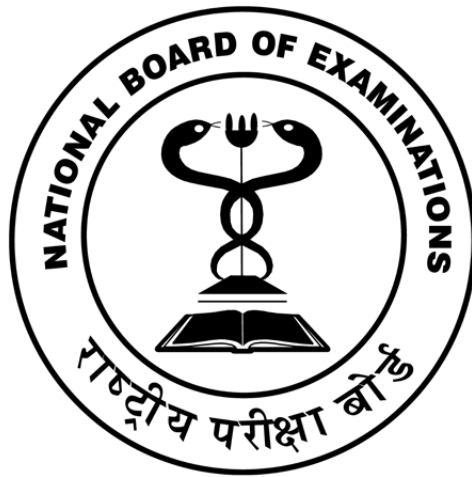


Guidelines  
for  
Competency Based Training Programme  
in  
**FNB- Interventional Cardiology**



**NATIONAL BOARD OF EXAMINATIONS**

Medical Enclave, Ansari Nagar, New Delhi-110029, INDIA  
Email: [mail@natboard.edu.in](mailto:mail@natboard.edu.in) Phone: 011 45593000

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## INTRODUCTION

Ensuring both quality of patient care, and clinical excellence in interventional Cardiology is of the utmost importance.

### Mission Statement

The directive of the Interventional Cardiac Catheterization Laboratory is to provide state-of-the-art invasive diagnostic and therapeutic procedures for patients with cardiovascular disease.

### Statement of Educational Goals

The goal of this fellowship is to understand the fundamentals of cardiovascular pathophysiology as it relates to clinical disease through the analysis and interpretation of hemodynamic records and angiographic images and to understand and master the techniques of interventional cardiology procedures required to treat these cardiovascular diseases.

The curriculum is designed to promote six broad based goals based on the six ACGME core competencies:

- 1) Medical Knowledge: exposure by direct patient contact to a broad range of acute and chronic cardiovascular problems that present for invasive cardiac evaluation and management. Formal and informal didactic teaching sessions are used as well.
- 2) Patient Care: accurate, physiologically-reasoned diagnosis, in the cardiac catheterization laboratory as well as at the bedside prior to and after invasive management; expert understanding of the need for invasive management, restrained by considerations of risk, benefit and cost; formulation of a management plan sensitively tailored to the unique medical and life circumstances of each patient. This plan must include rehabilitative and preventive measures.
- 3) Professionalism: effective, mutually satisfying communication with patients, families and other physicians and allied health care personnel. Working with other allied health care team professionals to provide patient focused care. This is especially important in the “surgical” atmosphere of the cardiac catheterization laboratory where a team approach is essential. Maintaining highest ethical standards and strict privacy when discussing patient case plans with other providers.
- 4) Interpersonal and Communication Skills: Effective communication with other non-cardiology physicians, nurses and allied professions in working with them to develop and institute a plan of care for patients undergoing

invasive cardiac evaluation. Being able to explain the necessity of invasive cardiac evaluation and management clearly and concisely using verbal and written communication will be of paramount importance. In addition, since you are not the patient's long-term primary physician, rapidly developing a rapport with patients and families in a limited time period through good listening and communication skills will be critically important.

- 5) Practice Based Learning: Using information technology, literature sources and other available resources to practice evidence based medicine based on sound medical principles, guidelines and best practices, while being still able to individualize this for a particular patient's circumstances.
- 6) Systems Based Learning: during interaction with other medical services and providers in the cardiac catheterization laboratory, it will be important to learn how their care delivery systems work, e.g. both inpatient (non-acute and acute care units, operating room), outpatient (ambulatory clinics), and non-invasive testing facilities. Understanding this will be critical to your ability to synthesize and implement an efficient invasive cardiac management plan.

## **General Statement of Objectives**

The specific educational goals include:

- 1) Understanding the indications, risks, and benefits of invasive diagnostic and therapeutic procedures in cardiovascular disease,
- 2) Obtaining a basic understanding of radiation physics, radiation safety, radiological cardiovascular anatomy, clinical cardiovascular physiology, clinical pharmacology of antiplatelet agents, antithrombin agents and thrombolytics, mechanisms of restenosis, and basics of vascular brachytherapy
- 3) Using the data obtained from invasive procedures to select medical, catheter-based, or surgical treatment,
- 4) Obtaining mechanical training in invasive diagnostic and interventional procedures,
- 5) Understanding peripheral anatomy and the non-invasive assessment of peripheral vascular disease (PVD) and using this data to select proper treatment of PVD,
- 6) Obtaining mechanical training in invasive diagnostic and therapeutic peripheral procedures. Specifically, fellows will learn to perform, and will become proficient in, temporary right ventricular pacemaker insertion, pericardiocentesis, right and left heart catheterization including coronary angiography and ventriculography, intra-aortic balloon pump placement, conventional balloon angioplasty, stenting,

rotational atherectomy, directional atherectomy, rheolytic thrombectomy, intravascular ultrasound, Doppler flow wire, pressure wire, percutaneous vascular access site closure, intracoronary brachytherapy, peripheral angiography of the brachiocephalic, renal and lower extremity vasculature, and peripheral angioplasty and stenting including the subclavian, renal and iliac arteries.

The goals of this rotation will be achieved primarily by teaching using the case method. All procedures will be under the direct supervision of full-time faculty. All cases will be reviewed in an informal daily teaching conference. Fellow will also be directly supervised in the post-procedural care of patient under going interventional procedures by the full time faculty. There is also a weekly formal Cardiac Catheterization Conference attended by all division personnel and each month this conference is combined with Cardiothoracic Surgery or Vascular Surgery/Radiology for additional insights into vascular pathophysiology. Interventional fellows will be able to attend and participate in additional conferences offered by the General Cardiology unit including a weekly Journal Club and a weekly basic science conference.

## **General Statement of Expectations of Fellows**

The fellowship will consist of two year and time spent under direct supervision in the cardiovascular laboratories performing diagnostic and interventional procedures, as well as time spent in the clinic evaluating patients, and protected time doing independent research. All rotations will take place at Strong Memorial Hospital. At the end of the first year the fellow will have completed the ACGME requirements for training in interventional cardiology.

Each fellow will also be responsible for the care of patients while in hospital that have undergone these procedures. The full time faculty will supervise this care. The fellows will also be responsible for evaluating patients who return to the clinic or emergency room for complications. The independent research will be under the direction of a research committee consisting of the full-time invasive cardiology faculty with the goal to produce meaningful information acceptable for publication. The on call responsibilities are expected to average 1-2 night a week and 1-2 weekends a month. Each fellow is expected to do at least 300-350 coronary interventions during the fellowship.

## PROGRAMME GOALS

- Understand the pathophysiology of acute and chronic ischemic heart disease, valvular heart disease and peripheral vascular disease **(Medical Knowledge)**
- Understand the indications and contraindications of interventional procedures**(Medical Knowledge)**
- Appreciate the effectiveness and limitations of interventional procedures **(Medical Knowledge)**
- Learn predictors, recognize and manage interventional complications **(PBLI & Medical Knowledge)**
- Recognize and value the different modalities of treatment including medical therapy and surgical revascularization **(Systems-Based Practice & Medical Knowledge)**
- Understand and apply the latest methods of heart disease prevention **(Patient Care & Medical Knowledge)**
- Learn and apply the clinical and technical aspects of interventional procedures in compliance with the highest standards of care that emphasize the importance of humanistic qualities **(Patient Care, Interpersonal/Communication Skills & Professionalism)**
- Cultivate and maintain a quality approach to patient care based on critical thinking, compassion and dedication **(Patient Care)**
- Promote scholarly research **(PBLI)**
- Foster excellence in teaching **(PBLI)**

