



SNS COLLEGE OF ALLIED HEALTH SCIENCES

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DEPARTMENT : PHYSICIAN ASSISTANT

COURSE NAME : NEUROLOGY

UNIT : NEUROPATHOLOGY

**TOPICS : CEREBROVASCULAR DISEASES -
ATHEROSCLEROSIS, THROMBOSIS, EMBOLISM,
ANEURYSM, HYPOXIA, INFARCTION AND
HAEMORRHAGE**



CEREBROVASCULAR DISEASES



- Cerebrovascular diseases refer to a group of conditions that affect the blood vessels and blood supply to the brain.



ATHEROSCLEROSIS



- Atherosclerosis is a condition characterized by the buildup of fatty deposits, known as plaques, on the inner walls of arteries.
- This buildup can restrict blood flow or cause the arteries to become stiff and narrow.



Pathophysiology:

- **Endothelial Injury:** Damage to the endothelial lining of arteries due to factors like hypertension, hyperlipidemia, smoking, and diabetes.
- **Lipoprotein Accumulation:** Low-density lipoproteins (LDL) infiltrate the damaged endothelium and become oxidized.



- **Inflammation:** Oxidized LDL attracts monocytes, which enter the arterial wall and transform into macrophages. These macrophages ingest LDL, becoming foam cells, and form fatty streaks.
- **Plaque Formation:** Smooth muscle cells proliferate and migrate to the intima, secreting extracellular matrix components. This forms a fibrous cap over the fatty streak, creating a plaque.



- **Plaque Progression:** Plaques may enlarge, causing arterial narrowing and reducing blood flow. Plaques can become calcified, further stiffening the vessel.
- **Plaque Rupture:** Unstable plaques with thin fibrous caps may rupture, leading to thrombosis and potential vessel occlusion.



Clinical Manifestations:

- **Transient ischemic attacks (TIAs):** Temporary neurological deficits such as weakness, vision disturbances, and speech difficulties.
- **Stroke:** Sudden onset of severe symptoms like hemiparesis, aphasia, and loss of consciousness.



Diagnosis:

- **Imaging:** Carotid ultrasound, computed tomography angiography (CTA), magnetic resonance angiography (MRA), and digital subtraction angiography (DSA).
- **Blood Tests:** Lipid profile to assess cholesterol levels.



Treatment:

- **Lifestyle Changes:** Diet modification, smoking cessation, regular exercise.
- **Medications:** Statins for lipid control, antihypertensives, antiplatelet agents (aspirin, clopidogrel), and anticoagulants.
- **Surgical Interventions:** Carotid endarterectomy, angioplasty with stenting.



Complications:

- Coronary Artery Disease (CAD)
- Peripheral Artery Disease (PAD)
- Cerebrovascular Disease



THROMBOSIS



- Thrombosis is the formation of a blood clot (thrombus) within a blood vessel, which can impede or completely block the flow of blood through the circulatory system.
- It can occur in both veins and arteries and is classified based on its location and the type of blood vessel affected
- **Types** - Arterial Thrombosis and Venous Thrombosis



Pathophysiology:

- **Endothelial Injury:** Damage to the vascular endothelium initiates the clotting process.
- **Platelet Adhesion and Activation:** Platelets adhere to the injury site and become activated, releasing chemical signals that recruit more platelets.



- **Coagulation Cascade Activation:** A complex series of reactions involving clotting factors that culminates in the conversion of fibrinogen to fibrin, forming a stable clot.
- **Thrombus Formation:** The thrombus can grow and occlude the vessel, leading to reduced or blocked blood flow.



Clinical Manifestations:

- **Cerebral Venous Sinus Thrombosis (CVST):** Headache, visual disturbances, seizures, and focal neurological deficits.
- **Arterial Thrombosis:** Stroke symptoms such as sudden weakness, speech difficulties, and vision problems.



Diagnosis:

- **Imaging:** CT or MRI with venography, conventional angiography.
- **Blood Tests:** D-dimer levels, coagulation studies.



Treatment:

- **Anticoagulation:** Heparin initially, followed by oral anticoagulants like warfarin or direct oral anticoagulants (DOACs).
- **Thrombolysis:** Intravenous thrombolytic therapy in acute cases.
- **Underlying Condition Management:** Addressing risk factors such as atrial fibrillation, hypercoagulable states.



