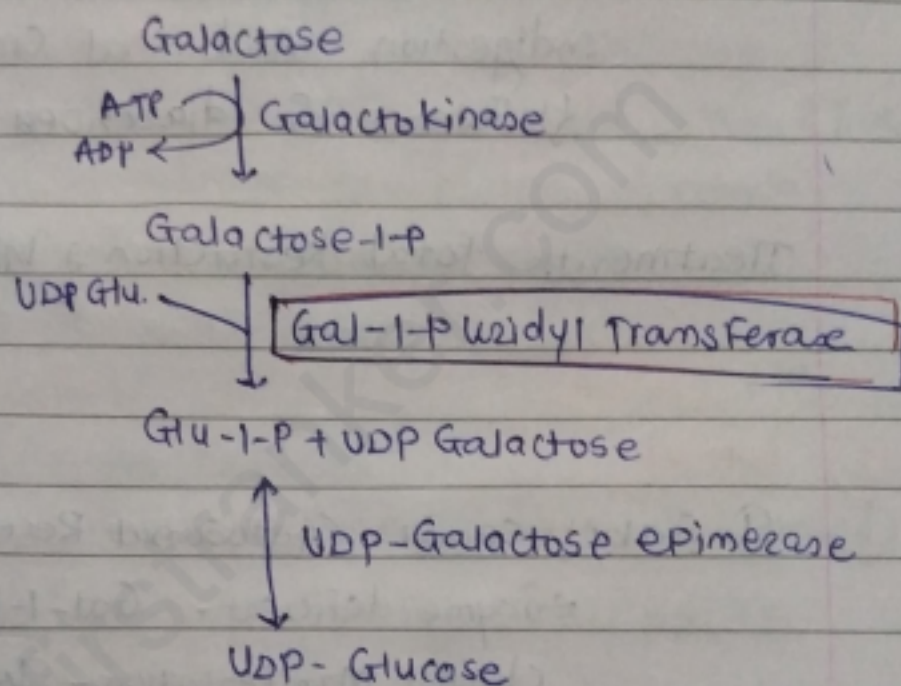
Galactosemia

प्रश्न में direct असेल:

→ ↑ blood Galactose

Symptoms - Mental Retardation & Cataract, liver & Kid. damage, Hepatosplenomegaly & Taundice

Defective enzyme - Galactose-1-Phosphate Uridyl Transf.

Biochemical Test -

- ① estimation of Galactose-1-P-uridyl transferase in RBC (Normal - 4-30 units / gm of Hb)
- ② Blood Galactose level ↑ ed.
- ③ Blood sugar level ↓ ed (Hypoglycemia)
- ④ Galactosuria
- ⑤ Albuminuria & Aminoaciduria.

Role -

Synthesis of Breast milk, glycoprotein, mucopolysaccharide & proteoglycans

⑪ Lactose Intolerance / Milk Intolerance

Abdominal discomfort, feeling of diarrhoea after taking milk.

