Reading Material for
Cardiac Technique – II

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PREFACE

A two years post matric teaching program of Cardiovascular Technology for the students of Allied Health Sciences. The purpose of this reading material is to provide basic education to the paramedics about Basics of Cardiology and techniques. This reading material attempts to cover almost all the basic theoretical knowledge required by students about Cardiovascular Technology so that they can perform their work better in emergency medical situations and provide optimal pre-hospital care for patients with cardiovascular conditions.

Contents

Chapter-8
Common diseases of cardiovascular system

Objective:

Upon completing this chapter, paramedic students will be able to:

Understand Ischemic Heart Disease (IHD): Explore the pathophysiology and variations in angina types.
Comprehend Myocardial Infarction (MI): Analyze the mechanisms, clinical presentation, and paramedic interventions for MI cases.
Analyze Hypertension (HTN): Define hypertension, its implications, and emergency management strategies.
Evaluate Congestive Cardiac Failure (CCF): Examine the causes, symptoms, and paramedic interventions for patients with CCF.
Examine Cardiogenic Shock: Understand the pathophysiology of cardiogenic shock and immediate paramedic responses.
Study Cardiomyopathies: Identify different types of cardiomyopathies and their
in specific arrhythmias.

This chapter aims to provide paramedic students with a detailed understanding of common cardiovascular diseases and arrhythmias, enhancing their ability to administer effective pre hospital care.

8.1 Common diseases of cardiovascular system:

Cardiovascular diseases (CVDs) are a class of diseases that involve the heart or blood vessels. They are a major global health concern and a leading cause of morbidity and mortality.
Cardiovascular diseases (CVDs) encompass a group of disorders affecting the heart and blood vessels. The main types of CVDs include coronary heart disease, stroke, peripheral arterial

disease, and aortic disease .These conditions can be caused by various factors such as atherosclerosis, high blood pressure, smoking, and high cholesterol. CVDs are a leading cause of death and disability worldwide, but many cases can be prevented by adopting a healthy lifestyle, including regular exercise, a balanced diet, and not smoking. Early detection and management of CVDs are crucial in reducing the associated risks and complications.

8.2 Ischemic Heart Disease (IHD), Angina & its types:

Ischemic Heart Disease (IHD) is a condition characterized by a reduced blood supply to the heart muscle, usually due to the buildup of fatty deposits (atherosclerosis) in the coronary arteries.
This reduced blood flow can lead to chest pain or discomfort, known as angina, and can eventually result in a heart attack if the blood flow is severely blocked.

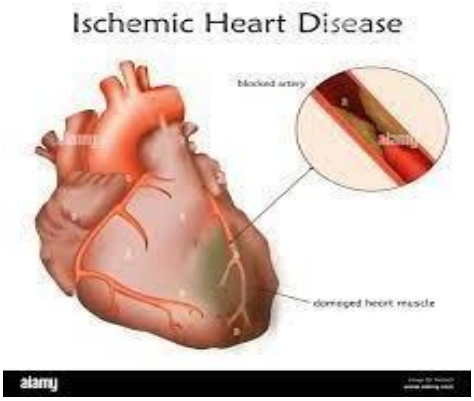


Fig:IHD

8.2.1 Angina:

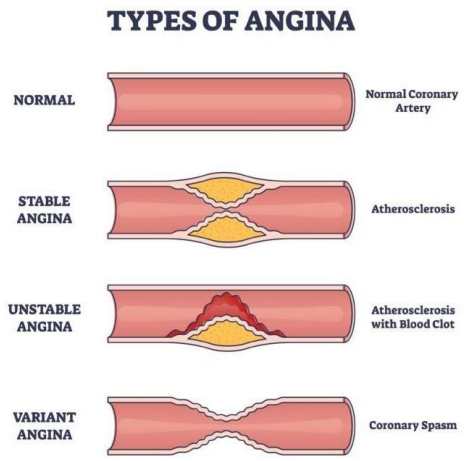
It is a symptom of IHD and is typically described as chest pain or discomfort. It occurs when the heart muscle doesn't receive enough blood and oxygen. There are several types of angina, including:

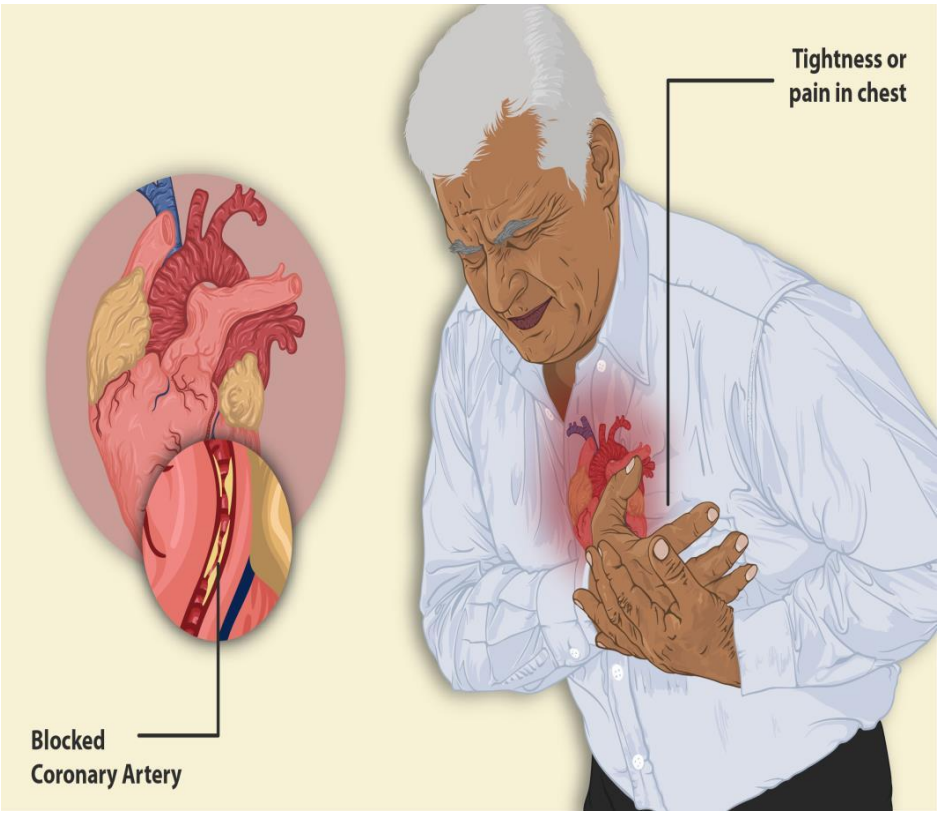
- **Stable Angina**: This is the most common type of angina. It occurs when the heart is working harder than usual, such as during exercise. The pain is predictable and often follows a pattern, subsiding with rest or medication.
- **Unstable Angina**: This type of angina is more serious and unpredictable. It can occur at rest or with minimal exertion and is not relieved by rest or medication. Unstable angina may be a sign of an impending heart attack and requires immediate medical attention.
- **Variant (Prinzmetal's) Angina:** This type is caused by a spasm in the coronary arteries, leading to a temporary reduction in blood flow. It can occur at rest and is often unrelated to physical exertion. Variant angina can be severe and usually responds well to medication. The pain or discomfort associated with angina is

often described as a

pressure, squeezing, burning, or tightness in the chest. It may also radiate to the arms, neck, jaw, shoulder, or back.

Other symptoms may include shortness of breath, nausea, sweating, and fatigue. It's important to note that angina is a symptom, not a disease, and it signals an underlying problem with the blood supply to the heart. Diagnosis and management of ischemic heart disease and angina involve lifestyle modifications, medication, and, in some cases, surgical interventions such as angioplasty or coronary artery bypass grafting. If you suspect you have angina or are experiencing chest pain, it is crucial to seek prompt medical attention.





8.3 Myocardial Infarction (MI):

A Myocardial Infarction (MI), commonly known as a heart attack, occurs when the blood flow to a part of the heart muscle is blocked. This blockage can lead to damage or death of the heart muscle tissue due to a lack of oxygen and nutrients. Most heart attacks are caused by a blood clot that forms in one of the coronary arteries, which supply blood to the heart muscle. Here are key aspects of a myocardial infarction:

Causes: The most common cause of a heart attack is the buildup of fatty deposits (plaque) on the walls of coronary arteries. These deposits can rupture and form a blood clot, blocking blood flow to a portion of the heart.

Symptoms: Common symptoms of a heart attack include chest pain or discomfort, which may feel like pressure, squeezing, fullness, or pain. The pain may also radiate to the arms, neck, jaw, shoulder, back, or abdomen.

Other symptoms can include shortness of breath, sweating, nausea, and lightheadedness.

Diagnosis: Diagnosis is typically based on a combination of symptoms, medical history, physical examination, and diagnostic tests. Electrocardiogram (ECG or EKG), blood tests (such as cardiac enzymes), and imaging studies (like a coronary angiogram) may be used to confirm the diagnosis and assess the extent of damage.

