

**CURRICULUM FOR RESIDENCY TRAINING
IN
INTERVENTIONAL RADIOLOGY**

Table of Contents

Introduction	1
Overview of IR Core Competencies	2
Curriculum Detail	5

I. Fundamentals of Image-Guided Interventions

I.a.i.	Imaging for Intervention and Invasive Diagnostic Procedures
I.a.ii.	Basic Tools of Image-Guided Intervention and Invasive Diagnostic Procedures
I.a.iii.	General Techniques of Image-Guided Intervention and Invasive Diagnostic Procedures
I.a.iv.	Specific Procedural Techniques and Devices—Vascular Interventions
I.a.v.	Specific Procedural Techniques and Devices—Non-Vascular Interventions and Invasive Diagnostic Procedures
I.b.i.	General Principles of Radiation Safety
I.b.ii.	Biological Hazards
I.b.iii.	Musculoskeletal Occupational Injuries
I.b.iv.	The Joint Commission (TJC) National Patient Safety Goals
I.b.v.	Quality Improvement
I.c.i.	Informatics
I.c.ii.	Regulatory Supervision and Reporting
I.d.i.	Certification, MOC
I.d.ii.	ACGME Competencies
I.d.iii.	Participation in IR Medical Societies

- I.e.i. Statistics Relevant to IR
- I.e.ii. IR Research and Reporting Techniques
- I.e.iii. Interpretation of IR Literature
- I.e.iv. HIPAA Compliance

II. Clinical Care in IR

- II.a.i. Focused History and Physical Examination
- II.a.ii. Informed Consent for IR Procedures
- II.a.iii. Procedural Sedation for IR Procedures
- II.a.iv. Recognition and Initial Management of Intra- and Peri-Procedural Emergencies
- II.a.v. Procedural Reporting
- II.a.vi. Inpatient Care
- II.a.vii. IR Clinic
- II.a.viii. Pharmacology Relevant to IR
- II.a.ix. Medical Conditions Relevant to IR Procedures
- II.b. Health Care Team Coordination
- II.c. Coding and Billing

III. Vascular Imaging and Diagnosis

- III.a.i. Clinical Vascular Examination
- III.a.ii. Non-Invasive Peripheral Vascular Lab
- III.a.iii. CT Angiography
- III.a.iv. MR Angiography
- III.a.v. Ultrasound
- III.b.i. Angiographic Diagnostic Catheters and Guidewires

- III.b.ii. Selective Catheterization Techniques
- III.c.i. Normal and Variant Arterial Anatomy
- III.c.ii. Normal and Variant Vascular Anatomy of the Systemic Veins
- III.c.iii. Normal and Variant Vascular Anatomy of the Portal Venous System
- III.c.iv. Normal and Variant Pulmonary Vascular Anatomy
- III.c.v. Normal and Variant Anatomy of the Lymphatics
- III.d.i. Arterial Vascular Disorders
- III.d.ii. Systemic Venous Disorders
- III.d.iii. Dialysis Access Disorders
- III.d.iv. Portal Venous Disorders
- III.d.v. Pulmonary Artery Disorders
- III.d.vi. Lymphatic Disorders

IV. Vascular Interventions

- IV.a. Principles of Vascular Interventions
- IV.b.i.a. Peripheral Arterial Intervention
- IV.b.i.b. Treatment of Ateriovenous Malformation (AVM)
- IV.b.i.c. Aortic Interventions
- IV.b.i.d. GI Bleeding—Arterial
- IV.b.i.e. Mesenteric Ischemia
- IV.b.i.f. Visceral Aneurysm Interventions
- IV.b.i.g. Renal Artery Interventions
- IV.b.i.h. Hepatic Arterial Interventions

IV.b.i.i.	Arterial Trauma Interventions
IV.b.i.j.	Uterine Artery Interventions
IV.b.i.k.	Bronchial Artery Embolization
IV.b.ii.a.	Transjugular Intrahepatic Porto-Systemic Shunt (TIPS)
IV.b.ii.b.	Variceal Obliteration, Sclerosis
IV.b.ii.c.	Balloon-occluded Retrograde Transvenous Obliteration (BRTO) of Gastric Varices
IV.b.ii.d.	Portal Vein Dilation and Stenting
IV.b.ii.e.	Portal Vein Recanalization
IV.b.iii.a.	Pulmonary Artery Arteriovenous Malformation (AVM)
IV.b.iii.b.	Pulmonary Embolism (PE) Management—Thrombolytic Therapy
IV.b.iv.a.	Reproductive Tract
IV.b.iv.b.	Upper-Extremity / Superior Vena Cava Occlusive Disease
IV.b.iv.c.	Lower-Extremity Venous Occlusive Disease
IV.b.iv.d.	Foreign Body Retrieval
IV.b.iv.e.	Caval Filtration
IV.b.iv.f.	Transvenous Biopsy
IV.b.iv.g.	Venous Sampling for Endocrine Disease
IV.b.iv.h.	Hemodialysis Access Management
IV.b.iv.i.	Venous Access
IV.b.v.a.	Lymphangiography
IV.b.v.b.	Thoracic Duct Ablation

V. Non-Vascular Intervention and Invasive Diagnostic Procedures

- V.a. Principles of Non-Vascular Intervention
- V.b.i.a. Biopsy in the Abdomen and Pelvis
 - V.b.i.b. Liver Biopsy
 - V.b.i.c. Thoracic Biopsy
 - V.b.i.d. Bone Biopsy
 - V.b.i.e. Soft Tissue Biopsy
- V.b.ii.a. Abdominal, Pelvic Drainage
- V.b.ii.b. Solid Organ Abscess Drainage
- V.b.ii.c. Appendiceal, Peri-Appendiceal Abscess Drainage
- V.b.ii.d. Pancreatic Inflammatory Disease
- V.b.ii.e. Enterocutaneous Fistula
- V.b.ii.f. Follow-Up Care and Procedures
- V.b.iii.a. Paracentesis
- V.b.iii.b. Simple Cysts
- V.b.iii.c. Placement of Tunneled Peritoneal Drain
- V.b.iii.d. Lymphocele Drainage and Sclerosis, Seroma Drainage and Sclerosis
- V.b.iv.a. Esophageal Intervention
- V.b.iv.b. Gastrostomy and Gastrojejunostomy
- V.b.iv.c. Percutaneous Cecostomy
- V.b.iv.d. Percutaneous Jejunostomy
- V.b.iv.e. GI Tract Stenting (Duodenal and Colonic)

V.b.v.a.	Percutaneous Transhepatic Cholangiography (PTC)
V.b.v.b.	Biliary Drainage
V.b.v.c.	Biliary Dilation and Stent
V.b.v.d.	Percutaneous Cholecystostomy
V.b.vi.a.	Percutaneous Nephrostomy
V.b.vi.b.	Nephroureteral Dilation and Stenting
V.b.vi.c.	Renal Cyst Sclerosis
V.b.vi.d.	Suprapubic Cystostomy
V.b.vi.e.	Renal and Peri-Renal Fluid Collection Drainage
V.b.vi.f.	Urodynamics
V.b.vi.g.	Ablation of the Kidney
V.b.vi.h.	Ablation of the Adrenal Gland
V.b.vii.a.	Hysterosalpingography and Fallopian Tube Interventions
V.b.vii.b.	High-Intensity Focused Ultrasound (HIFU) Treatment of Uterine Leiomyomata (Fibroids)
V.b.viii.a.	Ablation of Liver Masses
V.b.viii.b.	Chemical Ablation of Liver Masses
V.b.ix.a.	Thoracentesis
V.b.ix.b.	Chest Tube Placement
V.b.ix.c.	Tunneled Pleural Drainage Catheters
V.b.ix.d.	Sclerotherapy (Pleurodesis)
V.b.ix.e.	Lung Tumor Ablation
V.b.ix.f.	Airway Dilation and Stenting
V.b.x.a.	Breast Drainage

V.b.x.b.	Breast Biopsy
V.b.xi.a.	Percutaneous Vertebroplasty
V.b.xi.b.	Vertebral height Restoration
V.b.xi.c.	Thermal Ablation of Bone Lesions
V.b.xi.d.	Percutaneous Disc Interventions
V.b.xi.e.	Chemical Ablation of Desmoid Tumors
V.b.xii.a.	Selective Nerve Root Block
V.b.xii.b.	Stellate Ganglion Block
V.b.xii.c.	Facet Injections

Introduction

Residency training in Interventional Radiology is intended for medical school graduates interested in obtaining training in the clinical, imaging, and procedural skills required for a career in image-guided interventions. The basic schematic of the training is:

PGY 1:	Internship
PGY 2–4:	DR-focused training
PGY 5–6:	IR-focused training

The DR-focused portion of training will include Radiation Physics training. The IR resident will be required to take and pass the same Core Diagnostic Radiology Examination as the DR residents at the end of PGY 4. Subsequent to completion of PGY 4, the IR resident will enter the IR-focused segment of training.

This IR curriculum must provide an understanding of the clinical diagnosis and focused peri-procedural care of patients with diseases commonly treated with IR procedures, the imaging techniques and interpretation skills needed for procedure planning and patient follow-up, and competency in common IR procedures.

During the IR residency, the trainee will have graduated experience and responsibility in consultation, pre-procedural assessment, procedures and post-procedural care. The trainee will be responsible for ordering and interpreting appropriate pre- and post-procedural imaging and other testing. The trainee must have both inpatient and outpatient experience and graduated responsibility in focused peri-procedural patient care. This must include a dedicated IR outpatient clinic and inpatient admissions to an IR service. The specialty training should include training in noninvasive peripheral vascular lab interpretation (under the supervision of a faculty member with noninvasive vascular certification).

The senior IR residents will function as chief residents. They will provide supervision of the more junior residents on the IR service in focused peri-procedural patient care, performance of procedures and fair allocation of cases to IR and DR residents commensurate with their abilities.

Overview of IR Core Competencies

Since 1999, there has been a shift in graduate medical education from teacher expectations to the development of competencies focused on the trainee. The training program must create a work environment where the trainee can develop a set of core competencies that allows the trainee to practice in varying and complex environments. What follows are the core competencies, in the format put forward by the ACGME, adapted for residency training in Interventional Radiology.

Patient Care

1. Develop competence in arterial, venous, portal-venous, biliary and urinary percutaneous endoluminal procedures and percutaneous image-guided biopsy, drainage and ablative therapies
2. Demonstrate an ability to provide clinically useful consultation in a wide variety of clinical situations where image-guided therapies may be considered
3. Develop ability to deliver consistent focused pre-procedural evaluation and care, including assessment of procedure risks and potential benefits. This process should include the ability to recognize when consultation of another specialist is needed to help in this pre-procedural assessment of risks and benefits.
4. Demonstrate the appropriate use and interpretation of pre-procedural imaging studies
5. Demonstrate competence in case selection for a wide variety of image-guided therapies
6. Demonstrate appropriate use of conscious sedation and competence in the performance of conscious sedation for image-guided therapies in a wide variety of patient clinical situations
7. Provide post-procedural care with attention to common and uncommon adverse events, knowledge of when to obtain consultation from other services, and selection of appropriate discharge criteria
8. Understand the importance of focused clinical follow-up and develop an ability to arrange for appropriate long-term follow-up after an IR procedure
9. Participate in collaborative multidisciplinary patient care
10. Demonstrate competence in the interpretation of plain films, CT, MR, ultrasound and nuclear medicine studies pertinent to the practice of IR

Medical Knowledge

1. Understand the common principles that link image-guided therapies including fluoroscopic projection of 3D structures in 2D, planar image guidance (CT and US), Seldinger technique, contrast opacification and flow, and the relations between guidewire and device movement
2. Know the indications, contraindications, risks and benefits of all common IR procedures
3. Develop an understanding of the anatomy and pathology seen in IR and be able to correlate this knowledge with imaging used in the planning, follow-up and

execution of IR procedures

4. Demonstrate competence in Radiation Physics and Biology as it applies to IR and DR
5. Develop a working knowledge of coagulation, coagulation disorders, anticoagulation therapy and the correction of coagulation for procedures
6. Understand microbiology and antimicrobial therapy as it relates to IR procedures
7. Demonstrate mastery of radiographic contrast agent pharmacology and radiographic properties
8. Understand common IR clinical and translational research methods and statistical analysis

Practice-based Learning and Improvement

1. Develop an ability to work with other specialists to develop a treatment plan for patients undergoing IR consultation
2. Understand the impact of successful procedures and procedural complications through the focused follow-up of patients
3. Evidence-based medicine: Use the IR literature to plan procedures and manage patients
4. Through participation in quality improvement projects of faculty, develop the habits of measuring performance in practice and using practice performance data to shape improvements.
5. Develop an understanding of the natural history of the biliary, urinary, arterial, venous and solid organ pathology seen in IR through long-term follow-up of IR patients

Interpersonal and Communication Skills

1. Learn how to communicate effectively with patients and their families and develop the skills to manage difficult situations
2. Be able to clearly present the relative risks and benefits of a procedure to patients, families, staff and referring physicians
 - a. Overcome language barriers with patients and families
 - b. Demonstrate understanding of bringing staff and referring/consulting physicians into complex discussions of risks and benefits of procedures
 - c. Demonstrate how to succinctly and effectively relay pertinent information to referring and consulting physicians
3. Demonstrate enhanced interpersonal skills with staff, peers and referring physicians
 - a. Address staff concerns and questions appropriately and respectfully
 - b. Demonstrate collegial conversations with referring physicians regarding patient care plans
4. Be able to produce quality consults and be able to communicate these reports effectively
 - a. Understand judicious use of imaging studies
 - b. Appropriately weigh relative value of alternative medical or surgical management
5. Provide consistently high-quality procedure reports that are useful for all the

potential recipients within the health system

Professionalism

1. Develop bedside skills required for gaining trust and for obtaining appropriate consent for IR procedures
2. Demonstrate effective communication skills (written and oral) with staff and referring/consulting physicians
3. Develop the leadership skills to direct an IR procedure independently
4. Understand the professional contributions of all the staff and physicians of a hospital or clinic to allow an IR service to practice
5. Demonstrate working knowledge of the Medical Professionalism Charter, including the three fundamental principles and 10 professional commitments

Systems-based Practice

1. Display proficiency in the multidisciplinary collaborative care of patients
2. Display an ability to determine when referral of IR patients to other specialists is required
3. Recite the treatment alternatives for common image-guided therapies
4. Develop an understanding of the role of IR in health care, and work collaboratively with other specialists to optimize patient care across the health care system
5. Be able to evaluate the costs associated with IR procedures and alternative therapies

Curriculum Detail

There are four basic elements of the IR curriculum:

- 1) fundamentals of image-guided interventions;
- 2) clinical care in IR
- 2) vascular imaging and diagnosis;
- 3) vascular interventions; and
- 4) nonvascular interventions and invasive diagnostic procedures.

I.a.i. Fundamentals of Image-guided Procedures / General Principles of IR / Imaging for intervention and invasive diagnostic procedures

1. Content

Imaging for intervention and invasive diagnostic procedures

2. Learning objectives

- a. Demonstrate understanding of the principles of and competency in the application and interpretation of imaging modalities used in intervention and invasive diagnostic procedures
- b. Plan and perform procedural elements and techniques relevant to imaging
 - i. Requirements for imaging including
 - a. Physician competency in interpretation
 - b. Local and hospital requirements
 - c. Properly functioning equipment
 - d. Trained technical staff
 - e. Shielding
 - f. Exposure monitoring g. Patient safety
 - ii. Appropriate application and interpretation of imaging for intervention invasive diagnostic procedures utilizing
 - a. Fluoroscopy
 - b. Radiographs
 - c. US
 - d. CT
 - e. MR
 - f. Nuclear medicine
 - iii. Monitoring and recording of
 - a. Images

- b. Interpretations
 - c. Radiation exposure
- iv. Evaluation of imaging
 - a. Image quality
 - b. Patient safety
 - c. Operator safety
- v. Assess outcomes of imaging
 - a. Exposure thresholds
 - b. Image interpretation

I.a.ii. Fundamentals of Image-guided Procedures / General Principles of IR /

1. Content

Basic tools of image-guided intervention and invasive diagnostic procedures

2. Learning objectives

a. Demonstrate understanding of the basic devices used in diagnostic and interventional procedures.

b. Plan and perform procedural elements and techniques relevant to basic device selection relative to image-guided invasive diagnostic and interventional procedures

i. Requirements for procedural device selection related to patient-specific needs, disease process, and procedural aims

ii. Appropriate application of basic image-guided intervention and diagnostic devices

- a. Access needles
- b. Guidewires
- c. Catheters
- d. Sheaths / guide catheters
- e. Access management technologies
- f. Angioplasty balloons
- g. Stents
- h. Stent-grafts
- i. Thrombus management devices and drugs
- j. Debulking devices
- k. Embolic devices and materials
- l. Venous filtration devices
- m. Ablation devices and drugs
- n. Foreign body removal tools
- o. Biopsy devices
- p. Drainage devices

iii. Monitoring and recording of image-guided invasive interventional and diagnostic procedures including device inventory, patient monitoring, device malfunction reporting, image archiving, and medical reporting

iv. Evaluation of devices for image-guided intervention and diagnostic devices for integration into clinical practice

- a. Safety
- b. Efficacy

c. Cost effectiveness

v. Assess outcomes related to invasive image-guided interventional and diagnostic devices.

I.a.iii. Fundamentals of Image-Guided Interventions / General Principles of IR / General techniques of image-guided intervention and invasive diagnostic procedures

1. Content

General techniques of image-guided intervention and invasive diagnostic procedures

2. Learning objectives

- a. Demonstrate understanding of the basic techniques for performance of image-guided intervention and invasive diagnostic procedures.
- b. Plan and perform common procedural elements and techniques
 - i. Requirements for image-guided intervention and invasive diagnostic procedures including / such as
 - a. Access
 - 1. Arterial
 - 2. Venous
 - 3. Hollow organ
 - 4. Solid organ
 - 5. Fluid collection
 - b. Access site management
 - 1. Arterial
 - 2. Venous
 - 3. Non-vascular
 - c. Catheterization
 - 1. Arterial
 - 2. Venous
 - 3. Biliary
 - 4. Urinary
 - 5. Gastrointestinal
 - d. Patient selection and focused pre-procedure evaluation
 - e. Procedural imaging
 - f. Interventional technique and device selection
 - g. Application of technique and device
 - h. Documentation of result of intervention
 - i. Recognition and treatment of complications
 - j. Focused post-procedural patient management and follow-up
 - ii. Appropriate application of image-guided intervention and invasive diagnostic procedures
 - iii. Monitoring and recording of image-guided intervention and invasive diagnostic procedures

iv. Evaluation of image-guided intervention and invasive diagnostic procedures

v. Assess outcomes of image-guided intervention and invasive diagnostic procedures

I.a.iv. Fundamentals of Image-Guided Interventions / General Principles of IR / Specific procedural techniques and devices—vascular interventions

1. Content

Specific procedural techniques and devices—vascular interventions

2. Learning objectives

- a. Demonstrate understanding of the principles of vascular interventional procedures and devices
- b. Plan and perform procedural elements and techniques relevant to vascular interventions
 - i. Requirements for vascular interventions including
 - a. Techniques including
 - 1. Angioplasty
 - 2. Stenting
 - 3. Stent-grafts
 - 4. Thrombolysis / percutaneous thrombectomy
 - 5. Debulking
 - 6. Re-entry devices
 - 7. Embolization
 - 8. Venous filtration
 - 9. Infusion therapy
 - 10. Thermal ablation
 - 11. Foreign body removal
 - 12. Access closure
 - 13. Embolic protection
 - b. Patient selection and focused pre-intervention evaluation
 - c. Procedural imaging
 - d. Interventional technique and device selection
 - e. Application of technique and device
 - f. Documentation of result of intervention
 - g. Recognition and treatment of complications
 - h. Focused post-procedural patient management and follow-up
 - ii. Appropriate application of image-guided vascular interventions
 - iii. Monitoring and recording of image-guided vascular interventions
 - iv. Evaluation of image-guided vascular interventions
 - v. Assess outcomes of image-guided vascular interventions

I.a.v. Fundamentals of Image-Guided Interventions / General Principles of IR / Specific Procedural Techniques and Devices—non-vascular interventions and invasive diagnostic procedures

1. Content

Specific procedural techniques and devices—non-vascular interventions and invasive diagnostic procedures

2. Learning objectives

a. Demonstrate understanding of the principles of non-vascular interventions and invasive diagnostic procedures

b. Plan and perform procedural elements and techniques relevant to non-vascular interventions and invasive diagnostic procedures

i. Requirements for non-vascular interventions and invasive diagnostic procedures including

a. Techniques such as

1. Biopsy
2. Aspiration
3. Catheter drainage
4. Stent placement
5. Ablation
6. Sclerosis
7. Percutaneous biliary access
8. Percutaneous renal access

b. Patient selection and focused pre-intervention evaluation

c. Procedural imaging

d. Technique and device selection

e. Application of technique and device

f. Documentation of result of procedure

g. Recognition and treatment of complications

h. Focused post-procedural patient management and follow-up

ii. Appropriate application of non-vascular interventions and invasive diagnostic procedures

iii. Monitoring and recording of non-vascular interventions and invasive diagnostic procedures

iv. Evaluation of non-vascular interventions and invasive diagnostic procedures

v. Assess outcomes of non-vascular interventions and invasive

diagnostic procedures

I.b.i. Fundamentals of Image-Guided Interventions / Safety / General Principles of Radiation Safety

1. Content

General Principles of Radiation Safety

2. Learning objectives

- a. Demonstrate understanding of the principles of radiation biology, radiation safety, exposure monitoring
- b. Plan and perform procedural elements and techniques relevant to minimizing patient, staff, and support personnel staff exposures
 - i. Adhere to requirements for radiation safety including
 - a. Radiation safety guidelines (NRC requirements) / maximum safe exposures
 - b. ALARA (As Low as Reasonably Achievable) principles
 - c. Appropriate equipment (source of radiation) monitoring and quality control
 - d. Operator training (enough technique to perform procedure and minimize total exposure)
 - e. Shielding: patient, operator, and ancillary staff protective devices
 - f. Exposure monitoring, recording, long-term effects
 - ii. Appropriate application of radiation safety guidelines (NRC requirements) / maximum safe exposures, ALARA (As Low As Reasonably Achievable) principles, Appropriate equipment (source of radiation) monitoring and quality control, Operator training (enough technique to perform procedure and minimize total exposure), Shielding: patient, operator, and ancillary staff protective devices, Exposure monitoring, recording, long-term effects
 - iii. Monitoring and recording of patient, staff, and ancillary personnel exposure
 - iv. Evaluation of patient and staff exposure, including understand / expected findings of radiation injuries
 - v. Assess outcomes of radiation exposure monitoring and radiation injuries.

