CURRICULUM GOALS AND OBJECTIVES

Provided below are the specific educational goals for the residents as it pertains to their acquisition of knowledge in Thoracic Surgery. Each listing represents a section of the Comprehensive Requisite Thoracic Surgery Curriculum. The resident is to complete the designated topic prior to the specific Thoracic, Adult Cardiac, or Pediatric Cardiac rotation.

I. CHEST WALL
A. Anatomy, Physiology and Embryology

Program Objective: Upon successful completion of the residency program the resident understands the anatomy, physiology, and embryology of the chest wall and interprets diagnostic tests.

Learner Objectives: Upon successful completion of the residency program the resident:

1. Understands the anatomy and physiology of the cutaneous, muscular, and bony components of the chest wall and their anatomic and physiologic relationships to adjacent structures;
2. Understands the anatomy of the vascular, neural, muscular, and bony components of the thoracic outlet;
3. Knows all operative approaches to the chest wall;
4. Knows the surgical anatomy, neural, vascular, and skeletal components of the chest wall, as well as the major musculocutaneous flaps.

Contents:

1. Chest wall embryology
   a. Ectodermal, mesodermal, endodermal
2. Chest wall anatomy
   a. Skeletal
   b. Muscular
   c. Neural
   d. Vascular
   e. Relationships to adjacent structures
3. Diagnostic tests to define chest wall anatomy
   a. Chest x-ray
   b. CAT scans
   c. MRI scans
   d. Nuclear scans
   e. Pulmonary function tests
4. Major flaps of the chest wall and their vascular pedicles
   a. Latissimus dorsi
   b. Pectoralis major
   c. Serratus anterior
   d. Trapezius
   e. Intercostal
   f. Pleural
   g. Pericardial fat pad
   h. Rectus abdominis
   i. Omental
   j. Vascularized rib graft

Clinical Skills: During the training program the resident:

1. Recognizes the normal and abnormal anatomy of the chest wall;
2. Reads and interprets tests to diagnose chest wall abnormalities;
3. Performs operations utilizing major chest wall flaps and the correct application of prosthetic materials.

B. Acquired Abnormalities and Neoplasms

Program Objective: Upon successful completion of the residency program the resident understands acquired abnormalities and neoplasms of the chest wall and performs biopsy, incision, resection, reconstruction, and stabilization of the chest wall.

Learner Objectives: Upon successful completion of the residency program the resident:

1. Understands the diagnosis and management of various chest wall infections;
2. Evaluates and diagnoses primary and metastatic chest wall tumors, knows their histologic appearance, and understands the indications for incisional versus excisional biopsy;
3. Knows the radiologic characteristics of tumors;
4. Knows the indications for and methods of prosthetic chest wall reconstruction (e.g., methyl-methacrylate, Marlex®, Gortex®, Vicryl®, and Dacron® mesh);
5. Knows the types of chemotherapy and radiotherapy (induction neo-adjuvant and adjuvant therapy) of chest wall tumors and the indications for preoperative and postoperative therapy;
6. Knows the management of osteoradionecrosis of the chest wall.

Contents:
1. Malignant neoplasms of the chest wall
   a. Chondrosarcoma
   b. Osteogenic sarcoma
   c. Myeloma
   d. Ewing's sarcoma
   e. Metastatic lesions
   f. Lung cancer invading the chest wall
2. Benign neoplasms of the chest wall
   a. Fibrous dysplasia
   b. Chondroma
   c. Osteochondroma
   d. Eosinophilic granuloma

Clinical Skills: During the training program the resident:
1. Performs a variety of surgical incisions to expose components of the chest wall and interior thoracic organs;
2. Performs surgical resections of primary and secondary chest wall tumors;
3. Identifies the need for major flaps of the chest wall;
4. Identifies the need for prosthetic replacement of the chest wall;
5. Performs surgical reconstruction of chest wall defects.

C. Congenital Abnormalities and Thoracic Outlet Syndrome

Program Objective: Upon successful completion of the residency program the resident understands congenital abnormalities, including those leading to thoracic outlet syndrome, and uses operative and non-operative therapy.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Recognizes pectus excavatum and pectus carinatum, understands possible physiologic disturbances, and interprets diagnostic tests to identify such physiologic disturbances;
2. Understands the indications for the operative treatment of congenital chest wall abnormalities;
3. Knows the complications of reconstruction of congenital chest wall abnormalities and their management;
4. Understands the etiology, evaluation, differential diagnosis, and diagnostic criteria for thoracic outlet syndrome;
5. Knows the operative and non-operative management of thoracic outlet syndrome.

Contents:
1. Pectus excavatum
   a. Components
   b. Evaluation and management (operative and non-operative)
   c. Plastic surgical alternatives
2. Pectus carinatum
   a. Components
   b. Evaluation and management (operative and non-operative)
3. Thoracic outlet anatomy
   a. Skeletal, muscular, vascular, neural
4. Diagnostic tests
   a. Clinical examination and physical exam
   b. Nerve conduction studies
   c. Angiography
   d. CT scan
   e. MRI
   f. Non-invasive vascular studies
5. Forms of conservative management
   a. Physical therapy
   b. Weight reduction
6. Surgical management
   a. First rib resection (operative approaches)
   b. Cervical ribs
   c. Associated vascular abnormalities
   d. Management of intraoperative complications
   e. Re-operation
Clinical Skills: During the training program the resident:
1. Recognizes the varied presentations of thoracic outlet syndrome and interprets diagnostic tests;
2. Evaluates and treats patients with congenital chest wall malformations;
3. Reads and interprets diagnostic x-ray and performs physiologic examinations for congenital chest wall defects and thoracic outlet syndromes;
4. Performs the operative reconstruction of selected chest wall defects;
5. Performs first rib and cervical rib resection and repairs or releases vascular and neural abnormalities associated with thoracic outlet syndrome;
6. Manages intraoperative and postoperative complications associated with the repair of congenital chest wall abnormalities and thoracic outlet syndrome;
7. Performs re-operations for thoracic outlet syndrome.

II. LUNGS AND PLEURA
A. Anatomy, Physiology, Embryology and Testing

Program Objective: Upon successful completion of the residency program the resident understands the embryology and anatomy of the lungs and their relationship to adjacent structures, the physiology of airway mechanics, gas exchange, and blood flow, and applies the findings of invasive and non-invasive tests to patient management.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the segmental anatomy of the bronchial tree and bronchopulmonary segments;
2. Understands the arterial, venous and bronchial anatomy of the lungs and their inter-relationships;
3. Understands the lymphatic anatomy of the lungs, the major lymphatic nodal stations, and lymphatic drainage routes of the lung segments;
4. Knows the indications for different thoracic incisions, the surgical anatomy encountered, and the physiological impact;
5. Knows the indications for plain radiography, CT scan, magnetic resonance imaging, and PET scanning for staging of lung cancer;
6. Knows the indications, interpretation, and use of nuclear medicine ventilation/perfusion scanning (V/Q scan) to determine the operability of candidates for pulmonary resection;
7. Understands the methods of invasive staging (e.g., mediastinoscopy, Chamberlain procedure, scalene node biopsy, thoracoscopy);
8. Knows how to interpret pulmonary function tests;
9. Knows how to perform pulmonary function tests.

Contents:
1. Normal anatomy and histology of the lung
   a. Segmental anatomy of the bronchial tree
   b. Bronchopulmonary segments (topography)
   c. Hilar anatomy
   d. Lymphatic anatomy and drainage of the lung
   e. Histologic anatomy and cell types of the lung
   f. Endoscopic anatomy of the larynx, trachea, and bronchi
2. Normal physiology of the lung
   a. Chest wall mechanics
   b. Large and small airway mechanics
   c. Alveolar mechanics and gas exchange
   d. Chest x-ray
   e. CT scan of the chest and abdomen
   f. MRI of the chest
   g. Contrast angiography of major vessels within the chest
   h. Radioactive isotope scanning of organs within the chest
      i. Anterior thoracotomy
      j. Posterolateral thoracotomy
      k. Posterior thoracotomy
      l. Muscle sparing thoracotomy
      m. Mediastinotomy
      n. Transverse anterior sternotomy
      o. Incisions common to video assisted thoracic surgery
      p. Incisions common to cervical and anterior mediastinoscopy

Clinical Skills: During the training program the resident:
1. Reads and interprets pulmonary function studies, ventilation/perfusion scans, pulmonary arteriograms and arterial blood gases, and correlates the results with operability;
2. Applies knowledge of thoracic anatomy to the physical examination of the chest, heart, and vascular tree;
3. Applies knowledge of thoracic anatomy to flexible and rigid endoscopy;
4. Uses knowledge of chest, pulmonary, and cardiac physiology to interpret tests involving the thoracic cavity and to understand and treat diseases of the chest and its contents;
5. Reads and interprets plain radiography, CT scans, magnetic resonance imaging, and PET scanning of the chest;
6. Participates in the performance of exercise tolerance tests and pulmonary function tests.

B. Non-Neoplastic Lung Disease

Program Objective: Upon successful completion of the residency program the resident understands infectious, inflammatory, and environmental injuries of the lung and performs operative and non-operative management.