## PROGRAMME OBJECTIVES

- Upon completion of the interventional cardiology training program, interventional cardiology fellows are expected to:
- Be clinically experienced in the diagnosis and management of patients with acute and chronic ischemic heart disease and valvular disease **(Medical Knowledge)**
- Have developed an understanding of the indications and contraindications of coronary and peripheral interventions, and have a comprehensive understanding of the different modalities of revascularization and medical alternatives **(Medical Knowledge)**
- Have acquired knowledge to develop the decision-making process that leads to the selection of medical therapy versus coronary revascularization **(Medical Knowledge)**

- Have developed a clear understanding of coronary physiology, plaque morphology and composition, plaque vulnerability, lesion characterization and plaque response to intervention **(Medical Knowledge)**
- Have developed sufficient competency to practice interventional procedures without direct supervision **(Medical Knowledge)**
- Be able to recognize and manage procedure-related complications **(Medical Knowledge)**
- Have acquired knowledge in post-procedure management of bleeding; groin complications; acute vessel closure; etc., and in patient education, including risk factor modification and discharge planning **(Medical Knowledge, PBLI and Systems-Based Practice)**
- Have acquired the skills needed for the completion and interpretation of angiograms, hemodynamics, intravascular ultrasound, doppler, coronary flow reserve and pressure measurement **(Medical Knowledge)**
- Comprehend and have acquired experience in cardiovascular pharmacology **(Medical Knowledge)**
- Have learned femoral, brachial/radial cannulation for coronary and peripheral interventions **(Medical Knowledge)**
- Be able to recognize and manage all aspects of mechanical and ischemic complications **(Medical Knowledge)**
- Have acquired the necessary skills that are needed to manage acute hemodynamic resuscitation including use of vasoactive agents, use of antiarrhythmic drugs, use of thrombolytic agents, CPR, advanced life support, pericardiocentesis, intra-aortic balloon pump **(Medical Knowledge)**

## **RATIONALE & AIMS OF THIS CURRICULUM**

The intention of this curriculum is to identify an educational process for specialists in interventional cardiology.

Completion of a formal, two-year programme training must include:

- Cardiovascular anatomy and physiology
- Vascular biology and pathology
- Pathophysiology (with clinical applications: intracoronary imaging, QCA...)
- Pharmacology (including anti-thrombotic and thrombolytic therapy, Contrast agents)
- Radiology imaging and safe use of radiation
- Patient selection, indications, and limitations
- Interventional device design and performance
- Clinical management and strategy, pre- and post procedure

Completion of the training programmes will deliver international credibility and professional legitimacy to the candidate. Acquired knowledge and skills should be maintained by accredited continuing medical education (CME) activities.

## **Learning objectives for the subspecialty of interventional cardiology**

a. Appropriately select patients for percutaneous coronary revascularisation and identify the optimal timing for the procedure, applying evidence based medicine and current guidelines to the individual patient needs and characteristics, with optimal and cost-effective use of the available resources.

b. Be able to understand, explain and discuss the individual options of medical, percutaneous or surgical treatment with patients, patient relatives, referring physicians, other cardiologists, cardiac surgeons.

c. Acquire the theoretical knowledge and practical skills to perform coronary angioplasty procedures in adults as an independent primary operator.

d. Plan pre-procedural, intra procedural and post procedural patient management with particular emphasis on adjunctive pharmacological treatment, selection of vascular access, control of haemostasis and prevention of bleeding complications, prevention of allergic reactions and renal insufficiency.

e. Identify the optimal strategy of interventional treatment including device and technique selection, development of alternative plans in case of failure of the initially chosen approach, and handling of unexpected complications.

f. Plan long- term clinical follow up including secondary prevention and pharmacological treatment.

### **3.2. Learning methods**

#### **3.2.1. Apprenticeship learning**

Apprenticeship learning is the mainstay of the training process in interventional cardiology. Candidates will be required to be involved in procedure planning, assessment of indications and contraindications, specific establishment of the individual patient risks based on clinical and angiographic characteristics.

The trainee should:

1. Handle patient admission to the ward, obtain informed consent, prescribe pre-procedure drug therapy, and organise appropriate Non-invasive testing.



2. Perform supervised angioplasty procedures with progressive increase in the level of involvement based on incremental operator experience and case complexity. The trainee must discuss the procedure with his/her educational supervisor, who will also ensure appropriate tutorship in the catheterisation laboratory.
3. The trainee must be involved in post procedural management including timely preparation of the report, monitoring of the patient's status with special attention to the complications at the catheter entry site, heart and renal failure, bleeding and recurrent myocardial ischemia. The trainee should participate in the selection of the pharmacological treatment before, during and after the procedure based on established protocols and after discussion with the supervisor.
4. The trainee must participate in the cardiology night and weekend on-call with the aim to optimise exposure to acute interventional treatment in the setting of acute myocardial infarction and other emergency cardiology conditions.
5. Every trainee must be exposed to techniques of intravascular imaging and functional assessment of lesion severity (intravascular ultrasound, intra coronary pressure measurement).

## **ELIGIBILITY CRITERIA FOR ADMISSIONS TO THE PROGRAMME**

### **(A) FNB Interventional Cardiology Course:**

1. Any medical graduate with ***DNB/DM (Cardiology)*** qualification , who has qualified the ***Entrance Examination*** conducted by NBE and fulfill the eligibility criteria for admission to FNB courses at various NBE accredited Medical Colleges/ institutions/Hospitals in India is eligible to participate in the Centralized counseling for allocation of FNB Interventional Cardiology seats purely on merit cum choice basis.
2. Admission to 2 years FNB Interventional Cardiology course is only through ***Entrance Examination*** conducted by NBE and Centralized Merit Based Counseling conducted by National Board of Examination as per prescribed guidelines.

### **Duration of Course: 2 Years**

Every candidate admitted to the training programme shall pursue a regular course of study (on whole time basis) in the concerned recognized institution under the guidance of recognized post graduate teacher for assigned period of the course.

## TEACHING AND TRAINING ACTIVITIES

The fundamental components of the teaching programme should include:

1. Case presentations & discussion- once a week
2. Seminar – Once a week
3. Journal club- Once a week
4. Grand round presentation (by rotation departments and subspecialties)- once a week
5. Faculty lecture teaching- once a month
6. Clinical Audit-Once a Month
7. A poster and have one oral presentation at least once during their training period in a recognized conference.

The rounds should include bedside sessions, file rounds & documentation of case history and examination, progress notes, round discussions, investigations and management plan) interesting and difficult case unit discussions.

The training program would focus on knowledge, skills and attitudes (behavior), all essential components of education. It is being divided into theoretical, clinical and practical in all aspects of the delivery of the rehabilitative care, including methodology of research and teaching.

**Theoretical:** The theoretical knowledge would be imparted to the candidates through discussions, journal clubs, symposia and seminars. The students are exposed to recent advances through discussions in journal clubs. These are considered necessary in view of an inadequate exposure to the subject in the undergraduate curriculum.

**Symposia:** Trainees would be required to present a minimum of 20 topics based on the curriculum in a period of two years to the combined class of teachers and

students. A free discussion would be encouraged in these symposia. The topics of the symposia would be given to the trainees with the dates for presentation.

**Clinical:** The trainee would be attached to a faculty member to be able to pick up methods of history taking, examination, prescription writing and management in rehabilitation practice.

**Bedside:** The trainee would work up cases, learn management of cases by discussion with faculty of the department.

**Journal Clubs:** This would be a weekly academic exercise. A list of suggested Journals is given towards the end of this document. The candidate would summarize and discuss the scientific article critically. A faculty member will suggest the article and moderate the discussion, with participation by other faculty members and resident doctors. The contributions made by the article in furtherance of the scientific knowledge and limitations, if any, will be highlighted.

**Research:** The student would carry out the research project and write a thesis/ dissertation in accordance with NBE guidelines. He/ she would also be given exposure to partake in the research projects going on in the departments to learn their planning, methodology and execution so as to learn various aspects of research.