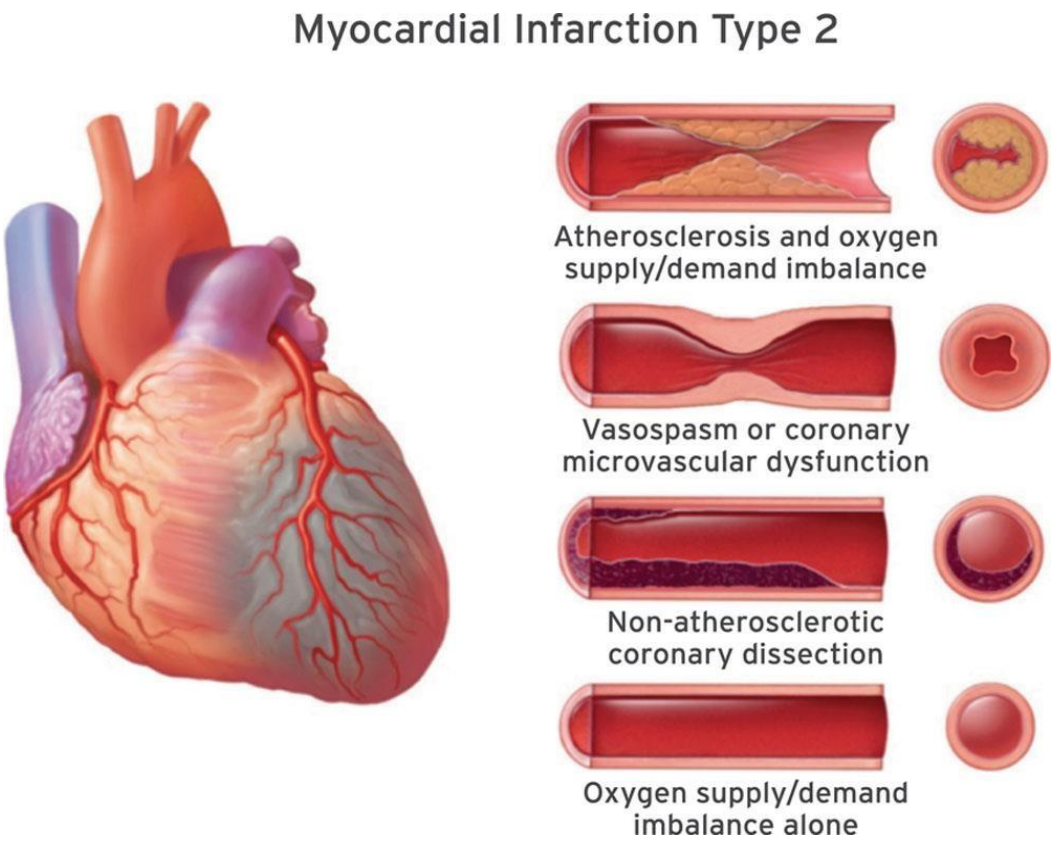
Treatment: Immediate treatment is crucial to minimize damage to the heart muscle. Treatment may include medications to dissolve or prevent blood clots, relieve pain, reduce the workload on the heart, and manage other symptoms. In some cases, procedures like percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) may be necessary to restore blood flow to the heart.

Recovery and Rehabilitation: After a heart attack, lifestyle changes are often recommended to prevent future events. This may involve adopting a heart-healthy diet, engaging in regular exercise, quitting smoking, and managing other risk factors like hypertension and diabetes.
Cardiac rehabilitation programs may also be recommended to support recovery and improve cardiovascular health.

Complications: Complications of a heart attack can include heart failure, arrhythmias (abnormal heart rhythms), and damage to the heart valves. Early and effective treatment can help minimize these complications.

Prevention: Prevention is a key aspect of managing heart health. Lifestyle modifications, such as maintaining a healthy diet, regular physical activity, avoiding tobacco, and managing stress, can help reduce the risk of a heart attack. Medications to control blood pressure, cholesterol levels, and diabetes may also be prescribed based on individual risk factors.

It's important to note that the symptoms of a heart attack can vary, and not everyone experiences classic chest pain. Prompt recognition of symptoms and seeking immediate medical attention are crucial for improving outcomes in the event of a heart attack. If you suspect you or someone else is having a heart attack, call emergency services immediately.



8.4 Hypertension (HTN):

Hypertension, commonly known as high blood pressure, is a prevalent cardiovascular condition characterized by elevated blood pressure in the arteries. Often asymptomatic, it can lead to severe complications such as heart attacks, strokes, and kidney disease if left untreated. Lifestyle modifications, including a balanced diet, regular exercise, and stress management, along with medications when necessary, are integral in managing hypertension and reducing the associated risks.

8.5 Congestive Cardiac Failure (CCF) or Heart Failure:

Congestive cardiac failure, or heart failure, results from the heart's inability to pump blood efficiently, leading to inadequate oxygen delivery to the body's tissues. This condition often presents with symptoms such as shortness of breath, fatigue, and fluid retention. Heart failure can be caused by various underlying factors, including hypertension, coronary artery disease, and cardiomyopathies. Treatment involves medications to improve heart function, lifestyle changes, and, in some cases, interventions such as implantable devices or heart transplantation.
Management strategies aim to alleviate symptoms, improve quality of life, and slow disease progression.

8.6 Cardiogenic Shock:

Cardiogenic shock is a critical condition resulting from severe heart pump failure, often triggered by acute myocardial infarction. It necessitates immediate interventions such as medications to improve heart function, mechanical support devices, and, in some cases, emergency revascularization procedures to restore blood flow to the heart muscle.

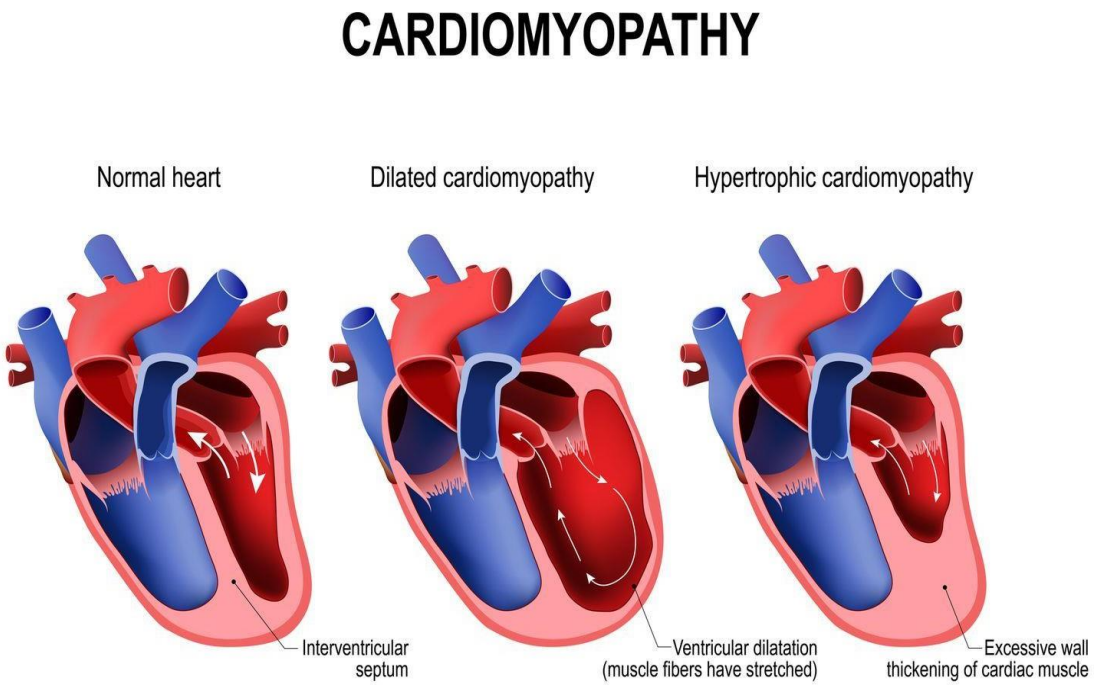
Hemodynamics of Shock

Red arrow indicates primary abnormality	PCWP (preload)	Cardiac Output	SVR (afterload)	Treatment
Hypovolemic shock	↓	↑	↑	IV fluids
Cardiogenic shock	↑	↓	↑	Inotropes Revascularization
Distributive shock (septic, neurogenic)	↓	↑	↓	Pressors IV fluids

PCWP = pulmonary capillary wedge pressure SVR = systemic vascular resistance

8.7 Cardiomyopathies:

Cardiomyopathies encompass diseases affecting the heart muscle's structure and function, including dilated, hypertrophic, and restrictive types. Treatment varies based on the specific type but may involve medications to manage symptoms, lifestyle changes, and, in severe cases, surgical interventions or heart transplantation.

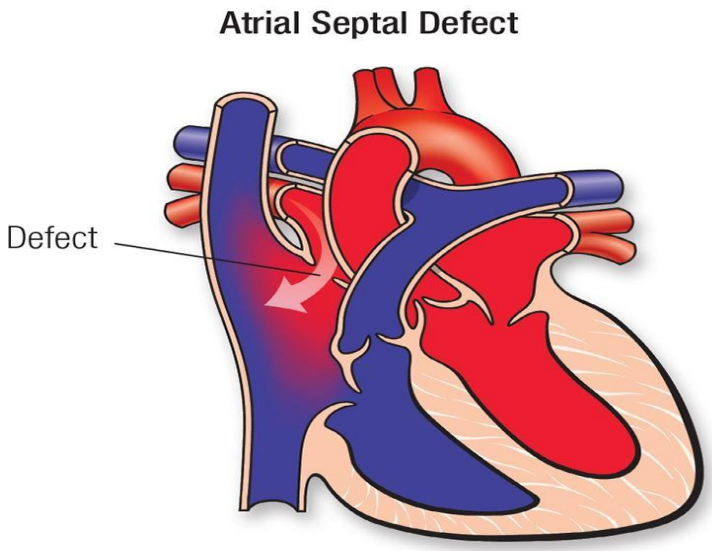


8.8 Valvular Heart Diseases:

Valvular heart diseases involve dysfunction of heart valves, affecting blood flow. Treatment depends on the severity and type of valve disorder and may include medications or surgical interventions such as valve repair or replacement.

8.9 Septal Diseases:

Septal diseases, such as atrial or ventricular septal defects, involve structural abnormalities in the heart's septum. Corrective measures, ranging from medications to surgical procedures, are employed to maintain proper blood circulation.

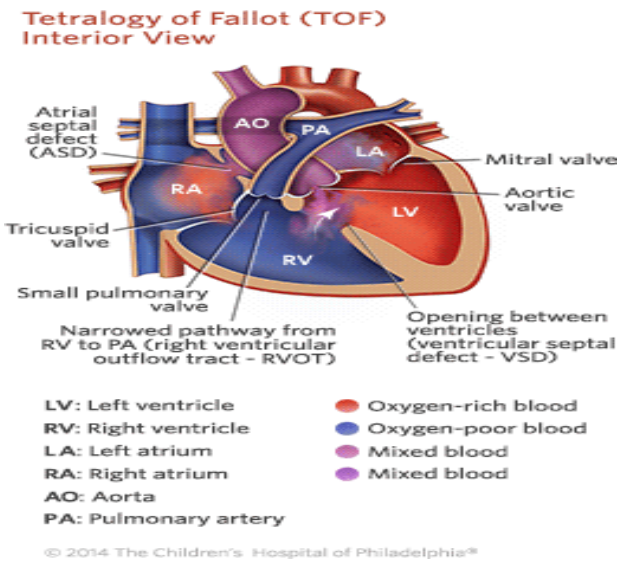


8.10 Tetralogy of Fallot:

Tetralogy of Fallot is a congenital heart defect comprising four structural abnormalities. Surgical correction is typically required in early childhood to address these anomalies and ensure proper heart function.

