



MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED AND PUBLIC HEALTH SCIENCES AND TECHNOLOGY

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Hyderabad-500055
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Program

Master of Science (M.Sc.)

Cardiovascular Technology (Cath Lab)

2025

MALLA REDDY VISHWAVIDYAPEETH**SCHOOL OF ALLIED AND PUBLIC HEALTH SCIENCES AND TECHNOLOGY****Master of Science (M.Sc.)****CARDIOVASCULAR TECHNOLOGY (CATH LAB)****COURSE STRUCTURE****I year I semester**

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1	CTH26910101	Research Methodology and Biostatistics	4	-	-	4	40	60	100
2	CTH26910102	Cardiac Anatomy, Physiology and Pathology of Cardiac diseases	3	-	-	3	40	60	100
3	CTH26910103	Introduction to Cath Lab & Interventional Cardiology	3	-	2	4	40	60	100
4	CTH26910104	Basics of Medical and Surgical Treatments of Cardiac Diseases	2	-	-	2	40	60	100
5	CTH26910105	Diagnostic Cardiovascular Imaging	2	-	-	2	40	60	100
6	CTH26910106	Clinical Postings I (Cath Lab/Cardiac ICU)	-	-	12	6	40	60	100
TOTAL			14	-	12	21	240	360	600

I year II semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1	CTH26910201	Advanced Electrocardiogram	3	-	2	4	40	60	100
2	CTH26910202	Applied Pharmacology	3	-	-	3	40	60	100
3	CTH26910203	Cath and Intervention in Ischemic / Valvular Heart Disease	3	-	2	4	40	60	100
4	CTH26910204	Electrophysiology And cardiac Pacemakers	3	-	2	4	40	60	100
5	CTH26910205	Clinical Postings II (Cath Lab/Cardiac ICU)	-	-	16	8	40	60	100
TOTAL			12	-	22	23	200	300	500

II year III semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1	CTH26910301	Innovations in Cath Lab	4	-	-	4	40	60	100
2	CTH26910302	Cath and Intervention in myocardial, pericardial Disease & Non cardiac intervention	3	-	2	4	40	60	100
3	CTH26910303	Cath and Intervention in Congenital Heart Diseases	3	-	2	4	40	60	100
4	CTH26910304	Clinical Postings III (Cath Lab/Cardiac ICU)	-	-	16	8	40	60	100
TOTAL			10	-	20	20	160	240	400

II year IV semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1	CTH26910401	Thesis/Research Project	-	-	16	8	40	60	100
2	CTH26910402	Quality Control in Cardiovascular Imaging	2	-	-	2	40	60	100
3	CTH26910403	Entrepreneurship in Cardiovascular Technology	2	-	-	2	40	60	100
4	CTH26910404	Clinical Postings – IV (Cath Lab/Cardiac ICU)	-	-	16	8	40	60	100
TOTAL			4	-	32	20	160	240	400

1.1 Post Graduate Programme

Sl. No.	Course	Duration	Eligibility for admission
1	M.Sc. Cardiovascular Technology (Cath Lab)	2 years	BSc in Cardiac Technology/ Cardiovascular Technology or equivalent examination of a recognized Indian University or a duly constituted Board with pass marks (50%).

1.2. Medium of Instruction:

English shall be the medium of instruction for all subjects of study and for examinations.

1.3. Duration of the Course

Duration details are mentioned under clause no. 1.1 of this booklet.

1.4 Examination Regulations

1.4.1 Attendance: 75% of attendance (physical presence) is mandatory.

Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the closing of attendance before the final examination.

1.4.2 Internal Assessments:

a) Regular periodic assessment shall be conducted throughout the course. In each semester there will be **two one-hour internal assessments (15 marks each)** and a continuous assessment (10 marks). Thus, a total of 40 marks for the internal exam. (i.e. weightage for internal assessment shall be 40% of the total marks in each subject).

b) **Exam pattern for internal assessment** in each semester will be

(a) Short questions 3 nos. each carrying 5 marks (i.e. $3 \times 5 = 15$ marks). Two such internal examinations will be conducted.

(b) Continuous assessment of the student will be done. Students' overall attendance, performance in class, behaviour of the student, presentations, extra-curricular activities etc will be assessed. Continuous assessment carries 10 marks.

(d) Thus, a total of 40 marks for the internal examination. ($15 + 15 + 10 = 40$ marks). A candidate should secure a minimum of 40% marks in the internal assessment in each subject to be eligible to appear for the University examination

(e) For value added courses, only internal examination will be conducted. The assessment comprised of five assignments/presentations/case presentations each carrying 10 (i.e. $5 \times 10 = 50$ marks). Final examination will be for 50 marks with 5 questions each carrying 10 marks ($5 \times 10 = 50$ marks). The minimum pass is 40% marks.

