NEET PG Pathology Sample Paper-5

Duration: 20 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **25** Multiple Choice Questions.
- Each correct answer carries **+4** mark. Incorrect answer: **−1** marks. Only **one** correct option.
- Unattempted questions carry **0** marks.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. A 58-year-old male with Type 2 Diabetes Mellitus undergoes a liver biopsy due to elevated transaminases. Histological examination reveals hepatocytes with intracytoplasmic triglyceride droplets of varying sizes. This pathological finding is best characterized as:

(A) Steatonecrosis with attendant acute inflammatory infiltration

(B) Hepatic steatosis representing reversible lipid accumulation

(C) Microvesicular steatosis with mitochondrial dysfunction and hepatocellular necrosis

(D) Cirrhotic transformation with portal hypertension

Q2. A 32-year-old female with a history of recurrent infections and oral candidiasis presents to the clinic. Flow cytometry analysis reveals a CD4+ T-cell count of 180 cells/μL. Which of the following opportunistic pathogens is least likely to manifest clinically at this immunological threshold?

(A) Mycobacterium avium complex (MAC) bacteremia

(B) Pneumocystis jirovecii pneumonia (PCP)

(C) Toxoplasma gondii encephalitis

(D) Candida albicans oesophagitis

Q3. A 56-year-old chronic smoker with long-standing hypertension is found to have severe aortic atherosclerosis at autopsy. Histological examination of the arterial wall reveals extensively lipid-laden macrophages admixed with smooth muscle cells within the intimal layer. Which cellular mechanism most directly contributes to the transformation of macrophages into foam cells in atherosclerotic lesions?

(A) Receptor-mediated endocytosis of native low-density lipoprotein (LDL) particles via LDL receptor binding

(B) Scavenger receptor-mediated uptake of oxidized LDL (oxLDL) without feedback downregulation

(C) Pinocytosis of serum albumin-bound lipid aggregates within tissue fluid

(D) Phagocytosis of apoptotic endothelial cell remnants

Q4. During the acute phase response to bacterial infection, a patient develops significantly elevated serum levels of C-reactive protein (CRP). Which of the following accurately describes the cellular origin and functional mechanism of CRP in acute inflammation?

(A) Synthesized by activated macrophages to opsonize pathogens and enhance complement fixation

(B) Produced by hepatocytes under IL-6 and TNF-alpha stimulation to bind phosphocholine ligands on pathogen surfaces

(C) Released from mast cells during degranulation as a direct mediator of vascular permeability

(D) Secreted by bone marrow B lymphocytes as an immunoglobulin M equivalent

Q5. A 19-year-old previously healthy male presents with acute-onset jaundice, hemoglobinuria, and hemoglobinemia following consumption of fava beans. Laboratory investigation reveals a reticulocytosis of 8% and a Coombs test that is negative. Which enzyme deficiency is responsible for this acute hemolytic crisis?

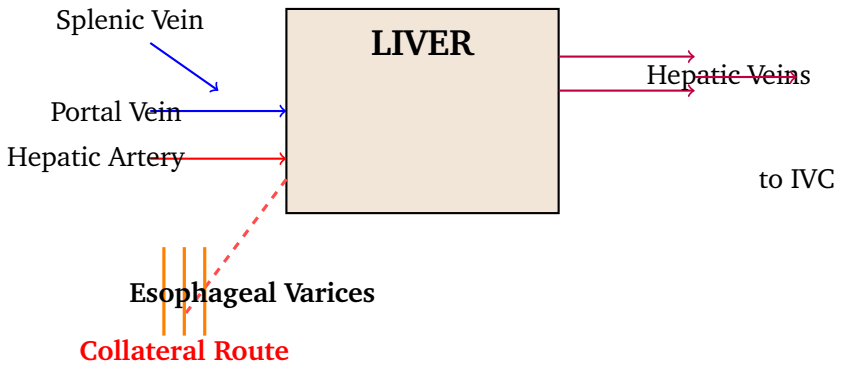
(A) Pyruvate kinase deficiency affecting anaerobic glycolysis

(B) Glucose-6-phosphate dehydrogenase (G6PD) deficiency impairing the pentose phosphate pathway

(C) Hexokinase deficiency limiting glycolytic flux

(D) Spectrin deficiency disrupting erythrocyte membrane integrity

Q6. A 62-year-old male with cirrhosis of the liver presents with variceal bleeding. A detailed anatomical schematic of the portal venous system is depicted below:



Which of the following best describes the haemodynamic mechanism underlying portal hypertensive variceal formation?

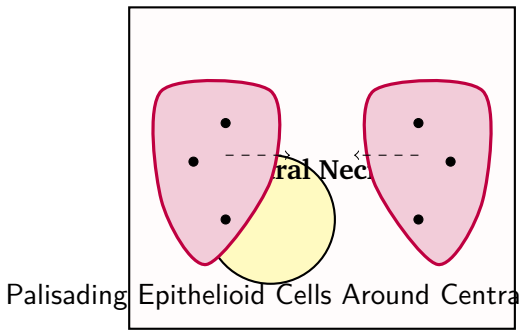
(A) Increased portal venous pressure forcing blood retrograde into esophageal submucosal venous plexuses

(B) Decreased hepatic artery perfusion pressure causing splenic vein engorgement

(C) Direct hepatic vein thrombosis obstructing normal venous outflow

(D) Selective splenomegaly-induced portal vein compression

Q7. A 68-year-old male smoker undergoes a bronchoscopy for evaluation of a suspicious lung nodule. Histopathology reveals a malignant proliferation showing a schematic architectural arrangement as depicted below:



Based on this histopathological architectural pattern, which diagnosis is most consistent?

(A) Small cell lung carcinoma with diffuse necrosis

(B) Squamous cell carcinoma with keratin pearl formation

(C) Adenocarcinoma with central mucin accumulation

(D) Non-small cell carcinoma resembling granulomatous inflammation architecture

Q8. A 28-year-old male with chronic kidney disease presents with fatigue and progressive dyspnea. Serum erythropoietin (EPO) levels are low-normal despite a hemoglobin level of 7.2 g/dL. Which of the following best explains the inadequate erythropoietic response in this patient?

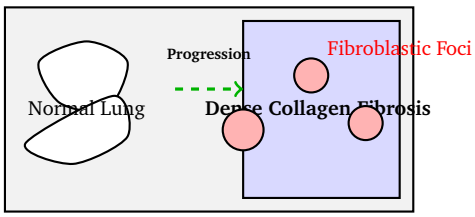
(A) Decreased EPO receptor expression on bone marrow erythroid progenitors

(B) Impaired renal peritubular fibroblast production of EPO secondary to chronic renal dysfunction

(C) Absolute iron deficiency limiting hemoglobin synthesis despite adequate erythropoiesis

(D) Inhibition of EPO by accumulating uremic toxins affecting transcription

Q9. A 55-year-old patient with a history of chronic cough and dyspnea undergoes a high-resolution CT scan of the chest showing a basilar-predominant, reticular interstitial pattern with traction bronchiectasis. A surgical lung biopsy reveals extensive fibrosis with temporal and spatial heterogeneity. The diagram below represents the histological architecture observed:



Which histopathological diagnosis is most consistent with this pattern of lung injury?

