

Cardiovascular- Interventional Technology Professional Curriculum

*Sponsored by the American Society of Radiologic Technologists, 15000 Central Ave. SE,
Albuquerque, NM 87123-3917.*

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Introduction

The Professional Curriculum for Cardiovascular-Interventional Technology provides the educational community with a plan for the minimum entry-level education necessary for cardiovascular-interventional technology.

This curriculum is suitable for all programs in cardiovascular-interventional technology including limited fellowships, extended fellowships, certificate programs and college-based educational programs. The development of this curriculum takes for granted that all students receiving education in cardiovascular-interventional technology will have completed the basic education in radiography.

The curriculum is in syllabus format so that educators are provided subjects that the students are expected to know as they progress through the program. Additional course work as well as expansion of the courses is expected to facilitate the overall learning process.

Individual educational program directors may determine the sequence of these courses because each educator is responsible for the quality of education of the students in the program.

Lists of references are included as a resource. They are not intended to be inclusive of all cardiovascular-interventional technology resources, nor are they intended to serve as an endorsement of any particular publication, except those materials published by the ASRT.

The American Society of Radiologic Technologists is most grateful to the committee who developed this curriculum. Gratitude also is extended to the other technologists, educators and physicians who contributed significantly through their review and critique.

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Anatomy and Physiology

Course Description

This course provides the student with an overview of anatomy and physiology involving the circulatory, lymphatic, central nervous, respiratory, gastrointestinal, hepatobiliary and genitourinary systems.

Circulatory System

Objectives

The student will:

1. Label the parts of blood and list the function of each.
2. Explain hemostasis within blood vessels.
3. Describe coagulation disorders.
4. List normal lab values.
5. Diagram and label the structures of the arteries, veins, capillaries and lymphatic system.
6. Explain the mechanics of vascular control by the autonomic nervous system.
7. Describe the normal position of the heart and great vessels.
8. Label, on radiographs and a diagram, the anatomy of the heart and great vessels.
9. Identify the location of the pericardium, myocardium and endocardium and describe their individual functions.
10. Label the internal structures of the heart on a radiograph and diagram.
11. Describe the blood flow through the heart during the cardiac cycle.
12. State the function and position of the heart during the cardiac cycle.
13. Describe and list the function of the sinoatrioventricular nodal system, bundle of His and Purkinje's fibers.
14. Describe action potentials for depolarization.
15. Describe the path of the electrical charges during the cardiac cycle.
16. List and describe disease processes, congenital and acquired, of the conducting system.
17. Define and list normal values for cardiac output.
18. Define and list normal values for blood volume.
19. List and describe pathologic conditions that alter blood volume, cardiac output, peripheral resistance and venous return.
20. Describe the procedure for evaluating peripheral resistance and venous return.
21. List the normal values for peripheral resistance and venous return.
22. Identify the normal and abnormal rates and rhythms of the heart.
23. List and describe pathological conditions, congenital and acquired, that affect rate and rhythms of the heart.
24. Label, on diagrams and radiographs, the cardiac, pulmonary, visceral, peripheral, coronary and cerebral circulation.
25. Describe the function of cardiac, pulmonary, visceral, peripheral, coronary and cerebral circulation.
26. List and describe congenital and acquired pathologies of the cardiac, pulmonary, visceral, peripheral, coronary and cerebral circulation.

27. List and describe congenital and acquired pathologies of the aorta.
28. Label, on diagrams and radiographs, the parts of the renal vascular system in various projections and positions.
29. List and describe the congenital and acquired vascular pathologies of the kidneys and renal vascular system.
30. Label the anatomy and describe the function of the pancreas, liver and spleen.

Content

I. Structure of Blood

A. Definition

B. Function

C. Parts

1. Solid

- a. Red blood cells
- b. White blood cells
- c. Platelets

2. Liquid

3. Plasma

- a. Plasma electrolytes

D. Hemostasis

E. Coagulation disorders

F. Clinical tests relating to blood

1. Prothrombin time (PT), partial thromboplastin time (PTT), International Normalized Ratio (INR)
2. Complete blood count (CBC) with platelets
3. Sequential multichannel autoanalyzer (SMA7)
4. Fibrin split products
5. Activated clotting time

II. Structure of the Circulatory System

A. Arteries

B. Veins

C. Capillaries

D. Lymphatic system

1. Anatomy
2. Pathway
3. Function

III. Autonomic Control

IV. Heart

- A. Location
- B. Anatomical parts
- C. Pericardium
- D. Myocardium
- E. Endocardium
- F. Conduction
 - 1. Sinoatrial-atrioventricular node
 - 2. Bundle of His
 - 3. Purkinje's fibers
 - 4. Electrical path
 - 5. Disease process
 - a. Congenital
 - b. Acquired
 - 6. Structural defects
 - a. Congenital
 - b. Acquired

V. Blood Pressure and Circulation

- A. Blood flow
- B. Systolic and diastolic phases
- C. Cardiac output values
- D. Cardiac output determination
- E. Blood volume values
- F. Pathologies
 - 1. Blood volume
 - 2. Cardiac output
 - 3. Peripheral resistance
 - 4. Venous return
- G. Peripheral resistance determination
- H. Venous return determination

I. Peripheral resistance values

J. Venous return values

VI. Pulse

A. Heart rates

1. Normal
2. Abnormal

B. Heart rhythms

1. Normal
2. Abnormal

C. Pathologies

1. Congenital
2. Acquired

VII. Systemic Circulation

A. Anatomy

1. Pulmonary
2. Visceral
3. Cardiac
4. Peripheral
5. Coronary
6. Cerebral

B. Function

1. Pulmonary
2. Visceral
3. Cardiac
4. Peripheral
5. Coronary
6. Cerebral

C. Pathologies

1. Congenital
2. Acquired

VIII. Aorta

A. Anatomy

B. Pathologies

1. Congenital
2. Acquired

IX. Renal Vascular

A. Anatomy

1. Kidneys
2. Spleen

B. Pathologies

1. Congenital
2. Acquired

X. Hepatobiliary

A. Anatomy

1. Pancreas
2. Liver
 - a. Bile ducts
3. Gallbladder

B. Pathologies

1. Congenital
2. Acquired

Central Nervous System

Objectives

The student will:

1. Label the anatomical structures of the brain and spinal cord.
2. Describe the physiology of the brain and spinal cord.
3. List and describe the congenital and acquired pathological conditions of the central nervous system.
4. Describe the clinical indications, diagnosis, treatment and prognosis of pathologies of the central nervous system.

Content

I. Structure

- A. Anatomy
 1. Brain
 2. Spinal cord
- B. Physiology
 1. Brain
 2. Spinal cord
- C. Ventricular system

II. Pathologies

- A. Congenital
- B. Acquired
- C. Clinical indications
- D. Diagnosis
- E. Treatment
- F. Prognosis

Respiratory System

Objectives

The student will:

1. Label the anatomical structures of the respiratory system.
2. Explain the physiology of respiration.
3. List and describe the congenital and acquired pathological conditions of the respiratory system.
4. Describe the clinical indications, diagnosis, treatment and prognosis of pathologies of the respiratory system.

Content

I. Structure

A. Anatomy

B. Physiology

1. External respiration
2. Internal respiration

II. Pathologies

A. Congenital

B. Acquired

C. Clinical indications

D. Diagnosis

E. Treatment

F. Prognosis

Genitourinary System

Objectives

The student will:

1. Label the anatomical structures of the genitourinary system.
2. Describe the physiology of the nephron.
3. List and describe the congenital and acquired pathological conditions of the genitourinary system.
4. Describe the clinical indications, diagnosis, treatment and prognosis of pathologies of the genitourinary system.

Content

I. Structure

- A. Anatomy
 1. Kidneys
 2. Ureters
 3. Bladder
 4. Prostate gland
- B. Physiology of the nephron

II. Pathologies

- A. Congenital
- B. Acquired
- C. Clinical indications
- D. Diagnosis
- E. Treatment
- F. Prognosis

Hepatobiliary System

Objectives

The student will:

1. Label the anatomical structures of the hepatobiliary system.
2. Describe the accessory digestive functions of the hepatobiliary system.
3. List and describe the congenital and acquired pathological conditions of the liver, gallbladder, bile ducts and pancreas.
4. Describe the clinical indications, diagnosis, treatment and prognosis of pathologies of the hepatobiliary system.

Content

I. Structure

A. Anatomy

1. Liver
2. Gallbladder
3. Bile ducts
4. Pancreas

B. Physiology of the hepatobiliary system

II. Pathologies

A. Congenital

B. Acquired

C. Clinical indications

D. Diagnosis

E. Treatment

F. Prognosis

Gastrointestinal System

Objectives

The student will:

1. Label the anatomical structures of the gastrointestinal system.
2. Explain the physiology of digestion.
3. List and describe the congenital and acquired pathological conditions of the central nervous system.
4. Describe the clinical indications, diagnosis, treatment and prognosis of pathologies of the gastrointestinal system.

Content

I. Structure

A. Anatomy

1. Salivary glands
2. Pharynx
3. Esophagus
4. Stomach
5. Small intestine
6. Large intestine

B. Physiology of digestion

II. Pathology

A. Congenital

B. Acquired

C. Clinical indications

D. Diagnosis

E. Treatment

F. Prognosis

Patient Psychology and Care

Course Description

This course provides the student with an overview of the special needs of patients who undergo cardiovascular-interventional procedures.

Psychology

Objectives

The student will:

1. Identify and relate to the psychological and emotional status of the patient undergoing a cardiovascular-interventional procedure.
2. Identify the specific anxiety status of the patient and provide emotional support to assist the patient in overcoming fears of the procedure.
3. Explain the procedure and provide needed education to patients and their families.
4. Describe the role of the CV technologist for patient care given a variety of patient emotional reactions.
5. Describe informed consent and its legal implications.

Content

I. Psychology

- A. Emotional state
- B. Fear
- C. Denial
- D. Bargaining

II. Anxiety

- A. Drug induced
- B. Normal apprehension
- C. Disease induced
- D. Patient management

III. Patient Cooperation

- A. Preprocedure interview
 1. Physician
 2. CV technologist
 3. Allergies
 - a. Contrast media

- b. Medications
- c. Latex
- 4. Medical conditions
 - a. Diabetes
 - 1) Oral agents
 - 2) Injectable agents
 - b. Hypertension
 - c. Asthma or other related diseases
- 5. Medications

B. Preparation stage

C. Soliciting patient cooperation

IV. Patient Education Material

A. Pamphlet

B. Audiovisual

V. CV Technologist's Role

VI. Consent Form

A. Verbal explanation

B. Patient reaction

C. Legal implications

Legal Considerations

Objectives

The student will:

1. Identify the legal implications of performing cardiovascular-interventional procedures.
2. List the legal requirements for obtaining a valid informed consent from the patient or family.
3. Evaluate consent forms for content and legality.
4. Explain the meaning of advanced directives.