# SYLLABUS

## Specific Programme Content

### 1. Basic Science

**a. Anatomy and physiology:** cardiac, vascular and coronary artery anatomy, including anatomical variants and frequent congenital abnormalities; basic circulatory physiology, myocardial blood flow regulation, myocardial physiology and metabolism.

**b. Vascular biology,** including the processes of vasoreactivity, plaque formation, vascular injury and healing, restenosis, SVG atherosclerosis, cardiac allograft vasculopathy.

**c. Function of progenitor cells** and their possible role in angiogenesis and myogenesis.

**d. Haematology,** including platelet function and aggregation, clotting cascade, and fibrinolysis.

**e. Coronary anatomy and physiology,** including

- Classification of coronary segments and lesion characteristics;
- Assessment of lesion severity, intracoronary pressure and flow velocity measurement, fractional flow reserve (FFR);
- Assessment of collateral circulation.

### 2. Pharmacology

a. Biologic effects and appropriate use of vasoactive drugs, antiplatelet agents, thrombolytics, anticoagulants, antiarrhythmics, inotropic agents, and sedatives.

b. Biologic effects and appropriate use of angiographic contrast agents, including prevention of renal dysfunction and allergic reactions.

c. Atherosclerosis prevention in PCI candidates focusing on optimal care of hypertension, dyslipidemia, diabetes and smoking cessation.

### 3. Imaging

**a. Radiation physics, radiation risks and injury, and radiation safety,** including glossary of radiological terms, methods to control radiation exposure for patients, physicians, and technicians.

**b. Specific imaging techniques in interventional cardiology**, such as quantitative angiography and intravascular ultrasonography.

**c. Principles of cardiac computed tomography**, potential role for non-invasive coronary imaging.

**d. Digital archiving and tele-communication** of angiographic images.

#### **4. Indications for treatment and patient selection**

a. Indications for elective cardiac catheterisation and related catheter-based interventions in management of ischaemic and valvular heart disease, in accordance with the ESC guidelines and evidence based medicine.

b. Indications for urgent catheterisation and management of acute myocardial infarction, including differentiation between patients who require primary or rescue angioplasty, coronary bypass surgery or conservative treatment.

c. Indications for mechanical support devices in the management of haemodynamically compromised patients (intra-aortic balloon pump etc.)

d. Present indications for surgical re-vascularisation in coronary artery disease

#### **5. Procedural Techniques**

a. Vascular access including principles of femoral, radial, and brachial procedures, closure techniques, detection and treatment of complications.

b. Appropriate catheter selection to achieve optimal opacification and support.

c. Selection of optimal projections for lesion visualisation and treatment.

d. Knowledge of angioplasty material and proper selection of guidewires, balloon catheters, and stents.

e. Knowledge of types and characteristics of bare metal and drug-eluting stents including post-implantation pharmacological treatment and their risk of thrombosis and restenosis.

f. Classification, mechanisms, and therapy of in-stent restenosis.

g. Knowledge of ancillary interventional techniques, including

- Therapeutic: anti-embolic protection with filters and occlusive balloons, rotablator, laser, atherectomy and thrombectomy devices.
- Diagnostic: intravascular ultrasound, Doppler and intracoronary pressure measurement

h. Indications for mitral, aortic, and pulmonary valvuloplasty in management of valvular disorders, including factors that differentiate patients who require surgical commissurotomy or valve repair or replacement.

i. Indication for catheter-based interventions in management of congenital heart disease in adults, such as closure of intracardiac defects (ASD, PFO, VSD, PDA).

j. Indications for septal alcoholisation in obstructive hypertrophic cardiomyopathy

## **6. Management of complications of percutaneous intervention**

a. Mechanical complications, such as coronary dissection, spasm, perforation, "slow/ no reflow", cardiogenic shock, left main trunk dissection, cardiac tamponade including pericardiocentesis, peripheral vessel occlusion, and retained components.

b. Thrombotic and haemorrhagic complications associated with percutaneous intervention or drugs.

## **7. Miscellaneous**

a. Peripheral angiography and angioplasty including essential radiological anatomy, indications and principles of carotid, subclavian, renal and iliac stenting.

b. Ethical issues and risks associated with diagnostic and therapeutic techniques.

c. Statistics, epidemiologic data, and economic issues related to interventional procedures.

## **Section I. Patient selection for catheter based interventions**

### **I) Indications**

- A) Symptomatic relief
  - 1) Chronic stable angina not controlled by acceptable medical therapy.
  - 2) Unstable angina persisting on medical therapy.
  - 3) To improve functional capacity.
  - 4) To improve quality of life (i.e. side effects of medication).
  
- B) Prognostic Benefit
  - 1) Improved survival (no documentation of this is available)
    - (a) BARI shows similar mortality for high risk subsets shown to benefit by surgery
  - 2) Relief of ischemic burden, both for symptomatic and silent ischemia
    - (a) Assumes reduction of ischemic myocardial damage
  - 3) Prevention of myocardial damage (i.e. acute MI, PTCA)
  - 4) Life saving (i.e. cardiogenic shock).
  - 5) Reduce risk of non-cardiac surgery.

### **II) Contraindications**

- A) Absolute
  - 1) No significant obstruction.
  - 2) Unprotected left main disease in patients who are candidates for bypass surgery.
  
- B) Relative
  - 1) Coagulopathy/bleeding diathesis.
  - 2) Diffuse disease.
  - 3) Non-infarct related artery during acute MI intervention.
  - 4) Co-morbid conditions (i.e. diabetes with renal impairment, short life expectancy etc.)

### **III) Risk versus benefit assessment**

- A) Patient specific
  - 1) age
  - 2) weight
  - 3) gender
  - 4) ventricular function
  - 5) amount of myocardium subtended by index vessel
  - 6) consequences of abrupt closure



- 7) assessment of status of collaterals supplying index territory
  - 8) assessment of collaterals supplied by index vessel
  - 9) Number of vessels diseased.
  - 10) Complete versus incomplete revascularization.
  - 11) previous CABG
    - (a) Risk of re-operation versus PTCA
  - 12) Peripheral vascular disease and access problems.
  - 13) restenosis potential with possible need for repeat procedure
- B) Lesion specific
- 1) Thrombus score (i.e. recent thrombolysis, recent occlusion).
  - 2) Total occlusion (i.e. recent, chronic, and viability of myocardium distal to occlusion.)
  - 3) Characteristics of type A, B and C lesions [2]
  - 4) Applicability advantages and risks of non-balloon devices.

## **Section II. Strategy for Percutaneous Intervention**

### **Introduction**

In addition to recognizing the general indications and contraindications for intervention, the trainee should be able to plan a strategy for the procedure. This plan should encompass both patient, anatomic, and technical issues and include potential approaches to anticipated problems.