Learner Objectives: Upon successful completion of the residency program the resident:

1. Understands diagnostic procedures used to evaluate non-neoplastic lung disease;
2. Knows the common pathogens that produce lung infections, including their presentation and pathologic processes, and knows the treatment and indications for operative intervention;
3. Understands the natural history, presentation and treatment of chronic obstructive lung disease;
4. Knows the indications for bullectomy, lung reduction, and pulmonary transplantation;
5. Understands the pathologic results and alterations of pulmonary function due to bronchospasm;
6. Understands the principles of surgical resection for non-neoplastic lung disease;
7. Understands the mechanisms by which foreign bodies reach the airways, how they cause pulmonary pathology, and the management of patients with airway foreign bodies;
8. Understands the causes, physiology, evaluation and management of hemoptysis;

Contents:

1. Common pulmonary pathogens
   a. Bacteria
   b. Fungi
   c. Tuberculosis mycobacterium
   d. Viruses
   e. Protozoa
   f. Immunocompromised patients
2. Chronic obstructive pulmonary disease
   a. Natural history
   b. Presentation, evaluation
   c. Alteration of lung function
   d. Complications requiring operative treatment
   e. Treatment (operative and non-operative)
3. Bronchospasm
   a. Natural history
   b. Evaluation
   c. Complications requiring operative treatment
   d. Treatment (operative and non-operative)
4. Foreign bodies of the lung and airways
   a. Common types
   b. Causes, pathology
   c. Evaluation
   d. Treatment (operative and non-operative)
5. Hemoptysis
   a. Causes
   b. Physiologic derangements
   c. Evaluation
   d. Treatment (operative and non-operative)
6. Pneumothorax
   a. Etiology
   b. Indications for treatment
   c. Types of treatment

Clinical Skills: During the training program the resident:

1. Diagnoses and treats patients with bacterial, fungal, tuberculous, and viral lung infections;
2. Performs operative and non-operative management of lung abscess;
3. Performs resections of lung and bronchi in patients with non-neoplastic lung disease;
4. Manages patients with chronic obstructive lung disease, bronchospastic airway disease, foreign bodies of the airways, and hemoptysis;
5. Performs thoracentesis, mediastinoscopy, mediastinotomy, flexible and rigid bronchoscopy, thoracoscopy, and open lung biopsy;
6. Performs bronchoalveolar lavage and transbronchial lung biopsy.

C. Neoplastic Lung Disease

Program Objective: Upon successful completion of the residency program the resident understands the natural history, types, evaluation, and management of lung neoplasms, and performs operative and nonoperative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands TNM staging of lung carcinoma and its application to the diagnosis, therapeutic planning, and management of patients with lung carcinoma;
2. Evaluates and diagnoses neoplasia of the lung, using a knowledge of the histologic appearance of the major types;
3. Knows the signs of inoperability;
4. Understands the therapeutic options for patients with lung neoplasms;
5. Understands the principles of bronchoplastic surgery;
6. Understands the complications of pulmonary resection and their management;
7. Understands the role of adjuvant therapy for lung neoplasms;
8. Understands the indications for resection of benign lung neoplasms;
9. Understands the indications for resection of pulmonary metastases.

Contents:
1. Benign tumors of the lung and airways
   a. Pathology, biologic behavior
   b. Evaluation, diagnosis, treatment (operative and non-operative)
2. Solitary lung nodule
   a. Differential diagnosis, evaluation, diagnostic techniques
   b. Treatment (operative and non-operative)
3. Malignant tumors of the lung and airways
   a. Pathology, biologic behavior
   b. Evaluation, diagnosis, treatment (operative and non-operative)
4. Metastatic tumors to the lungs
   a. Pathology and biologic behavior
   b. Evaluation, diagnosis, treatment (operative and non-operative)

Clinical Skills: During the training program the resident:
1. Evaluates patients with lung neoplasia and recommends therapy based on their functional status, pulmonary function and tumor type;
2. Performs staging procedures (e.g., bronchoscopy, mediastinoscopy, mediastinotomy, and thoracoscopy);
3. Performs operations to extirpate neoplasms of the lung (e.g., local excision, wedge resection, segmental resection, lobectomy, pneumonectomy, sleeve lobectomy, carinal resection, chest wall resection);
4. Recognizes and manages complications of pulmonary resections (e.g., space problem, persistent air leak, bronchopleural fistula, bronchovascular fistula, empyema, cardiac arrhythmia);
5. Performs bedside bronchoscopies and placement of tracheostomies and/or minitracheostomies;
6. Recognizes and treats the early signs of non-cardiac pulmonary edema.

D. Congenital Lung Disease

Program Objective: Upon successful completion of the residency program the resident understands the embryology, pathology and principles of management of congenital lung abnormalities and performs appropriate treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Recognizes various congenital lung abnormalities and understands their anatomy and indications for treatment

Contents:
1. Pulmonary sequestration
   a. Presentation (intralobar and extralobar)
   b. Evaluation and management
   c. Prognosis
2. Congenital lobar emphysema
   a. Presentation and physiology
   b. Evaluation and management
3. Cystic fibrosis
   a. Presentation and physiology
   b. Evaluation and management
c. Complications and their management
d. Role of pulmonary transplantation

4. Bronchogenic cysts
   a. Presentation
   b. Evaluation and indications for operation
   c. Operative options

5. Cystic adenomatoid malformation
   a. Presentation and physiology
   b. Evaluation and indications for operation
   c. Operative options

Clinical Skills: During the training program the resident:
1. Evaluates patients with congenital lung abnormalities;
2. Performs operations for congenital lung abnormalities and their complications.

E. Diseases of the Pleura

Program Objective: Upon successful completion of the residency program the resident understands the benign and malignant abnormalities of the pleura, pleural effusions, and the evaluation and treatment of pleural diseases.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Is familiar with the clinical presentation of benign and malignant diseases of the pleura;
2. Understands the types of pleural effusions, their evaluation and treatment;
3. Understands the management of empyema with and without bronchopleural fistula;
4. Understands the indications, contraindications, and complications of video assisted thoracic surgery and has a working knowledge of the equipment;
5. Understands the treatment of benign and malignant diseases of the pleura.

Contents:
1. Mesothelioma
   a. Pathology, biologic behavior, and natural history
   b. Treatment (operative and non-operative)
2. Pleural effusions
   a. Types
   b. Diagnosis
   c. Treatment (operative and non-operative)
3. Empyema
   a. Presentation with and without bronchopleural fistula
   b. Diagnosis
   c. Treatment (operative and non-operative)
   d. Surgical options (e.g., thoracentesis, tube thoracostomy, decortication, rib resection, repair of bronchopleural fistula)

Clinical Skills: During the training program the resident:
1. Evaluates pleural effusions and recommends appropriate therapy;
2. Performs invasive diagnostic studies (e.g., incisional and excisional biopsy, needle biopsy, fluid analysis);
3. Places tube thoracostomies and performs chemical or mechanical pleurodesis;
4. Performs initial drainage procedures and subsequent procedures for empyema (e.g., decortication, empymectomy, rib resection, Eloesser flap, Claggett procedure, closure of bronchopleural fistula);
5. Performs video assisted thorascopic surgery as necessary for the diagnosis and treatment of pleural disease.
6. Places pleuroperitoneal shunts;
7. Performs pleural stripping for mesothelioma.

III. TRACHEA AND BRONCHI

A. Anatomy, Physiology and Embryology

Program Objective: Upon successful completion of the residency program the resident understands the anatomy, blood supply, physiology, and embryology of the trachea and bronchi and applies findings of radiography, pulmonary function tests, and endoscopy to patient care.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the anatomy and blood supply of the trachea and bronchi;
2. Understands the endoscopic anatomy of the nasopharynx, hypopharynx, larynx, trachea, and major bronchi;
3. Understands and interprets pulmonary function studies of the trachea and bronchi;
4. Understands the radiologic assessment of the trachea and bronchi.
Contents:

1. Trachea
   a. Blood supply
   b. Histologic and gross anatomy
   c. Lymphatic anatomy and drainage
   d. Contiguous structures
   e. Radiographic anatomy and tests
   f. Endoscopic anatomy and tests
2. Bronchi
   a. Blood supply
   b. Histologic and gross anatomy
   c. Segmental anatomy
   d. Lymphatic relationships
   e. Radiographic anatomy and tests
   f. Endoscopic anatomy and tests
3. Physiologic evaluation
   a. Pulmonary function tests
   b. Flow volume loops
4. Radiologic evaluation
   a. Plain radiographs
   b. Tomography
   c. CT scan
   d. Fluoroscopy
   e. MRI
   f. Barium swallow

Clinical Skills: During the training program the resident:
1. Interprets plain radiographic analyses, CT scan, MRI, and pulmonary function studies involving the trachea and bronchi;
2. Performs endoscopy of the upper airway, trachea and major bronchi.

B. Congenital and Acquired Abnormalities

Program Objective: Upon successful completion of the residency program the resident understands congenital and acquired diseases of the trachea and adjacent structures, knows the physiology of tracheal abnormalities, and performs operative and non-operative management.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands congenital abnormalities and idiopathic diseases of the trachea;
2. Understands the etiology, presentation and management of acquired tracheal strictures and their prevention;
3. Understands the etiology, presentation, diagnosis and management of tracheoesophageal fistulas and tracheoinnominate artery fistulas;
4. Knows the operative approaches to the trachea and techniques of mobilization;
5. Knows the methods of airway management, anesthesia and ventilation for tracheal operations;
6. Knows the principles of tracheal surgery and release maneuvers;
7. Understands the complications of tracheal surgery and their management;
8. Understands the etiology, presentation, and principles of airway trauma management;
9. Understands the radiologic evaluation of tracheal abnormalities.