1.4.3 University Examinations (External):

a) University Examination shall be conducted at the end of every semester.

b) A candidate who satisfies the requirement of attendance and internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.

c) Examination will be of 3 hours duration (for theory). The question pattern for those subjects without practical examination (60 marks) will be (a) Three essay questions out of which the student should answer 2 questions each carrying 10 marks (i.e. $2 \times 10 = 20$ marks) (b) Eight short note questions out of which the student should attempt six questions, each carrying 5 marks ($6 \times 5 = 30$ marks). (c) Ten very short questions each carrying 1 mark (i.e. $10 \times 1 = 10$ marks). Thus, a total of 60 marks.

d) The question pattern for practical examination (a) Spotters/major practical/minor practical/case presenting/Viva/practical/log record.

The minimum pass for internal assessment is 40% and for the University Examination is 50%. i.e. a student should score a total of 50% (adding the internal and external examination) to pass in each subject.

SEMESTER I**RESEARCH METHODOLOGY AND BIOSTATISTICS**

L/T/P/C

4/-/-4

RESEARCH METHODOLOGY

Introduction to research; Types of research; Defining a research question; Qualitative study designs; Quantitative study; Type I and type II bias; Study design: types

Case study, Case series, longitudinal cohort, Pre post design, Time series design, repeated measures design, Randomized control design.

Sampling design, calculating minimum sample size based on design

Measurement: Properties of measurement: reliability, validity, responsiveness, MCID.

Outcome measures: Use of outcome measures in rehabilitation research

Research Methods: Designing methodology, Reporting results, Type I and Type II bias.

Communicating research.

Evaluating published research: looking at the evidence

Introduction to evidence-based practice, evaluating evidence

Asking clinical questions

Translating of evidence into practice: strategies

Use of clinical practice guidelines, clinical pathways, prediction rules to inform practice.

BIOSTATISTICS

Descriptive Statistics and measurement variability; Inferential Statistics; Comparison of group means: T test; Analysis of variance; Multiple comparison tests

Parametric and non-parametric tests

Correlations

Regression

Analysis of frequencies: Chi square

Statistical measure of validity and reliability

Factorial Design analysis

Power analysis – Determining sample size, Epidemiological Measures–Rate, Ratio, Proportion, Incidence and prevalence, Relative risk, Risk ratio, Odds ratio

Application of various statistical software.

RECOMMENDED TEXT BOOKS

1. Statistical methods in Biology by Bailey, N.T.J
2. Statistical methods by Gupta, S.P
3. Research Methodology by Kumar, R

CARDIAC ANATOMY, PHYSIOLOGY AND PATHOLOGY OF CARDIAC DISEASES

L/T/P/C

3/-/-/3

UNIT 1 ANATOMY OF HEART AND GREAT VESSELS

- Anatomy and its subdivisions
- Blood and nerve supply of the heart
- Great vessels of the heart
- Structure of pericardium
- Structure of Aorta
- Venous drainage
- Aortic branches and vasculature
- Coronary arteries and veins

UNIT 2 CARDIAC CYCLE

- Cardiac Cycle
- Conduction system of the heart
- Cardiac output and factors affecting cardiac output
- Sympathetic and Para Sympathetic innervations
- Systemic Circulation and Pulmonary Circulation
- Systemic hypertension and Pulmonary Hypertension
- Diastole, Ventricular filling and atrial diastole

UNIT 3 DISEASES OF CORONARY ARTERIES, HEART FAILURE

- CAD and its types
- Causes, pathology and prevention of coronary artery diseases
- Symptoms and management of coronary artery disease
- Heart failure, Pathophysiology of Heart failure
- Heart failure medical management
- Heart failure surgical management
- Rheumatic Fever, Pathophysiology of Heart failure
- Coronary artery spasm and Angina

UNIT 4 HEART FAILURE AND RHEUMATIC FEVER

- Disorders of valves, Valvular heart diseases
- Mitral valve diseases, its pathophysiology and its management
- Aortic valve diseases, its pathophysiology and its management
- Tricuspid valve diseases, its pathophysiology and its management
- Pulmonary valve diseases, its pathophysiology and its management
- Infective Endocarditis, Pathophysiology

- Management of Rheumatic fever
- Symptoms of Rheumatic fever

UNIT 5 CONGENITAL HEART DISEASES AND DISEASES OF MYOCARDIUM

- Classification of Congenital heart diseases
- Diseases of Myocardium, Myocarditis, causes and management of myocarditis
- Pericarditis, causes and management of pericarditis
- Types of Cardiomyopathies, Pathophysiology and management
- Dilated Cardiomyopathy, Pathophysiology and management
- Hypertrophic Cardiomyopathy, Pathophysiology and management
- Diseases of the Pericardium
- Arrhythmogenic right ventricular cardiomyopathy

Recommended Text Books:

1. The human heart by amar vasmani
2. Cardiovascular Physiology by richard

INTRODUCTION TO CATH LAB AND INTERVENTIONAL CARDIOLOGY

L/T/P/C

3/-/2/4

Basic Foundations

Pathophysiology of common cardiovascular diseases (CAD, valvular disease, congenital heart disease)

Basics of vascular anatomy relevant to access (femoral, radial, brachial)

Diagnostic Catheterization

Indications & contraindications for diagnostic catheterization

Catheterization equipment: catheters, guidewires, contrast agents, sheaths, introducers

Access techniques, vascular access complications

Hemodynamic monitoring: pressure curves, waveforms, cardiac output, shunts

Therapeutic / Interventional Procedures

Percutaneous Coronary Interventions (PCI): angioplasty, stenting, different stent types (bare metal, DES), lesion assessment (calcification, bifurcation, chronic total occlusion)

Non-coronary interventions: valvuloplasty, device closure (ASD, VSD, PDA), structural heart interventions

Balloon angioplasty, rotational atherectomy, thrombus aspiration etc.