- **Ventricular Septal Defect (VSD):** This is a hole in the wall (septum) between the two lower chambers of the heart (ventricles). The VSD allows oxygen-rich and oxygen-poor blood to mix, leading to decreased oxygen levels in the bloodstream.
- **Pulmonary Stenosis:** This condition involves a narrowing or obstruction of the pulmonary valve or the pulmonary artery. As a result, blood flow from the right ventricle to the lungs is restricted, causing the right ventricle to work harder to pump blood through the narrowed valve.
- **Overriding Aorta**: In a normal heart, the aorta (the main artery that carries oxygenated blood to the body) originates from the left ventricle. In Tetralogy of Fallot, the aorta is positioned above the VSD, allowing it to receive blood from both the left and right ventricles. This results in oxygen-poor blood being pumped to the body.
- **Right Ventricular Hypertrophy**: The right ventricle, which pumps blood to the lungs, becomes thickened and enlarged because it has to work harder to overcome the obstruction caused by pulmonary stenosis. Over time, this can lead to complications such as heart failure.

The combination of these four abnormalities results in reduced oxygen levels in the bloodstream, which can lead to cyanosis (bluish discoloration of the skin and mucous membranes). Tetralogy of Fallot usually requires surgical intervention to correct the defects and improve blood flow to the lungs and the rest of the body. Early diagnosis and treatment are essential for managing this congenital heart condition.



8.11 Arrhythmias:

Arrhythmias, irregular heart rhythms, encompass various conditions like tachycardia, bradycardia, and supraventricular tachycardia (SVT). Treatment may involve medications, lifestyle adjustments, or procedural interventions, such as ablation procedures, to restore normal heart rhythm.

Tachycardia: Tachycardia is a condition where the heart beats too fast. It can originate in the atria (supraventricular tachycardia or SVT) or ventricles (ventricular tachycardia). SVT often presents with a rapid but regular heartbeat, while ventricular tachycardia can be more serious and may require immediate medical attention.

Bradycardia: Bradycardia is a condition characterized by a slow heart rate. It can result from aging, heart disease, or issues with the heart's electrical system. In some cases, a pacemaker may be recommended to regulate the heart rate.

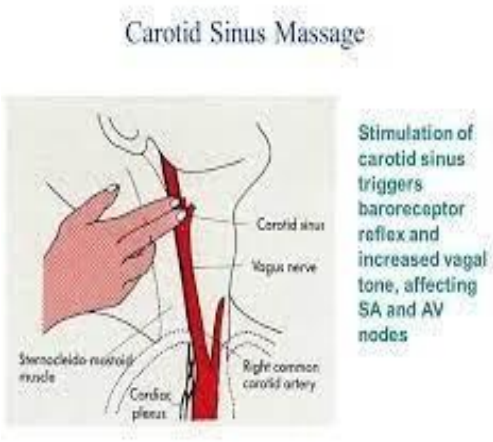
Supraventricular Tachycardia (SVT): SVT is a type of rapid heart rhythm originating above the heart's ventricles. It can cause palpitations, dizziness, and chest discomfort. Treatment options may include medications or procedures to restore normal heart rhythm.

8.12 Carotid Massage:

Carotid massage involves stimulating the carotid sinus to influence heart rate and blood pressure. While carotid massage may be used cautiously in a controlled medical setting to diagnose or treat certain arrhythmias, it is not without risks and is typically reserved for specific cases.

Holistic management strategies, including regular medical check-ups, tailored interventions, and lifestyle modifications, play pivotal roles in preventing and effectively managing these diverse

cardiovascular conditions. Early detection and comprehensive care contribute significantly to improving outcomes and enhancing overall cardiac health.



Review Questions:

What are the key features of Ischemic Heart Disease (IHD) and its types?
Explain the critical aspects of Myocardial Infarction (MI) pathophysiology.
How does hypertension impact the cardiovascular system, and what are the emergency management strategies?
Discuss the causes, symptoms, and interventions for Congestive Cardiac Failure (CCF).
Outline the pathophysiology and immediate paramedic interventions for Cardiogenic Shock.
Differentiate between hypertrophic, dilated, and restrictive cardiomyopathies.
How do valvular heart diseases affect heart function, and what considerations are important for paramedics?
Define and discuss the implications of common arrhythmias, including tachycardia and bradycardia.

Chapter-9
Investigation related to the cardiovascular diseases

Objective:

Explain the purpose and procedure of an Electrocardiogram (ECG) in assessing cardiac function.
Evaluate the significance of an Exercise Tolerance Test (ETT) and its role in diagnosing cardiovascular conditions.
Analyze the use of Echocardiography as a non-invasive imaging technique for visualizing the heart's structure and function.
Examine the utility of X-Ray Chest in identifying cardiac abnormalities and assessing heart size.
Discuss the importance of Cardiac Enzyme and Trop T tests in diagnosing myocardial infarction.
Outline the role of Lipid Profile tests in assessing cardiovascular risk factors and cholesterol levels.
Describe the procedure and indications for Angiography in visualizing blood vessels and detecting blockages.
Explore the purpose of Thallium Scan in evaluating blood flow to the heart muscle.
Discuss the significance of CT Angiography in diagnosing coronary artery disease and assessing vascular anatomy.

Investigation related to the cardiovascular diseases:

The diagnostic tools are commonly used in cardiology to assess heart health, identify abnormalities, and aid in the diagnosis of various cardiovascular conditions.

9.1 ECG (Electrocardiogram):

ECG is a standard test that records the electrical activity of the heart over a period. Electrodes placed on the skin detect the electrical impulses generated by the heart, producing a graphical representation of the heart's rhythm and activity. It is a quick and non-invasive tool used to identify abnormal heart rhythms (arrhythmias), conduction abnormalities, and signs of ischemia or heart attacks.

9.2 ETT (Exercise Tolerance Test):

Also known as a stress test, ETT measures the heart's response to physical activity. The patient is asked to exercise on a treadmill or stationary bike while the heart's electrical activity, blood pressure, and symptoms are monitored. This test helps evaluate cardiovascular fitness, detect exercise-induced arrhythmias, and assess for signs of ischemia.

9.3 Echocardiography:

Echocardiography uses ultrasound waves to create detailed images of the heart's structure and function. It can assess the heart's chambers, valves, and pumping ability. This test is valuable in diagnosing conditions such as heart valve disorders, heart muscle abnormalities, and congenital heart defects.

9 . 4 X-Ray Chest:

A chest X-ray provides images of the heart, lungs, and surrounding structures. It helps evaluate the size and shape of the heart and can identify conditions such as heart failure, fluid accumulation in the lungs, or abnormalities in the chest cavity.

9.5 Cardiac Enzyme:

Cardiac enzyme tests, including creatine kinase (CK-MB) and troponin, are blood tests that measure markers released when heart muscle cells are damaged. Elevated levels indicate myocardial injury, which is particularly important in diagnosing acute myocardial infarction (heart attack).

9.6 Trop T (Troponin T):

Troponin T is a specific troponin subtype used as a marker for myocardial injury. Elevated levels in the blood indicate damage to the heart muscle, and it is a critical diagnostic tool for assessing and monitoring heart conditions, especially myocardial infarction.

9.7 Lipid Profile:

A lipid profile measures levels of cholesterol, triglycerides, and other lipids in the blood. Abnormal lipid levels contribute to atherosclerosis, which can lead to coronary artery disease. Lipid profiles help assess cardiovascular risk and guide interventions to manage cholesterol levels.

9.8 Angiography:

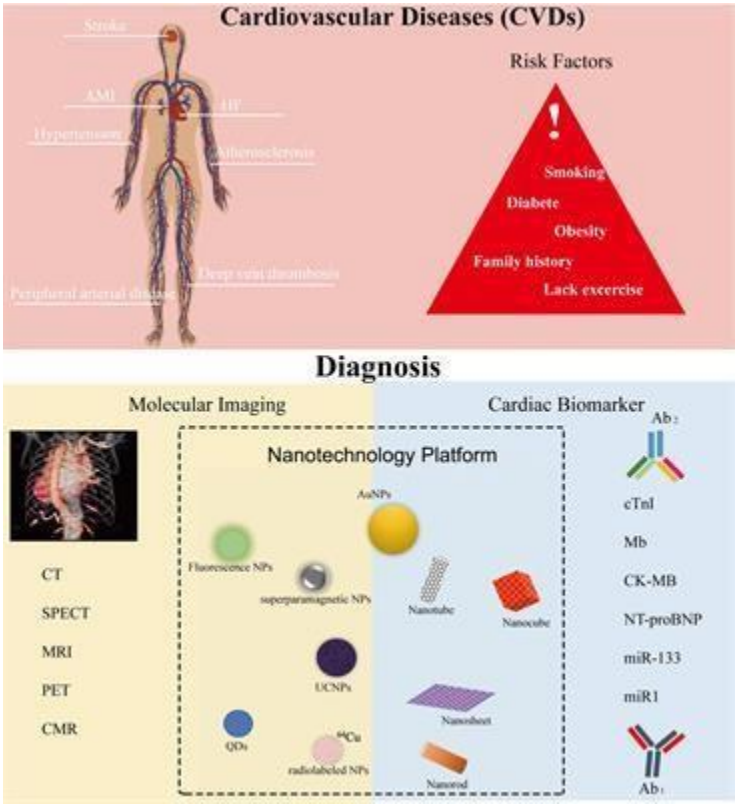
Coronary angiography involves injecting a contrast dye into the coronary arteries and capturing X-ray images. This procedure visualizes the coronary arteries and identifies blockages or narrowed areas, aiding in the diagnosis and treatment planning for coronary artery disease.

9.9 Thallium Scan:

Thallium scans, or myocardial perfusion scans, use a radioactive substance to assess blood flow to the heart muscle. It helps identify areas with reduced blood supply, indicating possible ischemia or infarction.

9.10 CT Angiography:

Computed Tomography (CT) angiography provides detailed images of the coronary arteries using X-rays. It is a non-invasive method for assessing the presence of coronary artery disease, detecting arterial blockages, and evaluating the anatomy of blood vessels. These diagnostic tools are essential in the comprehensive evaluation of cardiovascular health, enabling healthcare professionals to make accurate diagnoses and implement appropriate treatment strategies based on the specific findings.



Review Questions:

How does an Electrocardiogram (ECG) assist in evaluating cardiac function, and what are its key components?

What role does an Exercise Tolerance Test (ETT) play in diagnosing cardiovascular conditions, and what parameters are monitored during the test?

How does Echocardiography contribute to the assessment of the heart's structure and function, and what are its advantages in comparison to other imaging techniques?

Explain the use of X-Ray Chest in identifying cardiac abnormalities and assessing heart size. What limitations should be considered?

