UK Undergraduate Curriculum for Interventional Radiology

Backgound:
As IR has now become a recognised sub-speciality in its own right, there is a need for integrated undergraduate teaching and a curriculum appropriate for medical schools. This is not only important as IR techniques are becoming more central to the medical management of many conditions, but will also help to raise the profile of IR (as a possible career choice) within the undergraduate community.

Introduction:
It is anticipated that IR teaching will be best delivered as part of a clinical radiology teaching programme, but it should be noted that there are currently no GMC foundation competencies in IR. It is therefore considered important that any curriculum is consolidated through inclusion in clinical examinations and finals OSCE stations, with IR representation on medical school exam boards.
It is expected that much of this curriculum will be wholly or partially delivered during other modules and clinical attachments of the undergraduate course, and these sections are highlighted. This 'sign-posting' will direct curriculum boards to the areas of the curriculum, common to all medical school teaching programs, where it is expected such learning outcomes will be delivered. The aim is thus to avoid duplication of curriculum components already delivered elsewhere.
The anatomy and physiology relevant to IR will be taught as part of the 'pre-clinical' basic science teaching and suggested topics are included in appendices at the end of this document.

This document presents a suggested curriculum to medical schools based on:

- The anatomy and physiology relevant to interventional procedures
- The basic principles underpinning IR techniques
- IR in the management of specific clinical scenarios
- Issues of patient preparation, consent and potential complications of IR procedures.

Whilst there are many sub-specialist fields within IR, the curriculum concentrates on those basic or common procedures that are likely to be encountered whilst working as a clinical F1/F2 doctor.

Diagnostic Imaging for IR:

Vascular Imaging

Vascular Surgery attachment and MDT meetings

A basic understanding of the role of imaging in the diagnosis of vascular disease:
CTA, MRA, Duplex ultrasound, Angiography

- The principles of Duplex U/S, contrast enhanced CT, MR and digital subtraction angiography
- Indications/contra-indications and limitations of these techniques.
- The principles of artery and vein mapping on U/S and the use of Peak Systolic Velocity measurements to determine degree of stenosis.
- The purpose of cross sectional imaging to steer MDT discussion on appropriate management.

Non-vascular imaging

Urology / GI surgery attachment

- The role of ultrasound in demonstrating renal size and hydronephrosis
- The role of ultrasound in demonstrating liver and biliary anatomy and the presence of biliary obstruction
- Principles of contrast enhanced CT and MRI in demonstrating the abdominal organs and viscera.

Fundamental principles underpinning IR techniques:

New IR teaching

- Be familiar with the 'tools of IR': access needles, sheaths, catheters and guidewires.
- Understand the Seldinger technique for safe vascular access.
- The principles of contrast injection used in angiography (including DSA)
- Understand the management of contrast allergy/anaphylaxis (IV anti-histamine, IV Hydrocortisone, IM adrenaline)
- Familiarity with angioplasty balloons and sizing of arteries.
- Familiarity with the concept of balloon expandable and self expanding stents.
- The concept of embolisation agents (coils, particles, gelatin sponge, occluder devices)

Patient Safety:

- Understand the principles of informed consent
- Be familiar with the purpose and use of the WHO surgical checklist
- A basic understanding of the types of procedural complications encountered in IR practice.
- Understand the importance of post procedural care pathways and observations for detecting complications

IR Techniques:

The following clinical scenarios are those involving IR that are most likely to be encountered whilst working as a foundation doctor where a knowledge of the role of IR is considered important. Much of the teaching of these medical conditions will be given during the clinical attachments of the relevant specialty (indicated), but additional teaching on the precise role and techniques of IR should be considered.

Vascular:

Vascular surgery attachment

Pathology of Peripheral Arterial Disease:

Atherosclerosis – risk factors, genetics, anatomy/physiology of plaque formation, drug management.

Clinical: Symptoms and signs of PVD, Clinical examination of the vascular system.

Claudication and Critical Limb Ischamia:

- Diagnostic imaging (CTA, MRA, Duplex U/S)
- Understanding of conservative Vs surgical Vs endovascular treatment options.
- Indications for Iliac stenting, SFA angioplasty/stenting, crural vessel/distal angioplasty.

Acute limb Ischaemia:

- Understand the principles of acute embolic/thrombotic Vs chronic atherosclerotic arterial occlusion.
- The role of thrombectomy/embolectomy and thrombolysis

Aneurysmal disease:

- The principles of rupture risk related to aneurysm size (aortic, iliac and popliteal).
- Understand surgical Vs endovascular treatment options in elective and rupture scenarios.
- The definition, diagnosis and management options for pseudoaneurysms following angiography

Venous Disease:

Clinical Examination of the venous system.
Risk factors and physiology of DVT formation.
The principles of U/S in the assessment of venous disease and diagnosis of DVT

The priciples of A-V fistula formation for haemodyalysis
Understand the indications for fistulography and fistuloplasty to maintain fistula function.

Specific Vascular Interventional Radiology Techniques:

Trauma:

- CT imaging of the severely injured patient.
- Understand the physiological changes from major haemorrhage and the principles of hypotensive fluid resuscitation
- Understand the principles of trans-catheter embolisation techniques for solid organ injury and pelvic arterial haemorrhage
- Appreciate the diagnostic and treatment difficulties of venous haemorrhage.

