ANGIOGRAPHY AND INTERVENTIONAL RADIOLOGY LECTURE SCHEDULE FOR RADIOLOGY RESIDENTS

**Introductory Lecture #1** – Dr. Montgomery
**Introductory Lecture #2** – Dr. Montgomery

**Arterial**
- Introduction Lecture – Dr. Neese
- PVD – Dr. Montgomery
- AAA – Dr. Neese
- Case Conference – Dr. Dollar
- Case Conference – Dr. McDonald

**Venous**
- Introduction Lecture – Dr. McDonald
- TIPS – Dr. Neese
- EVLT – Dr. McDonald
- Venous Thrombolysis – Dr. Neese
- Case Conference – Dr. Dollar
- Case Conference – Dr. Montgomery

**Pain Management**
- Introduction Lecture – Dr. Neese
- Vertebroplasty – Drs. Montgomery and Dollar
- Case Conference – Dr. Dollar
- Case Conference – Dr. McDonald

**Oncology**
- Introduction Lecture – Dr. Montgomery
- IR Cancer Treatment – Dr. Montgomery
- Ablation Therapies – Dr. Montgomery
- Case Conference – Dr. McDonald
- Case Conference – Dr. Neese

**Non-Vascular**
- Introduction Lecture – Dr. Montgomery
- Bilary – Dr. Dollar
- Biopsy and Drainage – Dr. Montgomery
- Case Conference – Dr. McDonald
- Case Conference – Dr. Dollar
INTRODUCTORY LECTURE #1

A. Introduction To Vascular and Interventional Radiology

B. On Call Resident Responsibilities
   • Pre-procedure Assessment and Care
   • Consent
   • Intra-procedure Monitoring
   • Post-procedure Follow-up and Care

C. Laboratory Results
   • Correction of Abnormal Labs

D. General Pharmacologic Considerations
   • Analgesia/Anesthesia
   • Conscious Sedation
   • Antibiotic Treatment
   • Anticoagulation
   • Renal Insufficiency
   • Contrast Allergies
     - Premedication
   • Other

E. Imaging of the Vascular System
   • Plain Film
   • Angiography
   • Contrast Agents
     - Iodinated
     - CO2
     - Gadolinium
   • Vascular Catheterization
   • Risks/Complications
   • Ultrasound
     - Doppler
     - Intravascular Ultrasound
   • CT
     - CT Angio
   • MRI/MRA
   • Nuclear Medicine

F. Tour of Angiography Section and Suite
INTRODUCTORY LECTURE #2

A. History of C.V. and I.R.

B. Educational Issues
   • Training/Credentialing
   • CME
   • Research

C. Legal/Political Aspects
   • Consent
   • Regulatory Agencies

D. Economic Aspects
   • Coding
   • Equipment Purchase
   • Inventory

E. Q.A.
   • Complications

F. Workplace
   • Angiography Suite
   • Recovery
   • Safety Issues
     - Radiation Safety
     - Infection Control

G. Personnel Considerations
   • Nurses, Techs, Trainees, Medical Students, Other MDs
   • In-Service, Education
VASCULAR DIAGNOSIS
ARTERIAL AND VENOUS
(GENERAL)

A. Clinical/Lab Considerations
   • Symptoms
   • Non-invasive Imaging
   • Epidemiology

B. Vascular Anatomy

C. Vascular Physiology, Pathology
   • Histology
   • Hemodynamics
   • Vasoactive Agents
   • Atherosclerosis
   • Medial Sclerosis
   • Aneurysms
   • Thromboembolic Disorders
   • Dissection
   • Congenital Vascular Disorders
   • Infection
   • Vascular Alterations in Neoplasm
   • Systemic Vascular Disorders
   • Vascular Trauma
VASCULAR DIAGNOSIS
VENOUS
(SPECIFIC)

A. Lower Extremity
   • DVT (acute and chronic)
   • Vascular Malformation

B. Upper Extremity
   • Venous Thrombosis (acute and chronic)

C. Central Venous Disorders
   • SVC/Pelvic/IVC
VASCULAR DIAGNOSIS
VENOUS
(SPECIFIC)

- Pulmonary Angiography
  - Contraindication
  - Risks
  - Hemodynamics
  - Thromboembolic Diagnosis
  - AVM
VASCULAR DIAGNOSIS AND TREATMENT (VENOUS)

A. Portal Anatomy
   • Arterial Portography
   • Splenoportography
   • Direct Portography

B. Hepatic-Venography
   • Wedge (balloon occlusion)

C. Pressure Measurements

D. Budd Chiari

E. Portal HTN
   • Causes
   • Collaterals
   • Varices

F. TIPS
   • Preprocedure Assessment
   • Procedure
   • Post-procedure
   • Follow-up
     - Secondary Patency
VASCULAR DIAGNOSIS
(ARTERIAL)