Contents:

1. Radiologic assessment of the trachea and bronchi
   a. Plain x-rays
   b. CT scans
   c. MRI
   d. Barium swallow
2. Stricture of the trachea
   a. Post-intubation
   b. Post-tracheostomy
   c. Post-traumatic
3. Anesthesia for tracheal operations
   a. Methods of airway control
   b. Extubation concerns
4. Operative approaches to the trachea
   a. Reconstruction of the upper trachea
   b. Reconstruction of the lower trachea
5. Tracheostomy and its complications
   a. Tracheal stenosis
   b. Tracheo-esophageal fistula
   c. Tracheo-innominate artery fistula
   d. Persistent tracheal stoma

6. Airway trauma
   a. Airway control
   b. Evaluation of associated injuries
   c. Principles of repair (primary and secondary)
   d. Protecting tracheostomies

Clinical Skills: During the training program the resident:
1. Evaluates diagnostic tests of the trachea and bronchi;
2. Performs laryngoscopy and bronchoscopy of the trachea and bronchi, including dilation of stenoses;
3. Performs tracheostomy
4. Evaluates patients for tracheal resection and plans the operation;
5. Performs tracheal resection and reconstruction for tracheal stenosis;
6. Performs placement of tracheal T-tubes;
7. Performs the operations for tracheo-esophageal fistula, tracheo-innominate fistula, subglottic stenosis, and traumatic airway injury.

C. Neoplasms
Program Objective: Upon successful completion of the residency program the resident has a working knowledge of neoplasms affecting the trachea and adjacent structures, and performs operative and non-operative management.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the types, histology, and clinical presentation of tracheal neoplasms;
2. Understands the radiologic evaluation and operative management of tracheal neoplasms;
3. Understands the methods of airway management;
4. Knows the indications for and the use of radiotherapy and chemotherapy.

Contents:
1. Neoplasms of the trachea
   a. Benign
   b. Malignant
   c. Metastatic
2. Operative techniques
   a. Resection of tracheal tumors
   b. Methods of tracheal reconstruction
   c. Operative approaches
3. Prosthetics
   a. Silastic prosthetics
   b. Stents
   c. Types of tracheostomy tubes and tracheal T-tubes
4. Airway management
   a. Bronchoscopic "core out"
   b. Laser

Clinical Skills: During the training program the resident:
1. Performs rigid and flexible bronchoscopy for diagnosis and "core-out";
2. Performs resection of tracheal tumors;
3. Manages patients and their airways after tracheal resection;
4. Uses laser techniques in the management of endoluminal tumors;
5. Uses stents, tracheal T-tubes and tracheostomy tubes in the management of tracheal neoplasms;
6. Uses adjunctive therapy for the management of tracheal tumors.

IV. MEDIASTINUM AND PERICARDIUM
A. Anatomy, Physiology and Embryology
Program Objective: Upon successful completion of the residency program the resident understands the anatomy, physiology and embryology of the mediastinum and pericardium, the relationships of adjacent structures, and applies findings of invasive and non-invasive tests to patient management.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the anatomic boundaries of the mediastinum and the structures found within each region;
2. Understands the embryologic development of structures within the mediastinum and the variations and pathologic consequences of abnormally located structures;
3. Understands the radiologic assessment of the mediastinum including CT scan, MRI, contrast studies, and angiography;
4. Understands the aberrations caused by pericardial abnormalities and their effects on the heart and circulation.

Contents:
1. Superior mediastinum
   a. Major structures
   b. Diagnostic studies
2. Anterior mediastinum
   a. Major structures
   b. Diagnostic studies
3. Middle mediastinum (visceral compartment)
   a. Major structures
   b. Diagnostic studies
4. Posterior mediastinum (paravertebral sulcus)
   a. Major structures
   b. Diagnostic studies

Clinical Skills: During the training program the resident:
1. Reads and interprets mediastinal plain radiographs, CT scans, MRI, and contrast studies;
2. Applies knowledge of mediastinal anatomy and physiology to the diagnosis of mediastinal abnormalities;
3. Applies knowledge of pericardial physiology to the diagnosis of pericardial abnormalities.

B. Congenital Abnormalities of the Mediastinum

Program Objective: Upon successful completion of the residency program the resident understands congenital mediastinal abnormalities and performs operative and non-operative management.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Is able to diagnose mediastinal cysts;
2. Is familiar with the symptoms associated with mediastinal abnormalities;
3. Knows the indications for operations involving the mediastinum and the anatomic approaches.

Contents:
1. Mediastinal cysts
   a. Mediastinal cysts
   b. Pericardial cysts
   c. Cystic hygroma
   d. Bronchogenic cysts
   e. Esophageal duplications
   f. Management (operative and non-operative)
2. Symptoms of mediastinal abnormalities

Clinical Skills: During the training program, the resident:
1. Reads and interprets plain radiographs, CT scans, MRI's and contrast studies of congenital abnormalities of the mediastinum;
2. Diagnoses and manages patients with congenital abnormalities of the mediastinum;
3. Performs operations for congenital abnormalities of the mediastinum.

C. Acquired Abnormalities of the Mediastinum

Program Objective: Upon successful completion of the residency program the resident understands acquired mediastinal abnormalities and performs operative and non-operative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands mediastinal infections and their management;
2. Understands the diagnostic tests available;
3. Recognizes the histologic appearance of benign and malignant mediastinal neoplasms;
4. Understands the neoplastic and non-neoplastic mediastinal diseases;
5. Understands the operative management of benign and malignant mediastinal neoplasms;
6. Understands chemotherapy and radiotherapy in mediastinal neoplasm management.

Contents:
1. Anterior mediastinal tumors
   a. Thymoma
   b. Thyroid
   c. Teratoma
   d. Lymphoma
   e. Germ cell tumor
f. Histologic appearance  
g. Management (operative and non-operative)

2. Middle mediastinal tumors  
a. Lymphoma  
b. Hamartoma  
c. Cardiac tumors  
d. Histologic appearance  
e. Management (operative and non-operative)

3. Posterior mediastinum (paravertebral sulcus)  
a. Neurilemoma  
b. Neurofibroma  
c. Pheochromocytoma  
d. Ganglion neuroma  
e. Dumbbell neurogenic tumor  
f. Histologic appearance  
g. Management (operative and non-operative)

4. Mediastinal infection  
a. Postoperative  
b. Primary  
c. Management (operative and non-operative)

5. Diagnostic tests  
a. Plain radiographs  
b. CT scans  
c. MRI  
d. Contrast studies  
e. Radionucleotide studies  
f. Ultrasound  
g. Fine needle aspiration  
h. Core biopsy  
i. Mediastinoscopy  
j. Serologic tests

Clinical Skills: During the training program the resident  
1. Performs diagnostic tests and operations on the mediastinum;  
2. Diagnoses and manages mediastinal infection;  
3. Recognizes the histologic appearance of mediastinal tumors;  

D. Congenital and Acquired Abnormalities of the Pericardium  

Program Objective: Upon successful completion of the residency program the resident understands pericardial diseases and performs operative and non-operative management.

Learner Objectives: Upon successful completion of the residency program the resident:  
1. Understands the physiologic consequences of increased pericardial fluid and the techniques for diagnosis and management;  
2. Understands the operative management of benign and malignant pericardial neoplasms;  
3. Understands the physiologic consequences of pericardial constriction and the techniques for diagnosis and management.

Contents:  
1. Pericardial effusions  
a. Benign  
b. Malignant  
c. Diagnostic tests  
d. Management (operative and non-operative)  
2. Constrictive pericarditis  
a. Infectious  
b. Postoperative  
c. Management (operative and non-operative)  
3. Pericardial cysts and tumors  
a. Congenital cysts  
b. Benign tumors  
c. Malignant tumors  
d. Management (operative and non-operative)
Clinical Skills: During the training program the resident:
1. Uses an understanding of abnormal physiologic findings to diagnose pericardial pathology;
2. Evaluates and manages patients with pericardial cysts or tumors;
3. Performs diagnostic tests and therapeutic interventions for the treatment of pericardial tamponade, pericardial effusions, and constrictive pericardial disease.

V. DIAPHRAGM
A. Anatomy, Physiology and Embryology

Program Objective: Upon successful completion of the residency program the resident understands the anatomy, physiology, and embryology of the diaphragm and its relationship to adjacent structures, and interprets radiographic studies.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the embryologic origin of the diaphragm;
2. Understands the anatomy of the diaphragm and adjacent structures;
3. Understands the neural and vascular supply of the diaphragm and the pathologic consequences of injury;
4. Understands imaging studies for assessing the diaphragm;
5. Understands the consequences of incisions in the diaphragm;
6. Understands developmental anomalies of the diaphragm.

Contents:
1. Normal anatomy of the diaphragm
   a. Origins and insertions
   b. Vascular and neural supply
2. Foramina of the diaphragm
   a. Esophageal
   b. Vascular
   c. Morgagni and Bochdalek
3. Contiguous structures
   a. Heart
   b. Lungs
   c. Vessels
   d. Chest wall

Clinical Skills: During the training program the resident:
1. Uses knowledge of the normal anatomy and physiology of the diaphragm to treat primary or contiguous abnormalities;
2. Evaluates and interprets radiographic studies of the diaphragm, including fluoroscopy, CT scan, and MRI.

B. Acquired Abnormalities, Neoplasms

Program Objective: Upon successful completion of the residency program the resident understands acquired abnormalities of the diaphragm including traumatic injuries, inflammation, diaphragmatic paralysis and neoplasms, and performs the appropriate treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the presentation of diaphragmatic rupture and associated injuries;
2. Knows evaluation methods for penetrating injuries of the diaphragm;
3. Knows management of infections immediately above and below the diaphragm;
4. Understands the etiology, presentation, diagnosis, and management of acquired diaphragmatic hernias;
5. Understands the etiology, diagnosis, and treatment of diaphragmatic paralysis;
6. Understands the primary and secondary tumors of the diaphragm and their management;
7. Understands reconstruction methods for the diaphragm;
8. Understands the indications for and techniques of diaphragmatic pacing.