Imaging in Interventional Cardiology

Fluoroscopy basics: physics, image acquisition, contrast, dose management

Angiography techniques: projections, views, interpreting angiograms

Adjunct imaging: Intravascular Ultrasound (IVUS), Optical Coherence Tomography (OCT), Fractional Flow Reserve (FFR)

Use of CT angiography in pre-planning

Patient care, Safety, and Supportive Technologies

Pre- and post-procedure patient care: monitoring, sedation / anaesthesia, anticoagulation, anti-platelet therapy

Contrast media: types, reactions, kidney protection

Radiation safety: protection for patient / operator, ALARA principles

Infection control, sterile technique, procedural checklists

Emergency management: complications (bleeding, arrhythmias, perforation, no-reflow, etc.)

Ethical, Legal & Regulatory Issues

Patient consent; risk-benefit discussions; documentation
Regulatory standards for Cath labs; equipment maintenance; accreditation
Ethical issues in interventional cardiology (device costs, patient selection, end-of-life etc.)
Quality assurance and audit in interventional practice

Emerging Trends & Innovations

New devices, bioresorbable scaffolds, hybrid procedures
Structural heart interventions: TAVR, MitraClip, left atrial appendage occlusion etc.
Robotics, remote intervention, artificial intelligence in imaging & planning
Telemedicine / remote proctoring

PRACTICALS: Observation of (a) Diagnostic Catheterization (b) Therapeutic / Interventional Procedures (c) Emergency management: complications (bleeding, arrhythmias, perforation etc)
Imaging in Interventional Cardiology
Patient care, radiation safety, and infection control

Recommended Text Books

1. Interventional Cardiology: Principles and Practice by George D. Dangas, Carlo Di Mario, Nicholas N. Kipshidze, Peter Barlis, Tayo Addo, Patrick W. Serruys
2. Invasive Cardiology: A Manual for Cath Lab Personnel by Sandy Watson, Kenneth A. Gorski
3. Textbook of Catheter-Based Cardiovascular Interventions: A Knowledge-Based Approach by Peter Lanzer (editor) et al.

BASICS OF MEDICAL AND SURGICAL TREATMENTS OF CARDIAC DISEASES

L/T/P/C

2/-/-/2

UNIT 1 DIFFERENT TYPES OF SURGERY

- Coronary artery bypass grafting (ON PUMP CABG)
- Uses, Procedure of CABG
- Post- operative care, results and complications of CABG
- Valvular heart disease and its types
- Mitral valve diseases and its surgical procedures
- Difference between the repair and replacement of valves
- Aortic valve diseases and its surgical procedures
- Tricuspid and pulmonary valve diseases and its surgical procedures
- CABG surgery and its complications
- Aortic aneurysm repair

UNIT 2 SURGERY IN CONGENITAL HEART DISEASE

- Classification of congenital heart disease
- ASD closure / device / surgical
- Difference between device closure and surgical closure for CHD
- VSD closure / device / surgical
- TOF repair, uses, procedure and complications
- Glenn shunt procedure, uses and complications
- Fontan procedure, uses and complications
- Pulmonary artery banding procedure, uses and complications

UNIT 3 DISEASES OF AORTA AND THORACIC AORTA

- Classification diseases of Aorta
- Types of aneurysms of aorta and its complications
- Stanford classification
- DeBakey classification
- Procedure and surgery for aortic arch, management and their complications
- Procedure and surgery for ascending aorta, management and their complications
- Procedure and surgery for descending aorta, management and their complications
- Management and complications of diseases of aorta
- Marfan syndrome

UNIT 4 MANAGEMENT OF IHD/ VALVULAR / CONGENITAL HEART DISEASES

- Ischemic heart disease, and their management and complications
- Invasive techniques used in ischemic heart diseases
- Coronary artery diseases and its complications
- Valvular heart disease, and their management and complications
- Procedure and surgery for mitral stenosis and mitral regurgitation and their complications, management
- Procedure and surgery for aortic stenosis and aortic regurgitation and their complications, management
- Procedure and surgery for tricuspid stenosis and tricuspid regurgitation and their complications, management
- Procedure and surgery for pulmonary stenosis and pulmonary regurgitation and their complications, management
- Procedure and surgery of IHD, CHD
- Revascularization procedures