Cause -

- deficiency of lactase enzyme
- Accumulate in Intestine

Indigestion, Abdominal cramps, flatulence & diarrhoea

Treatment - total Restriction of Milk

19) G6PD deficiency - $\rightarrow$ Hemolytic Anaemia

condition -

Hb-reduced

Unconjugated Bilirubin - $\uparrow$

Antimalarial drug - Primaquine

Red colour urine

defect -

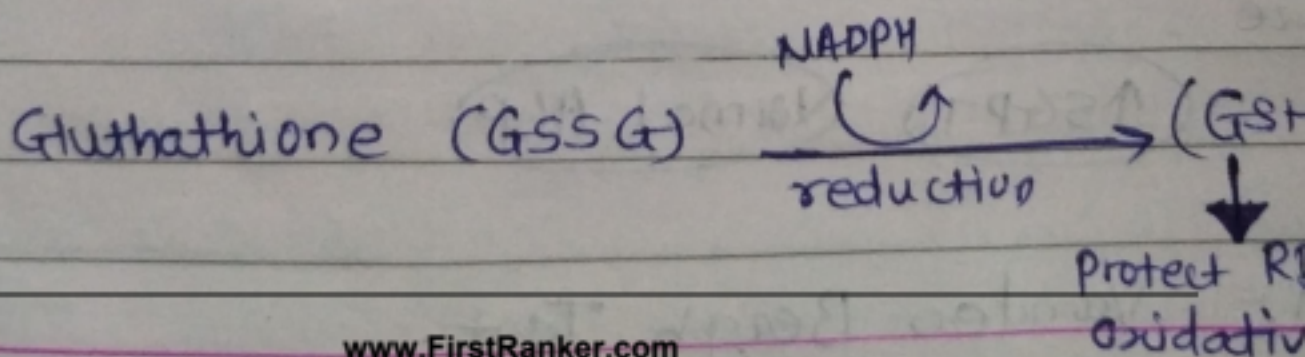
G6PD - (Glucose - 6-phosphate dehydrogenase)

First enzyme in HMP Shunt

Test -

① Intravascular Hemolysis

② Estimation of G6PD level in RBC



(20) Hepatic Jaundice + (Hb Metabolism)

Normal serum Bilirubin - 0.2-1.0 mg/l.

Urinary finding -

Urinary Bilirubin - Present ↑ (conj. & unconj.)

Urinary Bile salt - Absent

Urinary BPG - ↑ed (N ⇒ 0.4-4 mg/24h)

Cause

Stool - clay coloured (Absence of SBG)

Urine - dark coloured (Increased UBG)

(21) Hemolytic Jaundice + (Hb Metabolism)

- Unconjugated Bilirubin Increased.
- Total Bilirubin increased but less than 6 mg/l.
- All enzymes are in Normal Range
- excessive Break down of RBC after treatment of malaria. The heme degraded to form excess of bilirubin which can't be effectively conjugated & Hence increase in unconjugated bilirubin.

Feature

↑SGPT, Normal ALP

Test - Vanden Bergh Test.

Causes - Sickle cell Anemia

Incompatible blood Transfusion

G6PD deficiency

Thalassemia

Malaria

drug. eg - Sulphasalazine & dapsone

(22) Neonatal jaundice (Physiological Jaundice).

(Hb Metabolism)

Causes -

Increased Hemolysis & defective conjugation
of bilirubin.

Complication -

- ↑ in unconjugated bilirubin.
- when level exceed 20 mg %. it cross BBB & cause brainage damage - Kernicterus

Treatment -

Phototherapy.

(23) obstructive Jaundice (Hb Metabolism)

- Bilirubin Present
- UBG Absent

Manifestation - Pain in Abdomen, Jaundice, enlargement of Head of Pancreas, Itching & Fever

Cause -

- Gall stone
- carcinoma of Pancreas
- stricture of bile duct
- Hepatitis
- Alcohol
- Cirrhosis
- secondaries in liver
- Hodgkin disease
- Bacterial Infection

Enzyme for diagnosis -

- Increased level of serum Alkaline Phosphate
- SGPT Increased

Urinary finding -

Urinary bilirubin - Present (Fouchet's & Gmelin's test +ve)

Urinary bile salt - Present (Hay's Sulphur test +ve)

Urinary UBG - Absent (Ehrlich test Negative)

Colour of urine - Dark (↑ bilirubin)