### ***1) Pre-procedural - Considerations***

- A) Age
- B) Left Ventricular Function
- C) Prior MI
- D) Co-morbidity
- E) Peripheral Vascular Disease
- F) Associated Valve disease (i.e. Aortic Insufficiency is a contraindication for IABP assist)
- G) Revascularization goal
  - 1) "Culprit"
  - 2) Complete
- H) Direct MI
- I) Acute MI
- J) Cost

K) Informed Consent

## **II) Pre-procedural - Anatomic- Angio Review**

- A) Is there a need for additional views
- B) Are the diagnostic views adequate?
- C) Role of surgeon/support
  - 1) Back-up
  - 2) Surgical standby
  - 3) Degenerated Vein graft
  - 4) Native vessel in prior CABG pt
  - 5) Cardio-Pulmonary Support

## **III) Approach due to Coronary Anatomy / Technical**

- A) Calcified Vessels
- B) Fibroelastic lesion
- C) Bifurcation Lesion
  - 1) Kissing balloons
  - 2) Bifurcation Stenting
  - 3) Atherectomy
- D) Eccentric lesion
- E) Tapered lesion
- F) Ostial lesions
- G) Hypertensive Heart Disease (tortuous vessels)
- H) Chronic Total Occlusion
- I) Post MI patient
- J) Left Dominant
- K) Right Dominant
- L) Multivessel Disease
- M) Reduced Left Ventricular Systolic Function
- N) Degenerated Vein Graft
- O) Discrete focal vs. Diffuse Disease
- P) Anomalous Coronary
- Q) Shepherd's Crook Right Coronary
- R) Intracoronary Thrombus
- S) Difficulties with two monorail catheters
  - 1) Wire coiling
- T) Use of wire and balloon to crack hard lesions

## **IV) Difficulties with patient vascular anatomy**

- A) Tortuous Aorta
- B) Peripheral Vascular Disease
- C) Vascular Access
  - 1) Peripheral Vascular Disease (brachial, axillary, radial approach)

- 2) Femoral arterial and venous anatomy
  - (a) Malposition of stick
  - (b) When to use venous access
    - (i) Temp. pacemaker anticipated
- 3) Special guide wires
  - (a) Subintimal risk
  - (b) Glide Wire™
  - (c) Wholey wire™
  - (d) TAD™ wire
- 4) Pigtail and guide wire to negotiate difficult peripheral anatomy

## **V) Importance of Informed Consent**

- A) Family member meetings
- B) Problems with combined diagnostic/interventional procedures

## **VI) In-Lab Technology**

- A) Sheaths
  - 1) Long vs. short
  - 2) Calcified vessels/hard rubber
  - 3) Progressive dilatation
  - 4) Oversized dilation for smaller sheath
  
- B) Guide Catheters
  - 1) Torquability
  - 2) Support
  - 3) Coaxiality
    - (a) Importance of coaxial positioning
  - 4) 6,7,8, 9,10 Fr
    - (a) Increase support by increase Fr. Size
    - (b) Inner and outer diameters
      - (i) Expectations for devices
  - 5) Side Holes
  - 6) Special Curves/anatomy
    - (a) Voda/Amplatz
    - (b) Shorten JL curve for selective LAD
    - (c) Lengthen JL curve for selective LCX
    - (d) Amplatz Left for R-shepherd's crook
    - (e) Amplatz Left for anomalous RCA
    - (f) Left "Back-Up", i.e. XB and EBU
    - (g) Radial access specific guides
  
- C) Wires
  - 1) Curves

- 2) Tip configuration
  - (a) Floppy
  - (b) Intermediate
  - (c) Standard
- 3) Construction
  - (a) Transitionless wire
  - (b) "Extra support"
  - (c) Coated
- 4) Special Use Wires
  - (a) Rotablator
  - (b) Nitinol
  - (c) Cross-it
  - (d) Crosswire
  - (e) TEC wire

#### D) Balloons

- 1) Monorail
- 2) Over-the-wire
- 3) Convertible
- 4) On-the-wire
- 5) Perfusion
- 6) Performance Profiles
  - (a) Material
    - (i) Compliant
    - (ii) Non-compliant
  - (b) Profile
  - (c) Guide wire requirement
- (7) Peripheral balloons for coronary use

#### (E) Exchange Devices

- 1) Trapper
  - (a) Performs differently in larger guides (10 Fr)
- 2) DOC
- 3) Transfer Catheters
- 4) Convertible
- 5) Magnet

#### (F) Infusion Systems

- 1) Dispatch (local drug delivery)
- 2) Target Infusion Catheters, multiple sideholes, end-hole only
- 3) Dorros infusion catheter vs. End-hole for gradient measurement
- 4) Infusion wires
  - (a) Sos,
  - (b) Cragg

- G) Gradient Measurement
  - 1) Devices
    - (a) end-hole catheter
    - (b) Fluid filled wire
    - (c) Micromanometer tip wire
    - (d) Larger balloons
    - (e) Pressure wire
    - (f) Doppler wire
  - 2) Approach
    - (a) Intrinsic gradient
    - (b) Post stenotic gradient
  
- H) When to use rarely used equipment
  - 1) 0.063" wire
    - (a) Reduces bleeding in large guides
    - (b) straightens guides which bend
  
- I) Technical Difficulties
  - 1) Shepherd's Crook
  - 2) Tortuous Aorta
  - 3) Tortuous Iliac
  - 4) Hyperacute angle of LCX off LMCA
  
- J) Retrieval Techniques
  - 1) Microvena® Amplatz Goose Neck snares
  - 2) Basket
  - 3) Long wires folded
  - 4) Cook Retrieval System
  - 5) Pacemaker lead extraction
  - 6) Trap with balloon
  
- k) Devices
  - 1) Stent
  - 2) Directional Atherectomy
  - 3) Transluminal Extraction Catheter
  - 4) Excimer Laser
  - 5) Rotational Atherectomy
  - 6) Total Occlusion - Laser wire (0.018)
  - 7) Balloons
  - 8) Cutting Balloon
  
- L) Distal Protection Devices
  - 1) Percusurge
  
- M) Vascular Brachytherapy
  - 1) Novoste System

## 2) Cordis System

### VII) In lab management

- A) In Lab Pharmacology
  - 1) Intracoronary medications
  - 2) Intravenous medications
  - 3) Intravenous conscious sedation
  - 4) Heparin/ACT's
    - (a) Low molecular weight heparin
  - 5) No Reflow Rx
  - 6) Contrast : ionic vs. Nonionic
  - 7) Vasoactive cocktail for atherectomy
  - 8) Gp IIB/IIIA receptor antagonists
  - 9) Antithrombin Agents
  
- B) In Lab Phenomena
  - 1) Ischemic Preconditioning
  - 2) ECG changes
  - 3) Angina
  - 4) Ischemic MR/ LCX
  - 5) RV dysfunction
  - 6) No Reflow phenomenon
  
- C) Complications
  - 1) Dissection
  - 2) VT/VF
  - 3) Threatened Closure
  - 4) Acute Closure
  - 5) No Reflow
  - 6) Intracoronary Thrombus
  - 7) Perforation/Tamponade
    - (a) Perforation risk increases
      - (i) Rotablator
      - (ii) Laser
      - (iii) Directional Atherectomy with GTO Device
    - (b) Treatment
      - (i) Use of coils
      - (ii) Covered stents
  
- D) Anticoagulation Strategy
  - 1) Heparin
  - 2) Different techniques to ascertain ACT
  - 3) IIb/IIIa inhibitors
  - 4) Other Antiplatelet agents
    - (a) Aspirin

- (b) Ticlopidine
- (c) Clopidigrel
- 5) Anti-thrombin agents

### **VIII) Post procedure management/strategy**

- A) Anticoagulation Management
  - 1) Timing
    - (d) Sheath pulling
    - (e) Closure devices
  - 2) Peripheral Vascular Disease

### **IX) Lesion Assessment**

- A) IVUS
- B) Doppler wire
- C) Pressure Wire
- D) QCA
  - i. Definitions
    - 1. MLD
    - 2. Acute Gain/ Late Loss/ Loss Index
- E) Recoil
- F) Remodeling

## **Section III. Major Clinical Trials**

### **Introduction**

There have been clinical trials that have been critical in changing our understanding of the treatment of coronary artery disease. Although the emphasis here is on multi-center trials because of the size and statistical strength of these studies, some single center trials have also been included because of their importance to furthering our understanding. This list is not intended to be exhaustive but to provide the trainee with a core of literature important to this field.

