

**DM (INTERVENTIONAL RADIOLOGY)**

[Syllabus Approved by Board of Studies, Medical &amp; Health Sciences]

<b>Programme Code</b>	:	HLTH10A05
<b>Programme Details</b>	:	DM INTERVENTIONAL RADIOLOGY
<b>Programme Learning Outcomes (PLOs/PSOs)</b>	:	ANNEXED IN THE BELOW FORMAT
<b>Eligibility Criteria</b>	:	AS PER NMC NORMS
<b>Duration of the Course</b>	:	3 YEARS
<b>Programme Structure (Credit-Based)</b>	:	NA
<b>Detailed Course Syllabus</b>	:	ANNEXED IN THE BELOW FORMAT
<b>Teaching–Learning Methodologies</b>	:	3 YEARS RESIDENCY PROGRAM
<b>Examination &amp; Evaluation System</b>	:	ANNUAL APPRAISALS FOLLOWED BY FINAL YEAR EXAMINATION AS PER NMC NORMS
<b>Internship / Project / Dissertation Guidelines</b>	:	1 YEAR MANDATORY BOND
<b>Program In Charge</b>	:	HEAD, DEPT OF INTERVENTIONAL RADIOLOGY Dr. Suyash Kulkarni, <a href="mailto:suyash.kulkarni@tmc.gov.in">suyash.kulkarni@tmc.gov.in</a> Academic Coordinator Dr. Purvi Haria, <a href="mailto:purvi.haria@tmc.gov.in">purvi.haria@tmc.gov.in</a>
<b>Annexure (Books / Journals etc)</b>	:	ANNEXUED

## **D.M. (INTERVENTIONAL RADIOLOGY)**

*Program Code: HLTH10A06*

*Program Outcome:*

- To train the residents in skills in various aspects vascular and non vascular Intervention.
- To be able to participate in holistic management including diagnosis, planning treatment and performing vascular and nonvascular procedure.
- To contribute in multi-disciplinary team discussion in approaching particular case.
- To understand the need to identify emergency scenario and prompt reporting to help in patient management.
- Encourage and guide the residents for various paper and case presentations at national and International level.
- The candidate should complete the necessary training and mandatory theory as specified in the syllabus of the DM Interventional Radiology course.
- To participate and excel in the appraisal exams held each year of both theory and practical.
- To learn the need and importance of multidisciplinary approach in patient management.
- To attend and participate in lectures, case discussions and contribute value adding points.
- Provide adequate exposure to interventional non oncology cases in Interventional Radiology to give wholesome training.

## DETAILED SYLLABUS

### ▪ PREAMBLE

The DM (Interventional Radiology henceforth referred to as IR) program is designed to provide the students with an organized, comprehensive and supervised education in the principles and practice of body, chest, musculoskeletal and cardiovascular radiology and the interventional techniques in the use of image-guided techniques in the above body systems. The course will also include in-depth training in the physical aspects of imaging, hazards of radiation and measures of protection.

### ▪ ESSENTIAL REQUIREMENTS

- MD or DNB in Radiodiagnosis from an institution/university recognized by the Medical Council of India.
- Upper Age limit: 35 years with relaxations as per the Govt. of India rules

### ▪ SELECTION METHODOLOGY

By a selection process, including an entrance examination pertaining to the systems listed above; and an interview/practical examination for assessment of past performance, curricular ability to imbibe training, and case presentation for assessing the examinee's communication skills and targeted problem-solving approach.