Post-partum haemorrhage:

Obstetric teaching

- Ultrasound screening detection of pregnancies at higher risk of haemorrhage (placenta previa/accreta/percreta)
- The principles of reducing inta-operative haemorrhage with the use of iliac artery ballon placement.
- Uterine artery embolisation techniques for treating PPH

Gastro-intestinal Haemorrhage: *Gastroenterology teaching*

- Understand the clinical differentiation between upper and lower GI haemorrhage.
- Understand the pathology of gastric/duodenal ulceration, pancreatitis, varices and portal hypertension.
- Appreciate the causes of lower GI haemorrhage.
- Understand the role and limitations of CT angiography for the detection of GI haemorrhage.
- The role of endoscopic assessment and injection sclerotherapy in the initial management of upper GI haemorrhage.
- The role of trans-catheter embolisation in the celiac axis, SMA and IMA

Pulmonary emboli: *General medicine teaching*

- The indications for IVC filter placement
- The principles of CT in the detection of pulmonary emboli
- Principles of filter deployment.

Non-Vascular Techniques:

The principles of image guided biopsy/drainage techniques:

- The use of U/S and CT to guide percutaneous biopsies and drain insertions.
- The principles of safe local anaesthetic infiltration.
- Understand the use of patient monitoring (P, BP, pulse oximetry)
- Familiarity with FNA and core Biopsy techniques (eg Liver, thyroid, breast, retroperitoneum)

Specific non-vascular interventional techniques:

Obstructive uropathy: *Urology teaching*

- The causes of renal obstruction
- Indications for nephrostomy and ureteric stenting
- Principles of puncturing the renal collecting system
- The role of PCNL in the management of renal stone disease

Colonic/Oesophageal stricture: *Gastroenterology teaching*

- Imaging the upper and lower GI tracts
- Indications and technique for oesophageal and colonic stenting

Obstructive jaundice: *GI surgery teaching*

- List the common causes of obstructive jaundice
- The role of U/S, CT, MRCP, ERCP to define the level of obstruction
- Percutaneous Transhepatic Cholangiography Vs ERCP
- Technique of PTC and when to stent the CBD

Complex venous access: *Oncology / Nephrology teaching*

- What is a PICC line, Portacath and Hickman line.
- What are the indications for long term venous access
- Understand the relevant anatomy and principles of line insertion

Interventional Oncology:

Tumour ablation techniques: *Oncology teaching*

- Patient selection for surgery or ablation therapies, and the role of diagnostic imaging.
- Understand the principles of tumour ablation (RFA/cryotherapy/focussed U/S)
- Understand the principles of embolisation (including targeted chemo- and radiotherapy)

Basic Sciences:

The role and techniques of IR rely on a sound knowledge of systemic anatomy and physiology. This will be covered in the 'pre-clinical' basic science teaching of medical school curriculae, but can be re-visited during the clinical years, when targeted anatomy teaching (including pathological changes) relevant to specific procedures or pathologies will enhance an understanding of the role of IR in patient management.

Appendix 1: Anatomy teaching relevant to IR

Cardiovascular anatomy module	• Cardiac anatomy: the chambers, valves and coronary artery anatomy. Vascular anatomy: including the branches of the thoracic and abdominal aorta and the peripheral arteries. • Structure of an artery • Venous anatomy: the concept of deep and superficial venous systems in the leg. Jugular and vena cava anatomy.
Urogenital anatomy teaching	• The kidneys, ureter and bladder. Adrenal anatomy. Renal artery and vein anatomy. • Anatomy of the retroperitoneum including nodal groups.
Hepatobiliary anatomy teaching	• The biliary tree and pancreatic anatomy • Mesenteric and portal vascular anatomy (including hepatic artery, portal vein and hepatic vein antomy) – principles of the portal triad. • Couinard classification of liver segmental anatomy •
GI tract anatomy teaching	• The anatomy of the oesophagus, stomach, small bowel and large bowel • Principles of foregut/midgut and hindgut embryology in relation to COELIAC axis, SMA , IMA and IIA vascular supply to the GI tract.
Spinal and thoracic wall anatomy teaching	• Spinal anatomy (including vertebral anatomy, cord/cauda equina anatomy and nerve roots, spinal vasculature). • Anatomy of the thoracic inlet, first rib/clavicle and subclavian vessels.

Appendix 2: Physiology teaching relevant to IR

Cardiovascular physiology module	• Cardiac function including an understanding of myocardial contractility, valve function, stroke volume/ejection fraction. • Mechanisms of blood pressure control (peripheral vascular resistance, renin-angiotensin system, fluid balance)
Renal Physiology teaching	• Maintenance of renal artery perfusion. • Principles of glomerular function and excretion. • Adrenal function and hyper/hypo secretion syndromes.
Pancreatico-biliary physiology	• Principles of synthetic function and interpretation of LFTs (differentiation of obstructive jaundice from hepatocellular failure). • Bile excretion and gallbladder/ampullary function. • Pancreatic function – exocrine and endocrine functions.

Appendix 3: General complications of IR procedures

Vascular	Haemorrhage, Emboli / vessel thrombosis Pseudo-aneurysm formation
Urological	Sepsis / bacteraemia Haemorrhage Renal false aneurysm formation / AV fistula
Hepatobiliary	Hameorrhage Sepsis / bacteraemia Pain
Biopsy and drainage procedures	Haemorrhage Tumour seeding

Source documents:

CIRSE: Interventional Radiology Curriculum for Medical Students 2012
RCR: Undergraduate Radiology Curriculum 2012
RCR/BSIR: IR Curriculum