Biochemistry SAQs

- **Notes:**
- This file contains SAQs but it doesn't cover all of the lecture contents or objectives so read the objectives of each lecture and make sure that you studied them all.
- Don't use shortcuts in the exam.
- Don't stress out the exam will be very easy because basically you are smarter than white paper with black ink, Good Luck !

Done by: Rania Alessa

Lactic Acidosis Lecture:

- Objectives:
- Know the conditions associated with excessive blood lactate production.
- Recognize the importance and consequences of lactate production.
- Identify fates of lactate.
- Relate lactic acidosis Vs skeletal muscle cramp.
- Evaluate lactic acidosis as medical emergency.

- Omar was doing a vigorous exercise which caused sever hypoxia in most of his skeletal muscle tissues, his lactate level was 7
- What can hypoxia cause in this situation ?

Impaired oxidative phosphorylation and decreased ATP synthesis

- What will the body do to survive ?

Switches to anaerobic glycolysis for ATP synthesis which produces lactate as a final product.

- What's the differential diagnosis ?

Lactic Acidosis Type A, the blood lactate level is 7 so the patient has sever lactic acidosis.

- How can we treat it ?

Correcting the underlying conditions.

Restoring adequate tissue oxygen

Avoiding sodium bicarbonate

- Can you mention other tissues rather than skeletal muscle that can have inadequate supply of O2 ?

Myocardial infraction, pulmonary embolism, uncontrolled hemorrhage, tissue hypoprefusion(shock, cardiac arrest, acute heart failure) and anaerobic muscular exercise.

- ..

Lactic Acidosis Lecture:

What's Oxygen debt ?

The amount of O2 required to recover from oxygen deficiency.

What's lactic acidosis ?

Elevation in conc. Of plasma lactate.

How much does the body produce lactate per day ?

1500 mmoles

How does lactate form ?

all tissues can produce lactate under anaerobic conditions and then pyruvate is converted to lactate by lactate dehydrogenase enzyme..

- A patient presented to the ER with history of congenital lactic acidosis due to deficiency of pyruvate dehydrogenase enzyme his blood lactate was 3
- What's the cause of congenital lactic acidosis ?

Deficiency of pyruvate dehydrogenase enzyme.

- What's the diagnosis ?

Lactic acidosis Type B, the blood lactate is 3 so the patient has hyperlactemia.

- Can you mention other causes of the diagnosis ?
- Liver failure
- Drug intoxication
- Chronic hepatic disease accompanied by shock or bleeding
- How can we treat it ?

Correcting the underlying conditions.

Restoring adequate tissue oxygen

Avoiding sodium bicarbonate

Cholesterol metabolism lecture:

Objectives:
Know the structures and functions of cholestrol.
Relate hypercholesterolemia and atherosclerosis.
Define cholestrol biosynthesis and its regulation.
List the factors that decrease blood cholestrol level.
Identify bile salt functions and cholestrol ewecution

A patient presented to the ER with high cholestrol level which lead to atherosclerosis.

What can you give him to decrease his plasma cholestrol level ?

Stain drugs which inhibits the enzyme activity by competitive Inhibition.

What are the functions of cholesterol ?

- Maintains membrane fluidity
- Insulating effect on nerve fibers.
- What are the structures that the cholestrol is the parent molecule for them?
- Bile acids and bile salts
- Steroid hormones
- Vitamin D3

Cholesterol metabolism lecture:

What are the major sites of cholestrol synthesis ?

Liver, adrenal cortex, testes, ovaries and intestine.

Where do the enzymes that is involved in cholestrol biosynthesis located ?

Endoplasmic Reticulum and Cytoplasm.

- What are the major routes that the cholestrol leave the live by ?

Secretion of VLDL

Free cholestrol secreted in the bile.

Conversion to bile acids\salts.

- What are the steps that is involved in cholestrol synthesis ?
- Production of a 5 carbon unit:
- Isopentinyl pyrophosphate (IPP)
- Condensation to a 30C compound:
- Squalene
- Cycliztion of squalene to 30C lanosterol
- Synthesis of 27 Carbon cholestrol.
- What's the rate limiting enzyme in of cholestrol synthesis ?
- HMG CoA

Oxidative phosphorylation:

Objectives:

- Define oxidative stress
- Understand the harmful effects of oxidative stress to the cell and its diseases
- List the types, sources and effects of Reactive Oxygen Species (ROS)
- List various antioxidants in the body
- Understand the role of glutathione system in detoxifying oxidants in the body
- Discuss how G6PD deficiency leads to oxidative stress
- Understand the role of Reactive Nitrogen Species (RNS) in contributing to oxidative stress
- Correlate the role of oxidative stress to pathogenesis of atherosclerosis

What's oxidative stress ?

A condition in which cells are exposed to excessive levels of Reactive Oxygen Species and Reactive Nitrogen Species.

Numerate the diseases that is caused by Oxidative Stress.

Inflammatory diseases (rheumatoid arthritis), Atherosclerosis, Coronary Artery Disease, obesity, cancer and G6PD deficiency hemolytic anemia.

What are the types of ROS ?

Non- free radicals: H_2O_2

Free radicals: Superoxide and hydroxyl radical.

Oxidative phosphorylation:

- What are the sources of ROS ?
- Aerobic metabolism, partial reduction of molecular oxygen in ETC and Ingestion of drugs, toxins and chemicals.
- What are the effects of ROS ?
- Lipid peroxidation (polyunsaturated fatty acids) , DNA damage ,Protein denaturation, Cytoskeletal damage, Chemotaxis, Altered vascular tone, Increased endothelial cell permeability and

What are the antioxidants of the body ?