I.b.ii. Fundamentals of image-guided interventions / Safety / Biological hazards

1. Content

Biological hazards

2. Learning objectives

a. Demonstrate understanding of the principles / safety guidelines of exposure to biological hazards including: needle stick injuries, body fluid exposure, and universal precautions to exposure.

b. Plan and perform measures relevant to biohazard exposure including prevention, minimizing risk of exposure, consequences of exposure, reporting, and treatment steps after an exposure

i. Ensure understanding of patients at high risk for placing staff and support personnel at risk for exposure to contact, body fluid, and airborne biohazard risks as well as appropriate hand-washing, universal, and additional safety precautions

ii. Appropriate application of universal precautions minimizing exposure risks, intraprocedure safety precautions (IR table etiquette), and appropriate response / treatment after an exposure

iii. Monitoring and recording of biohazard exposures including body fluid, contact, and airborne risks. Maintain compliance with hospital safety precautions including

- a. Patient identification
- b. Procedural safety techniques
- c. Post exposure steps in treatment

iv. Evaluation of compliance with standard / universal precautions during the procedure, outcomes after biohazard exposure

v. Assess outcomes of biohazard exposure including:

- a. Appropriate response to exposure
- b. Updating / reviewing safety procedures

I.b.iii. Fundamentals of Image-Guided Interventions / Safety / Musculoskeletal occupational injuries

1. Content

Musculoskeletal occupational injuries

2. Learning objectives

a. Demonstrate understanding of the principles of musculoskeletal injury, “on the job injuries”, and the ergonomic techniques to minimize risk of injuries in the IR suites and dictation stations

b. Plan and perform ergonomic techniques to minimize risk of musculoskeletal injuries

i. Demonstrate understanding of the specific MSK risks related to IR

a. Neck / back injuries related to radiation safety equipment

b. Varicose vein / orthopedic injuries related to IR procedures

c. Desk / dictation ergonomic support

ii. Appropriate application of ergonomic equipment in the IR suites and dictation stations

a. Accessory monitors

b. Light-weight / supported radiation safety equipment

c. Venous support

d. Floor mats / orthopedic

iii. Employ appropriate monitoring, recording, and utilization of ergonomic equipment in the IR suite and dictation stations

iv. Evaluation of appropriate use of ergonomic equipment in the IR suite and dictation stations

v. Assess outcomes of appropriate use of ergonomic equipment in the IR suite and dictation rooms

I.b.iv. Fundamentals of Image-guided Interventions / Safety / The Joint Commission (TJC) National Patient Safety Goals to Improve Safety

1. Content

TJC national patient safety goals to improve safety

2. Learning objectives

- a. Demonstrate understanding of the TJC patient safety goals of appropriate patient identification, staff communication, medication use, minimization / prevention of infections, and minimization / prevention of mistakes in surgery
- b. Plan and perform procedural elements and techniques relevant to TJC national patient safety goals including
 - i. Requirements for safe and effective utilization of TJC national patient safety goals including / such as
 - a. Team pre-procedure pause
 - b. Sterile technique and infection preventions
 - ii. Appropriate application of TJC national patient safety goals
 - iii. Monitoring and recording of TJC national patient safety goals
 - iv. Evaluation of TJC national patient safety
 - v. Assess outcomes of TJC national patient safety goals

I.b.v. Fundamentals of Image-Guided Interventions / Safety / Quality improvement

1. Content

Quality improvement

2. Learning objectives

- a. Demonstrate understanding of the principles of quality assessment and reporting standards
- b. Present clinical / procedural care complications in divisional QA / QI / M&M conferences
 - i. Present the clinical course of patient care
 - ii. Explain the complication encountered and its management
 - a. Presenting signs and symptoms
 - b. Focused physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Therapies performed
 - iii. Discuss pathophysiology of the complication encountered
 - iv. Discuss alternative management possibilities
 - v. Identify quality improvement measures to prevent future occurrences
- c. Plan and perform a Practice Quality Improvement (PQI) project
 - i. Obtain initial data collection of the metric being assessed
 - ii. Evaluate the data for areas amenable to improvement
 - iii. Design and implement an intervention designed to improve outcomes
 - iv. Assess outcome of the intervention

I.c.i. Fundamentals of Image-Guided Interventions / Health Care Delivery / Informatics

1. Content

Informatics

2. Learning objectives

- a. Demonstrate understanding of the principles, elements, applications, and legal requirements of health care informatics
- b. Effectively utilize health care informatics in clinical care
 - i. Demonstrate competency and working knowledge / skill set of
 - a. Electronic medical records system
 - b. Radiology information system
 - c. PACS
 - d. IR-specific electronic patient information system
 - ii. Appropriate application of informatics
 - iii. Monitoring and recording of informatics through demonstrated competency in utilization of the elements of medical informatics
 - iv. Evaluation of informatics through demonstrated competency the elements of medical informatics
 - v. Assess outcomes of informatics through demonstrated competency and proficiency in the elements of medical informatics

I.c.ii. Fundamentals of Image-guided Interventions / Health Care Delivery / Regulatory supervision and reporting

1. Content

Regulatory supervision and reporting

2. Learning objectives

- a. Demonstrate understanding of the principles of regulatory supervision and reporting
- b. Demonstrate practice within appropriate regulatory guidelines
 - i. Requirements for regulatory supervision and reporting including an understanding of
 - a. The Joint Commission (TJC) regulations
 - b. Radiation regulations
 - c. Hospital regulations
 - d. Hospital-acquired infection regulations
 - e. IRB and clinical research regulations
 - f. HIPAA regulations
 - g. Mechanism and appropriate steps for reporting irregularities
 - h. Disclosure and reporting of conflicts of interest
 - ii. Appropriate application of regulatory supervision and reporting
 - a. Clinical patient care
 - b. Research
 - c. Education
 - iii. Monitoring and recording of regulatory supervision and reporting
 - a. Attendance at courses and passing grades on evaluations
 - b. Continual training / education
 - c. Clinical practice evaluations
 - iv. Evaluation of regulatory supervision and reporting
 - v. Assess outcomes of regulatory supervision and reporting
 - a. Quality assessment of reports
 - b. Review and evaluation sessions

I.d.i. Fundamentals of Image-Guided Interventions / Professionalism and medical ethics / Certification, MOC

1. Content

Certification, MOC

2. Learning objectives

a. Demonstrate understanding of the principles of certification and credentialing of physicians. The trainees will be able to recognize the different requirements of the ABMS-approved ABR certificates for physicians interested in Interventional Radiology and identify the ABR-defined pathways for maintenance of their ABR certificate

b. Plan and perform the required elements for credentialing that are appropriate to each level of training

i. Interventional Radiology Dual Certificate trainees will be able to distinguish between the requirements for the different ABMS-approved ABR certificates

a. Diagnostic Radiology

b. Interventional Radiology and Diagnostic Radiology Dual Certificate

c. Diagnostic Radiology with Subspecialty Certificate in Vascular and Interventional Radiology

d. Maintenance of Certificate 10-year process specific to each of the three previously described credentials

ii. Appropriate application of Dual Certificate trainees to the appropriate curriculum, credentialing exams and experience will be adhered to. This will include identifying the certificate that one wishes to pursue, participation in the appropriate core diagnostic and interventional radiology core curriculum and test sequence

iii. Monitoring and recording of the trainees' patient care experience through case logs, complication rates, PQRI projects, research, BLS and ACLS credentials and other hospital credentialing requirements will be demonstrated by the trainees as supervised by their Program Interventional Radiology and Diagnostic Radiology Directors

iv. Evaluation of trainees and of the program and faculty will occur in compliance with ABMS and ABR requirements

v. Assess outcomes of training need to be performed in compliance with ABMS and ABR requirements

I.d.ii. Fundamentals of Image-Guided Interventions / Professionalism and Medical Ethics / ACGME Competencies

1. Content

ACGME Competencies

2. Learning objectives

a. Demonstrate understanding of the principles of ACGME core competencies

b. Requirements for trainees to adhere to the six core competencies will be stressed to the trainees. They should be able to recite them

i. Requirements for

a. Patient Care requires trainees to demonstrate their abilities in providing patient care that is compassionate, appropriate and effective for the treatment of health problems

b. Medical Knowledge requires trainees to demonstrate knowledge of established and evolving biomedical, clinical, epidemiological, and social-behavioral sciences, as well as the application of this knowledge to patient care

c. Practice-based Learning and Improvement requires the trainee to investigate and evaluate their care of patients, appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and life-long learning

d. Systems-Based Practice requires trainees to demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care

e. Professionalism requires trainees to demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles

f. Interpersonal Skills and Communication requires the trainee to demonstrate skills that are effective in the exchange of information and collaboration with patients, their families, and health professionals

ii. Appropriate application of competencies will be employed in routine practice, in medical presentations, in research, during journal club and in Morbidity and Mortality Rounds. The ACGME core competencies that are involved in each case should be listed during Morbidity and Mortality

iii. Monitoring and recording of compliance with the competencies and

their understanding will be documented by the Diagnostic and Interventional Radiology Program Directors

iv. Evaluation of compliance with understanding and adhering to the core competencies will be performed by the DR and IR PDs at the time of the quarterly or oration based review of each trainee

v. Program improvement in application of competencies in response to observed deficiencies or weaknesses, and modifications in ACGME core competencies

I.d.iii. Fundamentals of Image-Guided Interventions / Professionalism and medical ethics / Participation in IR Medical Societies

1. Content

Participation in IR Medical Societies

2. Learning objectives

- a. Demonstrate understanding of the value to patient care and professional development of involvement with medical societies
- b. Plan and perform application to and participation in local, regional, national and international IR societies
 - i. Requirements for and applications for admission as a trainee and as a practicing physician to IR societies will be communicated to the trainees
 - ii. Appropriate application of the resources made available by IR societies for trainees should be communicated by the PD to the trainees
 - iii. Monitoring and recording of trainee participation in societies will be the responsibility of the trainee
 - iv. Encourage participation in volunteer committees of professional societies
 - a. Local
 - b. Regional
 - c. National
 - v. Attendance at professional societal meetings
 - a. Local
 - b. Regional
 - c. National

I.e.i. Fundamentals of Image-Guided Interventions / Research / Statistics relevant to IR

1. Content

Statistics relevant to IR

2. Learning objectives

- a. Demonstrate understanding of the statistical requirements of research including sample size determination, choosing endpoints, and choosing statistical tests
- b. Plan and perform techniques relevant to study design and statistical analysis
 - i. Requirements for study design and statistical analysis including / such as
 - a. Hypothesis generation
 - b. Power calculation and sample size determination
 - c. Choosing statistical tests
 - ii. Appropriate application of statistical tests for
 - a. Sample size calculation
 - b. Analysis of accrued data
 - iii. Monitoring and recording of data using electronic data collection systems such as
 - a. Databases
 - b. Spreadsheets
 - c. Electronic medical record
 - d. Radiology report evaluation
 - iv. Evaluation of data collected using appropriately chosen statistical tests v. assess outcomes of hypothesis test by applying appropriate statistical tests to data acquired

I.e.ii. Fundamentals of image-guided interventions / Research / IR research and reporting techniques

1. Content

IR research and reporting techniques

2. Learning objectives

- a. Demonstrate understanding of the principles of reporting the outcomes of interventional research including oral and poster abstract preparation and presentation, and manuscript preparation and submission
- b. Plan and perform procedural elements and techniques relevant to reporting completed IR research
 - i. Requirements for preparation of
 - a. Abstracts
 - b. Oral presentations
 - c. Scientific posters
 - d. Scientific manuscripts
 - ii. Appropriate application of scientific writing skill for preparation of abstracts and manuscripts
 - iii. Monitoring and recording of data from studies in formats for inclusion on scientific posters and in projected formats for oral presentation including PowerPoint and Keynote or other similar presentation software
 - iv. Evaluation of reported research results including
 - a. Evaluating abstracts
 - b. Evaluating scientific posters and generating probing questions related to presented scientific data
 - c. Evaluating content of oral presentations and generating probing questions related to presented scientific data
 - v. Assess outcomes of
 - a. Abstract preparation by acceptance rate and internal feedback
 - b. Poster preparation by viewer feedback and peer-reviewed evaluation
 - c. Oral presentations by audience survey
 - d. Manuscripts by reviewer feedback

I.e.iii. Fundamentals on Image-guided Interventions / Research / Interpretation of IR literature

1. Content

Interpretation of IR literature

2. Learning objectives

a. Demonstrate understanding of the principles of study design, manuscript preparation, data reporting and evaluation of the validity of conclusions based on the level of evidence presented in the literature

b. Plan and perform procedural elements and techniques relevant to critical reading of medical literature relevant to IR

i. Requirements for determining the validity and impact of scientific articles including

- a. Determining the power of the study design
- b. Assessing the bias in reported literature
- c. Assessing the validity of controls
- d. Evaluating the appropriateness of statistical analysis
- e. Evaluating the clinical relevance of the study outcomes
- f. Evaluating the level of evidence presented in the literature

ii. Appropriate application of study design, statistical, and bias control knowledge to assess the validity of published literature

iii. Monitoring and recording of the breadth of literature related to published scientific articles including

- a. Conducting literature searches for related articles
- b. Setting criteria for the level of evidence in related articles to be reviewed
- c. Collecting related literature and evaluating the body of evidence presented in the literature

iv. Evaluation of individual articles and the general breadth of the literature on IR topics including

- a. Evaluating the bias, data validity, controls, and scientific conclusion validity for an individual article
- b. Evaluating the level of evidence reported in the medical literature relevant to a topic in IR by
 - 1. Conducting a systematic literature search
 - 2. Evaluating the level of evidence in the literature
 - 3. Determining what further research is needed

v. Assess outcomes of medical literature by relating published articles to changes in clinical practice

I.e.iv. Fundamentals of Image-guided Interventions / Research / HIPAA compliance

1. Content

HIPAA compliance

2. Learning objectives

a. Demonstrate understanding of the principles of regulatory compliance as it relates to human research and animal research. Demonstrate understanding of the principles of intellectual integrity as it relates to conflict of interest, data integrity, and appropriate citations and plagiarism

b. Plan and perform procedural elements and techniques relevant to preparation of regulatory compliance documents for clinical or pre-clinical research

i. Requirements for preparation of regulatory compliance documents for research including

- a. Preparation of protocols for clinical research for IRB approval
- b. Preparation of protocols for animal research for IACUC approval
- c. Preparation of informed consent forms for clinical research studies
- d. Establishment of secure data collection systems to maintain patient confidential information in HIPAA compliant manner

ii. Appropriate application of secure data collection systems to

- a. Prevent data manipulation
- b. Maintain confidential patient information in a secure environment
- c. Maintain regulatory documents in a secure and retrievable manner

iii. Monitoring and recording of patient enrollment, compliance documentation, and annual reviews and amendments for clinical or pre-clinical research studies

iv. Evaluation of research compliance documentation for compliance with regulations including

- a. Evaluation of clinical protocols for patient HIPAA compliance
- b. Evaluation of clinical protocols and research consent forms for patient safety evaluation
- c. Evaluation of IACUC applications for compliance with the animal welfare act and PHS regulations

v. Assess outcomes of research compliance by evaluation of annual reviews of regulatory documents, trial performance outcomes, and continued regulatory compliance

II.a.i. Clinical Care in IR / Patient Care / Focused history and physical examination

1. Content

Focused history and physical examination

2. Learning objectives

a. Demonstrate understanding of the principles of focused history and physical examination relative to the proposed image-guided intervention

b. Plan and perform procedural elements and techniques relevant to a focused history and physical examination including appropriate clinical history, focused physical examination, appropriate laboratory examination, and indicated diagnostic imaging examinations

i. Requirements for focused history and physical examination including / such as

- a. Dedicated and appropriate examination and interview environment
- b. Adequate support staff
- c. Professionalism
- d. Effective patient communication
- e. Compassion

ii. Appropriate application of focused history and physical examination for

- a. Image-guided interventions
- b. Invasive diagnostic procedures

iii. Monitoring and recording of focused history and physical examination demonstrated by

- a. Documentation of the patient encounter
- b. Documentation of pertinent historical and physical findings
- c. Documentation of laboratory and imaging findings
- d. Synthesis of a patient-centered assessment and plan
- e. Documentation of communication of plan to patient and pertinent individuals
- f. Documentation of appropriate Evaluation and Management codes

iv. Evaluation of focused history and physical examination

- a. Patient evaluations
- b. Clinician evaluations

- v. Assess outcomes of focused history and physical examination
 - a. Patient selection for intervention
 - b. Patient outcome
 - c. Patient satisfaction

II.a.ii. Clinical Care in IR / Patient Care / Informed Consent for IR procedures

1. Content

Informed consent for IR procedures

2. Learning objectives

- a. Demonstrate understanding of the principles of informed consent for IR procedures
- b. Plan and perform procedural elements and techniques relevant to informed consent for IR procedures
 - i. Requirements for informed consent including / such as
 - a. Explanation of procedure
 - b. Explanation of risks
 - c. Explanation of alternative therapies
 - d. Demonstration of patient understanding
 - ii. Appropriate application of informed consent for IR procedures such as
 - a. Image-guided interventions
 - b. Invasive diagnostic examinations
 - iii. Monitoring and recording of informed consent for IR procedures
 - a. Ensure completion of consent forms
 - b. Verify informed consent in all image-guided diagnostic and interventional procedures
 - iv. Evaluation of informed consent in IR procedures
 - a. Timeliness
 - b. Appropriate
 - c. Documentation
 - v. Assess outcomes of informed consent
 - a. Sentinel events
 - b. Litigation
 - c. Patient outcomes

II.a.iii. Clinical Care in IR / Patient Care / Procedural Sedation for IR Procedures

1. Content

Procedural sedation for IR procedures

2. Learning objectives

a. Demonstrate understanding of the principles of procedural sedation and analgesia for invasive image-guided diagnostic procedures, image-guided interventions, and indications for general anesthesia

b. Plan and perform procedural elements and techniques relevant to procedural sedation

i. Requirements for procedural sedation for IR procedures including / such as

- a. Trained and certified personnel
- b. Pre-procedure assessment
- c. Intra-procedural monitoring
- d. Post-procedural recovery and follow-up

ii. Appropriate application of procedural sedation for

- a. Invasive image-guided diagnostic procedures
- b. Image-guided interventions

iii. Monitoring and recording of procedural sedation for IR procedures

- a. Pre-procedure assessment documentation
- b. Procedural sedation record documentation
- c. Post-procedure sedation assessment documentation
- d. Trained personnel
- e. Appropriate monitoring equipment

iv. Evaluation of procedural sedation for IR procedures

- a. Patient satisfaction
- b. Patient safety
- c. Operator satisfaction

v. Assess outcomes of procedural sedation for IR procedures

- a. Adverse respiratory events
- b. Adverse cardiovascular events
- c. Negative patient experiences
- d. Allergic reactions

II.a.iv. Clinical Care in IR / Patient Care / Recognition and initial management of intra- and peri-procedural emergencies

1. Content

Recognition and initial management of intra- and peri-procedural emergencies

2. Learning objectives

- a. Demonstrate understanding of the principles of recognition and initial management of intra-, and peri-, and post-procedural emergencies such as cardiovascular emergencies, respiratory emergencies, neurological emergencies, and access site emergencies
- b. Plan and perform procedural elements and techniques relevant to recognition and initial recognition management of intra-, peri-, and post-procedural emergencies
 - i. Requirements for recognition and initial management including / such as
 - a. Physiologic monitoring
 - b. Intra-procedural patient evaluation
 - c. Post- procedure monitoring and evaluation
 - ii. Appropriate application of
 - a. Monitoring tools
 - b. Ancillary personnel
 - c. Patient examination
 - d. Initial resuscitative measures
 - iii. Monitoring and recording of recognition and initial management
 - a. Procedural telemetry and recording
 - b. Pulse oximetry / capnography and recording
 - c. Blood pressure determination and recording
 - iv. Evaluation of recognition and initial management
 - a. Timeliness
 - b. Appropriateness
 - c. Utilization of consultants / rapid response teams / code teams
 - v. Assess outcomes of recognition and initial management
 - a. Determination of patient outcome
 - b. Determination of patient satisfaction
 - c. Presentation in morbidity and mortality conferences

II.a.v. Clinical Care in IR / Patient Care / Procedural Reporting

1. Content

Procedural Reporting

2. Learning objectives

- a. Demonstrate understanding of the principles of procedural reporting
- b. Understand and perform procedural elements and techniques relevant to procedural reporting
 - i. Requirements for procedural reporting including
 - a. Local and hospital requirements
 - b. Standards of specialty or subspecialty
 - c. Community standards
 - d. Appropriate department support (PACS, voice recognition software, transcription services, EMR)
 - ii. Appropriate application of procedural reporting for patient care in IR
 - a. Timeliness
 - b. Accuracy
 - c. Completeness
 - d. Communication with referring physicians including of critical findings or complications
 - e. Patient confidentiality
 - iii. Monitoring and recording of procedural reporting for
 - a. Timeliness
 - b. Accuracy
 - c. Completeness
 - d. Communication with referring physicians including of critical findings or complications
 - e. Patient confidentiality
 - iv. Evaluation of procedural reporting to ensure that appropriate standards are being met
 - v. Assess outcomes of procedural reporting for completion, accuracy, and timeliness

II.a.vi. Clinical Care in IR / Patient Care / Inpatient Care

1. Content

Inpatient Care

2. Learning objectives

- a. Demonstrate understanding of the principles of providing appropriate inpatient care for patients undergoing IR procedures
- b. Plan and perform procedural elements and techniques relevant to inpatient care
 - i. Appropriate application of inpatient care including
 - a. Admission orders
 - b. Imaging and other testing
 - c. Communication with patient, family, other caregivers
 - d. Rounding
 - e. Appropriate use of consultants / multidisciplinary care
 - f. Awareness and use of resources such as rapid response teams, code teams, and specialized care groups for diabetes, congestive heart failure, acute myocardial ischemia, etc
 - g. Discharge with appropriate discharge instructions, medications and planned follow-up
 - ii. Monitoring and recording of inpatient care for appropriateness, utilization, patient safety and readmission rates
 - iii. Evaluation of inpatient care for appropriateness, utilization, patient safety and readmission rates
 - iv. Assess outcomes of inpatient care for appropriateness, utilization, patient safety and readmission rates

II.a.vii. Clinical Care in IR / Patient Care / IR Clinic

1. Content

IR Clinic

2. Learning objectives

- a. Demonstrate understanding of the principles of having an IR clinic
- b. Plan and perform procedural elements and techniques relevant to having an IR clinic, such as focused history taking and physical examination, appropriate understanding and utilization of laboratory, imaging and other patient evaluation techniques, timely and complete documentation, timely correspondence with referring physicians, and appropriate utilization or patient referral to consultants
 - i. Requirements for an IR clinic including
 - a. Separate physical space separate and distinct from procedural area
 - b. Dedicated physician time
 - c. Use of assistants such as medical assistants, nurses, physician extenders
 - d. Medical record keeping in secure, confidential manner respecting HIPAA compliance
 - e. Patient evaluation areas with adequate measures to ensure patient safety and privacy
 - f. Adequate equipment for patient examination rooms such as for recording vital signs, appropriate examination table and ancillary equipment such as hand-held Doppler, etc
 - ii. Appropriate application of outpatient care skills for focused longitudinal patient care in IR clinic including
 - a. Ability to take an appropriate focused history and perform appropriate physical examination
 - b. Appropriate understanding and utilization of laboratory, imaging and other patient evaluation techniques such as non-invasive vascular lab
 - c. Timely and complete documentation
 - d. Timely correspondence with referring physicians
 - e. Appropriate utilization of consultants
 - iii. Monitoring and recording of quality of patient care provided in IR clinic
 - a. Medical records
 - b. Correspondence with referring physicians

- c. Patient satisfaction instruments
 - d. Physician productivity
 - e. Adherence to institutional and national standards
- iv. Evaluation of patient care provided in IR clinic
 - a. Patient satisfaction
 - b. Referring physician satisfaction
 - c. Patient follow-up and follow-through
- v. Assess outcomes of IR clinic

II.a.viii. Clinical Care in IR / Patient Care / Pharmacology relevant to IR

1. Content

Pharmacology relevant to IR

2. Learning objectives

a. Demonstrate understanding of the principles of pharmacology relevant to IR

b. Appropriately prescribe pharmaceutical agents relevant to IR, understanding modes of action, common drug interactions, dosages, side effects and contraindications as well as alternative agents

i. Appropriate prescribing of commonly used pharmaceutical agents in IR such as common dosages, drug interactions, side effects, mode of action, and contraindications as well as alternative agents for similar indication

- a. Antibiotics
- b. Conscious sedation agents
- c. Local anesthetic agents
- d. Anticoagulant and anti-platelet agents
- e. Thrombolytic agents
- f. Vasoactive agents
- g. Intravenous contrast agents
- h. Antihypertensive
- i. Chemotherapeutic agents
- j. Drug interactions
- k. Common side effects / intolerances
- l. Alternative agents for same / similar purpose

ii. Appropriate application of recognized prescribing practices for the commonly used pharmaceutical agents in IR such as cost, side effects, drug interactions, warnings and other cautions

iii. Monitoring and recording of prescribing of commonly used pharmaceuticals in IR such as utilizing physician updates, resources such as pharmacists, doctors of pharmacy, as well as consultation with specialists from other disciplines

iv. Evaluation of pharmacology in IR for

- a. Changes in antibiotic dosing / effectiveness
- b. Changes in specialty guidelines or standards
- c. Introduction of new, safer, or cheaper agents
- d. Changes in prescribing practices

- v. Assess outcomes of pharmacology in IR for
 - a. Safety of agents
 - b. Usefulness of agents
 - c. Cost
 - d. Introduction of safer, better, or cheaper agents

II.a.ix. Clinical Care in IR / Patient Care / Medical conditions relevant to IR procedures

1. Content

Medical conditions relevant to IR procedures

2. Learning objectives

a. Demonstrate understanding of the anatomy normal and variant and pathophysiology relevant to the medical conditions commonly encountered in IR practice

b. Perform focused peri-procedural patient care for patients undergoing diagnostic and interventional procedures with medical conditions commonly encountered in IR practice

i. Focused clinical consultation (inpatient and / or outpatient) and appropriate communication with and utilization of other clinical services as a part of coordinated clinical care of patients

ii. Appropriate patient evaluation to assess suitability and safety for patients undergoing diagnostic and interventional procedures with medical conditions commonly encountered in IR practice such as

a. Presenting signs and symptoms

b. Focused physical examination

c. Laboratory values and imaging

1. Relevant to the presenting complaint or disease process

2. Relevant to the planned procedure

d. Conditions including

1. Diabetes

2. Hypertension

3. Atherosclerosis

4. Infectious diseases

5. Respiratory disorders

6. Renal / urinary disorders

7. Hepatobiliary disease

8. Stroke

9. Cardiac disease

10. Anticoagulation

11. Anaphylaxis

iii. Obtain appropriate informed consent for procedures including risks, benefits, and alternative therapies

a. Medical

b. Interventional

c. Surgical

iv. Identify the need for and order appropriate pre-procedural therapies and consultants to prepare the patient for planned procedures

v. Perform focused post-procedural multidisciplinary coordinated care including

- a. Evaluation of short- and long-term outcomes
- b. Evaluation for short- and long-term complications
- c. Ordering of follow-up tests and procedures
- d. Coordination of longitudinal care
- e. Communication with other medical professionals

c. Plan procedural elements and techniques relevant to the patient's specific needs and medical condition

i. Ensure the administration of timely care based upon the patient's clinical needs

ii. Select the appropriate approach, imaging guidance, and tools for the planned invasive diagnostic or interventional procedure relevant to the patients presenting clinical problem and pre-existing medical conditions

iii. Create a plan for intra-procedural analgesia, sedation, and medications appropriate for the patient and planned procedure and medical conditions

iv. Recognize and manage procedural complications specific to the patient's pre-existing medical conditions

II.b. Clinical Care in IR / Health care delivery / Health care team coordination

1. Content

Health care team coordination

2. Learning objectives

- a. Demonstrate understanding of health care team coordination including identification and roles of members of health care team, care planning, work flow of health care, payment systems and mechanisms, and integration of health care
- b. Participate effectively and constructively in the coordinated health care team
 - i. Participate in a formal and hands-on curriculum including courses, lectures, multidisciplinary conferences, site visits, committee participation, and electives
 - ii. Appropriate application of health care team coordination
 - a. Collaborations with referral teams
 - b. Appropriate referral consultations
 - c. Appropriate and prompt patient consultation
 - d. Integrative work with other clinical teams
 - e. Integrative work with healthcare administrators
 - f. Integrative work with staff
 - g. Integrative work with colleagues
 - iii. Monitoring and recording of health care team coordination
 - a. Patient satisfaction
 - b. Referring physician satisfaction
 - c. Efficient work flow
 - d. Prompt consultation and care delivery
 - e. Staff satisfaction
 - iv. Evaluation of health care team coordination
 - a. 360 evaluations
 - b. Patient satisfaction
 - c. Referring physician satisfaction
 - d. Efficient work flow
 - e. Prompt consultation and care delivery
 - f. Staff satisfaction
 - v. Assess outcomes of Health care team coordination

II.c. Clinical Care in IR / Professionalism and medical ethics / Coding and billing

