
*DEPARTMENT OF IMAGING
SCIENCES
& INTERVENTIONAL RADIOLOGY*

*DM CARDIOVASCULAR IMAGING
AND VASCULAR INTERVENTIONAL
RADIOLOGY*

*Board of Studies for
Cardiac sciences*

*Curriculum and Assessment
Document- 2020*

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1.1 GENERAL PROGRAMME AIMS

The knowledge and practice of cardiovascular radiology and vascular interventional radiology comprise both imaging and interventional procedures related to the cardiovascular imaging & vascular interventions in adults and children. Special training and skills are required to enable the radiologist to function as expert diagnostic - therapeutic consultant, practitioner, teacher and researcher. The goal of the programme is to provide the residents with an organized, comprehensive, and supervised full-time educational experience in the selection, interpretations, and performance of cardiovascular imaging & vascular interventional procedures.

The purpose of training programmes in the specialty cardiac imaging and vascular intervention is to produce competent radiologists with focus on imaging and interventions related to cardiovascular diseases. Such a focus is a need of the nation when we consider the ever-increasing cardiovascular events in the country

Vascular intervention and endovascular skills along with cardiovascular imaging need special focus and expertise and are entirely different from general radiology practice. Hence special training is required for such a discipline

Guiding Principles

The following six core competencies will be the guiding principles of this programme

A. Medical Knowledge

1. Acquire general medical knowledge and practice-specific knowledge
2. Know and critically evaluate current medical information
3. Understand and incorporate evidence-based decision-making

B. Patient Care

1. Medical interview and physical exam
2. Patient education of disease and treatment

2. Synthesis of clinical data, performance skills

C. Interpersonal and Communication Skills

1. Communicate effectively with other professionals and team members
2. Maintain comprehensive, legible medical records

D. Professionalism

1. Demonstrate self-awareness and knowledge of limits
2. Demonstrate high standards of ethical and moral behavior
3. Demonstrate reliability and responsibility
4. Demonstrate respect for patient's dignity and autonomy
5. Participate in team work for giving better patient care and for gathering knowledge

E. Practice-Based Learning and Improvement

1. Engage in ongoing learning to improve knowledge and skills
2. Analyze one's practice to recognize strengths and deficiencies
3. Seek input to improve practice and quality care

F. Systems-Based Practice

1. Promote patient safety within the system
2. Provide value added and cost-effective care for patients
3. Promote health and prevention of disease and injury
4. Demonstrate effective practice management

1.2 SPECIFIC OBJECTIVES

Cardiovascular imaging

1. Provide clear, concise, and informative reports that are clinically relevant. Senior residents will notify referring clinicians of urgent and emergent findings in a timely fashion and document appropriately.
2. Become conversant with the protocols for imaging of various conditions as per guidelines of Society of Cardiovascular MRI and Cardiovascular CT and techniques of modifying it in special situations.
3. Become proficient in the use of picture archiving computer systems (PACS), online clinical document system, and other computer based modalities like voice recognition dictation systems, image processing Both in CT & MRI, 3D printing in congenital heart disease etc.
4. Demonstrate professional behavior at all times, adhering to ethical principles and demonstrating sensitivity. Senior Residents will be cognizant and respectful of patient confidentiality.
5. Critically evaluate the scientific literature and apply it to daily practice and develop good habits of continuing medical education.
6. Play an active role in teaching of students, peers, and other members of the health care team.
7. Comply with the requirements of the Indian Medical Council, ICMR and Drug Controller of India and other relevant guidelines like Health Insurance Portability and Accountability Act (HIPAA) and FDA

Vascular interventional radiology

The majority of learning during the interventional radiology training is practice based. That is most of the learning will center around specific cases and patients. This involves the pre-operative patient assessment and work-up, decision making, technical aspects of the actual procedure, post procedure patient care, communication with referring physicians, and documentation skills. All these elements are critical to good practice.

Six general competencies that cover all these skills are mentioned below. All residents are expected to learn these skills during the course of their training. Although each area of competency is separated for descriptive purposes, in actuality, they are less discrete.

At the end of his/her three-year training each resident,

1. Should be well acquainted with the current literature on relevant aspects of the basic investigations, diagnostic imaging relevant to decision making, clinical examination and peripheral vascular & nonvascular interventional sciences.
2. Should have acquired performance skills and ability to interpret relevant clinical investigations.
3. Should be able to diagnose, plan investigations and treat common conditions in the specialty by relevant current therapeutic methods.
4. Should have learned indications and performance skills of common vascular and nonvascular interventional procedures.
5. Should be acquainted with allied and general clinical disciplines to ensure appropriate and timely referral.
6. Should be capable of imparting basic peripheral interventions teaching, training and research.

The three-year program consists of fundamental clinical evaluation, cardiac and vascular diagnostic and vascular interventional training and research to allow for acquisition of graduated experience in all aspects of cardiovascular radiological imaging and interventional radiology. Critical care experience is also emphasized and there is extensive exposure to subspecialty services including congenital vascular malformation, palliative treatment for terminally ill patients, peripheral vascular diseases, gastrointestinal radiological interventions, trauma based interventions and patient management in cases with life threatening hemorrhage.

Preparation of scientific manuscripts, review articles, book chapters and abstracts, along with presentation skills are fostered with multi-disciplinary input and mentorship. Leadership and administrative skills are learned as senior residents' progress in their training and are honed during the final year. Routine academic activities will also include journal club, cardiovascular radiology conference, clinical case discussions and multi-disciplinary clinicopathological conferences. Residents will also be encouraged to present papers at various scientific forums both at regional, national and international levels.

Details of skills to be acquired in Diagnostic cardiovascular imaging and vascular interventional radiology and allied sciences.

Medical knowledge:

- Demonstrate detailed knowledge of gross anatomy and embryology of the heart and great vessels.
- Demonstrate in depth knowledge of various types of cardiomyopathies and other cardiac pathologies like tumors and infection and their follow up.
- Describe the complex anatomy of patients with congenital heart disease in a segmental fashion.
- Be familiar with common operative procedures done for congenital heart diseases and their feasibility and complications from preoperative and post-operative imaging respectively.
- Demonstrate proficiency in recognition of pathology and making differential diagnoses.
- Be familiar of MRI, CT, Doppler USG and Nuclear medicine (PET) studies of the heart and peripheral vessels.
- Demonstrate proficiency in the performance and interpretation of CT guided biopsies and ablations.
- Demonstrate understanding of advanced MR sequences and techniques such as T1,T2, t2* mapping, flow quantification, scar quantification & other applications and updates.
- Demonstrate proficiency in interpreting CTA for coronary imaging and planning for aortic stents and other devices.

- Understanding the basics and need for 3D imaging including post processing skills. Participate in the process of 3D printing for complex congenital heart disease cases.
- Develop thorough knowledge of the physical and physiological properties of contrast agents used in CT and MR; including contraindications and management of potential complications.
- Develop skills in identifying indications and risks and actual preparation and performance of angiography, endo-vascular interventional procedures like peripheral aneurysm, AVM and fistula embolization, peripheral angioplasty and stenting, intra-vascular thrombolysis for acute thrombosis and other image guided procedures.
- Discuss modifications of studies based on expected and unexpected pathology.
- Demonstrate a thorough knowledge of the vascular anatomy of the abdomen and chest and pathology as demonstrated by angiography.
- Demonstrate proficiency in the performance of catheterization of the aorta, spinal arteries, and visceral vessels.
- Demonstrate proficiency in the performance of vascular and non-vascular interventions and management of complications of surgeries and interventional procedures.
- Have exposure to management of emergency cases like Uterine artery bleeding, IVC filter placement, Gastrointestinal bleeding, cholangitis, intra-arterial treatment of acute limb ischemia.

Patient care:

- Screen, protocol, and supervise cardiac imaging procedures. Be able to modify imaging protocols based on identification of unexpected or novel findings.
- Supervise and screen patients for contrast administration especially for power injections.
- When appropriate, screen for non- use of contrast in consultation with the

referring physicians or when essential, consent is obtained for contrast induced nephropathy /other adverse effects in high risk patient population.