Discuss the significance of Cardiac Enzyme and Trop T tests in the diagnosis of myocardial infarction. How soon these tests are typically performed after symptoms arise?

In what ways does a Lipid Profile contribute to assessing cardiovascular risk factors, and what specific lipid markers are measured?

Describe the procedure of Angiography, its indications, and how it helps visualize blood vessels in the context of cardiovascular health.
What information does a Thallium Scan provide about blood flow to the heart muscle, and in what clinical situations is it commonly used?
Explain the role of CT Angiography in diagnosing coronary artery disease and assessing vascular anatomy. What are its advantages and limitations?

Chapter-10
Equipment/instruments used in cardiology:

Objective:

To familiarize readers with the essential equipment used in cardiology, enabling a comprehensive understanding of diagnostic and monitoring tools. Explore the purpose, functions, and significance of each instrument in the assessment and management of cardiovascular conditions, emphasizing their roles in clinical practice. Gain insight into the technological advancements shaping cardiology and appreciate the critical role these instruments play in enhancing patient care, diagnosis, and treatment strategies.

Equipment/instruments used in cardiology:

10.1 ECG Machine (Electrocardiogram): ECG machines are essential for recording the electrical activity of the heart. Modern ECG machines often come with advanced features like multiple leads for a more comprehensive analysis of the heart's electrical conduction system. They are widely used in hospitals, clinics, and ambulatory settings to diagnose various cardiac conditions, including arrhythmias, myocardial infarction, and conduction abnormalities.

10.2 Echocardiography Machine: Echocardiography machines use ultrasound technology to generate detailed images of the heart's structure and function in real-time. Doppler imaging allows assessment of blood flow patterns, making it a versatile tool for diagnosing and monitoring conditions such as valvular heart disease, congenital heart defects, and cardiomyopathies.

10.3 ETT Machine (Exercise Tolerance Test): Equipment for Exercise Tolerance Tests, or stress tests, includes a treadmill or stationary bike along with monitoring devices such as ECG electrodes and blood pressure cuffs. It is used to evaluate the heart's response to physical stress, aiding in the diagnosis of coronary artery disease and assessing overall cardiovascular fitness.

10.4 Holter Monitor: Holter monitors are portable devices worn by patients to record continuous ECG data over an extended period, typically 24 to 48 hours. This ambulatory monitoring is valuable for detecting intermittent arrhythmias, providing a more comprehensive assessment of cardiac activity in a patient's natural environment.

10.5 Cardiac Monitor: In hospital settings, cardiac monitors are central to patient care. These monitors continuously display and record a patient's heart rate and rhythm, helping healthcare providers identify changes in cardiac activity promptly. They are crucial in intensive care units, operating rooms, and telemetry units.

10.6 Pulse Oximeter: Pulse oximeters measure oxygen saturation in the blood by non- invasively attaching a sensor to a patient's finger or earlobe. These devices are used to monitor oxygen levels in individuals with respiratory or cardiac conditions, providing valuable information about oxygen delivery to tissues.

10.7 Defibrillators: Defibrillators deliver controlled electric shocks to the heart, restoring normal rhythm during life-threatening arrhythmias. Automated External Defibrillators (AEDs) are designed for public use and provide step-by-step instructions to bystanders during emergencies, making them critical for early defibrillation.

10.8 Oxygen Concentrator/Cylinder: Oxygen concentrators extract oxygen from ambient air, delivering a continuous flow to patients with respiratory or cardiac conditions requiring supplemental oxygen. Oxygen cylinders provide a portable source of oxygen for individuals who need mobility while maintaining oxygen therapy.

10.9 Ambulatory Blood Pressure Monitor: Ambulatory blood pressure monitors are portable devices that automatically measure blood pressure at regular intervals over a 24- hour period. This helps identify variations in blood pressure during daily activities and sleep, providing a more comprehensive assessment than traditional office-based measurements.

10.10 Angiography Equipment: Angiography equipment includes catheters, contrast media, and imaging systems used for invasive procedures such as coronary angiography. These procedures visualize blood vessels, identify blockages or abnormalities, and guide interventions like angioplasty and stent placement.

10.11 Pacemakers and Implantable Cardioverter-Defibrillators (ICDs): Pacemakers regulate heart rhythm by delivering electrical impulses to the heart when needed. Implantable Cardioverter-Defibrillators (ICDs) monitor heart rhythm and deliver shocks to restore normal rhythm in the presence of life-threatening arrhythmias. These advanced instruments play crucial roles in the diagnosis, monitoring, and treatment of cardiovascular conditions, contributing to improved patient outcomes and the overall advancement of cardiology as a medical discipline.

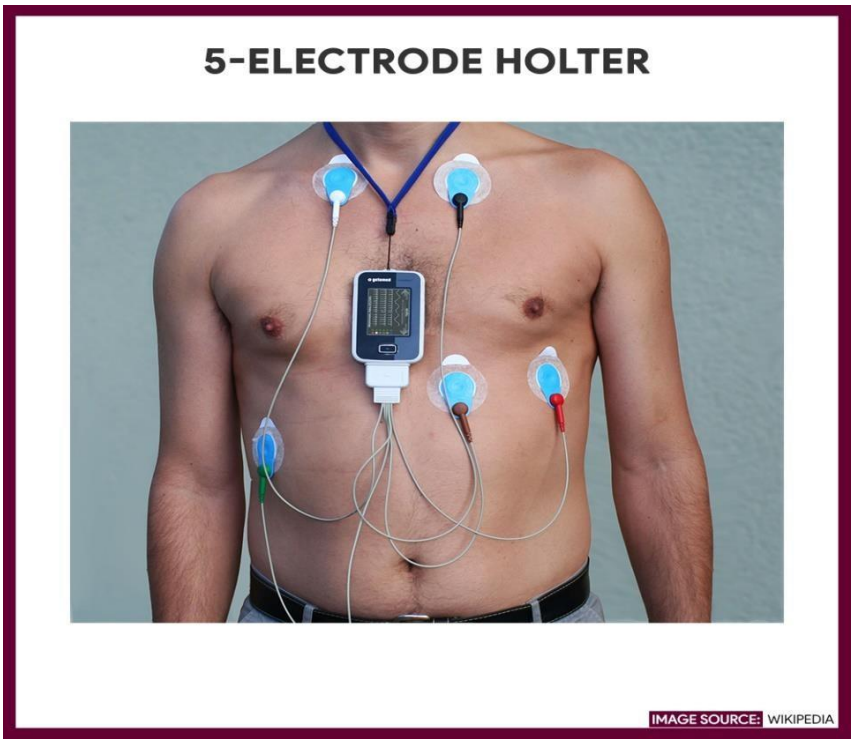


Fig: Holter Monitoring

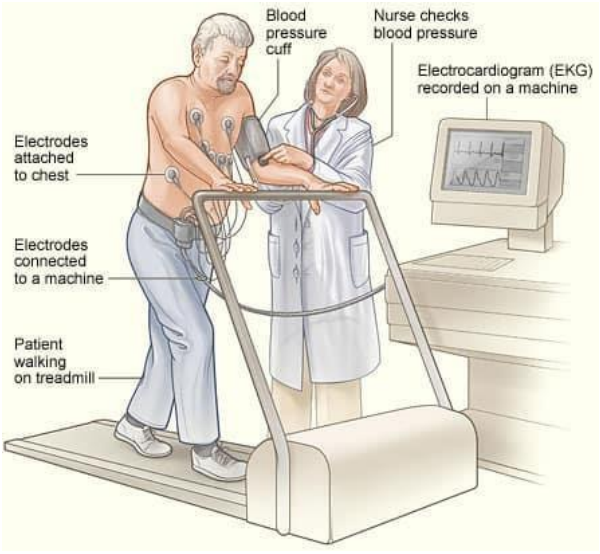


Fig: Exercise Tolerance Test Macine (ETT).

Fig: Pulse Oximeter

Fig: ECG machine.

Review Questions:

Explain the primary function of an ECG machine and its significance in cardiac diagnostics.
How does an Echocardiography Machine contribute to the assessment of heart conditions, and what information does it provide?
Discuss the purpose and procedure of an Exercise Tolerance Test (ETT) machine in evaluating cardiovascular health.
What role does a Holter Monitor play in monitoring cardiac activity, and in what situations is it commonly employed?
Elaborate on the functions of a Cardiac Monitor and its importance in critical care settings.
How does a Pulse Oximeter work, and what vital information does it offer regarding a patient's cardiovascular status?
Describe the role of Defibrillators in emergency situations and their impact on cardiac arrest management.
Explain the significance of Oxygen concentrators/cylinders in supporting patients with cardiovascular conditions, particularly in respiratory distress scenarios.

Chapter-11
Drugs Related to Cardiovascular Diseases

Objective:

Understand the pharmacological mechanisms and therapeutic indications of commonly used cardiovascular medications.
Explore the role of Nitrates in managing cardiovascular conditions and their impact on vascular function.
Examine the pharmacological properties of Beta-Blockers and their effects on heart rate and blood pressure regulation.
Investigate the therapeutic benefits and mechanisms of action of Ace-inhibitors in treating hypertension and heart failure.
Learn about the pharmacodynamics of Calcium Channel Blockers and their role in vasodilation and myocardial oxygen demand reduction.
Understand the pharmacological actions and clinical applications of Angiotensin II Receptor Blockers (ARBs) in cardiovascular therapy.
Explore the role of Diuretics in managing fluid retention and hypertension, and their impact on electrolyte balance.

Drugs Related to the cardiovascular diseases:

11.1 Nitrates:

Mechanism of Action: Nitrates, such as nitroglycerin, are vasodilators that work by releasing nitric oxide, leading to relaxation of smooth muscle in blood vessels, especially veins. This reduces preload on the heart and dilates coronary arteries, improving blood flow to the heart. **Clinical Uses:** Nitrates are primarily used to relieve angina symptoms in conditions like coronary artery disease. Nitroglycerin can be administered sublingually for rapid relief during angina attacks.

11.2 Beta-Blockers:

Mechanism of Action: Beta-blockers, like metoprolol and carvedilol, block the beta receptors in the heart and other tissues. This reduces the effects of adrenaline, resulting in a decreased heart rate, reduced blood pressure, and lower cardiac workload.

Clinical Uses: Beta-blockers are used to treat various cardiovascular conditions, including hypertension, angina, and heart failure. They are also beneficial post-myocardial infarction to improve survival and prevent future events.

11.3 ACE Inhibitors (Angiotensin-Converting Enzyme):

Mechanism of Action: ACE inhibitors, such as enalapril and lisinopril, block the conversion of angiotensin I to angiotensin II, a potent vasoconstrictor. This leads to vasodilation, reduced blood pressure, and decreased workload on the heart.