### ▪ COURSE DURATION: 3 years

### ▪ SCOPE OF SERVICES:

The DM (IR) Program provides didactic and clinical experiences covering the full-spectrum of body, chest, musculoskeletal and cardiovascular radiology and the interventional techniques in the use of image-guided techniques in the above body systems. The course will also include in-depth training in the physical aspects of imaging, hazards of radiation and measures of protection. Both diagnostic and interventional vascular & non-vascular procedures will be included in the training program. The candidates will be required to obtain an in depth knowledge of imaging of vascular as well as non-vascular diseases with computed tomography, magnetic resonance imaging, conventional radiological techniques and Color Doppler Ultrasound, vascular procedures including diagnostic arteriography, vascular recanalization techniques by angioplasty/ stenting or clot lysis, embolization, endovascular stent grafts, embolotherapy, transcatheter infusion therapy, IVC filters, radiofrequency ablation, percutaneous procedures for osseous & soft tissue pathologies and venous access.

## ▪ OBJECTIVES

The main objective of the course is to rationalize the DM (IR) candidate's clinical acumen and analytical abilities so as to make him capable of taking appropriate decisions with regards to the execution of all interventional therapeutic and diagnostic procedures. This includes performance and interpretation of imaging procedures relating to the vascular (venous and arterial) systems of the body, as well as invasive (interventional) procedures for vascular & non-vascular disorders exclusive of the neurologic system (brain and spinal cord). The opportunity and skills to become a provider of top quality patient care, be a knowledgeable and inspiring teacher, and to perform clinical and experimental research in the field of vascular and interventional radiology will also be provided.

### **Upon completion of his training, the DM (IR) candidate should be able to**

1. Become familiar with the signs and symptoms of vascular & non-vascular disorders amenable to diagnosis and/or treatment by percutaneous methods guided by radiologic imaging.
2. Gain experience in interpreting non-invasive evaluations of vascular diseases of the arterial and venous systems.
3. Become familiar with the medical and surgical therapeutic alternatives of these disorders.
4. Become familiar with the indications and contraindications for vascular and non-vascular interventional radiologic procedures.
5. Gain experience in performing preprocedural clinical evaluation of patients and providing post procedural follow-up care
6. Perform and interpret invasive vascular interventional techniques including endovascular recanalization, reconstruction and embolization.
7. Gain exposure to new and evolving interventional techniques & technology such as Radiofrequency ablative therapy and tumor chemo & particulate embolization.
8. Become familiar with the signs and symptoms of cardiac, body, chest, musculoskeletal and peripheral system disorders that would help him to perform and interpret non-invasive investigations tailored to the clinical question.
9. Obtain an in-depth training in the physical aspects of imaging, hazards of radiation and measures of protection.

The candidate will be encouraged to inculcate relevant knowledge in anatomy, pathology, biochemistry and physiology of vascular & non-vascular diseases, imbibe patient management skills through direct patient care, and update his skills and knowledge through attending academic conferences, CMEs and hands-on workshops.

## ■ **RESEARCH**

Candidates will be required to participate in at least 2 research projects during the course. Clinical and experimental research oriented to understand, analyze and improve upon the existing knowledge of vascular and interventional radiological procedures should be the primary objective of this exercise. The candidate will also be introduced to the ethical and moral aspects of human and animal research through the exercise. He/she should make all efforts to publish the outcome of the projects in peer-reviewed journals, with at least one project being published. A dedicated research time will be provided in the curriculum. The candidate will be encouraged to become well versed in the techniques of research methodology by participating in the statistics courses organized at the institution.

## ■ **TEACHING**

The candidate will be encouraged to develop his teaching skills by undertaking didactic lectures and practical demonstrations for the undergraduate and postgraduate students at the institute. The candidate will also get the opportunity to present Journal Club (one per week), case review (one per week), and academic seminar (one in 2 weeks) to peer groups. He will also get to participate regularly in the clinico-radiological conferences and multi-specialty conferences during his/her training period.

## ■ **EDUCATIONAL CURRICULUM**

The training program is designed to provide the candidate a closely supervised and comprehensive exposure of the clinical and radiological aspects of vascular and non-vascular diseases, through practical experience and supervised training. All aspects of image acquisition, physical aspects of the equipments and hazards of radiation & measures of protection will be taught.

