



Registered Radiologist Assistant

The purpose of continuing qualifications requirements (CQR) is to assist registered technologists in documenting their continued qualifications in the disciplines of certification and registration held. To accomplish this purpose the continuing qualifications requirements are presented in three parts: the professional profile, the structured self assessment (SSA) and continuing education (CE).

The purpose of the CQR SSA is to assist registered technologists identify gaps in the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required for practice within the disciplines of certification and registration held and help direct their professional development efforts.

The *Structured Self Assessment Content Specifications for Registered Radiologist Assistant* is provided to assist registered radiologist assistants during their CQR compliance period. Its purpose is to prepare registered radiologist assistants for the SSA and to help education providers develop coursework for the registered radiologist assistants who need to address specified areas with targeted continuing education. Targeted CE is assigned only if a standard is not met in a category on the SSA.

The SSA is composed of sets of questions that are designed to evaluate an individual's knowledge in topics related to current practice. Participants are allowed a maximum of two hours and 15 minutes to complete the SSA for Registered Radiologist Assistant.

The table below presents the major categories and subcategories covered on the SSA. The number of questions in each category are listed in bold and number of questions in each subcategory in parentheses. The potential number of targeted CE credits that would be prescribed if the standard is not met, are across from each subcategory, with the maximum amount listed at the bottom. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	Number of Questions¹	Potential CE Credits
Patient Care	20	
<i>Patient Interactions and Management (10)</i>		9
<i>Pharmacology and Anesthetic Guidelines (10)</i>		7
Safety	10	
<i>Radiation Protection and Equipment Operation (10)</i>		5
Procedures	40	
<i>Abdominal Section (10)</i>		10
<i>Thoracic Section (10)</i>		7
<i>Musculoskeletal and Endocrine Sections (10)</i>		5
<i>Neurological, Vascular, and Lymphatic Sections (10)</i>		5
	Total 70	Maximum CE 48

¹ The SSA includes an additional 35 unscored (pilot) questions.



Patient Care

1. Patient Interactions and Management¹

A. Ethics

1. Patient's Bill of Rights
2. informed consent and patient education
 - a. patient competence
 1. cognitive impairment
 2. competence-assessment
 3. mental status
 4. medication
 - b. surrogate consent
 1. health care power of attorney
 2. family
 - c. informed consent components
 1. explanation of procedure
 2. risk versus benefit
 3. alternatives and options to current procedure
 4. refusal of procedure and implications
 5. radiation procedure exposure and cumulative dose education
 - d. pre- and post-procedure care instructions
3. definitions
 - a. morals
 - b. values
 - c. ethics
4. ASRT Practice Standards
5. ARRT Standards of Ethics

B. Medical Law

1. definitions
 - a. negligence and malpractice
 1. gross
 2. contributing
 - b. standards of care
 - c. assault and battery
 - d. false imprisonment
 - e. slander and libel
 - f. elements of tort
2. legal doctrines
 - a. respondeat superior
 - b. res ipsa loquitur
 - c. foreseeability
 - d. personal liability
 - e. good samaritan law

C. Patient Communication

1. psychosocial support
 - a. communication skills and issues
 - b. cultural awareness
 - c. social support structures
2. patient interview
 - a. verification
 1. patient identification and correct procedure
 2. patient preparation
 3. pregnancy status
 - b. medical history
 1. chief complaint
 2. present illness
 3. past history
 4. family history
 5. personal and social history
 6. review of systems
 - c. risk factors
 1. medications
 2. allergy history
 3. medical or psychological indicators
 4. alternative medicines

D. Medical Data Review

1. indications for procedure (ACR Appropriateness Criteria®)
2. contraindications for procedure
3. laboratory values
4. prior diagnostic studies
5. current medications
6. previous history (*e.g., vital signs, nurses/physicians notes)
7. assessment of vital signs, height, and weight

E. Psychological Status

1. cognitive abilities
2. emotional stability
3. speech and language skills
4. disorders that affect communication
 - a. dementia
 - b. cognitive impairment
 - c. drug and/or alcohol impairment

(Patient Care continues on the following page.)