Content

I. Consent Form

- A. Content
- B. Verbal explanation
- C. Complications
- D. Patient reactions

II. Advanced Directives

Patient Care

Objectives

The student will:

1. Define communication.
2. Identify methods of communication as they relate to cardiovascular-interventional procedures.
3. Identify patient communication problems that are encountered in the working environment.
4. Demonstrate examples of pre-established, patient-technologist communication scenarios (explanation of procedures) in a role-play simulation.
5. Discuss radiation safety and protection questions patients might ask in connection with radiologic examinations and responses to each question.

Content

I. Communication

- A. Definition
- B. Methods
 1. Oral
 2. Written
 3. Pictures
 4. Signs or gestures
- C. Consumer relationships
 1. Patient
 2. Patient's family
 3. Referring physician
 4. Co-workers (inter- and intradepartmental)
 5. Insurance providers

II. Patient Communication Problems

- A. English as a second language
- B. Aphasia
- C. Deafness
- D. Blindness
- E. Age
- F. Physical condition
- G. Mental condition

H. Altered states of consciousness

I. Artificial speech mechanisms

1. Transesophageal puncture
2. Esophageal speech
3. Electrolarynx devices

III. Explanation of Examinations

A. Confirmation of patient's identity

B. Assessment of patient's level of comprehension

C. Elements of explanation

1. Greeting
2. Establishing rapport
3. Description of examination
4. Instructions
5. Response to questions

IV. Radiation Safety and Protection

A. Shielding

1. Contact
2. Shadow

B. Collimation

Vital Signs

Objectives

The student will:

1. State the normal values for pulse, respiration, blood pressure, oxygen saturation and heart rhythm.
2. Obtain, monitor and record pulse, respiration, blood pressure and oxygen saturation on a patient.

Content

I. Pulse

II. Respiration

III. Blood Pressure

IV. Oxygen Therapy

V. Heart Monitoring

Pharmacology and Drug Administration

Prerequisite

It is recommended that patient care (with CPR certification), the circulatory system and pharmacology be satisfactorily completed prior to start of this unit.

Course Description

This course provides the student with an overview of contrast media and medications that are administered in conjunction with cardiovascular-interventional procedures. This unit covers the theory and practice of the basic techniques of venipuncture and the administration of contrast media or intravenous medication.

Pharmacology

Objectives

The student will:

1. Identify and define the possible complications or reactions to an intravenous medication.
2. Describe the complication or reaction to an intravenous medication and how to respond appropriately.
3. Record the administration of an intravenous medication.
4. Record a complication or reaction to an intravenous medication.
5. State the normal values for pulse, respiration, blood pressure, oxygen saturation and heart rhythms.
6. Identify the different contrast media used for cardiovascular, vascular and nonvascular-interventional procedures.
7. List the indications and contraindications for contrast media.
8. List recommended dosages of contrast media for specific vascular and nonvascular examinations
9. List the characteristics, chemical and physical, that make a given contrast agent most useful in a given procedure.
10. Describe the effects to the central nervous system and the physiologic response of the cardiovascular system, kidneys, respiratory system and gastrointestinal tract to contrast media.
11. Describe and compare the advantages and disadvantages of high osmolar (ionic) and low osmolar (nonionic) contrast media used in vascular procedures.
12. Describe the procedure for preparation and administration of cardiovascular medications.
13. Describe the effects of each of the cardiovascular medications.
14. Identify compounds that are compatible or antagonistic with each other.
15. Describe possible complications that may occur with drug administration.
16. List the drugs that affect specific anatomical systems or subsystems.
17. Define sedation and its use in augmenting cardiovascular-interventional procedures.
18. List and explain procedures to prevent and treat reactions to specific medications.
19. Understand physiologic and medically-induced levels of consciousness and their implications for the procedure.

20. Discuss the medications used in conjunction with conscious sedation.
21. Describe the principles of oxygen delivery and airway management.
22. Describe the uses of drugs for pharmacoangiography.

Content

I. Contrast Media

- A. Contrast media
- B. Dosage
- C. Effects
 1. Cardiovascular system
 2. Central nervous system
 3. Hepatobiliary system
 4. Genitourinary system
 5. Gastrointestinal system
 - a. Hemodynamic
 - b. Histamine
- D. Characteristics
 1. Chemical
 2. Physical
- E. Comparison
 1. Conventional ionic contrast material
 2. Ionic (low osmolar)
 3. Nonionic
 4. Nonionic (iso-osmolar)
- F. Classification of reactions
- G. Minimization of reactions
 1. Minimize patient anxiety
 2. Histamine and steroid prep
- H. Resuscitative equipment

II. Sedation

- A. Definition
- B. Policy and procedure
- C. Aldrette score
- D. Medications used in sedation

E. Oxygen delivery systems

F. Continuous saturation

III. Medications Used in Cardiovascular-Interventional Procedures

A. Guidelines for drug administration

1. Premedication policy
2. Five rights of drug administration
3. Routes of drug administration

B. Drug classification

C. Complimentary drugs

1. Vasodilators
2. Vasoconstrictors
3. Inotropic agents and beta blockers
4. Calcium channel blockers
5. Diuretics
6. Anticoagulants
7. Antiplatelets
8. Thrombolytics
9. Anticholinergics
10. Narcotics
11. Benzodiazepines
12. Pharmacangiography
 - a. Vasoconstrictors
 - b. Vasodilators

D. Mode of action and effects

E. Doses and preparations

F. Antagonistic response and drug interactions

IV. Procedural Record

A. Personnel

B. Vital signs

C. Medication

D. Patient status

Venous System Anatomy

Objectives

The student will:

1. Identify and locate the veins most commonly used for upper extremity venipuncture.
2. Identify and locate other vascular access areas and describe the intravenous technique for each.
3. Explain the reasons for choosing which intravenous technique is appropriate for particular patients.
4. Identify alternate access routes to include existing lines and cutdowns.

Content

I. Upper Extremity Venous Anatomy

II. Common Venipuncture Sites

III. Other Access Routes

- A. Femoral vein
 1. Technique
 2. Advantages
 3. Disadvantages
 4. Postprocedure care
- B. Jugular veins
 1. Technique
 2. Advantages
 3. Disadvantages
 4. Postprocedure care
- C. Subclavian veins
 1. Technique
 2. Advantages
 3. Disadvantages
 4. Postprocedure care
- D. Feet
 1. Technique
 2. Advantages
 3. Disadvantages
 4. Postprocedure care
- E. Cutdowns
 1. Technique
 2. Advantages
 3. Disadvantages

4. Postprocedure care

F. Existing lines

1. Types
2. Complications
3. Maintenance

IV. Site Selection

Contrast Media and Intravenous Medications

Objectives

The student will:

1. Define contrast media.
2. Differentiate between ionic and nonionic contrast media.
3. Identify indications for the use of contrast media and pertinent medications.
4. Describe the contraindications for contrast media and pertinent medications.
5. Identify and define possible complications or reactions to a contrast medium or intravenous medication.
6. Know and be able to respond appropriately to either a complication or reaction to a contrast medium or intravenous medication.
7. State the common dosage for contrast media and pertinent medications.
8. Prepare contrast media or intravenous medication for injection using aseptic technique.

Course Content

I. Definitions

- A. Contrast media
 1. Ionic
 2. Nonionic

II. Indications and Contraindications

III. Dosage

IV. Preparation

V. Complications and Reactions

Administration and Venipuncture

Objectives

The student will:

1. Identify institutional and state policies regarding venipuncture and the injection of medications or contrast media by radiologic technologists.
2. Demonstrate universal precautions in practice.
3. Select and prepare an appropriate site for venipuncture.
4. Apply a tourniquet at the selected site.
5. Cleanse the site with antiseptic.
6. Insert the needle and ascertain proper venous backflow.
7. Inject the proper contrast media or intravenous medication at the correct rate, or connect the proper drip infusion contrast medium or intravenous medication.
8. Observe the site for infiltration or extravasation.
9. Observe the patient for reactions.
10. Withdraw the needle and apply pressure to the site on completion of the injection.
11. Document the administration of a contrast medium intravenous medication.
12. Document a complication or reaction to contrast media or intravenous medication.

Content

- I. Universal Precautions**
- II. Site Selection and Preparation**
 - A. Materials
 - B. Cleansing
 - C. Tourniquet application
 - D. Needle insertion
- III. Intravenous Administration**
 - A. Medication
 - B. Contrast media
- IV. Patient Observation**
 - A. Complications and reactions
 - B. Vital signs
- V. Documentation**
 - A. Medication or contrast media
 - B. Complications

C. Vital signs

VI. Institutional and State Policies

Quality Control

Course Description

This course provides the student with the primary factors that govern the production and accuracy of radiographic exposure, protection and the visibility of the radiographic and fluoroscopic image.

Objectives

The student will:

1. Perform sensitometric and densitometric measurements.
2. Evaluate sensitometric and densitometric data as related to darkroom environmental control.
3. Evaluate sensitometric film strips to determine and evaluate characteristic curves, speed, contrast (gamma and average gradient) and basefog values.
4. Adjust for variations in film response to exposure as compared to other films or film-screen combinations using sensitometric measurements.
5. Evaluate processor, cine and cut-film for preventive maintenance.
6. Develop a procedure manual for equipment quality control.
7. Perform tests and collect data on radiographic equipment including mA, kVp, timer accuracy and screen response and conditions.
8. Perform tests to determine safety and operability of the pressure injector, serial film changer, defibrillator and monitoring equipment.
9. Clean and evaluate recording equipment including the videotape recorder, cine cameras, spot film cameras and projectors, physiological monitors and serial film changers.
10. Develop adequate warm-up procedures for radiographic tubes.
11. Collect data and check protocols for sterile technique, surgical procedures, universal precautions and OSHA regulations.

Content

I. Quality Control

- A. Processor control
 1. Darkroom environment
 2. Sensitometry
 3. Equipment
 4. Parameters
 - a. Speed
 - b. Contrast
 - c. Gamma
 - d. Average gradient
 - e. Base fog
 5. Preventive maintenance
 - a. Cine
 - b. Cut-film
 - c. Storage mediums (optical disc, CD ROM, etc.)

6. Daily log
7. Darkroom disease

II. Equipment Control

- A. Radiographic unit
 1. kVp
 2. mA
 3. Timer accuracy
 4. Fluoroscopic resolution
 5. Fluoroscopic contrast
 6. Automatic brightness system (ABS)
 7. Collimator alignment (central ray)
 8. Screen response, condition and cleaning
- B. Electromechanical (flow rate, pressure) injector
 1. Flow rate, consistency
 2. Electrical safety
 3. Mechanical lock
- C. Serial film changer
- D. Digital subtraction equipment
- E. ECG equipment
- F. Defibrillator
- G. Pulse oximeter
- H. Doppler
- I. Video recorder
- J. Warm-up procedures for tubes
- K. Preventive maintenance on all equipment

III. Environmental Control

- A. Sterile technique
- B. Surgical control
- C. Universal precautions
- D. OSHA regulations

Radiation Protection

Course Description

This course provides the student with a review of the principles of radiation protection. Responsibilities of the CV technologist for the protection of patients and personnel are presented.

