



Australian Society of Medical Imaging and Radiation Therapy

The national professional organisation representing medical radiation practitioners

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MEDICAL IMAGING ADVISORY PANEL 1

Course Syllabus

Cardiac & Vascular Interventional Imaging (Angiography)

Vascular Interventional Stream

Section A: Angiographic Equipment

TOPICS:

General

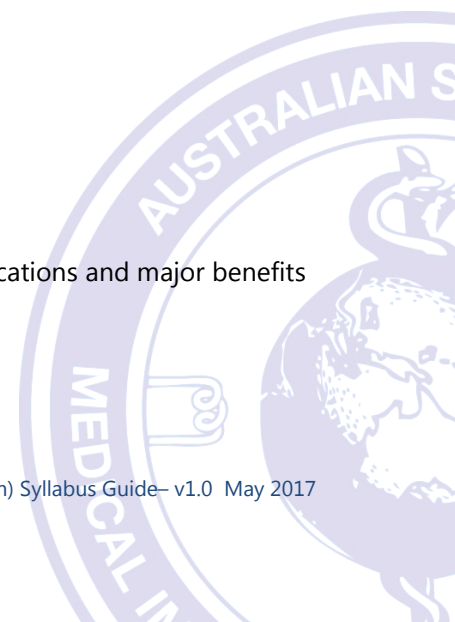
- Understand the French sizing system

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 shape of the following catheters
 - Hinck
 - Cobra
 - Rim
 - Simmonds 1&2
- Understand the common uses of the following catheters (principle anatomical engagements)
 - Cobra
 - Rim
 - Simmonds 1&2
 - Headhunter
- 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 0.018 vs 0.014
 - Understand the primary uses (and limits) of each system
- Know the primary uses, general length, and disadvantages associated with the use of Exchange Wires
 - Standard exchange
 - Stiff exchange
 - Amplatz
 - Lunderquist

Balloons

- Understand the term balloon compliance
 - Compare the uses of Compliant and Non-Compliant Balloons
- Understand the following angiography balloon terms
 - Rated Burst Pressure
 - Nominal Pressure
 - Difference between circumferential and longitudinal balloon rupture
- Understand the type and use of Occlusion Balloons
 - In the following regions: Neuro, Gastric and Aortic
 - Understand the principle uses of the CODA balloon
- 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
- Understand Flow Diverters
 - Indications
 - Design characteristics and how they work

Embolics

- Understand the design, use and function of embolising coils
 - Coil sizing
 - 3D (framing) vs. tornado vs. spiral
 - Fibred
- Detachable vs. pushable coils



- List indications for both
- Understand the characteristics and use of Amplatzer devices
 - Cardiac vs. vascular interventional applications
- Understand the characteristics and use of the following liquid embolics
 - Onyx
 - Histoacryl
 - Lipiodol
- Understand particulate embolics
 - Principle use
 - Common angiographic applications
- Understand Gelfoam
 - Composition
 - Angiographic applications

Thrombectomy

- Understand chemical thrombectomy
 - Angiographic applications
 - Thrombolytic drugs used
 - Catheters employed
 - Relationship to mechanical thrombectomy
- Understand mechanical thrombectomy
 - Angiographic applications
 - Understand the currently available devices and how they operate
 - Rotational atherectomy catheters
 - Trerotola device
 - Solitaire device
 - Angiojet (rheolytic) system



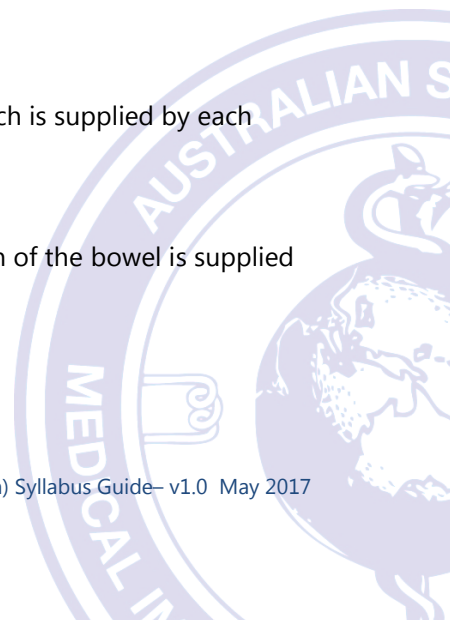
Section B: Angiographic Anatomy, Pathophysiology & Pharmacology