¹ Includes adaptations for pediatric, geriatric, and special needs populations.

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



Patient Care (continued)

- F. Patient Monitoring and Assessment (pre-, during, and post-procedure)
 - 1. physical status
 - 2. emotional status
 - 3. cardiac monitoring
 - 4. medical emergencies
 - a. cardiac arrest
 - b. hypoglycemia
 - c. seizure
 - d. respiratory arrest
 - e. shock
 - 5. sterile technique
 - 6. standard precautions (mechanism of disease transmission)
 - 7. patients with disabilities
- G. Common Laboratory Tests, Analysis, and Significance
 - 1. complete blood count (CBC), RBC, WBC, hemoglobin, platelets
 - 2. electrolytes (sodium, potassium, bicarbonate, chloride)
 - 3. pancreatic and cardiac enzymes
 - 4. calcium
 - 5. albumin and total protein
 - 6. coagulation factors (e.g., prothrombin time (PT), partial thromboplastin time (PTT), International Normalized Ratio (INR), platelets)
 - 7. liver function
 - 8. renal function
 - 9. glucose
 - 10. culture and sensitivity
 - 11. cytology and histopathology
- H. Intravenous Therapy
 - 1. venipuncture
 - 2. flow rate monitoring
 - 3. complications
- I. Oxygen Therapy
 - 1. level (flow rate)
 - 2. indications and contraindications
- J. Urinary Catheterization
 - 1. technique
 - 2. complications
 - 3. contraindications
- K. Radiological Procedure Complications
 - 1. contrast related complications
 - a. nephrotoxicity
 - 1. contrast induced nephropathy
 - 2. NSF (nephrogenic systemic fibrosis)
 - b. neurotoxicity
 - c. extravasation
 - 2. infection
 - 3. hemorrhage
 - 4. pneumothorax
 - 5. perforation (GI or GU)
 - 6. respiratory distress
 - 7. aspiration
 - 8. vasovagal reaction
 - 9. pulmonary edema
 - 10. vascular injury or occlusion
 - 11. complications of catheterization
 - 12. seizures
 - 13. pain
 - 14. anaphylactoid shock
 - 15. neurologic deficit
 - 16. stroke
 - 17. cardiac arrest
 - 18. radiation injury
 - 19. physical injury
 - 20. death
- L. Medical Records
 - 1. components of documentation
 - a. types of documentation for patient chart
 - b. electronic and paper records
 - c. fluoroscopic and image documentation
 - 2. techniques and procedures for documentation
 - 3. document development and administration
 - a. examination findings
 - b. exceptions from established protocol or procedure
 - c. patient's questions and concerns
 - d. information regarding patient care, the procedure, and final outcome
 - e. diagnostic/therapeutic procedure and patient data
 - f. radiologists report to referring physician
 - g. direct communication with referring physician
 - h. discharge summary

(Patient Care continues on the following page.)



Patient Care (continued)

2. Pharmacology and Anesthetics Guidelines

A. Terminology

1. regulations
 - a. Food and Drug Administration (FDA)
 - b. Drug Enforcement Agency (DEA)
 - c. controlled substances
2. identifying names
 - a. generic
 - b. trade
 - c. United States Pharmacopoeia (USP)
3. drug characteristics
 - a. actions
 - b. synergisms
 - c. indications
 - d. contraindications
 - e. side effects
 - f. adverse actions
4. dosage
 - a. loading
 - b. maintenance
 - c. therapeutic dose
 - d. lethal dose
5. safe dosage calculation
 - a. ratio
 - b. proportion
 - c. pediatric
 - d. geriatric
6. administration
 - a. oral
 - b. rectal
 - c. sublingual
 - d. parenteral
 - e. intravenous
 - f. intramuscular
 - g. intrathecal
 - h. cutaneous
 - i. nasal