The training in interventional vascular & non-vascular techniques will be provided in the angiography/fluoroscopy suites. The curriculum also includes rotations through the non-invasive imaging services to gain experience with performance and interpretation of imaging of different body parts (CT, MRI and Doppler) techniques. Special emphasis will be laid on recent advances in imaging and image-guided interventional techniques.

## ■ **1<sup>st</sup> YEAR**

### ● **Basics of Clinical Aspects**

- Clinical and Laboratory Considerations
  - Symptomatology and staging of vascular disease

- Laboratory data (including non-imaging aspects of noninvasive vascular testing; for example, ankle-brachial indices for lower extremity arterial disease, impedance plethysmography for lower extremity venous disease)
- Epidemiology of vascular & non-vascular diseases
- Natural history of vascular disorders
- Vascular anatomy: arterial and venous
  - Embryology
  - Normal anatomy
  - Variant anatomy
  - Anatomy of collateral pathways
- Vascular physiology, pathology and pathophysiology: arterial system
  - Normal histology/physiology/morphology
  - Hemodynamics: normal and abnormal flow
  - Vasoactive extrinsic/pharmacologic agents
  - Disorders related to pharmacologic/extrinsic agent exposure
- Atherosclerosis
- Medial sclerosis
- Pathophysiology of arterial ischemia
- Aneurysms
- Thromboembolic disorders
- Dissection
- Congenital vascular disorders
  - Vascular malformations
  - Other congenital disorders (eg. popliteal artery entrapment)
- Arterial effects of adjacent tissues/disorders
- Arterial infection

- Vascular alterations in neoplasia: vascular supply of neoplasms, primary vascular neoplasms, vascular invasion by neoplasms
- Vascular alterations in inflammatory diseases
- Systemic vascular disorders
  - Primary systemic vascular disorders: vasculitides and others
  - Altered vascular pathology in systemic disease states
- Vascular trauma: injuries and vascular response to injury
  - Mechanical injury: acute and chronic
  - Thermal injury
- Arterial endothelium
- Alterations in coagulation status
  - Hypercoagulable states
  - Impaired coagulation
- Post-operative or post-interventional disorders
  - Synthetic and endogenous grafts
  - Myointimal hyperplasia
- Other/unclassified
- **Vascular physiology, pathology and pathophysiology: venous/pulmonary arterial system**
  - Normal histology/physiology/morphology
  - Hemodynamics: normal and abnormal flow
  - Vasoactive extrinsic/pharmacologic agents
    - Normal response
    - Disorders related to pharmacologic/extrinsic agent exposure
  - Thromboembolic disorders: acute and chronic
  - Venous aneurysms
  - Venous effects of adjacent tissues/disorders

- Congenital vascular disorders
  - Vascular malformations
  - Other congenital disorders
- Venous infection
- Vascular alterations in neoplasia: vascular drainage of neoplasms, primary vascular neoplasms, vascular invasion by neoplasms
- Vascular alterations in inflammatory diseases
- Systemic vascular disorders
  - Primary systemic vascular disorders
- Altered vascular pathology in systemic disease states
- Vascular trauma: injuries and vascular response to injury
  - Mechanical injury—acute and chronic
  - Thermal injury
- Venous endothelium
- Alterations in coagulation status
  - Hypercoagulable states
  - Impaired coagulation
- Post-operative or post-interventional disorders
  - Synthetic and endogenous grafts
  - Intimal hyperplasia
- Other/unclassified
- **Cardiac anatomy, physiology, pathology and pathophysiology**
  - Normal anatomy of the pericardium and myocardium
  - Normal coronary anatomy
  - Cardiac metabolism and function
  - Cardiac hemodynamics
- **Pulmonary arteries and veins**
  - Pulmonary artery hemodynamics (as related to pulmonary angiography)