Clinical Uses: ACE inhibitors are commonly prescribed for hypertension, heart failure, and post- myocardial infarction. They also have renal protective effects.

11.4 Calcium Channel Blockers:

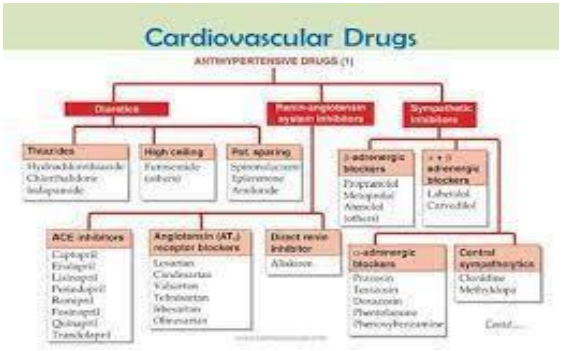
Mechanism of Action: Calcium channel blockers, like amlodipine and verapamil, block calcium channels in blood vessels and the heart. This results in vasodilation, reduced cardiac workload, and improved oxygen supply to the heart.

Clinical Uses: Calcium channel blockers are used for conditions such as hypertension, angina, and certain arrhythmias.

11.5 ARBs (Angiotensin II Receptor Blockers):

Mechanism of Action: ARBs, such as losartan and valsartan, block the effects of angiotensin II by selectively binding to its receptors. This leads to vasodilation and decreased blood pressure. **Clinical Uses:** Similar to ACE inhibitors, ARBs are used for conditions like hypertension, heart

failure, and post-myocardial infarction. They are an alternative for those who may experience side effects with ACE inhibitors.



11.6 Diuretics:

Mechanism of Action: Diuretics, like hydrochlorothiazide, increase urine production, reducing fluid volume in the body. This results in decreased blood volume and lower blood pressure.

Clinical Uses: Diuretics are commonly prescribed for conditions such as hypertension, heart failure, and edema (fluid retention).

11.7 Blood Thinners (Aspirin - Clopidogrel):

Mechanism of Action: Aspirin inhibits platelet aggregation by blocking the production of thromboxane, reducing the risk of blood clot formation. Clopidogrel is an antiplatelet agent that inhibits platelet activation.

Clinical Uses: Blood thinners, including aspirin and clopidogrel, are used for preventing blood clot formation and reducing the risk of cardiovascular events, especially in individuals with a history of heart attack or stroke.

TABLE 1. RECOMMENDED PERIOPERATIVE USE OF ANTIPLATELET AND ANTICOAGULANT AGENTS

Medication	Mechanism of Action	Typically Stopped	Typically Restarted
Aspirin	COX-1 inhibitor	Seven to 10 days before surgery	One to two days after surgery
Clopidogrel (Plavix)	P2Y12 receptor inhibitor	Seven to 10 days before surgery	One to two days after surgery
Warfarin (Coumadin)	Vitamin K antagonist	Five to six days before surgery	Up to one day after surgery
Apixaban (Eliquis) Rivaroxaban (Xarelto) Edoxaban (Savaysa) Betrixaban (Bevyxxa)	Direct factor Xa inhibitors	Two to four days before surgery	One to three days after surgery
Dabigatran (Pradaxa)	Direct thrombin inhibitor	Two to five days before surgery	One to three days after surgery

11.8 Statins:

Mechanism of Action: Statins, such as atorvastatin and simvastatin, inhibit HMG-CoA reductase, an enzyme involved in cholesterol synthesis. This leads to a reduction in cholesterol levels, particularly low-density lipoprotein (LDL) cholesterol.

Clinical Uses: Statins are used for the primary and secondary prevention of cardiovascular events by lowering cholesterol levels. They also have anti-inflammatory and plaque-stabilizing effects. These medications play vital roles in the management of cardiovascular diseases, and their selection depends on the specific condition, patient characteristics, and overall treatment goals. It's essential for healthcare providers to carefully tailor medication regimens based on individual patient needs and regularly monitor for effectiveness and potential side effects.
Patients should adhere to prescribed medications and communicate any concerns to their healthcare team.

CVS drugs	Nature of DRP	No. of cases	Department
Beta-blockers	Overdose	7	Emergency
	Drug reactions	22	
ACE inhibitors	Drug reactions	20	Cardiology
Diuretics	Drug reactions	20	Internal medicine
Nitrates	Drug reactions	6	Internal medicine
Angiotensin-II receptor blockers	Drug reaction	7	Internal medicine
Digoxin	Overdose	15	Emergency
Amiodarone	Drug reactions	14	Internal medicine
Calcium channel Blocker	Overdose	3	Internal medicine
Total DRP cases		114	

CVS, cardio vascular system; DRP, drug related problem; ACE, angiotensin converting enzyme.

Drug Tables of CVS Pharmacology

DRUG SUMMARY TABLE: Drugs Used in Hypertension

Subclass	Mechanism of Action	Clinical Applications	Pharmacokinetics	Toxicities, Interactions
Diuretics (see also Chapter 15)				
Hydrochlorothiazide, chlorthalidone	Block Na/Cl transporter in distal convoluted tubule	Hypertension, mild edema	Oral Duration: 8–12 h	Hypokalemia, hyperglycemia, hyperuricemia, hyperlipidemia
Furosemide	Block Na/K/2Cl transporter in thick ascending limb	Hypertension, heart failure, edema, hypercalcemia	Oral, parenteral Duration: 2–3 h	Hypokalemia, hypovolemia, ototoxicity
Sympathoplegics				
Centrally acting				
Clonidine	Agonist at α_2 receptors • in CNS this results in *decreased* SANS outflow	Hypertension	Oral and transdermal Oral duration: 2–3 days • transdermal 1 wk	Sedation, danger of severe rebound hypertension if suddenly stopped
Methyldopa	Prodrug converted to methylnorepinephrine in CNS, with effects like clonidine	Hypertension	Oral Duration: 12–24 h	Sedation, induces hemolytic antibodies
Ganglion blockers				
Hexamethonium	Obsolete prototype nicotinic acetylcholine (ACh) receptor blocker in ganglia • blocks all ANS transmission	None	Oral, parenteral; no CNS effect	Severe orthostatic hypotension, constipation, blurred vision, sexual dysfunction
Trimethaphan: IV, obsolete short-acting ganglion blocker for hypertensive emergencies, controlled hypotension *Mecamylamine:* oral ganglion blocker, several hours' duration, enters CNS				
Postganglionic neuron blockers				
Reserpine	Blocks vesicular pump (VMAT) in adrenergic neurons	Obsolete in hypertension, Huntington's disease	Oral Duration: 5 days	Sedation • severe psychiatric depression (high doses)
Guanadrel: blocks release of norepinephrine, depletes stores; oral, long duration; severe orthostatic hypotension (*guanethidine*, a similar drug, was withdrawn in the United States)				
Alpha blockers				
Prazosin	Selective α_1 blocker • reduces peripheral vascular resistance • prostatic smooth muscle tone	Mild hypertension, benign prostatic hyperplasia	Oral Duration: 6–8 h	First dose orthostatic hypotension
Doxazosin, terazosin: similar to prazosin but longer duration of action				
Beta blockers				
Propranolol	Prototype nonselective β blocker • reduces cardiac output • possible secondary reduction in renin release	Hypertension • many other applications (see Chapter 10)	Oral, parenteral Duration: 6–8 h (extended release forms available)	Bronchospasm in asthmatics • excessive cardiac depression, sexual dysfunction, sedation, sleep disturbances
Atenolol, metoprolol: like propranolol but β_1-selective; fewer adverse effects *Labetalol, carvedilol:* combined α and β blockade; oral and parenteral				

(*Continued*)

MedNotes Book Snippet

These specific drugs within each class have variations in their pharmacokinetics, mechanisms of action, and potential side effects. The selection of a particular drug depends on the individual patient's health status, coexisting conditions, and the overall treatment plan determined by healthcare professionals. It's crucial for patients to take medications as prescribed and inform their healthcare team about any side effects or concerns.

Review Questions:

What is the primary therapeutic role of Nitrates in cardiovascular medicine?
How do Beta-Blockers contribute to the management of cardiovascular conditions, and what are their effects on heart function?
Discuss the indications and mechanisms of action of Ace-inhibitors in treating hypertension and heart failure.
What is the role of Calcium Channel Blockers in cardiovascular therapy, and how do they impact vascular function?
Explain the clinical applications of Angiotensin II Receptor Blockers (ARBs) in managing

cardiovascular conditions.

Discuss the use of Diuretics in cardiovascular medicine, emphasizing their impact on fluid balance and blood pressure.

What are the clinical implications of using Blood Thinners, such as aspirin and Clopidogrel, in preventing thrombotic events?

Explore the therapeutic benefits of Statins in managing dyslipidemia and reducing cardiovascular risk.

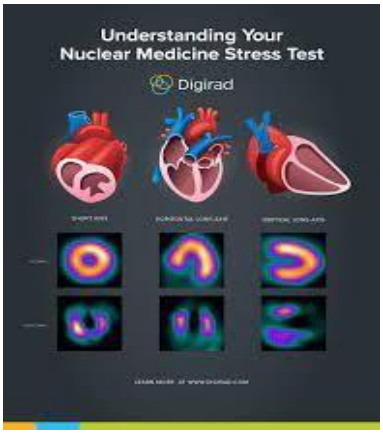
Chapter-12
Nuclear Cardiology

Objective:

Understand the principles and applications of Nuclear Cardiology in cardiovascular imaging.
Explore the role of Gamma Camera in capturing nuclear images of the heart and its structural components.
Examine the indications for Nuclear Cardiology, elucidating scenarios where it provides valuable diagnostic information.
Familiarize yourself with the structure and components of the Gamma Camera, essential for effective nuclear imaging.
Identify and comprehend the potential hazards of radiation associated with Nuclear Cardiology procedures.
Learn and apply radiation safety measures, including protection strategies and the use of protective devices.
Explore the various isotopes utilized in Cardiac Scanning, understanding their specific roles and applications in imaging.

Nuclear Cardiology:

Nuclear cardiology is a specialized field that utilizes radioactive tracers and imaging techniques to explore the intricacies of the heart's structure, function, and blood flow. This sophisticated branch of medical imaging plays a pivotal role in diagnosing and managing various cardiovascular conditions. The cornerstone of nuclear cardiology lies in the use of gamma cameras, which capture the emitted gamma rays from injected or ingested radioactive isotopes, translating this information into detailed images of the heart.