B. General Medications: classifications, indications, contraindications

1. anti-infective drugs
 - a. antibiotics
 - b. antiviral
 - c. antifungals

2. cardiac drugs
 - a. anti-hypertensive
 1. calcium channel blockers
 2. beta blockers
 3. ACE inhibitors
 - b. vasoconstrictors
 - c. vasodilators
 - d. anti-arrhythmics
3. gastrointestinal drugs
 - a. anti-reflux agents
 - b. hypomotility (glucagon)
 - c. cholecystokinetic (cholecystokinin)
 - d. antiemetics
4. vascular drugs
 - a. coagulation modifiers
 - b. tissue plasminogen activator (TPA)
5. anti-inflammatory drugs
 - a. analgesics (aspirin)
 - b. non-steroidal anti-inflammatory drugs (NSAIDs)
 - c. corticosteroids
6. endocrine drugs
 - a. diabetic medication
 - b. anti-hypoglycemic (glucagon)
 - c. insulin
 - d. thyroid medications
7. diuretics

(Patient Care continues on the following page.)



Patient Care (continued)

C. Anesthetics

1. local anesthetics
 - a. short acting
 - b. long acting
 - c. injectables
 - d. cutaneous
2. moderate/conscious sedation - American Society of Anesthesiologists (ASA) Guidelines
 - a. definitions
 - b. guidelines
 1. pre-procedure
 - a. history and physical
 - b. ASA guidelines
 2. intra-procedure
 3. post-procedure
 4. discharge scoring system
 - a. motor activity
 - b. respirations
 - c. standing blood pressure
 - d. consciousness
 - e. oxygen saturation
 - c. equipment
 - d. medications (indications, contraindications, dosing guidelines)
 1. fentanyl
 2. morphine
 3. meperidine
 4. diazepam
 5. midazolam
 6. lorazepam
 7. pentobarbital
 8. chloral hydrate
 9. naloxone
 10. flumazenil
 11. epinephrine
 12. atropine

D. Contrast Media

1. agents²
 - a. negative contrast agents
 - b. positive contrast agents
 - c. barium sulfate
 - d. iodinated contrast media
 1. osmolality (high versus low)
 2. molecular structure
 3. advantages
 - e. MRI agents
 - f. special considerations
 1. hydration status
 2. renal status (e.g., creatinine levels, GFR)
 3. diseases of concern (e.g., multiple myeloma, diabetes)
 4. incompatible medications (e.g., metformin/Glucophage)
2. allergies
 - a. allergy history
 - b. types of reactions (mild to severe)
 - c. premedications
 1. diphenhydramine
 2. corticosteroids
3. resuscitation
 - a. life support
 1. basic life support (BLS)
 2. advanced cardiac life support (ACLS)
 - b. basic drugs
 1. epinephrine
 2. atropine
 3. bronchodilator
 4. nitroglycerine
 5. lidocaine
 6. intravenous fluid

² Includes indications, contraindications, adverse reactions, dosage, routes of administration, and excretion process.



Safety

1. Radiation Protection and Equipment Operation

- A. Exposure and Dose
 - 1. exposure
 - 2. absorbed dose, equivalent dose, effective dose
 - 3. measurement and calculation of quantities (e.g., CTDI, DAP)
 - 4. high dose exams and modalities
- B. Radiation Safety Standards
 - 1. organizations and their roles
 - a. Nuclear Regulatory Commission (NRC)
 - b. Occupational Safety and Health Administration (OSHA)
 - c. Environmental Protection Agency (EPA)
 - d. Food and Drug Administration (FDA)
 - e. state health departments
 - 2. principles of dose limitation (time, distance, shielding, ALARA)
 - 3. monitoring and measuring devices
 - 4. effective dose limits
 - a. National Council on Radiation Protection and Measurement (NCRP)
 - 1. role
 - 2. reports
 - b. ACR Appropriateness Criteria®
 - 1. role
 - 2. reports
- C. Methods to Reduce Patient Exposure
 - 1. intermittent fluoroscopy
 - 2. limitation of field size
 - 3. exposure factors (x ray and CT)
 - 4. filtration of the x ray beam
 - 5. protective shielding
 - 6. immobilization
 - 7. grid selection
 - 8. limitation of fluoroscopic time
 - 9. proper fluoroscope use
 - 10. pediatric considerations
- D. Methods to Reduce Occupational Exposure
 - 1. location in radiation area
 - 2. shielding devices in x-ray rooms
 - 3. personal shielding devices
 - 4. proper fluoroscope use