Complications:

- **Deep Vein Thrombosis (DVT):** Clot in deep veins, which can lead to pulmonary embolism (PE) if dislodged and travels to lungs.
- **Arterial Thrombosis:** Can cause myocardial infarction (heart attack), ischemic stroke, or limb ischemia.



EMBOLISM



- An embolism is the obstruction of a blood vessel by an embolus, which is a material that travels through the bloodstream from one part of the body to another, causing a blockage.
- This can impede blood flow and result in tissue damage or death in the affected area.
- **Types** - Pulmonary Embolism, Air Embolism, Arterial Embolism, Fat Embolism, Amniotic Fluid Embolism.



Pathophysiology:

- **Embolus Formation:** An embolus can originate from a thrombus in the heart (e.g., due to atrial fibrillation) or from other sources such as fat, air, or tumor cells.
- **Embolus Travel:** The embolus travels through the bloodstream until it lodges in a smaller vessel.
- **Vessel Occlusion:** Once lodged, the embolus obstructs blood flow, leading to tissue ischemia and infarction.



Clinical Manifestations:

- Sudden neurological deficits such as hemiparesis, aphasia, vision disturbances, and loss of coordination.

Diagnosis:

- **Imaging:** Echocardiography to detect cardiac sources, transcranial Doppler ultrasound, CT/MRI.
- **Blood Tests:** Coagulation profile.



Treatment:

- **Anticoagulation:** To prevent further embolic events.
- **Thrombolysis and Thrombectomy:** In acute settings to dissolve or remove the embolus.
- **Long-term Management:** Antiplatelet or anticoagulant therapy, managing underlying conditions like atrial fibrillation.



Complications:

- **Pulmonary Embolism (PE):** Clot from legs or other parts blocks pulmonary artery, leading to respiratory distress or sudden death.
- **Cerebral Embolism:** Clot in brain arteries causing ischemic stroke.
- **Systemic Embolism:** Can affect other organs like kidneys, spleen, or extremities, causing infarction.



ANEURYSM



- An aneurysm is a localized, abnormal dilation or ballooning of a blood vessel, often an artery, due to a weakness in the vessel wall.
- This condition can occur in various parts of the body, but is most commonly found in the aorta, brain, legs, spleen, and intestines.
- **Types** - Aortic Aneurysm, Cerebral Aneurysm, Peripheral Aneurysm



Pathophysiology:

- **Vessel Wall Weakening:** Due to genetic factors, hypertension, atherosclerosis, or trauma, the arterial wall becomes weakened.
- **Aneurysm Formation:** The weakened wall bulges out, forming an aneurysm. Common sites include the Circle of Willis.
- **Risk of Rupture:** Aneurysms can remain stable or grow and eventually rupture, causing hemorrhage.



Clinical Manifestations:

- **Unruptured Aneurysm:** Headaches, cranial nerve palsies, visual disturbances.
- **Ruptured Aneurysm:** Sudden severe headache ("thunderclap headache"), nausea, vomiting, neck stiffness, altered consciousness.



Diagnosis:

- **Imaging:** CT scan for acute hemorrhage, CTA, MRA, DSA for detailed visualization of the aneurysm.
- **Lumbar Puncture:** If subarachnoid hemorrhage is suspected and imaging is inconclusive.



Treatment:

- **Surgical Clipping:** Directly clipping the neck of the aneurysm.
- **Endovascular Coiling:** Filling the aneurysm with coils to induce clotting and prevent rupture.
- **Risk Factor Management:** Controlling hypertension, avoiding smoking.



Complications:

- **Rupture:** Most serious complication, leading to severe internal bleeding and potentially fatal outcomes.
- **Thrombosis and Embolism:** Aneurysm can thrombose or embolize, causing downstream complications like stroke or limb ischemia depending on the location.



HYPOXIA



- Hypoxia is a medical condition characterized by a deficiency in the amount of oxygen reaching the tissues of the body.
- This shortage of oxygen disrupts normal cellular functions, as oxygen is crucial for generating energy through aerobic metabolism
- **Types** - Hypoxic Hypoxia, Anemic Hypoxia, Stagnant (Circulatory) Hypoxia, Histotoxic Hypoxia



Pathophysiology:

- **Oxygen Deprivation:** Causes include respiratory failure, cardiac arrest, or severe anemia.
- **Cellular Dysfunction:** Reduced oxygen impairs ATP production, leading to cellular energy failure.