Objectives

The student will:

1. Review radiation protection procedures (radiographic and fluoroscopic) for patient and personnel during cardiovascular-interventional procedures.
2. Monitor and record dose levels for procedures using thermoluminescent dosimeter (TLD) and other dosimetry techniques.
3. List biological effects of ionizing radiation.
4. Describe the significance of long and short-term radiation exposure.
5. Explain the protection procedure for pregnant personnel.
6. Explain the policy for protection of the pregnant patient and the unborn fetus.

Content

I. Radiation Protection

- A. Personnel monitoring
- B. Patient monitoring
- C. Biological effects
 1. Patient
 2. Personnel
 3. Fetus
- D. Dosimetry system
- E. Time, distance and shielding
- F. National Council's Radiation Protection and Measurement (NCRP) regulations

II. Policy for Pregnant Personnel or Patient

- A. Shielding
- B. Trimesters

C. 10-day rule

D. NCRP regulations

Procedural Equipment and Materials

Course Description

This course provides the student with an overview of radiographic and ancillary equipment and materials necessary to perform diagnostic and therapeutic cardiovascular-interventional procedures.

Specialized Radiographic Equipment and Instrumentation

Objectives

The student will:

1. List the parameters and essential requirements of generators for serial exposure, including cine, spot films, optical disks and large-format radiographs.
2. List the design characteristics of the tube in relationship to the anode, cathode, kilowatt determination, heat storage and cooling characteristics.
3. List the causes of tube malfunctions, including the anode, filament and vacuumized glass envelope.
4. Define primary and secondary switching concepts of cine pulse systems, including grid-controlled x-ray tubes, triodes and tetrodes.
5. Describe the various cine generating equipment.
6. Describe the methods of automatic exposure control (AEC).
7. Explain variable tube potential (kV modulation).
8. Explain variable tube current method (mA modulation).
9. Explain pulse side variation (time modulation).
10. Describe the application and use of combination systems for automatic brightness control.
11. Describe the function of the input phosphor, including photon conversion, quantum detection efficiency, contrast and resolution capabilities.
12. Describe the position and function of the photocathode, vacuum tube, electron-focusing lenses, anode, output phosphor and basic lens.
13. List and describe the factors affecting object field size.
14. Identify methods of increasing brightness gain of an image tube.
15. Describe the position and purpose of the basic lens, distributor, beam-splitting mirrors, cine, and TV camera lenses.
16. Describe lens aberrations, including direct, oblique, spherical, chromatic, depth of focus and vignetting.
17. Describe the relationship of lens combinations and film image sizes (selection of framing formats).
18. Explain the basic operation of digital subtraction angiography (DSA): acquisition, storage, archiving and its integration in the the imaging system.
19. Evaluate and make decisions regarding equipment operation and malfunction.
20. Describe the basic operation of the cine camera.
21. Describe the procedure of film transport loading technique, film perforation and pitch, trouble shooting, cleaning and preventive maintenance.
22. Describe the structural and functional differences of all angiographic tables.

23. Describe and list the functioning part of a cut-film, cassette and roll-film rapid serial film changers including the advantages and disadvantage of each.
24. Describe the function of the program selector.
25. Describe the operational and technical considerations of single and bi-plane serial filming.
26. Describe what is meant by linear and area magnification.
27. List and describe the primary and optimal components of all electromechanical (pressure, flow rate) injectors.
28. Compare the operation, advantages and disadvantages of electromechanical (pressure flow rate) injectors.
29. Describe the use of optical disks, CD ROM, etc., in place of cine film.
30. List and perform the steps in preventive maintenance of all equipment.
31. Describe the physical principles of image production as they relate to image quality.
32. Evaluate and set exposure factors to provide quality radiographs.

Content

I. Specialized Equipment Instrumentation

- A. Generator
 1. Essential requirements
 2. Bid specifications

- B. Radiographic tube requirements
 1. Anode characteristics
 2. Cathode characteristics
 3. Kilowatt determinations
 4. Heat storage and cooling

- C. Radiographic exposure
 1. Variable kVp
 2. Variable mAs

- D. Cine pulsing system

- E. Automatic exposure control (AEC)
 1. Methods
 2. kV modulation
 3. mA modulation
 4. Time modulation
 5. Automatic brightness control

- F. Image intensification
 1. Input phosphor
 - a. Photon conversion
 - b. Quantum detection
 - c. Contrast
 - d. Resolution
 2. Photocathode

3. Vacuum tube
4. Electron focusing lenses
5. Output phosphor
6. Basic lens
7. Brightness gain

G. Optics of image intensification

1. Basic lens
2. Beam-splitting mirrors
3. Camera lenses
4. Lens aberration
 - a. Direct
 - b. Oblique
 - c. Spherical
 - d. Chromatic
 - e. Depth of focus
 - f. Vignetting
5. Framing formats

H. Rapid serial film changers

1. Cut-film
2. Cassette
3. Roll-film
4. Operation
5. Function
6. Single-plane
7. Bi-plane
8. Magnification radiography requirements
9. Cleaning and preventive maintenance
10. Electrical safety

I. Programming devices

1. Types
2. Integration systems

J. Equipment specifications

II. Ancillary Equipment

A. Digital subtraction angiography (DSA) system

1. Integration with the imaging chain
2. Parts
3. Function
4. Operation
5. Trouble-shooting

- B. Cine camera
 - 1. Basic operation
 - 2. Film transport
 - 3. Lodging
 - 4. Film perforation
 - 5. Pitch
 - 6. Trouble-shooting

- C. Cardiovascular-interventional table
 - 1. Types
 - 2. Operation
 - 3. Cleaning and preventive maintenance

- D. Electromechanical (pressure, flow rate) injectors
 - 1. Types
 - 2. Major components
 - 3. Optional components
 - 4. Operation
 - 5. Cleaning and preventive maintenance
 - 6. Accuracy
 - 7. Electrical safety

- E. Recording equipment

Cardiovascular-Interventional Materials

Objectives

The student will:

1. List the sterile materials included on an cardiovascular-interventional tray.
2. Describe the procedure for setting up a sterile cardiovascular-interventional tray.
3. List the sterile apparel to be worn during a cardiovascular-interventional procedure.
4. List the materials used to prepare the entry site.
5. List the solutions required for a cardiovascular-interventional procedure.
6. Describe the physical characteristics, various dimensions, shapes and gauges of catheters, needles and guidewires.
7. Describe several factors that affect flow rate.
8. Describe the materials used in construction of catheters, guidewires, needles, rotablator catheters and vascular stents and drainage catheters.
9. Describe the function and application of angiography, atherectomy, balloon, intravascular sonography, retrieval, occluding and infusing catheters
10. Describe the construction, function and application of regular fixed-core, movable-core, exchange, J-shaped, biliary, axillary, tip-deflecting, high-torque and open-ended, stiff-shaft and coated guidewires.
11. Describe the function of dilators, introducer sheaths and stents (vascular and nonvascular).
12. Describe the uses of metal and plastic adaptors, connectors, stopcocks and manifolds.
13. Describe the types and construction of caval filters.
14. Describe the advantages and disadvantages of reusable and disposable supplies.
15. List materials required for emergency situations.
16. List the equipment required for radiation protection.

Content

I. Tray

- A. Sterile packs
 1. Instruments
 2. 4 x 4 gauze
 3. Syringes and needles
 4. Adaptors, topcocks and manifolds
 5. Sterile basins
 6. Drapes and towels
 7. Heparinized solution
 8. Guidewires
 9. Catheters
 10. Sharps container
 11. Contaminated waste container

II. Guidewires and Catheters

- A. Angiographic catheters
 1. Materials physical characteristics
 - a. Types

- b. Dimensions
 - c. Shapes
 - d. Side holes
 - e. Factors affecting flow rate
 - 2. Reusable vs. disposable products
 - 3. Methods of sterilization
- B. Occlusion and dilatation balloon catheters
 - 1. Types
 - 2. Construction
 - 3. Function
 - 4. Application
 - 5. Complications
- C. Atherectomy catheters
 - 1. Types
 - 2. Construction
 - 3. Function
 - 4. Application
 - 5. Complications
- D. Directional coronary catheter
 - 1. Types
 - 2. Construction
 - 3. Function
 - 4. Application
 - 5. Complications
- E. Rotablator catheters
 - 1. Types
 - 2. Construction
 - 3. Function
 - 4. Application
 - 5. Complications
- F. Transluminal extraction catheters (TEC)
 - 1. Types
 - 2. Construction
 - 3. Function
 - 4. Application
 - 5. Complications
- G. Biliary intravascular stents
 - 1. Types
 - 2. Construction

3. Function
4. Application
5. Complications

H. Intravascular ultrasound catheters

1. Types
2. Construction
3. Function
4. Application
5. Complications

I. Guidewires

1. Materials
2. Physical characteristics
 - a. Dimensions
 - b. Shapes
 - c. Types
3. Special guidewires

J. Cleaning and storage

III. Needles

A. Percutaneous arterial puncture

1. Construction and design
2. Application

B. Cubital vein puncture

1. Construction and design
2. Application

C. Nonvascular interventional procedures

1. Construction and design
2. Application

D. Pediatric

1. Special requirements
2. Application

E. Miscellaneous accessories

1. Dilators
2. Introducer sheaths
3. Stents
 - a. Coronary
 - b. Vascular
4. Caval filters

5. Adaptors
6. Connectors
7. Stopcocks
8. Manifolds

F. Reusable vs. disposable products

G. Methods of sterilization

IV. Solutions

- A. Preparation of solutions
 1. Systemic heparinization
 2. Surgical preparation and scrub materials
 - a. Razors
 - b. Antiseptic soap solution
 - c. Sterile basins
 - d. Drapes and towels
 - e. Gloves
 3. Contrast media
 4. Emergency drugs and crash cart

V. Apparel

- A. Sterile gowns
- B. Sterile gloves
- C. Masks
- D. Face shields
- E. Goggles
- F. Caps

VI. Radiographic supplies

- A. Film
- B. Processing film
- C. Materials for image enhancement

VII. Radiation protection

- A. Lead aprons
- B. Lead gloves and shields

C. Body shield

Physiologic Monitoring and Recording

Course Description

This course provides the student with an overview of the theories and application of patient physiologic monitoring and recording that takes place during a cardiovascular-interventional procedure. The student will be able to recognize the difference between atrial, junctional and ventricular arrhythmias as well as interpret them and discuss possible causes.