- E. Radiation Biology
 - 1. cell growth and division
 - 2. radiosensitivity of cells
 - a. direct and indirect effects
 - b. linear energy transfer (LET)
 - c. relative biological effectiveness (RBE)
 - d. oxygen enhancement ratio (OER)
 - e. dose rate, fractionation, and protraction
 - 3. radiation effects
 - a. deterministic effects verses stochastic effects
 - b. background radiation
 - c. dose-response relationships
 - d. skin effects
 - e. acute radiation syndromes
 - f. local tissue damage
 - g. hematological effects
 - h. carcinogenesis
 - i. fetal effects
 - j. genetic effects
- F. Regulations
 - 1. quality assurance management
 - a. facility rules
 - b. The Joint Commission requirements
 - 2. credentialing
 - a. local or hospital requirements
 - b. state licensing/registration regulations
 - c. continuing education requirements
 - d. supervisory notification
 - e. professional standards
 - 3. government regulations
 - a. Medical Practice Act – supervisory requirements
 - b. Health Insurance Portability and Accountability Act (HIPAA)

(Safety continues on the following page.)



Safety (continued)

- G. Equipment Operation, Image Post-Processing, Quality Improvement, and Research
 - 1. equipment operation
 - a. fluoroscopy
 - 1. components
 - a. x-ray tube
 - b. image intensifier
 - c. collimators
 - d. recording devices
 - 1. digital cameras
 - 2. cine
 - 3. spot films
 - 4. photo spot
 - e. generator
 - f. controls
 - g. display
 - h. recording
 - 2. static image storage
 - 3. dynamic image storage
 - 4. pulsed fluoroscopy
 - 5. high-level or boost mode
 - 6. exposure factors
 - 7. cumulative timer
 - b. dose monitoring equipment
 - 2. CT image post-processing
 - a. 3D reconstruction
 - b. modifications to field of view (FOV)
 - c. slice spacing
 - d. algorithm
 - e. maximum intensity projection (MIP)
 - f. multiplanar reconstruction (MRP)
 - g. quantitative measurements (volume, distance, diameter)
 - h. cardiac analysis (calcium scoring and coronary artery mapping)
 - i. shunt graft measurements
 - j. volume rendering
 - 3. MRI image post-processing
 - a. 3D reconstructions
 - b. maximum intensity projection (MIP)
 - c. volume rendering
 - d. multiplanar reconstruction
 - e. quantitative measurements (volume, distance, diameter)
 - f. subtraction
 - 4. quality improvement and research
 - a. definitions
 - 1. measures of frequency
 - 2. measures of central tendency
 - 3. measures of variance
 - b. assessment of outcomes



Procedures

Each section may include question related to the following topics:

- Anatomy: Gross and sectional anatomy, age-related changes, common surgical changes, congenital and developmental abnormalities/anomalies.
- Physiology: Age-related and surgery-related physiologic changes.
- Patient Assessment Procedures: e.g., visual inspection, auscultation, percussion, palpation.
- Procedures: Preparation for the procedure, access methods and closure devices and evaluation of images for diagnostic utility, alternative and/or complementary procedures.
- Pathophysiology: Alteration in function related to disease/injury, compensation mechanisms, and diseases/disorders/injuries (e.g., etiology, manifestations, physical examination, diagnostic studies, history and physical findings/clinical data).