UNIT 5 CONGENITAL HEART DISEASES

- Management of ASD both in adult and pediatric patients
- Management of VSD both in adult and pediatric patients
- Management of PDA both in adult and pediatric patients
- Management of COA both in adult and pediatric patients
- Management of TGA both in adult and pediatric patients
- Management of DORV both in adult and pediatric patients
- Management of Hypoplastic left heart syndrome in pediatric patients
- Lifestyle modifications and emotional support and counselling for child with CHD

REFERENCE:

1. Brounwakds heart diseases
2. Cardiology: An illustrated textbook, kanuchatterjee, 2013 edition

DIAGNOSTIC CARDIOVASCULAR IMAGING

L/T/P/C

2/-/-2

INTRODUCTION:

Cardiac Physiology & Anatomy: Cardiac cycle, ECG, heart structure, hemodynamics; ECG fundamentals and their correlation with imaging findings;
Overview of imaging modalities: strengths, weaknesses, clinical utility

IMAGING TECHNIQUES:

Echocardiography (Transthoracic, Doppler, TEE, 3D/4D, Stress)
Basic image acquisition, Doppler physics, quantitative analysis
Advanced tools: strain imaging, contrast echo, artifact recognition

CT (COMPUTED TOMOGRAPHY)

Coronary CT angiography protocols, dose metrics, interpretation of coronary artery disease
Radiation safety: CTDI, DLP, field-of-view impacts, dose-saving techniques

MRI (MAGNETIC RESONANCE IMAGING)

Physics: gating, cine sequences (bSSFP), T1/T2 mapping, phase-contrast imaging
Applications: viability, cardiomyopathy, myocarditis, congenital heart disease, angiography

NUCLEAR IMAGING & PET/SPECT

Myocardial perfusion assessments, tracer principles, hybrid imaging applications
Clinical Pathologies and imaging in: Congenital heart disease; ischemic heart disease; valvular disorders; cardiomyopathies; pericardial and aortic diseases; masses; arrhythmias; device-related imaging, transplants

IMAGING PHYSICS & POST-PROCESSING: CT/MRI physics, 3D reconstruction techniques (MPR, MIP, volume rendering)

QUALITY & SAFETY: Radiation dose management, diagnostic accuracy, artifact avoidance

RECOMMENDED TEXT BOOKS

1. Case-Based Textbook of Echocardiography and Cardiac MRI- Editors: Anita Sadeghpour, Azin Alizadehasl, Anita M. Kelsey
2. Advanced Cardiac Imaging by Nieman, Gaemperli, Lancellotti, Plein
3. Cardiac Imaging in Clinical Practice- Editors: Dmitriy Kireyev & Judy Hung

CLINICAL POSTINGS I

L/T/P/C

-/-/12/6

Students should be posted in,

- CATH LAB
- CARDIAC ICU

ADVANCED ELECTROCARDIOGRAM

L/T/P/C

3/-/2/4

UNIT 1 THE ABNORMAL ELECTROCARDIOGRAM

- Electrocardiogram waves, intervals and segments
- Electrocardiogram waves and its abnormalities
- The importance of chamber enlargement identifying in the ECG
- Left atrial and right atrial enlargement identifying in the ECG
- Left ventricular and right ventricular enlargement identifying in the ECG
- ECG finding in myocardial infarction.
- localization of ischemia/ infarction based on ECG
- primary and secondary T wave change
- Non-infarction q wave

UNIT 2 HEART BLOCKS

- Conduction system in heart
- Axis deviation
- ECG findings in 1st degree AV BLOCKS
- ECG findings in 2nd degree AV BLOCKS
- ECG findings in 3rd degree AV BLOCKS or complete heart block
- Management of complete heart block
- Left bundle branch block
- Right bundle branch block
- Fascicular blocks.
- WPW syndrome and sick sinus syndrome

UNIT 3 CARDIAC ARRHYTHMIAS

- Introduction and classification of cardiac arrhythmias
- Normal sinus rhythm
- ECG findings in tachyarrhythmia, bradyarrhythmia's
- Premature beats
- Supraventricular tachycardia
- Ventricular tachycardia
- Indications of Holter monitoring in cardiac arrhythmias.
- Cardioversion and Defibrillator
- Management of cardiac arrhythmia
-

UNIT 4 ELECTROLYTE IMBALANCES IN ECG

- Specific electrolyte imbalances and importance of ECG
- Causes and ECG findings in hypercalcemia
- Causes and ECG findings in hypocalcaemia
- Causes and ECG findings in hypokalemia
- Causes and ECG findings in hyperkalemia
- Causes and ECG findings in Hypermagnesemia
- Causes and ECG findings in hypomagnesemia

- Long QT syndrome
- ECG in digoxin toxicity
- ECG changes in pericardial diseases

UNIT 5 VALVULAR AND CONGENITAL HEART DISEASES IN ECG

- Causes and ECG findings in mitral valve disease
- Causes and ECG findings in aortic valve disease
- Causes and ECG findings in tricuspid valve disease
- Causes and ECG findings in pulmonary valve disease
- Importance of ECG in congenital heart disease
- ECG finding in atrial septal defect
- ECG finding in ventricular septal defect
- ECG finding in TOF
- ECG findings TGA
- Arrhythmias in congenital heart disease