Objectives

The student will:

1. Describe the procedure for determining the patient's baseline physiologic values (ECG, oxygen saturation, pulse, etc.).
2. Identify patterns of cardiac arrhythmias (atrial, ventricular, junctional) as they appear on ECG strips of a physiological oscilloscope.
3. Describe patient management procedures for arrhythmias.
4. Describe electronic calibration and balancing of components.
5. Describe dp/dt and how it is determined.
6. Describe the procedure for performing cardiac output measurements, including the Fick method, green dye and thermal dilution.
7. Describe area-length method and computer evaluation techniques for ventricular volume analysis.
8. Explain the function of transducers, amplifiers, recorders (hot stylus, optical, spray link), oscilloscopes and digital readout modules.
9. Describe the procedure for calibration of the transducer, amplifier, recorder and oscilloscope.
10. Identify valvular gradients and determine valve area.
11. Explain the necessity of inserting temporary or permanent pacemakers.

Content

I. Physiologic Monitoring

A. Equipment

1. Transducers
2. Amplifiers
3. Recorders
 - a. Hot stylus
 - b. Optical
 - c. Spray link
 - d. Oscilloscopes
 - e. Digital read out module
 - f. Calibration, balancing
 - g. Base-line determination

- B. Specialized techniques
 - 1. Dp/dt
 - 2. Cardiac output measurements
 - a. Fick method
 - b. Green dye
 - c. Thermal dilution
 - 3. Ventricular volume analysis
 - a. Area-length method
 - b. Computer evaluation
 - 4. Valvular gradients

II. Cardiac Monitoring

- A. Conduction pathway
 - 1. Recognition of arrhythmias
 - 2. Interpretation of arrhythmias
- B. Cardiac sinus rhythms
- C. Atrial rhythms
- D. Heart blocks
 - 1. AV blocks
 - 2. Bundle blocks
- E. Junctional rhythms
- F. Ventricular rhythms
- G. Management of arrhythmias
- H. Pacemakers
 - 1. Temporary
 - a. Transcutaneous pacing
 - b. Transvenous pacing
 - 2. Permanent
 - a. Transvenous pacing
 - b. Transmyocardial pacing
- I. Intra-aortic balloon pump
 - 1. Construction
 - a. Function
 - b. Technique
 - 2. Complications

J. Automated defibrillator

III. Recording Systems

Emergency Care Procedures

Prerequisite

It is recommended that CPR certification and the patient care and pharmacology units be satisfactorily completed prior to this unit.

Course Description

This course provides the student with the knowledge and ability to recognize characteristics of life-threatening patient conditions, identify the equipment necessary to handle emergencies and administer emergency care procedures.

Emergency Care

Objectives

The student will:

1. Describe the physiologic responses to contrast media or medications including early onset.
2. List the medications and corresponding physiologic response produced in counteracting reactions to contrast media or medications.
3. Identify the specific complications related to angiographic procedures, including transient ischemic attacks (TIA), strokes, embolism, thrombosis, myocardial infarction, congestive heart failure, cardiac arrhythmias, vasovagal responses, anaphylaxis, hypotensive and hypertensive episodes, renal failure, diabetic crisis and pericardial perforation.
4. Become certified in advanced cardiac life support (ACLS).

Content

I. Emergency Care

A. Contrast media and medication reactions

1. Early symptoms
 - a. Histamine reactions
 - b. Hemodynamic responses
2. Medications
 - a. Chemistry
 - b. Dose

B. Physiologic response

C. Contraindications

1. Physiologic response

II. Life-threatening Complications

A. Transient ischemic attack (TIA)

1. Symptoms
2. Emergency treatment

- B. Embolism
 - 1. Symptoms
 - 2. Emergency treatment
- C. Thrombosis
 - 1. Symptoms
 - 2. Emergency treatment
- D. Myocardial infarction (MI)
 - 1. Symptoms
 - 2. Emergency treatment
- E. Congestive heart failure (CHF)
 - 1. Symptoms
 - 2. Emergency treatment
- F. Cardiac arrhythmias
 - 1. Symptoms
 - 2. Emergency treatment
- G. Vasovagal response
 - 1. Symptoms
 - 2. Emergency treatment
- H. Anaphylaxia
 - 1. Symptoms
 - 2. Emergency treatment
- I. Hypotensive episodes
 - 1. Symptoms
 - 2. Emergency treatment
- J. Hypertensive episodes
 - 1. Symptoms
 - 2. Emergency treatment
- K. Diabetic crisis
 - 1. Symptoms
 - 2. Emergency treatment
- L. Pericardial perforation
 - 1. Symptoms
 - 2. Emergency treatment

- M. Renal failure
 - 1. Symptoms
 - 2. Complications

III. ACLS

Room and Patient Preparation

Objectives

The student will:

1. State the location of the closest code or crash cart.
2. State the location of the closest oxygen and suction equipment.
3. Prepare those items necessary for venipuncture, including tourniquet, needles and butterflies, tape, gauze, arm board, bandaids, contrast media and intravenous medication.
4. Identify the appropriate method of proper patient identification for the proper examination.
5. Obtain an allergy history, if any, from the patient.
6. Explain the entire procedure to the patient.

Content

I. Room Equipment

- A. Code or crash cart
 1. Oxygen
 2. Suction
 3. Defibrillator
 4. Medications
- B. Venipuncture equipment
 1. Tourniquet
 2. Needles and butterflies
 3. Alcohol wipes and betadine
 4. Tape
 5. Gauze
 6. Arm board
 7. Bandaids

II. Patient Preparation

- A. Proper examination identification
- B. Proper patient identification
- C. Patient allergy history
- D. Medications
- E. Contrast
- F. Latex

III. Examination Explanation

- A. Appropriate laboratory values

B. Appropriate patient history for study

Emergency Procedures and Equipment

Objective

The student will:

1. List the steps in performing cardioversion, defibrillation, respiratory assist techniques, thoracentesis and closed-chest cardiac massage.

Content

I. Equipment

- A. Code or crash cart
 1. Oxygen
 2. Suction
 3. Defibrillator
 4. Medications

II. Techniques

- A. Cardioversion
- B. Defibrillation
- C. Respiratory assist techniques
- D. Closed-chest cardiac massage
- E. Cardiac assist devices
- F. Thoracentesis
- G. Intubation technique

Sterile Technique

Course Description

This course provides the student with an overview of sterile technique and isolation procedures that apply to cardiovascular-interventional procedures.

Sterile Technique

Objectives

The student will:

1. Define the types of microorganisms.
2. Describe the defense systems of the body.
3. Define the process of infection.
4. List the elements needed to produce infection.
5. Describe the methods of transmitting infectious agents.
6. Define sterile, aseptic and disinfectant.
7. Describe the principles of aseptic technique.
8. Describe the methods of sterilization, including steam under pressure, gas, chemicals, dry heat and ionizing radiation.
9. List various disinfectants.
10. Describe the steps in scrubbing technique for procedural personnel.
11. Describe gowning and gloving to maintain a sterile field.
12. List the steps in scrubbing and preparation of the patient.

Content

I. Types of Microorganisms

- A. Bacteria
- B. Fungi
- C. Viruses
- D. Protozoa

II. Defense Systems of the Body

- A. Nonspecific defense system
- B. Active immunity system
- C. Passive immunity

III. Process of Infection

- A. Incubation period

- B. Prodromal phase
- C. Active stage
- D. Convalescence

IV. Elements Needed to Produce Infection

V. Methods of Transmitting Agents

- A. Direct
- B. Indirect
- C. Airborne
- D. Vehicle
- E. Vector

VI. Sterilization

- A. Steam under pressure
- B. Gas
- C. Chemical
- D. Dry heat
- E. Ionizing radiation

VII. Asepsis

- A. Betadine
- B. Alcohol
- C. Disinfectants

VIII. Sterile Field

- A. Patient preparation
- B. Cloth-wrapped supplies
- C. Steri-peel items
- D. Plastic wrapped supplies

IX. Scrubbing, Gowning and Gloving

A. Scrubbing techniques

B. Gowning methods

1. Self
2. Physician

C. Gloving

1. Open
2. Closed

Isolation Procedures

Objectives

The student will:

1. List the levels and identification of isolation regulations for infection control.
2. Describe the protocol for performing a procedure on an isolation patient.
3. Describe what is meant by universal blood and body fluid precautions.
4. Describe how contaminated articles and waste are disposed.
5. Describe the concept and precautions of body substance isolation and those diseases requiring precautions.
6. Describe sources and modes for transmission of infections and diseases.

Content

I. Infection Control

A. Levels of isolation

B. Precautions

II. Procedure on Isolation Patients

III. Body Substance Isolation

A. Concept

B. Precautions

C. Diseases

1. Viral hepatitis
 - a. Type A
 - b. Type B
 - c. Type C (non-A, non-B)
 - d. Type D
 - e. Type E
2. HIV/AIDS

Vascular Approaches

Course Description

This course provides the student with a theoretical and practical application of cardiovascular-interventional procedures. It will include an overview of the Seldinger technique of venipuncture for vascular procedures and examine the history that lead to its development.

Vascular Approaches

Objectives

The student will:

1. Describe the Seldinger technique.
2. Explain how angiographic procedures were performed prior to the development of the Seldinger technique.
3. Describe alternative vascular approaches, including axillary, direct carotid, brachial, radial, translumbar, venous and cutdowns.
4. Explain the reasons for selecting each of the alternative vascular approaches.

Content

- I. History of Angiography**
- II. Seldinger Technique**
- III. Femoral Approach**
 - A. Left and right approaches
 1. Indications
 2. Contraindications
 - B. Retrograde
 1. Indications
 2. Contraindications
 - C. Antegrade
 1. Indications
 2. Contraindications
 - D. Complications
- IV. Axillary Approach**
 - A. Left and right axillary technique
 1. Indications
 2. Contraindications
 - B. Complication

V. Direct Stick Carotid, Vertebral

- A. Indications
- B. Contraindications
- C. Technique
- D. Complications

VI. Translumbar

- A. Indications
- B. Contraindications
- C. Technique
- D. Complications

VII. Arterial or Venous Cutdown

- A. Indications
- B. Contraindications
- C. Technique
- D. Complications

VIII. Retrograde Brachial

- A. Indications
- B. Contraindications
- C. Technique
- D. Complications

IX. Radial Artery

- A. Indications
- B. Contraindications
- C. Technique
- D. Complications

Cardiovascular Studies

Objectives

The student will:

1. Identify normal anatomy.
2. List the indications and contraindications for these procedures.
3. Describe the procedural techniques for percutaneous catheterization, including transfemoral, transjugular, transbrachial, direct needle puncture and surgical arteriotomy.
4. Describe patient management procedures required for specific problems of patient care, including trauma and critical-care.
5. List contrast media considerations.
6. List equipment necessary to perform the procedure.
7. Describe patient positioning and selection of appropriate radiographic techniques.
8. Describe image enhancement techniques.
9. Identify procedural complications.