1. Abdominal Section

A. General Abdomen

1. anatomy and physiology
2. abdominal assessment
 - a. pre-procedure rectal exam
 - b. signs and symptoms
 1. tenderness on palpation
 2. diarrhea
 3. flatulence
 4. dysuria
 5. pain
 6. constipation
 7. reflux
 8. nausea and vomiting
3. related studies
 - a. paracentesis
 - b. abscess, fistula, or sinus tract study
 - c. change of percutaneous tube or drainage catheter
 - d. liver biopsy
4. medical devices (image appearance, indications, and purpose)
 - a. drainage catheters
 - b. peritoneal dialysis catheters
 - c. stents
 - d. umbilical vascular catheters
5. medical devices (image appearance, indications, purpose, appropriate location, and complications)
 - a. central venous catheters
 - b. IVC filter

6. pathophysiology

- a. abdominal calcifications
- b. abdominal aortic aneurysm
- c. normal and abnormal gas patterns (e.g., ileus, obstruction, volvulus)
- d. pneumatosis intestinalis
- e. portal venous gas
- f. peritonitis
- g. pneumoperitoneum
- h. abscess
- i. free fluid

B. Gastrointestinal

1. anatomy and physiology
2. related studies
 - a. esophageal study
 - b. swallowing function study
 - c. upper GI study
 - d. small bowel study
 - e. small bowel study via enteroclysis tube
 - f. enema with barium, air, or water soluble contrast
 - g. nasogastric/enteric and orogastric/enteric tube placement
 - h. defecography
3. medical devices (image appearance, indications, and purpose)
 - a. bariatric devices
4. medical devices (image appearance, indications, purpose, appropriate location, and complications)
 - a. gastroenteric tubes

(Procedures continue on the following page.)



Procedures (continued)

5. pathophysiology
 - a. achalasia
 - b. adhesions
 - c. Barrett esophagus
 - d. bezoar
 - e. constipation
 - f. diverticuli/diverticulosis
 1. Zenker
 2. Killian-Jameson
 3. epiphrenic
 4. Meckel diverticulum
 - g. dysphagia
 - h. fistulae
 - i. gastric outlet obstruction
 - j. gastroesophageal reflux disease (GERD)
 - k. gastroparesis
 - l. hernias
 - m. hiatal hernias
 - n. Hirschsprung disease
 - o. infections/inflammatory diseases
 1. appendicitis
 2. diverticulitis
 3. colitis
 4. Crohn disease
 5. duodenitis
 6. esophagitis
 7. gastritis
 8. necrotizing enterocolitis
 9. toxic megacolon
 - p. intussusception/ volvulus, non-rotation and malrotation
 - q. ischemia
 - r. malabsorption
 - s. malignant and benign masses
 1. tumors
 2. polyps
 - t. peptic ulcer disease
 - u. presbyesophagus
 - v. primary muscular and neural disorders
 - w. pyloric stenosis
 - x. scleroderma
 - y. superior mesenteric artery (SMA) syndrome
 - z. surgical variations
 1. Roux-en-Y
 2. gastric band
 3. Nissen fundoplication
 - aa. ulcers
 - bb. varices
 - cc. webs
- C. Hepatobiliary, Pancreas, and Spleen
 1. anatomy and physiology
 2. related study: t-tube cholangiogram
 3. pathophysiology
 - a. biliary calculi
 - b. biliary dyskinesia
 - c. cholecystitis
 - d. cirrhosis
 - e. fatty liver
 - f. Gaucher disease
 - g. hepatitis
 - h. inflammatory processes
 - i. liver failure
 - j. malignant and benign masses
 - k. pancreatic insufficiency
 - l. pancreatic pseudocyst
 - m. pancreatitis
 - n. portal hypertension
 - o. splenomegaly
 - D. Urinary
 1. anatomy and physiology
 2. related studies
 - a. antegrade urography (e.g., pyelostography, nephrostography)
 - b. cystography
 - c. loopography
 - d. retrograde urethrography or urethrocystography
 - e. voiding cystourethrography
 3. medical devices
 - a. image appearance, indications, and purpose
 1. urinary catheters
 4. pathophysiology
 - a. acute and chronic renal failure
 - b. calculi
 - c. glomerulonephritis and nephrotic syndrome
 - d. infarcts, ischemia, thrombosis
 - e. inflammatory processes and abscesses
 - f. malignant and benign masses
 - g. nephrocalcinosis
 - h. polycystic kidney disease
 - i. renal papillary necrosis
 - j. UPJ obstruction (congenital, adult)
 - k. vesicoureteral reflux

(Procedures continue on the following page.)



