Vascular Interventional Radiography

The purpose of the examination requirement is to assess whether individuals have obtained the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required in vascular interventional radiography for practice at entry level.

ARRT determined the tasks that entry-level vascular interventional radiographers typically perform by administering a comprehensive practice analysis survey to a nationwide sample of vascular interventional radiographers.[1] The *Task Inventory for Vascular Interventional Radiography* is on ARRT's website (www.arrt.org).

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

This document is not intended to serve as a curriculum guide. Although ARRT programs for certification and registration and educational programs may have related purposes, their functions are clearly different. Educational programs are generally broader in scope and address the subject matter that is included in the content outline, but do not limit themselves to only this content. ARRT administers this examination on a computer at a standardized testing center.

The table below presents the major content categories and subcategories that the examination covers. The table lists the number of test questions in each category in bold and the number of test questions in each subcategory in parentheses. The content outline, which makes up the remaining pages of this document, addresses specific topics within each category.

Content Category	Number of Scored Questions[2]
Patient Care	**22**
~~Patient~~ Interactions and Management (22)	
Image Production	**26**
~~Image~~ Acquisition and Equipment (26)	
Procedures	**112**
Vascular Diagnostic ~~Procedures~~ (39~~41~~)	
Vascular Interventional ~~Procedures~~ (39~~41~~)	
Nonvascular ~~Procedures~~ (3~~40~~)	
Total	**160**

1. A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.
2. The exam includes an additional 50 unscored (pilot) questions.

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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~~ medical history
   a. clinical notes
      1. medications
      2. allergies
   b. prior imaging
   c. procedure request or orders
2. interpersonal communication (e.g., patient care team, ~~physician~~provider)
3. scheduling and screening
   a. sequence~~ing~~ of imaging
   b. pre~~procedure~~/ and postprocedure (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. ergonomics, safe patient transfer techniques and devices
7. patient positioning (e.g., Velcro® straps, padding, wedges, arm boards, pannus retention, halo)
8. access assessment
   a. vascular patency (e.g., ultrasound, Allen test, Barbeau test)
   b. ~~peripheral~~ distal pulses (e.g., palpation, Doppler)
   c. anatomical location (e.g., femoral artery and ~~/~~vein, radial artery, jugular vein)
9. lab values (normal and abnormal ~~values~~)
   a. chemistry (e.g., glucose, sodium, potassium, BUN, creatinine, eGFR, liver function tests [LFT], ~~potassium~~)
   b. ~~blood~~ coagulation
      1. prothrombin time (PT)
      2. partial thromboplastin time (PTT)
      3. international normalized ratio (INR)
      4. activated clotting time (ACT)
   c. hematology (e.g., Hgb, WBC, platelet)

C. Patient Monitoring
1. physiologic monitoring and vital signs
   a. temperature
   b. ECG
      1. equipment and patient preparation
      2. interpretation (e.g., sinus rhythm, common arrhythmias)
   c. respiration
   d. noninvasive blood pressure
   e. intravascular pressure
   f. pulse oximetry
   g. capnography
   h. level of consciousness (LOC)
2. monitor and maintain accessory 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 ossibilities~~ *"e.g." indicates examples of the topics covered~~,~~ but is not a complete list.

~~(Patient Care continues on the following page.)~~

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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^2)
   f. physiologic monitoring and vital signs
   g. medications
   h. complications
   i. implantable devices

D. Contrast Administration
1. types and properties of contrast ~~agents~~media
   a. ionic
   b. nonionic low osmolar
   c. nonionic iso-osmolar
   d. CO_2
   e. gadolinium
2. indications and contraindications

E. Medications
1. types
   a. anticoagulants
   b. thrombolytics (e.g., tPA)
   c. vasoactives (e.g., constrictors, dilators)
   d. analgesics~~/~~ and anxiolytics including reversal agents (e.g., fentanyl, ~~versed~~midazolam, naloxone, flumazenil)
   e. anesthetics (e.g., lidocaine)
2. indications and contraindications
3. preparation (e.g., concentration, expiration date)
4. complications and reactions
5. administration routes
6. controlled substance wasting

F. ~~Asepsis and Sterile Technique~~Infection Control
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
   2. equipment cleaning and preparation for resterilization