### **Acute Myocardial Infarction**

- A) Primary Angioplasty in Myocardial Infarction Trial (PAMI)
- B) Global Utilization of Strategies to Open occluded Arteries (GUSTO)
- C) Thrombolysis and Angioplasty in Myocardial Infarction (TAMI)
- D) Thrombolysis in Myocardial Infarction (TIMI)

E) Should we Intervene Following Thrombolysis (SWIFT)

### ***Unstable Angina Pectoris***

A) Thrombolysis and Angioplasty in Unstable Angina (TAUSA)

### ***Revascularization vs. Medical Therapy***

- A) Coronary Artery Surgery Study (CASS)
- B) Angioplasty Compared to Medicine (ACME)
- C) Asymptomatic Cardiac Ischemia Pilot Trial (ACIP)

### ***PTCA vs. Coronary Artery Bypass Surgery***

- A) Randomized Intervention Treatment of Angina (RITA)
- B) German Angioplasty Bypass Intervention Trial (GABI)
- C) Coronary Angioplasty versus Bypass Revascularization Investigation (CABRI)
- D) Bypass Angioplasty Revascularization Investigation (BARI)
- E) Emory Angioplasty Surgery Trial (EAST)

### ***Angioplasty vs. Other interventional Devices***

- A) Coronary Atherectomy versus Angioplasty (CAVEAT)
- B) Balloon versus Optimal Angioplasty Trial (BOAT)
- C) Belgian Netherlands Stent Study (BENESTENT)
- D) Stent Restenosis Study (STRESS)
- E) Excimer Laser vs. balloon angioplasty (ERBAC)
- F) Amsterdam Rotterdam Trial (AMRO)

### ***Adjunctive Pharmacological Therapy with Anti-Platelet Agents***

- A) Evaluation of IIb/IIIa platelet receptor antagonist 7E3 in Preventing Ischemic Complications (EPIC)
- B) Evaluation of PTCA to Improve Long-term Outcome by c7E3 GPIIb/IIIa receptor blockade (EPILOG)
- C) Chimeric 7E3 Antiplatelet in Unstable Angina Refractory to standard treatment (CAPTURE)
- D) Randomized Efficacy Study of Tirofiban for Outcomes and Restenosis (RESTORE)



- E) Integrilin to Minimize Platelet Aggregation and Preventing Coronary Thrombosis (IMPACT II)
- F) Stent Antithrombotic Regimen Study (STARS)

### ***Intracoronary Doppler/Ultrasound***

- A) Doppler Endpoints Balloon Angioplasty Trial Europe (DEBATE)
- B) Function Angiometric Correlation with Thallium Scintigraphy Trial (FACTS)
- C) Doppler Endpoint Stenting International Investigation-Coronary Flow Reserve (DESTINI-CFR)
- D) Core Laboratory Ultrasound analysis study (CLOUT)
- E) Serial Ultrasound analysis of Restenosis trial (SURE)

### **Vascular Brachytherapy Trials**

- Multicentered Randomized Trial of Localized Radiation Therapy to Inhibit Restenosis After Stenting (GAMMA I)
- Sr Treatment of Angiographic Restenosis ( START)
- Beta Radiation After Denovo Coronary Angioplasty or Stenting (BETA-CATH)

### **Distal Embolization Trials**

- A) Saphenous Vein Graft Angioplasty Free of Emboli Randomized trial (SAFER)

## **Section IV. Hematology:**

### **Introduction**

Both bleeding and clotting are important parameters that must be regularly dealt with in patients undergoing interventional procedures. It is necessary for the fellow, therefore to understand the mechanisms that are operational in this setting as well as the role of therapeutic agents in modifying the risks and benefits of the procedures. [3-13]

### **I) Role of platelets in atherogenesis and acute coronary syndromes**

- A) Vessel Injury
  - 1) Degree of injury
    - (a) Functional alterations without morphologic changes
    - (b) Endothelial denudation and intimal injury

- (c) Deep injury involving intima and media
- 2) Vascular Response
  - (a) Lipid accumulation
  - (b) Monocyte adhesion
  - (c) Platelet deposition
  - (d) Thrombosis
  - (e) Smooth muscle cell proliferation
- B) Platelet Function
  - 1) Platelet Adhesion
    - (a) Platelet membrane receptors (GP IIb/IIIa)
    - (b) Adhesive glycoproteins
    - (c) Collagen substrate
    - (d) von Willebrand factor
  - 2) Mitogens
    - (i) Platelet derived growth factor (PDGF)
    - (ii) Epidermal growth factor (EGF)
    - (iii) Transforming growth factor-beta (TGF-B)
  - 3) Platelet Aggregation
    - (a) Platelet activation
      - (i) Agonists
        - a) Collagen
        - b) Thrombin
        - c) Epinephrine
        - d) Thromboxane A2
      - (ii) Platelet activation pathways
        - a) ADP and serotonin dependent
        - b) Thromboxane A2
        - c) Cyclooxygenase
        - d) Collagen and thrombin
    - (b) Platelet binding
      - (i) GP IIb/IIIa
      - (ii) Fibrinogen binding
      - (iii) von Willebrand factor
      - (iv) Fibronectin
      - (v) GP IIb/IIIa receptor
      - (vi) Rheologic factors
        - a) High shear rate
        - b) Turbulence
  - 4) Platelet activation leading to coagulation and thrombus formation
    - (a) Vessel injury
    - (b) Shear stress
    - (c) Platelet activation

(d) Activation of intrinsic and extrinsic coagulation pathways

### **C) Pharmacology of Platelet-Inhibitor Agents**

- 1) Aspirin
- 2) Dipyridamole
- 3) Sulfipyrazone
- 4) Ticlopidine
- 5) Clopidogrel
- 6) Dextran
- 7) Thromboxane inhibitors
  
- 8) Serotonin inhibitors
- 9) Prostacyclin
- 10) Selective thrombin inhibitors
- 11) GP IIb/IIIa inhibitors
- 12) Arg-Gly-Asp sequence blockers

### **D) Role of anti-platelet agents in coronary intervention**

- 1) Preventing acute complications of interventions
  - (a) Aspirin
  - (b) Aspirin plus Dipyridamole
  - (c) Ticlopidine
  - (d) GP IIb/IIIa inhibitors
- 2) Reducing restenosis
  - (a) GP IIb/IIIa inhibitors

## **Coagulation**

### Extrinsic system

- Initiated by tissue thromboplastin released by tissue injury
- Tissue thromboplastin plus factor VII converts X to Xa
- Coagulation within seconds
- Calcium dependent

### Intrinsic system

- Factor XII binds to negatively charged surface to initiate coagulation cascade
- Requires kininogen, prekallikrein, factors V and VIII, thrombomodulin, protein C and protein S, phospholipid and calcium.
- Coagulation within minutes

## Endogenous coagulation inhibitors

- Antithrombin III
- Protein S
- Protein C
- Antithrombin II
- Tissue factor pathway inhibitor
- Adenosine diphosphatase
- Nitrous oxide
- Prostacyclin
- Alpha1 antitrypsin
- Alpha2 macroglobulin
- Antithrombotic medication
- Oral anticoagulants
- Biological properties
  - Inhibit vitamin K epoxide reductase activity of liver
  - Inhibits factors II, VII, IX, X, proteins C and S
- Clinical pharmacology
  - Drug interactions
  - Indications
  - Complications and side effects

## Heparin

- Biological properties
  - Anticoagulant
  - Antiplatelet
  - Endothelial Function
  - Other
- Clinical pharmacology
  - Drug interactions
  - Indications
  - Complications and side effects

## Low molecular weight heparin

- Biological properties
  - Anticoagulant
  - Antiplatelet
  - Endothelial Function
  - Other
- Clinical pharmacology
  - Drug interactions
  - Indications
  - Complications and side effects

## Hirudin and other peptides

- Biological properties
  - Direct action
  - Selectively blocks thrombin without platelet or endothelial function
- Clinical pharmacology
  - Drug interactions
  - Indications
  - Complications and side effects

#### Monitoring anticoagulation

- Detection of hypercoagulable state
- Monitoring heparin therapy
  - a) aPTT
  - b) ACT
- Monitoring Coumadin therapy
  - a) PT
  - b) INR

#### Thrombolytics

- Agents
  - Streptokinase
  - Urokinase
  - t-PA/r-PA/TNK
  - APSAC
- Biological properties
  - Clinical pharmacology
  - Drug interactions
  - Indications
  - Complications and side effects

## **Section V. Molecular biology and other related topics**

### ***Introduction***

Although molecular biology is relatively new to clinical cardiology it is likely that agents will be available for use in the foreseeable future. Although the specifics may change, a basic understanding of the concepts related to molecular biology is important for the trainee in order for them to interpret the current and future activities in this area.