- Supervise and screen patients for MR safety. Perform cardiovascular imaging of patients with cardiac pacing implants and other implants.
- Be able to evaluate patients for sedation and obtain informed consent.
- Perform prioritization and triage for cardiovascular radiologic emergencies.
- Make decisions to modify a procedure when unexpected pathology or abnormalities occur, then follow through with the performance and supervision of the procedure.
- Make decisions in the treatment of different vascular and nonvascular pathologies in conjunction with clinical counterparts or the referring physicians.
- Make clinical decisions based on patients' overall condition when dealing with the patient, both in pre- or post – procedure state.
- Write pre- and post – procedure orders.
- Be able to evaluate the clinical status of patients prior to, during and after the procedure.
- Learn to recognize complications of these procedures and to initiate appropriate treatment.

Communication Skills

- Effectively obtain informed consent for procedures and sedation.
- Communicate with referring physicians for review and routine follow up
- Discuss with referring clinicians the appropriateness of advanced imaging techniques and post processing techniques such as T1, T2* mapping, flow quantification, scar quantification, coronary artery stenosis analysis, TAVR planning, EVAR planning and virtual endoscopy.
- Present pre-reviewed cases in a complete, concise and accurate fashion during readout.

- Produce clear and concise radiology reports of imaging and procedure performed.
- Participate in teaching of other residents and technical students.

Professionalism

- Demonstrate altruism (putting the interests of patients and others above own self- interest).
- Demonstrate compassion: Be understanding and respectful of the patients, patient families, and staff and physicians caring for patients.
- Be honest with patients and all members of the health care team.
- Interact with others without discriminating on the basis of religious, ethnic, sexual or educational differences and without employing sexual or other types of harassment.
- Demonstrate positive work habits, including punctuality and professional appearance.
- Demonstrate an understanding of broad principles of biomedical ethics.
- Demonstrate principles of confidentiality with all information transmitted during a patient encounter.
- Attend in-house and on-call duties as required by the rotations in compliance with regulations
- Formulate and get approvals for the research projects for thesis within the first 6 months of starting the training.

2. ACADEMIC PROGRAM COMMITTEE

2.1 Duties of the Head of the Department:

1. Overall supervision of the conduct of academic programs and evaluation process in the department.
2. Assess the quality and adequacy of content of academic program.
3. Evaluate the progress of each student through the APC.
4. He / She will be member of the appraisal committee and will assess the remedial measures taken to enhance performance of the resident/student.
5. Conduct of the external examination and supervision of conduct of internal examinations.

2.2 Program In-Charge (PIC)

The Program In-Charge is accountable to the Head of the Department of IS&IR, the Board of studies and the Academic council.

The Program In-Charge will ensure that the formal teaching available in the program is organized, relevant, and continually updated. Assistance and resources will be provided to faculty involved in educational programs. The Program In-Charge acts as a liaison between the residents and faculty, frequently in the role of resident advocate. Residents' specific needs and requests are to be dealt with compassionately and rationally. With the assistance of faculty, the Program In- Charge is required to have an ongoing awareness of resident performance. Concerns must be taken to the resident and the faculty in a timely manner.

Duties of the Program In-Charge, assisted by the residency training committee include:

1. Will be responsible for ensuring the implementation of academic programs as envisaged by the BOS.
2. Assign equal number of academic programs for each resident for each year and ensure it is conducted
3. Supervise the conduct of evaluation of academic programs by PC
4. Supervise the internal evaluation process
5. Organize external and internal examinations

6. Verify and validate entry of marks in the e-portfolio after it has been verified and validated by PC.
7. Report to BOS/academic council, deficiencies, suggestions and feedback on the upgraded curriculum and evaluation.

2.3 Programme Co-Ordinator (PC):

The Programme coordinator will function as a personal educational supervisor for the residents and will be accountable to the program In-Charge. The role of the Postgraduate training coordinator as a supervisor is to support the clinical and academic learning process throughout the training period.

Specific duties of the programme coordinator include:

1. Circulate monthly academic roster of department and send a copy to the academic division for its records
2. Maintain dossier for each student till the end of the course
3. Circulate and collect evaluation forms after each academic program
4. Maintain register of attendance in academic programs of both students and faculty.
5. Enter and validate entry of information and marks for each student for each program at the end of each month in the e-portfolio.
6. E-portfolio entry, if made by dept secretary, should be verified and validated
7. Monitor log book entries
8. Organize appraisal meetings
9. Collect student feedback
10. Organize internal examination
11. Report to PIC periodically about progress and problems with implementation and resolve them. Can seek guidance from academic council if needed

2.4 Research guide mentor:

Each student should have a mentor in the department. A research mentor will be assigned for the thesis and research projects. The Research mentor is the primary liaison between residents and faculty for research and works to ensure that the research requirements of the department are met.

Specific duties

1. The mentor could be the thesis guide for post doctoral courses or any other faculty member nominated by the APC.
2. Can guide the student in the selection of appropriate thesis topic, process of submission to TAC and IEC, both procedures being mandatory.
3. Ensure participation and presentation in a national conference-mandatory requirement
4. Guidance for publication of research paper
5. Review abstract submitted for conference and ensure that abstract is sent to e-portfolio
6. Participate in appraisal meeting conducted by departmental academic
7. Committee and assist in planning remedial actions for candidates' progress
8. Guide and counsel students in managing work and stress
9. Guidance students in planning their careers

3. EDUCATIONAL STRATEGIES

TRAINING SYSTEM

Exclusively on whole time in service basis, on residency pattern.

ELIGIBILITY

Essential

M D (Radiodiagnosis) degree of an Indian University recognized by the Medical Council of

India or any other equivalent examination recognized for the purpose by the MCI.

Mode of Selection

Once a year on All India basis, based entirely on merit (by a written test followed by

departmental assessment and Board interview). For written test (MCQ. type) 50% of questions should be of level of MD (Radiodiagnosis) and the rest 50% will be from the subspecialty. Those acquiring more than 50% marks in the theory will be eligible for departmental assessment. Approximately three times of the number of post available should be called for departmental assessment strictly on the basis of merit. Two times the post available will be shortlisted for the final Board interview.

3.1 CLINICAL TRAINING

The clinical training program will be modular, wherein, the clinical modules will be clearly defined. It has been designed to provide the candidate a comprehensive clinical training in different aspects of cardiovascular imaging and vascular interventional radiology.

Schedule of postings:

The clinical training program will be modular, wherein, the clinical modules will be clearly defined. It has been designed to provide the candidate a comprehensive clinical training in different aspects of interventional radiology and cardiovascular radiology.

The Clinical training modules and their duration (months)

DM CARDIOVASCULAR IMAGING – 3 year course							
Postings	CT & post processing	MRI & post processing	D S A	OP & patient management skill	Cardiology /cardiac surg Dept	USG- Doppler	Out posting
Duration	6	6	12	6	2	3	1

TRAINING METHODS

1. Clinical teaching in the daily case discussions, teaching programmes, out patients clinics and interventional labs.
2. Special teaching sessions like Cardiology – Cardiac radiology joint forums, Cardiology-

cardiac surgery- vascular surgery cardiac pathology case discussions.

3. Seminars, journal clubs, mortality, morbidity conferences and faculty lectures.
4. Treatment planning sessions.
5. Assisting and performing peripheral vascular and non-vascular -diagnostic and interventional procedures.
6. Paper presentations at conferences.
7. Preparation of manuscript for publication.
8. Training in an experimental / research activities and simulators.

BASIC TOPICS

(Detailed syllabus and syllabus for part I and part II are given in annexure 3)

- Cardiac and vascular anatomy and embryology
- Cardiac physiology
- Cardiac & vascular pathology, microbiology, and pharmacology
- Physical principles of imaging and advances in imaging
- Instrumentation and Biomedical Engineering
- Interventional Procedures and techniques
- Radiofrequency ablation and procedures
- Epidemiological Studies and Biostatistics
- Evidence based treatment

CLINICAL TOPICS

(Detailed syllabus and syllabus for part I and part II are given in annexure 3)

- Diagnostic cardiovascular imaging: Principles and practice of clinical and applied cardiovascular radiology.
- Vascular interventional radiology: Principles and practice of peripheral vascular Interventions
- Relevant cardiology, cardiac surgery, vascular surgery, cardiac critical care, - Principles theory and practice
- Practice Management, Legal, and Socioeconomic issues in peripheral vascular interventions and in Diagnostic cardiovascular imaging.

RESEARCH

The resident should review and understand all principles of the scientific methods.

The resident should master the area of scientific inquiry involved in his research. This knowledge should be adequate to serve as the basis for future academic activity.