(A) Acute Respiratory Distress Syndrome (ARDS) with diffuse alveolar damage

(B) Usual Interstitial Pneumonia (UIP) consistent with Idiopathic Pulmonary Fibrosis

(C) Non-specific Interstitial Pneumonia (NSIP) with uniform temporal features

(D) Respiratory Bronchiolitis-associated Interstitial Lung Disease (RB-ILD)

Q10. A 42-year-old female presents with a tender breast mass and overlying skin dimpling. Biopsy reveals infiltrating ductal carcinoma with evidence of invasion into the dermis. Which of the following represents the most critical molecular alteration underlying the loss of epithelial cell adhesion and consequent invasive phenotype in this carcinoma?

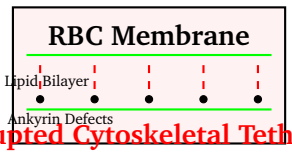
(A) Downregulation of E-cadherin expression via transcriptional suppression or promoter hypermethylation

(B) Upregulation of integrin-mediated focal adhesions to extracellular matrix proteins

(C) Loss of keratin intermediate filament expression converting epithelial to mesenchymal cytoskeleton

(D) Increased expression of tight junction claudins sealing intercellular spaces

Q11. A 7-year-old boy presents with severe hemolytic anemia and jaundice. Osmotic fragility test reveals increased RBC fragility at physiological saline concentrations. Blood smear shows spherocytes and polychromasia. The molecular defect in this patient most likely involves:



Which protein is most likely mutated in Hereditary Spherocytosis?

(A) Beta-globin chain affecting hemoglobin structure

(B) Ankyrin-1 or Spectrin disrupting the membrane cytoskeleton linkage

(C) Glucose-6-phosphate dehydrogenase affecting antioxidant defense

(D) Pyruvate kinase limiting ATP generation for ion pump function

Q12. A 58-year-old male with a 30-year history of alcohol abuse presents with jaundice, ascites, and coagulopathy. Laboratory investigation reveals markedly elevated transaminases and INR of 4.2. Which of the following accurately characterizes the primary pathophysiological mechanism underlying the coagulopathy observed in this patient's advanced liver disease?

(A) Splenic sequestration of platelets secondary to portal hypertension and splenomegaly

(B) Decreased hepatic synthesis of coagulation factors, fibrinogen, and hepatic clearance dysfunction

(C) Disseminated intravascular coagulation secondary to infectious peritonitis

(D) Autoimmune destruction of circulating clotting factors by lupus-like inhibitors

Q13. A 73-year-old female with a history of myocardial infarction five years prior presents with progressive exertional dyspnea. Echocardiography reveals a dilated left ventricle with markedly reduced ejection fraction. Histopathological examination of myocardial tissue obtained via endomyocardial biopsy shows extensive replacement of myocytes by fibrous connective tissue and sparse, degenerative myofibers. Which of the following best characterizes the pathological process observed in post-infarction remodeling?

(A) Acute myocarditis with inflammatory cellular infiltration and myocyte necrosis

(B) Hypertrophic cardiomyopathy with concentric myofiber thickening

(C) Dilated cardiomyopathy with fibrotic replacement and chamber enlargement

(D) Restrictive cardiomyopathy with diastolic dysfunction and infiltrative processes

Q14. A 35-year-old previously healthy male presents with fever, generalized lymphadenopathy, hepatosplenomegaly, and atypical lymphocytosis on peripheral blood smear. Serological testing is positive for heterophile antibodies (Monospot test). Which of the following represents the correct pathogenesis of the lymphocytosis observed in this acute infectious condition?

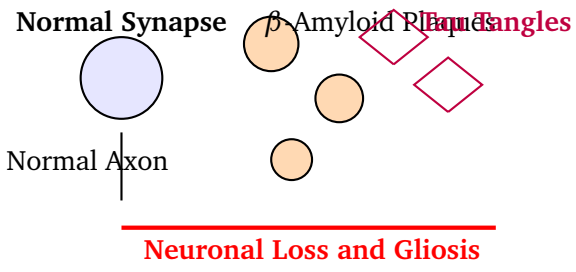
(A) Clonal proliferation of malignant B lymphocytes with suppression of normal T-cell function

(B) Polyclonal activation and expansion of CD8+ T lymphocytes responding to Epstein-Barr virus (EBV) antigen presentation

(C) Reactive myeloproliferation of immature granulocytic precursors

(D) Suppurative transformation of lymph node architecture with abscess formation

Q15. A 71-year-old male with progressive cognitive decline and memory loss undergoes neuropsychological testing confirming dementia. MRI shows generalized cerebral atrophy with hippocampal shrinkage. Neuropathology reveals extensive amyloid-beta plaques and neurofibrillary tangles composed of hyperphosphorylated tau protein. The diagram below illustrates the molecular pathology:



Which of the following most accurately describes the primary pathogenic mechanism in Alzheimer's disease?

(A) Amyloid cascade hypothesis: abnormal amyloid-beta accumulation triggers tau hyperphosphorylation and neurodegeneration

(B) Tau-first hypothesis: primary tau pathology initiates amyloid-beta deposition

(C) Inflammatory microglia activation hypothesis: neuroinflammation drives neuronal death independently of amyloid and tau

(D) Cholinergic deficit hypothesis: loss of acetylcholine-producing neurons is the sole driver of cognitive decline

Q16. A 45-year-old male with a family history of early coronary artery disease presents with recurrent tendon xanthomas and arcus cornealis. Plasma cholesterol levels exceed 600 mg/dL. Genetic testing reveals a heterozygous mutation in the LDL receptor gene. Which of the following best explains the molecular consequence of this genetic defect?

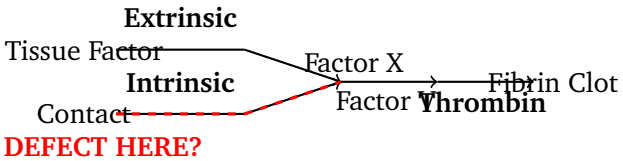
(A) Reduced LDL receptor expression on hepatocytes limiting LDL particle uptake and clearance

(B) Defective apolipoprotein B-100 synthesis leading to impaired lipoprotein assembly

(C) Increased lipoprotein lipase activity accelerating triglyceride hydrolysis

(D) Enhanced reverse cholesterol transport via apolipoprotein A-I

Q17. A 52-year-old patient with persistent bleeding manifestations is referred for coagulation studies. Laboratory results reveal: PT normal, activated partial thromboplastin time (aPTT) prolonged, platelet count normal, and bleeding time normal. A mixing study corrects the aPTT, confirming a factor deficiency. The coagulation cascade diagram is depicted below:



Based on the laboratory pattern and the diagram, which clotting factor is most likely deficient?

(A) Factor II (Prothrombin)

(B) Factor VIII (Antihemophilic Factor)

(C) Factor VII (Stable Factor)

(D) Factor X (Stuart-Prower Factor)

Q18. A 38-year-old female with severe hypertension presents with tremor, excessive sweating, and palpitations. Laboratory studies reveal elevated 24-hour urinary metanephrines and catecholamine metabolites. Imaging identifies a 4 cm adrenal mass. Which of the following represents the most characteristic histopathological hallmark of pheochromocytoma?