Content

I. Cardiac Angiography

- A. Right heart
- B. Left heart
- C. Coronary
- D. Pulmonary
- E. Right and left atrial study
- F. Hemodynamic studies
- G. Left ventricular study
- H. Cardiac assist
- I. Procedures
 1. Abnormal anatomy
 2. Indications
 3. Contraindications
 4. Catheterizations
 5. Patient management
 6. Contrast media
 7. Equipment
 8. Patient positioning
 9. Radiographic technique

10. Image enhancement
11. Complications

Angiography

Objectives

The student will:

1. Identify abnormal anatomy.
2. List indications and contraindications for the procedure.
3. Discuss procedural techniques for percutaneous catheterization, including transfemoral, transaxial, brachial arteriotomy and translumbar.
4. Describe the management procedures required for specific problems of patient care, including the trauma and critical-care patient.
5. List the contrast media considerations for the procedure.
6. List equipment necessary to perform the procedure.
7. Describe patient positioning and selection of appropriate radiographic techniques.
8. Describe image enhancement techniques.
9. Identify procedural complications.

Content

I. Abdominal Aortography

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization
- D. Patient management
- E. Contrast media
- F. Equipment
- G. Patient positioning
- H. Radiographic technique
- I. Image enhancement
- J. Complications

II. Thoracic Aortography

- A. Procedures
 1. Ascending aorta
 2. Transverse (arch) aorta
 3. Descending thoracic aorta
- B. Abnormal anatomy

- C. Indications and contraindications
- D. Catherization
- E. Patient management
 - 1. Preprocedure
 - 2. Postprocedure
- F. Contrast media
- G. Equipment
- H. Patient positioning
- I. Radiographic technique
- J. Image enhancement
- K. Complications

III. Peripheral Angiography

- A. Procedures
 - 1. Iliac arteriography (common, internal, external)
 - 2. Femoral-popliteal (lower extremity)
 - a. Balloon occlusion technique
 - b. Reactive hyperemia
 - 3. Subclavian (upper extremity)
- B. Abnormal anatomy
- C. Indications and contraindications
- D. Catheterization
- E. Patient management
 - 1. Preprocedure
 - 2. Postprocedure
- F. Contrast media
- G. Equipment
- H. Patient positioning
- I. Radiographic technique

J. Image enhancement

K. Complications

IV. Visceral Angiography

A. Procedures

1. Selective celiac axis (hepatic, splenic, gastric)
2. Superior mesenteric
3. Renal and adrenal
4. Inferior mesenteric
5. Endocrine sampling
 - a. Renin
 - b. Aldosterone
6. Indirect method of viewing the portal system

B. Abnormal anatomy

C. Indications and contraindications

D. Catheterization

E. Patient management

F. Contrast media

G. Equipment

H. Patient positioning

I. Radiographic technique

J. Image enhancement

K. Complications

V. Neuroangiography

A. Procedures

1. Aortic arch
2. Selective carotid
 - a. Internal
 - b. External
3. Selective vertebral
4. Cross-compression technique
5. Orbital venography

6. Percutaneous
7. Spinal arteriography
8. Epidural venography

- B. Abnormal anatomy
- C. Indications and contraindications
- D. Catheterization
- E. Patient management
 1. Preprocedure
 2. Postprocedure
- F. Contrast media
- G. Equipment
- H. Patient positioning
 - I. Radiographic technique
 - J. Image enhancement
- K. Complications

VI. Lymphangiography

- A. Lymphatic system
- B. Abnormal anatomy
- C. Indications and contraindications
- D. Catheterization
- E. Patient management
 1. Preprocedure
 2. Postprocedure
- F. Contrast media
- G. Equipment
- H. Patient positioning

I. Radiographic technique

J. Image enhancement

K. Complications

Vascular Interventional Procedures

Objectives

The student will:

1. Identify abnormal anatomy.
2. List indications and contraindications for the procedure.
3. Discuss procedural techniques for percutaneous catheterization, including transfemoral and brachial catheterization.
4. List contrast media considerations.
5. List the types of embolic agents used for embolization procedures.
6. Describe the technique for transjugular intrahepatic portosystemic shunt (TIPS).
7. Explain the various methods used in the angiographic management of vascular obstruction.
8. Describe the various methods for arterial and venous thrombolysis.
9. Explain the cross-catheters method for dialysis graft thrombolysis.
10. Explain the development of endovascular grafts.
11. Describe the technique for performing hepatic chemoembolization.
12. List the equipment necessary to perform a specific procedure.
13. Describe patient positioning and select appropriate radiographic techniques.
14. Describe image enhancement techniques.
15. Identify procedural complications.

Content

I. Angiographic Embolization Techniques

- A. Angiographic management of bleeding
- B. Management of malignant tumors in the thorax, abdomen and bones
- C. Embolization techniques in the brain, head, neck and spinal cord
- D. Embolization of the spleen
- E. Embolization of arteriovenous malformations, varicoceles and abdominal aortic aneurysms
- F. Presurgical balloon occlusion technique for the internal carotid artery
- G. Detachable balloon technique for carotid cavernous sinus fistulas
- H. Embolization materials
 1. Temporary
 2. Permanent

II. Angiographic Management of Vascular Obstruction

- A. Percutaneous transluminal angioplasty
 1. Carotid arteries

2. Coronary arteries
3. Peripheral arteries
4. Visceral arteries
5. Renal arteries
6. Venous vessels
7. Saphenous vein grafts
8. Subclavian arteries

B. Vascular stent placement

1. Coronary arteries
2. Peripheral arteries
3. Renal arteries
4. Saphenous vein grafts
5. Subclavian arteries
6. Carotid arteries

C. Atherectomy

D. Rotablation

1. Coronary arteries
2. Peripheral arteries
3. Saphenous vein grafts

III. Thrombolysis

A. Arterial method

B. Venous method

C. Cross catheter dialysis shunts

IV. Endovascular Grafts

A. Type

B. Construction

C. Indications

D. Contraindications

E. Technique

F. Patient positioning

G. Complications

V. Hepatic Chemoembolization

- A. Medications
- B. Indications
- C. Contraindications
- D. Special equipment
- E. Catheterization technique
- F. Complications

VI. Transjugular Intrahepatic Portasystemic Shunt (TIPS)

- A. Normal anatomy
- B. Abnormal anatomy
- C. Indications
- D. Contraindications
- E. Special equipment
- F. Catheterization technique
- G. Complications

VII. Miscellaneous Vascular Procedures

- A. Pulmonary angiography
- B. Pulmonary embolectomy
- C. Foreign body extraction
- D. Laser-assisted angioplasty
- E. Intra-aortic balloon pump

Nonvascular Interventional Procedures

Objectives

The student will:

1. Identify abnormal anatomy.
2. List indications and contraindications for the procedure.
3. Discuss procedural techniques for percutaneous catheterization, including transfemoral and brachial catheterization.
4. List contrast media considerations.
5. List all equipment necessary to perform a specific procedure.
6. Describe patient positioning and selection of appropriate radiographic techniques.
7. Describe image enhancement techniques.
8. Identify procedural complications.

Content

I. Percutaneous Biopsy

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Percutaneous puncture or catheterization
- D. Patient management
- E. Contrast media
- F. Equipment
- G. Patient positioning
- H. Radiographic technique
- I. Image enhancement
- J. Complications

II. Percutaneous Management of Fluid Collections

- A. Percutaneous drainage technique
- B. Intraperitoneal fluid collections
- C. Retroperitoneal fluid collections
- D. Pelvic fluid collections

- E. Percutaneous drainage of thoracic fluid collections
- F. Patient management
- G. Radiographic technique

III. Endoscopic and Percutaneous Management of Biliary Disease

- A. Percutaneous transhepatic cholangiography
- B. Percutaneous biliary drainage
- C. Biliary endoprotheses in malignant obstruction
- D. Percutaneous irradiation of the bile ducts
- E. Percutaneous management of benign bile duct disease
- F. Percutaneous biliary stone extraction
- G. Percutaneous placement of biliary stents
- H. Patient management
- I. Radiographic technique

IV. Endoscopic and Percutaneous Management of Urinary Disease

- A. Percutaneous nephrostomy
- B. Endoscopic and percutaneous management of urethral structures and fistulas
- C. Endoscopic management of stones in the urinary tract
- D. Percutaneous management of stones in the urinary tract
- E. Patient management
- F. Radiographic technique

V. Interventional Procedures in the Digestive Tract

- A. Dilatation of esophageal strictures
- B. Percutaneous gastrostomy
- C. Percutaneous management of fistulas in the digestive tract

D. Placement of esophageal stents

E. Patient management

F. Radiographic technique

VI. Miscellaneous Nonvascular Procedures

A. Percutaneous lysis of the vertebral disk

B. Percutaneous management of the neural structures

C. Celiac plexus

D. Sympathetic chain

E. Patient management

F. Radiographic technique

Venography

Objectives

The student will:

1. Identify abnormal anatomy.
2. List the indications and contraindications for the procedure.
3. Describe procedural technique for percutaneous function or catheterization, including transfemoral and brachial catheterization.
4. List contrast media considerations.
5. List the equipment necessary to perform a specific procedure.
6. Describe patient positioning and selection of appropriate radiographic techniques.
7. Describe image enhancement techniques.
8. Describe the purpose of caval filtration.
9. Describe intravenous stent placement.
10. Describe the placement of percutaneously inserted central catheters (PICC).
11. Identify procedural complications.

Content

I. Peripheral Venography

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique
- D. Patient positioning
- E. Contrast media
- F. Equipment
- G. Image enhancement
- H. Complications
- I. Patient management
- J. Radiographic technique

II. Hepatic Venography

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique

- D. Hepatic wedge pressures
- E. Patient positioning
- F. Contrast media
- G. Equipment
- H. Image enhancement
- I. Complications
- J. Patient management
- K. Radiographic technique

III. Renal Venography

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique
- D. Patient positioning
- E. Contrast media
- F. Equipment
- G. Image enhancement
- H. Complications
- I. Patient management
- J. Radiographic technique

IV. Spenoportography

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique

- D. Patient positioning
- E. Contrast media
- F. Equipment
- G. Image enhancement
- H. Complications
- I. Patient management
- J. Radiographic technique

V. Caval Filters

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique
- D. Patient positioning
- E. Contrast media
- F. Equipment
- G. Image enhancement
- H. Complications
- I. Patient management
- J. Radiographic technique

VI. Intravenous Stent Placement

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique
- D. Patient positioning
- E. Contrast media

- F. Equipment
- G. Complications
- H. Patient management
- I. Radiographic technique

VII. Percutaneously Inserted Central Catheters (PICC)

- A. Abnormal anatomy
- B. Indications and contraindications
- C. Catheterization technique
- D. Patient positioning
- E. Contrast media
- F. Equipment
- G. Complications
- H. Patient management
- I. Radiographic technique

Imaging Enhancement Technology

Course Description

This course provides the student with an overview of various techniques that influence and enhance image quality.

Film Techniques

Objectives

The student will:

1. Describe the principles and steps of radiographic subtraction.
2. Describe the operation of the radiographic reducer.
3. Explain the steps in producing slides of radiographs.
4. Describe the process of making prints for publication.
5. Describe the application of compensating filtration in pulmonary, cerebral, peripheral and visceral angiography.
6. List the equipment requirements for magnification radiography.
7. Describe the application of magnification radiographs.
8. Describe the procedures for production of magnified radiographs.