1. Content

Coding and billing

2. Learning objectives

- a. Demonstrate understanding of the coding systems used in medicine including the history, regulation, modification, and application of coding
- b. Demonstrate the ability to appropriately code / bill for patient care encounters
 - i. Outpatient clinical care encounters
 - a. ICD coding to support patient visit and ordering of ancillary tests
 - b. E&M CPT coding
 - ii. Inpatient clinical care encounters
 - a. ICD coding to document health issues
 - b. Admission and discharge CPT coding
 - c. Consultation CPT coding
 - d. Follow-up visit CPT coding
 - iii. Procedural encounters
 - a. ICD coding to document appropriateness of the procedure
 - b. CPT coding of procedures
 - iv. Evaluation of coding accuracy via
 - a. Internal or external auditing processes
 - b. Participation in coding surveys
 - c. Participation on local, regional, and national payment committees
 - v. Assess outcomes of coding and billing
 - a. Rejection reasons and rates from payers
 - b. Cost effectiveness of various patient-care techniques (i.e. percutaneous vs. open surgical techniques)

III.a.i. Vascular Imaging and Diagnosis / General Assessment and Imaging Techniques / Clinical vascular examination

1. Content

Clinical vascular examination

2. Learning objectives

- a. Demonstrate understanding of the principles of history and physical examination in the patient with vascular and lymphatic diseases
- b. Plan and perform procedural elements and techniques relevant to history and physical examination in patients with vascular and lymphatic diseases
 - i. Requirements for history and physical examination including
 - a. Interpersonal communication
 - b. Listening skills
 - c. Knowledge of techniques of physical exam
 - d. Knowledge of physical manifestations of the disease processes
 - e. Knowledge of normal and abnormal physical exam findings
 - ii. Appropriate application of history and physical exam for clinical vascular examination in patients with vascular and lymphatic diseases
 - iii. Monitoring and recording of history and physical exam findings in patients with vascular and lymphatic diseases
 - iv. Evaluation of history and physical exam in patients with vascular and lymphatic diseases
 - a. Accuracy
 - b. Completeness
 - c. Timeliness
 - v. Assess outcomes of accuracy of history and physical examination with respect to patient's final diagnosis

III.a.ii. Vascular Imaging and Diagnosis / General Assessment and Imaging Techniques / Non-invasive peripheral vascular lab

1. Content

Non-invasive peripheral vascular lab

2. Learning objectives

- a. Demonstrate understanding of the principles of non-invasive peripheral vascular assessment including ABI, PVR, segmental pressures, transcutaneous pO₂, Duplex evaluation, and treadmill testing
- b. Plan and perform procedural elements and techniques relevant to non-invasive peripheral vascular assessment
 - i. Requirements for performance of non-invasive peripheral vascular assessment including / such as
 - a. Local or hospital requirements
 - b. Properly functioning equipment
 - c. Trained technical staff
 - d. Trained physician staff
 - e. Patient safety
 - f. Accreditation by recognized vascular laboratory certification organizations
 - ii. Appropriate application of non-invasive peripheral vascular assessment for
 - a. Evaluation of patients with suspected vascular disease
 - b. Treatment planning
 - iii. Monitoring and recording of findings of non-invasive peripheral vascular assessment
 - a. Standardized recording of results
 - b. Reporting
 - iv. Evaluation of non-invasive peripheral vascular assessment
 - a. Accuracy
 - b. Consistency
 - c. Patient safety
 - v. Assess outcomes of non-invasive peripheral vascular assessment
 - a. Continuous quality control
 - b. Maintenance of accreditation

III.a.iii. Vascular Imaging and Diagnosis / General Assessment and Imaging Techniques / CT angiography

1. Content

CT angiography

2. Learning objectives

- a. Demonstrate understanding of the principles of CT angiography including contrast utilization, computed tomography, and image reconstruction
- b. Plan and perform procedural elements and techniques relevant to CT angiography
 - i. Requirements for CT angiography including / such as
 - a. Local or hospital requirements
 - b. Properly functioning equipment
 - c. Trained technical staff
 - d. Trained physicians e. Patient safety
 - f. Shielding
 - g. Exposure monitoring
 - ii. Appropriate application of CT angiography for evaluation and planning for intervention
 - iii. Monitoring and recording of
 - a. Images
 - b. Radiation exposure
 - c. Contrast safety and appropriateness d. Interpretations
 - iv. Evaluation of CT angiography
 - a. Image quality
 - b. Patient safety
 - v. Assess outcomes of CT angiography
 - a. Exposure thresholds
 - b. Image interpretation

III.a.iv. Vascular Imaging and Diagnosis / General Assessment and Imaging Techniques / MR angiography

1. Content

MR angiography

2. Learning objectives

- a. Demonstrate understanding of the principles of MR angiography including contrast utilization, magnetic resonance imaging, image reconstruction
- b. Plan and perform procedural elements and techniques relevant to MR angiography
 - i. Requirements for MR angiography including / such as
 - a. Local or hospital requirements
 - b. Properly functioning equipment
 - c. Trained technical staff
 - d. Trained physicians e. Patient safety
 - f. Magnet safety
 - ii. Appropriate application of MR angiography for evaluation and planning for intervention
 - iii. Monitoring and recording of
 - a. Images
 - b. Contrast safety and appropriateness
 - iv. Evaluation of MR angiography
 - a. Image quality
 - b. Patient safety
 - c. Protocol appropriateness
 - v. Assess outcomes of MR angiography
 - a. Image interpretation
 - b. Specificity and sensitivity

III.a.v. Vascular Imaging and Diagnosis / General Assessment and Imaging Techniques / Ultrasound

1. Content

Ultrasound

2. Learning objectives

- a. Demonstrate understanding of the principles of vascular ultrasound including grey scale ultrasound, Doppler, Color flow, contrast agents, and 3-dimensional reconstruction
- b. Plan and perform procedural elements and techniques relevant to vascular ultrasound
 - i. Requirements for vascular ultrasound including / such as
 - a. Local or hospital requirements
 - b. Properly functioning equipment
 - c. Trained technical staff
 - d. Trained physicians e. Patient safety
 - ii. Appropriate application of vascular ultrasound for evaluation and planning for intervention
 - iii. Monitoring and recording of
 - a. Images
 - b. Doppler information
 - iv. Evaluation of vascular ultrasound
 - a. Image quality
 - b. Exam technique
 - v. Assess outcomes of vascular ultrasound
 - a. Image interpretation
 - b. Doppler interpretation

III.b.i. Vascular Imaging and Diagnosis / Catheter angiography / Angiographic diagnostic catheters and guidewires

1. Content

Angiographic diagnostic catheters and guidewires

2. Learning objectives

- a. Demonstrate understanding of the principles of selection of angiographic diagnostic catheters and guidewires
- b. Plan and perform procedural elements and techniques using angiographic diagnostic catheters and guidewires
 - i. Requirements for selection and use of angiographic diagnostic catheters and guidewires
 - a. Provide appropriate evaluation of patient history, physical exam, and prior imaging to determine equipment needed to begin an image-guided procedure
 - b. Demonstrate appropriate knowledge of available standard (flush and selective) and specialty (micro or superselective, infusion, balloon occlusion, etc.) angiographic catheters and guidewires
 - ii. Appropriate application of selection and use of angiographic diagnostic catheters and guidewires
 - a. Utilize palpation, US guidance, fluoroscopic guidance, and CT guidance for arterial and venous vascular access in patients with normal, diminished, and absent pulses
 - b. Utilize microaccess, standard, and sheathed access needles
 - c. Utilize appropriate initial and subsequent guidewires and catheters for selective catheterization
 - d. Safely perform arterial or venous (standard percutaneous and alternate, i.e., translumbar, transvisceral, and open) access
 - iii. Monitoring and recording of selection and use angiographic diagnostic catheters and guidewires
 - a. Demonstrate intra-procedural decision-making to safely perform initial and subsequent guidewire and catheter placement to acquire diagnostic images
 - b. Demonstrate appropriate recording and interpretation of catheter-acquired physiological data, i.e., pressures, waveforms, and gradients
 - c. Demonstrate effective use of road-mapping, image-overlay, and intra-procedural image manipulation

iv. Evaluation of selection and use of angiographic diagnostic catheters and guidewires

a. Knowledge of appropriate initial and subsequent guidewires and catheters for selective catheterization

v. Assess outcomes of selection and use of angiographic diagnostic catheters and guidewires

a. Assess quality of angiographic image acquisition, including digitally-subtracted, non-subtracted, and post-processed imaging

b. Demonstrate appropriate modification of intra-procedural technique to optimize image quality

c. Recognize and manage vascular complications due to catheters and guidewires, including appropriate interventional and medical treatment and, if needed, consultation of other specialists

III.b.ii. Vascular Imaging and Diagnosis / Catheter angiography / Selective catheterization techniques

1. Content

Selective catheterization techniques

2. Learning objectives

- a. Demonstrate understanding of the principles of selective catheterization techniques
- b. Plan and perform procedural elements and techniques relevant to selective catheterization techniques
 - i. Requirements for selective catheterization techniques
 - a. Provide appropriate evaluation of patient history, physical exam, and prior imaging to determine equipment needed to begin an image-guided procedure
 - b. Demonstrate appropriate knowledge of available standard and specialty (micro or superselective) angiographic catheters and guidewires
 - c. Demonstrate appropriate use of image guidance
 - ii. Appropriate application of selective catheterization techniques
 - a. Show appropriate use of standard catheter or microcatheter position to guide non-selective, selective, and sub-selective angiography studies
 - b. Demonstrate use of fluoroscopic guidance for catheter-wire manipulation
 - c. Demonstrate effective use of road-mapping, image-overlay, and intra-procedural image manipulation
 - d. Demonstrate second order and higher catheterization of visceral and peripheral arterial branches
 - e. Utilize normal and reduced pulse mode fluoroscopy, road-map, last image hold, and fluoro-fade technologies
 - f. Select appropriate contrast concentrations, volumes, and injection rates for digital subtraction angiography
 - g. Select and appropriately utilize alternative contrast agents including carbon-dioxide gas and gadolinium-based contrast materials
 - h. Select appropriate tube angulation, magnification, and frame rates for digital subtraction angiography
 - iii. Monitoring and recording of selective catheterization techniques
 - a. Recognize intra-procedural tactile feedback in guiding

catheters and wires

- b. Utilize coning, reduced frame and pulse rates, shielding, and limited fluoroscopic times to minimize patient, operator, and staff exposure to radiation
- c. Demonstrate intra-procedural decision-making to safely acquire selective diagnostic images
- d. Demonstrate appropriate recording and interpretation of catheter-acquired physiological data, i.e., pressures, waveforms, and gradients

iv. Evaluation of selective catheterization techniques

- a. Recognize appropriate image quality and adjust angiographic and imaging technique / parameters as needed to optimize quality
- b. Utilize re-masking, pixel-shifting, and other post-processing techniques to evaluate and enhance digital subtraction images

v. Assess outcomes of selective catheterization techniques

- a. Show appropriate acquisition of imaging to make a diagnosis
- b. Balance radiation exposure and contrast volume relative to adequacy of diagnostic imaging
- c. Recognize and minimize digital subtraction artifacts such as bowel motion, standing waves, and pre-existing contrast
- d. Show knowledge of potential complications (dissection, embolization, rupture) associated with selective catheterization and management of these complications

III.c.i. Vascular Imaging and Diagnosis / Normal and Variant Vascular Anatomy / Arteries

1. Content

Normal and variant arterial anatomy

2. Learning objectives

- a. Demonstrate understanding of normal and variant arterial anatomy, and collateral pathways
- b. Understand, plan, perform, and interpret physical examination and imaging studies demonstrating normal and variant arterial anatomy, and collateral pathways
 - i. Presentation of arterial anatomy
 - a. Pulse examination and symptoms
 - b. US
 - c. CT / CTA
 - d. MR / MRA
 - e. Angiography
 - ii. Appropriate application of imaging for evaluation of arterial anatomy
 - a. Demonstration of anatomy
 - b. Quantitative evaluation of blood vessels
 - iii. Monitoring and recording of physical examination and imaging studies
 - iv. Evaluation of quality of
 - a. Physical examination
 - b. Imaging studies
 - v. Assess outcomes of physical examination and imaging for evaluation of arterial anatomy
 - a. Accuracy

III.c.ii. Vascular Imaging and Diagnosis / Normal and Variant Vascular Anatomy / Systemic Veins

1. Content

Normal and variant vascular anatomy of the systemic veins

2. Learning objectives

- a. Demonstrate understanding of normal and variant systemic venous anatomy, and collateral venous pathways
- b. Understand, plan, perform, and interpret physical examination and imaging studies demonstrating normal and variant venous anatomy
 - i. Presentation of normal and venous anatomy
 - a. Physical examination and symptoms
 - b. US
 - c. CT / CTA
 - d. MR / MRA
 - e. Venography
 - f. Angiography
 - ii. Appropriate application of imaging for evaluation of arterial anatomy
 - a. Demonstration of anatomy
 - b. Quantitative evaluation of blood vessels
 - iii. Monitoring and recording of physical examination and imaging studies
 - iv. Evaluation of quality of
 - a. Physical examination
 - b. Imaging studies
 - v. Assess outcomes of physical examination and imaging for evaluation of venous anatomy
 - a. Accuracy
 - b. Safety

III.c.iii. Vascular Imaging and Diagnosis / Normal and Variant Vascular Anatomy / Portal venous system

1. Content

Normal and variant vascular anatomy of the portal venous system

2. Learning objectives

- a. Demonstrate understanding of normal and variant portal venous anatomy, and portal-portal, and portal-systemic collaterals
- b. Understand, plan, perform, and interpret physical examination and imaging studies demonstrating normal and variant portal anatomy, and collateral pathways
 - i. Presentation of portal venous anatomy
 - a. Physical examination and symptoms
 - b. US
 - c. CT / CTA
 - d. MR / MRA
 - e. Angiography
 - f. Portography
 - ii. Appropriate application of imaging for evaluation of portal venous anatomy
 - a. Demonstration of anatomy
 - b. Quantitative evaluation of blood vessels
 - iii. Monitoring and recording of physical examination and imaging studies
 - iv. Evaluation of quality of
 - a. Physical examination
 - b. Imaging studies
 - v. Assess outcomes of physical examination and imaging for evaluation of portal venous anatomy
 - a. Accuracy
 - b. Safety

III.c.iv. Vascular Imaging and Diagnosis / Normal and Variant Vascular Anatomy / Pulmonary vasculature

1. Content

Normal and variant pulmonary vascular anatomy

2. Learning objectives

- a. Demonstrate understanding of normal, variant, and collateral pulmonary vascular anatomy
- b. Understand, plan, and perform imaging studies demonstrating normal and variant pulmonary vascular anatomy, and collateral pathways
 - i. Presentation of pulmonary vascular anatomy
 - a. Physical examination and symptoms
 - b. US
 - c. CT / CTA
 - d. MR / MRA
 - e. Angiography
 - f. Nuclear medicine
 - ii. Appropriate application of imaging for evaluation of pulmonary vascular anatomy
 - a. Demonstration of anatomy
 - b. Quantitative evaluation of blood vessels
 - iii. Monitoring and recording of physical examination and imaging studies
 - iv. Evaluation of quality of
 - a. Physical examination
 - b. Imaging studies
 - v. Assess outcomes of physical examination and imaging for evaluation of pulmonary vasculature
 - a. Accuracy
 - b. Safety

III.c.v. Vascular Imaging and Diagnosis / Normal and Variant Vascular Anatomy / Lymphatics

1. Content

Normal and variant anatomy of the lymphatics

2. Learning objectives

- a. Demonstrate understanding of normal, variant, and collateral lymphatic anatomy
- b. Understand, plan, perform, and interpret physical examination and imaging studies demonstrating lymphatic anatomy
 - i. Presentation of portal venous anatomy
 - a. Physical examination and symptoms
 - b. US
 - c. CT / CTA
 - d. MR / MRA
 - e. Nuclear scintigraphy
 - f. Lymphangiography
 - ii. Appropriate application of imaging for evaluation of portal venous anatomy
 - a. Demonstration of anatomy
 - b. Quantitative evaluation of blood vessels
 - iii. Monitoring and recording of physical examination and imaging studies
 - iv. Evaluation of quality of
 - a. Physical examination
 - b. Imaging studies
 - v. Assess outcomes of physical examination and imaging for evaluation of lymphatic anatomy
 - a. Accuracy
 - b. Safety

III.d.i. Vascular Imaging and Diagnosis / Pathophysiology of Vascular Disorders / arterial vascular disorders

1. Content

Arterial vascular disorders

2. Learning objectives

a. Demonstrate understanding of pathophysiology of arterial vascular disorders relevant to image-guided interventions and focused peri-procedural patient care including risk factors, the biological / cellular basis, clinical presentation, and natural history of the following arterial vascular disorders

- i. Atherosclerosis
- ii. Aneurysms
- iii. Dissection
- iv. Fibromuscular dysplasia
- v. Embolic Disease
- vi. Intimal Hyperplasia—restenosis
- vii. Traumatic Vascular Injury
- viii. Inflammatory Vasculitis
- ix. Compression syndromes
- x. Vascular malformations
- xi. Vascular infection
- xii. Physiologic disturbances
- xiii. Tumor
- xiv. Vascular neoplasia—primary
- xv. Inherited vascular disorders
- xvi. Metabolic vascular disorders

xvii. Trauma

xviii. Post-operative

b. Plan and perform procedural elements and techniques based on an understanding of the pathophysiology of arterial diseases

i. Evaluation of arterial vascular disorders

- a. Focused history and physical examination
- b. Laboratory studies
- c. Noninvasive vascular laboratory
- d. Imaging
- e. Working knowledge of appropriate societal guidelines

ii. Appropriate application of imaging, physical examination, and laboratory studies for arterial vascular disorders

- a. Noninvasive vascular laboratory
- b. Ultrasound
- c. CT / CTA
- d. MRI / MRA
- e. Fluoroscopy / Angiography
- f. Nuclear medicine

iii. Monitoring and recording of

- a. Documentation of history
- b. Documentation of physical examination
- c. HIPAA-compliant record management
- d. Images and reports

iv. Evaluation of

- a. Image quality
- b. Patient safety

v. Assess outcomes of

- a. Clinical assessments
- b. Imaging interpretations
- c. Correlation of imaging and clinical evaluation
- d. Adherence to appropriate clinical guidelines

III.d.ii. Vascular Imaging and Diagnosis / Pathophysiology of Vascular Disorders / Systemic venous disorders

1. Content

Systemic venous disorders

2. Learning objectives

a. Demonstrate understanding of pathophysiology of systemic venous disorders relevant to image-guided interventions and focused peri-procedural patient care including risk factors, biological / cellular basis, clinical presentation, and natural history of

- i. Thrombosis
- ii. Embolus
- iii. Stenosis
- iv. Chronic occlusion
- v. Reflux
- vi. Varicosities
- vii. Extrinsic compression
- viii. Aneurysm
- ix. Dissection
- x. Tumor encasement
- xi. Tumor invasion
- xii. Vasculitis

b. Plan and perform procedural elements and techniques based on an understanding of the pathophysiology of systemic venous disorders such as

- i. Requirements for systemic venous disorders
 - a. Focused history and physical examination
 - b. Laboratory studies
 - c. Noninvasive vascular laboratory
 - d. Imaging

- e. Working knowledge of appropriate clinical guidelines
- ii. Appropriate application of imaging, physical examination, and laboratory studies for systemic venous disorders
 - a. Noninvasive vascular laboratory
 - b. Ultrasound
 - c. CT / CTA
 - d. MRI / MRV
 - e. Fluoroscopy / venography
 - f. Nuclear medicine
- iii. Monitoring and recording of
 - a. Documentation of history
 - b. Documentation of physical examination
 - c. HIPAA-compliant record management
 - d. Images and reports
- iv. Evaluation of
 - a. Image quality
 - b. Patient safety
- v. Assess outcomes of
 - a. Clinical assessments
 - b. Imaging interpretations
 - c. Correlation of imaging and clinical evaluation
 - d. Adherence to appropriate clinical guidelines

III.d.iii. Vascular Imaging and Diagnosis / Pathophysiology of Vascular Disorders / Dialysis access disorders

1. Content

Dialysis access disorders

2. Learning objectives

a. Demonstrate understanding of pathophysiology of dialysis access disorders relevant to image-guided interventions and focused peri-procedural patient care including risk factors, biological / cellular basis, clinical presentation, and natural history

b. Plan and perform procedural elements and techniques based on an understanding of the pathophysiology of dialysis access disorders

i. Requirements for dialysis access disorders

- a. Focused history and physical examination
- b. Laboratory studies
- c. Noninvasive vascular laboratory
- d. Imaging
- e. Functional knowledge of current DOQI guidelines

ii. Appropriate application of imaging and physical examination for dialysis access disorders

- a. Noninvasive vascular laboratory
- b. Ultrasound
- c. CT / CTA
- d. MRI / MRA
- e. Fluoroscopy / angiography / venography

iii. Monitoring and recording of

- a. Documentation of history
- b. Documentation of physical examination
- c. HIPAA-compliant record management
- d. Images and reports

iv. Evaluation of

- a. Image quality
- b. Patient safety

v. Assess outcomes of

- a. Clinical assessments
- b. Imaging interpretations
- c. Correlation of imaging and clinical evaluation

d. Adherence to DOQI guidelines

III.d.iv. Vascular Imaging and Diagnosis / Pathophysiology of Vascular Disorders / Portal venous disorders

1. Content

Portal venous disorders

2. Learning objectives

a. Demonstrate understanding of pathophysiology of portal disorders relevant to image-guided interventions and focused peri-procedural patient care including risk factors, biological / cellular basis, clinical presentation, and natural history

b. Plan and perform procedural elements and techniques relevant to portal venous disorders

i. Requirements for portal venous disorders

- a. Focused history and physical examination
- b. Laboratory studies
- c. Noninvasive vascular laboratory
- d. Imaging
- e. Working knowledge of relevant clinical guidelines

ii. Appropriate application of imaging, physical examination, and laboratory studies for portal venous disorders

- a. Noninvasive vascular laboratory
- b. Ultrasound
- c. CT / CTA
- d. MRI / MRA
- e. Fluoroscopy / angiography
- f. Nuclear medicine

iii. Monitoring and recording of

- a. Documentation of history
- b. Documentation of physical examination
- c. HIPAA-compliant record management
- d. Images and reports

iv. Evaluation of

- a. Image quality
- b. Patient safety

v. Assess outcomes of

- a. Clinical assessments
- b. Imaging interpretations

- c. Correlation of imaging and clinical evaluation
- d. Adherence to relevant clinical guidelines

III.d.v. Vascular Imaging and Diagnosis / Pathophysiology of Vascular Disorders / Pulmonary artery disorders

1. Content

Pulmonary artery disorders

2. Learning objectives

a. Demonstrate understanding of pathophysiology of arterial vascular disorders relevant to image-guided interventions and focused peri-procedural patient care including risk factors, biological / cellular basis, clinical presentation, and natural history

b. Plan and perform procedural elements and techniques based on an understanding of the pathophysiology of pulmonary artery disorders

i. Requirements for arterial vascular disorders

- a. Focused history and physical examination
- b. Laboratory studies
- c. Imaging
- d. Working knowledge of relevant clinical guidelines

ii. Appropriate application of imaging and physical examination for pulmonary artery disorders

- a. Echocardiography b. CT / CTA
- c. MRI / MRA
- d. Fluoroscopy / angiography
- e. Nuclear medicine studies
- f. Nuclear medicine

iii. Monitoring and recording of

- a. Documentation of history
- b. Documentation of physical examination
- c. HIPA-compliant record management
- d. Images and reports

iv. Evaluation of

- a. Image quality
- b. Patient safety

v. Assess outcomes of

- a. Clinical assessments
- b. Imaging interpretations
- c. Correlation of imaging and clinical evaluation
- d. Adherence to relevant clinical guidelines

III.d.vi. Vascular Imaging and Diagnosis / Pathophysiology of Vascular Disorders / Lymphatic disorders

1. Content

Lymphatic disorders

2. Learning objectives

a. Demonstrate understanding of pathophysiology of arterial vascular disorders relevant to image-guided interventions and focused peri-procedural patient care including risk factors, biological / cellular basis, clinical presentation, and natural history

b. Plan and perform procedural elements and techniques based on an understanding of the pathophysiology of lymphatic disorders

i. Requirements for lymphatic disorders

- a. Focused history and physical examination
- b. Laboratory studies
- c. Noninvasive vascular laboratory
- d. Imaging
- e. Working knowledge of relevant clinical guidelines

ii. Appropriate application of imaging and physical examination for lymphatic disorders

- a. Ultrasound
- b. CT
- c. MRI
- d. Fluoroscopy / lymphangiography
- e. Nuclear medicine

iii. Monitoring and recording of

- a. Documentation of history
- b. Documentation of physical examination
- c. HIPAA-compliant record management
- d. Images and reports

iv. Evaluation of

- a. Image quality
- b. Patient safety

v. Assess outcomes of

- a. Clinical assessments
- b. Imaging interpretations
- c. Correlation of imaging and clinical evaluation

d. Adherence to relevant clinical guidelines

IV.a. Vascular Interventions / Principles of vascular interventions

1. Content

Principles of vascular interventions

2. Learning objectives

a. Demonstrate understanding of the principles, basic skills, and techniques of vascular interventions such as

- i. Revascularization
- ii. Embolization
- iii. Device placement
- iv. Foreign body removal
- v. Infusion therapy
- vi. Thrombus management
- vii. Ablation

b. Plan and perform procedural elements and techniques relevant to

- i. Requirements for vascular interventions including
 - a. Patient selection and pre-intervention evaluation
 - b. Procedural imaging
 - c. Interventional technique and device selection
 - d. Application of technique and device
 - e. Documentation of result of intervention
 - f. Recognition and treatment of complications
 - g. Post-procedural patient management and procedure-related follow-up
- ii. Appropriate application of techniques and devices for
 - a. Revascularization
 - b. Embolization
 - c. Device placement
 - d. Foreign body removal
 - e. Infusion therapy
 - f. Thrombus management
 - g. Ablation
- iii. Monitoring and recording of vascular interventions