faecal SBG - Absent

Colour of stool - Chalky white, Pale @ clay coloured

24

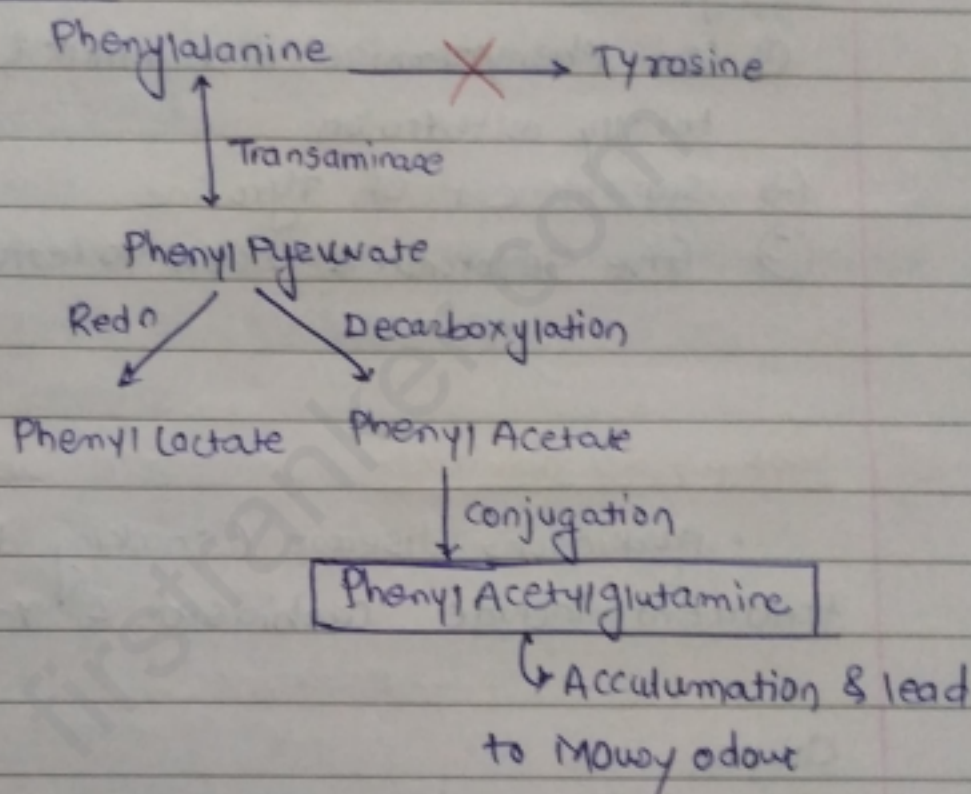
Phenylketonuria (PKU) -

 (Autosomal Recessive Gene)
 (PRN)

Condition -

 Mousy odour to urine
 excretion of Phenyl Pyruvate
 mental retardation, eczema, seizures

Why Mousy odour?



Test -

- ① Fecl₃ Test
- ② Guthrie's Test

 Normal plasma level - 1-2 mg/l

 In PKU level of Phenylalanine - 20-65 mg/l

- ③ Prenatal diagnosis with DNA Probe

effect -

- ① Mental Retardation
- ② Failure to grow properly
- ③ walk & Talk seizure
- ④ Psychosis
- ⑤ Tremors

Types-

- PKU type I - deficiency of Phenylalanine Hydroxylase
PKU type II - defect in H_2 -biopterin reductase
PKU type III - defect in H_2 -biopterin Synthesis

Management-

- ① Low Phenylalanine diet. Milk & Milk Product are totally withdrawn.
- ② Supplement of Tyrosine
- ③ Give Serotonin & DOPA to restore their deficiency

25) Parkinson's disease-

- Parkinson's disease (Shaking Palsy) bcz the treatment include Carbidopa & L-Methyl dopa.

Cause-

to decreased production of dopamine

Manifestation-

Tremors, rigidity, expressionless face, lethargy,
Involuntary movement.