Contents:
1. Diaphragmatic rupture
   a. Clinical presentation
   b. Physiologic effects
   c. Operative management
   d. Management of associated injuries
2. Periphrenic abscess
   a. Clinical presentation
   b. Physiologic effects
   c. Operative management
3. Acquired diaphragmatic hernias
   a. Esophageal
   b. Eventration
   c. Treatment

4. Tumors of the diaphragm
   a. Mesenchymal origin (benign and malignant)
   b. Neurogenic (benign and malignant)
   c. Secondary (lung, esophageal, mesothelioma)
   d. Treatment

5. Paralysis of the diaphragm
   a. Causes
   b. Diagnosis
   c. Treatment

Clinical Skills: During the training program the resident:
1. Interprets plain and contrast x-rays, fluoroscopy, CT scans, and MRI of the diaphragm;
2. Performs operative repair of acquired diaphragmatic abnormalities and provides preoperative and postoperative care;
3. Reconstructs defects of the diaphragm;
4. Performs diagnostic studies of the diaphragm (e.g., pneumoperitoneum, direct incisional and excisional biopsy, video assisted thoracoscopic surgery);
5. Performs diaphragmatic mobilization for exposure of the spine and aorta;
6. Performs operative removal of diaphragmatic tumors;
7. Inserts permanent diaphragmatic pacemakers.

C. Congenital Abnormalities

Program Objective: Upon successful completion of the residency program the resident understands congenital diaphragmatic abnormalities and their pathologic effects, and provides operative and non-operative management.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the anatomy of congenital diaphragmatic hernias;
2. Understands the physiologic consequences of diaphragmatic hernias;
3. Knows the indications for operative repair of diaphragmatic hernias;
4. Diagnoses and manages infants and adults with diaphragmatic hernias;

Contents:
1. Congenital diaphragmatic hernias
   a. Clinical presentations
   b. Pulmonary abnormalities
   c. Gastrointestinal abnormalities
   d. Cardiovascular abnormalities
   e. Treatment

Clinical Skills: During the training program the resident:
1. Evaluates neonates with congenital diaphragmatic hernias;
2. Performs or participates in the operative treatment of infants with diaphragmatic hernias;
3. Participates in the preoperative and postoperative management of multisystem abnormalities of infants with congenital diaphragmatic hernias;
4. Performs operative treatment of adults with delayed presentation of diaphragmatic hernias;

VI. ESOPHAGUS

A. Anatomy, Physiology and Embryology

Program Objective: Upon successful completion of the residency program the resident understands the anatomy, physiology, and embryology of the esophagus and the diagnostic tests of normal and abnormal function.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the anatomy, embryology, innervation, and vascular supply of the esophagus and adjacent structures;
2. Understands the physiologic function of the esophagus and pharynx;
3. Understands the radiographic evaluation of the esophagus.

Contents:
1. Anatomy of the esophagus
   a. Histology
   b. Blood supply
   c. Nerve supply
d. Sphincters
 e. Muscular composition
 f. Mucosa

2. Physiology of the esophagus
   a. Normal peristalsis
   b. Hormonal influences
   c. Neural influences

3. Assessment of the esophagus
   a. Contrast studies
   b. Manometry
   c. pH studies
   d. Radionucleotide scans
   e. Endoscopy

Clinical Skills: During the training program the resident:
1. Interprets esophageal plain radiographs, contrast studies, CT scans, MRI, and intraluminal echo;
2. Orders and interprets manometric and pH studies of the esophagus;
3. Performs rigid and flexible endoscopy of the pharynx and esophagus.

B. Congenital Abnormalities
Program Objective: Upon successful completion of the residency program the resident understands congenital esophageal abnormalities, including esophageal atresia, tracheo-esophageal fistula and esophageal duplications, and performs operative and non-operative management.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the clinical presentations, types, diagnosis and treatment of esophageal atresia and congenital tracheo-esophageal fistula;
2. Understands the clinical presentation and diagnosis of esophageal duplication cysts.

Contents:
1. Esophageal atresia/tracheo-esophageal fistula
   a. Types
   b. Clinical presentation
   c. Diagnosis
   d. Operative and non-operative management
2. Esophageal duplication
   a. Histology
   b. Clinical presentation
   c. Diagnosis
   d. Operative management

Clinical Skills: During the training program the resident:
1. Evaluates patients with various types of esophageal atresia/tracheoesophageal fistula and recommends management;
2. Performs diagnostic tests of congenital esophageal diseases;
3. Performs or participates in the operative repair of tracheo-esophageal fistula;
4. Performs the operative management of esophageal duplication cysts.

C. Acquired Abnormalities
Program Objective: Upon successful completion of the residency program the resident understands the types and causes of acquired abnormalities of the esophagus and provides appropriate treatment.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the pathophysiology, histology, complications, and diagnosis of esophageal reflux;
2. Understands the indications for and principles of anti-reflux operations;
3. Understands the clinical presentation, diagnosis, and management of paraesophageal hernias;
4. Knows the clinical presentation, causes, diagnosis, and treatment of motility disorders of the esophagus;
5. Understands the clinical presentation, diagnosis, and management of esophageal perforation;
6. Understands the clinical presentation, diagnosis, and management of chemical injuries and trauma of the esophagus;
7. Understands the indications, methods, and operative approaches for esophageal replacement;
8. Understands the clinical presentation, diagnosis, and management of esophageal foreign bodies;
9. Understands the presentation and management of complications of esophageal operations;
10. Understands the etiology, presentation, and management of infections after esophageal injuries and operations.

Contents:

1. Esophageal reflux
   a. Histology
   b. Clinical presentation
   c. Etiology
   d. Diagnosis
   e. Operative and non-operative management
   f. Management of complications (bleeding, ulceration, Barrett's mucosa, stricture)

2. Paraesophageal hernias
   a. Clinical presentation
   b. Diagnosis and indications for operation
   c. Operative management

3. Motility disorders
   a. Achalasia
   b. Scleroderma
   c. Spasm
   d. Diverticula
   e. Clinical presentation
   f. Diagnosis
   g. Operative and non-operative management

4. Esophageal perforation
   a. Etiology
   b. Clinical presentation and diagnosis
   c. Operative and non-operative management

5. Trauma
   a. Chemical injuries
   b. Blunt and penetrating trauma
   c. Clinical presentation and diagnosis
   d. Operative and non-operative management

6. Esophageal replacement
   a. Stomach
   b. Jejunum
   c. Colon
   d. Free jejunal replacement

7. Foreign bodies
   a. Clinical presentation and diagnosis
   b. Methods of removal

8. Video assisted thoracic surgery for esophageal disorders
   a. Indications
   b. Techniques

9. Infections
   a. Moniliasis
   b. Diagnosis
   c. Treatment

10. Rings and webs
    a. Diagnosis
    b. Treatment

Clinical Skills: During the training program the resident:

1. Interprets esophageal plain radiographs, contrast studies, CT scans, MRI, manometry, pH studies, and intraluminal echo;
2. Performs esophagoscopy, foreign body removal and biopsy;
3. Uses various operative approaches to different parts of the esophagus;
4. Performs anti-reflux operations including management of strictures;
5. Performs resection and reconstruction using various esophageal substitutes;
6. Evaluates and manages patients with esophageal motility disorders, performs myotomy and resection of diverticula;
7. Diagnoses, manages, and performs operations for esophageal perforation, chemical burns, and trauma;
8. Manages the complications of esophageal operations;
9. Uses video assisted thoracic surgery for esophageal diseases where appropriate.
D. Neoplasms

Program Objective: Upon successful completion of the residency program the resident understands benign and malignant esophageal neoplasms and the various forms of treatment, and performs operative and nonoperative management.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the types of benign esophageal neoplasms, their clinical presentation, diagnosis, and treatment;
2. Understands the types of malignant esophageal neoplasms, their clinical presentation, diagnosis, histologic appearance, and treatment;
3. Understands the TNM staging of esophageal cancer;
4. Understands the role of chemotherapy and radiotherapy in esophageal cancer;
5. Understands the operative approaches, methods, and complications of esophageal resection and reconstruction;
6. Understands the indications for operative and non-operative treatment of esophageal cancer;
7. Understands the principles of patient management after esophageal resection;
8. Understands the nutritional management of patients with esophageal neoplasms.

Contents:
1. Benign esophageal tumors
   a. Histology
   b. Fibrovascular polyp
   c. Leiomyoma
   d. Operative and non-operative management
2. Malignant esophageal tumors
   a. Histology
   b. Squamous cell carcinoma
   c. Adenocarcinoma
   d. Sarcoma
   e. Small cell carcinoma
   f. Melanoma
   g. Staging
   h. Adjuvant treatment
   i. Operative management
   j. Methods of palliation

Clinical Skills: During the training program the resident:
1. Evaluates malignant and benign esophageal tumors and recommends overall management, including neoadjuvant therapy;
2. Performs diagnostic tests for esophageal neoplasms and correlates the results with clinical staging;
3. Performs esophagectomy through various approaches;
4. Performs reconstruction with various esophageal substitutes;
5. Diagnoses and manages complications of esophageal surgery;
6. Manages nutritional needs after esophageal surgery;
7. Performs palliative operations for obstructing esophageal lesions;
8. Recommends appropriate postoperative or alternate therapy for advanced or recurrent disease.

VII. CONGENITAL HEART DISEASE

A. Embryology, Anatomy and History

Program Objective: Upon successful completion of the residency program the resident understands the embryology of the heart and great vessels as it relates to the development of congenital heart anomalies, the normal anatomy of the heart, and the abnormal anatomy of the principal congenital cardiac anomalies, and applies this knowledge to the interpretation of echocardiograms, angiocardograms, and other imaging techniques.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the embryology and anatomy of the normal heart;
2. Knows the embryology and anatomy of major cardiac anomalies;
3. Interprets angiocardograms, echocardiograms, and other images and correlates these with normal and abnormal cardiac anatomy;
4. Knows the history of congenital cardiac surgery, and the intellectual development of operations used to manage each cardiac anomaly.