A. Thoracic Aorta
   • Anatomy
     - Intercostals
     - Bronchial
     - Congenital Variants
   • Atherosclerosis
     - Aneurysm Disease
     - Dissection
       □ Classifications
   - Trauma
     □ Aortic Disruption

B. Upper Extremity
   • Anatomy
     - Collaterals
   • Atherosclerosis
   • Steal Syndromes
   • Thoracic Outlet Syndromes
   • Thromboembolism
   • Vasospastic Disorder
   • Trauma
VASCULAR DIAGNOSIS

A. Abdominal Aorta and Pelvis
   • Anatomy
   • Atherosclerosis
     - Occlusive Disease
     - Dissection
     - Aneurysms
   • Trauma
   • Vascular Malformations
   • Vasculogenic Impotence
VASCULAR DIAGNOSIS
(ARTERIAL)

Lower Extremities

A. Anatomy
   • Anatomic Variants
   • Collateral Circulation

B. Aneurysm

C. Occlusive Disease
   • Atherosclerosis
   • Thromboangiitis Obliterans
   • Thromboembolic Occlusive
   • Atheroma/Cholesterol Emboli

D. Trauma

E. Vasospastic Disorders
   • Drug Induced
   • Post-Traumatic
   • Raynards

F. Miscellaneous
   • AVM
   • Hemangioma
   • Klippel-Trenaunay-Weber
   • Adventitial Cystic Disease
   • Popliteal Entrapment

G. Post Surgery
VASCULAR INTERVENTION

A. Recanalization
   I. Thrombolytic Therapy
      - Pharmacologic Agents
      - Mechanical Technique
   II. Balloon Angioplasty/Vascular Stents
   III. Miscellaneous

B. Embolization
   - Techniques
   - Agents

C. Venous Intervention
   I. DVT
   II. PE
   III. Foreign Body Removal
   IV. Fibrin Sheath Stripping
   V. Catheter Repositioning

D. Hemodialysis Grafts/Fistulas

E. Venous Access
VASCULAR DIAGNOSIS
(ARTERIAL)

B. Visceral Angiography (Esophago – Gastrointestinal, Liver, Spleen, Pancreas)
   • Anatomy
     - Collaterals
     - Variants
   • Celiac Artery Compression
   • Mesenteric Ischemia
     - Papaverine
   • Tumors
     - Benign
     - Malignant
   • GI Bleeding
   • Fistulae
   • Inflammatory Diseases
   • Atherosclerosis
   • Embolic Occlusive Disease
   • FMD
   • Arteritis
   • Trauma

C. Renal
   • Tumors
     - Benign
     - Malignant
   • Fistulae
   • Atherosclerosis
   • Embolic Occlusive Disease
   • FMD
   • Arteritis
     - Polyarteritis Nodosa
   • Trauma
VASCULAR INTERVENTION

A. Recanalization
   I. Thrombolytic Therapy
      • Pharmacologic
         - History
         - Agents
         - Contraindications
      • Mechanical
         - Fogarty
         - Suction
         - New Devices
Vascular Intervention

A. Recanalization
II. Angioplasty/Stents
   • History
   • Catheters/Stents
   • Techniques
   • Post Procedure Care
   • Complications
   • Troubleshooting
   • Success
VASCULAR INTERVENTION

A. Recanalization

III. Miscellaneous
   • Atherectomy
   • Mechanical Thromboectomy
   • Laser

IV. Endovascular Stent/Grafts
   • Arterial
   • Venous
VASCULAR INTERVENTION

B. Embolization
   • History
   • Agents
   • Techniques
   • Anatomical Considerations
   • Specific Cases (including but not exclusively)
     - GI Bleeding
     - Trauma
     - Tumor
     - Varicocele
     - Uterine Artery Fibroids
     - Postpartum Bleeding
VASCULAR INTERVENTION  
(VENOUS)  

C. Venous Intervention  
   I. DVT  
      • Anticoagulation  
      • Thrombolytic Treatment  
      • Filters  
   II. PE  
      • Anticoagulation  
      • Thrombolytic Treatment  
      • Thrombectomy
VASCULAR INTERVENTION

D. Hemodialysis (Grafts/Fistulas)
   • Monitoring
   • Diagnosis
   • Recanalization
     - Thrombolytic Therapy
     - Mechanical Thrombectomy
VASCULAR INTERVENTION

Venous Access

- Patient Selection
- Risks/Benefits
- Patency Rates
  - PICC lines
  - Quinton Catheters (non-tunneled central lines)
  - Pass Port
  - Port-a-cath
  - Perm-a-cath (tunneled central lines and catheters)
Non-Vascular Intervention

A. Biliary Intervention
   • PTC
   • Biliary Intervention
     - PTC
     - Biliary Obstruction
       □ Malignant
       □ Benign
       □ Drainage
       □ Stenting
   • Percutaneous Cholecystostomy
     - Acalculous Cholecystitis
     - Calculous Cholezystitis
   • Treatment of Biliary Calculi
   • Brush Biopsies