PRACTICAL

Abnormal Electrocardiogram; ECG finding in Blocks

Electrolyte Imbalances in ECG

Valvular and Congenital Heart diseases in ECG

Holter Monitoring

REFERENCE Text Books:

1. Leo Schamroth introduction to Electrocardiography clamber Narasimhan, Johnson Francis, Leo Schamorth
2. Marriott's Practical Electrocardiography – Galen S. Wagner, David G Strauss

APPLIED PHARMACOLOGY

L/T/P/C

3/-/-/3

General Pharmacology Basics

Definition, classification of drugs

Pharmacokinetics (absorption, distribution, metabolism, excretion)

Pharmacodynamics (dose-response, receptor theory, agonists/antagonists)

Routes of drug administration, bioavailability, half-life, volume of distribution

Drug interaction basics (pharmacokinetic, pharmacodynamic)

Cardiovascular PharmacologyAnti-hypertensives: ACE inhibitors, ARBs, β -blockers, calcium channel blockers, diuretics, vasodilators

Anti-arrhythmics: classification, indications, mechanism (e.g. Vaughan Williams classification)

Anti-ischemic agents: nitrates, ranolazine, etc.

Lipid-lowering agents: statins, fibrates, PCSK9 inhibitors, etc.

Anti-platelet & anti-coagulants: aspirin, clopidogrel, newer agents (P2Y₁₂ inhibitors), GP IIb/IIIa inhibitors, oral anticoagulants (warfarin, DOACs), heparins (UFH, LMWH)**Pharmacology in Interventional Procedures**

Sedation / analgesia: drugs used (local anaesthetics, moderate sedation, conscious sedation), safety

Contrast agents: types, reactions (allergic, nephropathy), prevention and management

Vasodilators during procedure: nitrates, adenosine etc.

Drugs used in thrombolysis / adjunctive therapy during percutaneous coronary intervention (PCI)

Anti-platelet therapy around stenting: loading dose, maintenance, duration, dual antiplatelet therapy (DAPT), specifics in DES vs BMS, in special populations

Drugs in Emergency Management within Cath Lab

ACLS drugs: epinephrine, amiodarone, lidocaine, magnesium

Vasopressors & inotropes: e.g. dopamine, dobutamine, norepinephrine, milrinone.

Anti-shock medications; management of arrhythmias during interventions

Antagonists and antidotes: e.g. reversal of anticoagulants, managing overdose / toxicity

Safety, Regulation, Ethics in Pharmacology

Adverse drug reactions, monitoring, reporting (pharmacovigilance)

Drug regulatory agencies, approvals, labeling, generic vs brand names

Drug storage, handling in hospital setting (sterility, expiry etc.)

Ethical issues in drug trials, off-label use, cost vs access

Patient counselling, informed consent regarding drugs

Recent Advances in Pharmacotherapy

New anticoagulants / antiplatelets / lipid agents (e.g. PCSK9 inhibitors, RNA therapies etc.)

Novel drug-eluting stent coatings / local drug delivery systems

Drug-device combination products

Personalized medicine in cardiovascular pharmacotherapy: pharmacogenomics etc.

Recommended Text Books

- 1, Textbook of Interventional Cardiovascular Pharmacology by Nicolas Kipshidze, Jawad Fareed, Patrick W. Serruys, Jeff Moses
2. Pharmacotherapeutic Management of Cardiovascular Disease Complications: A Textbook for Medical Students by M.S. Umashankar, A. Bharath Kumar

CATH AND INTERVENTION IN ISCHEMIC / VALVULAR HEART DISEASE

L/T/P/C

3/-/2/4

Basics

Review of coronary anatomy, coronary pathophysiology (atherosclerosis, plaque rupture, chronic total occlusion)

Valvular anatomy & physiology (aortic, mitral, tricuspid, pulmonary), types of valvular disease: stenosis, regurgitation, mixed lesions, congenital vs acquired

Hemodynamics in valvular lesions: pressure gradients, orifice area, regurgitant volume etc.

Ischemia vs infarction physiology, collateral circulation

Diagnostic Catheterisation in IHD & Valve Disease

Coronary angiography: indications, projections, quantification of stenosis, anatomical variations, non-invasive vs invasive imaging modalities

Hemodynamic catheterization: left and right heart catheterization, measurement of pressures, gradients across valves, cardiac output (Fick / thermodilution), valve orifice calculation, assessment of pulmonary pressures in MR/TR etc.