(A) Sheets of polygonal chief cells with abundant granular cytoplasm and central nuclei

(B) Delicate fibrovascular network (sustentacular cells) supporting tumor cells with neurosecretory granules

(C) Diffuse infiltration of round blue cells with scant cytoplasm and nuclear molding

(D) Sheets of fusiform cells with nuclear palisading simulating schwannoma architecture

Q19. A 68-year-old male with chronic kidney disease stage 4 presents with fatigue and dyspnea. Serum calcium is low-normal despite high-normal phosphate levels. X-ray of the hand shows soft tissue calcification around the joints. This systemic pathology is best characterized as:

(A) Dystrophic calcification in response to localized hypoxia and tissue necrosis

(B) Metastatic calcification secondary to elevated serum calcium-phosphate product exceeding solubility equilibrium

(C) Vascular calcification driven by deficiency of pyrophosphate-mediated inhibitors of mineralization

(D) Granulomatous calcification as a response to chronic foreign body irritation

Q20. A 55-year-old male with a 20-year history of type 2 diabetes presents with progressive renal dysfunction. Serum creatinine is 3.2 mg/dL and proteinuria is 4.5 g/day. Renal biopsy reveals thickening of the glomerular basement membrane and nodular glomerulosclerosis. Which of the following best characterizes the primary glomerular lesion in diabetic nephropathy?

(A) Proliferative glomerulonephritis with crescent formation

(B) Nodular glomerulosclerosis (Kimmelstiel-Wilson disease) with basement membrane thickening

(C) Focal segmental glomerulosclerosis with visceral epithelial cell collapse

(D) Membranous glomerulonephritis with subepithelial immune complex deposits

Q21. A 25-year-old male with sickle cell disease presents with acute chest pain and dyspnea. Chest X-ray shows a new pulmonary infiltrate. Which of the following mechanisms best explains the acute chest syndrome observed in this patient's hemoglobinopathy?

(A) Microvascular obstruction by polymerized hemoglobin S leading to infarction and fat embolism

(B) Acute leukemia transformation of bone marrow with metastatic lung infiltration

(C) Direct pulmonary infection by encapsulated bacteria due to functional asplenia

(D) Acute left ventricular failure secondary to chronic aortic regurgitation

Q22. A 45-year-old female undergoes abdominal hysterectomy for uterine fibroids. Histopathological examination of the specimen reveals a benign leiomyoma composed of interlacing bundles of smooth muscle cells with abundant collagen stroma. Which of the following best describes the cellular and molecular origin of uterine leiomyomas?

(A) Clonal proliferation of myometrial smooth muscle cells with altered growth factor responsiveness

(B) Polyclonal hyperplasia of skeletal muscle cells migrating from muscularis propria

(C) Neoplastic transformation of peritoneal mesothelial cells

(D) Metaplastic ossification of endometrial connective tissue

Q23. A 65-year-old patient presents with profound hypovolemic shock following massive gastrointestinal hemorrhage. Despite aggressive fluid resuscitation, the patient develops multi-organ dysfunction within hours. Which of the following best characterizes the pathophysiological sequence in irreversible shock?

(A) Compensatory vasoconstriction and tachycardia initially maintain perfusion, but progressive cellular hypoxia and metabolic acidosis lead to irreversible mitochondrial dysfunction

(B) Direct myocardial depression from circulating endotoxins overwhelms catecholamine compensation

(C) Selective renal ischemia causing acute tubular necrosis with consequent electrolyte derangement

(D) Massive release of lysosomal enzymes causing generalized tissue autodigestion

Q24. A 35-year-old male presents with fever, night sweats, and generalized lymphadenopathy. Lymph node biopsy reveals capsular thickening and fibrosis with nodular collections of abnormal cells. Immunohistochemistry shows CD30+ and CD15+ cells. Flow cytometry analysis demonstrates monoclonal B-cell population. Which of the following represents the most likely diagnosis?

(A) Diffuse large B-cell lymphoma (DLBCL) with secondary nodal involvement

(B) Nodular sclerosis Hodgkin lymphoma with characteristic Reed-Sternberg cells

(C) Follicular lymphoma with nodular growth pattern

(D) Burkitt lymphoma with high proliferation index

Q25. A 19-year-old male with a history of bleeding tendencies presents with petechiae, mucosal bleeding, and epistaxis. Laboratory evaluation reveals: platelet count $18,000/\mu$L, normal PT and aPTT, normal bleeding time. The bone marrow aspiration shows numerous megakaryocytes. Which of the following best characterizes the pathophysiological defect in this patient's thrombocytopenia?

(A) Impaired platelet production secondary to megakaryocytic hypoplasia

(B) Immune-mediated platelet destruction with compensatory megakaryocytic hyperplasia

(C) Disseminated intravascular coagulation with consumption of circulating platelets

(D) Dilutional thrombocytopenia secondary to massive transfusion

Detailed Solutions

Q1.

Solution

Concept:

Hepatic steatosis represents abnormal triglyceride accumulation within hepatocytes, manifesting as intracytoplasmic lipid droplets visible on histological examination. Understanding the pathological distinctions between reversible steatosis and irreversible steatonecrosis is critical for assessing liver disease severity and progression potential.

Solution:

(a) Type 2 Diabetes Mellitus creates a metabolic environment favoring hepatic lipid accumulation through impaired fatty acid oxidation and increased hepatic de novo lipogenesis.

(b) Histologically, the presence of varying-sized triglyceride droplets within hepatocytes defines hepatic steatosis, a potentially reversible lipid storage disorder.

(c) This pathological process reflects an imbalance between lipid acquisition (uptake and synthesis) and lipid disposal (oxidation and export as VLDL).

(d) The key distinction is that simple hepatic steatosis lacks associated hepatocellular necrosis, inflammatory infiltration, or fibrotic changes.

(e) When steatosis progresses to include hepatocellular injury, inflammation, and oxidative stress, it becomes nonalcoholic steatohepatitis (NASH).

(f) Microvesicular steatosis, characterized by small, numerous lipid droplets with peripheral nuclei, is associated with acute mitochondrial dysfunction and carries a grave prognosis.

(g) Cirrhotic transformation requires years of chronic hepatic inflammation and repeated injury cycles.

Final Answer: This pathological finding is best characterized as hepatic steatosis representing reversible lipid accumulation.

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept:

Advanced HIV disease with profound T-cell immunosuppression creates distinct opportunistic infection risks dependent on specific CD4+ count thresholds. Knowing these thresholds guides prophylaxis and infection surveillance strategies.

Solution:

(a) A CD4+ count of 180 cells/μL indicates severe immunosuppression in advanced AIDS.

(b) Each opportunistic pathogen has a characteristic CD4+ count threshold below which the risk of disease manifestation dramatically increases.

(c) Mycobacterium avium complex (MAC) bacteremia typically emerges when CD4+ counts fall below 50 cells/μL, making it extremely unlikely at a count of 180.

(d) Pneumocystis jirovecii pneumonia (PCP) typically occurs when CD4+ counts fall below 200 cells/μL.

(e) Toxoplasma gondii encephalitis typically manifests when CD4+ counts are below 100 cells/μL.

(f) Candida albicans oesophagitis can occur at relatively higher CD4+ counts, often manifesting between 200-100 cells/μL.

(g) At a CD4+ count of 180 cells/μL, the patient is at immediate risk for PCP, toxoplasmosis, and oral candidiasis, but MAC bacteremia remains unlikely.

Final Answer: Mycobacterium avium complex (MAC) bacteremia is least likely at this CD4+ count threshold.

Answer: (A)

Go Back to Question 2

Q3.

Solution

Concept:

Foam cell transformation is a pivotal event in atherosclerotic lesion initiation. The mechanism by which macrophages become lipid-laden foam cells differs fundamentally from normal lipoprotein metabolism, explaining the progressive nature of atherosclerotic disease.

