



# Cardiac Interventional Radiography

The purpose of examination requirement is to assess whether individuals have obtained the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required in cardiac interventional radiography for practice at entry level. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of cardiac interventional radiographers<sup>1</sup>. The *Task Inventory for Cardiac Interventional Radiography* may be found on the ARRT's website ([www.arrt.org](http://www.arrt.org)).

The *Examination Content Specifications for Cardiac Interventional Radiography* and attached content outline identify the knowledge areas underlying performance of the tasks on the *Task Inventory for Cardiac Interventional Radiography*. Every content category can be linked to one or more tasks on the task inventory.

The table below presents the major content categories covered on the examination. The number of test questions in each category are listed in bold and the number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

<b>Content Category</b>	<b>Number of Scored Questions<sup>2</sup></b>
<b>Patient Care</b>	<b>40</b>
<i>Patient Interactions and Management (40)</i>	
<b>Image Production</b>	<b>20</b>
<i>Image Acquisition and Equipment (20)</i>	
<b>Procedures</b>	<b>85</b>
<i>Diagnostic and Electrophysiology Procedures (35)</i>	
<i>Interventional Procedures (50)</i>	
<b>Total</b>	<b>145</b>

<sup>1</sup>. A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents and reviewers.

<sup>2</sup>. The exam includes an additional 40 unscored (pilot) questions.



## Patient Care

### 1. Patient Interactions and Management

- A. Patient Communication
  - 1. preprocedure
    - a. explanation of procedure
    - b. explanation of radiation risk
    - c. preprocedure time-out
  - 2. intraprocedure
  - 3. postprocedure care instructions (\*e.g., discharge instructions)
- B. Patient Assessment and Preparation
  - 1. patient history
    - a. clinical notes
      - 1. medications
      - 2. allergies
    - b. prior imaging
  - 2. interpersonal communication (e.g., patient care team, physician)
  - 3. scheduling and screening
    - a. sequencing of imaging
    - b. pre/post procedure (e.g., contrast administration, NPO status)
  - 4. patient education (e.g., preparation, diet, medications)
  - 5. consent
    - a. informed (e.g., written, verbal)
    - b. emergent (e.g., implied)
  - 6. patient positioning (e.g., Velcro® straps, padding, wedges, arm boards)
  - 7. access assessment
    - a. vascular patency (e.g., ultrasound, Allen test, Barbeau test)
    - b. peripheral pulses (e.g., palpation, Doppler)
    - c. anatomical location (e.g., femoral artery/vein, radial artery, jugular vein)
    - d. imaging (e.g., ultrasound, fluoroscopy)

- 8. lab values (normal and abnormal values)
  - a. chemistry
    - 1. glucose
    - 2. blood urea nitrogen (BUN)
    - 3. creatinine
    - 4. electrolytes
    - 5. cardiac enzymes (e.g., troponin)
  - b. hematology
    - 1. hematocrit
    - 2. hemoglobin
    - 3. platelet count
    - 4. white blood count (WBC)
  - c. coagulation
    - 1. prothrombin time (PT)
    - 2. partial thromboplastin time (PTT)
    - 3. international normalized ratio (INR)
    - 4. activated clotting time (ACT)
  - d. arterial blood gas
    - 1. pH
    - 2. PaCO<sub>2</sub>
    - 3. HCO<sub>2</sub>

- C. Patient Monitoring
  - 1. physiologic monitoring
    - a. temperature
    - b. ECG
    - c. respiration
    - d. noninvasive blood pressure
    - e. intravascular pressure
    - f. pulse oximetry
    - g. capnography
    - h. level of consciousness (LOC)
  - 2. monitor and maintain medical equipment
    - a. oxygen delivery systems
    - b. chest tubes
    - c. indwelling catheters
    - d. drainage bags
    - e. IVs
    - f. suction

\* The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)