B. Gastrointestinal Intervention
   • Percutaneous G-tube
   • Percutaneous G-J tube
   • GI Strictures
   • GI Foreign Body Retrieval
NON-VASCULAR INTERVENTION

C. Genitourinary Intervention
   • Renal Obstruction
     - Antegrade pyelography and percutaneous nephrostomy
     - Whitaker Test
     - Nephroureteral stenting
     - Strictures
     - Calculi
   • Percutaneous Nephrolithotomy
   • Urinary Leaks/Fistulas
   • Urinary Diversions
   • Bladder
   • Urethra
     - Strictures
   • Male Specific
   • Female Specific
     - Fallopian tube recanalization
NON-VASCULAR INTERVENTION

D. Biopsies/Aspiration
   • Thoracic
     - Lung
     - Mediastinum
     - Pleura
   • Cervical
   • Abdominal
     - Liver
     - Pancreas
     - Spleen
     - Adrenals
     - GU
     - GI
     - Peritoneum

E. Abscess Drainage
   • Chest
     - Thoracentesis
     - Chest Tube Placement and Management
       □ Pleural Collections
         o PTX
         o Emphysema
         o Hemothorax
       □ Fibrinolytics
         o Malignant
   • Abdomen/Pelvis
     - Peritoneal
     - Paracentesis
     - Retroperitoneal
     - GU
       □ Renal Abscess
       □ Renal Cyst
         o Ablation
     - Liver
     - Pancreas
       □ Types of collections
       □ Pancreatic inflammatory disease
     - Lymphoceles
       □ Ablation
NON-VASCULAR INTERVENTION

All topics under Non-Vascular items will include or be introduced with:

- Patient Care
- Clinical and Lab considerations
- Natural History
- Imaging
- Anatomic Considerations
- Physiology/Pathophysiology
- Procedural Aspects
Resident Responsibilities:

- Start time is 7:30 AM (if Physics lecture is attended, then 8:00 AM).
- Review the cases for the following day with appropriate attending. (If not night before, then early AM, at AM rounds.)
- All patients to be seen (consented) day/night before exam. This includes checking labs, review of chart, short history and physical, and obtaining consent.
- If the patient is an OP (outpatient) or SDA (same day admit, usually 6:00 AM), patient can be seen that AM.
- If patient is admitted after 6:00 PM the night before, resident on-call may perform pre-procedure work-up.
- At the end of each day's procedures all cases to be reviewed/dictated with a appropriate attending.
- Initially observe attending dictating then begin dictating the less complex cases until resident feels comfortable dictating all cases.
- Resident is responsible for placing one interesting case every two weeks during their rotation.
- More specific responsibilities will be discussed when resident is doing Special Procedures rotation.

Suggested Reading List:
ANGIOGRAPHY

Reference Text:

1. Interventional Radiology – The Requisites by Kaufman (Mosby)

2. Normal and Variant Angiographic Anatomy by Kadir (Saunders)
INTERVENTIONAL

Reference Text:

1. Interventional Radiology by Castaneda-Zuniga (Williams & Wilkins)

2. SUGGESTED PURCHASE (either A or B)

Core Book

A. Handbook of Interventional Radiology and Angiography by Myron Wojtowycz (Mosby)

B. Handbook of Cardiovascular and Interventional Radiologic Procedures by Krishna Kandarpa, M.D., Ph.D (Little, Brown)

JOURNALS

1. Journal of Vascular and Interventional Radiology (published monthly)

2. Radiology - Vascular and Interventional Section (published monthly)

All of the above are available from the Library or from Dr. Montgomery

SAMPLE OF PRE-PROCEDURE NOTE:

Patient is a age / sex with chief complaint.

Short History

Patient is for a specific special procedure to be done tomorrow a.m. or p.m. The entire procedure has been explained to the patient. The benefits vs. potential risks, including but not exclusively allergic reaction, hemorrhage, infection have been discussed. The use of IV conscious sedation has also been discussed. Questions answered. Procedure understood and consent has been signed. Above discussed with Interventional attending.

Patient Labs

Short Physical Including Pertinent Pulses In Angiographic Cases

Sign & I.D.
STANDARD INTRODUCTION TO GROIN APPROACH
ARTERIOGRAM
(ABDOMINAL AORTOGRAM)

PROCEDURE:

Following sterile preparation and draping and using standard aseptic technique puncture of Right common femoral artery was done and then using Seldinger technique a 5 Fr Pigtail Catheter was advanced over a wire into the abdominal aorta and left at the level of T12. An abdominal aortogram was performed injecting 60% of non-ionic contrast at a rate of 10 cc per sec. for a total of 15 cc. Patient tolerated the procedure well and no immediate post angiogram complications were observed. Hemostasis of the Right groin was obtained with manual pressure upon removal of the catheter.