The resident should teach the basic principles of his research area to other residents and faculty. The resident should master the principles of scientific manuscript preparation during this rotation.

3.2 CURRICULUM

A well-defined preset curriculum will be implemented during the 3-year DM program. The trainee residents are expected to actively participate in the academic activities conducted during their training period. The curriculum will be announced by program In-Charge of Diagnostic cardiovascular imaging & Vascular interventional radiology division at the commencement of the training period.

The curriculum will include the following:

Structured teaching program: Attending and presenting lectures, seminars, symposia, journal clubs, clinical case discussions, panel discussions, etc.

Maintenance of the record of experience - the log book

Thesis and at least one project

3.2.1 Mandatory requirements to be met by all senior residents

I. Publication: (credits 5)

At least one scientific paper as first author should be submitted for publication before the end of the course and final evaluation. There will be uniform credit of 5 for satisfying this requirement.

II. Conference attendance (5 credits)

There should be one paper/poster presented at a national, regional or international conference. There will be equal credit of 5 for this.

The senior resident has to present certificate of participation to PC and submit abstract of presentation to the PC and also ensure entry in e-portfolio

III. Statistics course for senior residents: (credits 5)

Students have to get minimum of 80% attendance for the mandatory course (20 hours) in statistics. There will be an evaluation at the end of the course and marked for performance. Marks will be entered in e-portfolio.

IV. BMT wing posting for senior residents (3 credits)

2-week course and evaluation. 80% attendance is mandatory and there will be end of course evaluation and marks given and entered in e-portfolio.

3.2.2 Structured teaching programme:

The responsibility for planning and implementing the annual academic program of DM Diagnostic cardiovascular imaging and vascular interventional radiology will be shouldered by the program coordinator. A structured teaching program will be implemented for the trainee residents, which will principally include, although not restricted to lectures, seminars, symposia, clinical cases, journal clubs, panel discussions, etc.

Every DM resident will be informed about the annual academic program at the

beginning of the academic year and will be expected to present the allotted topics. A faculty will be assigned the task of moderating the presentation topic prepared by the trainee resident.

Presentation articles for journal clubs are chosen by residents under the guidance of the faculty moderator. Anyone wishing to suggest particular papers for discussion, which is not included in the annual schedule, is encouraged to forward the articles to the program coordinator.

The residents ensure that they remain punctual for attending the academic sessions. Attendance at academic sessions is mandatory for residents, although it is understood that residents on call duties may not be able to attend.

The academic schedule of the department will be as follows:

	Academic sessions	Day	Time
1	Cardiac Radiology Seminar	Monday	7:30-8:30 am
2	Pediatric Cardiology Forum Cardiac MRI meet	Tuesday	8:00-9:00 am 3:00-4:00 pm
3	Neurovascular meeting Joint Pediatric Cardiac Meeting	Wednesday	8:00-9:00 am 3:00-4:00 pm
4	DAMIT Seminar/ Cath meet Consultant class	Thursday	8:00-9:00 am 3:00-4:00 pm
6	Vascular surgery – Radiology Session Stroke Meeting	Friday	8.00-9.00 am 3:00-4:00 pm
7	Clinical case discussions, Journal clubs Joint Pediatric Cardiac Meeting	Alt Saturday	8.00-12.00pm 2:00-3:00 pm

3.3 PORTFOLIO

A portfolio can be defined as a purposeful collection of information that demonstrates development or evidences learning outcomes, skills or competencies.

Benefits of portfolio to the trainee:

- Effective portfolios provide a structure to guide the resident through the learning process, enabling them to set and review personal goals, targets and objectives.
- Portfolio-based learning helps residents use structured reflection to identify specific learning needs.
- Work-based assessments by the supervisors may demonstrate whether the trainee has attained practical skills appropriate to Diagnostic cardiovascular imaging & vascular interventional radiology specialty.
- This should be used alongside a record of all completed procedures (logbook) to ensure the breadth and quality of experience is represented.
- Portfolios can maintain record of procedures and allow learning points to be noted alongside. This can be powerful as the learning from successes and failures is reviewed by the trainee and supervisor.

Benefits of portfolio for the program In-Charge and supervisors:

The curriculum functions like competency framework and is often used to define the specific assessments, competencies and examinations that trainees must attain at differing levels of training. The integration of curriculum within Portfolio can be a valuable focus for discussion in educational supervision.

The portfolios provide potential to evaluate a doctor's ability to reflect on practice and learn from experience. Portfolios provide an infrastructure to record all educational and clinical supervision meetings, personal development plans, personal reflections and a plan of development, along with skills and a record of work-based assessments. This provides supervisors and program directors with a transparent longitudinal record ensuring that a trainee's progress can be reviewed as

he/she rotates from post to post.

3.3.1 The record of experience - the log book

Trainees will be expected to maintain a Log book of the clinical activities and academic experiences. The log book is part of the portfolio, which should be maintained in the form of a printed copy and an electronic version.

The log book has the following functions:

It provides trainees with a personal record of all procedural and other training experiences, which are requirements for satisfactory completion of the training program.

It will be used by the Educational mentor to monitor the trainee's experience to ensure that it is appropriate.

Procedure of completing the logbook:

- The trainee residents should enter the data regarding their clinical and academic experiences in a format of weekly data entry chart. All residents are expected to complete the weekly data entry charts at the end of the same week. Instructions for completing the charts will be available with the format logbook.
- The weekly data entry charts must be attested by the concerned consultants every week. All charts must be preserved and produced for verification to the Program In-Charge of DM cardiovascular imaging and vascular interventional radiology at the time of final preparation of logbook.
- Resident doctors should create a logbook folder in their personal computer similar to the format logbook. It will be a good practice to update the data in the logbook folder at regular intervals.

3.3.2 Submission of Thesis:

- Submission of at least one thesis project is compulsory for the trainee DM residents, who should design the project under guidance of the research mentor. It will be recommended for the trainees to submit the thesis proposals within 3 months after

joining the program and necessary permissions and findings should be sought within 6 months of joining the programme.

- The project must be approved by the institute technical advisory committee (TAC) and the institute ethics committee (IEC).
- Guidelines for preparation and submission for the TAC and IEC are available in the institute web site

Submission of thesis for publication should be done at 30 months and will be evaluated by external examiners/experts.

3.3.3 Conducting research:

Research categories: The research projects may be of 2 categories:

Clinical research:

Residents can gain research experience either by joining departmental clinical projects or collaborative studies with other departments. The project design may be prospective or retrospective. Conducting retrospective analysis of large case series may also be considered as clinical research.

All clinical research projects must be submitted to the Institute technical advisory committee and institute ethics committee for approval.

Biomedical technology research:

One of the objectives of Institute is to enable the indigenous growth of biomedical technology.

All trainee residents must complete the introductory course in biomedical technology wing of the institute (**mandatory BMT wing posting for senior residents**).

Biomedical technology research may be conducted under the guidance of research mentor in collaboration with the scientist-engineers in the biomedical technology wing.

3.4 CONTINUING PROFESSIONAL DEVELOPMENT:

3.4.1 Performance evaluation by faculty members:

- Residents in Diagnostic cardiovascular imaging and vascular intervention radiology participate in the provision of radiology services both inside and outside the diagnostic and interventional radiology suits.
- All resident activities must be supervised by the responsible attending consultant. The degree of this supervision must take into account the condition of each patient,

the nature of the radiology service, and the experience and capabilities of the resident (increasing professional responsibility).

- At the discretion of the supervising consultant, residents may provide a range of patient care/intervention with minimal supervision. In all cases, the supervising attending consultant must remain readily available to give advice or assist the resident with urgent or routine patient care.
- Whether supervision is direct or indirect, close communication between the resident and the responsible supervising faculty is essential for safe patient care.
- The faculty members, who are involved in supervising the training process, will provide their honest opinion on performance evaluation of the trainees and report it to the program In-Charge.

Competency in following core areas will be assessed by the faculty members:

1. Patient care
2. Medical knowledge
3. Practice-based learning and improvement
4. Interpersonal and communication skills
5. Professionalism
6. Systems-based practice

The performance evaluation should be done by senior faculty members (Additional Professors and Professors) and mentor of the resident.

