



Australian Society of Medical Imaging and Radiation Therapy

The national professional organisation representing medical radiation practitioners

ABN 26 924 779 836



MIAP1

Nov 2018

MEDICAL IMAGING ADVISORY PANEL 1

Course Syllabus

Cardiac & Vascular Interventional Imaging (Angiography)

CARDIAC Stream

Section A: Angiographic Equipment

TOPICS:

General

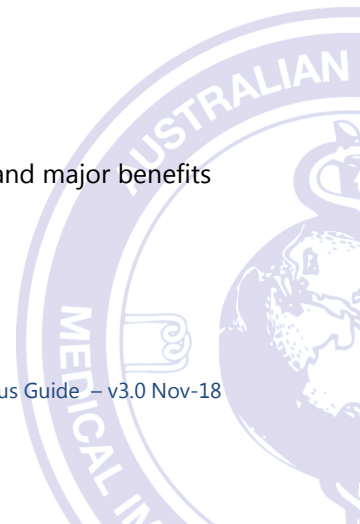
- Understand the French sizing system

Sheaths

- Understand vascular sheaths
 - General design and purpose
 - Use of long Sheaths
 - Purpose of Break-Away (peel apart) sheaths

Catheters

- Understand the terms
 - Pushability
 - Crossability
 - Torque
 - Steerability
- Compare and contrast the shape, characteristics and use of the following flush catheters
 - Pigtail
 - Contra/VCF/ Omni Flush
- Understand the general (visual) shape of the following catheters
 - JR4
 - AL1
 - JL4
 - IM
- Understand the common uses of the following catheters (principle anatomical engagements)
 - TIG
 - JR4
 - AL1
 - IM
- Understand the design and primary uses of Glide Catheters
- Understand the following characteristics of Guide Catheters
 - Sizing
 - Indications for use
 - How they differ from a standard diagnostic catheter
- Understand the general definition of a micro-catheter and describe its applications and major benefits



Guide Wires

- J-Wires vs. straight wires
 - Indications for use
 - Advantages and disadvantages
- Understand the design and general use of Glide Wires
- Compare and contrast the following wire-based delivery systems
 - 0.035 vs 0.014
 - Understand the primary uses (and limits) of each system in coronary angiography/angioplasty
- Know the primary uses, general length, and disadvantages associated with the use of Exchange Wires
 - Standard exchange
 - Stiff exchange
 - Amplatz

Balloons

- Understand the term balloon compliance
 - Compare the uses of compliant vs. non-compliant balloons
- Understand the following angiography balloon terms
 - Rated Burst Pressure
 - Nominal Pressure
 - Difference between circumferential and longitudinal balloon rupture
- Specialist balloons
 - Cutting balloons - Describe the design and indications of cutting balloon use
 - Drug Eluting Balloons – describe their uses and the drugs routinely applied

Stents

- Compare and contrast Self Expanding and Balloon Expandable Stents
 - Delivery mechanisms
 - Advantages vs. disadvantages (including radial strength characteristics)
- Understand the design and general uses of Covered Stents
- Indications and differences between drug eluting and bare metal coronary stents
- Understand what is meant by 'in-stent restenosis'
 - Causes
 - Treatment



Section B: Angiographic Anatomy, Pathophysiology & Pharmacology

TOPICS:

- Identify the macroscopic and microscopic structure of arteries and veins
- Understand the principles of Virchow's triad
- List pathological processes that may result in arterial narrowing
 - Intrinsic vs. extrinsic
 - Acute
 - Chronic
- List pathological process that result in vascular occlusion
 - Acute
 - Chronic
- Understand the pathological process behind aneurysm development
 - Fusiform vs. saccular vs. mycotic
 - True vs. false (pseudo) aneurysm
- Understand the following terms
 - Arterio-venous malformation
 - Arterio-venous fistula