FINDINGS:

IMPRESSION:

Cardiovascular and Interventional Radiology Curriculum Outline

Developed by the Education Committee of the Society of Cardiovascular and Interventional Radiology

OVERVIEW

SECTION I: GENERAL TOPICS IN CARDIOVASCULAR AND INTERVENTIONAL RADIOLOGY

Included in this section are the historical aspects of the subspecialty as well as various General practice considerations: legal, political, economic, training, and workplace issues.

SECTION II: PATIENT CARE

This section includes general aspects of patient care; its topics are in turn included, as Appropriate, as they relate to more specific sections of the outline which follows.

SECTION III: VASCULAR DIAGNOSIS

This section starts with a list of “common” topics -radiological and non-radiological aspects of vascular diagnosis--which, in turn, are included as they relate to more specific sections. The specific sections are divided primarily by anatomic regions, and then by organs or organ systems. Although most of the section relates to the circulatory system, the lymphatic system is also included as a special topic.
SECTION IV: VASCULAR INTERVENTION
This section starts with a broad overview of major categories of vascular intervention which, in turn, are included as they relate to more specific sections. The specific sections are then divided primarily by anatomic regions and then by organs or organ systems.

SECTION V: NONVASCULAR INTERVENTION
This section starts with a list of “common” topics--radiological and non-radiological aspects of non vascular intervention--which, in turn, are included as they relate to more specific sections. The specific sections are divided into traditional subsections which relate primarily to organs or organ systems.

SECTION I:
GENERAL TOPICS IN CARDIOVASCULAR AND INTERVENTIONAL RADIOLOGY

• History of Cardiovascular and Interventional Radiology
• Educational Issues
• Training and credentialing
• Continuing education
• Research in Vascular and Interventional Radiology
  • Guidelines for research projects
  • Biostatistics
  • Grants/funding options
• Legal and Political Aspects of Cardiovascular and Interventional Radiology
  • Informed consent
  • Malpractice
• Regulatory agencies
  • Investigational devices and procedures
• Organized medicine
• Business/Economic Aspects
  • CPT coding and related issues
  • Equipment purchase
  • Inventory management
  • Capitation
• Quality Assurance Issues
  • Outcomes analysis
  • Practice guidelines
  • Complications: classification, documentation
• Workplace considerations
  • The vascular/interventional radiology suite
    • Equipment
    • Fluoroscopy
    • Standard angiography
• Digital angiography
• Image processing and recording
• Other equipment (e.g. interventional ultrasound units)
• Layout
  • Recovery room
  • Noninvasive vascular laboratory
    • Equipment
    • Management
  • Occupational Safety Issues
  • Radiation safety and hygiene
  • Infection control
  • Other
• Personnel Considerations
  • The vascular/interventional radiology “team”: role and relationship of nurses, technologists, trainees, other physicians
  • Inservice/continuing education

SECTION II:
PATIENT ARE IN VASCULAR AND INTERVENTIONAL RADIOLOGY
* These topics stand alone as general subjects, but are also assumed to be included as appropriate under subheadings of Sections III-V of the outline.

• Pre-procedural assessment and care
• Intraprocedural monitoring
• Post-procedural followup and care
• General pharmacologic considerations
  • Analgesia/anesthesia
  • Conscious sedation
  • Antibiotic therapy
  • Anticoagulation
  • Other

SECTION III:
VASCULAR DIAGNOSIS

PART I: Common topics
• Although many of these topics can be discussed in a general sense, they are also applicable to the more specific subjects of Section III, Part II and can be assumed to be subheadings of these specific subjects, where appropriate.

• Patient Care (see Section II)