### **Molecular Biology for the Interventionist**

- A) Nucleic acid and protein synthesis
  - 1) Cellular architecture

- 2) DNA
- 3) DNA function
- 4) Protein synthesis
- B) Gene expression and regulation
- C) Molecular genetics
  - 1) Reverse genetics
  - 2) Anti-sense genes
  - 3) Vectors for delivery
  - 4) Growth Factors

### **Free Radical Scavengers**

- D) Sources
- E) Biochemistry
- F) Effects on cardiac tissue
- G) Antioxidants

### **Leukocytes**

- H) Mechanism of neutrophil injury
- I) Neutrophil inhibition
- J) Leukocyte induced injury mediators

### **Growth Factors and Cytokines**

- K) Platelet factors
- L) Platelet derived growth factor A and B
- M) Transforming growth factors
- N) Fibroblast growth factors
- O) Angiotensin II
- P) Interleukins
- Q) Insulin like growth factors

## **Section VI. Alternative imaging modalities:**

### **Introduction**

Although angiography has traditionally been considered the gold standard for assessing lesions, it is clear that other technologies are important adjuncts for assessing vessel and lesions characteristics. It is important that the fellow has an understanding of these techniques and how they may be applied in interventional and diagnostic procedures.

### **I) Intravascular ultrasound (IVUS):**

A) Instrument

1. Settings
2. Sterile Bags for equipment on the field
3. Catheter preparation, selection
4. Handling of videotapes
5. Troubleshooting

B) Performance:

1. Guiding catheter selection
  - a. Must have internal diameter compatibility
2. Heparinization protocol
3. Wire selection
4. Intracoronary/Intravenous nitroglycerin administration

C) Imaging Protocol

1. Uniform protocol
  - a. Place Imaging catheter beyond the target lesion
  - b. Set videotape to record
  - c. Activated automatic transducer pullback
  - d. Continue imaging until transducer reaches the aorto-ostial junction.
2. On-screen and audio annotation
3. Off-line measurements

D) Qualitative Interpretation of IVUS images:

1. Basics:
  - a. Reflection from different tissues
    - I. Calcified plaque
    - II. Fibrous plaque
    - III. Fatty plaque
    - IV. Blood
    - V. Thrombus
  - b. Catheter position relative to plaque or vessel
  - c. Orientation of the images (axial vs. rotational)
2. Appearance of normal coronary arteries
  - a. Layers
    - I. Intima
    - II. media-adventitia border
3. Appearance of diseased vessels
  - a. Early plaque
  - b. Mild to moderate disease vs. severe disease
  - c. Calcification
  - d. Concentricity
  - e. Eccentricity

#### 4. Unusual Lesions

#### E) Quantitative Analysis of IVUS images:

1. On-line/Off-line measurements
  - a. Calibration
  - b. Measurement and Analysis in real time
  - c. Measurement and Analysis from tape
2. Choosing sites for measurement
  - a. Reference segment (within 10mm of target lesion)
  - b. Target lesion (smallest diameter lumen)
3. Typical IVUS measurements
  - a. Minimum lumen diameter (MLD)
  - b. Lumen cross-sectional area (CSA)
  - c. External elastic lamina CSA
  - d. Percent luminal diameter (or area) stenosis
  - e. Plaque Cross sectional area
  - f. Percent Cross sectional narrowing (plaque burden, plaque volume))
  - g. Arc of deep and superficial calcium

### **II) IVUS in the Context of Interventional Procedures:**

#### A) Need for Intervention

#### B) Endpoints

#### C) Balloon Angioplasty (PTCA):

1. Mechanism of balloon coronary angioplasty
2. Pre-PTCA Imaging
  - a. Plaque composition and topography
  - b. Balloon sizing by IVUS
    - I. Mid-wall at reference site
    - II. Media-to-media at the lesion site
  - c. Plaque composition and balloon selection
  - d. Severity of intermediate and ambiguous lesions
3. Post-PTCA procedural endpoints- quantitative results
  - a. Mechanism
  - b. Dissections post PTCA
  - c. Need for adjunct PTCA
  - d. Need for adjunct Stenting

#### D) Directional Atherectomy (DCA):

1. Vessel and lesion characteristics for safety margin for DCA



2. Device sizing
    - a. Reference vessel size
  3. Exclusion of unsafe lesions
    - a. Calcified lesions
  4. IVUS guided DCA
  5. Optimizing the use of DCA
- E) Rotational Atherectomy (RA):
1. Mechanism of RA
  2. Image interpretation in calcified vessels
    - a. Extent of calcification
  3. IVUS guided burr sizing
  4. Need for adjunct devices
    - a. Stent
    - b. Balloon
- F) Stents:
1. Stent sizing
  2. Expansion
  3. Apposition
  4. Dissections
  5. Symmetry
  6. Stent cross sectional area (CSA)
  7. In-stent neointima

### **III) Doppler Velocity Flowwire:**

- A) Basic concepts:
1. Coronary flow physiology in normal vessels
  2. Factors influencing coronary flow
  3. Doppler catheters and wires
    - a. 0.018" or 0.014" wires
  4. Features of proper signal
  5. Adenosine administration and dosing
  6. Guiding catheter choice
    - a. Implication of side holes for dose of agent
    - b. Implication of side holes for vessel occlusion
- B) Coronary flow velocity signals
1. Establishment of acceptable baseline flow pattern
  2. Patterns in normal coronary arteries
  3. Patterns in significantly stenosed coronary arteries
  4. Coronary flow reserve
- C) Clinical Utility

1. Assessment of intermediate lesions
2. Alteration of coronary flow
  - a. After PTCA
  - b. After Stenting,
  - c. After atheroablation
3. Coronary flow monitoring during interventions
4. Assessment of collateral flow
5. Comparative utility of Doppler wire and IVUS

#### **IV) PRESSURE WIRE:**

##### A) Basics

1. Trans-lesion gradient
  - a. Femoral pressure
  - b. Central aortic pressure
2. Distal coronary pressure
3. Adenosine administration and dosing
4. Guiding catheter choices

##### B) Pressure measurements

1. Baseline
2. Hyperemia
3. Atrial pacing
4. Pharmacologic agents:
  - a. Nitroprusside,
  - b. Dopamine/phenylephrine
5. Before and after intervention

##### C) Parameters

1. Trans-lesion pressure gradient
2. Fractional flow reserve

### **Section VII. Peripheral Vascular Component**

#### **Introduction**

Atherosclerosis is a systemic disease that affects both the coronary arteries and the peripheral vasculature. Peripheral vascular disease is common among patients with coronary disease, and the management of these two entities is interdependent. As an integral component of the interventional cardiovascular fellowship, trainees will be exposed to all issues surrounding the management of peripheral arterial occlusive disease, including its etiology, pathophysiology,

natural history, noninvasive evaluation, medical management, and indications for endovascular or surgical intervention. Particular emphasis will be placed on knowledge of indications for and performance of diagnostic angiography and percutaneous revascularization. The curriculum is based on guidelines proposed by the American Heart Association, The American College of Cardiology, and The Society for Cardiac Angiography and Interventions [14-16]. Many of the pharmacologic principles and technical skills inherent to coronary angiography and intervention as discussed above, especially those related to obtaining vascular access and manipulation of intravascular catheters and guidewires, apply directly to peripheral angiography and intervention.