Solution:

(a) Within atherosclerotic plaques, smooth muscle cells and macrophages accumulate lipid, transforming into foam cells that comprise the earliest fatty streak lesions.

(b) Native LDL particles circulating in plasma are normally taken up by hepatocytes through LDL receptor-mediated endocytosis, a highly regulated process.

(c) However, when LDL particles reside in the arterial intimal space, they undergo oxidative modification, becoming oxidized LDL (oxLDL) through reaction with reactive oxygen species.

(d) OxLDL is recognized by macrophage scavenger receptors (SR-A and SR-B), which lack the feedback downregulation present on classical LDL receptors.

(e) This unregulated uptake allows macrophages to ingest excessive lipid, rapidly accumulating cholesteryl esters and transforming into foam cells.

(f) Unlike LDL receptor-mediated uptake, scavenger receptor-mediated oxLDL uptake continues unabated even when intracellular lipid levels are high.

(g) This pathological distinction explains why atherosclerosis progresses despite normal systemic lipid levels in some individuals.

Final Answer: The mechanism is scavenger receptor-mediated uptake of oxidized LDL without feedback downregulation.

Answer: (B)

Go Back to Question 3

Q4.

Solution

Concept:

The acute phase response is a coordinated systemic reaction to infection and inflammation involving rapid synthesis of circulating proteins that enhance pathogen clearance and immune activation. Understanding the cellular origin and function of these mediators is essential for interpreting inflammatory laboratory markers.

Solution:

(a) C-reactive protein is a pentameric protein synthesized in response to systemic inflammation, making it a classical acute phase reactant.

(b) Hepatocytes, not macrophages or mast cells, synthesize CRP in response to the pro-inflammatory cytokines IL-6 and TNF-alpha released during acute infection.

(c) IL-6 binds to hepatocyte surface receptors, activating the JAK-STAT signaling pathway and increasing transcription of the CRP gene.

(d) Once secreted, CRP circulates in the blood and binds to phosphocholine moieties on the surfaces of microorganisms and apoptotic cells.

(e) This binding serves two critical functions: enhancement of complement activation via the classical pathway and opsonization of pathogens for phagocytic destruction.

(f) CRP is not an immunoglobulin, and macrophage-derived IL-6 is a stimulator, not a source, of CRP.

(g) Measuring serum CRP levels provides rapid assessment of systemic inflammation severity and treatment response.

Final Answer: CRP is produced by hepatocytes under IL-6 and TNF-alpha stimulation to bind phosphocholine ligands on pathogen surfaces.

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept:

Glucose-6-phosphate dehydrogenase deficiency predisposes to acute hemolytic crises triggered by oxidative stress, despite maintaining normal hemoglobin structure. The enzyme's critical role in antioxidant defense explains why exposure to specific triggering agents precipitates hemolysis in susceptible individuals.

Solution:

(a) The clinical presentation describes acute hemolysis characterized by hemoglobinuria, hemoglobinemia, elevated reticulocytosis, and negative Coombs test, ruling out immune-mediated hemolysis.

(b) The classic trigger of fava bean ingestion combined with acute hemolytic crisis in a previously healthy male strongly suggests G6PD deficiency.

(c) Glucose-6-phosphate dehydrogenase catalyzes the first step of the pentose phosphate pathway, generating NADPH, which is essential for reducing oxidative damage via glutathione antioxidant systems.

(d) When G6PD is deficient, red blood cells cannot adequately neutralize reactive oxygen species generated by oxidative stress, leading to lipid peroxidation and hemoglobin denaturation.

(e) Fava beans contain oxidative compounds, and their ingestion precipitates oxidative stress in G6PD-deficient individuals, causing acute intravascular hemolysis.

(f) Other enzyme deficiencies produce different clinical patterns: pyruvate kinase deficiency causes chronic hemolysis independent of triggering agents, and spectrin defects cause hereditary spherocytosis without oxidative triggers.

Final Answer: The enzyme deficiency is glucose-6-phosphate dehydrogenase (G6PD) impairing the pentose phosphate pathway.

Answer: (B)

Go Back to Question 5

Q6.

Solution

Concept:

Portal hypertension develops when intrahepatic resistance to blood flow increases, forcing portal venous blood to seek alternative, lower-pressure collateral pathways. Esophageal varices form within these collateral networks, representing a life-threatening complication of advanced liver disease.

Solution:

(a) Cirrhotic liver disease destroys normal hepatic parenchymal architecture, replacing it with fibrous bands and regenerative nodules.

(b) These structural changes compress hepatic sinusoids and increase resistance to portal blood flow through the organ.

(c) Portal venous pressure rises progressively, reaching levels that activate opening of pre-existing, normally quiescent porto-systemic anastomoses.

(d) The esophageal venous system contains a critical anastomosis between the left gastric (coronary) vein, which drains the stomach and lower esophagus via the portal system, and the esophageal and azygos veins, which drain directly into the systemic superior vena cava.

(e) When portal pressure exceeds systemic venous pressure, blood preferentially diverts retrograde through the esophageal submucosa, dilating thin-walled venous plexuses into fragile varices.

(f) These engorged vessels are highly susceptible to rupture from mechanical trauma or mucosal ulceration, causing catastrophic upper gastrointestinal hemorrhage.

(g) The diagram illustrates this hemodynamic reversal, with high-pressure portal blood preferentially shunting into the low-pressure systemic azygos venous network.

Final Answer: Portal hypertensive variceal formation occurs due to increased portal venous pressure forcing blood retrograde into esophageal submucosal venous plexuses.

Answer: (A)

Go Back to Question 6

Q7.

Solution

Concept:

Lung cancers exhibit diverse histological patterns, each with distinct architectural organizations and biological behaviors. Recognizing palisading cell arrangements surrounding areas of necrosis guides differential diagnosis and treatment selection.

Solution:

(a) The schematic illustrates a malignant lung neoplasm displaying epithelioid tumor cells arranged in a palisading pattern circumscribing a central area of necrosis.

(b) This specific architectural pattern closely mimics granulomatous inflammation, where histiocytes (activated macrophages) arrange radially around central caseous debris.

(c) Small cell lung carcinoma presents as small, round cells with minimal cytoplasm, typically displaying diffuse sheets without palisading, and often demonstrates necrosis but without organized palisading architecture.

(d) Squamous cell carcinoma characteristically displays keratin pearl formation, where concentric layers of keratinized cells create whorl-like structures, not palisading epithelioid cells.

(e) Adenocarcinoma presents with glandular structures and mucin accumulation, not epithelioid palisading.

(f) Large cell lung carcinoma, a non-small cell variant, displays large polygonal cells arranged in sheets and often with central necrosis, closely resembling the depicted granulomatous architecture.

(g) This appearance can mimic granulomatous inflammation, potentially delaying diagnosis if immunohistochemical markers are not employed.

Final Answer: This pattern is consistent with non-small cell carcinoma resembling granulomatous inflammation architecture.

Answer: (D)

Go Back to Question 7

Q8.

Solution

Concept:

Renal anemia results from impaired erythropoietin production in chronic kidney disease, leading to inadequate stimulation of bone marrow erythropoiesis. Understanding the cellular source and regulation of EPO production is essential for managing anemia in renal patients.