Non-coronary imaging adjuncts: echocardiography, Doppler, TEE, CT angiography, MRI if relevant

Percutaneous Coronary Intervention (PCI) in Ischemic Heart Disease

Indications (stable angina, ACS, STEMI, NSTEMI), risk stratification, patient selection

Equipment: guidewires, balloons, stents (bare metal, drug-eluting), special devices (PTCA, drug-coated balloons, atherectomy, thrombus aspiration)

Technique: lesion preparation, wire strategy, bifurcation lesions, chronic total occlusion, calcified lesions, guidance by imaging / physiology (FFR, iFR)

Primary PCI: timing, adjunctive therapies

Post PCI pharmacotherapy, follow up, prevention of restenosis and stent thrombosis

Catheter-based Interventions in Valvular Heart Disease

Balloon valvuloplasty: mitral, aortic, pulmonary (in pediatric / adult) – indications, sizing, risks

Transcatheter valve replacement (TAVR / TAVI) for aortic stenosis/insufficiency: patient selection, valve types, access routes, procedural steps, imaging guidance, complications

Transcatheter mitral valve repair / replacement (including MitraClip etc.)

Percutaneous interventions for other valvular lesions: tricuspid interventions, pulmonary valve, etc.

Hybrid approaches vs surgical valve replacement: pros/cons, long-term outcomes

Complications & Their Management

Coronary perforation, dissection, no-reflow, distal embolization, acute closure, stent thrombosis

Valve-specific complications: paravalvular leak, valve malpositioning, prosthesis-patient mismatch, coronary obstruction in TAVR, heart block etc.

Access site complications, contrast nephropathy, stroke, bleeding, arrhythmias

Measures to prevent complications: anticoagulation, antiplatelet therapy, imaging guidance, adjunctive devices, patient monitoring

Patient Management Pre-, During, & Post-Intervention

Pre-procedure workup: labs, imaging, patient counseling, risk scoring (STS, EuroSCORE etc.), dual antiplatelet, anticoagulation, renal protection

Intra-procedure: sedation / anaesthesia, contrast use, radiation safety, monitoring, team roles

Post-procedure care: hemodynamic monitoring, antiplatelet / anticoagulation regimens, follow-up imaging, rehabilitation, managing ischemia / residual lesion, valve function follow up, prosthetic valve care

PRACTICAL

Assisting Diagnostic Catheterisation process; Assisting various Catheter-based Interventions; Assisting clinician in Patient Management Pre-, During, & Post-Intervention

Recommended Text Book

1. The Interventional Cardiac Catheterization Handbook by Morton J. Kern, Michael J. Lim, Paul Sorajja
2. The Interventional Cardiology Handbook Editors: Salvatore Brugaletta, Manel Sabaté

ELECTROPHYSIOLOGY AND CARDIAC PACEMAKERS

L/T/P/C

3/-/2/4

Cardiac Electrophysiology Fundamentals

Electrical conduction system of the heart

Ion channels and action potentials

Electrocardiography (ECG) interpretation

Mechanisms of arrhythmias

Electrophysiological properties of cardiac tissues

Arrhythmias and Their Mechanisms

Supraventricular arrhythmias (e.g., atrial fibrillation, atrial flutter)

Ventricular arrhythmias (e.g., ventricular tachycardia, ventricular fibrillation)

Conduction disorders (e.g., AV block, bundle branch block)

Inherited arrhythmias and syndromes

Mechanisms of arrhythmia induction and termination

Electrophysiology Study (EPS) Techniques

Indications for EPS

Catheter placement and manipulation

Intra-cardiac recording techniques

Programmed stimulation and mapping techniques

Use of 2D and 3D mapping systems

Cardiac Pacemakers and Implantable Devices

Indications for pacemaker implantation

Types of pacemakers (single-chamber, dual-chamber, biventricular)

Lead placement and fixation techniques

Pacemaker programming and troubleshooting

Implantable cardioverter-defibrillators (ICDs)

Advanced Topics in Electrophysiology

Catheter ablation techniques (radiofrequency, cryoablation)

Conduction system pacing (His bundle pacing, left bundle branch area pacing)

Resynchronization therapy (CRT)

Lead extraction techniques

Emerging technologies in electrophysiology

PRACTICAL

Electrocardiography (ECG) interpretation; Electrophysiology Studies; Cardiac Pacemakers and Implantable Devices; Pacemaker programming and troubleshooting

Recommended Text Books

1. Clinical Cardiac Electrophysiology: Techniques and Interpretations by Mark E. Josephson
2. Cardiac Pacing and ICDs by Kenneth A. Ellenbogen, Mark A. Wood, and Jonathan L. Wilkoff
3. Electrophysiologic Disorders of the Heart by Douglas P. Zipes and Jose Jalife
4. Practical Electrophysiology by Peter W. Macfarlane

CLINICAL POSTINGS – II

L/T/P/C

-/-/16/8

Students should be posted in CATH LAB

SEMESTER III

INNOVATIONS IN CATH LAB

L/T/P/C

4/-/-/4

Advancements in Catheterization Technologies

Robotic-Assisted Procedures: Integration of robotic systems for precise catheter navigation and reduced operator fatigue.

Automated Catheter Tip Repositioning: Development of systems that allow for automated repositioning of catheter tips during procedures, enhancing imaging quality and procedural efficiency.