• Clinical and Laboratory Considerations
  • Symptomatology and staging of vascular disease
• Laboratory data (including non-imaging aspects of noninvasive vascular testing; for example, ankle-brachial indices for lower extremity arterial disease, impedance plethysmography for lower extremity venous disease)
• Epidemiology of vascular disease
• Natural history of vascular disorders
• Vascular anatomy: arterial and venous
  • Embryology
  • Normal anatomy
  • Variant anatomy
  • Anatomy of collateral pathways
• Vascular physiology, pathology and pathophysiology: arterial system
  • Normal histology/physiology/morphology
  • Hemodynamics: normal and abnormal flow
  • Vasoactive extrinsic/pharmacologic agents
  • Normal response
  • Disorders related to pharmacologic/extrinsic agent exposure
• Atherosclerosis
• Medial sclerosis
• Pathophysiology of arterial ischemia
• Aneurysms
• Thromboembolic disorders
• Dissection
• Congenital vascular disorders
  • Vascular malformations
  • Other congenital disorders (for example, popliteal artery entrapment in the case of lower extremity vascular disorders)
• Arterial effects of adjacent tissues/disorders
• Arterial infection
• Vascular alterations in neoplasia: vascular supply of neoplasms, primary vascular neoplasms, vascular invasion by neoplasms
• Vascular alterations in inflammatory diseases
• Systemic vascular disorders
  • Primary systemic vascular disorders: vasculitides and others (polyarteritis nodosa, Takayasu’s arteritis, giant cell arteritis, Buerger’s disease)
  • Altered vascular pathology in systemic disease states (for example, in diabetes mellitus, collagen vascular disease, Behçet’s disease, etc.)
• Vascular trauma: injuries and vascular response to injury
  • Mechanical injury: acute and chronic
  • Thermal injury
• Arterial endothelium
• Alterations in coagulation status
  • Hypercoagulable states
  • Impaired coagulation
• Post-operative or post-interventional disorders
  • Synthetic and endogenous grafts
• Myointimal hyperplasia
• Other/unclassified
• Vascular physiology, pathology and pathophysiology: venous/pulmonary arterial system
  • Normal histology/physiology/morphology
  • Hemodynamics: normal and abnormal flow
  • Vasoactive extrinsic/pharmacologic agents
    • Normal response
    • Disorders related to pharmacologic/extrinsic agent exposure
• Thromboembolic disorders: acute and chronic
• Venous aneurysms
• Venous effects of adjacent tissues/disorders
• Congenital vascular disorders
  • Vascular malformations
  • Other congenital disorders
• Venous infection
• Vascular alterations in neoplasia: vascular drainage of neoplasms, primary vascular neoplasms, vascular invasion by neoplasms
• Vascular alterations in inflammatory diseases
• Systemic vascular disorders
  • Primary systemic vascular disorders
• Altered vascular pathology in systemic disease states
• Vascular trauma: injuries and vascular response to injury
  • Mechanical injury--acute and chronic
  • Thermal injury
• Venous endothelium
• Alterations in coagulation status
  • Hypercoagulable states
  • Impaired coagulation
• Post-operative or post-interventional disorders
  • Synthetic and endogenous grafts
  • Intimal hyperplasia
• Other/unclassified

Imaging of the vascular system: general principles
• Plain film
• Angiography: arteriography and venography
  • Standard angiography
  • Digital subtraction angiography
  • Contrast agents
    • Iodinated agents
    • Carbon dioxide
  • Vascular catheterization
    • Equipment: needles, guidewires, catheters, etc.
    • Vascular access
    • Selective and subselective catheterization
• Risks and complications
• Contrast reactions, iodinated agents
  • Anaphylactoid reactions
    • Classification
    • Prevention
      • Ionic vs. nonionic agents
      • Premedication
  • Treatment
• Dose dependent reactions
  • Classification
    • Acute and chronic renal effects
    • Other
  • Prevention
  • Treatment
• Procedural complications
  • Puncture site complications
  • Catheterization-related complications (apart from puncture site)
  • Systemic/generalized complications
• Pharmacoangiography: agents and uses
  • Vasodilatation
  • Vasoconstriction
  • Other
• Ultrasonography
  • Gray scale
  • Duplex Doppler
  • Color flow
  • Intravascular ultrasound
• Computed Tomography
  • General
  • Spiral and Cine CT
  • CT angiography
• Magnetic Resonance Imaging
  • General
  • Blood flow evaluation and MR angiography
• Nuclear medicine
• Angioscopy

PART II: Specific Topics
* The topics listed in Part I should be considered subheadings of the following. However, areas of particular importance are listed specifically.