Solution:

(a) Chronic kidney disease destroys functional nephrons and the peritubular fibroblasts responsible for EPO synthesis and secretion.

(b) Normally, the renal cortex and outer medulla contain fibroblasts that respond to tissue hypoxia by increasing EPO gene transcription and releasing EPO into the bloodstream.

(c) In advanced CKD, the progressive loss of functioning nephrons reduces the population of EPO-producing fibroblasts, resulting in inadequate EPO levels despite the patient's significant anemia.

(d) The low-normal EPO level combined with severe anemia represents a fundamental mismatch between the degree of anemia and the erythropoietic response.

(e) In normal physiology, such severe anemia would trigger robust EPO increases, attempting to drive red cell production back to normal.

(f) The impaired renal EPO response prevents adequate compensatory erythropoiesis, perpetuating the anemia.

(g) This pathophysiology is distinct from absolute iron deficiency, which would show normal or elevated EPO but inadequate iron for hemoglobin synthesis.

Final Answer: The inadequate response is explained by impaired renal peritubular fibroblast production of EPO secondary to chronic renal dysfunction.

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept:

Idiopathic pulmonary fibrosis represents the prototype of interstitial lung disease, characterized by progressive, irreversible fibrosis with a distinctive histopathological pattern that guides diagnosis and prognosis estimation.

Solution:

(a) The clinical and radiological findings of basilar-predominant reticular disease with traction bronchiectasis are highly characteristic of advanced interstitial lung disease.

(b) The key diagnostic histopathological feature is temporal and spatial heterogeneity, demonstrating patches of active fibroblastic proliferation alongside areas of dense, mature collagen deposition.

(c) Temporal heterogeneity refers to the coexistence of fibroblastic foci (early, active fibroblast proliferation) with old, established collagen scars, indicating ongoing waves of injury and repair.

(d) Spatial heterogeneity indicates that fibrosis is patchily distributed, with normal lung parenchyma alternating directly with fibrotic areas within the same tissue section.

(e) This pattern defines Usual Interstitial Pneumonia (UIP), the histological correlate of Idiopathic Pulmonary Fibrosis (IPF).

(f) Non-Specific Interstitial Pneumonia exhibits uniform, temporally homogenous inflammation without fibroblastic foci or dense collagen.

(g) Desquamative Interstitial Pneumonia shows diffuse intra-alveolar macrophage accumulation rather than fibrosis.

(h) The diagram clearly illustrates normal lung alternating with dense fibrosis and active fibroblastic foci, consistent with UIP.

Final Answer: The diagnosis is Usual Interstitial Pneumonia (UIP) consistent with Idiopathic Pulmonary Fibrosis.

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept:

The transition from in situ to invasive carcinoma requires loss of normal epithelial cell-cell adhesion. Understanding the molecular alterations underlying this transition is critical for comprehending cancer progression and metastatic potential.

Solution:

(a) The patient presents with infiltrating ductal carcinoma invading the dermis, representing progression beyond non-invasive disease.

(b) This transition from non-invasive to invasive phenotype is fundamentally dependent on loss of E-cadherin, a calcium-dependent cell adhesion molecule that links epithelial cells into organized, polarized sheets.

(c) E-cadherin is a tumor suppressor whose loss enables epithelial-to-mesenchymal transition (EMT), allowing cells to disassemble from the epithelial architecture and invade surrounding stroma.

(d) Transcriptional repression of E-cadherin can occur through activation of zinc finger transcription factors like SNAIL, SLUG, and ZEB, or through epigenetic hypermethylation of the E-cadherin promoter.

(e) Loss of E-cadherin abolishes the adhesive connections that normally confine epithelial cells within organized layers above the basement membrane.

(f) Upregulation of integrins and increased integrin-ECM interactions actually promote invasive migration, so these changes complement rather than initiate invasion.

(g) Keratin loss represents a secondary consequence of EMT rather than a primary driver.

Final Answer: The critical alteration is downregulation of E-cadherin expression via transcriptional suppression or promoter hypermethylation.

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept:

Hereditary spherocytosis results from defects in the red blood cell cytoskeletal architecture, disrupting the normal linkages between the lipid bilayer and the underlying cytoskeletal network. These defects impair the cell's ability to maintain its deformable biconcave shape, predisposing to splenic sequestration and hemolysis.

Solution:

(a) The clinical presentation describes a young child with spherocytes, increased osmotic fragility, and hemolytic anemia, all hallmark features of hereditary spherocytosis.

(b) Osmotic fragility testing demonstrates that these cells lyse at higher saline concentrations than normal, reflecting their reduced surface-area-to-volume ratio and diminished ability to accommodate fluid influx.

(c) The red blood cell membrane maintains its biconcave shape through a spectral network of proteins, including spectrin, ankyrin, band 3, and protein 4.2.

(d) Ankyrin acts as a critical bridging protein, anchoring the N-terminal end of beta-spectrin to the cytoplasmic tail of band 3, a transmembrane protein in the lipid bilayer.

(e) This tethering mechanism maintains the structural integrity of the membrane skeleton.

(f) Mutations in ankyrin-1 or spectrin genes disrupt this linkage, causing the membrane skeleton to detach from the lipid bilayer.

(g) The detached lipid gradually blebs away, the cell becomes progressively more spherical, and it eventually is trapped and destroyed in the spleen.

(h) Beta-globin mutations cause sickle cell disease, G6PD deficiency causes oxidative hemolysis, and pyruvate kinase deficiency impairs glycolytic ATP generation.

Final Answer: The protein mutation is most likely ankyrin-1 or spectrin disrupting the membrane cytoskeleton linkage.

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept:

Advanced liver cirrhosis disrupts the synthetic function of hepatocytes, impairing the production of coagulation factors and plasma proteins essential for normal hemostasis. Understanding this mechanism of coagulopathy guides appropriate therapeutic interventions.

Solution:

(a) The patient presents with clinical signs of advanced cirrhosis: jaundice, ascites, and severe coagulopathy.

(b) The laboratory pattern of markedly elevated INR, reflecting prolonged prothrombin time, indicates deficiency of factors in the extrinsic coagulation cascade.

(c) All vitamin K-dependent factors (II, VII, IX, X) and fibrinogen are synthesized in hepatocytes.

(d) In advanced cirrhosis, the destruction of hepatic parenchyma progressively reduces the number of functioning hepatocytes, impairing their synthetic capacity.

(e) The liver normally synthesizes factors II, V, VII, VIII, IX, X, XI, XII, and XIII, as well as fibrinogen and natural anticoagulants like proteins C and S.

(f) With declining hepatic synthetic function, the levels of all these factors decrease, prolonging PT and aPTT.

(g) Additionally, the cirrhotic liver loses its ability to clear activated clotting factors and fibrin degradation products from circulation, promoting pathological thrombin generation.

(h) Splenic sequestration of platelets from portal hypertension and splenomegaly contributes to thrombocytopenia but does not directly cause coagulation factor deficiency.

(i) DIC occurs as a secondary complication in patients with infected ascites, but primary cirrhosis creates coagulopathy through synthetic dysfunction.

Final Answer: The mechanism is decreased hepatic synthesis of coagulation factors, fibrinogen, and hepatic clearance dysfunction.

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept:

Post-infarction cardiac remodeling represents a maladaptive response to myocardial necrosis, characterized by progressive chamber dilation, fibrotic replacement of myocytes, and deteriorating ventricular function. Understanding the temporal sequence of these changes is essential for interventions aimed at limiting remodeling.