- a. Images
 - b. Physiologic data
 - c. Device tracking
- iv. Evaluation of vascular interventional procedures including
 - a. Radiation exposure
 - b. Contrast utilization
 - c. Device utilization
- v. Assess outcomes of vascular interventions including
 - a. Complications
 - b. Procedural success
 - c. Clinical success
 - d. Cost effectiveness

IV.b.i.a. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Peripheral arterial intervention

1. Content

Peripheral arterial intervention

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to peripheral arterial intervention

i. Knowledge of cross-sectional vascular anatomy of the extremities, aorta, pelvis, infrahyoid neck

ii. Recognition of hemodynamically significant pathology

iii. Knowledge of the etiology of underlying pathology

b. Perform peri-procedural patient care for patients undergoing peripheral arterial intervention

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with peripheral arterial disease

ii. Appropriate patient evaluation to assess suitability and safety for peripheral arterial intervention

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Bleeding

b. Damage to adjacent structures

c. Distal embolization

d. Medical management

e. Surgical bypass

f. Contrast adverse reactions

g. Potential for re-intervention

iv. Pre-procedural therapies including

a. Intravenous fluids

- b. Medications including renal protection, contrast pre-medication, and correction of coagulation abnormalities
- v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Medications including anticoagulation
 - c. Recognition and management of procedure-related complications
 - d. Coordinated medical management of the patient as an inpatient / outpatient
 - e. Ensure coordination of appropriate follow-up imaging and clinical evaluation
- c. Plan and perform procedural elements and techniques relevant to peripheral arterial intervention
 - i. Select approach, imaging guidance, and appropriate tools for peripheral arterial intervention
 - ii. Techniques including
 - a. Vascular access
 - b. Catheter selection, positioning
 - c. Interpretation of angiography imaging and pre-intervention planning
 - d. Hemodynamic measurement
 - e. Angioplasty
 - f. Stents
 - g. Use of endovascular interventional devices
 - h. Thrombus management
 - iii. Intra-procedural analgesia, sedation, and medications including
 - a. Anticoagulation
 - b. Vasodilators
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Distal embolization
 - c. Dissection
 - d. Thrombosis
 - e. Recoil

IV.b.i.b. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Treatment of arteriovenous malformation

1. Content

Treatment of arteriovenous malformation (AVM)

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided treatment of vascular anomalies

i. Imaging (CT, MR, scintigraphic, fluoroscopic, ultrasound, and radiographic) findings and anatomy associated with vascular anomalies

ii. Etiologies, physical findings, and natural history of vascular anomalies

b. Perform peri-procedural patient care for patients undergoing percutaneous image-guided treatment of vascular anomalies

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient undergoing treatment of a vascular anomaly

ii. Appropriate patient evaluation to assess suitability and safety for percutaneous image-guided treatment of vascular anomalies

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Non-target organ damage, including skin necrosis, non-target embolization

b. Hemorrhage

c. Infection

d. Renal failure

e. Hemolysis

f. Allergic reaction

g. Surgical resection

h. Laser treatment

iv. Pre-procedural therapies including

a. Blood product utilization

- b. Medications, including antibiotics, sodium bicarbonate
 - c. IV fluids
 - d. Management of contrast allergy
- v. Procedure-related multidisciplinary coordinated care including
 - a. Peri-procedural pain management
 - b. Recognition and management of procedure-related complications
 - c. Follow-up evaluation
- c. Plan and perform procedural elements and techniques relevant to image-guided treatment of vascular anomalies
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous and transvascular image-guided treatment of vascular malformations
 - ii. Techniques including
 - a. Angiography
 - b. Venography
 - c. Direct puncture
 - d. Sclerotherapy
 - e. Embolization
 - f. Flow control
 - iii. Intra-procedural analgesia, sedation, and medications appropriate for treatment of vascular anomalies
 - iv. Recognize and manage procedural complications related to treatment of vascular anomalies such as
 - a. Non-target organ damage, including skin necrosis, non-target embolization
 - b. Hemorrhage
 - c. Infection
 - d. Renal failure
 - e. Hemolysis
 - f. Allergic reaction

IV.b.i.c. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Aortic Interventions

1. Content

Aortic interventions

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to aortic aneurysm, occlusive disease, dissection, vasculitis, inherited structural disorders, trauma, and infection

b. Perform peri-procedural patient care for patients undergoing angioplasty, stent placement, endograft placement, recanalization, and fenestration

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with aortic disease

ii. Appropriate patient evaluation to assess suitability and safety for aortic intervention

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Infection
- c. Allergy to contrast
- d. Renal failure
- e. Injury to the aortic wall
- f. Bowel ischemia
- g. Spinal cord ischemia
- h. Distal embolization
- i. Access site pseudoaneurysm

iv. Pre-procedural therapies including

- a. Blood pressure management
- b. Management of cardiovascular risk factors
- c. Medications including antibiotics

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
 - c. Coordination of care with other specialties related to aortic disease, hypertension, diabetes, and cardiovascular risk factor management
 - d. Establishment of appropriate monitoring to detect late complications
- c. Plan and perform procedural elements and techniques relevant to aortic interventions
 - i. Select approach, imaging guidance, and appropriate tools for aortic interventions
 - ii. Techniques including
 - a. Angioplasty
 - b. Stents
 - c. Stent-grafts
 - d. Fenestration
 - iii. Intra-procedural analgesia, sedation, and medications including an assessment for need for general anesthesia
 - iv. Recognize and manage procedural complications including
 - a. Dissection
 - b. Endoleak
 - c. Aortic rupture
 - d. Thrombosis
 - e. Access site pseudo aneurysm
 - f. Contrast induced nephropathy
 - g. Embolization

IV.b.i.d. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / GI Bleeding—arterial

1. Content

GI bleeding—arterial

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to treatment of arterial gastrointestinal bleeding

i. Imaging (CT, MR, scintigraphic, fluoroscopic) findings and anatomy associated with mesenteric ischemia

ii. Etiologies, physical and clinical findings, and natural history of arterial gastrointestinal bleeding

iii. Role of endoscopy and endoscopy management

b. Perform peri-procedural patient care for patients undergoing treatment of arterial gastrointestinal bleeding

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient undergoing treatment of arterial gastrointestinal bleeding

ii. Appropriate patient evaluation to assess suitability and safety for treatment of arterial gastrointestinal bleeding

a. Presenting signs and symptoms including

1. Location of bleeding

2. Quantity and quality

b. Physical examination including

1. Hemodynamic status

c. Laboratory values including

1. Blood product requirements

d. Imaging with CT, MRI, fluoroscopy, scintigraphy

e. Alternative therapies including

1. Endoscopy

2. Surgery

3. Medical management

iii. Appropriate informed consent including risks, benefits, and alternative therapies, such as

a. Bleeding

b. Damage to bowel or adjacent structures

- c. Sepsis
 - d. Renal failure
 - e. Non-target embolization
 - f. Arterial injury
 - g. Conservative treatment
 - h. Surgical resection
 - i. Endoscopic management
- iv. Pre-procedural therapies including
 - a. Blood product utilization
 - b. Medications, including antibiotics
 - c. IV fluids
 - d. Management of contrast allergy
- v. Procedure-related multidisciplinary coordinated care including
 - a. Peri-procedural pain management
 - b. Recognition and management of procedure-related complications
 - c. Follow-up evaluation
- c. Plan and perform procedural elements and techniques relevant to image-guided treatment of arterial gastrointestinal bleeding
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous and transvascular image-guided treatment of arterial gastrointestinal bleeding
 - ii. Techniques including
 - a. Arteriography
 - b. Embolization
 - c. Infusion therapy
 - iii. Intra-procedural hemodynamic support, analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Damage to bowel or adjacent structures
 - c. Sepsis
 - d. Renal failure
 - e. Failure to control bleeding
 - f. Non-target embolization
 - g. Arterial injury

IV.b.i.e. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Mesenteric ischemia

1. Content

Mesenteric ischemia

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided treatment of acute and chronic mesenteric ischemia

i. Etiologies, physical and clinical findings, and natural history of mesenteric ischemia

ii. Distinguish between acute and chronic mesenteric ischemia

b. Perform peri-procedural patient care for patients undergoing image-guided treatment of mesenteric ischemia

i. Clinical consultation (inpatient and / or outpatient) and appropriate interaction with other clinical services as a part of coordinated care of the patient undergoing image-guided evaluation and treatment of mesenteric ischemia

ii. Appropriate patient evaluation to assess suitability and safety for image-guided treatment of acute and chronic mesenteric ischemia

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Non-target embolization
- c. Lactic acidosis and reperfusion injury
- d. Renal failure
- e. Arterial injury
- f. Conservative treatment
- g. Surgical treatment

iv. Pre-procedural therapies including

- a. Blood product utilization
- b. Medications, including antibiotics
- c. IV fluids

- d. Management of contrast allergy
- v. Procedure-related multidisciplinary coordinated care including
 - a. Peri-procedural pain management
 - b. Recognition and management of procedure-related complications
 - c. Follow-up evaluation
- c. Plan and perform procedural elements and techniques relevant to image-guided treatment of mesenteric ischemia
 - i. Select appropriate patients, approach, target artery, imaging guidance, and tools for image-guided treatment of mesenteric ischemia
 - ii. Techniques including
 - a. Angiography
 - b. Angioplasty
 - c. Stent
 - d. Stent-graft
 - e. Thrombolytic therapy
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Embolization
 - c. Lactic acidosis and reperfusion injury
 - d. Renal failure
 - e. Arterial injury
 - f. Restenosis

IV.b.i.f. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Visceral Aneurysm Interventions

1. Content

Visceral aneurysm interventions

2. Learning objectives

- a. Demonstrate understanding of the pathophysiology, indications, and principles of visceral artery interventions for aneurysms and pseudo-aneurysms
- b. Perform peri-procedural patient care for patients undergoing visceral artery interventions
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with suspected visceral artery aneurysm or pseudo-aneurysm
 - ii. Appropriate patient evaluation to assess suitability and safety for visceral artery interventions
 - a. Presenting signs and symptoms
 - 1. Splenic aneurysms
 - 2. Hepatic aneurysms
 - 3. Mesenteric aneurysms
 - 4. Pancreatic aneurysms
 - b. Physical examination
 - c. Laboratory values including when appropriate
 - 1. Hepatic function
 - 2. Pancreatic enzymes
 - d. Imaging with CT, US, MRI, fluoroscopy
 - 1. Visceral arteries
 - 2. Solid abdominal organ parenchyma
 - e. Alternative therapies
 - 1. Surgery
 - 2. Observation
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies
 - iv. Pre-procedural therapies including
 - a. Correction of coagulopathy
 - b. Fluid resuscitation
 - c. Immunization

- v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of organ function
 - b. Assessment of response to therapy
- c. Plan and perform procedural elements and techniques relevant to visceral artery interventions
 - i. Select approach, imaging guidance, and appropriate tools for visceral artery interventions
 - ii. Techniques including
 - a. Vascular access
 - b. Visceral angiography
 - c. Embolization
 - d. Endograft placement
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Dissection
 - b. Thrombosis
 - c. Rupture
 - d. Non-target organ embolization

IV.b.i.g. Vascular Interventions / Vascular Interventional Procedures / Arterial Interventions / Renal Artery Interventions

1. Content

Renal artery interventions

2. Learning objectives

a. Demonstrate understanding of the pathophysiology, indications, and principles of renal artery interventions for hypertension, renal failure, dissection, aneurysms, tumor, vascular malformation, and trauma in native and transplant kidneys

b. Perform peri-procedural patient care for patients undergoing renal artery interventions

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with suspected renovascular abnormality or vascular renal tumor

ii. Appropriate patient evaluation to assess suitability and safety for renal artery interventions

a. Presenting signs and symptoms

1. Renal vascular disorders

2. Vascular renal tumors

b. Physical examination

c. Laboratory values

d. Imaging with CT, US, MRI, fluoroscopy

1. Renal arteries

2. Renal veins

3. Renal parenchyma

e. Alternative therapies

1. Surgery

2. Renal ablation

3. Systemic therapy

4. Radiation therapy

iii. Appropriate informed consent including risks, benefits, and alternative therapies

iv. Pre-procedural therapies including

a. Blood pressure control

b. Fluid resuscitation

c. Treatment of life-threatening injuries

- v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of renal function
 - b. Assessment of response to therapy
- c. Plan and perform procedural elements and techniques relevant to renal artery interventions
 - i. Select approach, imaging guidance, and appropriate tools for renal artery interventions
 - ii. Techniques including
 - a. Vascular access
 - b. Renal angiography
 - c. Revascularization
 - d. Denervation
 - e. Embolization
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Dissection
 - b. Thrombosis
 - c. Rupture
 - d. Non-target organ embolization

IV.b.i.h. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Hepatic arterial interventions.

1. Content

Hepatic arterial interventions

2. Learning objectives

- a. Demonstrate understanding of the pathophysiology, indications, and principles of hepatic artery interventions for primary and metastatic tumor, aneurysms, vascular malformations, trauma, and occlusive disease in native and transplant livers
- b. Perform peri-procedural patient care for patients undergoing hepatic artery interventions
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with suspected hepatic arterial abnormality or vascular hepatic tumor
 - ii. Appropriate patient evaluation to assess suitability and safety for hepatic artery interventions
 - a. Presenting signs and symptoms
 - 1. Vascular hepatic tumors
 - 2. Hepatic vascular disorder
 - b. Physical examination
 - c. Laboratory values including serologic markers of malignancy when appropriate
 - d. Imaging with CT, US, MRI, fluoroscopy
 - 1. Hepatic arteries
 - 2. Portal veins
 - 3. Hepatic veins
 - 4. Hepatic parenchyma
 - e. Alternative therapies
 - 1. Surgery
 - 2. Ablation
 - 3. Systemic therapy
 - 4. Radiation therapy
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies
 - iv. Pre-procedural therapies including
 - a. Systemic therapy
 - b. Correction of coagulopathy

- c. Fluid resuscitation
 - d. Treatment of life-threatening injuries
- v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of hepatic function
 - b. Assessment of response to therapy
- c. Plan and perform procedural elements and techniques relevant to hepatic artery interventions
 - i. Select approach, imaging guidance, and appropriate tools for hepatic artery interventions
 - ii. Techniques including
 - a. Vascular access
 - b. Hepatic angiography
 - c. Embolization
 - d. Revascularization
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Dissection
 - b. Thrombosis
 - c. Rupture
 - d. Non-target organ embolization

IV.b.i.i. Vascular Intervention/ Vascular Interventional Procedures/ Arterial Interventions / Arterial Trauma Interventions

1. Content

Arterial trauma interventions

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to arterial trauma. Recognize pathophysiology of blunt vs. penetrating trauma
- b. Perform peri-procedural patient care for patients undergoing interventions for arterial injury due to trauma
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care
 - ii. Appropriate patient evaluation to assess suitability and safety for and appropriateness of treatment options including the role of endovascular interventions
 - a. Presenting signs and symptoms of hemorrhage, hemodynamic instability, assess end organ viability
 - b. Physical examination including the role of peripheral pulses to determine appropriate management options
 - c. Laboratory values including serial hemoglobin and coagulation parameters and the need for blood product administration
 - d. Imaging with CT, US and angiography to diagnose the extent of injury and plan treatment
 - e. Alternative therapies including surgery and conservative management
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as risk of non-target embolization, organ infarction, limb loss, failure to achieve desired goals of treatment
 - iv. Pre-procedural therapies including appropriate resuscitation, treatment of life-threatening injuries, and reduction of displaced orthopedic injuries
 - v. Procedure-related multidisciplinary coordinated care including assessment of organ / limb viability, serial blood count follow-up
- c. Plan and perform procedural elements and techniques relevant to diagnosis and treatment of arterial trauma

- i. Select approach, imaging guidance, and appropriate tools to achieve hemostasis or revascularization when appropriate
- ii. Techniques including
 - a. Selective catheterization
 - b. Embolization
 - c. Stents
 - d. Stent-grafts
 - e. Foreign body retrieval
- iii. Intra-procedural resuscitation, analgesia, sedation, and medications
- iv. Recognize and manage procedural complications including
 - a. End organ ischemia
 - b. Limb loss
 - c. Non-target embolization
 - d. Infection
 - e. Bleeding

IV.b.i.j. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Uterine Artery Interventions

1. Content

Uterine artery interventions

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to symptomatic fibroids, post-partum hemorrhage and management of non-operative hemorrhage from other causes such as neoplasm and cervical ectopic pregnancy

b. Perform peri-procedural patient care for patients undergoing uterine artery embolization. Demonstrate knowledge of appropriate antibiotic coverage and peri-procedural pain management

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care uterine artery embolization. Appropriate patient selection related to age, fertility and symptoms

ii. Appropriate patient evaluation to assess suitability and safety for uterine artery interventions

a. Presenting signs and symptoms including hemorrhage and mass symptoms, and impact on adjacent organs

b. Physical examination as appropriate in the clinical setting of uterine disease

c. Laboratory values including hemoglobin, coagulation status and renal function and pregnancy status

d. Imaging with CT, US, MRI, fluoroscopy to define the disease process

e. Knowledge of alternative therapies including minimally invasive percutaneous or gynecologic interventions, including high-frequency focused ultrasound, and thermal ablation options

iii. Appropriate informed consent including risks, benefits, and alternative therapies non-target embolization, loss of fertility, infection, early menopause

iv. Pre-procedural therapies including a trial of pharmacologic therapies when appropriate including hormone therapy and resuscitation when indicated

v. Procedure-related multidisciplinary coordinated care including follow-up clinic visits, inpatient rounding, communication with the

primary caregivers. Non-invasive imaging follow-up including ultrasound and MRI / MRA

c. Plan and perform procedural elements and techniques relevant to uterine artery interventions

- i. Select approach, imaging guidance, and appropriate tools for uterine artery interventions, including selective catheters and microcatheters and the choice of embolic agents relevant to the goal of treatment
- ii. Techniques including selective and superselective catheterization and proper embolization techniques and endpoints. Familiarity with indications and techniques for emergent interventions
- iii. Intra-procedural analgesia, sedation, and medications including the use of patient-controlled analgesic pumps and anti-emetics. Post-procedural management including recommendations for appropriate use of antibiotics
- iv. Recognize and manage complications such as non-target embolization, infection, infarction, pain, and recurrence of symptoms

IV.b.i.k. Vascular Intervention / Vascular Interventional Procedures / Arterial Interventions / Bronchial Artery Embolization

1. Content

Bronchial arterial embolization

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to hemoptysis due to malignant and benign processes. This includes variant anatomy relevant to bronchial arteries as well as non-bronchial systemic arterial supply to the lung in the setting of various diseases. Demonstrate a clear understanding of the goals and endpoints of treatment
- b. Perform peri-procedural patient care for patients undergoing bronchial arterial embolization
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate interaction with other clinical services as a part of coordinated clinical care hemoptysis
 - ii. Appropriate patient evaluation to assess suitability and safety for bronchial arterial embolization. Correlation with bronchoscopy including lateralization of the site of bleeding
 - a. Presenting signs and symptoms quantification of hemorrhage to determine appropriateness of intervention
 - b. Physical examination when pertinent including assessment of airway status and need for intubation including unilateral intubation
 - c. Laboratory values including oxygenation, hemoglobin and coagulation status
 - d. Imaging with CT, MRI, chest radiographs, and bronchoscopy
 - e. Alternative therapies including surgical resection, the role of bronchoscopic interventions and therapeutic radiation
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies. Procedure-specific risk such as possibility of spinal cord injury and / or bronchial infarction
 - iv. Pre-procedural therapies including unilateral intubation for airway protection and other bronchoscopic interventions
 - v. Procedure-related multidisciplinary coordinated care including follow-up imaging evaluation, clinical response to intervention, need for repeat or alternative interventions

c. Plan and perform procedural elements and techniques relevant to bronchial arterial embolization

i. Select approach, imaging guidance, and appropriate tools for bronchial arterial embolization including

- a. Catheter selection
- b. Imaging strategy
- c. Embolic agents

ii. Techniques including

- a. Selective catheterization of the bronchial artery
- b. Selective catheterization of collateral arteries
- c. Embolization

iii. Intra-procedural analgesia, sedation, and medications including the safe use of conscious sedation vs. general anesthesia for airway protection

iv. Recognize and manage procedural complications including

- a. Spinal cord ischemia
- b. Recurrent hemoptysis
- c. Non-target organ embolization

IV.b.ii.a. Vascular Intervention / Vascular Interventional Procedures / Portal Venous Interventions / Transjugular Intrahepatic Porto-systemic Shunt (TIPS)

1. Content

Transjugular Intrahepatic Porto-systemic Shunt (TIPS)

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to portal hypertension and its various etiologies and classification as well as clinical presentation including hematemesis and intractable ascites. Demonstrate an understanding of the role of interventions such as TIPS in each setting

b. Perform peri-procedural patient care for patients undergoing TIPS

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with portal hypertension

ii. Appropriate patient evaluation to assess suitability and safety for TIPS, including Childs classification and MELD scoring systems and their application in patient selection for TIPS

a. Presenting signs and symptoms including massive or recurrent hemorrhage, ascites, and hepatic hydrothorax. Also other manifestations of liver disease such as thrombocytopenia, coagulopathy and liver dysfunction

b. Physical examination when appropriate, including pre-procedure presence of hepatic encephalopathy and ascites

c. Laboratory values and results of other procedures including liver function test, coagulation panel, hemoglobin, renal function, endoscopy

d. Imaging with CT, US, MRI and possible angiography to assess the status of the portal, splenic, mesenteric and hepatic veins prior to the procedure

e. Alternative therapies including pharmacologic reduction of portal pressure, endoscopic variceal banding or sclerotherapy, role of surgical shunt procedures, splenic artery embolization, balloon-occluded retrograde transvenous obliteration (BRTO). Alternative therapies for intractable ascites including repeat large-volume paracentesis or peritoneal-venous shunt procedures

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as worsening liver failure and hepatic encephalopathy, hemorrhage, renal failure and death

- iv. Pre-procedural therapies including control of variceal bleeding, fluid management, paracentesis, and correction of coagulation abnormalities
 - v. Procedure-related multidisciplinary coordinated care including participation in management of encephalopathy, ongoing hemorrhage, liver dysfunction or renal failure
- c. Plan and perform procedural elements and techniques relevant to TIPS
- i. Select approach, imaging guidance, and appropriate tools for performing TIPS. Demonstrate understanding of the hepatic venous and portal venous anatomy, the pressure relationships between the portal and systemic circulation, and the need for additional interventions such as variceal embolization in the setting of massive hemorrhage
 - ii. Techniques including
 - a. Access to the jugular vein and hepatic vein
 - b. Creation of a TIPS or variant such as Direct IVC to Portal Shunt (DIPS)
 - c. Embolization of varices
 - d. Reduction of TIPS
 - e. Reversal of TIPS
 - f. Revision of TIPS
 - iii. Intra-procedural analgesia, sedation, and medications and the need for coordinating with anesthesia
 - iv. Recognize and participate in management of complications including portal vein injury and hemorrhage, thrombosis, stent migration or malfunction

IV.b.ii.b. Vascular Intervention / Vascular Interventional Procedures / Portal Venous Interventions / Variceal Obliteration, sclerosis

1. Content

Variceal obliteration, sclerosis

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to portal hypertension and varices leading to hemorrhage. Demonstrate knowledge of patient selection for transcatheter variceal obliteration and sclerosis. Demonstrate knowledge of alternative or combined techniques such as mini-laparotomy with jejunal vein catheterization and retrograde variceal embolization

b. Perform peri-procedural patient care for patients undergoing transcatheter variceal obliteration and sclerosis

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with varices

ii. Appropriate patient evaluation to assess suitability and safety for transcatheter variceal obliteration and sclerosis

a. Etiology of varices

b. Location of venous obstruction

c. Recognize presenting signs and symptoms

d. Physical examination

e. Laboratory values and results of other procedures including liver biopsy, serum chemistries, hematologic panel, endoscopy

f. Imaging with CT, US, MRI, fluoroscopy

g. Alternative therapies such as surgical or endoscopic intervention, TIPS, pharmacologic reduction of portal pressure

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as skin necrosis, pulmonary and systemic embolization leading to non-target necrosis or systemic complications

iv. Pre-procedural therapies including optimization of coagulation and renal status

v. Procedure-related multidisciplinary coordinated care including pain management, assessment for response to therapy, identification of complication

c. Plan and perform procedural elements and techniques relevant to transcatheter variceal obliteration and sclerosis

i. Select approach, imaging guidance, and appropriate tools for transcatheter variceal obliteration and sclerosis including the use of ultrasound and the appropriate embolic and sclerosant agents

ii. Techniques including

a. Percutaneous transhepatic portal vein cannulation

b. Direct percutaneous access to the varices

c. Portal venography

d. Selective catheterization of varices

e. Balloon-occluded retrograde transvenous obliteration (BRTO)

f. Embolization

g. Sclerosis

iii. Intra-procedural analgesia, sedation, and medications usually with conscious sedation

iv. Recognize and participate in management of procedural complications such as skin or other adjacent organ necrosis, or systemic complications

IV.b.ii.c. Vascular Intervention / Vascular Interventional Procedures / Portal Venous Interventions / Balloon-occluded retrograde transvenous obliteration (BROTO) of gastric varices

1. Content

Balloon-occluded retrograde transvenous obliteration (BROTO) of gastric varices

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to gastric varices and the appropriate use of balloon-occluded retrograde transvenous obliteration (BROTO) of gastric varices. Demonstrate understanding of the clinical presentation including hematemesis. Demonstrate understanding of the role of interventions such as upper endoscopy, Transjugular Intrahepatic Porto-systemic Shunt (TIPS), and surgery

b. Perform peri-procedural patient care for patients undergoing BROTO

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with symptomatic gastric varices

ii. Appropriate patient evaluation to assess suitability and safety for BROTO

a. Presenting signs and symptoms of gastric variceal bleeding

b. Physical examination

c. Laboratory values and results of other procedures including liver biopsy, serum chemistries, hematologic panel, endoscopy

d. Imaging with CT, US, MRI, fluoroscopy to delineate relevant venous anatomy, splenic vein patency, and relationship and collateral pathways relevant to BROTO

e. Alternative therapies when applicable including pharmacologic reduction of portal pressure, TIPS, splenic artery embolization, endoscopic or surgical interventions such as partial gastrectomy