Contents:
1. Anatomy and embryology of the normal heart;
2. Embryology and pathologic anatomy of each major congenital cardiac anomaly;
3. Interpretation of angiocardograms, echocardiograms, and other images
   a. Normal heart
b. Major congenital cardiac anomalies
4. History of cardiac surgery of congenital heart disease.

Clinical Skills: During the training program the resident:
1. Applies knowledge of the normal and abnormal anatomy of the heart to the planning and performance of operations;
2. Interprets angiograms, echocardiograms, and other images to diagnose congenital heart disease;
3. Uses knowledge to select the best procedure for individual patients.

B. Physiology and Physiologic Evaluation
Program Objective: Upon successful completion of the residency program the resident understands the physiology of the developing heart, the physiologic changes of advancing age and transition ex-utero, and the physiologic consequences of congenital heart disease. The resident understands the findings in and limitations of invasive and non-invasive tests to define physiologic abnormalities and uses them in patient management.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands normal fetal circulation;
2. Understands the transitional nature of circulation as the fetus becomes a neonate;
3. Understands the physiology of obstructions, of intra- and extracardiac shunts, of abnormal connections to the heart, and of combinations of these anomalies in the fetus, neonate, and child.

Contents:
1. Fetal circulation
   a. Oxygen source
   b. Flow pattern of blood through the heart and circulation
   c. Cardiac output and its distribution
   d. Myocardial function
   e. Regulation of the circulation
2. Transitional and neonatal circulation
   a. General changes
   b. Pulmonary circulation changes (e.g., mechanical factors, oxygen effects, vasoactive substances, hormonal factors)
   c. Ductus arteriosus changes (factors effecting closure or maintaining patency)
   d. Foramen ovale changes (factors effecting closure or maintaining patency)
   e. Physiologic assessment of the neonate
3. Fundamental anatomic abnormalities and physiologic consequences
   a. Anatomic abnormalities: obstruction (e.g., aortic stenosis, pulmonary atresia); extra pathways (e.g., atrial septal defect, ventricular septal defect); abnormal connections (e.g., transposition of the great vessels)
   b. Increased blood flow to a region
   c. Decreased blood flow to a region
   d. Combinations of increased or decreased blood flow to a region (e.g., tetralogy of Fallot, double outlet right ventricle, anomalous pulmonary veins)
   e. Application of these anatomic and physiologic principles to derive the common names for defects
   f. Hemodynamic manifestations of these anatomic and physiologic elements
4. Hemodynamic assessment
   a. Usefulness and limitations of echocardiographic doppler
   b. Usefulness and limitations of cardiac catheterization
   c. Calculations of regional flows and resistances
   d. Calculation of flow resistance and ratio
   e. Pulmonary vascular resistance and pulmonary hypertension
5. Indications for operation
   a. Clinical symptoms and signs of obstructive lesions
   b. Clinical symptoms and signs of extra pathway lesions
   c. Clinical symptoms and signs of abnormal connections

Clinical Skills: During the training program the resident:
1. Describes the physiologic changes of circulation during neonatal life;
2. Diagnoses clinically important congenital heart diseases in the neonate, infant, and child;
3. Applies a knowledge of anatomic abnormalities and their physiologic consequences to diagnose congenital heart defects;
4. Manages the physiologic aspects of the neonate, infant, and child with congenital heart disease preoperatively, intraoperatively, and postoperatively;
5. Stabilizes patients who are critically ill with congenital heart disease;
6. Performs calculations of blood flows and resistances from cardiac catheterization data.
C. Cardiopulmonary Bypass for Operations on Congenital Cardiac Anomalies

Program Objective: Upon successful completion of the residency program the resident has a working knowledge of the principles of cardiopulmonary bypass for congenital heart disease, the techniques of myocardial preservation, and the use of profound hypothermia and total circulatory arrest in the infant and child.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the indications for the various techniques of bypass (anatomy, pathophysiology, and technical requirements of the underlying cardiac defects);
2. Knows arterial and venous cannulation techniques for different intracardiac defects;
3. Understands the techniques of myocardial protection in the neonate and young infant;
4. Understands the use of varying levels of hemodilution and anticoagulation;
5. Understands perfusion flow and pressure control;
6. Knows the methods of body temperature manipulation, and the indications for and techniques of profound hypothermia with and without total circulatory arrest.

Contents:
1. Monitoring for cardiopulmonary bypass
   a. Arterial pressure lines
   b. Central venous pressure, pulmonary artery pressure
   c. Temperature monitoring (nasopharyngeal, esophageal, rectal, bladder)
   d. O2 saturation, end-tidal CO2
   e. Urine output
2. Cannulation
   a. Single venous (indications, technique)
   b. Double venous (indications, technique)
   c. Arterial (technique)
   d. Venting (indications, technique)
   e. Cardioplegia
3. Myocardial preservation techniques
   a. Crystalloid, blood
   b. Cold, warm
   c. Antegrade, retrograde
   d. Additives
   e. Fibrillation
4. Profound hypothermia and total circulatory arrest
   a. Indications
   b. Benefits, disadvantages
   c. Safe duration of total circulatory arrest
   d. Early cerebral complications
   e. Late intellectual, neurological, psychiatric outcome

Clinical Skills: During the training program the resident:
1. Performs arterial and venous cannulation and initiates cardiopulmonary bypass;
2. Directs the perfusionist in the intraoperative management and conduct of cardiopulmonary bypass;
3. Performs or participates in the repair of congenital heart defects using cardiopulmonary bypass.

D. Left-To-Right Shunts

Program Objective: Upon successful completion of the residency program the resident understands the diagnosis and treatment of left-to-right shunts caused by congenital cardiac anomalies, and performs operative and non-operative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the anatomy, embryology, and physiology of the most common or important anomalies;
2. Knows the operative indications of the most common or important anomalies;
3. Knows the technical components of the operative repair of the most common or important anomalies;
4. Understands the postoperative care of each anomaly.

Contents:
1. Atrial septal defect
   a. Anatomy
      i. types of atrial septal defects and key landmarks of the right atrium.
   b. Clinical features
      i. natural history, indications for operation
      ii. clinical signs and symptoms, physical exam
iii. chest x-ray and ECG
iv. echocardiogram and cardiac catheterization

**c. Operative repair and complications**

i. extracorporeal bypass and myocardial protection
ii. incisions in the heart
iii. techniques for defect closure
iv. treatment of associated anomalies (e.g., cleft mitral valve)
v. complications of closure (e.g., air embolism, conduction abnormalities, residual defects)

**d. Outcome**

i. expected operative mortality
ii. long-term results
iii. complications

2. Ventricular septal defect

a. **Anatomy**

i. types

b. **Clinical features**

i. clinical signs and symptoms, physical exam
ii. echocardiogram and cardiac catheterization
iii. chest x-ray and ECG
iv. natural history
v. indications, contraindications, timing of operation (e.g., total repair vs. pulmonary artery banding)

c. **Operative repair and complications**

i. extracorporeal bypass and myocardial protection
ii. incisions for different types of defects
iii. closure techniques (direct suture vs. patch)
iv. treatment of associated anomalies (e.g., atrial septal defect, right ventricular muscle bands)
v. complications (rhythm disturbances, residual defects, air)
vi. techniques of PA banding

d. **Outcomes**

i. expected operative mortality
ii. long-term results
iii. complications

3. Patent ductus arteriosus

a. **Anatomy**

b. **Physiology**

i. neonate vs. older child
ii. effect of prostaglandin and prostaglandin inhibitors

c. **Diagnosis and clinical features**

i. symptoms and physical findings
ii. echocardiogram and cardiac catheterization
iii. chest x-ray and ECG
iv. natural history (neonate vs. older child, endocarditis)
v. indications for operation
vi. associated anomalies (e.g., ductus-dependent conditions)

d. **Operative repair and complications**

i. operative techniques for simple ductus
ii. management of the difficult ductus
iii. complications of operative repair

e. **Outcome**

i. expected operative mortality
ii. long-term results
iii. complications

4. Atrioventricular septal defect

a. **Anatomy**

i. types (complete, transitional, ostium primum ASD)
ii. atrioventricular valve pathologic anatomy

b. **Physiology**

i. shunts and resistance calculation
ii. complete vs. incomplete
c. Diagnosis and clinical features
   i. symptoms and signs (infant vs. older patient, physical exam)
   ii. echocardiogram, angiogram, cardiac catheterization
   iii. chest x-ray and ECG
   iv. natural history (development of Eisenmenger's syndrome)
   v. indications for and timing of operation (size of shunt, endocarditis risk, total repair vs. pulmonary artery banding)
d. Operative repair and complications
   i. cardiopulmonary bypass and myocardial protection
   ii. incisions in the heart
   iii. operative techniques
   iv. complications (residual defects, residual "mitral valve" insufficiency, heart block)
e. Outcome
   i. expected operative mortality
   ii. long-term results
   iii. complications

5. Double-outlet right ventricle
   a. Anatomy
      i. types (subaortic, subpulmonic, uncommitted)
      ii. associated anomalies
   b. Clinical features
      i. natural history
      ii. indications for and timing of operation
      iii. signs and symptoms of each of the anatomic types
      iv. chest x-ray, ECG
      v. echocardiogram and cardiac catheterization
c. Operative repair and complications
   i. palliative operations vs. total repair (application of shunts, pulmonary artery band, total repair)
   ii. cardiopulmonary bypass and myocardial protection
   iii. approach to each anatomic subtype and placement of incisions in the heart
   iv. specific operative techniques (e.g., suturing, placement of patches)
   v. complications and their management
d. Outcome
   i. expected operative mortality
   ii. long-term results
   iii. complications

6. Aorto-pulmonary window
   a. Anatomy
   b. Clinical features
      i. natural history (development of pulmonary vascular obstructive disease)
      ii. symptoms and signs
      iii. echocardiogram, angiogram, cardiac catheterization
      iv. chest x-ray, ECG
c. Operative repair
d. Outcome
   i. expected operative mortality
   ii. long-term results
   iii. complications

Clinical Skills: During the training program the resident:
1. Participates in or performs the operative repair of atrial septal defects, ventricular septal defects, patent ductus arteriosus, and pulmonary artery banding;
2. Participates in or performs the repair of more complex cardiac anomalies;
3. Performs the preoperative evaluation of patients with each of these anomalies;
4. Manages postoperative care.