G. Handling and Disposal of Hazardous Materials
1. biohazardous (e.g., sharps, blood)
2. tissue samples
3. chemotherapeutic agents
4. radioactive material (e.g., Y-90)

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, epinephrine)
      2. indications and contraindications
2. symptoms and treatment ~~of the following medical emergencies~~
   a. cerebral vascular accident (CVA) or~~/~~ transient ischemic attack (TIA)
   b. embolism
      1. air
      2. thrombotic
   c. thrombosis
   d. respiratory arrest
   e. cardiac events (e.g., arrhythmias, congestive heart failure, hypotensive or ~~/~~hypertensive episodes, myocardial infarction)
   f. vasovagal response
   g. anaphylaxis
   h. shock
   i. sepsis
   j. dissection or ~~/~~perforation
   k. bleeding (e.g., hemothorax, hematoma)
   l. pneumothorax

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Image Production

1. ~~Image~~ Acquisition and Equipment

A. Data Acquisition and Processing
1. fluoroscopy
   a. high and ~~/~~low dose rate
   b. pulse rate
   c. roadmapping
   d. field of view
      (e.g., magnification, collimation)
   e. compensating filters
      (e.g., wedge, soft)
2. digital acquisition
   a. exposure technique
   b. frame rate
   c. digital subtraction angiography (DSA)
   d. field of view
      (e.g., magnification, collimation)
   e. compensating filters
      (e.g., wedge, soft)
   f. 3D imaging
3. projections or ~~/~~positions
4. post-processing
   (e.g., reconstruction, pixel shifting, annotations)

~~5. PACS~~

B. ~~Automatic Pressure~~ Contrast ~~Injectors~~ Media Delivery Systems (e.g., iodinated, CO_2)
1. parts
2. function and safety
3. operation
4. cleaning

C. Procedural Equipment**
1. ultrasound machine~~unit~~**
~~2. intravascular ultrasound (IVUS)~~
2. CT (cone-beam CT [CBCT])**
~~3. ablation (e.g., cryo, microwave)~~
~~4. thrombectomy~~
~~5. thrombolysis~~
~~6. atherectomy~~
~~7~~. ~~laser~~
~~8~~. ~~lithotripsy (balloon or catheter)~~
3~~9~~.intravascular pressure transducers**
4. needles
5. sheathes
6. wires
7. catheters
8. balloons

D. Radiation Safety and Protection
1. patients
   a. collimation (e.g., shutters, virtual collimation)
   b. magnification and digital 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 (disposable and nondisposable)
   b. monitoring devices
   c. occupational exposure reports
   d. promotion~~e~~ of radiation awareness
   e. controlled access to restricted areas
   f. geometry
      (e.g., SID, OID, tube angle)
3. quality control (QC)
   a. aprons and shields
   b. imaging equipment
   c. role of dose calibration
4. mandatory radiation reporting
   a. Substantial Radiation Dose Level (e.g., National Council on Radiation Protection and Measurements [NCRP 168])
   b. cumulative air kerma
      (e.g., 5 Gy)

E. Informatics
1. information systems
   (e.g., HIS, RIS, EMR, EHR)
2. networking
   a. PACS or MIMPS
   b. DICOM
   c. security and confidentiality
3. billing (e.g., verify procedure ordered versus performed, ICD codes, supplies used)

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

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Procedures

1. Vascular Diagnostic ~~Procedures~~

A. Neurologic Angiogram~~phy~~
1. intracranial ~~arteriography~~
2. carotid and ~~/~~vertebral ~~arteriography~~
3. spinal ~~arteriography~~

B. Thoracic Angiogram~~phy~~
1. ~~thoracic aortography~~
2. pulmonary ~~arteriography~~
3. bronchial ~~arteriography~~

C. Abdominal Angiogram~~phy~~
1. ~~abdominal aortography~~
2. pelvic ~~arteriography~~
3. renal ~~arteriography~~
4. adrenal ~~arteriography~~
5. celiac ~~arteriography~~
6. hepatic
7. splenic
8. superior mesenteric artery (SMA) ~~arteriography~~
9. inferior mesenteric artery (IMA) ~~arteriography~~