Arterial Anatomy - Principles

- Describe the composition of the femoral triangle
- Understand the structure of an artery (Intima, Media, Adventitia)
- Understand what is meant by left vs. right coronary artery dominance
- List the arterial supply to the heart indicating which portion of the heart is supplied by each vessel
- Understand the chambers and valves of the heart
 - Functional and anatomical (structural) differences between each chamber
 - Valve locations and anatomical (structural) differences
- List the arterial pathway for a coronary arteriogram using
 - A right radial access approach
 - A right femoral access approach
- List the arteries (and veins) commonly used for Coronary Artery Bypass Grafting
 - Understand the difference between venous and arterial grafts
- List the arteries of the aortic arch (the great vessels)
 - Understand the positions (proximal/distal) relative to the arch
- List the names of the structure of the ascending aorta
 - Aortic sinuses
 - Coronary artery origins
 - Structural anatomical junctions



Bloodwork

Clotting Factors

- Understand the clinical relevance of a low haemoglobin level, and its primary causes
- Understand an International Normalised Ratio (INR) test and when it should be performed
- Discuss the functions of platelets during vessel haemostasis.
 - Understand the implications of a low platelet count
- Understand an Activated Clotting Time (ACT) test and when it should be performed

Renal Function

- Understand the clinical importance of Glomerular Filtration Rate (GFR) tests in angiography, and know the levels for safe operation
- Understand Creatinine: What it is, how it is produced, and how to manage high levels prior to angiography
- Understand Urea: What it is, how it is excreted, and the clinical relevance of low levels

Troponin

- Understand Troponin testing: Why it is done, safe levels, and what it reveals clinically

Drugs

- Lignocaine
 - Drug class
 - Common dosing
 - Effect of combining with Epinephrine
- Fentanyl
 - Drug class
 - Primary Uses
 - Common dosing
- Midazolam
 - Drug class
 - Primary Uses
 - Common dosing
- GTN
 - Discuss the primary angiographic use
 - Mechanism of action
- Heparin
 - Drug class
 - Primary angiographic uses
 - Common dosing
- Indications for use during angiography:
 - Adrenaline
 - Atropine



Section C: Angiographic Physics

Radiation Biology & Safety

- Understand what contributes to patient dose in fluoroscopic procedures
 - Types of photons (transmitted, scattered and absorbed)
 - Common methods for reducing these doses
- Understand what contributes to operator dose in fluoroscopic procedures
 - Areas of highest scatter dose
 - Types of photons (transmitted, scattered and absorbed)
 - Common methods for reducing these doses
- Discuss the importance and uses of Diagnostic Reference Levels (DRL) in angiography
 - Understand how DRL values are arrived at
- Compare and contrast acute and chronic radiation injury
 - Define each type
 - Common forms these injuries may take
 - Trigger levels

Radiation Dose Metrics

- Describe the location and purpose of the Interventional Reference Point (IRP)
 - Understand the implications of changing table height on the resultant radiation dose measurements
- Understand Dose Area Product (DAP)
 - What it is
 - Where it is measured
 - Clinical relevance
- Discuss Air Kerma (AK)
 - What is it
 - Clinical relevance, and how it differs from the Surface Entrance Dose
 - Understand how to determine the maximum skin dose (single region) where multiple projections have been used

Radiation Protection

- Know the Australian Standards for
 - Heavy lead gowns
 - Annual absorbed dose limits

Imaging Physics

- Understand the effects of a changing field of view (FOV) on patient dose
 - Collimation vs. magnification
- List image magnification changes with changes to the following
 - Source-to-image distance



- Source-to-object distance
- Object-to-image distance
- Know the common focal spot sizes in use in angiography, and understand
 - The effect on image resolution
 - The effect on heat loading
- Understand the effects of changing matrix size on image resolution
- Understand what the Detective Quantum Efficiency (DQE) says about an angiography system.
 - What is its relevance?
- Vessel calibration methods
 - Understand the limitations of each method (foreshortening, magnification, errors induced when calibrating from small distances)
 - Measuring catheters
 - Catheter/sheath width calibration
 - Automatic (magnification factor) calibration
 - Ruler calibration (top of table, or on top of patient)

Bi-Plane Angiography

- List advantages of bi-planar angiographic systems
- List disadvantages of bi-planar angiographic systems
- Understand the uses of bi-planar imaging during cardiac imaging