Procedures (continued)

E. Reproductive

1. anatomy and physiology
2. related study: hysterosalpingography
3. pathophysiology
 - a. female
 1. ectopic pregnancy
 2. endometriosis
 3. malignant and benign masses
 4. pelvic inflammatory disease
 5. polycystic ovary disease
 6. pregnancy
 - b. male
 1. benign prostatic hypertrophy
 2. hydrocele
 3. inflammatory processes
 4. malignant and benign masses
 5. testicular torsion

2. Thoracic Section

A. General Thoracic

1. anatomy and physiology
2. related studies
 - a. chest fluoroscopy
 - b. insertion of non-tunneled central venous catheter
 - c. insertion of tunneled central venous catheter
 - d. port injection
3. pathophysiology
 - a. calcification
 - b. diaphragmatic paresis
 - c. inflammatory and infectious diseases
 - d. malignant and benign masses
 - e. pneumomediastinum

B. Cardiovascular

1. anatomy and physiology
2. assessment procedures
 - a. perfusion status
 - b. electrocardiogram (ECG)
 - c. vital signs
3. signs and symptoms
 - a. edema
 - b. exercise/activity tolerance
 - c. heart rate and rhythm
 - d. pain
 - e. peripheral pulse
 - f. skin changes (e.g., ulceration)
 - g. venous distention
4. related study: Peripheral Insertion of Central Venous Catheter (PICC) placement

5. medical devices

- a. image appearance, indications, and purpose
 1. IABP
 2. pacers/AICD
 3. cardiovascular valves

6. medical devices

- a. image appearance, indications, purpose, appropriate location, and complications
 1. Swan-Ganz catheters

7. pathophysiology

- a. cardiac dysrhythmias
- b. congestive heart failure (CHF)
- c. coronary artery disease
- d. pericardial disease
- e. valvular heart disease

C. Pulmonary

1. anatomy and physiology
2. assessment procedures
 - a. chest wall excursion
 - b. oxygen saturation measurement
3. signs and symptoms
 - a. cough/sputum production
 - b. pain
 - c. breathing pattern
 - d. skin changes (e.g., cyanosis)
 - e. clubbing
 - f. exercise/activity tolerance
4. studies
 - a. thoracentesis
 - b. placement of catheter for pneumothorax
5. medical devices
 - a. image appearance, indications, purpose, appropriate location, and complications
 1. chest tubes
 2. tracheal tubes

(Procedures continue on the following page.)



Procedures (continued)

6. pathophysiology
 - a. adult respiratory distress syndrome (ARDS)
 - b. asthma
 - c. atelectasis
 - d. bronchopulmonary dysplasia (BPD)
 - e. chronic obstructive pulmonary disease (COPD)
 - f. hyaline membrane disease (HMD)
 - g. infant respiratory distress syndrome (IRDS)
 - h. pleural diseases
 - i. pleural effusions
 - j. pneumothorax
 - k. pulmonary edema
 - l. pulmonary emboli
 - m. pulmonary fibrosis
 - n. pulmonary venous and arterial hypertension
- D. Breast and Axilla
 1. anatomy and physiology
 2. assessment procedures
 - a. clinical breast examination
 3. signs and symptoms
 - a. asymmetry
 - b. depression
 - c. discharge
 - d. mass
 - e. nipple changes
 - f. pain/tenderness
 - g. skin changes
 4. related studies
 - a. injection for sentinel node localization
 - b. breast needle localization
 5. pathophysiology
 - a. benign and malignant masses
 1. cysts
 2. ductal carcinoma in situ
 3. fibroadenoma
 4. inflammatory breast cancers
 5. invasive ductal carcinoma
 6. invasive lobular carcinomas
 7. Paget disease
 8. phyllodes
 - b. inflammatory diseases