26) Albinism - (Protein Metabolism)

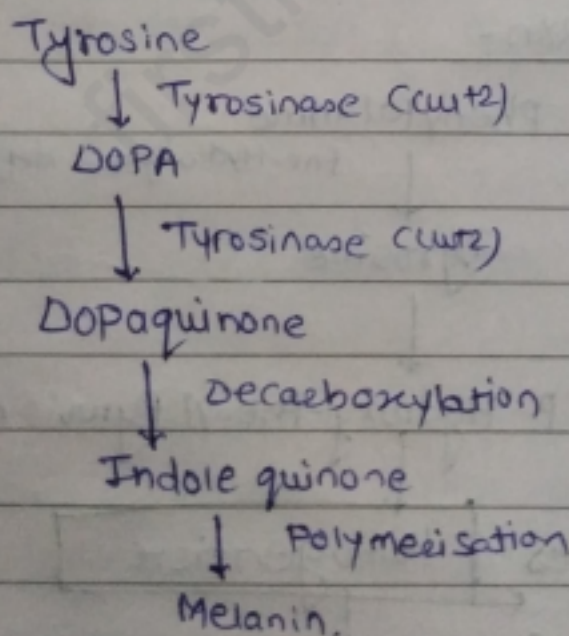
Condition - Lack of Pigmentation (HYPO-pigmentation)
Blue eye & White hair

Defective enzyme - Tyrosinase required for synthesis of Melanin.

Derived Compound -

- ① Melanin.
- ② Catecholamine - dopamine, epinephrin & Norepi
- ③ Thyroid H - T_3 & T_4
- ④ Tyramine

Biochemical Reaction -



Manifestation -

- ① Hypopigmentation of skin, hair, eye
- ② Photophobia (Intolerance to Light)

- ③ ↑ sensitivity to Light
- ④ ↑ chances of skin cancer
- ⑤ Diminished Visual Acuity & Nystagmus.

Types -

- ① Ocular Albinism - Affect only eye & Not skin
- ② Oculo-cutaneous Albinism - ↓ Pigmentation.

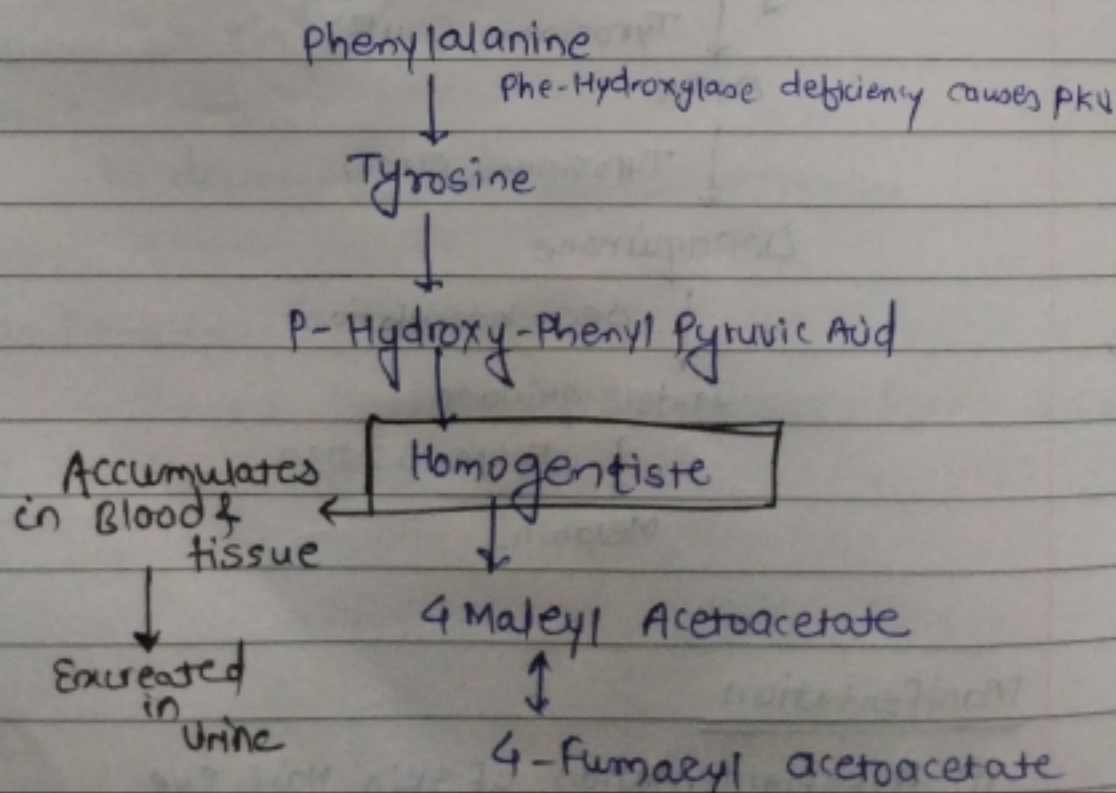
②7 Alkaptonuria - (p.m)