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as risk of systemic embolization or damage to the stomach or esophagus or other adjacent organs

iv. Pre-procedural therapies including optimization of coagulation and renal protection

- v. Post-procedural coordinated care including participation in multidisciplinary clinical, imaging, and endoscopic follow-up to assess response
- c. Plan and perform procedural elements and techniques relevant to catheterization of the IVC and left renal vein and of the gastric varices
 - i. Select approach, imaging guidance, and appropriate tools for balloon-occluded retrograde transvenous obliteration (BROTO) of gastric varices
 - ii. Techniques including
 - a. Catheterization of the left renal vein and its tributary branches
 - b. Retrograde gastric variceal venography
 - c. Balloon occlusion techniques
 - d. Embolization of varices
 - c. Sclerosis of varices
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and participate in management of procedural complications such as portal vein thrombosis, pulmonary embolism, variceal rupture, renal vein thrombosis

IV.b.ii.d. Vascular intervention / Vascular Interventional Procedures / Portal Venous interventions / Portal Vein Dilation and Stenting

1. Content

Portal vein dilation and stenting

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to portal vein stenosis
- b. Perform peri-procedural patient care for patients undergoing portal vein dilation and / or stenting
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of a patient with portal vein stenosis
 - ii. Appropriate patient evaluation to assess suitability and safety for portal vein dilation and stenting
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies including surgical shunts, endoscopic management of varices, pharmacologic reduction of portal pressure
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Infection
 - c. Damage to adjacent structures
 - d. Thrombosis
 - e. Surgical treatment
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Fluid resuscitation
 - c. Renal protection
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of post-procedure complications

c. Plan and perform procedural elements and techniques relevant to portal vein dilation and stenting

i. Select approach, imaging guidance, and appropriate tools for portal vein dilation and stenting

ii. Techniques including

- a. Image-guided venous access
- b. Image-guided percutaneous transhepatic portal vein access
- c. Performance and interpretation of portal venography
- d. Hemodynamic evaluation of the portal system
- e. Image-guided placement of stents and / or balloon dilation

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and participate in the management of procedural complications including

- a. Bleeding
- b. Sepsis
- c. Liver damage
- d. Thrombosis

IV.b.ii.e. Vascular intervention/ Vascular Interventional Procedures / Portal Venous interventions / Portal Vein Recanalization

1. Content

Portal vein recanalization

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, and clinical presentations relevant to acute and chronic portal vein occlusion
- b. Perform peri-procedural patient care for patients undergoing portal vein recanalization
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients with portal vein thrombosis or occlusion
 - ii. Appropriate patient evaluation to assess suitability and safety for portal vein recanalization
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values and results of other procedures including liver biopsy, serum chemistries, hematologic panel, endoscopy
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies such as pharmacologic reduction of portal pressure, systemic anticoagulation, endoscopic or surgical interventions such as portosystemic shunts
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding, local or distant if thrombolytic therapy is performed
 - b. Infection
 - c. Damage to adjacent structures
 - d. Surgical treatment
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Fluid resuscitation
 - c. Antibiotic therapy
 - d. Systemic anticoagulation
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of post-procedure complications
 - c. Imaging surveillance

c. Plan and perform procedural elements and techniques relevant to portal vein recanalization

i. Select approach, imaging guidance, and appropriate tools for portal vein recanalization

ii. Techniques including

- a. Image-guided venous access
- b. Image-guided percutaneous transhepatic portal vein access
- c. Performance and interpretation of portal venography
- d. Hemodynamic evaluation of the portal system
- e. Image-guided placement of stents and / or balloon dilation
- f. Chemical and / or mechanical thrombolytic therapy

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and participate in management of procedural complications including

- a. Bleeding
- b. Sepsis
- c. Liver damage

IV.b.iii.a. Vascular intervention / Vascular Interventional Procedures / Pulmonary Artery Intervention / Pulmonary artery arteriovenous malformation (AVM)

1. Content

Pulmonary artery arteriovenous malformation (AVM)

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to pulmonary AVM

b. Perform peri-procedural patient care for patients undergoing Pulmonary AVM evaluation and management

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients with pulmonary AVM

ii. Appropriate patient evaluation to assess suitability and safety for pulmonary AVM embolization

a. Presenting signs and symptoms—patient and possibly family evaluation for Hereditary Hemorrhagic Telangiectasia

b. Physical examination

c. Laboratory values including shunt fraction determination

d. Imaging with CT, US, MRI, fluoroscopy of the

1. Lungs

2. Brain

3. Spinal cord

4. Liver

e. Alternative therapies including surgery

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

a. Bleeding

b. Non-target embolization

c. Cardiac arrhythmias

d. Damage to adjacent structures

e. Surgical treatment

iv. Pre-procedural therapies including

a. Blood products to normalize coagulation

b. Baseline cardiopulmonary evaluation

v. Procedure-related multidisciplinary coordinated care including

a. Procedure-related pain management

- b. Recognition and management of post-procedure complications
 - c. Imaging surveillance
- c. Plan and perform procedural elements and techniques relevant to pulmonary AVM embolization
 - i. Select approach, imaging guidance, and appropriate tools for pulmonary AVM embolization
 - ii. Techniques including
 - a. Intravenous line filters
 - b. Image-guided venous access
 - c. Image-guided pulmonary artery catheterization
 - d. Performance and interpretation of pulmonary arteriography
 - e. Hemodynamic evaluation of the pulmonary arteries
 - f. Image-guided embolization of the pulmonary AVM
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Sepsis
 - c. Lung damage
 - d. Non-target or systemic embolization
 - e. Arrhythmias

IV.b.iii.b. Vascular intervention / Vascular Interventional Procedures / Pulmonary Artery Intervention / Pulmonary embolism (PE) management—thrombolytic therapy

1. Content

Pulmonary embolism (PE) management—thrombolytic thereapy

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to acute PE management with thrombolytic therapy and percutaneous thrombectomy devices

b. Perform peri-procedural patient care for patients undergoing percutaneous PE management

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of a patient with acute PE

ii. Appropriate patient evaluation to assess suitability and safety for PE thrombolytic therapy

a. Presenting signs and symptoms of massive and sub-massive PE

b. Physical examination

c. Laboratory values including

1. EKG

2. Cardiac echo

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies including

1. Systemic thrombolysis

2. Surgical thrombectomy

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

a. Bleeding, both local and distant

b. Cardiac arrhythmias

c. Damage to adjacent structures

d. Death

e. Surgical treatment

iv. Pre-procedural therapies including

a. Anticoagulation

b. Cardiopulmonary evaluation

c. Fluid resuscitation

- v. Procedure-related multidisciplinary coordinated care including
 - a. Recognition and management of complications
 - b. Assess response to therapy
 - c. IVC filter removal
- c. Plan and perform procedural elements and techniques relevant to acute PE management with thrombolytic therapy and percutaneous thrombectomy devices
 - i. Select approach, imaging guidance, and appropriate tools for PE management with thrombolytic therapy and percutaneous thrombectomy devices
 - ii. Techniques including
 - a. Image-guided venous access
 - b. Image-guided pulmonary artery catheterization
 - c. Performance and interpretation of pulmonary arteriography
 - d. Hemodynamic evaluation of the pulmonary arteries
 - e. Chemical and mechanical thrombolysis
 - f. IVC filter placement
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Sepsis
 - c. Lung damage
 - d. Arrhythmias and / or cardiovascular compromise

IV.b.iv.a. Vascular intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Reproductive Tract

1. Content

Reproductive tract

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to pelvic congestion syndrome or varicocele
- b. Perform peri-procedural patient care for patients undergoing gonadal vein embolization
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients with pelvic congestion syndrome or varicocele
 - ii. Appropriate patient evaluation to assess suitability and safety for gonadal vein embolization
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including
 - 1. Pregnancy test in women
 - d. Imaging with CT, US, MRI, fluoroscopy including
 - 1. Testicular US in men
 - 2. Pelvic imaging in women
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Infection
 - c. Surgical treatment
 - d. Medical management
 - iv. Pre-procedural therapies including
 - a. Treatment of reproductive tract infection
 - b. Hormonal therapy in women
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of post-procedure complications
 - c. Imaging surveillance

- c. Plan and perform procedural elements and techniques relevant to gonadal vein embolization
 - i. Select approach, imaging guidance, and appropriate tools for gonadal vein embolization
 - ii. Techniques including
 - a. Image-guided venous access
 - b. Gonadal vein selective catheterization and venography
 - c. Sclerotherapy and / or embolization of gonadal veins
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection
 - c. Evaluation for clinical failure and need for repeat intervention

IV.b.iv.b. Vascular intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Upper-Extremity / Superior Vena Cava occlusive disease

1. Content

Upper-extremity / superior vena cava occlusive disease

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to acute and chronic upper-extremity and superior vena cava (SVC) occlusive disease

b. Perform peri-procedural patient care for patients undergoing upper-extremity or SVC thrombolytic therapy, recanalization, angioplasty and / or stenting

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care patients with upper extremity venous occlusive disease

ii. Appropriate patient evaluation to assess suitability and safety for upper extremity thrombolytic therapy, recanalization, angioplasty and / or stenting

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies

- a. Bleeding
- b. Infection
- c. Surgical treatment
- d. Medical management
- e. Radiation treatment

iv. Pre-procedural therapies including

- a. Anticoagulation
- b. Airway management

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
- b. Recognition and management of post-procedure complications
- c. Imaging surveillance

- c. Plan and perform procedural elements and techniques relevant to upper-extremity thrombolytic therapy, recanalization, angioplasty and / or stenting
 - i. Select approach, imaging guidance, and appropriate tools for upper-extremity thrombolytic therapy, recanalization, angioplasty and / or stenting
 - ii. Techniques including
 - a. Image-guided venous access
 - b. Perform and interpret upper-extremity venography
 - c. Perform chemical and / or mechanical thrombolysis
 - d. Perform venous angioplasty and / or stenting
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection
 - c. Recognize clinical failure and need for repeat intervention

IV.b.iv.c. Vascular intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Lower-extremity venous occlusive disease

1. Content

Lower-extremity venous occlusive disease

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to lower-extremity acute and chronic venous disease

b. Perform peri-procedural patient care for patients undergoing lower-extremity venous thrombolytic therapy, angioplasty and / or stenting, ablation, phlebectomy and sclerotherapy

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients with lower-extremity acute and chronic venous disease

ii. Appropriate patient evaluation to assess suitability and safety for lower-extremity venous thrombolytic therapy, angioplasty and / or stenting, ablation, phlebectomy and sclerotherapy

a. Presenting signs and symptoms

b. Physical examination including

1. CEAP classification chronic disease

2. Recognition of venous emergencies

c. Laboratory values including

1. Abnormalities of coagulation factors

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Bleeding

b. Infection

c. Surgical treatment

d. Medical management

iv. Pre-procedural therapies including

a. Anticoagulation

b. Compression garments / devices

v. Procedure-related multidisciplinary coordinated care including

a. Post-procedure-related pain management

b. Recognition and management of post-procedure complications

- c. Imaging surveillance
- d. Anticoagulation
- e. IVC filter removal

c. Plan and perform procedural elements and techniques relevant to lower extremity venous thrombolytic therapy, angioplasty and / or stenting, ablation, phlebectomy and sclerotherapy

i. Select approach, imaging guidance, and appropriate tools for lower extremity venous thrombolytic therapy, angioplasty and / or stenting, ablation, and phlebectomy

ii. Techniques including

- a. Image-guided venous access
- b. Lower-extremity venography
- c. Chemical and / or mechanical thrombolytic therapy
- d. Venous angioplasty and / or stenting
- e. Vena cava filter placement
- f. Venous ablation, phlebectomy and sclerotherapy

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications such as

- a. Bleeding
- b. Infection
- c. Venous thromboembolic disease
- d. Evaluation for clinical failure and need for repeat intervention

IV.b.iv.d. Vascular intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Foreign Body Retrieval

1. Content

Foreign Body Retrieval

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to retained foreign bodies
- b. Perform peri-procedural patient care for patients undergoing foreign body retrieval
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients with retained foreign bodies
 - ii. Appropriate patient evaluation to assess suitability and safety for foreign body retrieval
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Infection
 - c. Thrombosis
 - d. Central embolization
 - e. Surgical treatment
 - f. Conservative management
 - iv. Pre-procedural therapies including
 - a. Anticoagulation
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of post-procedure complications
- c. Plan and perform procedural elements and techniques relevant to foreign body retrieval

- i. Select approach, imaging guidance, and appropriate tools for foreign body retrieval for the object to be retrieved
 - a. Sheaths
 - b. Retrieval tools
- ii. Techniques including
 - a. Image-guided venous access
 - b. Venography
 - c. Image-guided retrieval with various tools
- iii. Intra-procedural analgesia, sedation, medications, management of arrhythmias
- iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Thrombosis
 - c. Central embolization
 - d. Failure to retrieve foreign body and consult for appropriate medical or surgical management

IV.b.iv.e. Vascular Intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Caval Filtration

1. Content

Caval filtration

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to caval filtration including normal venous anatomy and variants, etiology and clinical presentation of deep venous thrombosis and thromboembolic disease, and current guidelines for treatment of venous thromboembolic disease (VTE)

b. Perform peri-procedural patient care for patients undergoing caval filtration and filter removal

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with VTE or risk of VTE and / or complication from anticoagulation

ii. Appropriate patient evaluation to assess suitability and safety for caval filter placement and removal

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values including
 - 1. Coagulation studies
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Anticoagulation therapy
- b. Surgical caval ligation
- c. Observation

iv. Pre-procedural therapies including

- a. Anticoagulation status
- b. Contrast allergy prophylaxis
- c. Sedation and analgesia
- d. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Hemostasis and puncture site care
- b. Recognition and management of procedure-related complications

- c. Initiation of appropriate therapy for venous VTE
 - d. Determination of appropriate timing for filter removal
- c. Plan and perform procedural elements and techniques relevant to caval filtration
 - i. Select approach, imaging guidance, and appropriate tools for caval filter placement and removal
 - ii. Techniques including
 - a. Venous access with landmarks or ultrasound guidance
 - b. Seldinger technique
 - c. Performance and interpretation of venography
 - d. Use of alternative imaging modalities such as IVUS
 - e. Filter placement
 - f. Filter retrieval
 - iii. Intra-procedural analgesia, sedation, and medications, particularly anticoagulants
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection
 - c. Venous injury
 - d. Filter migration
 - e. Caval thrombosis

IV.b.iv.f. Vascular Intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Transvenous Biopsy

1. Content

Transvenous biopsy

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to transvenous biopsy including normal venous anatomy and variants, and the etiologies and clinical presentations of diseases requiring transvenous biopsy

b. Perform peri-procedural patient care for patients undergoing transvenous biopsy

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with diseases requiring transvenous biopsy

ii. Appropriate patient evaluation to assess suitability and safety for transvenous biopsy

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values including

1. Coagulation parameters

2. Tumor markers

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies, including percutaneous and surgical biopsy

iii. Appropriate informed consent including risks, benefits, and alternative therapies procedure including

a. Bleeding

b. Infection

c. Contrast allergy

d. Contrast induced nephropathy

e. Damage to target organ

f. Damage to adjacent structures

g. Surgical and percutaneous biopsy techniques

iv. Pre-procedural therapies including:

a. Blood products to normalize coagulation profile

b. Contrast allergy prophylaxis

c. Sedation and analgesia

d. Intravenous fluids

- v. Procedure-related multidisciplinary coordinated care including
 - a. Hemostasis and puncture site care
 - b. Recognition and management of procedure-related complications
 - c. Appropriate specimen handling
 - d. Procedure-related pain management
- c. Plan and perform procedural elements and techniques relevant to transvenous biopsy
 - i. Select approach, imaging guidance, and appropriate tools for transvenous biopsy
 - ii. Techniques including
 - a. Venous access with landmarks or ultrasound guidance
 - b. Seldinger technique
 - c. Fluoroscopic selective catheter positioning
 - d. Performance and interpretation of venography
 - e. Use of alternative contrast media including carbon dioxide
 - f. Patient monitoring
 - g. Proper use of biopsy devices
 - h. Determination of specimen adequacy
 - i. Specimen handling
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Infection
 - c. Contrast allergy
 - d. Contrast induced nephropathy
 - e. Damage to target organ
 - f. Damage to adjacent structures

IV.b.iv.g. Vascular Intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Venous Sampling for Endocrine Disease

1. Content

Venous Sampling for Endocrine Disease

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to venous sampling for endocrine disease normal and variant venous anatomy, etiology and clinical presentation of endocrine diseases requiring venous sampling, use of appropriate provocative medication in specific neuroendocrine disease, and interpretation of sampling results

b. Perform peri-procedural patient care for patients undergoing venous sampling for endocrine disease

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care for patients requiring venous sampling for endocrine disease

ii. Appropriate patient evaluation to assess suitability and safety for patients requiring venous sampling for endocrine disease

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values including

1. Hormonal assays

d. Imaging with CT, US, MRI, fluoroscopy, nuclear medicine

e. Alternative diagnostic procedures including

1. Cross-sectional imaging

2. Angiography

iii. Appropriate informed consent including risks, benefits, and alternative diagnostic testing

a. Bleeding

b. Infection

c. Contrast allergy

d. Contrast induced nephropathy

e. Damage to target organ

f. Alternative diagnostic procedures

iv. Pre-procedural therapies including:

a. Blood products to normalize coagulation profile

b. Contrast allergy prophylaxis

c. Sedation and analgesia

- d. Intravenous fluids
 - e. Provocative agents
- v. Procedure-related multidisciplinary coordinated care including
 - a. Hemostasis and puncture site care
 - b. Recognition and management of procedure-related complications
 - c. Appropriate specimen handling
 - d. Procedure-related pain management
 - e. Interpretation of sampling results
- c. Plan and perform procedural elements and techniques relevant to venous sampling for endocrine disease
 - i. Select approach, imaging guidance, and appropriate tools for venous sampling including
 - a. Venous sampling
 - b. Venous sampling with peripheral venous stimulation
 - c. Venous sampling with simultaneous arterial stimulation
 - ii. Techniques including
 - a. Venous access
 - b. Arterial access
 - c. Catheter size and type
 - d. Fluoroscopic selective catheter positioning
 - e. Performance and interpretation of venography
 - f. Use of alternative contrast media including carbon dioxide
 - g. Administration of provocative agent
 - h. Venous specimen collection
 - i. Specimen labeling and handling
 - iii. Intra-procedural analgesia, sedation, and medications including
 - a. Provocative agents
 - iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Thrombosis
 - c. Venous rupture
 - d. Contrast allergy
 - e. Contrast induced nephropathy
 - f. Damage to target organ

IV.b.iv.h. Vascular Intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Hemodialysis Access Management

1. Content

Hemodialysis access management

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to hemodialysis access management including normal and post-surgical vascular anatomy and variants; etiology and clinical presentation of renal disease requiring hemodialysis access management; relevant evaluation and imaging including flow parameters, clearance calculations, MR, CT, US, arteriography, and venography; and application of current Dialysis Outcome Quality Initiative (DOQI) recommendations

b. Perform peri-procedural patient care for patients undergoing hemodialysis access management

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with renal disease and need for hemodialysis access management

ii. Appropriate patient evaluation to assess suitability and safety for the patient requiring hemodialysis access management

a. Presenting signs and symptoms

b. Physical examination including

1. Access examination

2. Volume status

c. Laboratory values including

1. Serum potassium

d. Imaging with CT, US, fluoroscopy, MRI

e. Alternative therapies, including surgical management

iii. Appropriate informed consent including risks, benefits, and alternative therapies

a. Bleeding

b. Infection

c. Contrast allergy

d. Damage to fistula / graft or adjacent vascular structures

e. Thromboembolism

f. Surgical management

iv. Pre-procedural therapies including:

a. Management of hyperkalemia

- b. Contrast allergy prophylaxis
 - c. Sedation and analgesia
 - d. Intravenous fluids
- v. Procedure-related multidisciplinary coordinated care including
 - a. Hemostasis and puncture site care
 - b. Recognition and management of procedure-related complications
 - c. Procedure-related pain management
 - d. Patient follow-up, including access surveillance
 - e. Anticoagulant and antiplatelet therapy
- c. Plan and perform procedural elements and techniques relevant to hemodialysis access management
 - i. Select approach, imaging guidance, and appropriate tools for hemodialysis access management
 - ii. Techniques including
 - a. Graft or fistula access with palpation or ultrasound guidance
 - b. Seldinger technique
 - c. Fluoroscopic selective catheter positioning
 - d. Performance and interpretation of fistulagram
 - e. Use of alternative contrast media including carbon dioxide
 - f. Patient monitoring
 - g. Use of thrombolytics
 - h. Use of mechanical thrombectomy devices
 - i. Angioplasty and stenting
 - iii. Intra-procedural analgesia, sedation, and medications including thrombolytics, anticoagulants and vasodilators
 - iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Infection
 - c. Contrast allergy
 - d. Damage to fistula / graft or adjacent vascular structures
 - e. Thromboembolism

IV.b.iv.i. Vascular Intervention / Vascular Interventional Procedures / Systemic Venous Interventions / Venous Access

1. Content

Venous access

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to venous access device placement and management
- b. Perform peri-procedural patient care for patients undergoing venous access device placement and venous access device management
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care patient requiring venous access device placement or management
 - ii. Appropriate patient evaluation to assess suitability and safety for venous access device placement or management
 - a. Presenting signs and symptoms of conditions relevant to venous access device placement or management
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - 1. Intramuscular administration
 - 2. Intramedullary administration
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies of venous access device placement or management
 - iv. Pre-procedural therapies including
 - a. Correction of coagulopathy
 - b. Antibiotic therapy
 - v. Procedure-related multidisciplinary coordinated care including assessment of device function and complications
- c. Plan and perform procedural elements and techniques relevant to venous access device placement and management
 - i. Select approach, imaging guidance, appropriate tools, and appropriate device for venous access device placement and management

- ii. Techniques including
 - a. Venous access
 - b. Central venous catheterization
 - c. Placement and removal of
 - 1. Peripherally Inserted Central Catheters
 - 2. Non-tunneled Central Venous Catheters (non-PICC)
 - 3. Tunneled Central Venous Catheters
 - 4. Subcutaneous Ports
 - d. Fibrin sheath management
 - e. Catheter tip repositioning
- iii. Intra-procedural analgesia, sedation, and medications including
 - a. Antibiotics
- iv. Recognize and participate in management of procedural complications including
 - a. Pneumothorax
 - b. Arterial injury
 - c. Device malposition
 - d. Catheter kink / pinch
 - e. Venous injury
 - f. Air embolism
 - g. Infection
 - h. Fibrin sheath
 - i. Thrombosis

IV.b.v.a. Vascular Intervention / Vascular Interventional Procedures / Lymphatic Interventions / Lymphangiography

1. Content

Lymphangiography

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to lymphatic disorders
- b. Perform peri-procedural patient care for patients undergoing lymphangiography
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient requiring lymphangiography
 - ii. Appropriate patient evaluation to assess suitability and safety for lymphangiography
 - a. Presenting signs and symptoms of patients with lymphatic disorders
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, nuclear medicine, fluoroscopy
 - e. Alternative therapies including
 - 1. Compressive therapy
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Infection
 - b. Lymph leak
 - c. Oil pneumonitis
 - d. Scar / tattoo
 - iv. Pre-procedural therapies including
 - a. Compressive therapy
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Wound care
 - b. Recognition of wound infection
 - c. Recognition of lymph leak
- c. Plan and perform procedural elements and techniques relevant to lymphangiography

- i. Select approach, imaging guidance, and appropriate tools for lymphangiography
- ii. Techniques including
 - a. Administration of isosulfan blue
 - b. Lymphatic cut-down
 - c. Lymphatic cannulation
 - d. Infusion of Lipiodol
 - e. Wound closure
 - f. Interpretation of imaging
- iii. Intra-procedural analgesia, sedation, and medications
- iv. Recognize and manage procedural complications such as
 - a. Infection
 - b. Lymph leak
 - c. Oil pneumonitis

IV.b.v.b. Vascular Intervention / Vascular Interventional Procedures / Lymphatic Interventions / Thoracic duct embolization

1. Content

Thoracic duct embolization

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to thoracic duct leak, chylous pleural effusion, and chylous ascites
- b. Perform peri-procedural patient care for patients undergoing thoracic duct embolization
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with suspected thoracic duct leak
 - ii. Appropriate patient evaluation to assess suitability and safety for thoracic duct embolization
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including
 - 1. Analysis of pleural fluid
 - 2. Analysis of ascites
 - d. Imaging with CT, US, MRI, nuclear medicine, fluoroscopy
 - e. Alternative therapies including
 - 1. Low fat total diet / parenteral nutrition
 - 2. Surgical ligation
 - 3. Pleurodesis
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Injury to abdominal viscera or vasculature
 - b. Conversion to chylous ascites
 - c. Conservative management with low-fat total parenteral nutrition
 - d. Surgical management
 - iv. Pre-procedural therapies including lymphangiography
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Monitoring response to therapy
 - b. Wound care

c. Plan and perform procedural elements and techniques relevant to thoracic duct embolization

i. Select approach, imaging guidance, and appropriate tools for lymphangiography and thoracic duct embolization

ii. Techniques including

- a. Lymphangiography
- b. Image-guide access cisterna chyli
- c. Thoracic duct catheterization
- d. Thoracic duct embolization
- e. Cisterna chyli fenestration

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications including

- a. Non-target organ embolization
- b. Bleeding
- c. Complications of lymphangiography
- d. Procedural failure

V.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Principles of Non-Vascular Intervention