3. Musculoskeletal and Endocrine Sections

- A. Musculoskeletal
 1. anatomy and physiology
 2. assessment procedures
 - a. range of motion analysis
 - b. mobility and strength testing
 3. signs and symptoms
 - a. skin changes (e.g., redness, temperature)
 - b. swelling
 - c. crepitus
 - d. pain
 - e. change in function
 4. related studies
 - a. joint injection and aspiration
 - b. arthrogram
 1. radiography
 2. CT
 3. MRI
 5. pathophysiology
 - a. arthritis
 1. gout
 2. osteoarthritis
 3. rheumatoid arthritis
 4. ankylosing spondylitis
 5. psoriatic arthritis
 - b. trauma
 1. fractures
 2. dislocations
 3. associated soft tissue injuries
 - c. tumors
 1. chondrosarcoma
 2. enchondroma
 3. Ewing sarcoma
 4. metastatic disease
 5. multiple myeloma/plasmacytoma
 6. osteochondroma
 7. osteoid osteoma
 8. osteosarcoma
 - d. infections
 1. acute and chronic osteomyelitis
 2. soft tissue infection
 - e. diseases
 1. fibrous dysplasia
 2. osteogenesis imperfecta
 3. osteomalacia
 4. osteoporosis
 5. Paget disease
 6. renal osteodystrophy

(Procedures continue on the following page.)



Procedures (continued)

B. Endocrine

1. anatomy and physiology
2. related study: thyroid biopsy
3. pathophysiology
 - a. adrenal disorders
 - b. diabetes
 - c. hyperparathyroidism
 - d. osteoporosis
 - e. pituitary disorder
 - f. renovascular hypertension
 - g. thyroid disorders
 1. malignant and benign masses
 2. hypo and hyperthyroidism

4. Neurological, Vascular, and Lymphatic Sections

A. Neurological

1. anatomy and physiology
2. assessment procedures
 - a. visual inspection (e.g., pupil size, symmetry, and reactivity)
 - b. sensory evaluation
 - c. motor evaluation
3. signs and symptoms
 - a. pain
 - b. weakness
 - c. sensory changes
 - d. motor changes
4. related studies
 - a. lumbar puncture
 - b. myelogram
 1. cervical
 2. thoracic
 3. lumbar
5. medical devices
 - a. image appearance, indications, and purpose
 1. CSF shunts
 2. intrathecal catheters
 3. neuro stimulators
6. pathophysiology
 - a. Alzheimer disease
 - b. amyotrophic lateral sclerosis (ALS)
 - c. cerebrovascular accident (CVA)
 - d. dementia
 - e. herniated disc
 - f. hydrocephalus
 - g. increased cranial pressure
 - h. infection/inflammation
 - i. malignant and benign masses
 - j. multiple sclerosis (MS)

- k. myasthenia gravis
- l. normal pressure hydrocephalus (NPH)
- m. open and closed head injuries
- n. Parkinson disease
- o. pseudotumor cerebri
- p. seizures
- q. spinal cord injury
- r. syring

B. Vascular and Lymphatic

1. anatomy and physiology
2. peripheral vascular assessment
 - a. pulse and edema scoring
 - b. Ankle Brachial Index (ABI)
3. signs and symptoms of arterial occlusion and insufficiency
 - a. pain
 - b. skin changes
 - c. altered pulses
 - d. arterial bruits
 - e. claudication
 - f. thrills
4. signs and symptoms of venous obstruction and insufficiency
 - a. skin changes
 - b. generalized edema
 - c. varicose veins
 - d. venous hum
5. related study: extremity venography
6. pathophysiology
 - a. anemias
 - b. aneurysm
 - c. arterial venous malformations (AVM)
 - d. arterio and atherosclerosis
 - e. blood clotting disorders
 - f. coarctation of aorta
 - g. hypertension
 - h. leukemias
 - i. lymphedema
 - j. lymphomas
 - k. shock
 - l. varicosities