Solution:

(a) The patient presents with dilated cardiomyopathy developing five years after acute myocardial infarction, representing post-infarction ventricular remodeling.

(b) Immediately following acute infarction, necrotic myocytes are replaced by granulation tissue, which progressively matures into dense fibrous scar.

(c) Over subsequent years, the scar tissue progressively replaces the dead myocardium, and the infarct-related wall thins and becomes akinetic.

(d) Simultaneously, the viable myocardium remote from the infarct undergoes hypertrophy and progressive stretching, attempting to compensate for the loss of functioning myocardium.

(e) This chronic hemodynamic overload triggers pathological hypertrophy characterized by eccentric chamber dilation and myocyte elongation.

(f) Neurohumoral activation, including the renin-angiotensin-aldosterone system, perpetuates myocyte hypertrophy and stimulates fibroblast activation, promoting collagen deposition throughout the ventricle.

(g) The result is a progressively dilating, dysfunctional ventricle with a thin scar and scattered, degenerative hypertrophied myocytes interspersed with extensive fibrotic replacement.

(h) This histological picture defines dilated cardiomyopathy of ischemic origin.

Final Answer: The pathological process is dilated cardiomyopathy with fibrotic replacement and chamber enlargement.

Answer: (C)

Go Back to Question 13

Q14.

Solution

Concept:

Acute infectious mononucleosis caused by Epstein-Barr virus (EBV) triggers a vigorous cellular immune response that manifests as lymphocytosis on peripheral blood examination. Understanding the lineage of the proliferating cells guides accurate diagnosis and prognosis.

Solution:

(a) The patient presents with fever, lymphadenopathy, hepatosplenomegaly, and atypical lymphocytosis on blood smear, all classic features of acute EBV-induced mononucleosis.

(b) The Monospot test detects heterophile antibodies (IgM antibodies that cross-react with sheep red blood cells), confirming EBV infection.

(c) EBV infects and immortalizes B lymphocytes through expression of latent membrane proteins that block apoptotic signals and stimulate B-cell proliferation.

(d) However, the marked lymphocytosis observed in acute mononucleosis is not caused by direct EBV-infected B-cell proliferation, but rather by a polyclonal expansion of CD8+ T lymphocytes.

(e) These CD8+ T cells are activated in response to EBV-infected B cells and drive an intense antiviral cytotoxic response, killing the infected B cells while expanding rapidly in numbers.

(f) The atypical lymphocytes observed on blood smear are activated T lymphocytes with abundant cytoplasm and irregular cell borders, not immature lymphoblasts.

(g) This polyclonal T-cell expansion is the basis for the marked lymphocytosis, which can reach $40,000/\mu$L in severe cases.

(h) The condition is self-limited as the immune response progressively controls EBV replication.

Final Answer: The lymphocytosis results from polyclonal activation and expansion of CD8+ T lymphocytes responding to EBV antigen presentation.

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept:

Alzheimer's disease is a progressive neurodegenerative disorder characterized by extracellular amyloid-beta plaque deposition and intracellular tau tangle accumulation. The amyloid cascade hypothesis represents the leading mechanistic framework, proposing that abnormal amyloid metabolism drives subsequent tau pathology.

Solution:

(a) The clinical presentation of cognitive decline with histopathological confirmation of amyloid plaques and tau tangles defines Alzheimer's disease.

(b) The amyloid-beta protein is produced from the amyloid precursor protein (APP) through cleavage by beta-secretase and gamma-secretase enzymes.

(c) Normally, amyloid-beta is cleared from the brain by microglia-mediated phagocytosis and enzymatic degradation, maintaining homeostatic levels.

(d) In Alzheimer's disease, excessive production and/or impaired clearance leads to abnormal amyloid-beta accumulation, forming extracellular oligomers and fibrillary plaques.

(e) These amyloid deposits trigger microglial activation, neuroinflammation, and the generation of reactive oxygen species, creating an oxidative stress microenvironment.

(f) Within this stressed neuronal environment, tau protein becomes hyperphosphorylated through activation of kinases like GSK-3 beta and CDK5.

(g) Hyperphosphorylated tau dissociates from microtubules, aggregates intracellularly, and forms neurofibrillary tangles that disrupt axonal transport and eventually trigger neuronal death.

(h) This sequence—amyloid accumulation leading to tau pathology—defines the amyloid cascade hypothesis.

(i) While tau-first, inflammatory-first, and cholinergic-deficit mechanisms contribute, amyloid-cascade remains the dominant pathogenic framework supported by genetic evidence.

Final Answer: The mechanism is the amyloid cascade hypothesis: abnormal amyloid-beta accumulation triggers tau hyperphosphorylation and neurodegeneration.

Answer: (A)

Go Back to Question 15

Q16.

Solution

Concept:

Familial hypercholesterolemia results from genetic defects affecting LDL receptor function or lipoprotein metabolism. Understanding the cellular and molecular consequences of these defects guides risk stratification and therapeutic intervention strategies.

Solution:

(a) The patient presents with heterozygous Familial Hypercholesterolemia (FH), characterized by extremely elevated plasma cholesterol, tendon xanthomas, premature coronary disease, and a positive family history.

(b) Genetic testing revealing an LDL receptor mutation indicates defective LDL receptor-mediated cholesterol homeostasis.

(c) Normally, LDL receptors on hepatocytes bind apolipoprotein B-100, the principal apoprotein of LDL particles, internalizing them via receptor-mediated endocytosis.

(d) This internalization is the primary mechanism for clearing circulating LDL particles and maintaining cholesterol homeostasis.

(e) Loss-of-function mutations in the LDL receptor gene reduce either the number of functional receptors or their ability to bind and internalize LDL.

(f) With reduced LDL receptor expression, hepatic LDL clearance declines significantly, causing plasma LDL levels to rise dramatically.

(g) The elevated circulating LDL promotes deposition in tendons (xanthomas) and arterial walls (atherosclerosis), accounting for the clinical phenotype.

(h) Heterozygous FH individuals carry one mutant and one normal allele, reducing LDL clearance by approximately 50-75

(i) Other lipid metabolism disorders affect different pathways: apolipoprotein B mutations affect particle assembly, lipoprotein lipase deficiency affects triglyceride hydrolysis, and ABCA1 mutations affect reverse cholesterol transport.

Final Answer: The molecular consequence is reduced LDL receptor expression on hepatocytes limiting LDL particle uptake and clearance.

Answer: (A)

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Q17.

Solution

Concept:

Coagulation factor deficiencies produce characteristic laboratory patterns reflecting which part of the coagulation cascade is compromised. Mapping the laboratory abnormalities onto the cascade pathway guides identification of the deficient factor.

Solution:

(a) The laboratory pattern shows: - Normal prothrombin time (PT), indicating normal extrinsic pathway function - Prolonged aPTT, indicating abnormal intrinsic or common pathway - Normal platelet count and bleeding time, excluding platelet disorders - Mixing study corrects the aPTT, confirming a factor deficiency (not an inhibitor)

(b) These findings narrow the diagnosis to an intrinsic or common pathway factor deficiency.

(c) The intrinsic pathway includes factors XII, XI, IX, and VIII.

(d) The common pathway includes factors X, V, II, and fibrinogen.

(e) Since PT is normal, extrinsic pathway (factor VII) and common pathway factors that affect PT (II, V, fibrinogen) are likely normal.