- Program In-Charge should allot a number to each senior faculty member to document it on the chart. The number may be allotted in randomized fashion rather than in the order of seniority. Individual faculty member should return the assessment chart to the program In-Charge, without mentioning his/her name on it. It will help the program
- In-Charge in identifying the faculty; simultaneously maintaining confidentiality on the matter.
- The program In-Charge should summarize performance rating of individual faculty before the process of appraisal.

Format for the performance evaluation is provided in ANNEXURE.

3.4.2 Mid-term Appraisal:

Good Medical Practice is central theme to appraisal. The appraisal should include data on clinical performance, training and education, audit, concerns raised and serious clinical complaints, application of relevant clinical guidelines, relationships with patients and colleagues, teaching and research activities, and personal and organizational effectiveness.

Appraisal process:

The appraisal committee will consist of 3 members:

Head of the department, Mentor Programme In-Charge of Diagnostic cardiovascular imaging and vascular intervention radiology and two Appraiser nominated by the Board of Studies, preferably a faculty from another department. Every DM candidate will be appraised in the mid-term of every academic year, preferably in the month of July. Process of appraisal is mentioned in ANNEXURE. The Appraisal committee will submit its report card to the Board of studies for further evaluation.

3.4.3 Personal development planning:

Personal development planning (PDP) is a structured and supported process undertaken by individuals that enables them to reflect on their own learning, performance and achievement. It allows the individual to plan personal, educational and career development. It typically includes a statement of one's aspirations, strengths or competencies, education and training, and stages or steps to indicate how the plan is to be realized. A PDP is developed in agreement with the appraisal committee every mid-term. The personal development plan should include identifying and developing areas of special interest in the training process.

3.5 Credit point system:

In the system of credit-based evaluation of practicing doctors, physicians are expected to maintain professional competence and upgrade their knowledge in developing areas of their specialty that follows medical school and residency training. Physicians use continuing medical education (CME) credit to measure their participation in educational activities. The CME participation is translated into credit hours, which is

considered as one of the units of evaluation. Credit point system for the evaluation continuous professional development of resident doctors in DM (Cardiovascular imaging & vascular interventional radiology) at SCTIMST will primarily involve achievement of yearly target credit score.

Following parameters have been identified for the purpose of crediting.

1. Invasive procedures performed
2. Emergency duties attended
3. Departmental activities attended
4. Clinical biomedical technology research conducted
5. Attending academic events

Resident doctors are expected maintain records pertaining to the departmental activities, which will award them credit points. Please refer ANNEXURE for credit point system.

Out-of-bounds before appearing for examinations:

A period of one week before the final theory examination of Part II will be “out of bounds” to senior residents. Attendance has to be marked on these days as usual. The residents will be free of all duties during this period.

Feedbacks from residents:

Without feedback from residents the department cannot make improvements. The resident doctors are strongly encouraged to present their overall impressions about the program every 6 months. Re-appraisal meetings will be conducted at 6 monthly intervals, to evaluate the progress.

3.6 EXAMINATIONS AND FINAL ASSESSMENT

Each DM candidate has to pass 2 examinations before the DM degree is awarded.

Part I examination will be conducted at the end of first 18 months of training. Those unable to clear the Part I examination in first attempt may write the examination after 6 months. Their training process in the department continues during those 6 months.

Those who have passed part I examination may appear for Final (part II) examination at the end of the training program.

In addition to this, internal evaluation by the Academic division including theory papers with limited syllabus will be conducted at 6 monthly intervals.

Distribution of marks in examinations

Internal assessment - 200 marks

Part I theory – 200 marks (paper I and paper II), 50% required for pass

Part II theory – 200 marks (paper I and paper II), 50% required for pass

Part II practical examination – 400 marks, 50% required for pass

Case discussion – long case 100 marks, short case 100 marks (total 200 marks)

Spotters – 100 marks

Viva – 100 marks

Candidate has to score 50% for Part II theory and practical separately to pass.

3.7 CERTIFICATION

The final marks at the end of each year will be converted to absolute grades

Grade A = >80%, B=60 to 80%, C = 40 to 59%, D =<40%.

Total marks of internal and external examinations will given as transcript to student with final grades for both. The final transcript of the student will have only the grades of each activity, and not the individual marks for each session. The transcript will also specify the credit weightage for that particular activity/ posting.

Annexure: 1

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

**TRIVANDRUM,
KERALA**

EVALUATION FORM FOR CLINICAL/CASE PRESENTATION

Name of the student:

Name of the Faculty / Observer:

Date:

Sl. No.	Items of observation during Presentation	Poor 0	Below average 1	Average 2	Good 3	Very good 4
1	Completeness of history					
2	Accuracy of clinical and					
3	Clarity of Presentation					
4	Assessment of problem					
5	Diagnosis/Treatment plan					
6	Ability to defend					
7	Knowledge of the current					
	Grand Total					

EVALUATION OF JOURNAL PRESENTATIONS

Name of the Student:

Name of the Faculty / Observer:

Date:

Sl. No.	Items of observation during Presentation	Poor 0	Below average 1	Average 2	Good 3	Very good 4
1	Extent of understanding of scope & objectives of the					
2	To critically evaluate methods, <i>analysis and interpretations</i>					
3	Whether cross references					
4	Whether other					
5	Ability to respond to					
6	Ability to defend the paper					
7	Clarity of Presentation					
8	Audio – Visual aids used					
9	Ability to propose new					
	Total Score					

EVALUATION OF SEMINAR PRESENTATIONS

Name of the student:

Name of the Faculty / Observer:

Date:

Sl. No.	Items of observation during Presentation	Poor 0	Below average 1	Average 2	Good 3	Very good 4
1	Whether all relevant					
2	Understanding of the					
3	Completeness of					
4	Clarity of presentation					
5	Current concepts coverage					
6	Ability to answer					
7	Time scheduling					
8	Appropriate use of Audio					
9	Overall performance					
10	Any other observation					
	Total Score					

EVALUATION OF CLINICAL WORK IN WARD / OPD

Name of the student:

Name of the Faculty / Observer:

Date:

Sl. No.	Items of observation during presentation	Poor 0	Below average 1	Average 2	Good 3	Very good 4
1	Regularity of attendance and punctuality					
2	Presentations of cases during rounds					
3	Maintenance of case records					
4	Investigations work up					
5	Interaction with colleagues and supporting staff					
6	Teaching and training junior colleagues					
7	Bedside Manners					
8	Rapport with patients and family					
9	Counseling Patient's relatives for blood donation or					
10	Overall quality of clinical					
	Total Score					

LOG BOOK

Table 1: Academic activities attended

Name:

Admission Year:

College:

Date	Type of activity Specify Seminar, Journal club, Presentation, teaching	Particulars

LOG BOOK

Table 2: Academic presentations made by the students

Name:

Admission Year:

College:

Date	Topic	Type of activity Specify Seminar, Journal club, Presentation, UG teaching

LOG BOOK

Table 3: Diagnostic and Interventional procedures performed

Name:

Admission Year:

College:

Date	Name	ID No.	Procedure	Category O. A. PA.

Key:

O - Washed up and observed

A - Assisted a more senior surgeon

PA - Performed procedure under the direct supervision of a senior surgeon

PI - Performed independently

MODEL OVERALL ASSESSMENT SHEET

Name of the college:

Academic Year:

Sl. No.	Particulars	Name of the student and Mean score		C*	D*	E*	F*	G*	H*	I*	J*
		A*	B*								
1	Journal										
2	Seminars										
3	Clinical work										
4	Clinical										
5	Teaching										
	Total Score										

Note: Use separate sheet for each year.

Signature of the HOD:

Signature of the Dean:

The above overall assessment sheet used along with the log book should form the basis for certifying satisfactory completion of course of study, in addition to the attendance required

Annexure: 2

CREDIT POINT SYSTEM FOR EVALUATION OF SENIOR RESIDENTS

Credit-based evaluation

The internal evaluation of the senior residents will be based on grading. The grading will be based on the performance in each module with specified maximum credits against them.

The respective modules, with the maximum credits allotted against them, are given below.