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 processes that may result in venous 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 and compare the following terms
 - Arterio-venous malformation
 - Nidus
 - Arterio-venous fistula
 - Pathological
 - Surgically created
 - Angiogenesis
- Define hepatic-portal venous pressure gradient and its clinical significance in portal hypertension
 - Understand clinically relevant pressure gradient values

Arterial Anatomy - Principles

- Describe the composition of the femoral triangle
- List the arterial supply to the stomach indicating which portion of the stomach is supplied by each vessel
- List arterial supply to duodenum and pancreas
 - Pancreatic head supply vs. pancreatic tail supply
- List arterial supply to the lower gastrointestinal tract indicating which portion of the bowel is supplied by each vessel
- List the vertebral levels of the following
 - Coeliac trunk
 - Superior mesenteric artery (SMA)



- Right and left renal artery
- Inferior mesenteric artery (IMA)
- Aortic bifurcation
- Iliac venous confluence
- List structures passing through each diaphragmatic hiatus
 - Include vertebral level for each one
- Describe the arterial supply to the brain
- List all major intracranial arterial vessels
 - Cerebral branches
 - Cerebellar branches
- List the arteries of the aortic arch (the great vessels), from proximal to distal
 - Brachiocephalic/Subclavian artery and subsidiary branches
 - Carotid arteries and its subsidiaries

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

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
- Heparin
 - Drug class



- Primary angiographic uses
 - Common dosing
- GTN
 - Discuss the primary angiographic use
 - Mechanism of action
- Papaverine
 - Drug class
 - Primary functions
 - Angiographic applications
- Verapamil and Nimodopine
 - Drug class
 - Mechanism of action
 - Angiographic applications
- Urokinase
 - Drug class
 - Angiographic applications



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's) 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 to 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
- List angiographic procedures from which bi-planar imaging provides significant benefits

Digital Subtraction Techniques

- List indications for x-ray (acquisition) delays vs. Injection delays
- List approximate acquisition rates for the following common protocols
 - Arch/Thoracic aorta
 - Abdominal aorta
 - Common femoral artery
 - Below knee imaging (tibial arteries)
- Compare and contrast Image/mask averaging and Maximum Opacification techniques
 - Indications for use
 - Effect on signal-to-noise ratio (SNR)
- Compare and contrast Image Overlay and Roadmap techniques
 - Discuss when they should and should not be used

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

Rotational Angiography

- List the advantages and disadvantages of rotational angiography
- Understand the technique differences between 3D rotational angiography (3DRA) and 3D digital subtraction angiography (3DDSA)
 - Acquisition parameters
 - Injection dilution
 - Injection volume
- Describe the difference between the following (3DRA/3D DSA) standard image reconstruction modes
 - Volume rendered (VR)
 - Maximum intensity projections (MIP)



Section D: Fundamental vascular angiographic and interventional procedures

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, heart rate 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, and patient*
 - The use of sterile gowns/gloves/drapes
 - 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
- Understand basic principles of sterile technique *as they relate to the x-ray equipment*
 - Avoiding contamination of the sterile field

Vascular Access

- List all steps (in order) of the modified Seldinger technique
 - Indicate equipment required at each stage
- Compare and contrast brachial artery vs. common femoral arterial access
 - Indications
 - Contraindications
- List standard and alternative endovascular approaches to venography

Procedure Risks & Complications

- List potential complications related to arterial access
- List contraindications to performing angiographic procedures
- List major and minor complications related to the injection of iodinated contrast media
- List potential procedural complications

Fluoroscopic Intervention

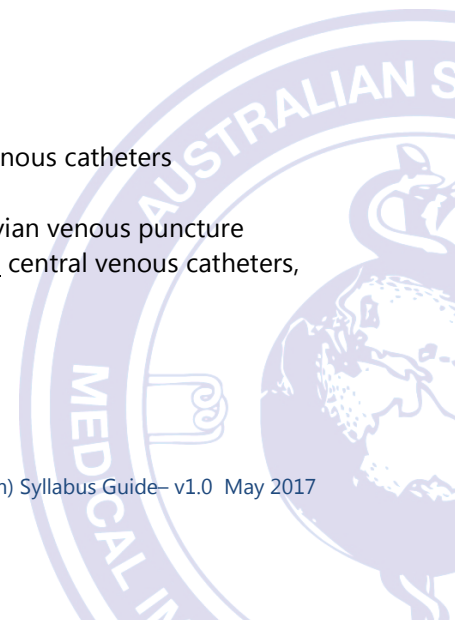
- Understand nephrostomy tube insertion
 - Indications
 - Procedure requirements
 - Patient positioning