Content

I. Subtraction

- A. Mask
- B. First-order subtraction
- C. Second-order subtraction
- D. Film
- E. Equipment
- F. Reversal

II. Photographic

- A. Minification
- B. Slides from radiographs
- C. Prints for publication

III. Compensation Filtration

- A. Pulmonary

B. Cerebral

C. Peripheral

D. Visceral

IV. Magnification

A. Application

B. Procedure

Film-Screen Imaging

Objectives

The student will:

1. Describe the film-screen speed requirements of various cardiovascular-interventional procedures.
2. Describe exposure requirements for various film-screen combinations.
3. Describe the difference between various film-screen combinations.
4. Evaluate several types of cine film for use in the cardiovascular laboratory.
5. Evaluate test results of cine film comparisons.
6. Describe the spectral distribution of photon absorption as it pertains to speed and contrast.
7. Calculate required adjustments in exposure for differences in film speed.

Content

I. Film-Screen Systems

- A. Speed
- B. Resolution
- C. Contrast
- D. Uses

II. Cine Imaging

- A. Evaluation
- B. Spectral distribution
- C. Exposure evaluation
- D. Equipment
- E. Display factors

Electronic Imaging

Objectives

The student will:

1. Describe various electronic image acquisition methods and their applications.
2. Describe various electronic image manipulations and their applications, reconstruction, border enhancement, etc.
3. Describe various electronic image storage methods and their applications.

Content

I. Image Acquisition

A. Methods

B. Applications

II. Image Manipulation

A. Methods

1. Reconstruction
2. Enhancement

B. Applications

III. Image Storage

A. Methods

1. Disc (electronic and optical)
2. Tape and floppy disc
3. CD ROM

B. Applications

Vascular Correlation and Surgical Intervention

Course Description

This course will provide the student an overview of vascular correlation and surgical intervention for specific congenital and acquired disease processes.

Disease Pathologies

Objectives

The student will:

1. Explain the process of atherosclerosis.
2. Explain the clinical aspects of atherosclerosis.
3. List the most common sites of atherosclerosis.
4. Describes the types and most common location of arterial aneurysms.
5. Explain the clinical aspects of arterial dissections.
6. List the various types of traumatic arterial injuries.
7. Define renovascular disease and describe the disease process.
8. Define the various angiographic pathologies of mesenteric vessels.
9. Explain the process and the clinical aspects of peripheral arterial disease.
10. Explain the various disease pathologies in cerebrovascular disease.

Content

I. Atherosclerosis

- A. Definition
- B. Clinical aspects
- C. Common occlusion sites

II. Arterial Aneurysms

- A. Definition
- B. Types
- C. Clinical aspects
- D. Common aneurysm sites

III. Arterial Dissections

- A. Definition
- B. Types
- C. Clinical aspects

D. Classifications

IV. Types of Arterial Trauma

V. Renovascular Disease

A. Stenosis

B. Aneurysms

C. Fibromuscular dysplasia

D. Trauma

VI. Mesenteric Vessels Pathologies

A. Atherosclerosis

B. Aneurysms

C. Embolism

D. Angiodysplasia

E. GI bleeding

F. Trauma

VII. Peripheral Arterial Disease

A. Atherosclerosis

B. Aneurysms

C. Embolism

D. Trauma

E. Dissection

VIII. Cerebrovascular Disease

A. Types of pathologies

1. Tumor

2. Arterial venous malformations

3. Infarctions

4. Intracranial bleeds

5. Aneurysms

6. Fibromuscular dysplasia

7. Dissection

B. Clinical Aspects

IX. Coronary Artery Disease

A. Stenosis

B. Total and subtotal occlusions

C. Thrombosis formation and atherosclerosis

D. Calcified lesions

Vascular Correlation

Objectives

The student will:

1. Correlate vascular diagnosis with the patient's clinical history.
2. Correlate vascular diagnosis with medical and surgical treatment.

Content

I. Radiographic Diagnosis

- A. Cardiovascular-interventional procedure

II. Clinical Diagnosis Correlation

- A. Preprocedural
 1. Clinical assessment
- B. Postprocedural

Surgical Intervention

Objectives

The student will:

1. Describe the difference between accepted surgical techniques for specific vascular abnormalities or pathologies.
2. Provide image enhancement techniques and special radiographic views to augment surgical intervention.
3. Provide technical assistance during temporary or permanent cardiac pacemaker insertions and placement of mechanical circulatory assist devices.
4. Describe the prognosis of surgical intervention techniques.

Content

I. Surgical Intervention

- A. Accepted surgical correction procedures
 1. Coronary
 2. Peripheral
 3. Grafts
 4. Prostheses
 5. Endarterectomy
 6. Aneurysm
 - a. Aortic
 - b. Cerebral
- B. Vascular assist techniques
 1. Image enhancement
 2. Additional views
- C. Postsurgical checkup (prognosis)

Clinical Practicum

Suggested Credit

The number of hours varies; three hours of clinic practice for every hour of didactic lecture is suggested.

Course Format

1. Cooperative clinical experience, preferably with clinical competencies
2. Laboratory or simulations
3. Film review sessions

Course Description

1. Clinical experience in cardiovascular-interventional technology, patient screening and related activities
2. Individual research project

Syllabus Course Content

1. Clinical time (attendance)
2. Clinical examination record
3. Competency evaluation
4. Personal and professional evaluation
5. Clinical objective
6. Miscellaneous

Because no essentials govern the educational activities in cardiovascular-interventional technology education, there are no mandatory clinical requirements. However, the clinical education experience should be conducted using sound educational principles based on a competency evaluation system that reflects both personal and professional growth of the student.

Suggestions include:

1. Observations of patient preparation
2. Proper scrub technique
3. Procedure performance, including working with the physician and other members of the health care team
4. Filming and storage of data
5. Assisting the cardiovascular-interventional technologist in the areas listed.

The final section should be in the area of standardized clinical competencies performed with a cardiovascular-interventional technologist present where the student completes the entire exam from request and chart review to patient screening, explaining the procedure to the patient, preparing and positioning the patient, using required accessories, programming the equipment, completing the exam, releasing the patient, final paperwork, filming and storing the data.

Introduction to Cardiovascular-Interventional Technology Practice Standards

Cardiovascular-interventional technology (CV) is an ever-changing and evolving profession within radiology. In the past, the profession primarily consisted of diagnostic angiographic procedures. Presently, it consists of diagnostic angiographic procedures, complex vascular and nonvascular interventional and therapeutic procedures. The cardiovascular-interventional technologist has evolved from a special-procedures radiologic technologist who produced radiographic images to a vital member of a multidisciplinary team consisting of interventional radiologists, nurses and CV technologists. These team members form a core of highly trained health care professionals who each bring expertise to the area of patient care.

Cardiovascular-Interventional Technologist

The cardiovascular-interventional technologist assumes many roles within an interventional procedure.

Cardiovascular-interventional technologists:

1. Scrub in and assist the physician in the surgical procedure.
2. Circulate within the procedure room and procure all equipment needed for any given procedure.
3. Position the patient, select radiation exposure parameters and image the patient.
4. Maintain a high degree of accuracy and an awareness of all radiation and patient safety issues involved with any invasive procedure.
5. Demonstrate a thorough understanding and working knowledge of normal anatomy, abnormal anatomy and physiology, radiation safety, interventional supplies and equipment operation.
6. Recognize and resolve equipment operations.
7. Recognize and resolve equipment problems and discrepancies, anticipate patient needs and concerns and determine the appropriate care needed.
8. Use professional judgment and critical thinking when performing procedures.

Education and Certification

Cardiovascular-interventional technologists prepare for their role on the interdisciplinary team by satisfactorily completing an accredited educational program in radiologic technology. Two-year certificate, associate degree and four-year baccalaureate degree programs exist throughout the United States.

Accredited programs must meet specific curricular and educational standards. The Joint Review Committee on Education in Radiologic Technology (JRCERT) is the accrediting agency for radiologic technology programs recognized by the U.S. Department of Education.

Upon completion of a course of study in radiologic technology, individuals apply to take the national certification examination. The American Registry of Radiologic Technologists (ARRT) is the recognized certifying agency for radiologic technology and offers examinations three times per year. Those who successfully complete the certification examination in radiologic technology may use the credential R.T.(R) following their name; the R.T. signifies registered technologist and the (R) indicates radiography. To maintain ARRT certification, a level of expertise and awareness of changes and advances in practice, radiologic technologists must complete 24 hours of appropriate continuing education every two years.

Eligibility to take the advanced-level examination in cardiovascular-interventional technology requires certification as a registered technologist in radiography for a minimum of one year. After successfully completing the cardiovascular-interventional technology advanced-level examination, the credentials R.T.(R)(CV) may be used.

Practice Standards

The practice standards define the practice and establish general criteria to determine compliance. Practice standards are authoritative statements enunciated and promulgated by the profession for judging the quality of practice, service and education. They include desired and achievable levels of performance against which actual performance can be measured.

Professional practice constantly changes and actual practice varies from state to state as determined by local law and community custom. Recognizing this, the profession has adopted standards that are general in nature. The general format was favored over a “cookbook” style or “step-by-step” approach that would be difficult to maintain in a changing environment and confining for those practitioners with an expanded practice.

The standards focus on the dynamic nature of the health care delivery system. The standards are adaptable not only to the area of practice but also the locality of practice and institutional needs. While a minimum standard of acceptable performance is appropriate and should be followed by all practitioners in a specific area, it is unrealistic and highly inappropriate to assume that professional practice is the same in all regions of the United States.¹ State statute or regulation may dictate practice parameters. To conduct an appropriate review of the standards, one must look to the professional standard as well as local or state law that may impact the nature and scope of practice.

Format

The cohesive nature and inherent differences of medical imaging and radiation therapy are recognized in the general format of the standards. The standards are divided into three sections: clinical performance, quality performance, and professional performance.

¹ The term “practitioner” is used in all areas of the standards in place of the various names used in medical imaging and radiation therapy, such as radiologic technologist, sonographer or radiation therapist. Practitioner is defined as any individual practicing in a specific area or discipline. The profession believes that any individual practicing in one of the defined disciplines or specialties should be held to a minimum standard of performance to protect the patients who receive professional services.

Clinical Performance Standards. The clinical performance standards define the activities of the practitioner in the care of patients and delivery of diagnostic or therapeutic procedures and treatments. The section incorporates patient assessment and management with procedural analysis, performance and evaluation.

Quality Performance Standards. The quality performance standards define the activities of the practitioner in the technical areas of performance including equipment and material assessment, safety standards and total quality management.

Professional Performance Standards. The professional performance standards define the activities of the practitioner in the area of education, interpersonal relationships, personal and professional self-assessment and ethical behavior.

Each section of the standards is subdivided into individual standards. The standards are numbered and followed by a term or set of terms that identify the standards, such as “assessment” or “analysis/determination.” The next statement is the expected performance of the practitioner when performing the procedure or treatment. A rationale statement follows and explains why a practitioner should adhere to the particular standard of performance.