E. Cyanotic Anomalies
Program Objective: Upon successful completion of the residency program the resident knows the anatomy and physiology of anomalies that result in cyanosis, their diagnosis, their preoperative, operative, and postoperative management, and performs operative and non-operative treatment.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the anatomy and physiology of each anomaly;
2. Knows the methods of diagnosis;
3. Understands the role of medical management and interventional cardiology as treatment options;
4. Knows the indications for and timing of operation;
5. Understands the technical components of operative repair;
6. Knows the postoperative care, expected outcome, long-term results, and complications.

Contents:
1. Tetralogy of Fallot
   a. Anatomy and embryology
      i. embryology of malaligned ventricular septal defect
      ii. levels of right ventricular outflow tract obstruction
   b. Physiology
      i. genesis of “tet spells” and infundibular spasm
      ii. factors which affect degree of right-to-left shunt
      iii. associated anomalies
   c. Clinical features
      i. symptoms and physical findings
      ii. cardiac catheterization, echocardiogram, angiogram
      iii. chest x-ray, ECG
      iv. natural history
      v. indications for and timing of operation
   d. Operative repair and complications
      i. role of systemic-to-pulmonary artery shunt vs. total repair
      ii. types of aortic-to-pulmonary artery shunts
      iii. extracorporeal bypass and myocardial protection
      iv. ventricular septal defect closure by transventricular or transatrial approach
      v. techniques for relief of right ventricular outflow tract obstruction and indications for transannular patching
      vi. indications for conduit repair
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications
2. Transposition of the great vessels (TGA)
   a. Anatomy
      i. simple TGA
      ii. complex TGA (ventricular septal defect, pulmonary stenosis)
   b. Physiology
      i. concept of circulations in parallel and mixing
   c. Clinical features
      i. symptoms and physical findings
      ii. echocardiogram, angiogram, cardiac catheterization
      iii. chest x-ray, ECG
      iv. natural history, role of balloon atrial septostomy
      v. indications for and timing of operations
   d. Operative repair and complications
      i. technique of Blalock-Hanlon atrial septectomy, open atrial septectomy
      ii. cardiopulmonary bypass and myocardial protection
      iii. operative techniques for total repair (Mustard, Senning, arterial switch, Rastelli)
      iv. palliative operations (PA band, systemic-to-pulmonary artery shunt)
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications
      iv. arrhythmias after atrial repairs
      v. semilunar insufficiency, PA stenosis, coronary problems after arterial switch
      vi. conduit obstruction after Rastelli
3. Truncus arteriosus
   a. Anatomy
      i. types of truncus arteriosus
      ii. associated anomalies (VSD, left ventricular outflow tract obstruction, arch interruption, DiGeorge syndrome)
   b. Clinical features
      i. symptoms and physical findings
      ii. cardiac catheterization, echocardiogram, angiocardiogram
      iii. chest x-ray, ECG
      iv. natural history (development of pulmonary vascular obstructive disease)
      v. indications for and timing of operation
   c. Operative repair and complications
      i. extracorporeal bypass and myocardial protection
      ii. operative techniques
         conduits (composite and homograft)
         modifications required for types II and III truncus
      iii. techniques for repair of associated anomalies
   d. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications

4. Tricuspid atresia
   a. Anatomy
      i. types I and II, subtypes
   b. Physiology
      i. subtypes with right-to-left shunt
      ii. subtypes with left-to-right shunt
   c. Clinical features
      i. symptoms and physical findings
      ii. echocardiogram, angiocardiogram, cardiac catheterization
      iii. chest x-ray, ECG
      iv. natural history, role of balloon atrial septostomy
      v. indications for and timing of operation
      vi. role of palliative operations (systemic-pulmonary artery shunts, PA banding, bidirectional Glenn, Fontan, other right heart bypass operations)
   d. Operative repair and complications
      i. palliative operations
      ii. operations for right heart bypass (bidirectional Glenn, Fontan)
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications

5. Total anomalous pulmonary venous connection
   a. Anatomy
      i. supracardiac, cardiac, infracardiac, mixed
   b. Physiology
      i. obstructive vs. nonobstructive
   c. Clinical features
      i. symptoms and physical findings
      ii. cardiac catheterization, echocardiogram, angiocardiogram
      iii. chest x-ray, ECG
      iv. natural history
      v. indications for and timing of operation
   d. Operative repair and complications
      i. extracorporeal bypass, myocardial protection
      ii. operative techniques for different subtypes
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications
6. Ebstein's anomaly
   a. Anatomy
   b. Physiology
      i. concept of atrialized ventricle
      ii. right ventricular outflow tract obstruction
   c. Clinical features
      i. symptoms and physical findings
      ii. cardiac catheterization, echocardiogram, angiocardiogram
      iii. chest x-ray, ECG
      iv. natural history
      v. associated lesions (e.g., Wolf-Parkinson-White syndrome)
      vi. indications for and timing of operation
   d. Operative repair and complications
      i. extracorporeal bypass and myocardial protection
      ii. technique of tricuspid repair, obliteration of atrialized ventricle
      iii. technique of tricuspid valve replacement
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications

Clinical Skills: During the training program the resident:
1. Participates in or performs the major palliative operations for these congenital cardiac anomalies;
2. Participates in or performs operative repair of tetralogy, TGA, Truncus arteriosus, TAPVR, Ebstein's anomaly, and Fontan-type operations;
3. Performs preoperative evaluation and preparation;
4. Manages postoperative care.

F. Obstructive Anomalies

Program Objective: Upon successful completion of the residency program the resident understands the anatomy and physiology of obstructive anomalies of the left and right sides of the heart and aorta, their diagnosis, management, and postoperative care, and performs the operative and non-operative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the anatomy and physiology of each anomaly;
2. Knows the methods of diagnosis;
3. Understands the role of medical management and interventional cardiology;
4. Knows the indications for and timing of operation;
5. Knows the technical components of operative repair;
6. Understands the principles of postoperative care;
7. Knows the expected outcome, long-term results and complications

Contents:
1. Aortic stenosis
   a. Anatomy
      i. supravalvular, valvular, subvalvular (including subtypes)
   b. Physiology
      i. associated anomalies
   c. Clinical features
      i. symptoms and physical findings
      ii. cardiac catheterization, echocardiogram, angiocardiogram
      iii. chest x-ray, ECG
      iv. natural history
      v. indications for and timing of operation
   d. Operative repair and complications
      i. extracorporeal bypass, myocardial protection
      ii. operative techniques
      iii. pros and cons of various techniques and patch configurations for supravalvular stenosis
      iv. techniques of aortic valvotomy
      v. operations to enlarge the aortic annulus (e.g., Konno-Rastan procedure, Ross procedure)
      vi. technique of apical aortic conduit
      vii. myomectomy and myotomy for subaortic obstruction
2. Pulmonary stenosis
   a. Anatomy
      i. valvular and supravalvular
      ii. associated anomalies (e.g., atrial septal defect, ventricular septal defect, branch stenosis)
   b. Clinical features
      i. symptoms and physical findings
      ii. echocardiogram, angiography, cardiac catheterization
      iii. chest x-ray, ECG
      iv. natural history; role of balloon valvuloplasty
   c. Operative repair and complications
      i. extracorporeal bypass, myocardial protection
      ii. incisions in the heart and great vessels
      iii. operative considerations (technique of valvulotomy, indications for transannular patching, division of right ventricular muscle bands)
      iv. complications (residual obstruction)
   d. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications

3. Coarctation of the aorta
   a. Anatomy
      i. relationship to the ductus arteriosus
      ii. associated anomalies (e.g., hypoplasia of transverse aorta, patent ductus arteriosus, LVOT obstruction)
   b. Physiology
      i. infant vs. older child
      ii. "preductal" vs. "postductal"
      iii. assessment of adequacy of collateral circulation
   c. Clinical features
      i. symptoms and physical findings (neonate with a closing ductus Vs. older infant and child)
      ii. echocardiogram, angiogram, cardiac catheterization
      iii. chest x-ray, ECG
      iv. natural history
      v. indications for and timing of operation
      vi. role of prostaglandins in stabilizing neonates
      vii. effect of associated anomalies (e.g., patent ductus arteriosus, aortic stenosis, ventricular septal defect)
   d. Operative repair and complications
      i. methods of repair (end-to-end vs. patch vs. subclavian angioplasty)
      ii. methods of arch reconstruction
      iii. complications (residual obstruction, paraplegia, chylothorax)
      iv. extracorporeal bypass, shunts in the absence of adequate collateral circulation
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications
      iv. re-coarctation

4. Interrupted aortic arch
   a. Anatomy
      i. types A, B, and C
      ii. associated anomalies (e.g., DiGeorge syndrome, VSD)
   b. Physiology
      i. role of ductal patency, prostaglandin
   c. Clinical features
      i. symptoms and physical findings
      ii. echocardiogram, angiography, cardiac catheterization
iii. chest x-ray, ECG
iv. natural history
v. indications for and timing of operation
vi. the role of prostaglandins in preoperative stabilization
vii. DiGeorge syndrome (hypocalcemia, need for irradiated blood)

d. Operative repair and complications
   i. extracorporeal bypass, hypothermic arrest
   ii. median sternotomy vs. left thoracotomy
   iii. techniques (e.g., end-to-end anastomosis, interposition grafting, absorbable vs. nonabsorbable sutures)
   iv. complications (e.g., residual obstruction, recurrent laryngeal nerve injury, chylothorax)
   v. repair of associated anomalies

e. Outcome
   i. expected operative mortality
   ii. long-term results
   iii. complications
   iv. reoperation
   v. management of DiGeorge syndrome