Urine - Coke like colour (Black)

Arthritis

deficient enzyme - Homogentisate oxidase enzyme

Biochemical Rxn -



Treatment - No specific treatment
Provide Low protein diet with low
Phenylalanine & Tyrosine Content.

(28) Hartnup disease - (P.M)

Symptoms - Pellagra, Mental Retardation &
excessive Urinary excretion of
Tryptophan.

Deficiency of Tryptophan & Lead to decreased synth.
of Serotonin & Niacin (NAD^+ & NADP^+)

Diagnosis - (Dibemeyer's Test)

- ① ↑ed Urinary excretion of Tryptophan
- ② ↑ed excretion of Indole Acetic acid.

Treatment -

High protein diet with supplement of Niacin.

(29) Maple syrup urine disease (MSUD) (P.M)

Urine Smell like Burnt sugar
defective enzyme - α -keto acid dehydrogenase

Urinary finding - ↑ excretion of branched chain A.A

Diagnosis - ① Urine + 2,4-dinitro Phenyl Hydrazine in HCl.

② Rothemeyer's test purple ring

③ Chromatography

(30) Vit. A -

Condition - diminished vision of light.
Low Plasma retinol level.

Finding -

- ① Impaired vision.
- ② Night blindness (Nyctalopia)
- ③ Xerophthalmia - dryness of conjunctiva & cornea
- ④ Keratomalacia - Corneal ulceration & degeneration
- ⑤ Bitot's spot - White opaque spot on conjunctiva.

Cycle -

RDA -

Adult - 2500 - 3500 IU

Children - 1500 - 2000 IU

Infant - 1000 IU

Pregnancy & Lactation - 3000 - 4000 IU.

Source -

Rich source - Cod liver oil, & Animal liver

Good source - Milk & Milk Product, egg yolk,
yellow-green fruit vegetable.

• Precursor of Vit. A is Beta-Carotene. It is yellow pigment in fruit & veg. & act as Antioxidant.

③ Vit-D -

Condition - Bone deformities
(Low Ca^{2+} , P, Calcitriol) (High ALP) (High PTH)
Bone Fracture $\rightarrow$ Low bone density.

disease - Rickets

Type -

- Renal Rickets - seen in chronic Renal Failure
- Resistant Rickets - resistant to Vit-D
- Hypophosphatemic rickets - due to defective renal Al^{3+}
- 2° Rickets - due to malabsorption state
- Drug Induced Rickets - Anticonvulsants

Investigation -

- Low serum calcium (N.R - 9-10 mg%)
- Low Serum Phosphate (N.R - 3-4 mg%)
- Low serum Calcitriol (N.R - 25-60 Pg%)
- High ALP (N.R - 3-13 KA Unit)