SI No.	Module	Credits
1	Patient evaluation and management	75
2	Clinical evaluation, Imaging performance and Interpretation	75
3	Academic presentation	70
4	Invasive and interventional DSA procedures and decision making.	100
5	Publications and conference attendance (5 credits each)	10
6	Statistics course	5
7	BMT wing postings	3
8	Internal practical and theory evaluation	25
9	Outside training posting	20
10	Any outstanding activities	5
11	Project/thesis	12
	Total	400

Module I : Patient evaluation and management (75 Credits)

I. Ward posting (30 credits)

The evaluation tools will be as follows,

1. Completion of admission and discharge summaries & at discharge patient education and prescription.
2. Evaluation of his understanding of the clinical problem of all inpatients under his charge and recognition using clinical laboratory parameters of patient's progress, deterioration or complications.
3. Identification of all clinical issues setting targets to be achieved at discharge.
4. Patient education and counseling especially with respect to post discharge life style, diet, exercise, behavior modification & drugs and drug interactions.
5. Clinical appreciation of bedside signs and symptoms
6. Interpretation of all laboratory and invasive and noninvasive test results
7. Discharge Summary quality and completeness
8. Bedside procedures including catheterization, wound and puncture site care

2. Assessment of Outpatient training (25 credits).

1. Clinical cases seen and discussed with Consultant.
2. Completeness of case history writing and the plan of management along with patient education and quality of prescription given to patient.
3. Interpretation of all routine investigation including Imaging & Laboratory reports.
4. Total evaluation / plan management strategy of patient on completed routine investigations.
5. Patients identified with new problem / worsening of existing clinical issues requiring change of management plan and management discussed with consultant and also presented to the Medical/Surgery Dept meetings charting out plan of management, with

- all relevant investigations.
6. Identification of critically ill patients and channeling their acute management.
 7. Inter-departmental consultations

3. ICU and Emergency (20 Credits)

1. This includes evaluation of patient management in the ICU (newly admitted. transferred from wards, transferred after intervention procedure, etc.) and charting out plan of management and carrying out the same.
2. All emergency room visits of patients outside office hours / their evaluation /charting out plan of management including ICU admissions and preparation for emergency intervention/ surgery as indicated.

ICU training will include management of acute dissection, ruptured aneurysm, acute GI bleed and hemoptysis, cyanotic spells, Ventilatory care, Fluid- Electrolyte care and CPR protocol etc.

	Ward posting	Assessment of Outpatient training	ICU and Emergency
1 st year	10	10	5
2 nd year	10	10	5
3 rd year	10	5	10
total	30	25	20

Module II: Clinical evaluation, Imaging performance and Interpretation (75 credits)

1. Evaluation of MRI: Reporting and Analysis (40 credits)

Patient scheduling, evaluating, performing and reporting MRIs in 3 years

1. To have a collection of at least 30 MRIs with all known abnormalities collected in a log book. (Including all advanced cardiovascular imaging studies and their clinical, imaging

and histopathological follow up).

2. The evaluation will be based on the quality of the log book submitted.

2.Evaluation of CT: Reporting and Analysis (25 credits)

Patient scheduling, evaluating, performing and reporting CT studies in 3 years

1. To have a collection of at least 30 CTs with all known abnormalities collected in a log book. (Including all advanced cardiovascular imaging studies and their clinical, imaging and /histopathological follow up).
2. The evaluation will be based on the quality of the log book submitted.

3. Evaluation of USG/Doppler: Reporting and Analysis (10 credits)

Analysis and reporting of at least 200 USG/ doppler cases with a collection of at least 20 representative cases in the log book.

	MRI	CT	USS
1 st year	10	10	4
2 nd year	15	10	4
3 rd year	15	5	2
total	40	25	10

Module III : Academic Presentation (70 credits)

1. Journal Review (Duration 30 min each) [20 credits]

Purpose of journal presentation it to instill qualities of enquiry and analysis of scientific medical articles and to evaluate its relevance and impact in understanding pathophysiology of disease or in clinical management. The resident can select recent articles of clinical relevance,

or consult the faculty to help select scientific articles with original research content for presentation. The presentation should reflect the senior resident's understanding of the problem under discussion and the outcome and analysis of the results with regard to various aspects of disease state and the clinical relevance. Two articles with brief exposition of the highlights of the study and its clinical relevance and the take home message should be included. The senior resident should include a short report of all the articles presented in print in the log, highlighting the aim, methodology, patient recruitment criteria, results, discussion and implications for clinical practice.

2. Seminar 45 min [20 credits]

It is intended to encourage extensive literature review on the topic and present the highlights of the topic under review in a succinct manner with clear take home messages, but at the same time the extensive literature search elevates the presenter as an authority on the topic. The topic should be prepared as a review article with complete bibliography in a publishable format, along with the topic presentation. The presentation and the write up are equally weighted.

3. Participation and presentations in Stroke and vascular surgery- radiology meet [6 credits]

4. Participation and presentations in Radiology-cardiac surgery meet [4 credits]

5. Participation and presentations in cardiology- radiology meet [10 credits]

6. Clinical case discussion [10 credits]

	Journal Review	Seminar	presentations in Stroke and vascular surgery meet	presentations in Radiology-cardiac-surgery meet	presentations in cardiac radiology meet	Bed side clinical case discussion
1 st year	5	5	2	1	2	2
2 nd year	5	5	2	1	3	3
3 rd year	10	10	2	2	5	5
total	20	20	6	4	10	10

The purpose of this exercise is to identify daily clinical problems confronted during the routine hospitalization and management of patients; clinical problems significant enough to influence patient management (diagnosis/therapy). The literature review will be up to date, and will enable evidence-based approach to patient management in different clinical scenarios. The

assessment will be based on the following parameters; review of the literature to chart out evidence-based management plan and to write up a short report on the clinical problems and the current state of the art management and the level of evidence for such management option. The oral presentation and the write up are equally weighted for purpose of evaluation.

Module IV: Invasive and interventional DSA procedures and decision making (100 credits)

The resident is supposed to perform a wide array of diagnostic angiogram, vascular interventions, non-vascular interventions and guided procedures during the 12 months of posting.

1. Pre-procedural work up and detailed knowledge of the case
 2. Evaluation of available diagnostic images
 3. Taking proper consent and investigations
 4. DSA procedure Knowledge and execution (as a First operator/ Assistant)
 5. Post procedure care and orders
 6. Follow up of patients
 7. To have a collection of 20 cases of interventions performed or assisted during the period and their relevant learning points.
- 1st Year – 30 credits, 2nd Year – 30 credits, 3rd year – 40 credits

Module V. Publications and conference attendance (5 credits each).

At least one scientific paper as first author should be submitted for publication before the end of the course and final evaluation. There will be uniform credit of 5 for satisfying this requirement.

There should be one paper/poster presented at a national, state or international conference. There will be equal credit of 5 for this.

The senior resident has to present certificate of participation to PC and submit abstract of presentation to the PC and also ensure entry in e-portfolio

Module VI and VII: Statistics and BMT wing postings

1. Medical Statistics and research methodology (5 credits)
2. Biomedical Technology posting (3 credits)

Module VIII. Internal Examinations: Theory and Practicals (25 credits)

There will be internal practical and theory examinations, each having 100 marks during the 3-year course. These examinations will be conducted at every 6 months.

Module IX. Outside training posting (20 credits)

Candidates will be sent to other academic institutes which are conducting training in the field of Cardiovascular imaging and peripheral interventional radiology. The objective of out posting would be to learn gather a different perspective of interventional radiology, trauma imaging and intervention and nuclear medicine. That posting will be for a total period of 1 month.

Module X. Outstanding activities: (5 credits)

Additional credits will be awarded for additional publications, projects, national and international conference presentations obtaining prizes, certificates of merits and awards etc.

Module XI. Projects and thesis : (12 credits)

1. Mid-term evaluation of projects mandatory and will carry credits
2. Prospective / Retrospective Study
3. Ethical Committee clearance / Institute funding obtained
4. Contribution of candidates experience in the study

5. Descriptive data collection / Quantitative data subjected to statistical analysis.
8. Midterm Review: At 18 months of DM course: Aims and objectives, review of literature, materials and methods (exclusion / inclusion criteria), data collection and presentation (% of target of the project) and preliminary data analysis.
7. Review at 30 months: Presentation of the full project as thesis and also in publishable form, complete with statistical analysis, discussion, study limitations, conclusion, and bibliography
8. Overall impact of the project in adding to our knowledge base, and patient management. Between 30-34 months, the project should be sent for publication to peer reviewed journals.
9. Presentation of the project work as scientific presentation at national level and at state level-desirable. Additional publication ready manuscript should also be prepared.