Criteria. Criteria are used in evaluating a practitioner’s performance. Each set of criteria is divided into two parts, the general criteria and the specific criteria. Both the measurement and specific criteria should be used when evaluating performance.

General Criteria. General criteria are written in a general style that applies to either medical imaging or radiation therapy practitioners. These criteria are the same in all sections of the standards and should be used for the appropriate area of practice. For example, a radiographer should use good professional judgement when making decisions concerning the adaptation of equipment and technical variables for a diagnostic procedure. Under these circumstances, the evaluation of the decision-making process concerning radiation therapy procedures would not be appropriate and should not be applied unless the procedure is diagnostic in nature, such as simulation.

Specific Criteria. While many areas of performance within medical imaging and radiation therapy are similar, others are not. The specific criteria are drafted with these differences in mind. For example, a criterion that calls for daily review of patient treatment records and doses to ensure that treatment does not exceed prescribed dose or normal tissue tolerance is imperative for those who practice in radiation therapy yet is not applicable to those who practice in the imaging professions.

A profession’s practice standards serve as a guide for appropriate practice. Standards provide role definition for practitioners that can be used by individual facilities to develop job descriptions and practice parameters. Those outside the medical imaging and radiation therapy community can use the standards as an overview of the role and responsibilities of the practitioner as defined by the profession.

Cardiovascular-Interventional Technology

Clinical Performance Standards

Standard One – Assessment

The practitioner collects pertinent data about the patient and about the procedure.

Rationale

Information about the patient's health status is essential in providing appropriate imaging and therapeutic services.

General Criteria

The practitioner:

1. Uses consistent and appropriate techniques to gather relevant information from the medical record, significant others and health care providers. The collection of information is determined by the patient's needs or condition.
2. Reconfirms patient identification and verifies the procedure requested or prescribed.
3. Verifies the patient's pregnancy status when appropriate.
4. Determines whether the patient has been appropriately prepared for the procedure.
5. Assesses factors that may contraindicate the procedure, such as medications, insufficient patient preparation or artifacts.

Specific Criteria

The practitioner:

1. Obtains and assesses information in conjunction with the cardiovascular team.
2. Verifies current patient history and physical examination is available.
3. Documents or assists in documenting patient medical history related to the procedure including:
 - a. Indications/diagnosis.
 - b. Clinical presentation.
 - c. Height and weight.
 - d. Allergies.
 - e. Lab results according to procedural protocol or standards. Alerts physician to abnormal results.
 - f. Current medications.
 - g. Pertinent data from current or previous examination relative to the procedure.
4. Documents or assists in documenting patient assessment including:
 - a. Cardiovascular indicators such as heart rate, blood pressure, rhythm or arrhythmias, chest pain.
 - b. Respiratory indicators such as rate, oximetry, supplemental oxygen.
 - c. Status of peripheral pulse when appropriate.
 - d. Psychological factors such as the patient's needs, concerns, anxiety level.
 - e. NPO status.
5. Identifies and removes any artifact-producing objects from area to be imaged.

Standard Two – Analysis/Determination

The practitioner analyzes the information obtained during the assessment phase and develops an action plan for completing the procedure.

Rationale

Determining the most appropriate action plan enhances patient safety and comfort, optimizes diagnostic and therapeutic quality and improves cost effectiveness.

General Criteria

The practitioner:

1. Selects the most appropriate and cost-effective action plan after reviewing all pertinent data and assessing the patient's abilities and condition.
2. Uses his or her professional judgment to adapt imaging and therapeutic procedures to improve diagnostic quality and therapeutic outcome.
3. Consults with appropriate medical personnel when necessary to determine a modified action plan when necessary.
4. Determines the need for accessory equipment.

Specific Criteria

The practitioner:

1. Analyzes and determines action plan in conjunction with the cardiovascular team.
2. Reviews and reports information to the physician prior to the procedure and takes appropriate measures including:
 - a. Lab values according to procedural protocols or standards.
 - b. Premedication as indicated.
 - c. Patient assessment information such as heart rate, oxygenation, peripheral pulse, anxiety, level of consciousness.
3. Documents appropriate information in the patient's record.
4. Determines the appropriate imaging modality.
5. Determines practice of care such as puncture site, position technique, medical supplies, immobilization, etc., using patient assessment and presentation according to the procedure requested.

Standard Three – Patient Education

The practitioner provides information about the procedure to the patient, significant others and health care providers.

Rationale

Communication and education are necessary to establish a positive relationship with the patient, significant others and health care providers.

General Criteria

The practitioner:

1. Verifies that the patient has consented to the procedure and fully understands its risks, benefits, alternatives and follow-up. When appropriate, the practitioner verifies that written consent has been obtained.

2. Provides accurate explanations and instructions at an appropriate time and at a level the patient can understand. Addresses and documents patient questions and concerns regarding the procedure when appropriate.
3. Refers questions about diagnosis, treatment or prognosis to the patient's physician.
4. Provides appropriate information to any individual involved in the patient's care.

Specific Criteria

The practitioner:

1. Educates the patient and significant others in conjunction with the cardiovascular team.
2. Addresses and documents patient questions and concerns regarding the procedure when appropriate.
3. Assesses the patient's understanding of the procedure and verifies the patient's willingness to participate in the procedure including required follow-up.

Standard Four – Implementation

The practitioner implements the action plan.

Rationale

Quality patient services are provided through the safe and accurate implementation of a deliberate plan of action.

General Criteria

The practitioner:

1. Implements an action plan that falls within established protocols and guidelines.
2. Elicits the cooperation of the patient to carry out the action plan.
3. Uses an integrated team approach as needed.
4. Modifies the action plan according to changes in the clinical situation.
5. Administers first aid or provides life support in emergency situations.
6. Uses accessory equipment when appropriate.
7. Assesses and monitors the patient's physical and mental status.

Specific Criteria

The practitioner:

1. Implements the action plan in conjunction with the cardiovascular team.
2. Explains each step of the action plan to the patient as it occurs.
3. Positions the patient properly for the procedure to include appropriate immobilization.
4. Monitors ECG, BP, respiration, oxygen saturation and level of consciousness pre-, peri- and postprocedure.
5. Starts and maintains IV access per orders when applicable.
6. Starts and maintains oxygen administration per orders when applicable.
7. Uses principles of sterile technique according to the protocol for the exam requested.
8. Prepares, sets and implements appropriate technical parameters such as generators, power injectors, etc.
9. Obtains and documents appropriate data in the record pre-, peri- and postprocedure.
10. Administers medications at the physician's request according to policy.

11. Maintains universal precautions according to policy.
12. Uses radiation protection standards according to established guidelines.
13. Prepares and initiates emergency protocols as needed.
14. Provides appropriate procedural information to postprocedure health care provider.
15. Assesses the patient upon completion of the procedure and provides appropriate post-procedure and discharge instructions to the patient, significant others or the caregiver.

Standard Five – Evaluation

The practitioner determines whether the goals of the action plan have been achieved.

Rationale

Careful examination of the procedure is important to determine that all goals have been met.

General Criteria

The practitioner:

1. Evaluates the patient and the procedure to identify variances that may affect patient outcome. The evaluation process should be timely, accurate and comprehensive.
2. Measures the procedure against established protocols and guidelines.
3. Identifies any exceptions to the expected outcome.
4. Documents any exceptions clearly and completely.
5. Develops a revised action plan to achieve the intended outcome if necessary.
6. Disseminates reasons for revisions to all team members.

Specific Criteria

The practitioner:

1. Evaluates the action plan in conjunction with the cardiovascular team.

Standard Six – Implementation

The practitioner implements the revised action plan.

Rationale

It may be necessary to make changes to the action plan to achieve the intended outcome.

General Criteria

The practitioner:

1. Bases the revised plan on the patient's condition and the most appropriate means of achieving the intended outcome.
2. Takes action based on patient and procedural variances.
3. Measures and evaluates the results of the revised action plan.
4. Notifies appropriate health provider when immediate clinical response is necessary based on procedural findings and patient condition.

Specific Criteria

The practitioner:

1. Implements revised action plan in conjunction with cardiovascular team.

2. Collects and documents additional patient data as needed.
3. Performs, based on findings, additional procedures to achieve optimal results.
4. Uses alternative methods, additional equipment or medical supplies to achieve optimal results.

Standard Seven – Outcomes Measurement

The practitioner reviews and evaluates the outcome of the procedure.

Rationale

To evaluate the quality of care, the practitioner compares the actual outcome with the intended outcome.

General Criteria

The practitioner:

1. Reviews all diagnostic or therapeutic data for completeness and accuracy.
2. Determines whether the actual outcome is within established criteria.
3. Evaluates the process and recognizes opportunities for future changes.
4. Assesses the patient's physical and mental status prior to discharge from the practitioner's care.

Specific Criteria

The practitioner:

1. Secures a safe and sterile environment for patients and staff.
2. Evaluates outcome measurements in conjunction with cardiovascular team.

Standard Eight – Documentation

The practitioner documents information about patient care, the procedure and the final outcome.

Rationale

Clear and precise documentation is necessary for continuity of care, accuracy of care and quality assurance.

General Criteria

The practitioner:

1. Documents diagnostic, treatment and patient data in the appropriate record. Documentation must be timely, accurate, concise and complete.
2. Documents any exceptions from the established criteria or procedures.
3. Records diagnostic or treatment data.

Specific Criteria

The practitioner:

1. Documents in conjunction with cardiovascular team.

Quality Performance Standards

Standard One - Assessment

The practitioner collects pertinent information regarding equipment, procedures and the work environment.

Rationale

The planning and provision of safe and effective medical services relies on the collection of pertinent information about equipment, procedures and the work environment.

General Criteria

The practitioner:

1. Ensures that services are performed in a safe environment in accordance with established guidelines.
2. Ensures that equipment maintenance and operation comply with established guidelines.
3. Assesses equipment to determine acceptable performance based on established guidelines.
4. Ensures that protocol and procedure manuals include recommended criteria and are reviewed and revised on a regular basis.

Specific Criteria

The practitioner:

1. Provides, maintains and documents radiation safety equipment such as lead aprons, thyroid shields, etc.
2. Maintains documentation of properly calibrated imaging equipment and uses the equipment in accordance with established guidelines.
3. Maintains documentation of required preventive maintenance on imaging equipment.
4. Performs quality control on all equipment used for patient care in accordance with established guidelines.
5. Reviews and revises procedure manuals on a regular basis.

Standard Two - Analysis/Determination

The practitioner analyzes information collected during the assessment phase and determines whether changes need to be made to equipment, procedures or the work environment.

Rationale

Determination of acceptable performance is necessary for the provision of safe and effective services.

General Criteria

The practitioner:

1. Assesses whether services, procedures and environment meet or exceed established guidelines. If not, the practitioner must develop an action plan.
2. Evaluates equipment to determine if it meets or exceeds established standards. If not, the practitioner must develop an action plan.