Treatment -

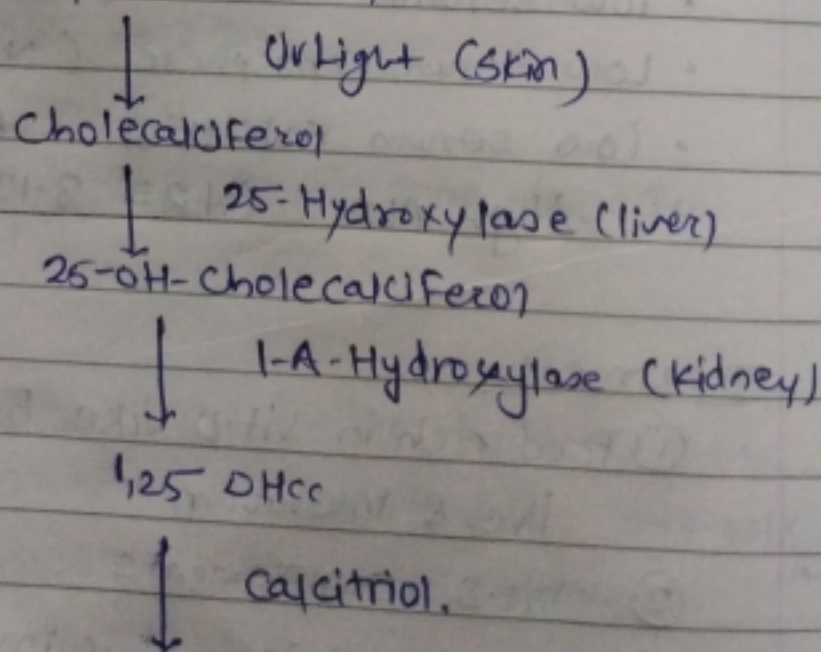
- ① Food rich in Vit-D like Fish, liver oil, egg, yolk, liver & Mushroom
- ② Vit-D supplements
- ③ Food rich in calcium & Phosphorus
eg - milk

Manifestation-

- ① Bossing of forehead.
- ② Bow leg.
- ③ Knocked leg / knee
- ④ Soft & pliable bone
- ⑤ Pigeon chest
- ⑥ Delay in chest formation
- ⑦ Protuding Abdomen (pot belly)
- ⑧ Increased ALP
- ⑨ Low serum Ca^{+2}
- ⑩ Low serum phosphate
- ⑪ Thickening of Wrist & Ankle

Hormone ?

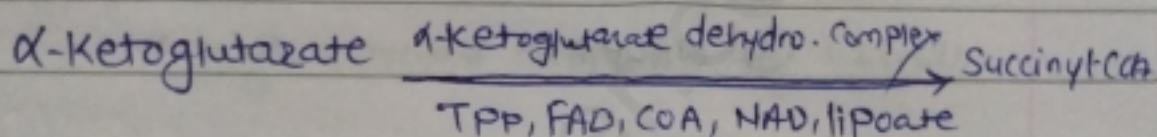
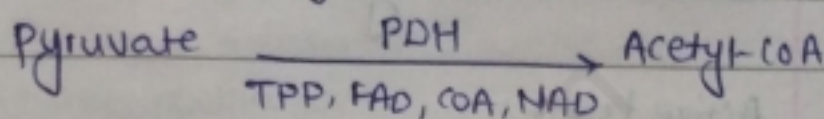
7-dehydrocholesterol

Act on Intestinal mucosa bone to ↑ Ca^{+2}

(32) Thiamine (B₁) - Anorexia, Neuropathy, Muscular Weakness
↑ed Pyruvate level, Memory loss.

Diagnosis - Wernick's encephalopathy / Wernicke's
Korsakoff syndrome / Beri-Beri.

Active form - Thiamine Pyrophosphate (TPP)



Source -

Germinated seed, Unrefined cereals, Nuts &
Pulses, Beans, Lentils, Milk, liver, Egg, meat

ROA -

Adult - 1.2-1.5 mg

Children - 0.7-1.2 mg

Infant - 0.3-0.5 mg

Pregnancy & Lactation - 1.5-1.6 mg

Diagnosis -

① Measurement of Blood Thiamine, Pyruvate &
lactate level

② Assayed by whole blood & trans erythro-
cyte transketolase Activity.

(33)

Niacin (B3)

Symptoms - wt. loss, digestive disorders, dermatitis, depression, poor memory.