D. Peripheral Angiogram~~phy~~
1. upper extremity ~~arteriography~~
2. lower extremity ~~arteriography~~

E. Venogram~~phy~~
1. pelvic ~~venography~~
2. superior vena cava~~gram~~ (SVC)
3. inferior vena cava~~gram~~ (IVC)
4. renal ~~venography~~
5. adrenal ~~venography~~
6. celiac
7. hepatic ~~venography~~
8. portal ~~venography~~
9. splenic
10. gonadal ~~venography~~
~~11. upper extremity venography~~
~~12. lower extremity venography~~

F. Peripheral Venogram
1. upper extremity
2. lower extremity

~~F~~G. Miscellaneous Studies
1. hemodialysis graftogram or ~~/~~arteriovenous fistulagram ~~study~~
2. central venous device check (e.g., port, PICC, hemodialysis catheter)
3. physiologic pressure measurement
4~~2~~. pelvic lymphangiogram~~phy~~ ~~(general mapping)~~
5. venous sampling

FOCUS OF QUESTIONS

Questions about procedures listed on the left ~~for each section of the exam~~ may ~~address~~ focus on any of the following ~~factors, as appropriate~~:

- ~~1.~~ **Anatomy and Pathophysiology**
- ~~2.~~ **Indications** ~~for Procedure~~
- ~~3.~~ **Contraindications** ~~for Procedure~~
- ~~4.~~ **Image Analysis and** ~~Utilization~~**Use**
- ~~5.~~ **Access Methods**
  - ~~A.~~ ~~A~~arterial
  - ~~B.~~ ~~V~~venous

~~6. Ultrasound Guidance~~

- ~~7.~~ **Equipment and Devices Used**
  - ~~A.~~ ~~Types~~ Function (e.g., sheaths, catheters, guidewires, needles, IVUS catheter, ICE catheter)
  - ~~B.~~ ~~i~~Indications for Use
  - preparation, setup, and operation
- ~~8.~~ **Complications**
  - ~~A.~~ ~~R~~recognition
  - ~~B.~~ ~~T~~treatment
- ~~9.~~ **Postprocedure Care**
  - suture
  - c~~C~~losure d~~D~~evices
  - ~~, P~~puncture s~~S~~ite p~~P~~ressure~~, and D~~dressing (e.g., manual, external, ~~permanent~~, ~~nonpermanent~~, surgical glue)

~~(Procedures continues on the following page.)~~

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Procedures (continued)

2. Vascular Interventional ~~Procedures~~

A. Neurologic
1. Angioplasty
2. Endovascular Stent Placement
3. Embolization
4. Thrombolysis
5. Thrombectomy
6. Atherectomy

B. Body
1. Angioplasty
2. Endovascular Stent Placement
3. Embolization
4. Thrombolysis
5. Thrombectomy
6. Atherectomy

~~A. Angioplasty~~
~~1. neurologic~~
~~2. body~~
~~B. Stent Placement~~
~~1. neurologic~~
~~2. body~~
~~C. Embolization~~
~~1. neurologic~~
~~2. body~~
~~D. Thrombolysis~~
~~1. neurologic~~
~~2. body~~
~~E. Thrombectomy~~
~~1. neurologic~~
~~2. body~~
~~F.Atherectomy~~

C~~G~~. Percutaneous Thrombin Injection
D~~H~~. Distal Protection Device Placement
E~~I~~. Foreign Body Retrieval (e.g., broken catheter, bullet, guidewire, filter piece)
F~~J~~. Endograft Placement
G~~K~~. ~~Caval~~ IVC or SVC Filter Placement and ~~/~~Removal
H~~L~~. Transjugular Intrahepatic Portosystemic Shunt (TIPS) Placement or Revision
I~~N~~. Chemoembolization
J. Transvenous Biopsy
K~~O~~. Radioembolization
L~~P~~. Venous Access
1. peripheral IV
2. PICC line placement
3. central venous catheter (CVC) and PICC exchange
4. tunneled CVC ~~catheter~~ placement or removal
5. nontunneled CVC ~~catheter~~ placement or removal
6. port placement or removal
~~4. port removal~~