12.1 Introduction to Gamma Camera:

Gamma cameras are vital tools in nuclear cardiology, allowing for the visualization of radioactive tracers within the body. These cameras detect gamma rays emitted by radiopharmaceuticals, providing detailed images of organ function, particularly the heart. In nuclear cardiology, gamma cameras play a crucial role in non-invasive imaging to assess cardiac perfusion, function, and viability.

Indications: Gamma cameras in nuclear cardiology are used for various indications, including:

- Myocardial Perfusion Imaging (MPI): Assessing blood flow to the heart muscle.
- Ventricular Function Imaging: Evaluating the heart's pumping ability.
- Viability Studies: Determining if damaged heart tissue is still functional.
- Stress Testing: Assessing heart function under stress conditions.

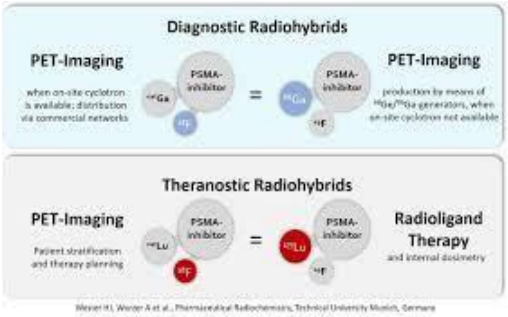
12.1.2 Structure and Parts of the Gamma Camera:

- **Collimator:** Directs gamma rays to the crystal, enhancing image resolution.
- **Crystal Detector**: Converts gamma rays into visible light.
- **Photomultiplier Tubes (PMTs):** Amplify and convert light into electronic signals.
- **Positioning System**: Allows flexibility in adjusting camera position.
- **Computer System:** Processes and reconstructs images for interpretation.
- **Display Monitor:** Presents the final images for analysis.

12.1.3 Hazards of Radiation:

Gamma cameras involve exposure to ionizing radiation. Potential hazards include:

- Radiation Exposure: Prolonged exposure can harm living tissues.
- Risk of Cancer: Cumulative radiation exposure may increase cancer risk.
- Genetic Effects: Radiation exposure may affect future generations.



12.1.4 Radiation Safety (Protection and Protective Devices):

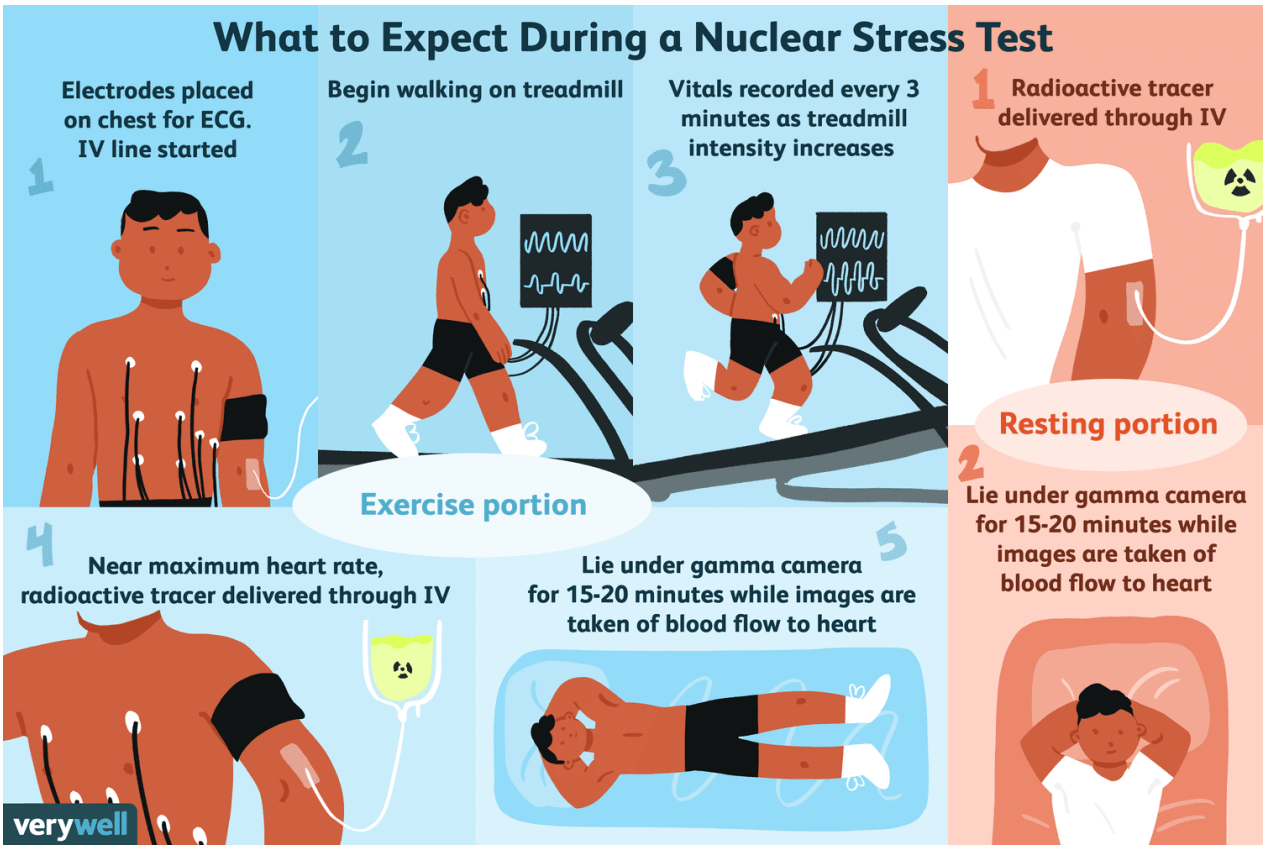
- Lead Aprons: Shields the body from radiation during procedures.
- Lead Collars and Thyroid Shields: Protect sensitive areas. Distance: Maintaining a safe distance reduces radiation exposure.
- Time: Minimizing exposure time reduces risk.
- Shielding: Lead-lined walls in nuclear medicine labs provide additional protection.
- Dosimetry Badges: Monitors individual radiation exposure for healthcare workers.

12.2 Different Isotopes Used for Cardiac Scanning:

- Technetium-99m (Tc-99m): Commonly used for myocardial perfusion imaging.
- Thallium-201 (Tl-201): Used for stress testing and viability studies.
- Iodine-123 (I-123): Used for assessing ventricular function.
- Fluorine-18 (F-18): Used in PET imaging for metabolic assessment.
- Rubidium-82 (Rb-82): Used in PET imaging for myocardial perfusion.

Isotope	Half-Life	Energy (keV)
Thallium-201 (^{201}Tl)	73 h	68–83, 162
Technetium-99m (^{99m}Tc)	6 h	140
Indium-111 (^{111}In)	67.2 h	171, 246
Fluorine-18 (^{18}F)	110 min	511
Rubidium-82 (^{82}Rb)	76 s	511
Nitrogen-13 (^{13}N)	10 min	511

Nuclear cardiology with gamma cameras is a valuable diagnostic tool providing crucial information about cardiac function and perfusion. While the benefits of these procedures are significant, ensuring radiation safety and protection is paramount for both patients and healthcare providers involved in nuclear cardiology studies.



Review Questions:

What is the primary role of a Gamma Camera in Nuclear Cardiology?
Enumerate the indications for utilizing Nuclear Cardiology in diagnosing cardiovascular conditions.
Describe the structural components of a Gamma Camera and their significance in cardiac imaging.
What are the potential hazards of radiation associated with Nuclear Cardiology, and how can they be mitigated?
Discuss the importance of radiation safety in Nuclear Cardiology, including protective measures and devices.
Explain the specific roles and applications of different isotopes used for Cardiac Scanning.
How does Nuclear Cardiology contribute to the overall diagnosis and management of cardiovascular diseases?

Chapter-13
CATH LAB

Objective:

Acquire a comprehensive understanding of Nuclear Cardiology, encompassing the principles of Gamma Camera technology, indications for its usage, the structure and components of the machine, potential hazards of radiation, and the importance of radiation safety and protective measures. Explore the various isotopes utilized for cardiac scanning in Nuclear Cardiology.

13.1 Cath Lab:

The Catheterization Laboratory, or Cath Lab, is a specialized facility within a hospital designed for diagnosing and treating cardiovascular conditions through minimally invasive procedures. This high-tech environment is dedicated to interventions that include diagnostic imaging, angiography, and various therapeutic procedures, offering a vital avenue for managing a spectrum of cardiovascular diseases.

13.2 Introduction to Angiography:

Angiography is a medical imaging technique that involves injecting a contrast dye into blood vessels to visualize them on X-ray images. In the catheterization laboratory (Cath Lab), a specialized unit, angiography is commonly used to examine blood vessels, particularly coronary arteries, to identify blockages or abnormalities. This procedure aids in diagnosing and guiding interventions for various cardiovascular conditions.

13.2.1 Indications of Angiography:

Common indications for angiography include:

- Coronary Angiography: Assessing coronary artery disease.
- Peripheral Angiography: Evaluating blood flow in peripheral arteries (e.g., legs).
- Cerebral Angiography: Visualizing blood vessels in the brain.
- Renal Angiography: Examining blood vessels in the kidneys.
- Pulmonary Angiography: Assessing pulmonary blood vessels.
- Aortic Angiography: Evaluating the aorta for aneurysms or dissections.