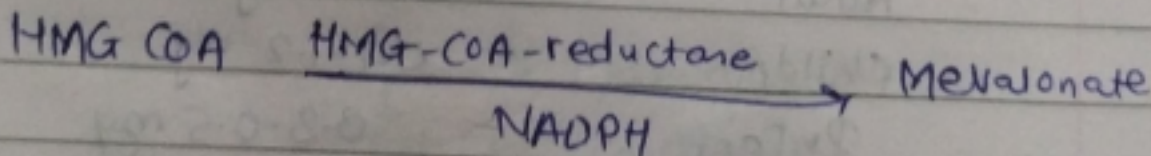
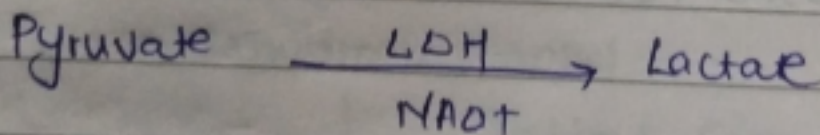
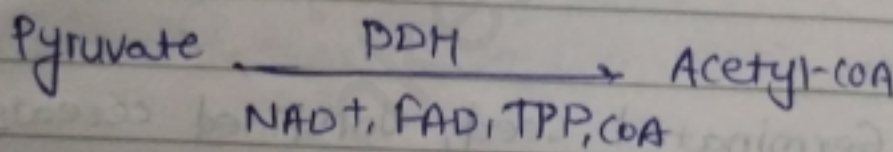
Disorder - Pellagra

Cause - deficiency of vit. Niacin

Active form -

- ① NAD⁺ (Nicotinamide Adenine dinucleotide)
- ② NADP⁺

Reaction -



Precipitating factor -

- ① High corn diet
- ② High lower diet
- ③ Alcoholism
- ④ Vit. B6 deficiency
- ⑤ Carcinoid syndrome

Management -

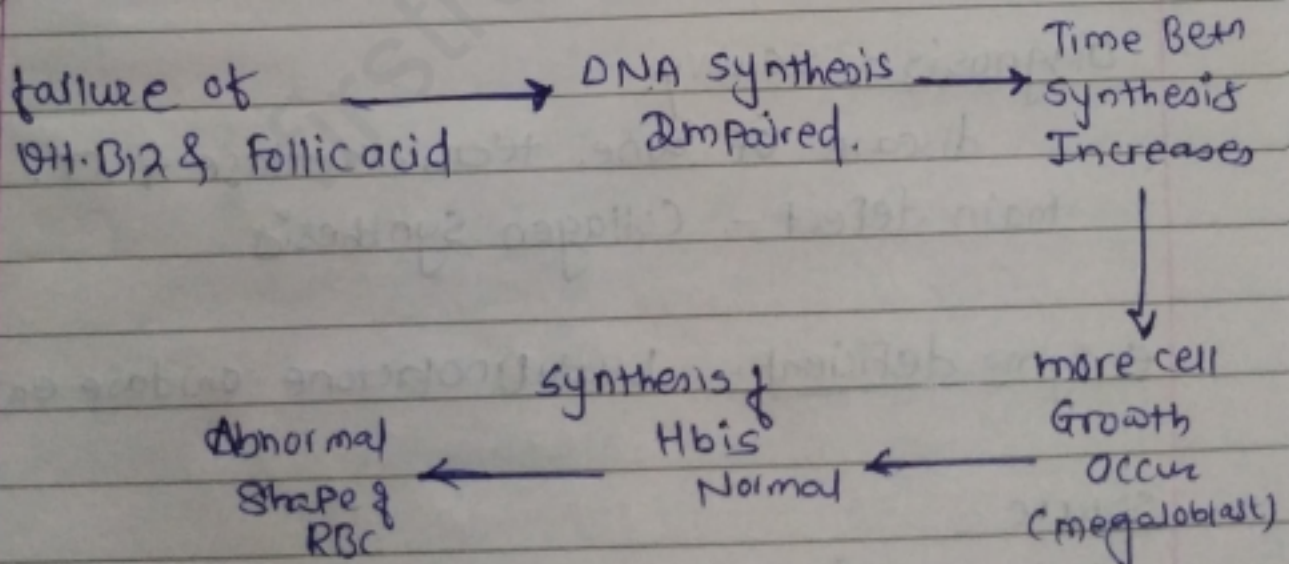
- ① Oral 100 mg. Nicotinamide every 6 H.
- ② Nutrition & High protein diet
- ③ Supplementation of Vit. B with iron & folic acid