- **Ion Imbalance and Excitotoxicity:** Failure of ion pumps leads to cellular swelling and calcium influx, causing excitotoxic neuronal damage.
- **Cell Death:** Prolonged hypoxia results in irreversible cell injury and death.



Clinical Manifestations:

- **Mild:** Confusion, lethargy, cognitive impairment.
- **Severe:** Loss of consciousness, seizures, brain death.



Diagnosis:

- **Blood Tests:** Arterial blood gas analysis.
- **Imaging:** CT/MRI to assess brain injury.
- **Pulse Oximetry:** Monitoring oxygen saturation.



Treatment:

- **Oxygen Therapy:** Supplemental oxygen, mechanical ventilation.
- **Underlying Cause Management:** Treating respiratory or cardiac conditions.
- **Supportive Care:** In severe cases, intensive care support.



Complications:

- **Tissue Damage:** Lack of oxygen can lead to organ dysfunction or failure.
- **Brain Damage:** Prolonged hypoxia can cause cognitive impairment or permanent neurological damage.
- **Cardiac Complications:** Hypoxia can exacerbate heart conditions and lead to arrhythmias or heart failure.



HYPOXIA



- Infarction refers to the death or necrosis of tissue in a specific area due to a lack of blood supply.
- This condition occurs when the blood flow to a particular part of the body is interrupted, leading to ischemia (reduced blood flow) and subsequent tissue damage or cell death.
- **Types** - Ischemic Infarction, Hemorrhagic Infarction



Pathophysiology:

- **Ischemia:** Blockage of a cerebral artery due to thrombosis or embolism leads to reduced blood flow.
- **Core and Penumbra:** Central area of infarction (irreversibly damaged) and surrounding penumbra (potentially salvageable).
- **Cell Death:** Ischemic cascade involving energy failure, ion imbalance, excitotoxicity, oxidative stress, and inflammation leads to neuronal death.



Clinical Manifestations:

- Sudden onset of neurological deficits such as hemiparesis, aphasia, visual disturbances, and altered consciousness.

Diagnosis:

- **Imaging:** CT to rule out hemorrhage, MRI for detailed infarct characterization.
- **Blood Tests:** Assessing clotting factors, blood glucose, electrolytes.



Treatment:

- **Acute Management:** Thrombolytic therapy (e.g., tPA) within a time window, mechanical thrombectomy.
- **Secondary Prevention:** Antiplatelet drugs, anticoagulants, statins, lifestyle changes.
- **Rehabilitation:** Physical, occupational, and speech therapy.



Complications:

- **Tissue Necrosis:** Death of tissue due to lack of blood supply, leading to permanent damage or loss of function in affected organs.
- **Organ Failure:** Depending on the location (e.g., heart, brain, kidneys), infarction can lead to organ failure and related complications.



HEMORRHAGE



- Hemorrhage is defined as the escape of blood from a ruptured blood vessel, leading to bleeding either internally within the body or externally from a wound.
- **Types** - Internal Hemorrhage, External Hemorrhage



Pathophysiology:

- **Bleeding:** Intracerebral hemorrhage (within brain tissue) or subarachnoid hemorrhage (between brain and arachnoid membrane).
- **Increased Intracranial Pressure:** Accumulation of blood increases pressure, compressing brain tissue.
- **Tissue Damage:** Direct damage from blood and secondary ischemic injury due to increased pressure.



Clinical Manifestations:

- **Intracerebral Hemorrhage:** Sudden headache, vomiting, altered consciousness, focal deficits.
- **Subarachnoid Hemorrhage:** Sudden severe headache, neck stiffness, photophobia, loss of consciousness.



Diagnosis:

- **Imaging:** CT for acute hemorrhage, MRI for detailed assessment.
- **Lumbar Puncture:** To detect subarachnoid blood if imaging is negative.



Treatment: Depends on the type and severity of hemorrhage. It may include:

- **Direct Pressure:** Applying pressure to the bleeding site to control bleeding.
- **Surgical Intervention:** Procedures to repair damaged blood vessels or stop bleeding internally.



- **Medications:** Administration of medications to promote clotting or manage underlying conditions.
- **Blood Transfusion:** Replacement of lost blood with donor blood, if necessary.



Complications:

- **Hypovolemic Shock:** Severe loss of blood leading to inadequate blood flow and oxygen delivery to tissues.
- **Organ Damage:** Prolonged or severe hemorrhage can lead to damage to organs and tissues, affecting their function.



ASSESSMENT



- What is Thrombosis ?
- What all are the types of Hypoxia?