1. Content

Principles of non-vascular intervention

2. Learning objectives

a. Demonstrate understanding of the principles of non-vascular interventions and invasive diagnostic procedures

b. Plan and perform procedural elements and techniques relevant to non-vascular interventions

i. Requirements for non-vascular interventions and invasive diagnostic procedures including

a. Patient selection and pre-intervention evaluation

b. Procedural imaging

c. Technique and device selection

d. Application of technique and device

1. Biopsy

2. Aspiration

3. Catheter drainage

4. Stent placement

5. Ablation

6. Percutaneous organ access

e. Documentation of result of procedure

f. Recognition and treatment of complications

g. Post-procedural patient management and procedure-related follow-up

ii. Appropriate application of non-vascular interventions and invasive diagnostic procedures

iii. Monitoring and recording of non-vascular interventions and invasive diagnostic procedures

iv. Evaluation of non-vascular interventions and invasive diagnostic procedures including ongoing quality improvement

v. Assess outcomes of non-vascular interventions and invasive diagnostic procedures and modify practice as indicated to improve quality

V.b.i.a. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Biopsy / Abdomen and pelvis

1. Content

Biopsy in the abdomen and pelvis

2. Learning objectives

- a. Demonstrate understanding of the principles of the anatomy and pathophysiology relevant to image-guided biopsy of abdominal and pelvic structures including cross-sectional anatomy of the abdomen and pelvis; common abdominal and pelvic tumor types and their route of spread
- b. Perform peri-procedural patient care for patients undergoing biopsy of abdominal and pelvic structures
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient requiring biopsy of abdominal and / or pelvic structures
 - ii. Understand and perform appropriate patient evaluation to assess suitability and safety for percutaneous image-guided biopsy of abdominal and / or pelvic structures
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including
 1. Coagulation studies
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Needle tract seeding
 - e. Surgical biopsy as alternative
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Use of desmopressin to limit renal biopsy related bleeding
 - c. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management

- b. Appropriate specimen handling
 - c. Recognition and management of procedure-related complications
 - d. Interpretation of pathology reports
 - e. Recognition and management of sampling error
- c. Plan and perform procedural elements and techniques relevant to image-guided biopsy of abdominal and pelvic structures
 - i. Select approach, imaging guidance, and appropriate tools for image-guided biopsy of abdominal and pelvic structures
 - ii. Techniques including
 - a. Tandem
 - b. Coaxial
 - c. Core needle biopsy
 - d. Fine needle aspiration
 - e. Determination of sample adequacy
 - f. Handling of samples for appropriate analysis
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection
 - c. Adjacent structure / organ injury
 - d. Needle tract seeding

V.b.i.b. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Biopsy / Liver

1. Content

Liver biopsy

2. Learning objectives

- a. Demonstrate understanding of the principles of the anatomy and pathophysiology relevant to image-guided biopsy of the liver including cross-sectional anatomy of the liver; common liver tumor types and their imaging characteristics; common medical diseases of the liver and their imaging characteristics
- b. Perform peri-procedural patient care for patients undergoing biopsy of the liver
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient requiring liver biopsy
 - ii. Understand and perform appropriate patient evaluation to assess suitability and safety for percutaneous image-guided biopsy of the liver
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including coagulation studies
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Needle tract seeding
 - e. Transvenous biopsy as alternative
 - f. Surgical biopsy as alternative
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Pre-biopsy paracentesis when required
 - c. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Appropriate specimen handling

- c. Recognition and management of procedure-related complications
 - d. Interpretation of pathology reports
 - e. Recognition and management of sampling error
- c. Plan and perform procedural elements and techniques relevant to image-guided liver biopsy
 - i. Select approach, imaging guidance, and appropriate tools for image-guided biopsy of the liver
 - ii. Techniques including
 - a. Tandem
 - b. Coaxial
 - c. Core needle biopsy
 - d. Fine needle aspiration
 - e. Determination of sample adequacy
 - f. Handling of samples for appropriate analysis
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection
 - c. Adjacent structure / organ injury
 - d. Needle tract seeding

V.b.i.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Biopsy / Thoracic

1. Content

Thoracic biopsy

2. Learning objectives

- a. Demonstrate understanding of the principles of the anatomy and pathophysiology relevant to image-guided thoracic biopsy including cross-sectional and fluoroscopic anatomy of thoracic compartments (chest wall, pleura, parenchyma, mediastinum); understanding of the role of thoracic biopsy in evaluation of neoplastic and non-neoplastic thoracic pathology
- b. Perform peri-procedural patient care for patients undergoing thoracic biopsy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient undergoing thoracic biopsy
 - ii. Understand and perform appropriate patient evaluation to assess suitability and safety for image-guided thoracic biopsy
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, fluoroscopy, MRI
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding (hemothorax, hemoptysis, pulmonary hemorrhage)
 - b. Pneumothorax
 - c. Air embolus
 - d. Damage to adjacent structures
 - e. Tumor tract seeding
 - f. Infection
 - iv. Pre-procedural therapies including
 - a. Administration of blood products and managing medications to normalize coagulation
 - b. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management

b. Recognition and management of procedure-related complications

V.b.i.d. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Biopsy / Bone

1. Content

Bone biopsy

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided biopsy of bone: cross-sectional and fluoroscopic bone anatomy; relevant adjacent vital structures to avoid (nerves, arteries, organs)

b. Perform peri-procedural patient care for patients undergoing bone biopsy

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing bone biopsy

ii. Appropriate patient evaluation to assess suitability and safety for patient undergoing bone biopsy

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values including coagulation studies
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative approach to diagnosis

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Infection
- d. Tumor tract seeding
- e. Imaging diagnosis
- f. Surgical biopsy

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
- b. Appropriate specimen handling
- c. Recognition and management of procedure-related complications
- d. Interpretation of pathology reports

- e. Recognition and management of sampling error
- c. Plan and perform procedural elements and techniques relevant to bone biopsy
 - i. Select approach, imaging guidance, and appropriate tools for bone biopsy
 - ii. Techniques including
 - a. Transpedicular / peri-pedicular approach to vertebral lesions
 - b. Bone marrow aspiration
 - c. Core biopsy
 - d. Determination of sample adequacy
 - e. Handling of samples for appropriate analysis
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Nerve injury
 - c. Infection

V.b.i.e. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Biopsy / Soft Tissue

1. Content

Soft tissue biopsy

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided biopsy of soft tissue: anatomy; relevant adjacent vital structures to avoid (nerves, arteries, organs)
- b. Perform peri-procedural patient care for patients undergoing soft tissue biopsy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing soft tissue biopsy
 - ii. Appropriate patient evaluation to assess suitability and safety for patients undergoing soft tissue biopsy
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including coagulation studies
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Tumor tract seeding
 - e. Imaging diagnosis
 - f. Surgical biopsy
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to soft tissue biopsy

i. Select approach, imaging guidance, and appropriate tools for soft tissue biopsy

ii. Techniques including

a. Percutaneous approach

b. Core biopsy

c. Fine needle aspiration

d. Determination of sample adequacy

e. Handling of samples for appropriate analysis

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications such as

a. Bleeding

b. Infection

c. Damage to adjacent structures

V.b.ii.a. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular interventional procedures / Abscess drainage / Abdominal Pelvic

1. Content

Abdominal, pelvic drainage

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided abdominal and pelvic abscess drainage: cross-sectional and compartmental anatomy of the abdomen, and pelvis; etiology of spontaneous and post-operative abscess formation; common microbiology of abscess formation

b. Perform peri-procedural patient care for patients undergoing abdominal and pelvic abscess drainage

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abscess drainage

ii. Appropriate patient evaluation to assess suitability and safety for image-guided abscess drainage

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Bleeding

b. Damage to adjacent structures

c. Sepsis

d. Conservative treatment

e. Surgical drainage

iv. Pre-procedural therapies including

a. Blood products to normalize coagulation

b. Medications including

c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

a. Procedure-related pain management

b. Drain maintenance and management

c. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to abscess drainage

i. Select approach, imaging guidance, and appropriate tools for abdominal and pelvic abscess drainage

ii. Techniques including

a. Seldinger

b. Trochar

c. Percutaneous

d. Natural orifice access

e. Collection of samples for appropriate analysis

f. Catheter selection and placement

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications such as

a. Bleeding

b. Bowel perforation

c. Urinary tract injury

d. Sepsis

V.b.ii.b. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular interventional procedures / Abscess drainage / Solid organ abscess drainage

1. Content

Solid organ abscess drainage

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided solid organ abscess drainage: cross-sectional and compartmental anatomy of the abdomen, and pelvis; etiology of spontaneous and post-operative solid organ abscess formation; common microbiology of solid organ abscess formation

b. Perform peri-procedural patient care for patients undergoing solid organ abscess drainage

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with solid organ abscess drainage

ii. Appropriate patient evaluation to assess suitability and safety for image-guided solid organ abscess drainage

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Sepsis
- d. Conservative treatment
- e. Surgical drainage
- f. Risks to target organ function

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management

- b. Drain maintenance and management
 - c. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to solid organ abscess drainage
 - i. Select approach, imaging guidance, and appropriate tools for solid organ abdominal and pelvic abscess drainage
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Percutaneous
 - d. Natural orifice access
 - e. Collection of samples for appropriate analysis
 - f. Catheter selection and placement
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Non-target organ injury
 - c. Sepsis
 - d. Compromise of target organ function

V.b.ii.c. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Abscess Drainage / Appendiceal, Peri-appendiceal

1. Content

Appendiceal, peri-appendiceal abscess drainage

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided abdominal and pelvic abscess drainage: cross-sectional and compartmental anatomy of the abdomen, and pelvis; etiology (spontaneous and post-operative); microbiology
- b. Perform peri-procedural patient care for patients undergoing appendiceal and peri-appendiceal abscess drainage
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with appendiceal and peri-appendiceal abscess drainage
 - ii. Appropriate patient evaluation to assess suitability and safety for image-guided appendiceal and peri-appendiceal abscess drainage
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Sepsis
 - d. Conservative treatment
 - e. Surgical drainage
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Drain maintenance and management

c. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to appendiceal and peri-appendiceal abscess drainage

i. Select approach, imaging guidance, and appropriate tools for appendiceal and peri-appendiceal drainage

ii. Techniques including

a. Seldinger

b. Trochar

c. Percutaneous

d. Natural orifice access

e. Collection of samples for appropriate analysis

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications such as

a. Bleeding

b. Non-target organ injury

c. Sepsis

V.b.ii.d. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Abscess Drainage / Pancreatic Inflammatory Disease

1. Content

Pancreatic inflammatory disease

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided pancreatic inflammatory disease: cross-sectional and compartmental anatomy of the thorax, abdomen and pelvis; etiology of spontaneous and post-operative pancreatic inflammatory disease; common microbiology of pancreatic inflammatory disease

b. Perform peri-procedural patient care for patients undergoing pancreatic inflammatory disease interventions

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with pancreatic inflammatory disease

ii. Appropriate patient evaluation to assess suitability and safety for image-guided pancreatic inflammatory disease

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Sepsis
- d. Conservative treatment
- e. Surgical drainage
- f. Endoscopic interventions

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
 - b. Drain maintenance and management
 - c. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to pancreatic inflammatory disease
 - i. Select approach, imaging guidance, and appropriate tools for pancreatic inflammatory disease interventions
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Percutaneous
 - d. Transgastric
 - e. Collection of samples for appropriate analysis
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Non-target organ injury
 - c. Sepsis
 - d. Pancreatitis

V.b.ii.e. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Abscess Drainage / Enterocutaneous Fistula

1. Content

Enterocutaneous fistula

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to enterocutaneous fistula: cross-sectional and compartmental anatomy of the abdomen and pelvis; etiology of spontaneous and post-operative enterocutaneous fistula formation; common microbiology; natural history

b. Perform peri-procedural patient care for patients with enterocutaneous fistula

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with enterocutaneous fistula

ii. Appropriate patient evaluation to assess suitability and safety for image-guided treatment

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory evaluation
- d. Imaging with CT, US, MRI, gastrointestinal radiologic studies, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Sepsis
- d. Conservative treatment
- e. Surgical correction

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
- b. Drain maintenance and management

- c. Recognition and management of procedure-related complications
 - d. Consideration for parenteral nutrition
- c. Plan and perform procedural elements and techniques relevant to management of enterocutaneous fistula
 - i. Select approach, imaging guidance, and appropriate tools for management of enterocutaneous fistula
 - ii. Techniques including
 - a. Tract catheterization
 - b. Fistulography
 - c. Collection of samples for appropriate analysis
 - d. Drain placement
 - e. Tract embolization
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Sepsis
 - c. Leak

V.b.ii.f. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Abscess Drainage / Follow-Up Care and Procedures

1. Content

Follow-up care and procedures

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to abscess formation, pathophysiology and subsequent drainage placement, and principles of percutaneous drain management and post-procedural care
- b. Perform peri-procedural patient care for patients undergoing abscess drain placement
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abscess drainage
 - ii. Appropriate patient evaluation to assess adequacy of drainage
 - a. Physical examination
 - b. Drain outputs and vital signs
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - iii. Coordinated patient follow-up including
 - a. Staff and patient education on routine tube care
 - b. Inpatient rounds
 - c. Outpatient clinic visits
 - iv. Recognition of drain-related complications such as
 - a. Bleeding
 - b. Infection
 - c. Pain
 - d. Drain occlusion
 - e. Drain dislodgement
 - f. Drain erosion into adjacent structures
 - v. Coordinated multidisciplinary management of drains including
 - a. Determination of drainage endpoints
 - b. Tube removal
 - c. Tube manipulation / exchange
 - d. Abscessogram
 - e. Additional tube placement or alternative therapies

V.b.iii.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Drainage of non-infected fluid collections / Paracentesis

1. Content

Paracentesis

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to paracentesis: etiologies of ascites; anatomy of the peritoneal cavity; relevant adjacent vital structures to avoid (epigastric artery, bowel, solid organs); fluid shifts and volume replacement involved in large-volume paracentesis
- b. Perform peri-procedural patient care for patients undergoing paracentesis
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing paracentesis
 - ii. Appropriate patient evaluation to assess suitability and safety for patients undergoing paracentesis
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Hypotension
 - e. Management with diuretics, salt restriction
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to paracentesis

i. Select approach, imaging guidance, and appropriate tools for paracentesis

ii. Techniques including

a. Percutaneous approach

b. Drainage devices

c. Collection and handling of samples for analysis

iii. Intra-procedural analgesia, sedation, and medications including

a. Albumin replacement

iv. Recognize and manage procedural complications

a. Bleeding

b. Infection

c. Damage to adjacent structures

d. Complications from fluid shifts

V.b.iii.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Drainage of non-infected fluid collections / Simple Cysts

1. Content

Simple cysts

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to drainage of simple cysts: etiologies of simple cysts; indications for intervention; related organ anatomy; relevant adjacent vital structures to avoid

b. Perform peri-procedural patient care for patients undergoing cyst drainage

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing cyst drainage

ii. Appropriate patient evaluation to assess suitability and safety for patients undergoing cyst drainage

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies

- a. Bleeding
- b. Damage to adjacent structures
- c. Infection

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
- b. Recognition and management of procedure-related complications
- c. Potential cyst sclerosis
- d. Follow-up imaging

c. Plan and perform procedural elements and techniques relevant to cyst drainage

- i. Select approach, imaging guidance, and appropriate tools for cyst drainage
- ii. Techniques including
 - a. Percutaneous approach
 - b. Trochar technique
 - c. Drain placement
 - d. Sclerosis
 - e. Samples for analysis
- iii. Intra-procedural analgesia, sedation, and medications
- iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Infection
 - c. Damage to adjacent structures
 - d. Leakage of sclerosant and associated complications

V.b.iii.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Drainage of non-infected fluid collections / Placement of tunneled peritoneal drain

1. Content

Placement of tunneled peritoneal drain

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to placement of tunneled peritoneal drain: etiologies of ascites; indications for tunneled peritoneal drains; relevant adjacent vital structures to avoid (epigastric artery, bowel, and solid organs)
- b. Perform peri-procedural patient care for patients undergoing placement of tunneled peritoneal drain
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing placement of tunneled peritoneal drain
 - ii. Appropriate patient evaluation to assess suitability and safety for placement of tunneled peritoneal drain
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Surgical shunts
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Intravenous fluids
 - c. Antibiotics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications

- c. Patient education on drain management
- c. Plan and perform procedural elements and techniques relevant to placement of tunneled peritoneal drain
 - i. Select approach, imaging guidance, and appropriate tools for placement of tunneled peritoneal drain
 - ii. Techniques including
 - a. Percutaneous access peritoneal cavity
 - b. Drainage catheter insertion
 - c. Tunnel creation
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Infection
 - c. Damage to adjacent structures
 - d. Drain malfunction

V.b.iii.d. Nonvascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Drainage of Non-Infected Fluid Collections / Lymphocele Drainage and Sclerosis, Seroma Drainage and Sclerosis

1. Content

Lymphocele drainage and sclerosis, seroma drainage and sclerosis

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to image-guided lymphocele drainage and sclerosis, seroma drainage and sclerosis: cross-sectional and compartmental anatomy of the abdomen, and pelvis; etiology of spontaneous and post-operative formation of lymphoceles / seromas

b. Perform peri-procedural patient care for patients undergoing drainage and or sclerosis of lymphoceles / seromas

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient undergoing drainage and or sclerosis of lymphoceles / seromas

ii. Appropriate patient evaluation to assess suitability and safety for patient undergoing drainage and or sclerosis of lymphoceles / seromas

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy, conventional lymphangiography, lymphoscintigraphy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Sepsis
- d. Conservative treatment
- e. Surgical drainage

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Dietary modifications
- c. Intravenous fluids

v. Post-procedural coordinated care including

- a. Procedure-related pain management
 - b. Drain maintenance and management
 - c. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to drainage and or sclerosis of lymphoceles / seromas
 - i. Select approach, imaging guidance, and appropriate tools for patients undergoing drainage and or sclerosis of lymphoceles / seromas
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Percutaneous
 - d. Lymphangiography
 - e. Collection of samples for appropriate analysis
 - f. Sclerosant agent selection and dosing
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. High-output lymph leak
 - c. Sepsis
 - d. Injury to adjacent structures

V.b.iv.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Gastrointestinal Interventions / Esophageal Intervention

1. Content

Esophageal intervention

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to esophageal diseases amenable to image-guided catheter-based interventions

b. Perform peri-procedural patient care for patients undergoing esophageal intervention

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with esophageal diseases amenable to image-guided catheter-based interventions

ii. Appropriate patient evaluation to assess suitability and safety for esophageal stenting and dilation

a. Presenting signs and symptoms such as

1. Dysphagia

2. Inability to handle secretions or oral intake

3. Aspiration

b. Physical examination to rule out other disease processes and identify pertinent negatives

c. Laboratory values compatible with dehydration and malnutrition

d. Imaging with CT, US, MRI, fluoroscopy, endoscopy

e. Alternative therapies radiation oncology, endoscopic stent placement, surgery, dietary measures

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

a. Bleeding

b. Esophageal perforation

c. Mediastinitis

d. Nonsurgical alternatives

e. Brachytherapy

f. Esophageal exclusion

g. Diversion

iv. Pre-procedural therapies including endoscopy

- v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of adequacy of therapy
 - b. Recognition of complications
- c. Plan and perform procedural elements and techniques relevant to esophageal intervention
 - i. Select approach, imaging guidance, and appropriate tools
 - a. Fluoroscopic versus endoscopic guidance
 - b. Temporary versus permanent stent
 - c. Angioplasty devices
 - ii. Techniques including
 - a. Fluoroscopic or endoscopic esophagram
 - b. Pre-dilation of stricture
 - c. Deployment of covered or uncovered stent self-expanding versus balloon expandable
 - iii. Intra-procedural analgesia, sedation, and medications for esophageal intervention
 - a. General anesthesia versus conscious sedation
 - iv. Recognize and manage procedural complications such as
 - a. Perforation
 - b. Rupture of esophagus
 - c. Technical failure
 - d. Mediastinitis

V.b.iv.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Gastrointestinal Interventions / Gastrostomy and Gastrojejunostomy

1. Content

Gastrostomy and gastrojejunostomy

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to indications for and placement of percutaneous gastrostomy and gastrojejunostomy
- b. Perform peri-procedural patient care for patients undergoing percutaneous gastrostomy and gastrojejunostomy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing percutaneous gastrostomy and gastrojejunostomy
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous gastrostomy and gastrojejunostomy
 - a. Presenting signs and symptoms including
 - 1. Inability to maintain adequate nutrition orally
 - 2. Gastroesophageal reflux
 - 3. Planned esophageal surgery
 - b. Physical examination
 - c. Laboratory values including results of endoscopy when appropriate
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies including
 - 1. Endoscopic placement of gastrostomy and gastrojejunostomy
 - 2. Surgical placement of gastrostomy and gastrojejunostomy
 - 3. Intravenous nutritional support
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Injury to adjacent organs
 - b. Bleeding
 - c. Peritonitis
 - d. Endoscopic placement
 - c. Surgical placement

- iv. Pre-procedural therapies including
 - a. NPO or nasogastric drainage
 - b. Oral barium prior to the procedure
- v. Procedure-related multidisciplinary coordinated care including
 - a. Management of catheter
 - b. Management of access site
 - c. Catheter replacement
- c. Plan and perform procedural elements and techniques relevant to percutaneous gastrostomy and gastrojejunostomy
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous gastrostomy and gastrojejunostomy
 - a. Determine need for gastrostomy or gastrojejunostomy
 - ii. Techniques including
 - a. Nasogastric intubation
 - b. Percutaneous gastric access
 - c. Percutaneous placement of gastric fasteners
 - d. Placement of percutaneous gastrostomy and gastrojejunostomy
 - iii. Intra-procedural analgesia, sedation, and medications including
 - a. Bowel paralytics such as glucagon
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Gastric leak
 - c. Infection
 - d. Reflux

V.b.iv.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Gastrointestinal Interventions / Percutaneous Cecostomy

1. Content

Percutaneous Cecostomy

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to the indications for and placement of percutaneous Cecostomy
- b. Perform peri-procedural patient care for patients undergoing percutaneous Cecostomy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care referred for percutaneous Cecostomy
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous Cecostomy
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies including surgical Cecostomy
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Injury to adjacent organs
 - c. Peritoneal spill
 - d. Infection
 - e. Tube malfunction
 - f. Surgical Cecostomy
 - iv. Pre-procedural therapies including maximized bowel care
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Patient and family education on tube management
 - b. Recognitions of complications
 - c. Assist in tube maintenance
- c. Plan and perform procedural elements and techniques relevant to percutaneous Cecostomy

- i. Select approach, imaging guidance, and appropriate tools for percutaneous Cecostomy
- ii. Techniques including
 - a. Localization of the cecum
 - b. Percutaneous access
 - c. Placement of percutaneous retention devices
 - d. Placement of appropriate Cecostomy catheter
- iii. Intra-procedural analgesia, sedation, and medications
- iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Peritonitis
 - c. Tube dislodgement / malposition

V.b.iv.d. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Gastrointestinal Interventions / Percutaneous Jejunostomy

1. Content

Percutaneous Jejunostomy

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to percutaneous jejunostomy
- b. Perform peri-procedural patient care for patients undergoing percutaneous jejunostomy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care percutaneous jejunostomy
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous jejunostomy including
 - a. Gastric versus jejunal feeding
 - b. Ability to localize jejunal loop
 - c. Presenting signs and symptoms of the patient requiring percutaneous jejunostomy
 - d. Physical examination
 - e. Laboratory values
 - f. Imaging with CT, US, MRI, fluoroscopy
 - g. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Injury to adjacent organs
 - c. Peritoneal spill
 - d. Infection
 - e. Tube malfunction
 - f. Surgical jejunostomy
 - iv. Pre-procedural therapies including bowel preparation
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Patient and family education on tube management
 - b. Recognitions of complications
 - c. Assist in tube maintenance

c. Plan and perform procedural elements and techniques relevant to percutaneous jejunostomy

i. Select approach, imaging guidance, and appropriate tools for percutaneous jejunostomy

ii. Techniques including

- a. Localization of the jejunal loops
- b. Percutaneous access
- c. Placement of percutaneous retention devices
- d. Placement of appropriate jejunostomy catheter

iii. Intra-procedural analgesia, sedation, and medications

- a. Bowel paralytics such as Glucagon

iv. Recognize and manage procedural complications such as

- a. Bleeding
- b. Peritonitis
- c. Injury to adjacent organs
- d. Tube dislodgement / malposition

V.b.iv.e. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Gastrointestinal Interventions / GI Tract Stenting (Duodenal and Colonic)

1. Content

GI tract stenting (duodenal and colonic)

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to gastrointestinal obstruction amenable to image-guided stent placement
- b. Perform peri-procedural patient care for patients undergoing image-guided gastrointestinal tract stenting
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient undergoing image-guided gastrointestinal tract stenting
 - ii. Appropriate patient evaluation to assess suitability and safety for image-guided gastrointestinal tract stenting including
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including endoscopy
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bowel perforation
 - b. Stent dislodgement
 - c. Stent occlusion
 - d. Endoscopic stent placement
 - e. Surgery
 - iv. Pre-procedural therapies including
 - a. Endoscopy
 - b. Gastrointestinal tract decompression
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of adequacy of decompression
 - b. Imaging of stents
- c. Plan and perform procedural elements and techniques relevant to image-guided gastrointestinal tract stenting

- i. Select approach, imaging guidance, and appropriate tools for image-guided gastrointestinal tract stenting such as
 - a. Stent type
 - b. Access
 - c. Imaging modalities
 - d. Combined endoscopy and imaging procedures
- ii. Techniques including
 - a. Catheterization of the gastrointestinal tract
 - b. Crossing lesions
 - c. Stent delivery
 - d. Dilation of lesions
- iii. Intra-procedural analgesia, sedation, and medications
- iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Perforation
 - c. Stent malposition / dislodgement
 - d. Stent obstruction

V.b.v.a. Nonvascular intervention and invasive diagnostic procedures / Non-vascular interventional procedures / Biliary interventions / Percutaneous transhepatic cholangiography (PTC)

1. Content

Percutaneous transhepatic cholangiography (PTC)