5. Vascular ring
   a. Anatomy
      i. double aortic arch, anomalous subclavian artery, unusual rings, pulmonary artery sling
   b. Physiology
      i. compression of airway and esophagus
   c. Clinical features
      i. signs and symptoms
      ii. barium esophagogram, CT scan, MRI
   d. Operative repair and complications
      i. techniques for exposure by left thoracotomy, indications for other approaches
      ii. technique for correction of each type
      iii. role of aortopexy
      iv. complications (e.g., recurrent laryngeal nerve paralysis, chylothorax, residual tracheomalacia)
   e. Outcome
      i. expected operative mortality
      ii. long-term results
      iii. complications
      iv. residual tracheomalacia

Clinical Skills: During the training program the resident:
1. Performs corrections for patent ductus arteriosus and coarctation of the aorta;
2. Participates in or performs aortic valvotomy, repair of supravalvular and subvalvular aortic stenosis, pulmonary valvotomy, correction of subvalvular pulmonary stenosis, correction of vascular rings;
3. Participates in or performs operations for left ventricular outflow obstruction and interrupted aortic arch;
4. Performs preoperative evaluation and preparation;
5. Manages postoperative care;
6. Uses prostaglandins in the management of patients with neonatal coarctation, interrupted aortic arch, critical aortic stenosis.

G. Miscellaneous Anomalies
Program Objective: Upon successful completion of the residency program the resident is familiar with the anatomy, physiology, diagnosis, and operative treatment of unusual complex congenital anomalies and performs operative and nonoperative treatment.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the natural history, evaluation, and treatment of coronary anomalies, congenital complete heart block, hypoplastic left heart syndrome, pulmonary atresia (with and without VSD), “corrected transposition”, single ventricle, cor triatriatum, and cardiac tumors;
2. Understands the role of corrective and palliative operations for the above anomalies and of cardiac transplantation for appropriate cardiac pathology.

Contents:
1. Normal and abnormal anatomy
2. Physiology of each anomaly
3. Preoperative evaluation and diagnosis
4. Operative strategies and complications
5. Outcomes

Clinical Skills: During the training program the resident:
1. Performs or assists in pacemaker insertion, systemic-to-pulmonary artery shunting for pulmonary atresia or
stenosis (with or without VSD), and pulmonary artery banding for large left-to-right shunts;
2. Evaluates angiocardiograms, echocardiograms, and cardiac catheterizations of the above anomalies;
3. Develops treatment plans for the above anomalies;
4. Participates in or performs operative treatment for the above anomalies;
5. Manages postoperative care for the above anomalies.

H. Principles of Postoperative Care
Program Objective: Upon successful completion of the residency program the resident understands postoperative care of
patients having palliation or correction of congenital cardiac anomalies and manages all aspects of their postoperative
care.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the physiologic characteristics of neonates and small infants;
2. Understands the management of infants and children who have undergone operative correction of simple and
complex congenital cardiac anomalies;
3. Understands the postoperative management of patients with systemic-to-pulmonary artery shunts;
4. Understands the management of patients who have had a right heart bypass operation;
5. Understands the physiologic preoperative and postoperative management of patients with hypoplastic left heart
syndrome;
6. Understands which infants and children are prone to have a pulmonary hypertensive crisis;

Contents:
1. Preoperative assessment and preparation
   a. Clinical and diagnostic data
   b. Physical examination.
2. Expected postoperative course for each operation.
3. Ventilatory management
   a. Reactive pulmonary vasculature
   b. Left heart syndrome
   c. Right heart bypass operations
4. Pharmacologic management

VIII. ACQUIRED HEART DISEASE
A. Coronary Artery Disease
Program Objective: Upon successful completion of the residency program the resident understands the physiology of
coronary circulation, the pathophysiologic causes and derangement of ischemic heart disease and the sequelae of
coronary events, and performs comprehensive short and long term management.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the physiology of coronary circulation and the physiologic derangements caused by stenosis and
obstruction;
2. Understands the development of atherosclerotic plaques and the current theories of plaque origination;
3. Knows the normal and variant anatomy of coronary circulation as well as the radiographic anatomy of the
coronary arteries and the left and right ventricles;
4. Understands the rationale for and techniques of coronary artery bypass operations as well as the use of
various conduits;
5. Understands the risks and complications of coronary artery bypass operations, coronary angiography, and
percutaneous coronary artery balloon angioplasty;
6. Understands the preoperative and postoperative care of patients undergoing coronary artery bypass grafting;
7. Can describe outcomes of angioplasty and of operative and non-operative treatment of coronary artery
disease, using statistical methods.

Contents:
1. Cardiac anatomy
   a. Left and right main coronary arteries
   b. Left anterior descending coronary artery
   c. Circumflex coronary artery
   d. Right coronary artery
   e. Coronary venous system
   f. Left and right ventricular anatomy
Clinical Skills: During the training program the resident:
1. Evaluates patients with angina pectoris, unstable angina pectoris, and acute myocardial infarction;
2. Reads and interprets invasive and non-invasive tests of patients with ischemic heart disease;
3. Performs operative and non-operative management of patients with ischemic heart disease, including coronary artery bypass grafting using the internal mammary artery;
4. Participates in or performs surgery for the complications of myocardial infarction;
5. Directs the critical care management of preoperative and postoperative patients with ischemic heart disease;
6. Participates in the performance and evaluation of exercise tolerance tests, echocardiograms, and cardiac catheterizations.

B. Myocarditis, Cardiomyopathy, Hypertrophic Obstructive Cardiomyopathy, Cardiac Tumors

Program Objective: Upon successful completion of the residency program the resident understands the pathology and etiology of diseased myocardium, the natural history of the diseases and physiologic alterations, and performs operative and non-operative management.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the types of cardiac tumors (frequency, anatomic location, physiologic and pathologic derangements, diagnostic methods and surgical management);
2. Understands myocarditis (causes, physiologic changes, treatment, prognosis, and radiographic, EKG and echocardiographic changes);
3. Understands hypertrophic cardiomyopathy (genetic linkage, pathologic and anatomic changes, physiologic derangements, clinical features, diagnostic tests, natural history, medical and surgical treatment);
4. Knows the types of cardiomyopathies (causes, natural history, diagnostic methods, operative and nonoperative treatment);
5. Understands cardiac transplantation (immunology/rejection and treatment, physiology, indications, operative techniques, diagnostic techniques in followup).
Contents:

1. Tumors
   a. Types, pathology
   b. Location
   c. Physiology
   d. Primary vs. metastatic
   e. Malignant pericardial effusion
   f. Diagnostic methods
   g. Treatment
   h. Outcome

2. Myocarditis
   a. Pathologic changes
   b. Etiology
   c. Clinical findings
   d. Radiographic changes
   e. Electrocardiography
   f. Echocardiography
   g. Treatment
   h. Outcome

3. Hypertrophic cardiomyopathy (HCM)
   a. Pathologic changes
   b. Anatomic changes
   c. Pathophysiology
   d. Obstructive vs. non-obstructive
   e. Arrhythmias
   f. Diagnosis
   g. History and physical examination
      i. echocardiography
      ii. cardiac catheterization
   h. Mitral valve
      i. systolic anterior motion
      ii. mitral regurgitation
   i. Treatment
      i. mitral valve replacement
      ii. myectomy and myotomy
      iii. pacing
   j. Outcome
      i. complications
      ii. long-term results

4. Cardiomyopathy
   a. Dilated
   b. Restrictive
   c. Causes
   d. Pathology
   e. Pathophysiology
   f. Diagnosis
      i. echocardiography
      ii. endomyocardial biopsy
   g. Clinical course
   h. Treatment
   i. Outcome

5. Cardiac transplantation
   a. Techniques
   b. Indications
   c. Immunology
   d. Immunosuppressive treatment
   e. Physiology
   f. Complications and infection
   g. Rejection
      i. diagnosis
      ii. treatment
h. Coronary artery disease development
i. Organ harvesting, preservation
j. Long term complications and outcome

Clinical Skills: During the training program the resident
1. Evaluates and interprets chest x-rays, CT scans, MRI, echocardiograms, and cardiac catheterizations of patients with cardiac tumors, myocarditis, cardiomyopathy and hypertrophic cardiomyopathy (HCM);
2. Participates in or performs operative excision of cardiac tumors;
3. Participates in or performs operations for the treatment of HCM when indicated;
4. Participates in or performs heart transplants and provides preoperative and postoperative care;
5. Participates in echocardiography, cardiac catheterization, endomyocardial biopsy, and donor heart harvesting.

C. Abnormalities of the Aorta

Program Objective: Upon successful completion of the residency program the resident understands the etiology and physiology of diseases of the aorta and performs operative and non-operative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the etiology and the physiology of aortic dissections and all aneurysms involving the ascending, transverse, descending, and abdominal aorta;
2. Recognizes the potential morbidity and mortality associated with aortic aneurysms and develops appropriate treatment plans for their management;
3. Knows the operative and nonoperative management of patients with acute and chronic aortic dissections;

Contents:
1. Aortic aneurysms (atherosclerotic, aortic dissections)
   a. Ascending
   b. Transverse
   c. Descending
   d. Abdominal
2. Operative and non-operative treatment
   a. Ascending
   b. Transverse
   c. Descending
   d. Abdominal

Clinical Skills: During the training program the resident:
1. Evaluates and interprets plain radiography, echocardiography, CT scans, MRI, and contrast studies for diseases of the aorta;
2. Participates in or performs operative and non-operative management of thoracic aortic disease, including aneurysms, dissections, and occlusive disease;
3. Plans and directs the use of extracorporeal bypass, hypothermia, and circulatory arrest for aortic diseases;
4. Performs preoperative and postoperative care of patients with aneurysms, dissections, and occlusive disease of the aorta.