(f) This leaves the intrinsic pathway-specific factors (VIII, IX, XI, XII) or factor X (which affects both pathways through the extrinsic and common pathways).

(g) Factor X is the first step of the common pathway, where factors from both extrinsic (VII) and intrinsic (IX with VIII as cofactor) pathways converge.

(h) Factor VIII deficiency (hemophilia A) is the most common intrinsic pathway defect, presenting with prolonged aPTT and normal PT.

(i) Factor II, VII, IX, and X deficiencies are rarer but can present similarly depending on which factors are affected.

(j) Given the clinical presentation of bleeding and the laboratory pattern, Factor VIII deficiency is most likely.

Final Answer: The factor most likely deficient is Factor VIII (Antihemophilic Factor).

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept:

Pheochromocytomas are rare neuroendocrine tumors arising from chromaffin cells of the adrenal medulla. Recognizing the characteristic histopathological architecture is essential for accurate diagnosis and distinguishing these tumors from other adrenal and neural neoplasms.

Solution:

(a) The patient presents with classic symptomatic pheochromocytoma: hypertension, sweating, tremor, palpitations, and elevated plasma metanephrines and catecholamines.

(b) Pheochromocytomas arise from the neuroendocrine chromaffin cells of the adrenal medulla, which normally synthesize and store catecholamines in dense neurosecretory granules.

(c) Histologically, pheochromocytomas display sheets and nests of polygonal chief cells (also called chromaffin cells) with abundant granular cytoplasm containing these neurosecretory granules.

(d) Interspersed among the tumor chief cells is a delicate network of sustentacular cells and fine fibrovascular septa, creating a characteristic organoid architecture.

(e) Sustentacular cells are S100-positive supporting cells that create the delicate fibrovascular scaffold, distinguishing pheochromocytomas from other neural tumors.

(f) The nuclei are typically central and may display significant variation in size and hyperchromasia, but mitotic activity is generally low.

(g) Round blue cell tumors represent undifferentiated malignancies like lymphoma or neuroblastoma.

(h) Spindle cell palisading patterns are characteristic of schwannomas and neurofibromas, which lack the neurosecretory granule content of pheochromocytomas.

Final Answer: The characteristic hallmark is sheets of polygonal chief cells with abundant granular cytoplasm and sustentacular cell support network.

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept:

Calcification in tissues can occur through two distinct mechanisms: dystrophic calcification in response to local tissue injury, and metastatic calcification secondary to systemic abnormalities in calcium-phosphate metabolism. Distinguishing between these mechanisms guides therapeutic approach.

Solution:

(a) The patient with chronic kidney disease presents with soft tissue calcification around joints despite low-normal serum calcium, indicating abnormal mineral metabolism.

(b) In CKD stage 4, the kidneys lose their ability to activate vitamin D to its hormonal form (1,25-dihydroxyvitamin D3), leading to secondary hyperparathyroidism and hyperphosphatemia.

(c) The elevated serum phosphate combined with even normal serum calcium produces a calcium-phosphate product that exceeds the solubility equilibrium.

(d) When this product exceeds approximately 70 mg^2/dL^2 (calcium in mg/dL $\times$ phosphate in mg/dL), spontaneous precipitation of calcium phosphate occurs in soft tissues.

(e) This phenomenon is metastatic calcification, where minerals deposit in previously normal tissues due to systemic imbalances in mineral metabolism.

(f) In contrast, dystrophic calcification occurs when calcium deposits in areas of tissue necrosis or damage, occurring even when systemic calcium-phosphate levels are normal.

(g) The pattern of periarticular calcification is typical of secondary hyperparathyroidism and metastatic calcification.

(h) Pyrophosphate and other inhibitors of calcification are normally produced by tissues to prevent unwanted mineralization, and deficiencies in these inhibitors contribute to vascular and soft tissue calcification in CKD.

Final Answer: This is metastatic calcification secondary to elevated serum calcium-phosphate product exceeding solubility equilibrium.

Answer: (B)

Go Back to Question 19

Q20.

Solution

Concept:

Diabetic nephropathy is the leading cause of end-stage renal disease in developed nations. Understanding the glomerular lesions that distinguish diabetic kidney disease from other forms of glomerulonephritis guides diagnostic confirmation and prognosis estimation.

Solution:

(a) The patient presents with the clinical triad of long-standing type 2 diabetes, progressive renal dysfunction, and significant proteinuria.

(b) Renal biopsy showing thickened glomerular basement membrane and nodular glomerulosclerosis is pathognomonic for diabetic nephropathy.

(c) Nodular glomerulosclerosis, also known as Kimmelstiel-Wilson disease, is the characteristic hallmark lesion of diabetic nephropathy.

(d) This lesion consists of nodular accumulations of hyaline material (plasma proteins) in the mesangial regions of the glomerulus, creating characteristic "nodular" expansions.

(e) The nodular lesions are surrounded by patent capillary loops, distinguishing them from diffuse proliferative glomerulonephritis.

(f) Concurrent glomerular basement membrane thickening results from increased deposition of type IV collagen and laminin, due to sustained hyperglycemia and growth factor stimulation.

(g) The primary pathogenic mechanism involves hyperglycemia-induced activation of aldose reductase, protein kinase C, and the production of advanced glycation end products (AGEs).

(h) These factors stimulate increased production of extracellular matrix components, particularly in the glomerular mesangium.

(i) Proliferative glomerulonephritis with crescents and focal segmental glomerulosclerosis are distinct entities with different etiologies and clinical presentations.

(j) Membranous glomerulonephritis presents with subepithelial spike-and-dome immune complex deposits.

Final Answer: The primary lesion is nodular glomerulosclerosis (Kimmelstiel-Wilson disease) with basement membrane thickening.

Answer: (B)

Go Back to Question 20

Q21.

Solution

Concept:

Acute chest syndrome is a life-threatening pulmonary complication of sickle cell disease characterized by acute hypoxemia, infiltrates, and acute tissue infarction. Understanding the microvascular pathophysiology guides appropriate diagnostic and therapeutic interventions.

Solution:

(a) Sickle cell disease results from a single nucleotide substitution (glutamic acid to valine) at position 6 of the beta-globin gene, producing hemoglobin S.

(b) Under hypoxic, acidic, or dehydrating conditions, deoxygenated hemoglobin S molecules polymerize into long, rigid crystalline fibers.

(c) These polymers distort red blood cells into the characteristic sickle shape, reducing their deformability and promoting vascular occlusion in small vessels.

(d) In acute chest syndrome, sickling predominantly affects the pulmonary microvasculature, causing: 1. Microvascular obstruction by sickled erythrocytes, leading to pulmonary infarction 2. Ischemic endothelial injury triggering activation of tissue factor and thrombosis 3. Release of phosphatidylserine from damaged RBCs, promoting coagulation activation

(e) Additionally, fat embolism occurs when bone marrow undergoes infarction, releasing lipid-laden marrow contents into the systemic circulation, causing pulmonary artery obstruction.

(f) The net result is acute pulmonary infiltrates, hypoxemia, and potential respiratory failure.

(g) While functional asplenia in sickle cell disease does predispose to encapsulated bacterial infections, acute chest syndrome is primarily driven by microvascular sickling and thrombosis rather than infection.

(h) The acute presentation with new infiltrates in the setting of vaso-occlusive pain is classic for acute chest syndrome from microvascular pathology.

Final Answer: The mechanism is microvascular obstruction by polymerized hemoglobin S leading to infarction and fat embolism.