- Equipment required
- Understand ureteric stent insertion (performed in radiology)
 - Indications
 - Procedure requirements
 - Patient positioning
 - Equipment required
- Understand percutaneous trans-hepatic cholangiography (PTC/PTHC)
 - Indications
 - Internal/external biliary drainage
 - Biliary stenting
 - Rendezvous procedure
 - Procedure requirements
 - Patient positioning
 - Equipment required
- Understand endoscopic retrograde cholangio-pancreatography (ERCP)
 - Indications
 - Procedure requirements
 - Patient positioning
 - Equipment required
 - Imaging requirements
- ERCP – Intervention
 - Describe biliary sphincterotomy
 - Indications for plastic vs. metal stents
 - Methods for stone extraction
- Understand radiologically inserted gastrostomy tubes (RIG)
 - Indications
 - Procedure requirements
 - Imaging requirements
 - Equipment required

Venous Interventional Procedures

- Understand peripherally inserted central catheters (PICC)
 - Indications
 - Procedure
 - Equipment required
 - Imaging requirements
 - Ideal catheter tip placement
- Understand the differences between tunnelled and non-tunnelled central venous catheters
 - Clinical situations in which they are employed
 - List the advantages and disadvantages of internal jugular vs. subclavian venous puncture
- Understand the indications and differences between the following tunnelled central venous catheters, defining ideal tip position
 - Permcath, Hickmans, Portacath



Thoracic Angiography

- For arch arteriography list
 - Indications
 - Standard projection
 - Catheter used
- List indications for performing the following selective thoracic angiographic procedures
 - Bronchial arteriography
 - Spinal arteriography
 - Intercostal arteriography
- List indications for performing pulmonary angiography
 - Acute vs. Chronic conditions

Abdominal Angiography

- Understand infra-renal endovascular aortic repair (EVAR) procedures
 - Indications
 - Equipment
 - Describe the composition of stents used in EVAR procedures
 - Wires used
 - Catheters used
- Understand the categorisation of endoleaks
 - List all 5 types of endoleak
 - List treatment options for type 2 endoleak
- In the treatment of hepatic tumours
 - Differentiate between Trans-arterial chemo-embolisation (TACE) and selective internal radiation therapy (SIRT) procedures
 - List indications
 - TACE infusion/embolisation rationale
- Understand the application of endovascular techniques in the embolisation of visceral bleeding, listing the choice of embolic in each case
 - Renal
 - Hepatic
 - Splenic
 - Rationale of distal vs. proximal splenic embolisation
 - Lower gastrointestinal
- Understand uterine artery embolization (UAE) procedures
 - Indications
 - Embolics employed
- Understand procedures for infra-renal inferior vena cava (IVC) filter insertion
 - Indications
 - Vascular approach
 - Target zone for IVC filter placement
 - Maximum IVC widths for insertion
- Understand procedures for infra-renal inferior vena cava (IVC) retrieval
 - Indications



- Retrieval methods
 - Vascular approach
 - Snare vs cone retrieval
- Pre retrieval venography rationale
- Understand gonadal vein embolisation procedures
 - Indications
 - Venous anatomy
 - Embolics employed

Peripheral Angiography

- List indications for performing diagnostic lower limb angiography
- Define ankle-brachial index (ABI)
- For peripheral angiography understand clinical scenarios for utilisation of a retrograde approach
 - Advantages and disadvantages
 - Describe the up-and-over technique
- For peripheral angiography understand clinical scenarios for utilisation of an antegrade approach
 - Advantages and disadvantages
- List common projections required to image the following
 - Common iliac bifurcation
 - Common femoral bifurcation
- Understand the application of CO₂ in peripheral angiographic imaging
 - Indications and contraindications
 - Angiographic technique variations when imaging with CO₂ vs. iodinated contrast
 - Table tilt
 - Post processing techniques