Active Lubrication Techniques: Implementation of ultrasonic vibrations to reduce friction during catheter insertion, minimizing tissue trauma and improving maneuverability.

Enhanced Imaging Modalities

Intravascular Imaging: Utilization of technologies like Optical Coherence Tomography (OCT) and Intravascular Ultrasound (IVUS) for detailed vessel wall assessment.

Fusion Imaging: Combining angiography with other imaging modalities (e.g., CT, MRI) to provide comprehensive anatomical and functional information.

Real-Time 3D Mapping: Adoption of three-dimensional mapping systems for accurate localization of catheter positions during interventions.

Minimally Invasive Techniques

Transcatheter Valve Therapies: Advancements in procedures like Transcatheter Aortic Valve Replacement (TAVR) and MitraClip implantation.

Percutaneous Coronary Interventions (PCI): Innovations in stent design, drug-eluting technologies, and bioresorbable scaffolds.

Leadless Pacemakers: Development and implementation of leadless pacing systems to reduce complications associated with traditional pacemaker leads.

Integration of Artificial Intelligence (AI) and Machine Learning

AI in Imaging Analysis: Application of AI algorithms to analyze imaging data for enhanced diagnostic accuracy.

Predictive Analytics: Use of machine learning models to predict patient outcomes and guide therapeutic decisions.

Automation in Procedure Planning: Development of AI-driven tools to assist in procedural planning and real-time decision-making.

Quality Control and Safety Protocols

Radiation Dose Management: Implementation of strategies to minimize radiation exposure to patients and healthcare providers.

Sterilization and Infection Control: Advancements in sterilization techniques and infection control measures in the cath lab environment.

Standardization of Procedures: Development of standardized protocols to ensure consistency and safety in cath lab operations.

Recommended Text Books

- 1. Cardiovascular Catheterization and Intervention** by Debabrata Mukherjee, Eric R. Bates, Marco Roffi, Richard A. Lange, David J. Moliterno
- 2. Interventional Cardiology: Principles and Practice** by Eric J. Topol
- 3. Manual of Interventional Cardiology** by Eric J. Topol, Peter W. Armstrong

CATH AND INTERVENTION IN MYOCARDIAL, PERICARDIAL DISEASE & NON - CARDIAC INTERVENTION

L/T/P/C

3/-/2/4

Myocardial Diseases

Ischemic Heart Disease: Pathophysiology, diagnostic approaches, and interventional strategies.

Non-Ischemic Cardiomyopathies: Dilated, hypertrophic, restrictive, and arrhythmogenic right ventricular cardiomyopathies.

Myocardial Infarction: Acute and chronic management, including percutaneous coronary interventions (PCI).

Myocardial Viability Assessment: Techniques such as dobutamine stress echocardiography and positron emission tomography (PET).

Pericardial Diseases

Pericarditis: Etiology, clinical presentation, and management.

Pericardial Effusion and Tamponade: Diagnostic imaging, hemodynamic assessment, and pericardiocentesis techniques.

Constrictive Pericarditis: Pathophysiology, diagnostic challenges, and surgical interventions.

Non-Cardiac Interventions

Renal Artery Interventions: Percutaneous transluminal renal angioplasty and stenting.

Pulmonary Artery Interventions: Management of pulmonary artery stenosis and interventions.

Vascular Access Techniques: Arterial and venous access for diagnostic and therapeutic procedures.

Endovenous Procedures: Laser and radiofrequency ablation for varicose veins.

PRACTICALS:

Observation/assisting clinicians in procedures including Coronary Angiography; Percutaneous Coronary Intervention; Acute Myocardial Infarction (AMI) Interventions; Pericardiocentesis

Observation/assisting clinicians in Noncardiac interventions including Peripheral Vascular Interventions; Pulmonary Artery & Right Heart Interventions; Non-vascular Interventions

Recommended Text Books

1. Cardiovascular Catheterization and Intervention: A Textbook of Coronary, Peripheral, and Structural Heart Disease by Debabrata Mukherjee, Eric R. Bates, Marco Roffi, Richard A. Lange, David J. Moliterno
2. Manual of Interventional Cardiology by Eric J. Topol, Peter W. Armstrong
3. Interventional Cardiology: Principles and Practice by Eric J. Topol

CATH AND INTERVENTION IN CONGENITAL HEART DISEASES

L/T/P/C

3/-/2/4

Anatomy and Physiology of Congenital Heart Defects (CHDs)

Normal fetal and postnatal circulatory physiology

Embryology of common congenital heart defects

Hemodynamic consequences of congenital anomalies

Diagnostic Techniques in Congenital Heart Disease

Echocardiography: transthoracic and transesophageal approaches

Cardiac MRI and CT imaging

Cardiac catheterization: indications and procedural techniques

Hemodynamic assessment: pressure and oxygen saturation measurements

Interventional Procedures

Balloon atrial septostomy

Percutaneous closure of atrial septal defects (ASD) and patent foramen ovale (PFO)