Digital Subtraction Techniques

- Understand the creation of DSA images
 - Understand why DSA is not routinely used in coronary angiography
 - Understand the use of mask images

Contrast Injection Principles

- Understand Poiseuille's Law
 - Factors affecting the pressure of injection
 - Maximising injection flow rates
- Understand the use of angiographic powered injectors and what each parameter controls
 - Injection rate
 - Injection volume
 - Injection delay
 - X-ray delay
 - Rate rise
 - Pressure limit
- Understand injection related 'catheter recoil' and how this can be minimised



Section D: Fundamental cardiac angiographic *principles*

General Principles

- Understand why patients must remain still during procedures and the methods used to achieve this
- Understand why monitoring a patient's blood pressure, oxygen saturation, and respiratory rate during a procedure is important
- Understand the risks of pressure injury and for the patient and ways to prevent this

Sterile Technique

- Understand basic principles of sterile technique *as they relate to the procedure, staff, patient and xray equipment*
- Why and how sterile gowns/gloves/drapes are used
- How to dispense sterile equipment/fluids into the sterile field
- Cleaning preparation of the access site
- Use of personal protective equipment in the procedure room

Vascular Access

- List all steps (in order) of the 'modified' Seldinger technique
 - Indicate equipment required at each stage
- Compare and contrast radial vs. common femoral arterial access
 - Indications
 - Contraindications
 - Post-operative benefits
- Know what the Allen's Test is and how it is performed
- List potential complications related to arterial access
- Understand vessel closure methods
 - Radial access
 - Femoral access
 - Manual Pressure
 - Fem-Stop process
 - Vascular closure devices

Patient Care, Procedural Risks & Complications

- Understand the risks and complications of coronary angiography
 - Procedural
 - Post-procedural
- List major and minor complications related to the injection of iodinated contrast media
- Understand the concepts of post procedural patient care
 - Haematoma risk
 - Radial vs Femoral approach
 - Differences between diagnostic coronary angiography and PCI procedures



- Understand the key concepts of patient preparation for coronary angiography
 - Fasting
 - Warfarin
 - Access Site Preparation

ECG Interpretation

- Understand why the ECG is monitored in the Cardiac cath lab
- On an ECG rhythm strip, be able to recognise the P, Q, R, S and T waves
- Understand what each wave on the ECG represents physiologically
- Know what is meant by an arrhythmia
- On an ECG rhythm strip, be able to recognise:
 - Ventricular Fibrillation (and know what to do)
 - Ventricular Tachycardia (understand the difference to ventricular fibrillation)
- On an ECG rhythm strip, be able to recognise:
 - Ventricular Standstill (and understand its importance)
 - ST elevation
- Know the basic functions of an automatic external cardiac defibrillator
- Understand what is meant by bradycardia and tachycardia
- Understand the SA and AV nodes
 - Where they are located
 - What are their functions
- Have a basic knowledge of the electrical conduction through the heart



Section E: Fundamental cardiac angiographic *procedures* – Part 1: Coronary/Arterial procedures

Angiographic Procedures: Cardiac Angiography

- Understand why monitoring a patient's intra-arterial blood pressure is important for cardiac procedures
 - How is this achieved
- List indications and contra-indications for performing diagnostic cardiac angiography
- List projections required to demonstrate the left main coronary artery
- List projections required to demonstrate the left anterior descending artery
- List projections required to demonstrate the circumflex artery
- List projections required to demonstrate the right coronary artery
- Describe left ventriculography
 - Indications
 - Projection
 - Catheter used
- Understand the use of the *pullback gradient* after entering the left ventricle
 - Understand the normal gradient value
 - What does a high gradient value clinically mean
- For arch aortography list
 - Indications
 - Standard projection
 - Catheter used
 - The normal diameter of the ascending aorta

Angiographic Procedures: Coronary Angioplasty (PCI)