Cerebral Angiography

- List indications for performing diagnostic cerebral angiography
- For intracranial imaging list advantages/disadvantages of catheter angiography compared to computed tomographic angiography (CTA)
- Understand baseline neurovascular projections, indicating the alignment of bony landmarks and area of interest
 - Intracranial internal carotid artery (ICA)
 - Posterior-Anterior (PA)
 - Lateral
 - Trans-orbital oblique
 - Intracranial vertebral artery
 - Posterior-Anterior (PA)
 - Lateral
- Understand the intracranial vascular anatomy best demonstrated for each standard neuro-angiographic projection (as listed above)
 - Arterial
 - Anterior, middle and posterior cerebral vessels
 - Basilar artery



- Ophthalmic artery
 - Venous
 - Intracranial sinuses
- Understand endovascular treatment options for wide necked vs. narrow necked aneurysms
 - Definition of wide vs. narrow necked aneurysms
 - Treatment options
 - Coiling
 - Balloon/Stent assisted coiling
 - Flow diversion
- Understand the treatment options for embolic stroke
 - Intravenous therapy
 - Endovascular treatment
 - Mechanical and suction thrombectomy systems
- Understand the endovascular treatment options for cerebral vasospasm
 - Equipment required
 - Drugs employed
 - Indications for angioplasty
- List indications for the following neuro-vascular procedures
 - (Inferior) petrosal sinus sampling
 - Balloon occlusion testing
 - Maxillary artery embolisation



Section E: Angiographic/Fluoroscopic Image Labelling

List and/or Label the Following Anatomical Structures:

Head & Neck

- Extracranial arterial supply
 - Common carotid bifurcation
 - Internal carotid
 - External carotid
 - Vertebral
- Intracranial arterial supply
 - Anterior cerebral artery
 - Middle cerebral artery
 - Posterior cerebral artery
 - Superior cerebellar artery
 - Anterior-inferior cerebellar artery
 - Posterior-inferior cerebellar artery
- Intracranial venous drainage
 - Superior sagittal sinus
 - Inferior sagittal sinus
 - Transverse sinus
 - Sigmoid sinus
 - Internal cerebral veins
 - Great vein of Galen
 - Cavernous sinus
 - Inferior petrosal sinuses

Thoracic

- Aortic arch and great vessels
- Thoracic aortic branches
 - Bronchial
 - Intercostal
- Central venous
 - Superior vena cava
 - Inferior vena cava
 - Right atrium
 - Main pulmonary trunk

Abdominal

- Coeliac arterial branches
 - Common hepatic artery
 - Hepatic proper
 - Gastroduodenal artery
 - Superior pancreato-duodenal artery



- Right gastroepiploic artery
 - Right gastric artery
 - Splenic artery
 - Dorsal pancreatic/Pancreata magna
 - Left Gastric
- Superior and Inferior mesenteric arteriography
 - Right colic
 - Middle colic
 - Left colic
 - Sigmoid
 - Superior Rectal
- Abdominal wall arterial supply
 - Parietal arteries
 - Inferior phrenic
 - Lumbar
 - Median sacral
- Pelvic Arteriography
 - Common iliac
 - Internal iliac branches
 - Anterior trunk
 - Ilio-lumbar
 - Gluteal branches
 - Posterior trunk
 - Obturator
 - Vesicle
 - Uterine
 - Internal pudendal
 - External Iliac
 - Deep iliac circumflex
 - Inferior epigastric
- Central venous
 - Inferior vena cava
 - Renal vein
 - Hepatic vein
- Portal venous
 - Superior mesenteric vein
 - Splenic vein
 - Inferior mesenteric vein
- Cholangiography
 - Hepatic ducts
 - Cystic duct
 - Common bile duct
 - Pancreatic duct



Peripheral

- Upper arm arteriography
 - Subclavian artery and branches
 - Vertebral artery
 - Thyrocervical trunk
 - Costocervical trunk
 - Internal thoracic (mammary) artery
 - Axillary artery
 - Brachial artery
 - Radial, ulnar and interosseous arteries
 - Deep and superficial palmar arches
 - Proximal brachial artery

- Lower limb arteriography
 - Common femoral arterial bifurcation
 - Superficial and Deep (profunda) femoral
 - Popliteal
 - Genicular arteries
 - Anterior and Posterior tibial arteries
 - Peroneal artery
 - Median and lateral plantar arch
 - Dorsalis pedis