## Patient Care (continued)

3. documentation
  - a. radiographic exposure factors
  - b. contrast administration parameters
  - c. fluoroscopy time
  - d. cumulative dose or air kerma (e.g., mGy)
  - e. dose area product (DAP) (e.g., mGy-cm<sup>2</sup>)
  - f. physiologic monitoring
  - g. medications
  - h. complications
  - i. implantable devices
- D. Contrast Administration
  1. types and properties of contrast agents
    - a. nonionic low osmolar
    - b. nonionic iso-osmolar
    - c. CO<sub>2</sub>
  2. indications and contraindications
- E. Medications
  1. types
    - a. anticoagulants
    - b. thrombolytics
    - c. vasoactives (e.g., constrictors, dilators)
    - d. emergency medications
    - e. other (e.g., analgesics, antiemetics, antihypertensives, antiarrhythmics, antiplatelets, moderate sedation medications)
  2. indications and contraindications
  3. safety and complications
  4. preparation
  5. reactions
- F. Asepsis and Sterile Technique
  1. disinfection and cleaning
    - a. medical asepsis
    - b. sterile technique
      1. patient preparation
      2. procedural tray (e.g., sterile supplies)
      3. maintenance of sterile fields
      4. scrubbing
- G. Handling and Disposal of Hazardous Materials
  1. biohazardous (e.g., sharps, blood)
  2. tissue samples
  3. chemotherapeutic agents
  4. radioactive material
- H. Emergency Care
  1. contrast reactions and complications
    - a. allergy type
      1. mild
      2. moderate
      3. severe
    - b. adverse
      1. nephrotoxicity
      2. physiological responses (e.g., airway, hemodynamic, CNS)
    - c. treatment and medications
      1. types (e.g., steroids, antihistamines)
      2. indications and contraindications
  2. symptoms and treatment of the following medical emergencies
    - a. cerebral vascular accident (CVA)/ transient ischemic attack (TIA)
    - b. embolism
      1. air
      2. thrombotic
    - c. thrombosis
    - d. respiratory arrest
    - e. myocardial infarction
    - f. congestive heart failure
    - g. cardiac arrhythmias
    - h. vasovagal response
    - i. anaphylaxis
    - j. hypotensive/hypertensive episodes
    - k. shock (e.g., cardiogenic, hypovolemic, septic)
      - l. cardiac tamponade
    - m. dissection/perforation
    - n. access site management
    - o. bleeding (e.g., hemothorax, hematoma)
    - p. pneumothorax
    - q. flash pulmonary edema



## Image Production

### 1. Image Acquisition and Equipment

#### A. Data Acquisition and Processing

1. fluoroscopy
  - a. high/low dose rate
  - b. pulse rate
2. digital acquisition
  - a. exposure technique
  - b. frame rate
3. roadmapping
  - a. digital subtraction
  - b. field of view  
(e.g., magnification, collimation)
  - c. compensating filters  
(e.g., wedge, soft)
  - d. 3D imaging
4. projections/positions
5. post processing  
(e.g., reconstruction)
6. archiving/PACS

#### B. Automatic Pressure Injectors

1. parts
2. function and safety
3. operation
4. cleaning

#### C. Procedural Imaging Equipment\*\*

1. ultrasound unit
2. intravascular ultrasound (IVUS)
3. optical coherence tomography (OCT)
4. intracardiac echocardiography (ICE)

#### D. Radiation Protection

1. patients
  - a. collimation (e.g., shutters, virtual collimation)
  - b. magnification
  - c. frame rates
  - d. geometry (e.g., SID, OID, tube angle)
  - e. pulsed or continuous
  - f. last image hold
  - g. dose rate
2. personnel (ALARA)
  - a. shielding
  - b. monitoring devices
  - c. occupational exposure reports
  - d. promote radiation awareness
3. quality control
  - a. aprons
  - b. role of dose calibration

\*\*The cardiac interventional radiographer is expected to have the basic knowledge of this equipment and its operation.



## Procedures

### 1. Diagnostic and

#### Electrophysiology Procedures

##### A. Cardiac Diagnostic Procedures

1. right and left heart hemodynamics
2. angiography
  - a. coronary
  - b. bypass graft
  - c. pulmonary
  - d. aortography
  - e. ventriculography
3. intracardiac echocardiography (ICE)
4. flow reserve (e.g., FFR, IFR, RFR)
5. intravascular imaging (e.g., OCT, IVUS)
6. biopsy

##### B. Peripheral Angiography

1. femoral
2. carotid
3. renal
4. great vessel
5. radial
6. brachial
7. jugular
8. axillary
9. internal mammary

##### C. Hemodynamic Calculations

1. stroke volume measurement
2. valve area (e.g., Gorlin, Hakki)
3. shunt detection and calculation
4. cardiac output calculation and measurement
  - a. Fick
  - b. thermodilution
  - c. angiographic
5. flow reserve (e.g., FFR, IFR, RFR)

### FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

1. Anatomy and Pathophysiology
2. Indications for Procedure
3. Contraindications for Procedure
4. Image Analysis and Utilization
5. Access Methods
6. Ultrasound Guidance
7. Equipment and Devices Used
  - A. Types (e.g., sheaths, catheters, guidewires, needles, manifold/pressure transducers)
  - B. Indications for Use
  - C. Preparation, Set Up, and Operation
8. Complications
  - A. Recognition
  - B. Treatment
9. Closure Devices, Puncture Site Pressure, and Dressing (e.g., manual, external, permanent, nonpermanent, surgical glue)
10. Interventional Suite and Hybrid OR

(Procedures continue on the following page.)



## Procedures (continued)

- D. Electrophysiology
  - 1. arrhythmia detection
  - 2. arrhythmia ablation
    - a. atrial fibrillation
    - b. atrial flutter
    - c. ventricular tachycardia
  - 3. cardioversion
  - 4. implants
    - a. pacemaker
      - 1. permanent insertion
      - 2. temporary
      - 3. leadless
    - b. internal cardiac defibrillator (ICD) insertion
    - c. biventricular pacemaker
    - d. lead extraction

## FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

1. Anatomy and Pathophysiology
2. Indications for Procedure
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4. Image Analysis and Utilization
5. Access Methods
6. Ultrasound Guidance
7. Equipment and Devices Used
  - A. Types (e.g., sheaths, catheters, guidewires, needles, manifold/pressure transducers)
  - B. Indications for Use
  - C. Preparation, Set Up, and Operation
8. Complications
  - A. Recognition
  - B. Treatment
9. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, nonpermanent, surgical glue)
10. Interventional Suite and Hybrid OR

(Procedures continue on the following page.)



## Procedures (continued)

### 2. Interventional Procedures

- A. Percutaneous Intervention
  - 1. angioplasty
    - a. coronary
    - b. peripheral
  - 2. coronary atherectomy
    - a. directional
    - b. rotational
    - c. laser
    - d. orbital
  - 3. peripheral atherectomy
    - a. directional
    - b. rotational
    - c. laser
    - d. orbital
  - 4. stent placement
    - a. coronary
    - b. peripheral
  - 5. thrombectomy
    - a. mechanical
    - b. pharmacological
    - c. aspiration
  - 6. inferior vena cava (IVC) filter placement/retrieval
  - 7. pericardiocentesis
  - 8. intra-aortic balloon pump (IABP)
  - 9. foreign body removal/retrieval
  - 10. catheter-based ventricular assist device
    - a. left ventricle
    - b. right ventricle
  - 11. intravascular lithotripsy
  - 12. extracorporeal membrane oxygenation system placement (ECMO)
  - 13. distal embolic protection device placement/retrieval

### FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

- 1. Anatomy and Pathophysiology
- 2. Indications for Procedure
- 3. Contraindications for Procedure
- 4. Image Analysis and Utilization
- 5. Access Methods
- 6. Ultrasound Guidance
- 7. Equipment and Devices Used
  - A. Types (e.g., sheaths, catheters, guidewires, needles, manifold/pressure transducers)
  - B. Indications for Use
  - C. Preparation, Set Up, and Operation
- 8. Complications
  - A. Recognition
  - B. Treatment
- 9. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, nonpermanent, surgical glue)
- 10. Interventional Suite and Hybrid OR

(Procedures continue on the following page.)



## Procedures (continued)

- B. Structural Heart Procedures
1. patent foramen ovale/  
atrial septal defect closure
  2. ventricular septal defect closure
  3. transcatheter aortic valve  
implantation/replacement  
(TAVI/TAVR)
  4. valvuloplasty
  5. transcatheter mitral valve repair
  6. atrial appendage closure device  
implantation

## FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

1. Anatomy and Pathophysiology
2. Indications for Procedure
3. Contraindications for Procedure
4. Image Analysis and Utilization
5. Access Methods
6. Ultrasound Guidance
7. Equipment and Devices Used
  - A. Types (e.g., sheaths, catheters, guidewires, needles, manifold/pressure transducers)
  - B. Indications for Use
  - C. Preparation, Set Up, and Operation
8. Complications
  - A. Recognition
  - B. Treatment
9. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, nonpermanent, surgical glue)
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