- Understand what *Percutaneous Coronary Intervention* is and when it is performed
 - Understand the Chronic Total Occlusion (CTO) variation of the PCI procedure
- Understand the different lesion classifications (Types A, B, C)
 - Understand how the lesion classification may affect PCI treatment
- Understand the different stages of the PCI procedure
- Understand the use of guide catheters during PCI
 - Reasons for use
 - Understand why some guide catheters have side holes, and when they should be used
- Understand the principle radiographic elements of proper lesion assessment
 - The importance of using orthogonal views
 - The implications of image foreshortening in lesion sizing
- Understand why Heparin and GTN are used during PCI procedures
- List the basic complications of PCI
 - Procedural
 - Post-procedural
 - Radiation dose implications for patients and staff during extended PCI procedures



- Understand Acute Coronary Syndrome (ACS)
 - Symptomology
 - Understand the difference in patient presentations for ACS vs a stable, elective PCI procedure
 - Understand why ACS procedures must be performed in a timely manner
- Understand what is meant by ST Elevation Myocardial Infarction (STEMI)
 - Understand the difference between STEMI and NSTEMI presentations
- Understand the TIMI Flow Score and its clinical procedural relevance
- Understand Fractional Flow Reserve (FFR)
 - How it works
 - What the results clinically/physiologically represent
 - Why it may be used prior to PCI
 - The function and use of adenosine during testing

Angiographic Procedures: Right Heart Procedures

- Understand the primary indications for a right heart procedure
- Understand the normal ranges for the blood pressure in each of the right heart chambers
- Be able to recognize where a Swan Ganz catheter is purely from its visual pressure trace characteristics
 - Understand the pressure trace characteristics of the following four regions
 - RA
 - RV
 - PA
 - PWP
- Describe the construction of a Swan Ganz catheter and its use
 - Why does it have a balloon at its tip
 - Functions of the thermister
- Understand cardiac output testing
 - What is meant by Cardiac Output (what are the variables)
 - How is it measured during a right heart procedure
 - What is the relationship between the rate of blood flow and the change in temperature
- Understand the use of thermo-dilution during cardiac output studies
 - Why are multiple readings taken
- Understand what is meant by *pulmonary wedge pressure*
 - How can it be used to assess mitral valve gradients
 - How can it be used in the assessment of acute pulmonary oedema
- Understand how structural heart defects may be diagnosed during a right heart procedure
 - Left-to-right heart shunts
 - Paediatric/congenital deformities
- Understand how pulmonary valve gradients may be measured and their clinical relevance



Section E: Fundamental cardiac angiographic *procedures* – PART 2: Electrical and structural procedures

Angiographic Procedures: Pacemaker Procedures

- List the main indications for:
 - A permanent pacemaker (PPM)
 - An Automatic Internal Cardiac Defibrillator (AICD)
- Understand the functions of a pacemaker
 - Understand the differences between a PPM and an AICD
 - Understand the difference between single lead and dual lead pacing systems
 - Understand the difference between temporary and permanent pacing systems
- Understand pacemaker lead design and function
 - Understand the differences between *sensing, pacing and shocking*
 - Understand the differences between a *passive pacing* lead and an *active fixation* lead
- Understand loop recorder devices (Linq)
 - Where are they implanted
 - Why are they implanted
 - How do they differ from a PPM
- Understand bi-ventricular devices
 - How they differ from a standard pacing system
 - Describe the route taken by the left ventricular lead
 - Understand how a bi-ventricular device may assist cardiac function
- List the standard/common locations for a pacemaker generator
- List the main complications of inserting permanent pacemakers
 - Which plain x-ray is of most value post procedure
 - Understand the importance of sterility during permanent pacing procedures
- Understand the differences in radiographic quality requirements between pacemaker, bi-ventricular pacing and coronary angiography procedures
 - Magnification
 - Exposure parameters
- Understand the radiation exposure differences between
 - A loop recorder insertion
 - An easy single lead PPM insertion
 - A complicated three lead bi-ventricular AICD insertion
 -