ANNEXURE: 3

SYLLABUS

SYLLABUS-COURSE CONTENT & CURRICULUM FOR DM PROGRAMME

PART 1

BASIC SCIENCES

1. ANATOMY (gross and radiological anatomy)

- a. Normal morphology and structure
 - i. Embryology of Heart and great vessels including anomalies
 - ii. Fetal circulation
 - iii. Normal cardiac and peri-cardiac structures
- b. Common variants like:
 1. Anomalous coronary artery
 2. Left superior vena cava
 3. Azygous continuation of the IVC
- c. Segmental anatomy of the heart via imaging
 - i. Atrial situs
 - ii. Ventricular loop
 - iii. Identification of great vessels
 - iv. Assess pulmonary arteries and veins
 - v. Identify systemic venous return
- d. Normal measurements including:
 - i. Left ventricular wall thickness, diameter, fractional shortening, end-diastolic volume, end-systolic volume indexes
 - ii. Left atrium size
 - iii. Right ventricular wall thickness and size
 - iv. Right atrial size
 - v. Diameter of the thoracic aorta
- e. Embryology and anatomy of:

Lung, Tracheobronchial tree, Diaphragm, Pleura, Mediastinal structures

2. Basics of Clinical aspects of vascular disorder

- a. Clinical and Laboratory Considerations
 - i. Symptomatology and staging of vascular disease
 - ii. History, physical examination
 - iii. 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)
- b. Epidemiology of vascular disease
- c. Natural history of vascular disorders
- d. Vascular anatomy: arterial and venous
 - i. Embryology
 - ii. Normal anatomy
 - iii. Variant anatomy
 - iv. Anatomy of collateral pathways

3. PHYSIOLOGY (physiological aspects of cardiac & vascular imaging):

- a. Normal cardiac cycle and function.
- b. Electrocardiography:
 - Normal ECG pattern
 - Common abnormalities in ECG
- c. Physiological anatomy of cardiac muscle & the mechanics of cardiac contraction
- d. Physical basis for blood flow, pressure, and resistance
- e. Ventricular volume and pressure relationship
- f. Practical cardiac measurements
 - 1. Ejection fraction
 - 2. Stroke volume
 - 3. Left ventricular mass
 - 4. Flow calculation
 - 5. Gradient calculation
 - 6. Qp/Qs ratio
 - 7. Diastolic heart function

- g. Normal cardiac and pulmonary pressures
- h. Vascular regions supplied by the coronary arteries
- i. Standard nomenclature for topographic imaging of the heart
- j. Pulmonary, aortic and peripheral hemodynamics.

4. CARDIO VASCULAR PATHOLOGY & MICROBIOLOGY:

- Basic pathology in relation to common cardiovascular conditions -macroscopic and microscopic.
- Pathology of congenital malformations, neonatal and perinatal cardiac disorders.
- Pathology of various diseases primarily and secondarily involving the heart and the vascular system.
- Genetic and metabolic disorders of cardiovascular system
- Applied bacteriology, parasitology and virology
- 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

5. BIOCHEMISTRY AND PHARMACOLOGY

- Basic understanding of pharmacokinetics of drugs and pharmacodynamics of drugs used in cardiovascular practice with emphasis on intervention.
- Their mechanism of action, metabolism, adverse effects, drug interactions, use of drugs
- Contrast media
- Antihypertensive, antiplatelet, anti-coagulants
- Vasodilators and vasoconstrictors
- Embolic agents
- Thrombolytic agents
- detection of abnormal bleeding, use of blood products and other agents.
-
- Anesthetics and analgesics with respect to cardiovascular imaging and interventions.
- Applied aspect of the cardiac biochemistry in relation to cardiovascular radiology

6. PHYSICAL PRINCIPLES OF CARDIOVASCULAR IMAGING:

Radiography, CT scan, MRI, US scan, Nuclear study, Hybrid Imaging

A. CT physics

- i. MDCT artifacts relevant to cardiac and vascular imaging.
- ii. Understanding trade-off between noise, dose and image quality.
- iii. Spatial resolution, contrast resolution and imaging reconstruction algorithms
- iv. Temporal resolution, half scan and multi-segment reconstruction.
- v. Different CT technologies (MDCT, EBCT, dual source)
- vi. Concept of pitch.
- vii. ECG editing - when, what, how and why?
- viii. Contrast injection - principles, protocols, bolus geometry, iodine flux

B. MRI physics

- i. MRI artifacts relevant to cardiac and vascular imaging.
- ii. Tradeoff between spatial resolution, temporal resolution, contrast resolution and acquisition time
- iii. Principles of black blood, edema and scar imaging
- iv. Segmented K space cine imaging
- v. Phase velocity imaging - principles, applications and limitations
- vi. Imaging faster
- vii. Contrast enhanced 3-D MRA - advantages and limitations
- viii. Non-gadolinium MRA - principles, options and limitations

C. US and Doppler

- i. Principles of CEUS imaging

D. RADIATION CONCEPTS IN CARDIOVASCULAR IMAGING AND INTERVENTIONAL RADIOLOGY

- a. Distinguish between exposure, absorbed dose and effective dose
- b. Understand the measurements for dose - CTDI, CTDI vol, dose length product
- c. Understand the weighting factor for various organs and tissues.
- d. Be able to read and understand the dose sheets produced by the CT scanner at the end of the examination.
- e. Dose minimization techniques in cardiac and vascular CT
 - i. Scanner based
 - ii. Operator based
- f. Understand the implications in terms of dose of practical instances such as:
 - Increasing / decreasing the cranio-caudal field of view.

- Retrospective ECG gating vs prospectively triggered CT.
 - Altering kVp and mAs.
- g. Pediatric protocols for dose-quality optimization
- h. Radiation protection in Cath lab

E. IMAGING MODALITIES FOR THE HEART & GREAT VESSELS:

- a. Radiography
- b. Cardiovascular Computed tomography
- i. Indications & contraindications for:
 1. Coronary calcium scoring
 2. Cardiac CT
 3. Coronary CTA
 4. Peripheral CTA
 - ii. Physics and cardiac imaging considerations including ECG gating techniques for:
 1. Coronary artery calcium scoring
 2. Coronary CTA
 3. Aortic CTA
 4. Pulmonary CTA
 - iii. Advantages and limitations of CT for the above
 - iv. Protocols for specific clinical question (e.g. patients with grafts, combined aortic and coronary artery disease, triple rule out)
 - v. Radiation dosage & reduction tools
 - vi. Patient selection and preparation for the above procedures.
- c. Cardiovascular MRI:
- Indications & contraindications
 - Physics and imaging considerations, including pulse sequences, ECG-gating techniques, and respiratory compensation strategies
 - MRI safety and compatibility issues of ICDs and stents
 - Wall motion studies and tagging
 - Myocardial perfusion and viability scanning
 - Valvular disease assessment
 - Blood flow quantification
 - Shunt assessment

- Coronary MRA
- MR of the aorta
- Pulmonary MRA
- Atherosclerotic plaque evaluation
- Stress Testing
- Advantages, limitations, and contraindications

F. REPORTING TEMPLATES AND STANDARDS IN

- Ultrasound
- CT
- MRI
- CT, MR Angiography
- Interventional radiology

G. OTHER (WORKING KNOWLEDGE)

- i. Echocardiography (transthoracic and transesophageal)
 1. Indications & contraindications
 2. Technique including standard views and use of color Doppler
 3. Advantages and limitations
- ii. Cardiac and coronary catheter angiography
 1. Indications & contraindications
 2. Technique including standard views and transcatheter tools (e.g. intraluminal ultrasound)
 3. Pressure measurements
 4. Fundamentals of cardiology interventions.
 5. Advantages and limitations
- iii. **Imaging of Lung and Mediastinum**
- iv. **Nuclear study** : In relation to cardiovascular diseases

7. INSTRUMENTATION AND BIO MEDICAL ENGINEERING

- a. Knowledge about the various imaging and interventional equipment in the department.
- b. Patient monitoring equipments and various life support systems.
- c. Catheters and other biomaterials used in interventional radiology.