13.2.2 Making Different Views in Angiography (Procedure and Positions):

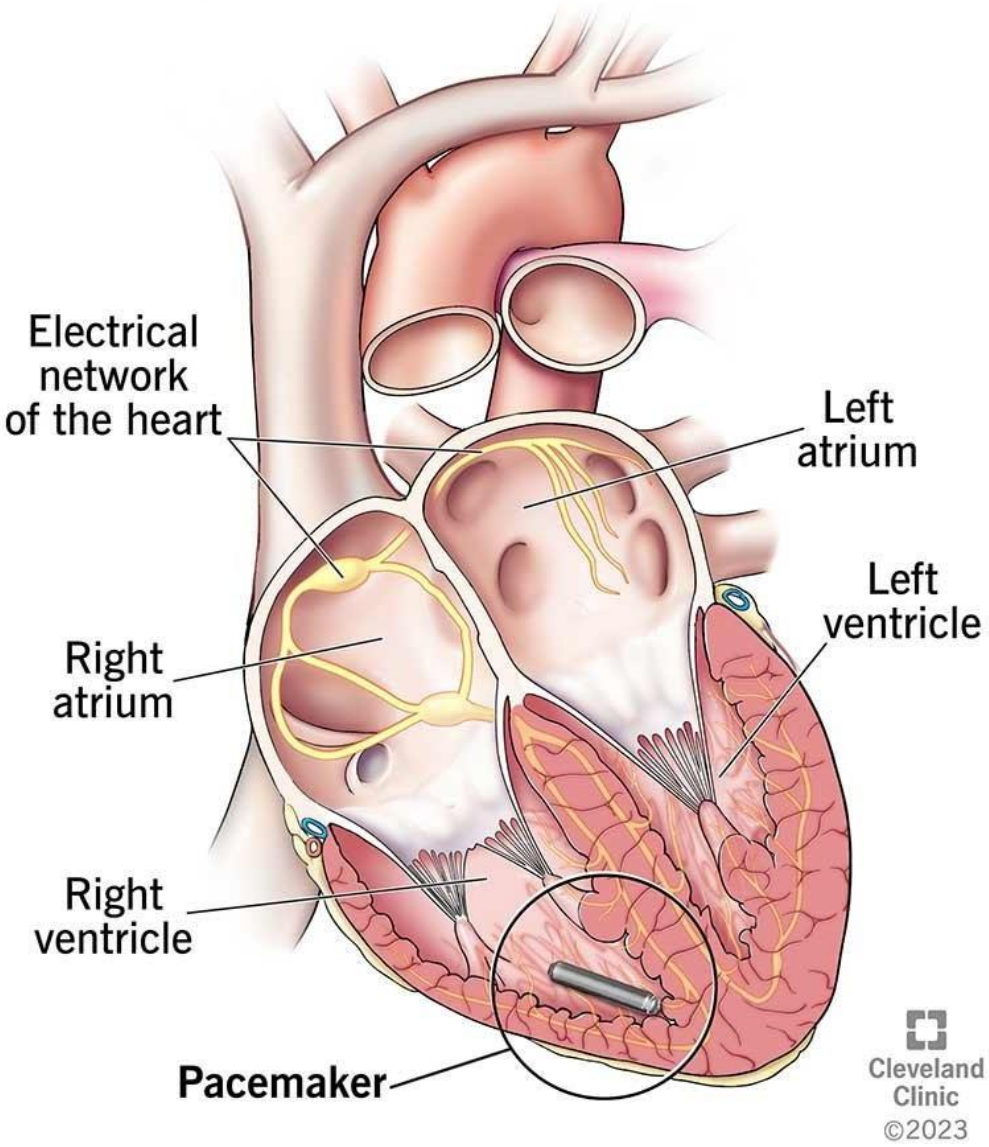
Coronary Angiography Views: Anteroposterior (AP) View Lateral View Left Anterior Oblique (LAO) View Right Anterior Oblique (RAO) View Cranial and Caudal Views The procedure involves threading a catheter through blood vessels to the area of interest and injecting contrast dye. Different positions and angles help visualize specific coronary arteries and identify blockages.

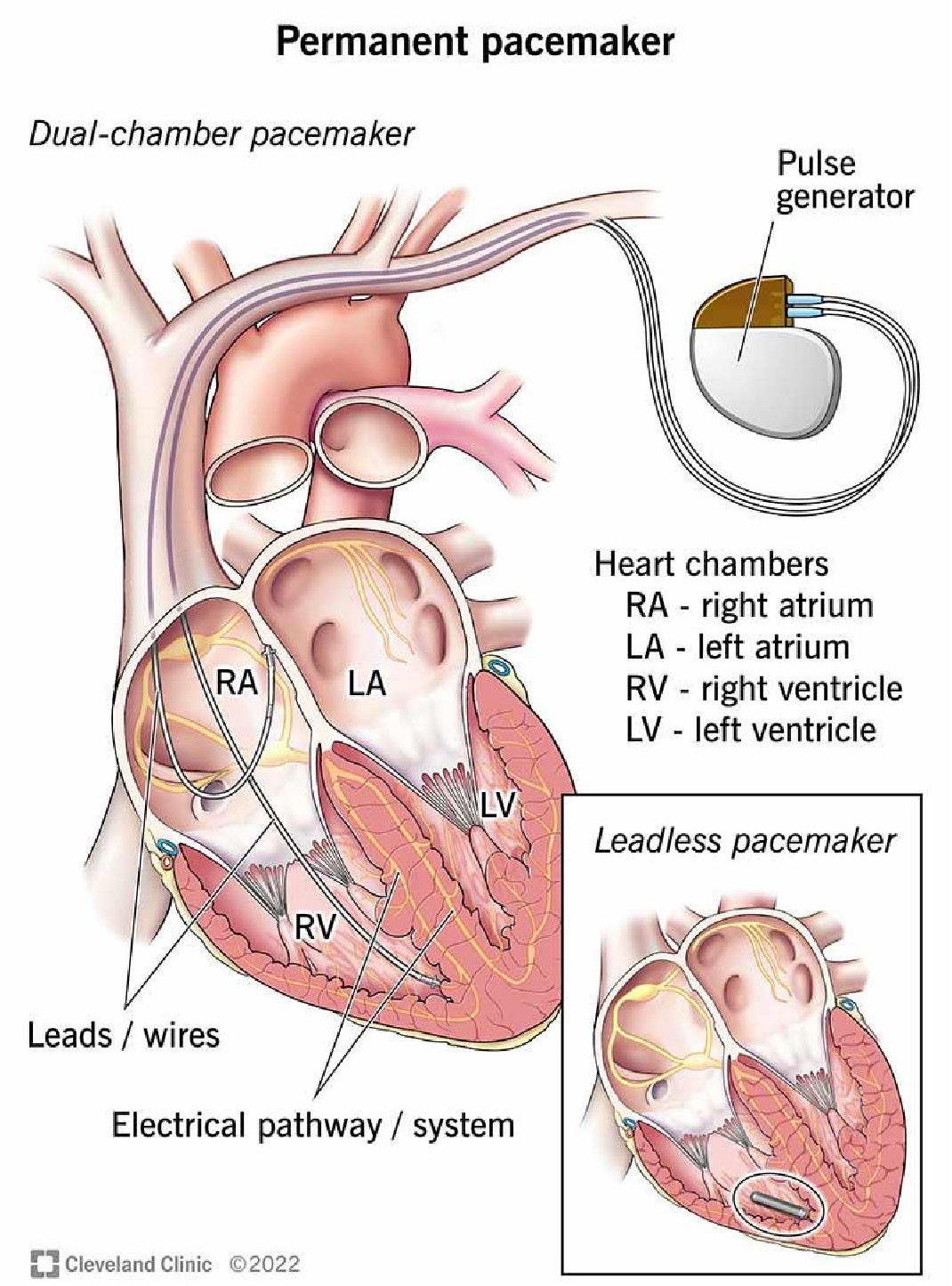
13.3 Pacemaker

Temporary and Permanent:

- Temporary Pacemaker: Used in emergent situations to address bradyarrhythmias. Electrodes are temporarily placed through a vein into the heart, and the external pacemaker provides electrical impulses until the patient stabilizes.
- Permanent Pacemaker: Surgically implanted to regulate heart rate in patients with persistent bradyarrhythmias. Leads are placed in the heart chambers, and the device is implanted subcutaneously, providing long-term support.

Leadless Pacemaker

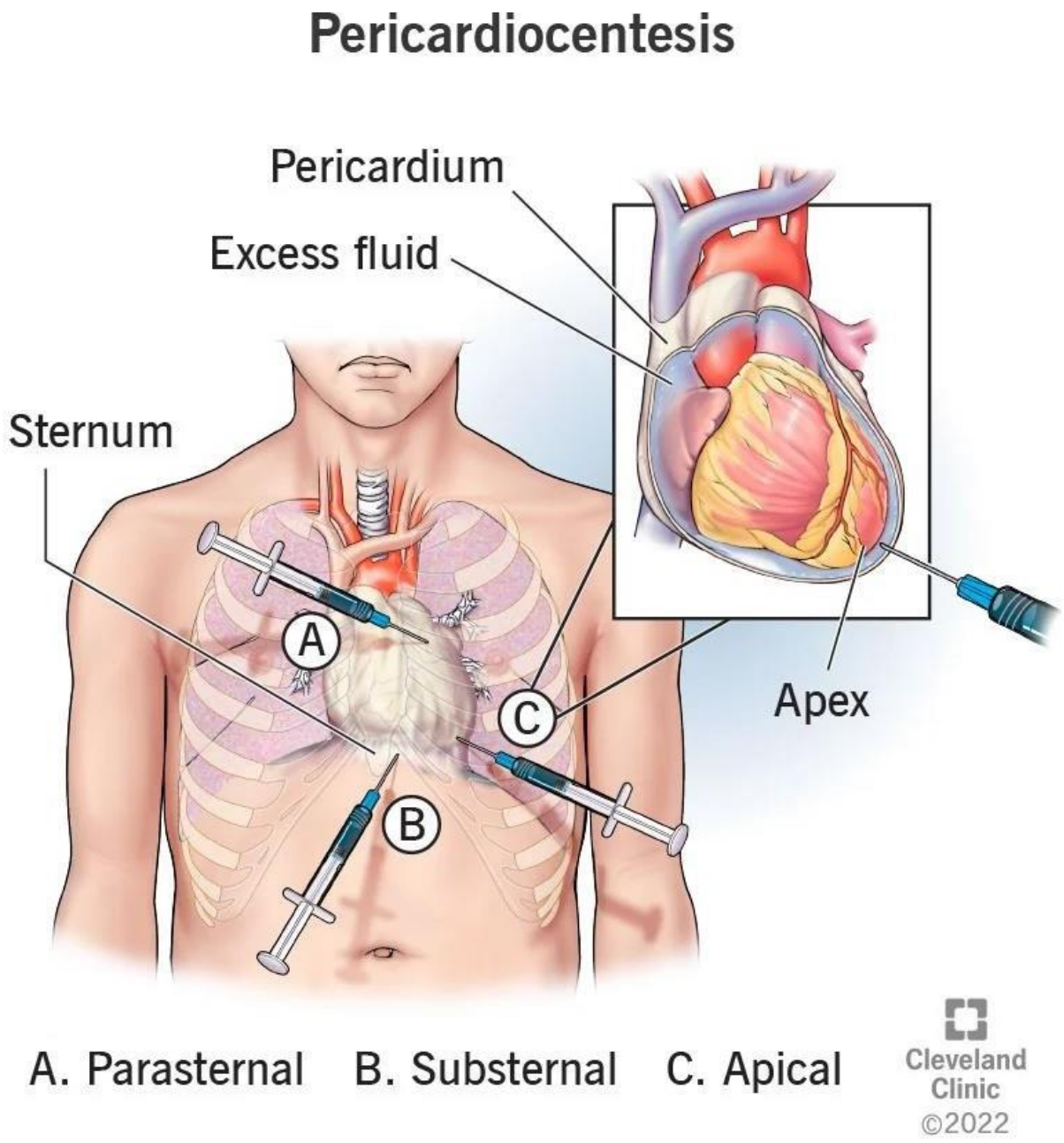




13.4 Pericardiocentesis:

Pericardiocentesis is a procedure involving the removal of excess fluid from the pericardial sac around the heart. This is typically done to relieve cardiac tamponade, a condition where fluid

accumulation compresses the heart, compromising its function. A needle is inserted into the pericardial space, and fluid is aspirated, relieving pressure on the heart.