• Lower extremity vascular disease
  • Arterial
    • Peripheral atherosclerotic arterial disease
    • Lower extremity aneurysms (iliac, femoral, popliteal, other)
• Nonatherosclerotic peripheral vascular disease (popliteal entrapment, adventitial cystic disease
• Iatrogenic disorders: puncture site complications
• Trauma
  • Venous
    • Acute deep venous thrombosis
    • Chronic deep venous thrombosis/venous insufficiency
  • Combined: vascular malformations
• Upper extremity vascular disease
  • Arterial
    • Thoracic outlet syndrome
    • Atherosclerosis
    • Vasculitis, Raynaud’s disease and phenomenon
    • Trauma
  • Venous
    • Acute upper extremity venous thrombosis
    • Chronic upper extremity venous thrombosis
  • Combined: vascular malformations
• Thoracic vascular disease
  • Hemothysis and its evaluation
  • Pulmonary arteries and veins
    • Pulmonary artery hemodynamics (as related to pulmonary angiography)
    • Pulmonary thromboembolic disease
    • Pulmonary arteriovenous malformations
    • Pulmonary venous disorders
• Aortic disorders
  • Aortic aneurysm
  • Aortic dissection
  • Aortic trauma
  • Congenital disorders
  • Vasculitides affecting the aorta
  • Post-operative aorta
• Central venous disorders (SVC, IVC)
  • Central venous occlusive disorders
• Vascular diagnosis, abdominal and pelvic viscera
  • Genitourinary system
    • Kidney
      • Renovascular hypertension: causes, workup, including noninvasive imaging, renin-angiotensin system and renin sampling, arteriography
      • Renal trauma
      • Renal neoplasms
    • Ureters/bladder
    • Prostate
    • Testes/scrotum
• Vasogenic impotence in men
• Uterus
  • Gynecologic hemorrhagic disorders
• Ovaries
• Gastrointestinal Tract
  • Gastrointestinal hemorrhage
  • Workup considerations: angiography vs. endoscopy vs. nuclear medicine
  • Specific causes
    • Gastritis
    • Peptic ulcer disease
    • Mallory-Weiss tear
    • Hepatobiliary: hemobilia
    • Neoplasms
    • Angiodysplasia
    • Diverticulitis
    • Vascular malformations
    • Venous bleeding (see also section on portal hypertension)
    • Other
  • Angiographic evaluation
• Mesenteric ischemia
  • Acute mesenteric ischemia
    • Embolic
    • Thrombotic
    • Nonocclusive
    • Mesenteric venous ischemia
    • Other
  • Chronic mesenteric ischemia/mesenteric atherosclerosis
• Mesenteric aneurysms
• Portal/hepatic vascular disorders
  • Portal hypertension
    • General imaging evaluation
    • Angiographic evaluation: arterial portography, splenoportography, direct portography, hepatic venography, wedge (or balloon occlusion) hepatic venography and pressure measurements
    • Classification
      • Budd-Chiari syndrome and other forms of hepatic venous outflow obstruction
      • Hepatic neoplasms: primary and secondary
  • Pancreas
    • Vascular manifestations of pancreatic inflammatory disease
    • Pancreatic neoplasms
      • Evaluation for resectability
      • Detection of islet cell tumors
        • Arteriography
- Venous sampling
  - Spleen
    - Splenic trauma
  - Adrenal glands
    - Arteriographic and venographic evaluation of neoplasms (including risks in setting of pheochromocytoma)
  - Cardiac/coronary vasculature
    - Congenital heart and great vessel disease
    - Coronary artery disease
    - Acquired non coronary heart disease
      - Valvular
      - Endocardial
      - Myocardial
      - Pericardial

- Neuroangiography
  - Atherosclerotic cerebral vascular disease
  - Aneurysms
  - Vascular malformations

- Vascular aspects of endocrine disorders
  - Clinical aspects
  - Venous sampling
    - Indications
    - Techniques
  - Specific sites
    - Thyroid/parathyroid
    - Adrenal
    - Pancreas
    - Ovarian
  - Postsurgical conditions
    - Arterial and venous bypass procedures
    - Grafts for aneurysms
    - Grafts for dissection
    - Dialysis access procedures and disorders

- Vascular aspects of organ transplantation
  - Liver
  - Kidney
  - Pancreas
  - Small bowel
  - Heart
  - Lung

- Lymphatic system
  - Anatomy
  - Lymphangiography
    - Performance
    - Interpretation
    - Indications and contraindications
• Risks
  • Other methods of evaluation
  • Physiology, pathology, pathophysiology
• Pediatric vascular diagnosis (see the general topics parts I and II of this section; although clear differences exist in vascular diagnostic considerations between pediatric and adult age groups, a detailed outline is not provided here)

SECTION IV:
VASCULAR INTERVENTION

PART I: Common Topics and Major Categories, Vascular Intervention
* Although many of these topics can be discussed in a general sense, they are also applicable to the more specific subjects of Section IV, Part II and can be assumed to be subheadings of these specific subjects, where appropriate.

• Patient Care (see Section II)
• Common Topics: vascular interventional procedures
  • Anatomic considerations
  • Indications and contraindications
  • Techniques, devices, materials
  • Results, efficacy
  • Risks and complications
  • Alternate techniques (surgical and medical therapeutic options)
• Vascular canalization/recanalization: re-establishment of flow
  • Thrombolytic therapy
    • Pharmacologic thrombolysis
      • General principles
      • Specific agents: urokinase, streptokinase, tissue plasminogen activator, others
    • Mechanical techniques
      • Fogarty balloon
      • Suction thromboembolectomy
      • Other/newer devices
  • Balloon angioplasty
  • Atherectomy
  • Laser recanalization
  • Mechanical recanalization
  • Vascular stents
  • Endovascular grafts
  • Other
• Vascular blockade: obliteration of flow
  • Embolization
    • Techniques
      • Transcatheter
      • Direct injection
    • Agents
• Other methods
  • Ultrasound guided compression repair

• Infusional therapy
  • Flow diminution
  • Flow enhancement

• Re-routing of flow
  • Endovascular repair of aneurysms
  • Creation of new vascular channels (e.g. TIPS, fenestration of aortic dissection)

• Vascular filters
• Vascular foreign body removal
• Intravascular/transvascular biopsy
  • Transvenous liver biopsy
  • Other

PART II: Specific Topics
* The topics listed in Part I should be considered subheadings of the following. However, areas of particular importance are listed specifically.