8. 3-D IMAGING AND POST-PROCESSING

- a. Post processing techniques relevant to cardiac CT

- b. Post processing for aortic valve, aortic aneurysm interventions or any device planning.
- c. Post processing for electrophysiological studies planning
- d. Post processing techniques in cardiac MRI- for various qualitative and quantitative assessment.
- e. 3D printing

9. EVIDENCE-BASED CARDIOVASCULAR IMAGING

- a. Understand the principles of technology assessment.
- b. Be aware of cardiovascular risk factors with an understanding of the Framingham risk score.
- c. Understand the imaging risk markers for atheromatous disease, notably coronary calcium score on CT and intimo-medial thickness on carotid ultrasound.
- d. Understand how the calcium score affects management above and beyond the Framingham risk score.
- e. Appreciate the arguments for and against screening for cardiovascular disease using coronary calcium score and the current guidelines.
- f. Appreciate the competing modalities for detection of chronic ischemic heart disease including myocardial perfusion scintigraphy, stress echo, stress MRI, cardiac CT, exercise ECG and PET. Be able to enlist advantages and disadvantages of each.
- g. Appreciate the competing modalities for detection of acute coronary syndrome.
- h. Have an understanding for the clinical contexts in which a high negative predictive value is important and for those in which a high positive predictive value is necessary.
- i. Be aware of some of the research comparing cardiac CT with myocardial perfusion imaging.
- j. Understand the controversies pertaining to cardiac CT particularly with regards to its costs and the costs of treating incidental findings.
- k. Appreciate the role of late gadolinium MRI in risk stratifying patients with various forms of cardiomyopathy. Understand the additional prognostic information offered.
- l. Understand the seminal study involving survival analysis of patients with hypertrophic cardiomyopathy and scar as detected on late gadolinium MRI.
- m. Appreciate how MRI guides the decision to revascularize and how this is superior to PET and myocardial perfusion imaging.
- n. Understand how MRI functions as a biomarker for iron involvement of the heart and how this has revolutionized survival of patients with thalassemia.
- o. Understand how MRI helps with the decision who should get an ICD and who should receive cardiac resynchronization therapy.

10. EPIDEMIOLOGY AND PREVENTIVE CARDIOLOGY:

- Principles of epidemiology in relation to cardiac diseases. Concepts of risk factors, population approaches, prevention of diseases and health promotion.

11. BASICS OF STATISTICAL METHODS, RESEARCH METHODOLOGY

Sections 1-5 for 1st internal assessment and Section 6-11 for 2nd internal assessment

Part2

I. CONGENITAL HEART DISEASE

- a. Cyanotic versus acyanotic heart disease.
- b. Most common and less common lesions: VSD, ASD, vascular rings etc
- c. Most common indications for cardiac MRI in the setting of congenital and acquired pediatric cardiovascular disease
 - i. Corrected Tetralogy of Fallot: monitor RV size, biventricular function, and degree of pulmonary regurgitation to determine timing of pulmonary valve replacement
 - ii. Presence and severity of RVOT and branch pulmonary artery stenosis s/p Tetralogy of Fallot repair or after RV-PA conduit placement
 - iii. Repaired coarctation of the aorta: to determine presence and severity of recurrent coarctation
 - iv. Monitor severity of aortic root and ascending aortic dilatation in conditions like connective tissue disorder, bicuspid aortic valve, s/p Ross procedure, s/p arterial switch procedure.
 - v. Neonatal imaging prior to initial palliation to diagnose anomalous pulmonary venous return, source of pulmonary blood flow, aortic arch obstruction or cause of vascular-mediated airway compromise
 - vi. Preoperative evaluation prior to stage 2 and stage 3 Norwood as an alternative to cardiac catheterization
 - vii. Post-operative evaluation after atrial or arterial switch for transposition of great arteries to screen for baffle leaks, obstruction, aortic root dilation and status of branch pulmonary arteries
 - viii. Screen for occult left-right shunt or anomalous pulmonary venous return in the setting of unexplained RV volume overload.
 - ix. Myocardial disorders like myocarditis, arrhythmogenic RV cardiomyopathy, LV non-compaction and other cardiomyopathies, including Duchenne's muscular dystrophy

- x. Primary cardiac tumors
 - xi. Situs anomalies (asplenia and polysplenia)
- d . Post-operative assessment of the following procedures:
- i. Atrial switch for transposition of great arteries: Senning and Mustard procedures
 - ii. Arterial switch for transposition of great arteries
 - 1. Jatene switch
 - 2. Rastelli procedure
 - 3. Lecompte maneuver
 - iii. Single ventricle repair:
 - 1. Norwood 1 and modifications (Sano, hybrid Norwood)
 - 2. Damus Kaye Stansel anastomosis
 - iv. Superior cavopulmonary connection:
 - 1. Bidirectional Glenn
 - 2. Kawashima procedures
 - v. Total cavopulmonary connection:
 - 1. Fenestrated Fontan procedure
 - 2. Modifications
 - a. Atriopulmonary
 - b. Lateral tunnel
 - c. Extra-cardiac Fontan procedure
 - vi. Pulmonary blood flow augmentation
 - 1. Blalock-Taussig (classic and modified)
 - 2. Waterston
 - 3. Pott's shunts
 - vii. Ross procedure
 - 1. Ross-Konno procedures of the LVOT
 - viii. Total correction of Tetralogy of Fallot, pulmonary atresia with VSD and truncus arteriosus: including RV- PA homograft placement and unifocalization
 - ix. Procedures involving the aortic arch, including vascular ring repair, coarctation repair, arch augmentation, and arch advancement procedures
 - x. Anomalous pulmonary vein correction
 - 1. TAPVR repair
 - 2. Warden procedure
 - xi. Repair of anomalous coronary artery
- e. Unusual congenital heart disease: advanced
- a. Double outlet right ventricle

- b. Single ventricle
- c. Cor triatriatum
- d. Hypoplastic left heart syndrome
- i. Aortic atresia
- ii. Mitral atresia
- e. Hypoplastic right heart syndrome
- f. Tricuspid atresia
- g. Uhl's anomaly
- h. Right ventricular dysplasia
- i. Pulmonary valve atresia
- j. Ebstein's anomaly
- k. Congenital absence of the pericardium
- l. Late or adult presentations of congenital heart disease including:
 - i. Mitral valve prolapse
 - ii. Aortic stenosis (e.g. valvular and subvalvular)
 - iii. Sinus of Valsalva aneurysm
 - iv. Marfan's syndrome
 - v. Bicuspid aortic valve and association of aortic aneurysm and dissection
 - vi. Postoperative CHD.

II. ISCHEMIC HEART DISEASE

- a. Risk factors, primary prevention, and screening
- b. Inducible myocardial ischemia & basis of stress testing
- c. Acute MI
- d. Chronic MI
- e. Post-MI complications
 - i. Cardiac rupture
 - ii. LV aneurysm
 - iii. Papillary muscle rupture
 - iv. Congestive heart failure
 - v. Dressler's syndrome
- f. Myocardial viability
 - i. Stunned myocardium
 - ii. Hibernating myocardium
- g. Therapeutic and interventional options

III. VALVULAR HEART DISEASE

- a. Aortic stenosis

- b. Aortic insufficiency
- c. Mitral stenosis/mitral insufficiency
- d. Tricuspid stenosis/tricuspid regurgitation
- e. Miscellaneous
 - i. Degenerative calcification
 - 1. Calcified aortic stenosis
 - 2. Mitral annular calcification
 - ii. Myxomatous degeneration
 - iii. Carcinoid syndrome
 - iv. Infective endocarditis
 - v. Rheumatic heart disease
- f. Therapeutic and interventional options

IV. CARDIAC AND PERICARDIAL MASSES

- a. Primary lesions
 - i. Myxoma
 - ii. Lipoma
 - iii. Angiosarcoma
 - iv. Rhabdomyoma
 - v. Lymphoma
 - vi. Lipomatous hypertrophy of the interatrial septum
- b. Metastasis
- c. Therapeutic and interventional options
- d. Thrombus vs tumor by imaging techniques

V. CARDIOMYOPATHY

- a. Hypertrophic
- b. Dilated
 - i. Ischemic
 - ii. Non-ischemic
- c. Restrictive (also infiltrative)
 - i. Amyloidosis
 - ii. Sarcoidosis
 - iii. Storage diseases
 - iv. Infection
 - v. Radiation
- d. Therapeutic and interventional options

VI. DISEASES OF THE PERICARDIUM

- a. Acute pericarditis
- b. Constrictive pericarditis
- c. Pericardial effusion
- d. Pericardial cyst
- e. Pericardial defect
- f. Therapeutic and interventional options