13.5 Complications of Angiography:

Complications may include: Bleeding at the Catheter Site: Hematoma or pseudoaneurysm formation. Allergic Reactions to Contrast Dye: Ranging from mild itching to severe anaphylaxis. Blood Vessel Damage: Rarely, blood vessels may be injured during catheter insertion. Infection:

Risk of infection at the catheter site. Blood Clot Formation: Can occur at the catheter insertion site or within blood vessels.

13.6 Pre and Post-Angiography Care:

- Pre-Angiography: Patient education about the procedure and informed consent. NPO (nothing by mouth) status before the procedure. Assessing allergies, renal function, and baseline vital signs. Administering pre-procedure medications, including sedatives.
- Post-Angiography: Monitoring vital signs and neurological status. Assessing for signs of bleeding at the catheter site. Monitoring for allergic reactions to contrast dye. Providing instructions on post-procedure care and potential complications. Encouraging hydration to help eliminate contrast dye.

In the Cath Lab, these procedures and interventions are executed with precision to diagnose and treat cardiovascular conditions, emphasizing patient safety and optimal outcomes. The multidisciplinary team in the Cath Lab collaborates to deliver comprehensive care during and after these procedures.

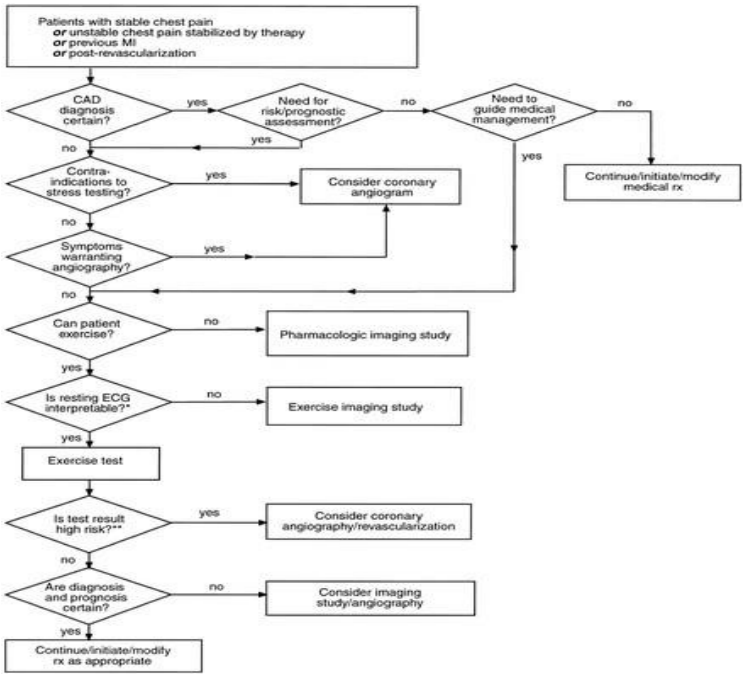


Fig: AHA Guidelines for Angio care patient.

Review Questions:

What are the primary indications for performing Angiography in cardiology?
Explain the procedural steps and positions involved in creating different views during Angiography.
Distinguish between temporary and permanent pacemakers, highlighting their respective applications in cardiac care.
Outline the process of Pericardiocentesis, including its purpose and potential complications.
Identify and elaborate on common complications that may arise during or after an Angiography procedure.
Discuss the essential aspects of pre-angiography care to ensure optimal patient preparation.
What measures are crucial for post-angiography care, and why are they important for patient recovery and well-being?

Chapter-14
Life Support Procedures

Objective:

Upon completion of the chapter on Life Support Procedures, the reader should be able to:

Understand Basic Life Support (BLS):

Comprehend the fundamental techniques and interventions involved in Basic Life Support.
Recognize the significance of timely and effective BLS in emergency situations.
Master Advanced Critical Life Support (ACLS):

Gain in-depth knowledge of advanced life-saving procedures and interventions in critical situations.
Learn to apply ACLS protocols for managing complex medical emergencies.
Understand the role of ACLS in improving patient outcomes during cardiac and respiratory distress.
This chapter aims to equip paramedics with the essential skills and knowledge required to execute life-saving interventions confidently and efficiently in emergency scenarios.

Life Support Procedures:

14.1 Basic Life Support (BLS): Basic Life Support is a fundamental set of life-saving techniques designed to provide immediate care to individuals experiencing cardiac arrest or other life- threatening emergencies. BLS interventions are typically initiated by bystanders or first responders before professional medical help arrives. The primary focus is on maintaining oxygenation and circulation.

- **Key Components of BLS**:
- Recognition of Emergency: Identifying the need for assistance and activating the emergency medical services (EMS) system.
- Cardiopulmonary Resuscitation (CPR): Providing chest compressions to circulate blood and rescue breaths to deliver oxygen.
- Use of Automated External Defibrillator (AED): Employing AED devices to analyze and, if necessary, shock the heart back into a normal rhythm.
- Management of Airway: Ensuring a clear airway to facilitate breathing.
- Control of Bleeding and Shock: Basic wound care and interventions to manage shock. **Indications for BLS:**
- Cardiac arrest

- Respiratory arrest
- Choking
- Severe bleeding
- Unconsciousness

BLS is the foundation for resuscitation efforts and serves as a critical link in the chain of survival.

BASIC LIFE SUPPORT STEP-BY-STEP

EUROPEAN RESUSCITATION COUNCIL GUIDELINES 2021

SEQUENCE/ACTION	TECHNICAL DESCRIPTION
SAFETY 	• Make sure that you, the victim and any bystanders are safe
RESPONSE Check for a response 	• Shake the victim gently by the shoulders and ask loudly: *"Are you all right?"*
AIRWAY Open the airway 	• If there is no response, position the victim on their back • With your hand on the forehead and your fingertips under the point of the chin, gently tilt the victim's head backwards, lifting the chin to open the airway
BREATHING Look, listen and feel for breathing 	• Look, listen and feel for breathing for **no more** than 10 seconds • A victim who is barely breathing, or taking infrequent, slow and noisy gasps, is not breathing **normally**
ABSENT OR ABNORMAL BREATHING Alert emergency services 	• If breathing is absent or abnormal, ask a helper to call the emergency services or call them yourself • Stay with the victim if possible • Activate the speaker function or hands-free option on the telephone so that you can start CPR whilst talking to the dispatcher
SEND FOR AED Send someone to get an AED 	• Send someone to find and bring back an AED if available • If you are on your own, **DO NOT** leave the victim, but start CPR
CIRCULATION Start chest compressions  	• Kneel by the side of the victim • Place the heel of one hand in the centre of the victim's chest - this is the lower half of the victim's breastbone (sternum) • Place the heel of your other hand on top of the first hand and interlock your fingers • Keep your arms straight • Position yourself vertically above the victim's chest and press down on the sternum at least 5 cm (but not more than 6 cm) • After each compression, release all the pressure on the chest without losing contact between your hands and the sternum • Repeat at a rate of 100-120 min-1

14.2 Advanced Cardiovascular Life Support (ACLS):

Advanced Cardiovascular Life Support is an extension of BLS, designed for healthcare providers involved in the management of cardiac emergencies. ACLS integrates advanced interventions and medications to improve the chances of restoring a stable cardiac rhythm.

- ❖ Key Components of ACLS: Cardiac Rhythm Interpretation: Identifying and interpreting cardiac rhythms on electrocardiograms (ECGs).
- ❖ Administration of Medications: Providing drugs such as epinephrine, amiodarone, and atropine to manage cardiac rhythms and support blood pressure.
- ❖ Advanced Airway Management: Securing and maintaining an airway through techniques like endotracheal intubation.
- ❖ Post-Cardiac Arrest Care: Implementing therapeutic hypothermia and other measures to optimize neurological outcomes after successful resuscitation.
- ❖ Team Dynamics: Coordinating resuscitation efforts within a healthcare team, emphasizing effective communication and leadership.

Indications for ACLS:

- ❖ Cardiac arrest
- ❖ severe arrhythmias
- ❖ Acute coronary syndromes
- ❖ Stroke Respiratory failure

ACLS is critical in providing a higher level of care for patients experiencing complex cardiac emergencies, especially within a hospital or healthcare setting. Regular training and certification in BLS and ACLS are essential for healthcare professionals to ensure competence in delivering timely and effective life support interventions.

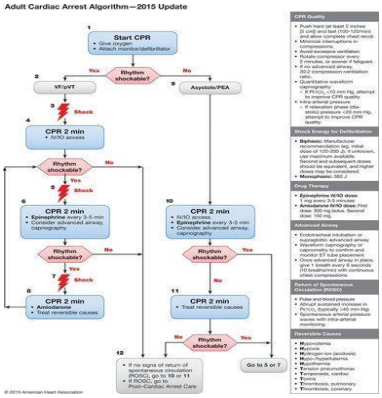


Fig: ACLS Guidelines

Review Questions:

What are the key components of Basic Life Support (BLS), and how do they contribute to emergency care?
Explain the significance of timely and effective BLS interventions in different emergency scenarios.
Outline the major differences between Basic Life Support (BLS) and Advanced Critical Life Support (ACLS).
What are the primary objectives and interventions involved in Advanced Critical Life Support (ACLS)?
Discuss the role of ACLS protocols in managing cardiac and respiratory emergencies.
How does ACLS contribute to improving patient outcomes in critical situations?
Identify the essential skills and knowledge required for executing life-saving interventions during emergencies.
Describe the importance of ongoing training and certification in BLS and ACLS for paramedics.
These review questions aim to reinforce the understanding of life support procedures, ensuring that paramedics are well-prepared to respond effectively to diverse emergency situations.

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