Answer: (A)

Go Back to Question 21

Q22.

Solution

Concept:

Uterine leiomyomas are the most common benign pelvic tumors in women, arising from the smooth muscle layer of the uterus. Understanding their origin as clonal neoplasms with altered growth factor responsiveness guides understanding of their development and potential treatment approaches.

Solution:

(a) Uterine leiomyomas are benign smooth muscle tumors composed of interlacing bundles of well-differentiated myocytes with collagen stroma, as described.

(b) Evidence from molecular analysis demonstrates that each leiomyoma arises as a clonal proliferation of a single smooth muscle cell that has undergone transformation.

(c) Cytogenetic analysis reveals that many leiomyomas carry recurrent chromosomal abnormalities: deletion of chromosome 7q, deletion of 12q, or rearrangements of the HMGA2 gene.

(d) These chromosomal abnormalities alter the growth factor responsiveness of myometrial smooth muscle cells, making them increasingly sensitive to mitogenic stimulation by growth factors.

(e) Key growth factors implicated in leiomyoma pathogenesis include: 1. Transforming growth factor-beta (TGF-beta) promoting fibrosis and myocyte proliferation 2. Fibroblast growth factors (FGFs) stimulating smooth muscle growth 3. Angiogenic growth factors promoting neovascularization

(f) The altered cellular responsiveness to these factors creates a proliferative advantage for the affected clone, leading to nodular enlargement over time.

(g) While estrogen and progesterone are important for myometrial physiology, direct hormone responsiveness abnormalities are not the primary pathogenic driver.

(h) Polyclonal hyperplasia would not explain the clonal cytogenetic abnormalities observed.

Final Answer: Leiomyomas arise from clonal proliferation of myometrial smooth muscle cells with altered growth factor responsiveness.

Answer: (A)

Go Back to Question 22

Q23.

Solution

Concept:

Shock is a pathophysiological state of inadequate tissue perfusion leading to cellular hypoxia and dysfunction. Understanding the transition from compensated shock to irreversible shock guides therapeutic timing and prognostication.

Solution:

(a) Hypovolemic shock from massive gastrointestinal hemorrhage represents one of the most immediately life-threatening forms of shock due to rapid intravascular volume loss.

(b) In early (compensatory) shock, baroreceptor and chemoreceptor reflexes activate the sympathetic nervous system, triggering: 1. Tachycardia via beta-adrenergic stimulation 2. Systemic and splanchnic vasoconstriction via alpha-adrenergic stimulation 3. Fluid shifts from interstitium to intravascular space

(c) These compensatory mechanisms initially maintain systemic perfusion pressure, preserving vital organ blood flow.

(d) However, if shock persists despite these compensations, prolonged microvascular hypoperfusion and vasoconstriction lead to: 1. Tissue hypoxia shifting metabolism from aerobic to anaerobic pathways 2. Accumulation of lactate and hydrogen ions creating metabolic acidosis 3. Acidosis impairing cellular function and worsening vasoconstriction

(e) The acidotic environment triggers progressive cellular dysfunction, particularly affecting mitochondrial energy production.

(f) Mitochondrial dysfunction leads to depletion of ATP, collapse of ion pumps, cellular swelling, and activation of apoptotic and necrotic death pathways.

(g) Once mitochondrial function becomes critically compromised, the shock state becomes irreversible, as cells can no longer generate ATP even with restored perfusion.

(h) Multi-organ dysfunction develops as vital organs (brain, heart, kidneys, lungs) progressively fail from cellular energy depletion.

Final Answer: Irreversible shock is characterized by progressive cellular hypoxia and metabolic acidosis leading to irreversible mitochondrial dysfunction.

Answer: (A)

Go Back to Question 23

Q24.

Solution

Concept:

Hodgkin lymphoma is characterized by malignant transformation of B lymphocytes, resulting in clonal proliferation with distinctive morphological features. Immunophenotypic profiling with CD30 and CD15 expression guides diagnostic confirmation and distinguishes Hodgkin variants.

Solution:

(a) The patient presents with B-symptoms (fever, night sweats) and generalized lymphadenopathy with nodal capsular fibrosis and nodular growth pattern.

(b) The key diagnostic finding is the immunophenotypic profile: CD30+, CD15+, and monoclonal B-cell population.

(c) Hodgkin lymphoma is uniquely characterized by malignant cells expressing CD30 and CD15, which are typically absent from normal B lymphocytes.

(d) CD30 is a member of the TNF receptor superfamily, and its expression on transformed lymphocytes is the hallmark of Hodgkin lymphoma.

(e) In nodular sclerosis Hodgkin lymphoma, the tumor cells are CD30+ and CD15+ and appear as large cells with vesicular nuclei and prominent eosinophilic nucleoli (Hodgkin cells and Reed-Sternberg cells).

(f) Nodular sclerosis is the most common Hodgkin lymphoma variant, characterized by nodular fibrosis bands with lacunar cells (artifacts from formalin fixation) within hyalinized collagen.

(g) In contrast, diffuse large B-cell lymphoma (DLBCL) presents with CD20+ cells and would not express CD15.

(h) Follicular lymphoma arises from germinal center B cells and displays nodular architecture but lacks CD30 and CD15 expression.

(i) Burkitt lymphoma is a small cell lymphoma with high proliferation index, not consistent with the morphology described.

Final Answer: The diagnosis is nodular sclerosis Hodgkin lymphoma with characteristic Reed-Sternberg cells.

Answer: (B)

Go Back to Question 24

Q25.

Solution

Concept:

Thrombocytopenia results from either decreased platelet production or increased platelet destruction. Understanding the bone marrow response to low platelet counts guides differentiation between these fundamental mechanisms and directs appropriate therapy.

Solution:

(a) The patient presents with severe thrombocytopenia (18,000 platelets/μL), causing petechiae and mucosal bleeding.

(b) Coagulation studies (PT, aPTT) are normal, indicating normal clotting factor function.

(c) Bleeding time is normal, confirming adequate platelet function despite low numbers.

(d) The critical diagnostic finding is the bone marrow showing numerous megakaryocytes, indicating the marrow is responding appropriately to the low platelet count by increasing production.

(e) This pattern—severe thrombocytopenia with megakaryocytic hyperplasia—indicates the platelets are being destroyed faster than the marrow can replace them.

(f) The mechanism is immune-mediated platelet destruction, most likely from Immune Thrombocytopenic Purpura (ITP).

(g) In ITP, autoantibodies bind to platelet surface antigens (particularly GPIIb/IIIa and GpIb/IX), triggering Fc-receptor-mediated phagocytosis of antibody-coated platelets in the spleen and reticuloendothelial system.

(h) The circulating lifespan of platelets drops from the normal 7-10 days to just hours.

(i) The bone marrow responds with megakaryocytic hyperplasia, attempting to increase platelet production to compensate.

(j) If marrow production were impaired (as in aplastic anemia), megakaryocytes would be decreased or absent.

(k) DIC would show evidence of coagulation factor consumption and fibrin deposition.

Final Answer: The pathophysiology is immune-mediated platelet destruction with compensatory megakaryocytic hyperplasia.

Answer: (B)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	B	4	B	5	B
6	A	7	D	8	B	9	B	10	A
11	B	12	B	13	C	14	B	15	A
16	A	17	B	18	B	19	B	20	B
21	A	22	A	23	A	24	B	25	B