• Lower extremity vascular disease
  • Arterial
    • Occlusive atherosclerotic disease: recanalization
      • Aortoiliac
      • Femoropopliteal
      • Tibioperoneal
    • Intervention for peripheral arterial trauma
    • Thromboembolic disorders: recanalization
    • Peripheral arterial graft failure: recanalization
    • Iatrogenic disorders: therapy for puncture site complications
  • Venous
  • Combined: vascular malformations: obliteration

• Upper extremity vascular disease
  • Arterial
    • Thromboembolic disorders: recanalization
    • Trauma
  • Venous
    • Acute upper extremity venous thrombosis: recanalization
    • Chronic upper extremity venous thrombosis: recanalization
  • Combined: vascular malformations: obliteration

• Thoracic vascular disease
  • Hemoptyisis
    • Bronchial embolization
    • Other techniques
  • Pulmonary arteries and veins
• Pulmonary thromboembolic disease: thrombolytic therapy, thromboembolectomy
• Pulmonary arteriovenous malformations: embolization

• Aortic disorders
  • Aortic aneurysm: embolization, endovascular grafting
  • Aortic dissection: endovascular grafting, fenestration
  • Aortic trauma

• Central venous intervention (SVC, IVC)
  • Central venous occlusive disorders
    • Thromboembolic disorders
    • Congenital webs
  • Indwelling central venous access
  • Caval filtration and related techniques for thromboembolic disease

• Vascular diagnosis, abdominal and pelvic viscera
  • Genitourinary system
    • Kidney
      • Renovascular hypertension: recanalization techniques
      • Renal trauma
      • Renal neoplasms
      • Renal ablation
    • Uterus: Treatment of gynecologic hemorrhage
    • Interventional techniques in treatment of vasogenic impotence
    • Varicoceles

• Gastrointestinal Tract
  • Gastrointestinal hemorrhage
    • Embolization vs. infusional therapy (vasopressin)
    • Specific sites
      • Upper GI (esophago-gastro-duodenal)
      • Small bowel
      • Colonic
  • Mesenteric ischemia
    • Acute mesenteric ischemia
      • Infusional therapy: vasodilators
    • Thromboembolic disease: thrombolytic therapy
    • Chronic mesenteric ischemia/mesenteric atherosclerosis
      • Recanalization techniques: angioplasty, stents, etc.
  • Mesenteric aneurysms/pseudoaneurysms

• Portal/hepatic vascular disorders
  • Portal hypertension
    • Variceal bleeding: embolization and infusional therapy
    • Transjugular intrahepatic portosystemic shunt-stent (TIPS)
  • Budd-Chiari syndrome and other forms of hepatic venous outflow obstruction
  • Hepatic neoplasms: infusional therapy and chemoembolization

• Pancreas
  • Therapy for vascular manifestations of pancreatic inflammatory disease
• Spleen
  • Vascular intervention for splenic trauma
  • Treatment of hypersplenism
• Cardiac/coronary vasculature
  • Congenital heart disease
  • Coronary artery disease
  • Valvular disease
• Neurovascular intervention
  • Chronic cerebrovascular occlusive disease
    • Atherosclerotic
    • Other
  • Neurovascular intervention in stroke
  • Aneurysms
  • Vascular malformations
  • Neoplasms
• Intravascular tumor therapy
  • Infusional therapy
  • Chemoembolization
• Vascular intervention in organ transplantation
  • Liver
  • Kidney
  • Pancreas
  • Small bowel
  • Heart
  • Lung
• Dialysis access intervention: recanalization techniques
• Congenital disorders: Principles and practice of interventional management of
  Arteriovenous malformations
• Pediatric vascular intervention (see the general topics parts I and II of this Section;
  although clear differences exist in types and frequencies of procedures between
  pediatric and adult age groups, a detailed outline is not provided here)

SECTION V:

NON VASCULAR INTERVENTION

PART I: Common topics
* Although many of these topics can be discussed in a general sense, they are also
  applicable to the more specific subjects of Section V, Part II and can be assumed to be
  subheadings of these specific subjects, where appropriate.

• Patient Care (see Section II): note that “tube management” plays a large role in many
  nonvascular interventions
• Clinical and Laboratory Considerations
  • Symptomatology and staging of nonvascular disorders
  • Laboratory data
• Epidemiology
• Natural history
• Imaging
  • Plain film
  • Endoluminal contrast studies: gastrointestinal tract, cholangiographic techniques
  • Intravascular contrast studies (intravenous urography, cholangiographic techniques)
  • Direct injection of contrast (percutaneous cholangiography, antegrade nephrostograms, retrograde ureteropyelography)
  • Ultrasonography
  • Computed tomography
  • Magnetic resonance imaging
  • Nuclear medicine
  • Endoscopic techniques
    • Gastrointestinal endoscopy
    • ERCP
    • Biliary endoscopy
    • Genitourinary endoscopy: antegrade, retrograde
• Anatomic considerations
  • Embryology
  • Normal anatomy
  • Variant anatomy
• Physiology, pathology and pathophysiology
  • Normal histology/physiology/morphology
  • Pathologic conditions
• Procedural aspects
  • Indications and contraindications
  • Techniques, devices, materials
  • Results, efficacy
  • Risks and complications
  • Alternate techniques (surgical and medical therapeutic options)

PART II: Specific Topics
* The topics listed in Part I should be considered subheadings of the following.