- Pulmonary thromboembolic disease
- Pulmonary arteriovenous malformations
- Pulmonary venous disorders
- **Cardiac disorders**
  - Congenital heart diseases
  - Acquired heart diseases : ischemic heart diseases
  - Acquired heart diseases : valvular, endocardial, myocardial, and pericardial
  - Post-operative and post-interventional disorders including synthetic and endogenous valve prosthesis, pericardial and synthetic baffles, PTFE and endogenous shunt materials, bypass grafts, intimal hyperplasia in coronary stents
- **Basics of interventional vascular/non-vascular catheterization Laboratory**
  - Workplace considerations
  - The vascular/interventional radiology suite
    - Equipment
    - Fluoroscopy
    - Standard angiography
    - Digital angiography
    - Image processing and recording
    - Other equipment (e.g. interventional ultrasound units)
    - Layout
  - Noninvasive vascular laboratories
    - Equipment – Color Doppler, CT and MRI
    - Management
    - Occupational Safety Issues
    - Radiation safety and hygiene
    - Infection control

- Others
- Patient Considerations
- Pre-procedural assessment and care
- Intraprocedural monitoring
- Post-procedural follow up and care
- General pharmacologic considerations
  - Analgesia/anesthesia
  - Conscious sedation
  - Antibiotic therapy
  - Anticoagulation
  - Other
- Personnel Considerations
- The vascular/interventional radiology "team": role and relationship of nurses, technologists, trainees, other physicians

## **2<sup>nd</sup> YEAR**

- **Imaging of the Vascular & Non-vascular System: General Principles**
- Plain film
- Angiography: Arteriography and Venography
  - Standard angiography
  - Digital subtraction angiography
  - Contrast agents
    - Iodinated agents
    - Carbon dioxide
  - Vascular catheterization

- Equipment: needles, guide wires, catheters, etc.
- Vascular access
- Selective and subselective catheterization
- Risks and complications
  - Contrast reactions, iodinated agents
    - Anaphylactoid reactions
    - Classification
    - Prevention
      - Ionic vs. nonionic agents
      - Premedication
    - Treatment
  - Dose dependent reactions
    - Classification
      - Acute and chronic renal effects
      - Other
    - Prevention
    - Treatment
- Procedural complications
  - Puncture site complications
  - Catheterization-related complications (apart from puncture site)
  - Systemic/generalized complications
- Pharmacangiography: agents and uses
  - Vasodilatation
  - Vasoconstriction
  - Other
- Intravascular Ultrasound
- Ultrasonography

- Gray scale
- Duplex Doppler
- Color flow
- Computed Tomography
  - General
  - Spiral and Multislice CT
  - CT angiography
- Magnetic Resonance Imaging
  - General-vascular & non-vascular
  - Cardiac MRI protocols
  - Blood flow evaluation and MR angiography

## ▪ **3<sup>rd</sup> YEAR**

- **Vascular Intervention : General**
  - Common Topics: vascular interventional procedures
    - Anatomic considerations
    - Indications and contraindications
    - Techniques, devices, materials
    - Results, efficacy
    - Risks and complications
    - Alternate techniques (surgical and medical therapeutic options)
- Vascular canalization/recanalization : re-establishment of flow
  - Thrombolytic therapy
    - Pharmacologic thrombolysis
      - General principles
      - Specific agents: urokinase, streptokinase, tissue plasminogen activator, others

- Mechanical techniques
  - Fogarty balloon
  - Suction thromboembolectomy
  - Other/newer devices
- Balloon angioplasty
- Atherectomy
- Laser recanalization
- Mechanical recanalization
- Vascular stents
- Endovascular grafts
- Other
- Vascular blockade: obliteration of flow
  - Embolization
    - Techniques
      - Transcatheter
      - Direct injection
    - Agents
  - Other methods
    - Ultrasound guided compression repair
- Re-routing of flow
  - Endovascular repair of aneurysms
  - Creation of new vascular channels (e.g. TIPS, fenestration of aortic dissection)
- Vascular filters
- Vascular foreign body removal
- Intravascular/transvascular biopsy
  - Transvenous liver biopsy
  - Other