2. Learning objectives

- a. Demonstrate understanding of anatomy of the liver and bile ducts and pathophysiology of conditions that require PTC
- b. Perform peri-procedural patient care for patients undergoing PTC
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with nonmalignant and malignant biliary tree pathology
 - ii. Appropriate patient evaluation to assess suitability and safety for PTC
 - a. Presenting signs and symptoms biliary pathology including leak, obstruction, malignancy, colic
 - b. Physical examination to discriminate findings of leak, obstruction, malignancy, biliary colic
 - c. Laboratory value including
 - 1. Liver chemistries
 - 2. Coagulation studies
 - 3. Complete blood count
 - d. Imaging with CT, US, MRI, fluoroscopy, NM for leak, obstruction, malignancy, infection, biliary colic, and ascites
 - e. Alternative therapies including
 - 1. Imaging with nuclear medicine, US, CT, and MR
 - 2. Endoscopic retrograde cholangiogram
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Sepsis
 - b. Hemorrhage
 - c. Injury to adjacent structures
 - d. Bile peritonitis
 - e. Success rates for dilated versus non-dilated systems
 - f. Alternatives including imaging and endoscopy
 - iv. Pre-procedural therapies including
 - a. Antibiotic coverage
 - b. Hemodynamic support

- c. Correction of coagulopathy
 - d. Drainage of ascites
- v. Procedure-related multidisciplinary coordinated care including
 - a. Identification of complications
 - b. Pain management
- c. Plan and perform procedural elements and techniques relevant to PTC
 - i. Select approach, imaging guidance, and appropriate tools for PTC
 - a. US versus fluoroscopic needle access of bile duct
 - b. Alternative approaches including transcholecystic
 - ii. Techniques including
 - a. Skinny needle
 - b. US versus fluoroscopic guidance
 - c. Specimen collection and handling
 - d. Recording and interpreting cholangiographic images
 - iii. Intra-procedural analgesia, sedation, and medications
 - a. General anesthesia versus conscious sedation
 - b. Antibiotic coverage
 - c. Hemodynamic stabilization / support
 - iv. Recognize and manage procedural complications such as
 - a. Sepsis
 - b. Hemorrhage
 - c. Injury to adjacent structures
 - d. Bile peritonitis

V.b.v.b. Nonvascular intervention and invasive diagnostic procedures / Non-vascular interventional procedures / Biliary interventions / Biliary drainage

1. Content

Biliary drainage

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to percutaneous transhepatic biliary drainage for diversion of bile obstruction, obtaining a pathologic specimen, removal of stones, bile leaks, stenting of malignant strictures, access for biliary interventions

b. Perform peri-procedural patient care for patients undergoing percutaneous transhepatic biliary drainage

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patients with percutaneous transhepatic biliary drainage

ii. Appropriate patient evaluation to assess suitability and safety for percutaneous transhepatic biliary drainage

a. Presenting signs and symptoms compatible with need for biliary drainage from benign or malignant process including jaundice, pain, cholangitis, pruritis, liver dysfunction, and bile leak

b. Physical examination to discriminate biliary pathology from other systemic processes

c. Laboratory values abnormalities of liver panel, coagulation, CBC, tumor markers

d. Imaging with CT, US, MRI, fluoroscopy, NM to support anatomy and diagnosis suitable for percutaneous biliary drainage

e. Alternative therapies such as

1. Endoscopic

2. Medical

3. Surgical

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

a. Bleeding

b. Infection

c. Technical failure

d. Injury to adjacent structures

e. Bile leak and peritonitis

f. Endoscopic, medical, or surgical alternatives

- iv. Pre-procedural therapies including antibiotics, correction of coagulation parameters, drainage of ascites
- v. Procedure-related multidisciplinary coordinated care including
 - a. Catheter or stent follow-up
 - b. Plan for repeat intervention / imaging
 - c. Recognition of complications
- c. Plan and perform procedural elements and techniques relevant to percutaneous biliary drainage
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous biliary drainage
 - a. US access vs. fluoroscopic vs. CT
 - b. Left or right access
 - ii. Techniques including
 - a. Selection of access site
 - b. Percutaneous access to biliary tree
 - c. Interpretation of cholangiogram
 - d. Selection of balloon for cholangioplasty
 - e. Selection of catheter size and type
 - f. Specimen collection and handling
 - iii. Intra-procedural analgesia, sedation, and medications
 - a. Antibiotic coverage
 - b. Sedation type
 - c. Hemodynamic support
 - d. Pain management
 - iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Infection
 - c. Technical failure
 - d. Injury to adjacent structures
 - e. Bile leak and peritonitis
 - f. Tube dislodgement
 - g. Tube occlusion

V.b.v.c. Nonvascular intervention and invasive diagnostic procedures / Non-vascular interventional procedures / Biliary interventions / Biliary dilatation and stenting

1. Content

Biliary dilatation and stenting

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to percutaneous transhepatic biliary dilatation and stenting for biliary obstruction

b. Perform peri-procedural patient care for patients undergoing biliary stents and dilation procedures

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with benign and malignant biliary strictures

ii. Appropriate patient evaluation to assess suitability and safety for percutaneous transhepatic biliary dilatation and stenting for benign and malignant strictures

a. Presenting signs and symptoms for biliary obstruction from benign or malignant process including jaundice, pain, cholangitis, pruritis, liver dysfunction

b. Physical examination to discriminate biliary pathology from other systemic processes

c. Laboratory value abnormalities of liver panel, coagulation, CBC, tumor markers

d. Imaging with CT, US, MRI, fluoroscopic, NM to support diagnosis of biliary obstruction / stricture and malignancy

e. Alternative therapies including

1. Endoscopic

2. Medical

3. Surgical

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Bleeding

b. Infection

c. Technical failure

d. Injury to adjacent structures

e. Bile leak and peritonitis

f. Endoscopic, medical, or surgical alternatives

- iv. Pre-procedural therapies including antibiotics, correction of coagulation parameters, drainage of ascites
- v. Procedure-related multidisciplinary coordinated care including
 - a. Catheter or stent follow-up
 - b. Plan for repeat intervention / imaging
 - c. Recognition of complications
- c. Plan and perform procedural elements and techniques relevant to percutaneous dilatation and stenting of the biliary tree
 - i. Select approach, imaging guidance, and appropriate tools
 - a. US access vs. fluoroscopic
 - b. Left or right access
 - ii. Techniques including
 - a. Selection of access site
 - b. Percutaneous access to biliary tree
 - c. Interpretation of cholangiogram
 - d. Selection of balloon for cholangioplasty
 - e. Selection of catheter size and type
 - f. Selection of stent size and type
 - iii. Intra-procedural analgesia, sedation, and medications
 - a. Antibiotic coverage
 - b. Sedation type
 - c. Hemodynamic support
 - d. Pain management
 - iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Infection
 - c. Technical failure
 - d. Injury to adjacent structures
 - e. Bile leak and peritonitis
 - f. Tube / stent dislodgement
 - g. Tube / stent occlusion

V.b.v.d. Non-vascular intervention and invasive diagnostic procedures / Non-vascular interventional procedures / Biliary interventions / Percutaneous cholecystostomy

1. Content

Percutaneous cholecystostomy

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to patients and conditions amenable to percutaneous cholecystostomy
- b. Perform peri-procedural patient care for patients undergoing percutaneous cholecystostomy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with acute cholecystitis, biliary colic, or bile leak and related peritonitis or sepsis
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous cholecystostomy
 - a. Presenting signs and symptoms of acute cholecystitis, biliary colic, or bile leak
 - b. Physical examination for recognition of clinical signs and symptoms of patients presenting with acute cholecystitis, biliary colic, or bile leak
 - c. Laboratory values compatible with patients presenting with acute cholecystitis, biliary colic, or bile leak; coagulation studies
 - d. Imaging with CT, US, MRI, fluoro, and nuclear medicine in patients presenting with acute cholecystitis, biliary colic, or bile leak
 - e. Alternative therapies for patients presenting with acute cholecystitis, biliary colic, or bile leak such as
 - 1. Surgical management
 - 2. Medical management
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Infection
 - c. Technical failure
 - d. Injury to adjacent structures
 - e. Bile leak and peritonitis
 - f. Endoscopic, medical, or surgical alternatives

- iv. Pre-procedural therapies including antibiotic coverage and hemodynamic stabilization
- v. Procedure-related multidisciplinary coordinated care including
 - a. Catheter follow-up
 - b. Plan for subsequent intervention / imaging
 - c. Recognition of complications
- c. Plan and perform procedural elements and techniques relevant to percutaneous cholecystostomy
 - i. Select approach, imaging guidance, and appropriate tools
 - a. Appropriate percutaneous guidance via CT, US, or fluoroscopic guidance
 - b. Transhepatic versus transperitoneal
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Tube selection
 - d. Placement of tube
 - e. Specimen collection and handling
 - iii. Intra-procedural analgesia, sedation, and medications:
 - a. General anesthesia versus conscious sedation
 - b. Hemodynamic monitoring
 - iv. Recognize and manage procedural complications including
 - a. Sepsis
 - b. Hemorrhage
 - c. Injury to adjacent structures
 - d. Bile peritonitis

V.b.vi.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Renal and Urinary Tract Interventions / Percutaneous Nephrostomy

1. Content

Percutaneous nephrostomy

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to percutaneous nephrostomies including: cross-sectional and compartmental anatomy of renal and peri-renal space; indications for percutaneous nephrostomy, including dilated and non-dilated systems, urosepsis, total renal obstruction with hyperkalemia, native and transplant kidneys

b. Perform peri-procedural patient care for patients undergoing percutaneous nephrostomies

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients undergoing percutaneous nephrostomy

ii. Appropriate patient evaluation to assess suitability and safety for percutaneous nephrostomy

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values including

1. Serum potassium

2. White blood cell count

3. Coagulation studies

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies of percutaneous nephrostomies, such as

a. Renal, peri-renal organ injury

b. Hemorrhagic complications

c. Bacteremia / sepsis

d. Surgery

e. Medical management

iv. Pre-procedural therapies including medical management including

a. Antibiotics

b. Correction of coagulopathy

c. Fluid resuscitation

d. Management of hyperkalemia

- v. Procedure-related multidisciplinary coordinated care including
 - a. Hemodynamic monitoring
 - b. Appropriate tube management
 - c. Pain management
 - d. Recognition of peri-procedural adverse events
 - e. Determination of additional procedures
- c. Plan and perform procedural elements and techniques relevant to percutaneous nephrostomies
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous nephrostomies
 - a. Dilated system
 - b. Non-dilated system
 - c. Native kidney
 - d. Transplant kidney
 - e. US, fluoroscopic, CT guidance
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Percutaneous
 - d. Collection of samples for appropriate analysis
 - iii. Intra-procedural analgesia, sedation, and medications for percutaneous nephrostomies including
 - a. Airway management of the prone patient
 - b. Management of septic shock
 - iv. Recognize and manage procedural complications such as
 - a. Renal and adjacent organ injury
 - b. Vascular complications
 - c. Bacteremia / sepsis
 - d. Adverse allergic reactions
 - e. Respiratory compromise

V.b.vi.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Renal and Urinary Tract Interventions / Nephroureteral dilation and stenting

1. Content

Nephroureteral dilation and stenting

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to nephroureteral dilation and stenting including: cross-sectional and compartmental anatomy of abdomen and pelvis; etiology of nephroureteral obstructions including malignant, non-malignant and iatrogenic

b. Perform peri-procedural patient care for patients undergoing nephroureteral dilation and stenting

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients' ureteral obstructions

ii. Appropriate patient evaluation to assess suitability and safety for nephroureteral dilation and stenting

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values

d. Imaging with CT, US, MRI, fluoroscopy, antegrade or retrograde pyelogram

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies of nephroureteral obstruction interventions such as

a. Renal, peri-renal organ injury

b. Ureteral perforation

c. Hemorrhagic complications

d. Bacteremia / sepsis

e. Surgery

f. Medical management

iv. Pre-procedural therapies including

a. Endoscopy

b. Antibiotics

c. Correction of coagulopathy

v. Procedure-related multidisciplinary coordinated care including

- a. Hemodynamic monitoring
 - b. Appropriate tube management
 - c. Pain management
 - d. Recognition of peri-procedural adverse events
 - e. Determination of additional procedures
- c. Plan and perform procedural elements and techniques relevant to nephroureteral obstruction interventions
 - i. Select approach, imaging guidance, and appropriate tools for nephroureteral obstruction interventions
 - a. Internal stents
 - b. Internal / external stents
 - c. Stent sizing
 - ii. Techniques including
 - a. Antegrade pyelogram
 - b. Catheterization of the bladder / bladder equivalent
 - c. Dilation of strictures
 - d. Collection of samples for appropriate analysis
 - e. Stent placement
 - iii. Intra-procedural analgesia, sedation, and medications associated with nephroureteral obstruction interventions
 - iv. Recognize and manage procedural complications such as
 - a. Renal and peri-renal organ injury
 - b. Hemorrhagic complications
 - c. Bacteremia / sepsis
 - d. Respiratory compromise
 - e. Stent occlusion

V.b.vi.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Renal and Urinary Tract Interventions / Renal cyst sclerosis

1. Content

Renal cyst sclerosis

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to renal cyst sclerosis

b. Perform peri-procedural patient care for patients undergoing renal cyst sclerosis

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patients with symptomatic renal cyst sclerosis

ii. Appropriate patient evaluation to assess suitability and safety for renal cyst sclerosis

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies for renal cyst sclerosis including

- a. Renal and peri-renal injury
- b. Hemorrhagic complications
- c. Bacteremia / sepsis
- d. Adverse allergic reactions
- e. Surgical intervention
- f. Medical management

iv. Pre-procedural therapies including medical management including

- a. Antibiotics
- b. Coagulation correction
- c. Intravenous fluid

v. Procedure-related multidisciplinary coordinated care including

- a. Hemodynamic monitoring
- b. Tube management, pain management
- c. Recognition of peri-procedural adverse events
- d. Follow-up imaging of renal cysts

c. Plan and perform procedural elements and techniques relevant to renal cyst sclerosis

i. Select approach, imaging guidance, and appropriate tools for renal cyst sclerosis

ii. Techniques including

a. Seldinger

b. Trochar

d. Collection of samples for appropriate analysis

e. Catheter placement

f. Cystography and identification of communication with collecting system

g. Sclerosant agent administration

iii. Intra-procedural analgesia, sedation, and medications for renal cyst sclerosis including sclerosant agents

iv. Recognize and manage procedural complications such as

a. Renal and peri-renal organ injury

b. Hemorrhagic complications

c. Bacteremia / sepsis

d. Adverse allergic reactions

e. Pain management

f. Sclerosant specific complications

V.b.vi.d. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Renal and Urinary Tract Interventions / Suprapubic cystostomy

1. Content

Suprapubic cystostomy

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to suprapubic cystostomy
- b. Perform peri-procedural patient care for patients undergoing suprapubic cystostomy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient requiring suprapubic cystostomy
 - ii. Appropriate patient evaluation to assess suitability and safety for suprapubic cystostomy
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bladder and neighboring pelvic organ injury
 - b. Hemorrhagic complications
 - c. Bacteremia / sepsis
 - d. Adverse allergic reactions
 - e. Surgical intervention
 - f. Medical management
 - iv. Pre-procedural therapies including medical management including antibiotics, coagulation correction, and intravenous fluid
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Appropriate tube management
 - b. Pain management
 - c. Recognition of peri-procedural adverse events
 - d. Determination of need for additional / subsequent procedures

c. Plan and perform procedural elements and techniques relevant to suprapubic cystostomy

i. Select approach, imaging guidance, and appropriate tools for suprapubic cystostomy

ii. Techniques including

a. Seldinger

b. Trochar

c. Collection of samples for appropriate analysis

d. Catheter placement

iii. Intra-procedural analgesia, sedation, and medications for suprapubic cystostomy

iv. Recognize and manage procedural complications such as

a. Bladder and pelvic organ injury

b. Hemorrhagic complications

c. Bacteremia / sepsis

d. Urinary ascites

**V.b.vi.e. Non-Vascular Intervention and Invasive Diagnostic Procedures /
Nonvascular Interventional Procedures / Renal and Urinary Tract Interventions
/ Renal and peri-renal fluid collection drainage**

1. Content

Renal and peri-renal fluid collection drainage

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to renal and peri-renal drainage procedures: cross-sectional and compartmental anatomy of retro-peritoneal space; etiology of spontaneous and iatrogenic renal and peri-renal fluid collections

b. Perform peri-procedural patient care for patients undergoing renal and peri-renal fluid collections

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with renal and peri-renal fluid collections

ii. Appropriate patient evaluation to assess suitability and safety for image-guided renal and peri-renal fluid collections

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies renal and peri-renal fluid collections such as

- a. Renal and adjacent organ injuries
- b. Hemorrhagic complications
- c. Bacteremia / sepsis
- d. Adverse allergic reactions
- e. Surgical intervention

iv. Pre-procedural therapies including medical management including

- a. Antibiotics
- b. Coagulation correction
- c. Intravenous fluid

v. Procedure-related multidisciplinary coordinated care including

- a. Hemodynamic monitoring
- b. Tube management
- c. Pain management

- d. Recognition of peri-procedural adverse events
 - e. Follow-up imaging
- c. Plan and perform procedural elements and techniques relevant to renal and peri-renal fluid collections
 - i. Select approach, imaging guidance, and appropriate tools for renal and peri-renal fluid collections
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Collection of samples for appropriate analysis
 - d. Catheter placement
 - iii. Intra-procedural analgesia, sedation, and medications for renal and peri-renal fluid collections
 - iv. Recognize and manage procedural complications such as
 - a. Renal and peri-renal organ injury
 - b. Hemorrhagic complications
 - c. Bacteremia / sepsis

V.b.vi.f. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Renal and Urinary Tract Interventions / Urodynamics

1. Content

Urodynamics

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to obstructive versus non-obstructive uropathy, antegrade pyelography, and urodynamic assessment
- b. Perform peri-procedural patient care for patients undergoing Whitaker test
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with obstructive versus non-obstructive uropathy
 - ii. Appropriate patient evaluation to assess suitability and safety for Whitaker test
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Damage to urinary or adjacent structures
 - c. Sepsis
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids
 - d. Pain medications
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Procedure-related bleeding
 - c. Procedure-related infection

c. Plan and perform procedural elements and techniques relevant to Whitaker test

i. Select approach, imaging guidance, and appropriate personnel and tools for Whitaker test

ii. Techniques including

- a. Antegrade pyelography
- b. Foley catheter placement
- c. Urodynamic study

iii. Intra-procedural analgesia, sedation, and medications for antegrade pyelography

iv. Recognize and manage procedural complications such as

- a. Bleeding
- b. Infection
- c. Pain
- d. Urinary tract injury

V.b.vi.g. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Renal and Urinary Tract Interventions / Ablation of the Kidney

1. Content

Ablation of the Kidney

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to: cross-sectional and compartmental anatomy of the retroperitoneum; etiology, natural history and pathophysiology of renal tumors
- b. Perform peri-procedural patient care for patients undergoing ablation of renal masses
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with a renal mass
 - ii. Appropriate patient evaluation to assess suitability and safety for patients undergoing ablation of renal masses
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Sepsis
 - d. Pain
 - e. Renal failure
 - f. Urinary leak
 - g. Conservative treatment
 - h. Surgical intervention
 - iv. Pre-procedural therapies for ablation of renal masses including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to ablation of renal masses
 - i. Select approach, imaging guidance, and appropriate tools for ablation of renal masses
 - ii. Techniques including
 - a. Ultrasound guidance
 - b. Computed tomography guidance
 - c. Magnetic resonance imaging guidance
 - d. Collection of appropriate samples
 - e. Thermal ablation technology
 - iii. Intra-procedural analgesia, sedation, anesthesia, grounding, and medications for ablation of renal masses
 - iv. Recognize and manage procedural complications such as
 - a. Vascular (local and systemic) complications
 - b. Adjacent organ / structure injury
 - c. Infection
 - d. Urinary tract injury
 - e. Tract seeding

V.b.vi.h. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Renal and Urinary Tract Interventions / Ablation of the Adrenal gland

1. Content

Ablation of the adrenal gland

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to: cross-sectional and compartmental anatomy of the retroperitoneum and its contents; etiology, natural history and pathophysiology of adrenal tumors

b. Perform peri-procedural patient care for patients undergoing ablation of the adrenal gland

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with an adrenal mass

ii. Appropriate patient evaluation to assess suitability and safety for patients undergoing ablation of the adrenal gland

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

- a. Bleeding
- b. Damage to adjacent structures
- c. Sepsis
- d. Pain
- e. Hypertensive crisis
- f. Adrenal failure
- g. Conservative treatment
- h. Surgical intervention

iv. Pre-procedural therapies for ablation of the adrenal gland including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to ablation of the adrenal gland
 - i. Select approach, imaging guidance, and appropriate tools for ablation of the adrenal gland
 - ii. Techniques including
 - a. Ultrasound guidance
 - b. Computed tomography guidance
 - c. Magnetic resonance imaging guidance
 - d. Collection of appropriate samples
 - e. Thermal ablation technology
 - iii. Intra-procedural analgesia, sedation, anesthesia, grounding, and medications for ablation of the adrenal gland
 - iv. Recognize and manage procedural complications such as
 - a. Vascular (local and systemic) complications
 - b. Adjacent organ / structure injury
 - c. Infection
 - d. Adrenal failure

V.b.vii.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Reproductive Tract Interventions / Hysterosalpingography and Fallopian Tube Interventions

1. Content

Hysterosalpingography and fallopian tube interventions

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to hysterosalpingography and fallopian tube interventions: cross-sectional and compartmental anatomy of the pelvis; etiology, natural history, pathophysiology, and management of fallopian tube occlusion

b. Perform peri-procedural patient care for patients undergoing fallopian tube recanalization

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patients with fallopian tube occlusion

ii. Appropriate patient evaluation to assess suitability and safety for Fallopian tube recanalization

a. Presenting signs and symptoms of fallopian tube occlusion

b. Physical examination

c. Laboratory values including

1. Pregnancy test

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Bleeding

b. Sepsis

c. Fallopian tube rupture

d. Conservative treatment, including in-vitro fertilization

e. Hysteroscopic interventions

f. Surgical interventions

iv. Pre-procedural therapies including

a. Normalizing coagulation

b. Medications including antibiotics

c. Intravenous fluids

v. Procedure-related multidisciplinary coordinated care including

a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to fallopian tube recanalization
 - i. Select approach, imaging guidance, and appropriate tools for fallopian tube recanalization
 - ii. Techniques including
 - a. Speculum placement
 - b. Cervical cannulation
 - c. Fluoroscopic catheter guidance
 - d. Selective catheterization of the fallopian tube
 - e. Recanalization techniques
 - f. Performance and interpretation of hysterosalpingography
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection / Sepsis
 - c. Tubal perforation
 - d. Procedure failure

V.b.vii.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Reproductive Tract Interventions / High-Intensity Focused Ultrasound (HIFU) Treatment of Uterine Leiomyomata (Fibroids)

1. Content

High-intensity focused ultrasound (HIFU) treatment of uterine fibroids

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to HIFU: Cross-sectional and compartmental anatomy of the pelvis; etiology, natural history, pathophysiology, and management of uterine fibroids

b. Perform peri-procedural patient care for patients undergoing HIFU treatment of uterine fibroids

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of patient with symptomatic uterine fibroids

ii. Appropriate patient evaluation to assess suitability and safety for HIFU treatment of uterine fibroids

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values including

1. Pregnancy test

d. Imaging with CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

a. Bleeding

b. Injury to adjacent organs

c. Treatment failure

d. Contraindications to MR imaging

e. Uterine artery embolization

f. Myomectomy

g. Hysterectomy

h. Hormonal therapy and medical management

iv. Pre-procedural therapies including

a. Normalizing coagulation

b. Medications including antibiotics

c. Hormonal therapy

- v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to HIFU treatment of uterine fibroids
 - i. Select approach, imaging guidance, and appropriate tools for HIFU treatment of uterine fibroids
 - ii. Techniques including
 - a. MR guidance
 - b. Patient positioning
 - c. Ultrasound focusing and dosimetry
 - d. Target contouring
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection / sepsis
 - c. Treatment failure
 - d. Injury to adjacent structures

V.b.viii.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Liver Interventions / Ablation of Liver Masses

1. Content

Ablation of liver masses

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, natural history, and management of primary and secondary liver tumors
- b. Perform peri-procedural patient care for patients undergoing percutaneous ablation of liver tumors
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patients with primary or secondary liver tumors
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous ablation of liver tumors
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including
 - 1. Tumor markers
 - d. Imaging with CT, US, MRI, nuclear medicine, and fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies of percutaneous ablation of primary and secondary liver tumors such as
 - a. Bleeding
 - b. Damage to adjacent liver / organs / blood vessels
 - c. Bile leak
 - d. Tract seeding
 - e. Infection
 - f. Pain
 - g. Incomplete treatment
 - h. Laparoscopic or open ablation
 - i. Surgery including transplant when appropriate
 - j. Chemotherapy
 - k. Supportive care
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics

- c. Intravenous fluids
 - d. Biliary drainage
- v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications
 - c. Follow-up imaging
 - d. Additional procedures
- c. Plan and perform procedural elements and techniques relevant to percutaneous liver tumor ablation
 - i. Select approach, imaging guidance, and appropriate tools for liver tumor ablation including
 - a. Ultrasound
 - b. Computed tomography
 - c. Magnetic resonance imaging
 - d. Selection of ablation technique
 - ii. Techniques including
 - a. Percutaneous access
 - b. Collection of samples for appropriate analysis
 - c. Probe placement
 - d. Monitoring of treatment
 - e. Access site management
 - iii. Intra-procedural analgesia, sedation, general anesthesia, grounding, and medications
 - iv. Recognize and manage procedural complications of percutaneous liver tumor ablation such as
 - a. Vascular complications
 - b. Adjacent organ / structure injury
 - c. Drainage of abnormal fluid collection
 - d. Pain

V.b.viii.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Liver Interventions / Chemical Ablation of Liver Masses