FOCUS OF QUESTIONS

Questions about procedures listed on the left ~~for each section of the exam~~ may ~~address~~ focus on any of the following ~~factors, as appropriate~~:

- ~~1.~~ **Anatomy and Pathophysiology**
- ~~2.~~ **Indications ~~for Procedure~~**
- ~~3.~~ **Contraindications ~~for Procedure~~**
-
- ~~4.~~ **Image Analysis and ~~Utilization~~Use**
- ~~5.~~ **Access Methods**
  - ~~A.~~ ~~A~~arterial
  - ~~B.~~ ~~V~~venous

~~6. Ultrasound Guidance~~

- ~~7.~~ **Equipment and Devices Used**
  - ~~A.~~ Function~~Types~~ (e.g., ~~catheters, balloons,~~ stents, snares, embolics, filters, IVUS catheter, ICE catheter, laser)
  - ~~B.~~ ~~I~~indications for ~~U~~use
  - preparation, setup, and operation
- ~~8.~~ **Complications**
  - ~~A.~~ ~~R~~recognition
  - ~~B.~~ ~~T~~treatment
- ~~9.~~ **Postprocedure Care**
  - suture
  - ~~C~~closure ~~D~~devices~~,~~
  - ~~P~~puncture ~~S~~site ~~P~~pressure and ~~D~~dressing (e.g., manual, external, ~~permanent, nonpermanent,~~ surgical glue)

- ~~10.~~ **Interventional Suite versus Hybrid OR**

~~(Procedures continues on the following page.)~~

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Procedures (continued)

3. Nonvascular ~~Procedures~~

A. Nephrostomy
B. Ureteral Dilatation or ~~/~~Stent~~s~~Placement
C. Antegrade Urography Through an Existing Catheter
D. Suprapubic Catheter Placement
E. Percutaneous Ablation (~~e.g.,~~ cryo, radiofrequency [RFA], microwave~~,~~, ~~cryo~~)
F. Percutaneous Transhepatic Cholangiogram (PTC)
G. Biliary Internal or ~~/~~External Drainage
H. Cholecystostomy
I. Gastrostomy or ~~/~~Gastrojejunostomy ~~Placement~~
J. Percutaneous Enteric Tube Evaluation (verified~~cation~~ with contrast)
K. Vertebroplasty or ~~/~~Kyphoplasty
L. Epidural Steroid Injection
M. Lumbar Puncture
N. Myelogram
O. Chest Tube or ~~/~~Drain Placement
P. Thoracentesis
Q. Percutaneous Biopsy
R. Paracentesis
S. Abscess, Fistula, or Sinus Tract Study
T. Tunneled Drainage Catheter Placement (~~1.~~ thoracic, ~~2.~~ abdominal)
U. Percutaneous Drainage With or Without Placement of Catheter (excluding thoracentesis or paracentesis)
V. ~~Removal of~~ Percutaneous Drainage Catheter Removal (~~e.g.,~~ tunneled, nontunneled)
W. ~~Change of~~ Percutaneous Tube or Drainage Catheter Exchange (tunneled, nontunneled)
X. Nerve Block (e.g., trigeminal, celiac plexus, hypogastric, intercostal, genicular)

FOCUS OF QUESTIONS

Questions about procedures listed on the left ~~for each section of the exam~~ may ~~address~~ focus on any of the following ~~factors, as appropriate~~:

- ~~1.~~ **Anatomy and Pathophysiology**
- ~~2.~~ **Indications** ~~for Procedure~~
- ~~3.~~ **Contraindications** ~~for Procedure~~
- ~~4.~~ **Image Analysis and ~~Utilization~~Use**

~~5. Ultrasound Guidance~~

- ~~6.~~ **Equipment and Devices Used**
  - ~~A.~~ Function~~Types~~ (e.g., sheaths, drainage catheters, guidewires, needles, lithotripsy)
  - ~~B.~~ Indications for ~~U~~use
  - preparation, setup, and operation
- ~~7.~~ **Complications**
  - ~~A.~~ ~~R~~recognition
  - ~~B.~~ ~~T~~treatment
- **Postprocedure Care**
  - suture
  - puncture site dressing (e.g., surgical glue)

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