3. Analyzes information collected during the assessment phase to determine whether optimal services are being provided. If not, the practitioner must develop an action plan.

Specific Criteria

The practitioner:

1. Maintains a quality assurance/improvement program to ensure optimal services are being provided to the patient.
2. Monitors unexpected outcomes to determine if a specific pattern exists.
3. Assesses and maintains the integrity of medical supplies such as a lot/expiration, sterility, etc.
4. Maintains appropriate documentation for tracking implantable devices.
5. Assesses quality assurance outcomes and adheres to institutional standards in accordance with recognized accrediting and regulatory bodies.

Standard Three - Education

The practitioner informs the patient, public and other health care providers about procedures, equipment and facilities.

Rationale

Open communication promotes safe practices.

General Criteria

The practitioner:

1. Elicits confidence and cooperation from the patient, the public and other health care providers by providing timely communication and effective instruction.
2. Presents explanations and instructions at the learner's level of understanding and learning style.

Specific Criteria

The practitioner:

1. Instructs the patient, the patient's family or significant others about pre-, peri- and postprocedural expectations.
2. Provides information to supporting health care providers about pre-, peri- and postprocedural expectations.
3. Provides information for public awareness of diagnostic and therapeutic vascular and nonvascular procedures.
4. Instructs patient, significant others and health care providers about radiation protection standards.

Standard Four – Performance

The practitioner performs quality assurance activities or acquires information on equipment and materials.

Rationale

Quality assurance activities provide valid and reliable information regarding the performance of materials and equipment.

General Criteria

The practitioner:

1. Performs quality assurance activities based on established protocols.
2. Provides evidence of ongoing quality assurance activities.

Specific Criteria

The practitioner:

1. Maintains controlled access to restricted area during radiation exposure to ensure the safety of patients, visitors and hospital personnel.
2. Applies principles of radiation safety and protection at all times, following ALARA guidelines to minimize radiation exposure to patient and staff.
3. Properly calibrates and maintains imaging systems and radiation safety equipment in accordance with department protocol.
4. Secures a safe and sterile environment for patients and staff.
5. Monitors image production to determine technical acceptability.
6. Reviews and revises procedure manuals on a regular basis.
7. Checks and maintains ancillary equipment and supplies in accordance with department protocol.
8. Participates in case review to ensure optimal services are provided.
9. Participates in in-service education regarding equipment, supplies and procedures.

Standard Five – Evaluation

The practitioner evaluates quality assurance results and establishes an appropriate action plan.

Rationale

Materials, equipment and procedure safety depend on ongoing quality assurance activities that evaluate performance based on established guidelines.

General Criteria

The practitioner:

1. Compares quality assurance results to established acceptable values.
2. Verifies quality assurance testing conditions and results.
3. Formulates an action plan following verification of testing.

Specific Criteria

The practitioner:

1. Evaluates documentation of quality assurance testing and reports findings to the appropriate personnel.

Standard Six – Implementation

The practitioner implements the quality assurance action plan.

Rationale

Implementation of a quality assurance action plan is imperative for quality diagnostic and therapeutic procedures and patient care.

General Criteria

The practitioner:

1. Obtains assistance from appropriate personnel to implement the quality assurance action plan.
2. Implements the quality assurance action plan.

Specific Criteria

The practitioner:

1. Ensures that an equipment preventive maintenance program is followed according to guidelines.
2. Performs repeat quality testing.
3. Participates in all aspects of quality assurance and implements activities to correct any quality assurance issues.

Standard Seven – Outcomes Measurement

The practitioner assesses the outcome of the quality assurance action plan in accordance with established guidelines.

Rationale

Outcome assessment is an integral part of the ongoing quality assurance plan to enhance diagnostic and therapeutic services.

General Criteria

The practitioner:

1. Reviews the implementation process for accuracy and validity.
2. Determines whether the performance of equipment and materials is safe for practice based on outcome assessment.
3. Develops and implements a modified action plan when testing results are not in compliance with guidelines.

Specific Criteria

None added.

Standard Eight – Documentation

The practitioner documents quality assurance activities and results.

Rationale

Documentation provides evidence of quality assurance activities designed to enhance the safety of patients, the public and health care providers during diagnostic and therapeutic services.

General Criteria

The practitioner:

1. Maintains documentation of quality assurance activities, procedures and results in accordance with established guidelines.

2. Provides timely, concise, accurate and complete documentation.
3. Provides documentation that includes current protocol, policy and procedures.

Specific Criteria

None added.

Professional Performance Standards

Standard One – Quality

The practitioner strives to provide optimal care to all patients.

Rationale

All patients expect and deserve optimal care during diagnosis and treatment.

General Criteria

The practitioner:

1. Works with others to elevate the quality of care.
2. Participates in quality assurance programs.
3. Adheres to the accepted standards, policies and procedures adopted by the profession and regulated by law.
4. Provides the best possible diagnostic study or therapeutic treatment for each patient by applying professional judgment and discretion.
5. Anticipates and responds to the needs of the patient.

Specific Criteria

None added.

Standard Two – Self-Assessment

The practitioner evaluates personal performance, knowledge and skills.

Rationale

Self-assessment is an important tool in professional growth and development.

General Criteria

The practitioner:

1. Monitors personal work ethics, behaviors and attitudes.
2. Monitors and evaluates orientation guidelines and recommends improvements or changes as needed.
3. Evaluates performance and recognizes opportunities for improvement.
4. Recognizes his or her strengths and uses them to benefit patients, coworkers and the profession.
5. Performs procedures only after receiving appropriate education and training.
6. Recognizes and takes advantage of opportunities for educational growth and improvement in technical and problem-solving skills.
7. Actively participates in professional societies and organizations.

Specific Criteria

None added.

Standard Three – Education

The practitioner acquires and maintains current knowledge in clinical practice.

Rationale

Advancements in medical science require enhancement of knowledge and skills through education.

General Criteria

The practitioner:

1. Maintains appropriate credentials and certification related to clinical practice.
2. Demonstrates completion of the appropriate education related to clinical practice.
3. Participates in educational activities to enhance knowledge, skills and performance.
4. Shares knowledge and expertise with others.

Specific Criteria

The practitioner:

1. Demonstrates competency in the function and operation of the following: imaging equipment, power injector, support equipment (i.e., processors, endoscopy, ultrasound, etc.) and information systems (hospital and radiology).
2. Demonstrates competency and comprehensive knowledge of diagnostic and interventional supplies including: needles, catheters, guidewires, balloons, filters, thrombotic devices, embolization materials.
3. Demonstrates competency and working knowledge of pre-, peri- and postprocedure care.
4. Demonstrates competency and working knowledge of the environment of care and infection control per institutional policies.
5. Demonstrates understanding and knowledge of the following: hemodynamic monitoring, medications, adverse reactions, emergency care, etc.

Standard Four – Collaboration and Collegiality

The practitioner promotes a positive, collaborative practice atmosphere with other members of the health care team.

Rationale

To provide quality patient care, all members of the health care team must communicate effectively and work together efficiently.

General Criteria

The practitioner:

1. Shares knowledge and expertise with colleagues, peers, students and all members of the health care team.
2. Develops collaborative partnerships with other health care providers in the interest of diagnostic and therapeutic quality and cost effectiveness.

Specific Criteria

The practitioner:

1. Promotes and participates in education of the following to include but not limited to: procedural requirements, equipment, radiation safety, catheter care, etc., to other health care providers.
2. Promotes communication and cooperation with all health care providers.

Standard Five – Ethics

The practitioner adheres to the profession's accepted Code of Ethics.

Rationale

All decisions and actions made on behalf of the patient are based on a sound ethical foundation.

General Criteria

The practitioner:

1. Provides health care services with respect for the patient's dignity and age-specific needs.
2. Acts as a patient advocate to support patients' rights.
3. Takes responsibility for professional decisions.
4. Delivers patient care and service without bias based on personal attributes, nature of the disease, sex, race, creed, religion or socioeconomic status.
5. Respects the patient's right to privacy and confidentiality.
6. Adheres to the established practice standards of the profession.

Specific Criteria

The practitioner:

1. Adheres to institution and department mission and vision.

Standard Six – Exploration and Investigation

The practitioner participates in the acquisition, dissemination and advancement of the professional knowledge base.

Rationale

Scholarly activities such as research, scientific investigation, presentation and publication advance the profession and thereby improve the quality and efficiency of patient services.

General Criteria

The practitioner:

1. Reads and critically evaluates research in diagnostic and therapeutic services.
2. Investigates new, innovative methods and applies them in practice.
3. Shares information with colleagues through publication, presentation and collaboration.
4. Pursues lifelong learning.
5. Participates in data collection.

Specific Criteria

The practitioner:

1. Adheres to institutional research and investigational guidelines including: informed consent, patient rights, data collection and billing requirements.

Cardiovascular-Interventional Technology Glossary

ALARA guidelines – Acronym for a philosophy of the use of radiation based on doses that are “As Low As Reasonably Achievable” to obtain a desired diagnostic or therapeutic goal.

Angiography – Diagnostic or therapeutic radiography of the heart and blood vessels using a radiopaque contrast medium.

Artifact – False features in the image produced by patient instability or equipment deficiencies.

Arrhythmic – Irregularity or loss of rhythm, especially of the heart beat.

Assess – To determine the significance, importance or value.

Contraindicate – To make the indicated or expected treatment or drug inadvisable.

Document – Record keeping for continuity of care. Also assists a facility in determining the course of treatment if there is a claim of improper or negligent care.

Embolization – Therapeutic introduction of various substances into the circulation to occlude vessels either to arrest or prevent hemorrhaging or to devitalize a structure or organ by occluding its blood supply.

Ethical – Conforming to the standards of conduct of a given profession or group.

Hemodynamic monitoring – General term for determining the functional status of the cardiovascular system as it responds to acute stress such as a myocardial infarction.

Interdisciplinary – Denoting the overlapping interests of different fields of medicine and science.

Intervention – An action that produces an effect or that is intended to alter the course of pathologic process.

JCAHO – Joint Commission on the Accreditation of Healthcare Organizations.

NPO – *Non per os*, nothing by mouth.

Oximetry – The use of an oximeter to determine the oxygen saturation of blood.

Power injector – Electromechanical injector often is referred to as a flow-rate injector. The name refers to the injector’s ability to deliver a specific flow rate for a given time period.

Prognosis – Prediction of the course and end of a disease and the estimate of recovery.

Quality assurance – Activities and programs designed to achieve a desired degree or grade of care in a defined medical, nursing or health care setting or program.

Sterile environment – Condition of being aseptic or free of all living microorganisms and their spores.

Thrombus – A blood clot that obstructs a blood vessel or a cavity of the heart.

Thrombolytic – Pertinent to or causing the breakup of a thrombus.

Universal precautions – Guidelines designed to protect workers from occupational exposure to bloodborne pathogens mandated by the OSHA Bloodborne Pathogens Standard in 1991.

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