1. Content

Chemical ablation of liver

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, natural history, and management of primary and secondary liver tumors
- b. Perform peri-procedural patient care for patients undergoing percutaneous chemical ablation of liver tumors
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patients with primary or secondary liver tumors
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous chemical ablation of liver tumors
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including
 - 1. Tumor markers
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies of liver chemical ablation such as
 - a. Bleeding
 - b. Damage to adjacent liver / organs / blood vessels
 - c. Bile leak
 - d. Tract seeding
 - e. Infection
 - f. Pain
 - g. Incomplete treatment
 - h. Percutaneous, laparoscopic or open thermal ablation
 - i. Surgery including transplant when appropriate
 - j. Chemotherapy
 - k. Supportive care
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids

- d. Biliary drainage
- v. Post-procedural coordinated multidisciplinary care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications
 - c. Follow-up imaging
 - d. Additional procedures
- c. Plan and perform procedural elements and techniques relevant to liver tumor chemical ablation
 - i. Select approach, imaging guidance, and appropriate tools for liver tumor ablation
 - a. Ultrasound
 - b. Computed tomography
 - c. Magnetic resonance imaging
 - d. Selection of ablation agent
 - ii. Techniques including
 - a. Percutaneous access
 - b. Collection of samples for appropriate analysis
 - c. Needle placement
 - d. Monitoring of treatment
 - e. Access site management
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications of liver tumor ablation including
 - a. Vascular complications
 - b. Adjacent organ / structure injury
 - c. Drainage of abnormal fluid collection
 - d. Pain

V.b.ix.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Thoracic Interventions / Thoracentesis

1. Content

Thoracentesis

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to the chest, with emphasis conditions of the lung, pleural space, and chest wall associated with pleural fluid collections

b. Perform peri-procedural patient care for patients undergoing thoracentesis

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with a pleural fluid collection

ii. Appropriate patient evaluation to assess suitability and safety for thoracentesis

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory evaluation
- d. Imaging with chest radiograph, CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Pneumothorax
- d. Sepsis
- e. Conservative treatment
- f. Surgical intervention

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Intravenous fluids
- d. Oxygenation

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
- b. Recognition and management of procedure-related complications
- c. Monitoring of respiratory status

c. Plan and perform procedural elements and techniques relevant to thoracentesis

i. Select approach, imaging guidance, and appropriate tools for thoracentesis

ii. Techniques including

a. Seldinger

b. Trochar

c. Collection of samples for appropriate analysis

d. Closed circuit drainage

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications such as

a. Bleeding (including hemothorax and hemoptysis)

b. Sepsis

c. Pneumothorax

d. Air embolism

e. Pulmonary edema

V.b.ix.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Thoracic Interventions / Chest Tube Placement

1. Content

Chest tube placement

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to the chest, with emphasis conditions of the lung, pleural space, and chest wall associated with pleural fluid collections and pneumothorax
- b. Perform peri-procedural patient care for patients undergoing chest tube placement
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with a pleural fluid or air collection
 - ii. Appropriate patient evaluation to assess suitability and safety for chest tube placement
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Relevant laboratory values
 - d. Imaging with chest radiograph, CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Pneumothorax
 - d. Sepsis
 - e. Conservative treatment
 - f. Surgical intervention
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids
 - d. Oxygenation
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
 - c. Monitoring of respiratory status
 - c. Plan and perform procedural elements and techniques relevant to chest tube placement
 - i. Select approach, imaging guidance, and appropriate tools for chest tube placement
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Collection of samples for appropriate analysis
 - d. Tube selection and placement
 - e. Closed circuit drainage
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding (including hemothorax and hemoptysis)
 - b. Sepsis
 - c. Pneumothorax
 - d. Injury to lung or adjacent organs
 - e. Air embolism
 - f. Pulmonary edema

V.b.ix.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Thoracic Interventions / Tunneled Pleural Drainage Catheters

1. Content

Tunneled pleural drainage catheters

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to the chest, with emphasis conditions of the lung, pleural space, and chest wall associated with malignant pleural fluid collections

b. Perform peri-procedural patient care for patients undergoing tunneled pleural drainage catheter placement

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with a malignant pleural fluid collection

ii. Appropriate patient evaluation to assess suitability and safety for tunneled pleural drainage catheter placement

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values

d. Imaging with chest radiograph, CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

a. Bleeding

b. Damage to adjacent structures

c. Pneumothorax

d. Sepsis

e. Conservative treatment

f. Pleurodesis

g. Surgical intervention

iv. Pre-procedural therapies including

a. Blood products to normalize coagulation

b. Medications including antibiotics

c. Intravenous fluids

d. Oxygenation

v. Procedure-related multidisciplinary coordinated care including

a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
 - c. Monitoring of respiratory status
 - d. Drain maintenance and management
- c. Plan and perform procedural elements and techniques relevant to tunneled pleural drainage catheter placement
 - i. Select approach, imaging guidance, and appropriate tools for tunneled pleural drainage catheter placement
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Collection of samples for appropriate analysis
 - d. Tube placement
 - c. Tunnel creation
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications
 - a. Bleeding (including hemothorax and hemoptysis)
 - b. Injury to lung or adjacent organs
 - c. Infection
 - d. Pneumothorax
 - e. Tube malfunction

V.b.ix.d. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Thoracic Interventions / Sclerotherapy (Pleurodesis)

1. Content

Sclerotherapy (pleurodesis)

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to the chest, with emphasis conditions of the lung, pleural space, and chest wall associated with refractory pleural fluid collections
- b. Perform peri-procedural patient care for patients undergoing pleural sclerotherapy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with a refractory pleural fluid collection
 - ii. Appropriate patient evaluation to assess suitability and safety for pleural sclerotherapy
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with chest radiograph, CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Pneumothorax
 - d. Sepsis
 - e. Conservative treatment
 - f. Surgical intervention
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - c. Intravenous fluids
 - d. Oxygenation
 - v. Post-procedural coordinated multidisciplinary care including
 - a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
 - c. Monitoring of respiratory status
 - d. Drain maintenance and management
- c. Plan and perform procedural elements and techniques relevant to pleural sclerotherapy
 - i. Select approach, imaging guidance, and appropriate tools for pleural sclerotherapy
 - ii. Techniques including
 - a. Seldinger
 - b. Trochar
 - c. Collection of samples for appropriate analysis
 - d. Sclerosant selection and administration
 - e. Closed circuit drainage
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding (including hemothorax and hemoptysis)
 - b. Infection
 - c. Pneumothorax
 - d. Air embolism
 - e. Pain
 - f. Failure of therapy

V.b.ix.e. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Thoracic Interventions / Lung Tumor Ablation

1. Content

Lung tumor ablation

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, natural history, and management of primary and secondary lung tumors
- b. Perform peri-procedural patient care for patients undergoing percutaneous lung tumor ablation
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with primary or secondary lung tumors
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous lung tumor ablation
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values including pathologic diagnosis
 - d. Imaging with CT, US, MRI, chest radiograph, fluoroscopy, bronchoscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Air embolism
 - d. Pneumothorax
 - e. Sepsis
 - f. Local recurrence, incomplete treatment of tumor
 - g. Systemic chemotherapy
 - h. Surgical intervention
 - i. Palliative care
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to percutaneous lung tumor ablation
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous lung tumor ablation
 - ii. Techniques including
 - a. Percutaneous access
 - b. Collection of appropriate specimens
 - c. Probe placement
 - d. Selection and application of ablation technology
 - e. Management of pneumothorax
 - iii. Intra-procedural analgesia, sedation, anesthesia, and medications
 - iv. Recognize and manage procedural complications
 - a. Bleeding (including hemothorax and hemoptysis)
 - b. Sepsis
 - c. Pneumothorax
 - d. Air embolism
 - e. Damage to adjacent structures
 - f. Incomplete treatment

V.b.ix.f. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Thoracic Interventions / Airway Dilation and Stenting

1. Content

Airway dilation and stenting

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to upper and lower respiratory tracts, mediastinum, and lung: cross-sectional and compartmental anatomy of the airway, mediastinum, and lung, etiology of benign and malignant airway strictures (including post- transplant)

b. Perform peri-procedural patient care for patients undergoing airway dilation and / or stenting

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with focal airway stenosis

ii. Appropriate patient evaluation to assess suitability and safety for airway dilation and / or stenting

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with chest radiograph, CT, US, MRI, fluoroscopy, bronchoscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies such as

- a. Bleeding
- b. Damage to adjacent structures
- c. Airway rupture
- d. Pneumothorax and / or pneumomediastinum
- e. Infection
- f. Conservative management
- g. Bronchoscopic
- h. Surgical intervention

iv. Pre-procedural therapies including

- a. Blood products to normalize coagulation
- b. Medications including antibiotics
- c. Airway management

- v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to airway dilation and stenting
 - i. Select approach, imaging guidance, and appropriate tools for airway dilation and stenting
 - a. Imaging guidance
 - b. Combined bronchoscopic and imaging procedure
 - c. Intubation considerations
 - d. Bare or covered stent
 - e. Permanent or removable stent
 - ii. Techniques including
 - a. Natural orifice access
 - b. Dedicated endotracheal tube
 - c. Bronchial catheterization
 - d. Bronchial dilatation
 - e. Stent selection and placement
 - iii. Intra-procedural analgesia, sedation, anesthesia, and medications
 - iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Airway rupture
 - d. Pneumothorax and / or pneumomediastinum
 - e. Infection
 - f. Stent dislodgement

V.b.x.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Breast Interventions / Breast Drainage

1. Content

Breast drainage

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, and management of breast abnormalities amenable to percutaneous drainage
- b. Perform peri-procedural patient care for patients undergoing breast drainage
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abnormal fluid collections in the breast
 - ii. Appropriate patient evaluation to assess suitability and safety for breast drainage
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with US, mammography, MRI, CT
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Sepsis
 - d. Conservative treatment
 - e. Surgical treatment
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Drain maintenance and management
 - c. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to percutaneous breast drainage

- i. Select approach, imaging guidance, and appropriate tools for breast drainage
- ii. Techniques including
 - a. Seldinger
 - b. Trocar
 - c. Collection of samples for appropriate analysis
 - d. Drain placement
- iii. Intra-procedural analgesia, sedation, and medications
- iv. Recognize and manage procedural complications such as
 - a. Bleeding
 - b. Infection
 - c. Adjacent organ injury

V.b.x.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-vascular Interventional Procedures / Breast Interventions / Breast Biopsy

1. Content

Breast biopsy

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology and management of breast masses
- b. Perform peri-procedural patient care for patients undergoing breast biopsy
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abnormal conditions of the breast
 - ii. Appropriate patient evaluation to assess suitability and safety for breast biopsy
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with mammography, US, MRI, CT
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Conservative treatment
 - d. Open biopsy
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to breast biopsy
 - i. Select approach, imaging guidance, and appropriate tools for breast biopsy
 - a. Patient positioning

- b. US
 - c. Mammography including stereotactic
 - d. MRI
 - e. Evaluation of sample for adequacy
- ii. Techniques including
 - a. Fine needle
 - b. Coring
 - c. Collection of samples for appropriate analysis
- iii. Intra-procedural analgesia, sedation, and medications
- iv. Recognize and manage procedural complications
 - a. Bleeding
 - b. Pain
 - c. Adjacent organ injury

V.b.xi.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Musculoskeletal Interventions / Percutaneous Vertebroplasty

1. Content

Percutaneous vertebroplasty

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to percutaneous vertebroplasty: cross-sectional anatomy of the spine, etiology, natural history and pathophysiology of vertebral compression

b. Perform peri-procedural patient care for patients undergoing percutaneous vertebroplasty

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with symptomatic vertebral compression fractures

ii. Appropriate patient evaluation to assess suitability and safety for percutaneous vertebroplasty

a. Presenting signs and symptoms

b. Physical examination

c. Laboratory values

d. Imaging with radiographs, CT, US, MRI, fluoroscopy

e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

a. Bleeding

b. Infection

c. Neurologic injury

d. Pulmonary embolism and venous embolization

e. Cement migration

f. Conservative management

iv. Pre-procedural therapies including

a. Normalizing coagulation

b. Medications including antibiotics and analgesics

v. Procedure-related multidisciplinary coordinated care including

a. Procedure-related pain management

b. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to percutaneous vertebroplasty

i. Select approach, imaging guidance, and appropriate tools for percutaneous vertebroplasty

ii. Techniques including

- a. Fluoroscopic guidance
- b. Patient positioning
- c. Cement preparation
- d. Transpedicular and peri-pedicular access to the vertebral body
- e. Controlled cement injection and visualization

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications such as

- a. Bleeding
- b. Infection
- c. Neurologic injury
- d. Pulmonary embolism and venous embolization
- e. Cement migration

V.b.xi.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Musculoskeletal Interventions / Vertebral Height Restoration

1. Content

Vertebral height restoration

2. Learning objectives

a. Demonstrate understanding of the anatomy and pathophysiology relevant to vertebral height restoration: cross-sectional anatomy of the spine; etiology, natural history and pathophysiology of vertebral compression

b. Perform peri-procedural patient care for patients undergoing vertebral height restoration

i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with symptomatic vertebral compression fractures

ii. Appropriate patient evaluation to assess suitability and safety for vertebral height restoration

- a. Presenting signs and symptoms
- b. Physical examination
- c. Laboratory values
- d. Imaging with radiographs, CT, US, MRI, fluoroscopy
- e. Alternative therapies

iii. Appropriate informed consent including risks, benefits, and alternative therapies including

- a. Bleeding
- b. Infection
- c. Neurologic injury
- d. Pulmonary embolism and venous embolization
- e. Cement migration
- f. Conservative management

iv. Pre-procedural therapies including

- a. Normalizing coagulation
- b. Medications including antibiotics and analgesics

v. Procedure-related multidisciplinary coordinated care including

- a. Procedure-related pain management
- b. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to vertebral height restoration

i. Select approach, imaging guidance, and appropriate tools for vertebral height restoration

ii. Techniques including

- a. Fluoroscopic guidance
- b. Patient positioning
- c. Cement preparation
- d. Transpedicular and peri-pedicular access to the vertebral body
- e. Kyphoplasty balloon insertion and inflation
- f. Controlled cement injection and visualization

iii. Intra-procedural analgesia, sedation, and medication

iv. Recognize and manage procedural complications such as

- a. Bleeding
- b. Infection
- c. Neurologic injury
- d. Pulmonary embolism and venous embolization
- e. Balloon rupture
- f. Cement migration

V.b.xi.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Musculoskeletal Interventions / Thermal Ablation of Bone Lesions

1. Content

Thermal ablation of bone lesions

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, and management of primary benign bone tumors and malignant / metastatic bone tumors
- b. Perform peri-procedural patient care for patients undergoing thermal ablation of bony lesions
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with symptomatic bone tumor
 - ii. Appropriate patient evaluation to assess suitability and safety for thermal ablation of bone lesions
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with radiographs, CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Infection
 - c. Injury to adjacent organs and structures
 - d. Iatrogenic fracture
 - e. Treatment failure
 - f. Conservative management
 - g. Radiation therapy
 - h. Surgical therapy
 - iv. Pre-procedural therapies including
 - a. Normalizing coagulation
 - b. Medications including antibiotics and analgesics
 - v. Post-procedural coordinated multidisciplinary care including
 - a. Procedure-related pain management

- b. Recognition and management of procedure-related complications
- c. Plan and perform procedural elements and techniques relevant to thermal ablation of bone lesions
 - i. Select approach, imaging guidance, and appropriate tools for thermal ablation of bone lesions
 - ii. Techniques including
 - a. Fluoroscopic / CT / MRI guidance
 - b. Patient positioning
 - c. Needle insertion
 - d. Ablation instrument protocol
 - e. Monitoring of treatment
 - iii. Intra-procedural analgesia, sedation, anesthesia, and medications
 - iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Infection
 - c. Injury to adjacent organ or structure
 - d. Iatrogenic fracture

V.b.xi.d. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Musculoskeletal Interventions / Percutaneous Disc Interventions

1. Content

Percutaneous disc interventions

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, and management relevant to percutaneous disc interventions: cross-sectional anatomy of the spine; etiology of spontaneous and post-operative abscess formation; common microbiology of disc infections; etiology and pathophysiology of disc related nerve compression
- b. Perform peri-procedural patient care for patients undergoing percutaneous disc interventions
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of symptomatic disc pathology
 - ii. Appropriate patient evaluation to assess suitability and safety for percutaneous disc interventions
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Relevant laboratory values
 - d. Imaging with radiographs, CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies such as
 - a. Bleeding
 - b. Infection
 - c. Neurologic and vascular injury
 - d. Conservative management
 - e. Surgical management
 - iv. Pre-procedural therapies including
 - a. Normalizing coagulation
 - b. Medications including antibiotics and analgesics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications

- c. Plan and perform procedural elements and techniques relevant to percutaneous disc interventions
 - i. Select approach, imaging guidance, and appropriate tools for percutaneous disc interventions
 - ii. Techniques including
 - a. Fluoroscopic / CT / MRI guidance
 - b. Patient positioning
 - c. Needle insertion
 - d. Sample collection for appropriate analysis
 - e. Contrast injection and interpretation
 - iii. Intra-procedural analgesia, sedation, and medications
 - iv. Recognize and manage procedural complications including
 - a. Bleeding
 - b. Infection
 - c. Neurologic and vascular injury

V.b.xi.e. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Musculoskeletal Interventions / Chemical Ablation of Desmoid Tumors

1. Content

Chemical Ablation of desmoid tumors

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology, management, and principles of percutaneous chemical ablation of desmoid tumors
- b. Plan and perform procedural elements and techniques relevant to chemical ablation of desmoid tumors
 - i. Requirements for chemical ablation of desmoid tumors including patient selection and appropriate image interpretation
 - ii. Appropriate application of image-guided skills for precise percutaneous needle placement and intra-tumoral injection of cytotoxic compounds
 - iii. Monitoring and recording of image-guided percutaneous needle placement under US or CT imaging
 - iv. Evaluation of precise percutaneous needle placement and intra-tumoral injection of cytotoxic compounds
 - v. Assess outcomes of intra-tumoral injection of cytotoxic compounds via clinical assessment and follow-up interval imaging with CT or MR

V.b.xii.a. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Percutaneous Pain Management / Selective Nerve Root Block

1. Content

Selective nerve root block

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology and management of conditions amenable to selective nerve root block
- b. Perform peri-procedural patient care for patients undergoing selective nerve root block
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abnormalities affecting the selective nerve root block
 - ii. Appropriate patient evaluation to assess suitability and safety for selective nerve root block
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies of selective nerve root block such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Conservative treatment
 - e. Surgical intervention
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of response to treatment
 - b. Recognition and management of procedural complications
 - c. Determination of additional or subsequent procedures

c. Plan and perform procedural elements and techniques relevant to selective nerve root block

i. Select approach, imaging guidance, and appropriate tools for selective nerve root block

- a. Ultrasound
- b. Computed tomography
- c. Magnetic resonance imaging
- d. Fluoroscopy

ii. Techniques including

- a. Needle placement
- b. Selection and administration of blocking agent

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications of selective nerve root block such as

- a. Vascular complications
- b. Adjacent organ / structure injury
- c. Pain

V.b.xii.b. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Percutaneous Pain Management / Stellate Ganglion Block

1. Content

Stellate ganglion block

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to abnormal conditions that affect stellate ganglia
- b. Demonstrate understanding of the anatomy, pathophysiology and management of conditions amenable to stellate ganglion block
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abnormalities affecting the stellate ganglia
 - ii. Appropriate patient evaluation to assess suitability and safety for stellate ganglia block
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies of liver ablation such as
 - a. Bleeding
 - b. Damage to adjacent structures
 - c. Infection
 - d. Conservative treatment
 - e. Surgical intervention
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to stellate ganglion block

i. Select approach, imaging guidance, and appropriate tools for stellate ganglion block

- a. Ultrasound
- b. Computed tomography
- c. Magnetic resonance imaging
- d. Fluoroscopy

ii. Techniques including

- a. Needle placement
- b. Selection and administration of blocking agent

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications of stellate ganglion block such as

- a. Vascular complications
- b. Adjacent organ / structure injury
- c. Pain

V.b.xii.c. Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Percutaneous Pain Management / Facet Injections

1. Content

Facet Injections

2. Learning objectives

- a. Demonstrate understanding of the anatomy, pathophysiology and management of conditions amenable to injections of the facet joints
- b. Perform peri-procedural patient care for patients undergoing facet injections
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with abnormalities of the facet joints
 - ii. Appropriate patient evaluation to assess suitability and safety for facet injections
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with CT, US, MRI, nuclear medicine, radiographs, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies including
 - a. Pain
 - b. Bleeding
 - c. Non-target organ injection
 - d. Neurologic injury
 - e. Infection
 - f. Conservative management
 - g. Surgical management
 - iv. Pre-procedural therapies including
 - a. Blood products to normalize coagulation
 - b. Medications including antibiotics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Assessment of response to treatment
 - b. Recognition and management of procedural complications
 - c. Determination of additional or subsequent procedures

c. Plan and perform procedural elements and techniques relevant to facet injection

i. Select approach, imaging guidance, and appropriate tools for facet injection

- a. Ultrasound
- b. Computed tomography
- c. Magnetic resonance imaging
- d. Fluoroscopy

ii. Techniques including

- a. Needle placement
- b. Facet contrast injection and imaging
- c. Selection and administration of blocking agent

iii. Intra-procedural analgesia, sedation, and medications

iv. Recognize and manage procedural complications of facet injection such as

- a. Vascular complications
- b. Adjacent organ / structure injury
- c. Pain
- d. Infection

V.b.xii.d Non-Vascular Intervention and Invasive Diagnostic Procedures / Non-Vascular Interventional Procedures / Percutaneous Pain Management / Epidural Steroid Injection

1. Content

Epidural steroid injection

2. Learning objectives

- a. Demonstrate understanding of the anatomy and pathophysiology relevant to epidural steroid injection: cross-sectional anatomy of the spine; etiology and pathophysiology of chronic back pain
- b. Perform peri-procedural patient care for patients undergoing epidural steroid injection
 - i. Clinical consultation (inpatient and / or outpatient) and appropriate communication with other clinical services as a part of coordinated clinical care of the patient with chronic back pain amenable to epidural steroid injection
 - ii. Appropriate patient evaluation to assess suitability and safety for epidural steroid injection
 - a. Presenting signs and symptoms
 - b. Physical examination
 - c. Laboratory values
 - d. Imaging with radiographs, CT, US, MRI, fluoroscopy
 - e. Alternative therapies
 - iii. Appropriate informed consent including risks, benefits, and alternative therapies
 - a. Bleeding
 - b. Infection
 - c. Neurologic and vascular injury
 - d. Conservative management
 - e. Surgical management
 - iv. Pre-procedural therapies including
 - a. Normalizing coagulation
 - b. Medications including antibiotics and analgesics
 - v. Procedure-related multidisciplinary coordinated care including
 - a. Procedure-related pain management
 - b. Recognition and management of procedure-related complications

c. Plan and perform procedural elements and techniques relevant to epidural steroid injection

i. Select approach, imaging guidance, and appropriate tools for epidural steroid injection

ii. Techniques including

- a. Fluoroscopic / CT / MRI guidance
- b. Patient positioning
- c. Steroid and anesthetic selection
- d. Needle insertion and steroid injection

iii. Intra-procedural analgesia, sedation, and medications

- a. Local anesthetic
- b. Steroid

iv. Recognize and manage procedural complications such as

- a. Infection
- b. Neurologic and vascular injury

ICU Rotation

The IR residency includes an ICU rotation. The purpose of this rotation is to acquaint the IR resident with the basic principles of recognition and management of critical illness and to understand the role of image-guided diagnostic and interventional procedures in these patients. The IR resident will be expected to function at the first-year resident level, under the direction of more senior residents, fellows and staff. Rotation in a surgical ICU is preferred.

The specific goals for this rotation are as follows:

Patient Care

1. Become familiar with the modes of mechanical ventilation in patients with respiratory failure, with particular attention to how these modes can be adjusted to reduce motion artifacts in the IR suite during procedures
2. Gain experience in floating a pulmonary artery wedge catheter
3. Understand how to interpret the pulmonary artery catheter data
4. Provide technical expertise in central lines
5. Assist the team in obtaining interpretation of chest X-rays, CTs and ultrasound used in the ICU
6. Gain confidence in the interpretation of EKGs

Medical Knowledge

1. Learn how to use pharmacologic control of cardiac output
2. Learn lung mechanics (e.g., restrictive lung diseases)
3. Learn how to interpret a blood gas and formulate treatment plan (acid-base balance, etc.)
4. Learn the differential diagnosis of, and diagnostic approach to, shock
5. Learn how to acutely manage gastrointestinal hemorrhage, especially how angiography fits in the diagnostic and treatment algorithms
6. Learn the management and diagnostic evaluation of sepsis
7. Learn how to acutely manage hemoptysis, particularly as it relates to bronchial angiography
8. Learn the differential diagnosis of, diagnostic approach to, and treatment of acute renal failure
9. Learn how to manage a diabetic hypoglycemic crisis
10. Understand the presentation and diagnostic difficulties of ICU cholecystitis

Practice-based Learning and Improvement

1. Residents are expected to read the current clinical literature to improve patient care
2. Develop an ability to learn from mistakes and use those mistakes to improve their care
3. Attend all rounds and conferences while on the ICU service

Interpersonal and Communication Skills

1. Develop interpersonal interactions and communication skills unique to the ICU
2. Learn how to effectively ask for appropriate consults from other services regarding ICU patients
3. Interact with consultants and referring physicians in a respectful manner
4. Maintain appropriately detailed, timely and legible medical records

Professionalism

1. Demonstrate respect, compassion, empathy and kindness with patients and their families
2. Demonstrate sensitivity to gender, age, culture, religion, sexual preference, socioeconomic status, beliefs, behaviors and disabilities
3. Understand the issues with confidentiality and informed consent in the ICU
4. Be able to provide constructive feedback to staff and physicians in response to problems in the ICU

Systems-based Practice

1. Observe how an ICU provides high-quality critical care compared to the floors and IR
2. Collaborate with social workers, physical therapists, occupational therapists, respiratory therapist and dialysis nurses to understand the health system