VII. MISCELLANEOUS

- a. Arrhythmogenic right ventricular dysplasia (ARVD)
- b. Coronary artery/sinus of Valsalva aneurysm and fistula
- c. Pulmonary arterial hypertension
- d. Pulmonary embolism
- e. Cardiac transplantation: basics & imaging issues.
- f. Imaging issues in the setting of Automatic implantable cardioverter defibrillator (AICD) and pacemakers
- g. RF ablation for atrial fibrillation

VIII. ADVANCES IN CARDIAC IMAGING

- a. Tissue mapping
- b. Strain imaging
- c. DTI
- d. Spectroscopy
- e. 4D flow
- f. 3D printing

IX. ACQUIRED DISEASE OF THE THORACIC AORTA

- a. Aneurysms
 - i. Atherosclerotic
 - ii. Marfan's syndrome
 - iii. Ehlers-Danlos syndrome
- b. Pseudoaneurysms
 - i. Mycotic
 - ii. Post-traumatic and post-surgical
- c. Dissection
- d. Aortoarteritis
- e. Atherosclerosis

- i. Plaque
 - ii. Ulcerated plaque
 - iii. Penetrating ulcer
 - iv. Intramural hematoma
- f. Therapeutic and interventional options

X. PERIPHERAL VASCULAR DISEASE

A. Arterial

- Atherosclerotic
- Buerger's disease
- Aortoarteritis
- Splanchnic arterial diseases
- Vascular trauma
- Tumor vascularity
- Therapeutic considerations including interventional treatment
- Imaging of complications
- Arterial tumors and arteriovenous malformations

B. Venous

- Varicose veins
- DVT
- Venous malformations
- BUDD chairi syndromes
- Central vein stenosis
- Arteriovenous fistula related complications

XI. INTERVENTIONAL RADIOLOGY

a. Diagnostic evaluation of vascular diseases: Radiography, CT, MRI, Doppler for diagnosis and planning of interventions.

b. Clinical Curriculum

1. Aneurysmal disease
2. Peripheral vascular occlusive disease
3. Renal artery disease
4. Visceral ischemia
5. Carotid artery disease
6. Innominate, subclavian and vertebrobasilar arterial disease.

7. Thoracic outlet syndrome
8. Acute arterial occlusion
9. Complications of vascular therapy
10. Management of vascular trauma
11. Venous thrombo-embolic disease, chronic venous insufficiency
12. Arteriovenous malformations and arteriovenous fistulae
13. Vascular access
14. Non-diabetic foot problems
15. Lymphoedema
16. Coagulation disorders.
17. Miscellaneous vasculogenic problems:

Lymphatic system:

- Anatomy, Lymphangiography- Performance, interpretation, indications & contraindications and risks
- Lymphatic malformations
- Chylous effusion and Chylous ascites

18. Non-atherosclerotic vasculogenic problems

19. Portal Hypertension

- Identification and diagnosing etiology
- Hepatic venous pressure gradient Complications of portal hypertension
- Interventions to reduce portal hypertension and complications
- Management of portosystemic shunts

20. Dialysis Fistula complications

- Venous stenosis
- Failing fistulas
- Arterial steal
- Central venous stenosis
- Fistula thrombosis

21. Biliary obstruction and pathologies

22. Hepatic Tumours

c. Endovascular therapy

- In the management of peripheral vascular disease
- Aneurysm /Dissection –Aorta; Carotid
- Common venous interventions e.g. In IVC obstruction, varicosities, IVC filters etc.
- Endovascular management of GI bleed- post operative , gastric varicosities, vascular malformation, splenic artery aneurysms, Tumour related

- Endovascular management of urinary tract bleed
- Endovascular management of hemoptysis – Bronchial artery embolisations, MAPCA coiling, PAVM managements
- Endovascular management of Uterine artery embolization
- Embolization techniques, materials, instruments, indications, contraindications, complications and results.
- Angioplasty techniques, indications, contraindications, complications and results.
- Vascular diagnosis, abdominal and pelvic viscera
 - Genitourinary system
 - Kidney
 - Renovascular hypertension: recanalization techniques
 - Renal trauma
- Congenital disorders: Principles and practice of interventional management of arteriovenous malformations
- Thoracic Duct embolization, management of chylous ascites and chylous effusion
- Post-surgical/endovascular management of complication
- Non Vascular Peripheral Interventional Techniques
 - Biliary interventions
 - Thermal ablative treatment
 - Interventions for pain reduction
 - Guided Biopsies and Drainage procedures

d. Principles of practice of Interventional Radiology

- Quality Assurance Issues
 - Outcomes analysis
 - Practice guidelines
 - Complications: classification, documentation
- Legal Aspects of Cardiovascular and Interventional Radiology

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

e. Evidence-based approach and practice

1. To understand incidence and prevalence of aneurysmal disease according to age
2. To understand the natural history of abdominal aortic aneurysm
3. To understand the genetic distribution of the disease
4. To understand the role of ultrasound, angiography, CT, MRI, MRA in screening, diagnosis, follow-up, prognosis and planning interventions.
5. To understand the indications for radiological interventions and factors which contribute to decision making
6. To understand the technical aspects of endovascular techniques in aortic aneurysm, peripheral arterial disease- options and alternatives
7. To describe the combined surgical and endovascular management of complex problems like aortocaval & aorto-duodenal fistulae etc.
8. To have knowledge of both the immediate and long-term outcomes of endovascular treatment.
9. To describe the management and prevention of complications.

Sections I to X for 3rd internal assessment and XI- XII for 4th internal assessment

• Recommended reading

1. Kaufman, Lee. Vascular and Interventional Radiology: The Requisites. Saunders; 2nd edition, 2013
2. Jan Bogaert, Steven Dymarkowski, Andrew M. Taylor, Vivek Muthurangu. Clinical Cardiac MRI, Springer; 2nd edition, 2012
3. Antonio F. Corno, Congenital Heart Defects: Decision Making for Cardiac Surgery (2 volumes), Steinkopff, 2012

4. Vincent B. Ho, Gautham P. Reddy. Cardiovascular Imaging, 2-Volume Set, Elsevier Health - US; 1st edition, 2010
5. Hugh D. Allen. Moss & Adams' Heart Disease in Infants, Children, and Adolescents, Including the Fetus and Young Adult, Wolters Kluwer Health; 9th edition, 2016
6. Shankar Sridharan, Gemma Price, Oliver Tann, Marina Hughes, Vivek Muthurangu. Cardiovascular MRI in Congenital Heart Disease: An Imaging Atlas, Springer; 2010 edition
7. Mark A. Fogel. Principles and Practice of Cardiac Magnetic Resonance in Congenital Heart Disease: Form, Function and Flow, Wiley-Blackwell; 1st edition, 2010
8. Waldman, Patel, Saad. Interventional Radiology Secrets. Hanley & Belfus, 2004 (strongly recommended)
9. Matthew A. Mauro, Kieran P. J. Murphy, Kenneth R. Thomson, Anthony C. Venbrux. Image-Guided Interventions, Saunders; 2nd edition, 2013
10. Kessel, Robertson. Interventional Radiology a Survival Guide, Second Edition. Elsevier Churchill Livingstone, 2005.
11. Kandarpa A. Handbook of Interventional Radiologic Procedures. Little, Brown and Company, 1996.
12. Wojtowycz M. Handbook of Interventional Radiology and Angiography, Second Edition. Mosby, 1995.
13. SCVIR Syllabus Series:
 - a. Peripheral Vascular Interventions, Second Edition.
 - b. Portal Hypertension: Diagnosis and Interventions, Second Edition.
 - c. Interventions in Oncology.
 - d. Venous Interventions.
14. Reuter RS, Redman HC. Gastrointestinal Angiography, Third Edition. W.B. Saunders, 1986.
15. Kadir S. Diagnostic Angiography. W.B. Saunders, Philadelphia, 1986.
16. Uflacker R. Atlas of Vascular Anatomy. Williams and Wilkins, 1997.
17. Baum P. Abrams Angiography: Interventional Radiology. Little, Brown and Company, 1997.

Recommended journals / Periodicals

- a. American Journal of Roentgenology
- b. Radiology
- c. Seminars in Interventional Radiology
- d. Techniques in Vascular and Interventional Radiology
- e. Journal of Cardiovascular Magnetic Resonance
- f. Journal of Endovascular surgery
- g. European Journal of Radiology
- h. JVIR