Angiographic Procedures: Electrophysiology (EP) Procedures

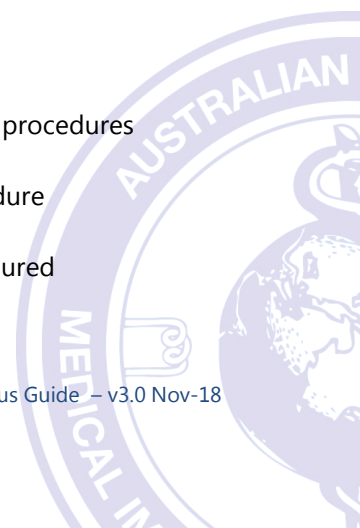
- List the main indications for an EP study
- Understand the following EP studies:
 - A diagnostic EP procedure
 - A Pulmonary Vein Isolation (PVI) procedure
- Understand *Cryo-ablation* and *Radio-Frequency Ablation* (RFA) therapies
 - The differences between the two
 - Understand how these methods are used to treat abnormal electrical pathways in the heart



- List the standard access routes for EP catheters
- Understand trans-septal punctures
 - When and why is it used during some EP procedures
 - Understand its risks
 - Describe the technique
- Understand the design and function of EP catheters
 - Describe where the CS catheter would sit during an EP study
- Understand the uses of the following drugs during an EP study
 - Flecainide
 - Isuprel (Isoprenaline)
- Understand the purpose of using an additional 3D mapping system (Carto, Navix, Pruker) during EP cases
 - Indications for use
 - Procedural benefits
 - Implications for radiation dose
- Understand the differences in radiographic quality requirements between EP studies and coronary angiography procedures

Angiographic Procedures: Structural Heart Procedures

- Understand Atrial Septal Defects (ASD)
 - Indications for closure
 - List what size ASD would be referred for surgery
 - What type of device is used to close an ASD
 - Know how an ASD can be measured angiographically
- Understand Patent Foramen Ovale (PFO) procedures
 - Understand the anatomical relationships
 - Indications for closure
 - Difference between an ASD and a PFO
- Understand Patent Ductus Arteriosus (PDA) closure procedures
 - Understand the anatomy and pathophysiology of a PDA
 - Understand the circumstances under which a PDA would be closed
 - Understand the access routes for a PDA closure
- Understand Aortic Valvuloplasty procedures
 - Indications
 - Understand why rapid ventricular pacing is required for aortic valvuloplasty
 - List the major complications of aortic valvuloplasty
- Understand Trans-Aortic Valve Implantation (TAVI) procedures
 - Indications
 - Understand why accurate profiling of the aortic sinuses is important in TAVI procedures
 - Why is accurate sizing of a TAVI device so important
 - What peripheral vascular presentations will prevent the use of a TAVI procedure
- Understand why a left atrial appendage (LAA) would require closure
 - Know the different ways in which a left atrial appendage orifice can be measured
- List the 3 main shapes of the left atrial appendage
 - List is the best fluoroscopic projections to profile the LAA orifice



Section F: Angiographic/Fluoroscopic Image Labelling

List and/or Label the Following Anatomical Structures:

Thoraco-Abdominal

- Aortic arch and great vessels
- Abdominal aorta
 - Coeliac artery
 - Superior mesenteric artery
 - Renal arteries
 - Lumbar arteries
- Pelvic Arteries
 - Common iliac
 - Internal iliac
 - External Iliac

Coronary Arterial Anatomy

- Left main coronary artery
- Left anterior descending artery
 - Diagonals
 - Septals
 - Anterior interventricular (mid and distal left anterior descending artery)
- Left Circumflex artery
 - Atrial branch
 - Obtuse marginal
- Ramus Intermediate
- Right Coronary Artery
 - Conus branch
 - Right ventricular branch
 - Right acute marginal branch
 - Posterior descending artery (in right coronary dominant system)
 - Postero-lateral left ventricular branch (in right coronary dominant system)

Peripheral

- Upper arm arterial supply
 - Subclavian artery and branches
 - Axillary artery
 - Brachial artery
 - Radial, ulnar and interosseous arteries
- Label the anatomy of the lower limb arteries
 - Common femoral arterial bifurcation
 - Superficial and Deep (profunda) femoral