### **I) Primary Disease Processes**

- A) Lower extremity arterial occlusive disease
  - 1. Intermittent claudication
  - 2. Rest / limb-threatening ischemia
  - 3. Acute thrombo-embolic disease
- B) Renal artery stenosis
- C) Abdominal aortic aneurysm
  
- D) Subclavian artery stenosis
  - 1. Vertebrobasilar insufficiency
  - 2. Upper extremity claudication
  - 3. Hemodynamic compromise of internal mammary artery to coronary artery bypass graft
- E) Carotid artery disease
  - 1. asymptomatic carotid stenosis
  - 2. symptomatic carotid stenosis
- F) Femoral artery pseudoaneurysm and arteriovenous fistula
- G) Cholesterol emboli syndrome

### **II) Cognitive Skills**

- A) Etiology and differential diagnosis of peripheral arterial diseases
- B) Natural history
- C) Arterial anatomy
- D) Pathophysiology of the disease states
- E) Outpatient and inpatient evaluation
- F) Indications for therapy
- H) Knowledge of treatment options
  - 1. Medical therapy
  - 2. Endovascular therapy
  - 3. Vascular surgical therapy

### **III) Interpretation of noninvasive testing**

- A) Ankle-brachial index
- B) Doppler/ultrasound
- C) Vascular computed tomography
- D) Magnetic resonance angiography

#### **IV) Performance of Peripheral Angiography**

- A) Lower extremity
  - a. determination of arterial access site (based on expected distribution of disease)
  - b. proper placement of pigtail catheter for distal abdominal aortography
  - c. techniques for selective angiography of the contralateral extremity
  - d. detailed knowledge of angiographic vascular anatomy
  - e. identification of previously implanted bypass grafts
  - f. measurement and understanding of translesional pressure gradients
  - g. recognition of stigmata of acute versus chronic arterial occlusive disease
  
- B) Renal Angiography
  - 1. abdominal aortography
    - a. arterial anatomy
    - b. recognition of accessory renal arteries
  - 2. catheter selection for selective renal angiography
  - 3. catheter manipulation skills to minimize the likelihood of atheroemboli
  - 4. measurement of translesional pressure gradients
  - 5. differentiation of atherosclerotic disease from fibromuscular dysplasia
  
- C) Carotid, Cerebral, and Brachiocephalic angiography
  - 1. arch aortogram
    - a. knowledge of anatomy relating to origins of the great vessels
    - b. Knowledge of common anatomic variations
  - 2. selective carotid angiography
    - a. catheter selection and manipulation skills
    - b. skills to minimize the risk of procedure-related stroke
    - c. Comprehension of the principles and use of digital subtraction angiography
    - d. knowledge of appropriate angiographic projections to view the carotid bifurcation.
    - e. knowledge of anatomy of the common, internal, and external carotid arteries
    - f. ability to quantitate stenosis severity based on accepted criteria
    - g. recognition of thrombus, calcification
  - 3. cerebral angiography
    - a. anatomy
    - b. proper angiographic projections

- c. recognition of common abnormalities, including branch occlusion, aneurysm, AV fistula
- 4. inominate/subclavian artery angiography
  - a. branch anatomy
  - b. measurement of translesional pressure gradients
- 5. vertebral angiography
  - a. anatomy of vertebral, basilar, and posterior cerebral arteries
  - b. catheter selection and techniques

## **Performance of Peripheral Interventions**

### **A) Lower extremity**

- 1. Aortoiliac disease
  - a. Principles of vascular access site selection
  - b. Peri-procedural pharmacology
  - c. Selection of appropriate guidewire
  - d. Selection of appropriate angioplasty balloon size
  - e. Proper selection of stent size and design (balloon vs self-expanding)
  - f. Understanding of the “kissing” balloon approach for ostial common iliac artery stenoses
  - g. Management of complications (dissection, thrombosis, embolism)
  - h. Technique and importance of assessing post-intervention residual pressure-gradient
- 2. Infra-iliac disease
  - a. Knowledge of appropriate indications
  - b. Access techniques from contralateral extremity
  - c. Antegrade arterial puncture techniques
  - d. Selection of proper guidewires / balloons
- 3. Lower extremity thrombolysis
  - a. Guidewire techniques to cross acute and chronic occlusions
  - b. Indications for thrombolysis
  - c. Pharmacology and dosing considerations for thrombolytic agents
  - d. Knowledge of available infusion catheters and wires
  - e. Monitoring the effectiveness of prolonged thrombolytic infusions
  - f. Recognition and management of hemorrhagic complications
  - g. Indications for and technical considerations of rheolytic thrombectomy

### **B) Renal artery**

- 1. Guide catheter selection based on arterial anatomy
- 2. Knowledge of techniques to minimize risk of aortic atheroembolism
- 3. Selection of guidewire

4. Techniques to minimize risk of guidewire-induced renal parenchymal trauma
5. Peri- and post-procedural anticoagulation
6. Principles of balloon and stent selection
7. Techniques of stent placement to ensure coverage of the renal artery ostium
8. Ability to minimize contrast dose in patients with renal insufficiency
9. Understanding of treatment strategy for fibromuscular dysplasia versus atherosclerotic renal artery stenosis
10. Measurement of residual pressure gradient post-intervention

C) Subclavian artery

1. Knowledge of considerations related to arterial access (femoral versus brachial artery approach)
2. Understanding of guidewire, balloon, stent choices
3. Case selection principles to avoid compromise of the vertebral artery
4. Use of balloon-expandable (ostial-proximal subclavian) versus self-expanding (mid-distal subclavian) stents

**Other areas in which knowledge is to be acquired:**

Biostatistics, Research Methodology and Clinical Epidemiology

Ethics

Medico legal aspects relevant to the discipline

Health Policy issues as may be applicable to the discipline

## **LOG BOOK**

A candidate shall maintain a log book of operations (assisted / performed) during the training period, certified by the concerned post graduate teacher / Head of the department / senior consultant.

This log book shall be made available to the board of examiners for their perusal at the time of the final examination.

The log book should show evidence that the before mentioned subjects were covered (with dates and the name of teacher(s)) The candidate will maintain the record of all academic activities undertaken by him/her in log book .

1. Personal profile of the candidate
2. Educational qualification/Professional data
3. Record of case histories
4. Procedures learnt
5. Record of case Demonstration/Presentations
6. Every candidate, at the time of practical examination, will be required to produce performance record (log book) containing details of the work done by him/her during the entire period of training as per requirements of the log book. It should be duly certified by the supervisor as work done by the candidate and countersigned by the administrative Head of the Institution.
7. In the absence of production of log book, the result will not be declared.

## Leave Rules

1. FNB Trainees are entitled to leave during the course of FNB training as per the Leave Rules prescribed by NBE.
2. FNB candidate can avail a maximum of 20 days of leave in a year excluding regular duty off/ Gazetted holidays as per Hospital/Institute calendar/policy.
3. MATERNITY / PATERNITY LEAVE:
  - a. There is no provision of maternity or paternity leave during the FNB tenure. However, if a FNB trainee avails maternity (90 days) or paternity (7 days) leave during the FNB tenure, her or his tenure will be extended by an equal number of days.
  - b. FNB trainees are required to complete their training by a prescribed cut off date (as per information bulletin of Exit exam) for being eligible to FNB Exit examination. Trainees whose FNB tenure is extended beyond this cut off date only due to the maternity/paternity leave availed by them shall be permitted to take exit examination, if otherwise eligible, with other registered candidates of same session.
4. No kind of study leave is permissible to FNB candidates. However, candidates may be allowed an academic leave of 10 days across the entire duration of training program to attend the conferences/CMEs/Academic programs/Examination purposes.
5. Under normal circumstances, leave of one year should not be carry forward to next year, however, in exceptional cases like prolonged illness or any meritorious ground the leave across the training program may be clubbed together with prior approval of NBE.
6. Any other leave which is beyond the above stated leave is not permissible and shall lead to extension/cancellation of FNB course.