▪ **Vascular Intervention: Specific Territories**

- Lower extremity vascular disease
  - Arterial
    - Occlusive atherosclerotic disease: recanalization
      - Aortoiliac
      - Femoropopliteal
      - Tibioperoneal
    - Intervention for peripheral arterial trauma
    - Thromboembolic disorders: recanalization
    - Peripheral arterial graft failure: recanalization
    - Iatrogenic disorders: therapy for puncture site complications
  - Venous
  - Combined: vascular malformations: obliteration
- Upper extremity vascular disease
  - Arterial
    - Thromboembolic disorders: recanalization
    - Trauma
  - Venous
    - Acute upper extremity venous thrombosis: recanalization
    - Chronic upper extremity venous thrombosis: recanalization
  - Combined: vascular malformations: obliteration
  - Venous varicose-Radiofrequency ablation
- Thoracic vascular disease
  - Hemoptysis
    - Bronchial artery embolization

- Other techniques
- Pulmonary arteries and veins
  - Pulmonary thromboembolic disease: thrombolytic therapy, thromboembolectomy
  - Pulmonary arteriovenous malformations: embolization
- Aortic disorders
  - Aortic aneurysm: embolization, endovascular grafting
  - Aortic dissection: endovascular grafting, fenestration
  - Aortic trauma
- Central venous intervention (SVC, IVC)
  - Central venous occlusive disorders
    - Thromboembolic disorders
    - Congenital webs
  - Caval filtration and related techniques for thromboembolic disease
- Vascular diagnosis, abdominal and pelvic viscera
  - Genitourinary system
    - Kidney
      - Renovascular hypertension: recanalization techniques
      - Renal trauma
      - Varicocele/ Ovarian Vein embolisations
  - Uterine Fibroid embolization
  - GI Bleeds
  - TACE for HCC
- **Non-vascular Interventions**

- Hepatobiliary interventions
  - Hepatic carcinomas-chemoembolization or RFA
  - Common bile ducts abnormalities
  - Liver cirrhosis
  - Other miscellaneous conditions
- Pain management for neoplastic & non-neoplastic conditions by interventional techniques under image guidance (fluoroscopy, CT, USG, MRI)
- Breast imaging & Interventions
- Vertebroplasty-Using alcohol or bone cement
- Kyphoplasty
- HIFU
- GENITOURINARY INTERVENTIONS – ESWL, PCN, PCNL
- Ureteric stenting/ Ureteric occlusions/ Management of Ureteric leaks
- Radiofrequency/ Microwave ablations of Renal tumors/ Prostate etc.
- RFA/ Microwave ablations of Lung tumors
- Fallopian tube recanalizations
- Transarterial chemo/ embolization of osteosarcomas/ retinoblastomas
- Biopsy and drainage procedures
- Newer techniques and applications of interventional radiology and Interventional Oncology -
  - Quality Assurance Issues
    - Outcomes analysis
    - Practice guidelines
    - Complications: classification, documentation
  - Legal Aspects of Interventional Radiology
    - Informed consent

- Malpractice
- Regulatory agencies
- Investigational devices and procedures
- Administrative Aspects
  - Equipment purchase
  - Inventory management

## ▪ **EVALUATION OF THE CANDIDATE**

The assessment of the candidate will be a continuous process. Each candidate will be required to maintain a logbook, wherein his clinical, teaching and research activities through the entire duration of the course will be entered. Evidence of having conducted research should be presented before the candidate is permitted to appear for the DM (final) examination.

**Four examiners, two of who will be external examiners, will conduct the DM examination.**

**The general scheme of conducting the examination will be as follows**

Theory

Practical

Viva/Voce

## ▪ **Course Outcomes**

The trainee successfully completing the DM (IR) course will be eligible for the award of a degree in Interventional Radiology.