Enzymes: Superoxide dismutase, Catalase and Glutathione system

Vitamins: Vitamins A, C, E and β-Carotene

What's the role of glutathione system ?

Detoxifies H2O2 by producing NADPH.

How G6PD deficiency lead to Oxidative stress ?

Leads to NADPH deficiency.

Cells are unable to reduce free radicals.

Oxidation of cellular proteins is increased causing impaired cell functions.

How NOS contributes to oxidative stress ?

Increased i-NOS activity ⟶ free radicals ⟶ oxidative stress

Lipoprotein metabolism and atherosclerosis:

- Objectives:
- Define and list the types, structure and composition of lipoproteins
- Understand various functions of lipoprotein particles
- Compare the functions of lipoprotein particles and their implications in disease
- Understand the metabolism of chylomicrons, VLDL and LDL particles
- List the diseases due to imbalance in the metabolism of lipoproteins.
- Correlate the imbalance in lipoprotein metabolism with the development of atherosclerosis
- Understand the functions and metabolism of LDL and HDL cholesterol
- Describe the receptor-mediated endocytosis of LDL and its regulation
- Recognize how LDL is considered a bad cholesterol whereas HDL a good cholesterol
- Understand the biochemistry of atherosclerosis and its laboratory investigations
- Discuss the role of lipoprotein(a) in the development of heart disease

Lipoprotein metabolism and atherosclerosis:

What are the types of lipoprotein ?

Chylomicrons (lowest density, largest), VLDL (very low density lipoproteins), LDL (low density lipoproteins)

And HDL (high density lipoproteins).

What are the compositions of lipoproteins ?

Neutral lipid core (hydrophobic): Triacylglycerols (TAGs) and Cholesteryl esters

Hydrophilic shell: Amphipathic apolipoproteins, Phospholipids and Free cholesterol

What are the functions of Apolipoproteins ?

- Provide structure to lipoprotein particles
- Provide recognition sites for cell-surface receptors
- Activators or coenzymes for the enzymes involved in lipoprotein metabolism

Lipoprotein metabolism and atherosclerosis:

What are the VLDL diseases ?

(مو مقرر علينا الاعراض او العلاج لذلك ما حطيتها على سياق كيس)

1- Hypolipoproteinemia:

Abetalipoproteinemia is due to inability to load apo B with lipids.

Few VLDLs and chylomicrons are formed

TAGs accumulate in liver and intestine

2-Steatohepatitis (Fatty liver disease) : Imbalance between:

TAG synthesis in the liver and Secretion from the liver, which leads to accumulation of TAGs in the liver (fatty liver)

3- Type I hyperlipoproteinemia:

A rare, autosomal recessive disease.

Due to familial deficiency of LPL or its coenzyme (Apo C-II)

Causes excessive accumulation of chylomicrons in plasma (≥1000 mg/dl) (hyperchylomicronemia)

High fasting plasma TAGs are observed in these patients

4-Type III hyperlipoproteinemia

Also called familial dysbetalipoproteinemia, or broad beta disease

Individuals homozygous for apo E-2 are deficient in clearing:

Chylomicron remnants and

IDL from the circulation

Leads to hypercholesterolemia and premature atherosclerosis

Lipoprotein metabolism and atherosclerosis:

- A patient presented to the ER with atherosclerosis symptoms.
- How can you investigate with the test that it is an Atherosclerosis ?
- Fasting serum lipid profile: TAG level (reflects chylomicron and VLDL levels), LDL, HDL levels and Total cholesterol level (reflects LDL, HDL and cholesterol levels)
- Other tests: Serum lipoprotein electrophoresis and Serum apoprotein levels (e.g., apo-B)

MI Biomarkers:

Objectives:

Describe the general sequence of events of myocardial infarction (MI)

- List the criteria for diagnosis of MI
- Discuss the features of an ideal MI marker
- Understand the significance of changes in plasma marker levels over time
- Identify the properties and diagnostic value of cardiac troponins, Creatine kinase, h-FABP and BNP
- Know about markers with potential clinical use

A patient presented to the ER with heart attack with chest pain, shortness of breath and tightness of jaws, the physician noticed that there's rise and gradual fall of cardiac troponin and the typical ECG pattern was abnormal

What's the differential diagnosis ?

Myocardial Infraction.

What are the general sequence of MI ?

1-Occlusion of the coronary arteries

2-Restricted blood supply to the heart tissue

3-Damage to the heart tissue

4-Release of enzymes and proteins into the blood

What are the pathogenesis of MI ?

Atherosclerotic Plaque, Plaque Rupture, thrombosis, Tissue Ischemia, Tissue Necrosis, Myocardial Dysfunction , heart failure.

MI Biomarkers:

- Numerate the features of an ideal marker.

1-High concentration in the myocardium

2-High sensitivity (detected even in low concentration at early stages of the disease)

3-High specificity (specifically detecting damage of cardiac tissue, and is absent in non-myocardial tissue injury)

4-Rapid release into plasma following myocardial injury

5-Easily measured (detectable by rapid, simple and automated assay methods) .

6-Good prognostic value (strong correlation between plasma level and extent of myocardial injury).

Numerate the plasma cardiac markers.

1-Markers of diagnostic value in heart failure:

B-type Natriuretic peptide (BNP)

2-Markers of diagnostic value in MI: Cardiac troponin T and I, Creatine kinase- MB

3-Markers of diagnostic value in Ischemia: Heart fatty acid binding protein (h-FABP)- it has a potential clinical use.