7. Any extension of FNB training for more than 2 months beyond scheduled completion date of training is permissible only under extra-ordinary circumstances with prior approval of NBE. Such extension is neither automatic nor shall be granted as a matter of routine
8. Unauthorized absence from FNB training for more than 7 days may lead to cancellation of registration and discontinuation of the FNB training and rejoining shall not be permitted.

9. MEDICAL LEAVE

- a. Leave on medical grounds is permissible only for genuine medical reasons and NBE should be informed by the concerned Institute/hospital about the same immediately after the candidate proceeds on leave on medical grounds.
- b. The supporting medical documents have to be certified by the Head of the Institute/hospital where the candidate is undergoing FNB training and have to be sent to NBE.
- c. The medical treatment should be taken from the Institute/hospital where the candidate is undergoing FNB training. Any deviation from this shall be supported with valid grounds and documentation.
- d. In case of medical treatment being sought from some other Institute/hospital, the medical documents have to be certified by the Head of the Institute/hospital where the candidate is undergoing FNB training.
- e. NBE reserves its rights to verify the authenticity of the documents furnished by the candidate and the Institute/hospital regarding Medical illness of the candidate and to take a final decision in such matters.

10.

- a. Total leave period which can be availed by FNB candidates is 40+10 = 50 days. This includes all kinds of eligible leave including academic leave. Any kind of leave including medical leave exceeding the

aforementioned limit shall lead to extension of FNB training. It is clarified that prior approval of NBE is necessary for availing any such leave.

- b. The eligibility for Fellowship Exit Examination shall be determined strictly in accordance with the criteria prescribed in the respective information bulletin.

Eg:- Candidate joining FNB 2 year course in 2017 admission session on 15th April, 2017 shall be completing his/her FNB training on 14th April, 2019 under normal circumstances wherein there is no extension of training. If his/her training is extended due to leave on medical grounds or any other reason for 3 months after adjusting eligible leave available in the entire duration of FNB training, the training shall be completing on 14th July, 2019. If as per the Information Bulletin for Final Examination December 2018, the cutoff date for completion of training is 30th June, 2019, such candidate shall not be eligible for December 2018 Final Examination.

Important: Extension of training due to maternity leave shall not be affected while deciding the cutoff date of FNB training.

# EXAMINATION

## FORMATIVE ASSESSMENT

Formative assessment includes various formal and informal assessment procedures by which evaluation of student's learning, comprehension, and academic progress is done by the teachers/ faculty to improve student attainment. Formative assessment test (FAT) is called as "Formative" as it informs the in process teaching and learning modifications. FAT is an integral part of the effective teaching. The goal of the FAT is to collect information which can be used to improve the student learning process.

Formative assessment is essentially positive in intent, directed towards promoting learning; it is therefore part of teaching. Validity and usefulness are paramount in formative assessment and should take precedence over concerns for reliability. The assessment scheme consists of Three Parts which has to be essentially completed by the candidates.

The scheme includes:-

Part I:- Conduction of theory examination

Part-II :- Feedback session on the theory performance

Part-III :- Work place based clinical assessment

### Scheme of Formative assessment

<b>PART – I</b>	<b>CONDUCT OF THEORY EXAMINATION</b>	Candidate has to appear for Theory Exam and it will be held for One day.
<b>PART – II</b>	<b>FEEDBACK SESSION ON THE THEORY PERFORMANCE</b>	Candidate has to appear for his/her Theory Exam Assessment Workshop.
<b>PART – III</b>	<b>WORK PLACE BASED CLINICAL ASSESSMENT</b>	After Theory Examination, Candidate has to appear for Clinical Assessment.

The performance of the resident during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student

#### 1. Personal attributes:

- **Behavior and Emotional Stability:** Dependable, disciplined, dedicated, stable in emergency situations, shows positive approach.
- **Motivation and Initiative:** Takes on responsibility, innovative, enterprising, does not shirk duties or leave any work pending.

- **Honesty and Integrity:** Truthful, admits mistakes, does not cook up information, has ethical conduct, exhibits good moral values, loyal to the institution.
- **Interpersonal Skills and Leadership Quality:** Has compassionate attitude towards patients and attendants, gets on well with colleagues and paramedical staff, is respectful to seniors, has good communication skills.

## 2. Clinical Work:

- **Availability:** Punctual, available continuously on duty, responds promptly on calls and takes proper permission for leave.
- **Diligence:** Dedicated, hardworking, does not shirk duties, leaves no work pending, does not sit idle, competent in clinical case work up and management.
- **Academic ability:** Intelligent, shows sound knowledge and skills, participates adequately in academic activities, and performs well in oral presentation and departmental tests.
- **Clinical Performance:** Proficient in clinical presentations and case discussion during rounds and OPD work up. Preparing Documents of the case history/examination and progress notes in the file (daily notes, round discussion, investigations and management) Skill of performing bed side procedures and handling emergencies.

**3. Academic Activity:** Performance during presentation at Journal club/ Seminar/ Case discussion/Stat meeting and other academic sessions. Proficiency in skills as mentioned in job responsibilities.

## FINAL EXAMINATION

The summative assessment of competence will be done in the form of Fellowship Exit Examination leading to the award of the degree of Fellow of National Board in Interventional Cardiology. The Fellowship Exit Examination is a two-stage examination comprising the theory and practical part.

### Theory Examination:

1. The Theory examination comprises of one paper with maximum marks of 100.
2. There are 10 short notes of 10 marks each in the Theory paper
3. Maximum time permitted is 3 hours.

**Practical Examination:**

1. Maximum marks : 300
  2. Comprises of Clinical Examination and viva
- The candidate has to score a minimum of 50% marks in aggregate i.e. 200 out of total 400 marks (Theory & Practical) with at least 50% marks in theory examination to qualify in the Fellowship Exit Exam.
  - The Theory and Practical of Fellowship Exit Examination shall be conducted at the same examination centre of the concerned specialty.

**Declaration of Fellowship Exit Results**

1. Fellowship Exit Examination is a qualifying examination.
2. Results of Fellowship Exit Examination (theory & practical) are declared as PASS/FAIL.
3. FNB degree is awarded to a FNB trainee in the convocation of NBE.

## RECOMMENDED TEXT BOOKS AND JOURNALS

### A. Books

1. Baim DS, Grossman W, eds. Cardiac Catheterization, Angiography, and Intervention, Sixth edition. Baltimore: Lippincott, Williams & Wilkins, 2000.
2. Pepine CJ, Hill JA, Lambert CR, eds. Diagnostic and Therapeutic Cardiac Catheterization. Third Edition, Baltimore: Williams & Wilkins, 1998.
3. Perler BA, Becker GJ, eds. Vascular Intervention: A Clinical Approach. New York: Thieme, 1998.
4. Safian R, Freed M, eds. The Manual of Interventional Cardiology. Third Edition, Birmingham: Physicians Press, 2001.
5. Topol EJ, ed. Textbook of Interventional Cardiology, Third Edition, Philadelphia: WB Saunders, 1999.
6. Uflacker R, ed. Atlas of Vascular Anatomy. Baltimore: Williams & Wilkins, 1997.

### B. CONFERENCES

1. Weekly Interventional Fellowship Core Curriculum Conference -Covers a comprehensive list of Interventional Cardiology milestones.
2. Weekly cath lab conference: Interventional Case Conference – Case based didactic conference emphasizing quality angiography.
3. Heart Alert Conference: Case based conference designed to identify ways to improve rapid transport and optimal therapy for patients with STEMI.
4. Best Practices conference – Didactic presentations designed to review guidelines and critical evidence.
5. M & M conference: Cases with adverse outcome are reviewed in detail and discussed.
6. Weekly Vascular Medicine Conference

7. Monthly Journal Club – An article of importance is presented by the fellow with discussion led by a designated faculty member.
8. Monthly Research Conference – Planned, ongoing or completed research projects are discussed presented by fellows and faculty.