Balloon valvuloplasty for pulmonary and aortic stenosis

Stent implantation for coarctation of the aorta

Transcatheter valve interventions

Device closure of ventricular septal defects (VSD)

Advanced Techniques and Technologies

Intravascular imaging: IVUS and OCT

Electrophysiological studies in congenital arrhythmias

Use of 3D mapping systems in complex congenital lesions

Emerging technologies: MRI-guided interventions and robotic-assisted procedures

Post-Procedure Care and Complications

Monitoring and management in the intensive care unit

Identification and management of complications: arrhythmias, embolism, bleeding

Long-term follow-up and surveillance strategies

Transitioning care from pediatric to adult cardiology

PRACTICALS:

Observation/assisting clinicians in Diagnostic Cardiac Catheterization in CHDs; Hemodynamic Measurements; observation of Angiographic Techniques; observation and assisting of Common CHDs Requiring Cath Study including Atrial Septal Defect (ASD), Ventricular Septal Defect (VSD) etc.

Post procedure care : Monitoring and management in the intensive care unit.

Recommended Text Books

- 1. Cardiac Catheterization in Congenital Heart Disease** by Neil Tailor, Ranjit Philip, and Shyam Sathanandam
- 2. Diagnostic and Interventional Catheterization in Congenital Heart Disease** by David Gaze
- 3. Cardiovascular Catheterization and Intervention: A Textbook of Coronary, Peripheral, and Structural Heart Disease** by Debabrata Mukherjee, Eric R. Bates, Marco Roffi, Richard A. Lange, David J. Moliterno

CLINICAL POSTINGS – III

L/T/P/C

-/-/16/8

Students should be posted in CATH LAB

SEMESTER IV

THESIS/RESEARCH PROJECT

L/T/P/C

/-/16/8

In project/thesis, the students should be able to:

- Independently conduct research
- Critically analyse findings with scientific methodology

QUALITY CONTROL IN CARDIOVASCULAR IMAGING

L/T/P/C

2/-/-/2

Introduction to Quality Control (QC): Definitions, quality domains (AHA), rationale, regulatory standards (accreditation: ACR, IAC)

Imaging Process QC: Patient selection, standardized protocols, reporting consistency

Modality-Specific QC – MRI: Protocol optimization, SNR/CNR metrics, QA programs

Modality-Specific QC – CT: Radiation dose audits, dose reduction strategies, multidisciplinary oversight

Modality-Specific QC – Echo: Reducing inter-observer variability, training interventions, EF measurement reproducibility

Accreditation and QA Systems: Accreditation benefits, reporting standards, dose registries and benchmarking

Automated QC Tools: AI in image quality prediction, automation in QC pipelines, integration in clinical workflow

Case Studies & Implementation: Quality failure analyses, best practice examples, implementation roadmaps

RECOMMENDED TEXT BOOKS

1. Quality and Safety in Imaging - Editors: Lluís Donoso-Bach & Giles W. L. Boland
2. Echocardiography: The Normal Examination and Echocardiographic Measurements by
Bonita Anderson

ENTREPRENEURSHIP IN CARDIOVASCULAR TECHNOLOGY

L/T/P/C

2/-/-/2

Introduction to Entrepreneurial Mindset: Role of entrepreneurship in healthcare; lean startup and business model canvas; specifics for cardiac tech innovation

Identifying Clinical Needs & Innovation: Unmet needs in cardiovascular care; stakeholder insight (clinicians, patients); case studies from devices like echo tools, AI imaging

Business Modeling & Value Proposition: Value creation in CV tech; customer segmentation; designing offerings for cardiologists, imaging centers

Intellectual Property & Regulatory Landscape: IP strategies, patenting in cardiac imaging devices; navigating ISO/GMP, CE, FDA pathways for cardiovascular technologies

Financing and Market Development: Funding sources—grants, VC, angel; economic modeling for devices; reimbursement and health-economics in CV imaging

Marketing, Strategy, & Scaling: Competitor mapping in CV imaging; go-to-market options—hospitals, diagnostic centers; international expansion

Entrepreneurship Ethics & Policy: Ethical implications; equity in cardiovascular diagnostics; health policy dynamics affecting CV technology

RECOMMENDED TEXT BOOKS

1. Healthcare Entrepreneurship and Management: A Comprehensive Guide for Biomedical

Engineers and Entrepreneurs by Arnab Chanda & Shubham Gupta

2. Medical Entrepreneurship: Trends and Prospects in the Digital Age- Editors: Lukman

Raimi & Ibrahim Adekunle Oreagba

CLINICAL POSTINGS – IV

L/T/P/C

-/-/16/8

- To provide supervised, hands-on clinical training in echocardiography and related cardiovascular imaging modalities.
- To observe or assist cardiologists in Diagnostic Cardiac Catheterization
- To enable students to apply theoretical knowledge in real-time patient care settings.
- To enable students in the post cath lab procedure care : Monitoring and management in the intensive care unit.
- The student should be able to independently perform, analyze, and report standard echocardiographic examinations, assist in advanced procedures, and integrate findings into patient management.