36) Folic acid

- Low Haemoglobin level.
- Abnormal Immature erythrocyte
- High elevated excretion of FIGLU.

Biochemical Basis -

Vit. B₁₂ & folic acid constitute DNA.



Why FIGLU - ?



Source -

- Green leafy veg. • Cabbage • Cauliflower • fruit
- liver • kidney • fish • Milk

RDA -

Adult - 150 - 200 μ g

children - 50 - 100 μ g

Infant - 25 - 35 μ g

Pregnancy & Lactation - 300 - 400 μ g.

(3)

Vit. C

Bleeding Gums, swollen conjunctiva, swelling bone, joint

Diagnosis - Scurvy.

disease of bone, teeth, cartilage & CT.

main defect - Collagen synthesis

enzyme deficient - L-Glutonolactone oxidase enzyme

Source -

- Amla • citrus fruit • lemon • lime • orange
- Pineapple • watermelon • tomato • Potato • Green Chilies • Cabbage • Carrot • Green Vegetable

RDA -

Adult - 50-60 mg
children - 40-50 mg
Infant - 30-35 mg
Pregnancy & lactation - 70-95 mg

Function -

- ① formation of CT, bone, teeth, cartilage
- ② Absorption of Iron,
- ③ Collagen synthesis
- ④ Antioxidant
- ⑤ Prevention of infection & disease
- ⑥ synthesis of serotonin, catecholamine, carnitine, bile acid, steroid -

36 Copper -

Green ring around cornea

Brown coloured ring around iris

- Hepatomegaly.

disease - Wilson's disease

RDA - 1.5-3 mg/day

Biochemical Basis -

- ① Accumulation of Cu in organ
- ② ↓ed synthesis of ceruloplasmin
- ③ Reduced binding of Cu with ceruloplasmin

Treatment - Administration of Penicillamine - a copper chelating agent

Copper containing enzyme

- ① Cytochrome oxidase (cozyme of ETC cycle)
- ② Catalase (Protect body from Peroxidase)
- ③ Superoxide dismutase - (Protect from free radicals)
- ④ ALA Synthase - (enzyme for Heme synthesis)

Manifestation -

- ① Hepatic Cirrhosis
- ② Renal damage
- * ③ Kayser Fleischer ring at edge of cornea
- ④ Brain Necrosis
- ⑤ Osteoporosis

Cu deposited in

Liver - Hepatic Cirrhosis
Brain - Brain Necrosis
eye - Kayser Fleischer Ring
Kidney - Kidney damage
Skeleton - Osteoporosis

deficiency of Cu

- Anaemia
- Hypo Pigmentation of skin
- Demyelination of N. tissue
- Greying Hair
- Myocardial fibrosis
- Loss of Ht.

- ③⑦ Zinc - • Growth Failure • Sexual immaturity • Loss of taste acuity • delayed wound healing.

Dietary source - Meat, fish, egg, milk, beans, Nuts

RDA -

Adult - 12-15 mg
Children - 15 mg
Infant - 5 mg
Pregnancy & Lactation - 15-20 mg

Enzyme -

- ① Carbonic Anhydrase $\text{H}_2\text{CO}_3 \xrightarrow{\text{CA}} \text{H}_2\text{O} + \text{CO}_2$
- ② Alcohol dehydrogenase (Oxidation of Alcohol)
- ③ super oxide dismutase (protect cell from toxic O_2^-)
- ④ Alkaline Phosphatase (Active ↑ in bone, liver, Placenta disease)