• Biopsy and diagnostic fluid aspiration
  • Specific sites
    • Thoracic (see also thoracic nonvascular intervention, below)
      • Lung
      • Mediastinum
      • Pleura
    • Cervical
      • Thyroid/parathyroid
      • Salivary
      • Other neck
• Breast (including biopsy and tumor localization)
• Superficial tissues
• Abdominal
  • Liver
  • Pancreas
  • Biliary system
  • Spleen
  • Adrenals
• Genitourinary
  • Kidneys
  • Ureters/bladder
  • Prostate
  • Uterus/ovaries
  • Testes
• Gastrointestinal tract
• Retroperitoneum
• Peritoneum
  • Paracentesis
  • Peritoneal masses
• Bone
• Tissue sampling considerations
• Fluid/abscess drainage
• Sites
  • Chest: see chest intervention, below
  • Abdomen/Pelvis
    • Peritoneal
    • Retroperitoneal
    • Genitourinary
      • Renal abscess
      • Renal cyst
  • Liver
    • Hepatic abscess
    • Bilomas
    • Hepatic cysts
  • Pancreas
    • Types of collections, pancreatic inflammatory disease (abscess, pseudocyst, etc.)
    • Drainage in pancreatic inflammatory disease
  • Spleen
  • Gastrointestinal tract: see gastrointestinal intervention, below
• Musculoskeletal
• Categories
  • Cysts
    • Cyst sclerosis
  • Hematomas
    • Use of thrombolytic therapy
• Lymphoceles
• Lymphocele sclerosis
• Abscesses

Biliary intervention
• Percutaneous transhepatic cholangiography
• Biliary obstruction: percutaneous biliary drainage and stenting
  • Malignant obstruction and strictures
  • Primary biliary tumors: cholangiocellular carcinoma, etc.
  • Ampullary and periampullary tumors
  • Metastatic disease (intraductal, extrinsic)
• Benign obstruction and strictures
  • Primary disorders
    • Inflammatory (including sclerosing cholangitis)
    • Neoplastic
  • Post-surgical
• Percutaneous cholecystostomy
  • Acalculous cholecystitis
  • Calculous cholecystitis
  • As an adjunct to cholangiography and biliary drainage
• Treatment of biliary calculi
  • In the gallbladder
  • In the biliary ducts

• Gastrointestinal intervention
  • Gastrointestinal intubation
  • Percutaneous gastrostomy and gastrojejunostomy
  • Percutaneous jejunostomy
  • Percutaneous cecostomy
  • Abscesses resulting from enteric leaks
  • Gastrointestinal fistulas: interventional management
  • Gastrointestinal strictures
  • Gastrointestinal obstruction
  • Gastrointestinal foreign body retrieval
  • Interventional radiology in specific disorders
    • Appendicitis
    • Diverticulitis
    • Inflammatory bowel disease

• Genitourinary intervention
  • Renal obstruction
    • Antegrade pyelography and percutaneous nephrostomy
    • Whitaker test
    • Nephroureteral stenting
    • Upper urinary tract strictures
    • Upper urinary tract calculi
  • Urinary leaks/fistulas
  • Urinary diversions
  • Bladder
• Urethra
  • Strictures

• Male specific
  • Benign prostatic hyperplasia

• Female specific
  • Fallopian tube recanalization

• Thoracic nonvascular intervention
  • Chest tube placement and management
    • Pleural collections
      • Pneumothorax
      • Empyema
        • Natural history
        • Principles of therapy
        • Use of fibrinolytic agents
    • Malignant pleural effusions
      • Sclerotherapy
    • Hemothorax
      • Principles of therapy
      • Use of fibrinolytic agents

• Infected parenchymal collections
• Tracheobronchial tree
  • Stricture dilatation and stenting
  • Transthoracic needle biopsy
• Mediastinal disorders

• Foreign body retrieval: nonvascular

• Nonvascular interventional aspects of organ transplantation
  • Liver
  • Kidney
  • Pancreas
  • Small bowel

• Nonvascular interventional methods of tumor therapy
  • Direct injection techniques: ethanol, chemotherapeutic agents, cryotherapy

• Nonvascular interventional methods of organ ablation

• Pediatric Nonvascular Intervention (see the general topics parts I and II of this section; although clear differences exist in types and frequencies of procedures between pediatric and adult age groups, a detailed outline is not provided here)

• Other nonvascular intervention