D. Cardiac Arrhythmias

Program Objective: Upon successful completion of the residency program the resident understands the etiology and physiology of cardiac arrhythmias, and performs operative and non-operative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the etiology of cardiac arrhythmias and underlying physiologic disturbances;
2. Understands operative and non-operative management;
3. Knows the indications for and techniques of electrophysiologic studies and the application of this information to patient management.

Contents:
1. Cardiac arrhythmias
   a. Atrial
   b. Ventricular
2. Non-operative management
   a. Anti-arrhythmic drugs
   b. Electrical cardioversion and pacing
   c. Catheter ablation
3. Operative management
   a. AICD
   b. Intraoperative mapping and ablation
   c. Permanent pacing systems
Clinical Skills: During the training program the resident:
  1. Performs the operative and non-operative management of patients with atrial arrhythmias;
  2. Participates in or performs operative management of patients with ventricular arrhythmias, including placement of automatic implantable cardioverter-defibrillator;
  3. Participates in electrophysiologic studies.

E. Valvular Heart Disease

Program Objective: Upon successful completion of the residency program the resident knows the normal and pathologic anatomy of the cardiac valves, understands their natural history, physiology and clinical assessment, and performs operative and non-operative treatment.

Learner Objectives: Upon successful completion of the residency program the resident:
  1. Understands the normal and pathologic anatomy of the atrioventricular and semilunar valves;
  2. Knows the natural history, pathophysiology, and clinical presentation of each major valvular lesion (mitral stenosis and incompetence, aortic stenosis and incompetence, tricuspid stenosis and incompetence);
  3. Understands the operative and non-operative therapeutic options for the treatment of each major valvular lesion;
  4. Knows the techniques for repair and replacement of cardiac valves;
  5. Knows the preoperative and postoperative management of patients with valvular heart disease.

Contents:

1. Assessment of patients with valvular heart disease
   a. History and physical examination
   b. Echocardiogram
   c. Cardiac catheterization data

2. Choice of treatment
   a. Prosthetic valves
   b. Stented xenografts
   c. Non-stented human and xenograft valves
   d. Autograft valves for aortic valve replacement
   e. Valve repair

3. Long term complications of replacement devices
   a. Thrombosis
   b. Embolus
   c. Prosthetic dysfunction

4. Mitral valve
   a. Normal anatomy
   b. Normal function
   c. Mitral stenosis
      i. etiology and pathologic anatomy
      ii. natural history and complications
      iii. physiology
      iv. non-operative treatment
      v. indications for intervention (risk stratification)
      vi. merits of balloon valve dilation vs. operative repair or replacement
      vii. techniques of valve repair and replacement
      viii. intraoperative and postoperative complications and management
      ix. early and late results of operative and balloon valvulotomy
   d. Mitral incompetence
      i. etiology and pathologic anatomy
      ii. natural history and complications
      iii. physiology (mechanisms of incompetence)
      iv. non-operative treatment
         for nonischemic etiology
         for ischemic etiology
      v. indications for surgical intervention (risk stratification)
      vi. techniques of valve repair
         ring and suture annuloplasty
         leaflet plication, excision
         chordal/papillary muscle shortening
         chordal transposition and artificial chordae
vii. perioperative care
viii. early and late results of repair and replacement

5. Aortic valve
   a. Normal anatomy
   b. Normal function
   c. Aortic stenosis
      i. etiology and pathologic anatomy
      ii. natural history and complications
      iii. physiology (ventricular hypertrophy, mitral incompetence)
      iv. non-operative therapy
      v. indications for operative intervention (risk stratification)
      vi. techniques of valve replacement and repair
         management of small aortic root
         homograft and autograft valve replacement
      vii. perioperative care considerations
      viii. early and late results
   d. Aortic incompetence
      i. etiology and pathologic anatomy
      ii. natural history and complications
      iii. physiology (LV dilatation and LV dysfunction)
      iv. non-operative treatment
      v. indications for operative intervention
        in absence of clinical symptoms
        when complicated by endocarditis
        when complicated by aortic root aneurysm
      vi. techniques of valve repair and replacement
        with endocarditis and aortic root abscess
        with ascending and root aneurysm
      vii. perioperative care considerations
      viii. early and late results

6. Tricuspid valve
   a. Normal anatomy
   b. Normal function
   c. Tricuspid incompetence
      i. etiology and pathologic anatomy
      ii. physiology
      iii. indications for operation
        functional incompetence
        endocarditis
      iv. techniques of repair, indications for replacement
        ring and suture annuloplasty
        endocarditis (valve excision vs. repair or replacement)
      v. perioperative care
        management of RV dysfunction
        interventions to decrease pulmonary vascular resistance
      vi. early and late results
   d. Tricuspid stenosis
      i. etiology and pathologic anatomy
      ii. physiology
      iii. differentiation from constrictive pericarditis
      iv. indications for operative repair vs. replacement
      v. techniques of repair and replacement
      vi. early and late results

Clinical Skills: During the training program the resident:
1. Evaluates, diagnoses and selects management strategies for patients with valvular heart disease, including participation in and interpretation of cardiac catheterizations and echocardiograms;
2. Makes use of the therapeutic options and relative risks of operative and nonoperative treatment for valvular heart disease in planning interventions;
3. Manages preoperative clinical preparation and early and intermediate postoperative care;
4. Performs valve repair and replacement for valvular disease, interprets intraoperative echo.
IX. THORACIC TRAUMA

A. Trauma of the Chest Wall

Program Objective: Upon successful completion of the residency program the resident understands the pathophysiology of chest wall injury, and diagnoses, resuscitates and treats trauma patients.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Evaluates patients with blunt or penetrating chest wall injury;
2. Understands the physiology and mechanics of operative drainage of the thoracic cavity;
3. Understands the operative and non-operative management of chest wall injuries;
4. Understands the pathophysiology of flail chest.

Contents:
1. Thorax
   a. Rib fracture
   b. Flail chest
   c. Sucking chest wounds
   d. Diagnosis and management
   e. Simple
   f. Tension
   g. Diagnosis and treatment
2. Hemothorax
   a. Diagnosis
   b. Operative and non-operative management

Clinical Skills: During the training program the resident:
1. Evaluates and treats chest wall injuries;
2. Performs emergency operations to repair chest wall injuries and provides postoperative management.

B. Tracheobronchial and Pulmonary Trauma

Program Objective: Upon successful completion of the residency program the resident understands the pathophysiology of tracheobronchial and pulmonary trauma, and diagnoses, resuscitates and treats patients with these injuries.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands clinical presentation and radiologic findings of tracheobronchial injury;
2. Understands the principles of airway management;
3. Understands the bronchoscopic findings of tracheobronchial and pulmonary injury;
4. Understands the management of tracheobronchial and pulmonary injury;
5. Understands the injuries associated with tracheobronchial and pulmonary injury.

Contents:
1. Tracheobronchial injury
   a. Signs and symptoms
   b. Radiologic findings
   c. Diagnosis and management
2. Airway control
   a. Intubation
   b. Bronchoscopy
   c. Emergency tracheostomy
   d. One-lung ventilation
   e. High-frequency ventilation
3. Pulmonary contusion
   a. Signs and symptoms
   b. Pathophysiology
   c. Radiologic findings
   d. Operative and non-operative management
4. Penetrating injury
   a. Signs and symptoms
   b. Indications for operation
   c. Management of peripheral injuries
   d. Management of hilar injuries
   e. Air embolism

Clinical Skills: During the training program the resident:
1. Evaluates and manages patients with tracheobronchial trauma;
2. Manages the airway of patients with tracheobronchial injuries;
3. Repairs tracheobronchial and associated injuries;
4. Performs non-operative management of pulmonary contusion;
5. Performs emergency operations to repair peripheral pulmonary and hilar injuries;
6. Uses precautions to avoid air embolism in patients with penetrating and blunt injuries.

C. Esophageal Trauma

Program Objective: Upon successful completion of the residency program the resident understands the pathophysiology of esophageal trauma, and diagnoses, resuscitates and treats patients with these injuries.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the etiology and presentation of esophageal trauma;
2. Understands the methods of assessment and diagnosis of esophageal trauma;
3. Understands the management of injuries that disrupt the esophagus;

Contents:
1. Esophageal trauma
   a. Signs and symptoms
   b. Radiologic assessment (e.g., plain radiographs, CT scans, contrast studies)
2. Methods of repair
   a. Primary repair
   b. Resection and reconstruction
   c. Diversion
3. Complications
   a. Esophageal leak
   b. Esophageal obstruction
   c. Management

Clinical Skills: During the training program the resident:
1. Evaluates and interprets diagnostic tests of patients with esophageal trauma;
2. Performs the operative treatment of patients with esophageal injuries;
3. Manages the complications of operations for esophageal injury.

D. Diaphragmatic Trauma

Program Objective: Upon successful completion of the residency program the resident understands the pathophysiology of diaphragmatic trauma, and diagnoses, resuscitates, and treats patients with these injuries.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the presentation, evaluation, and treatment of blunt and penetrating diaphragmatic injuries;
2. Understands the evaluation and management of associated injuries;
3. Knows the presentation of delayed diaphragmatic injury, its diagnosis and management.

Contents:
1. Blunt trauma
   a. Signs and symptoms
   b. Radiologic findings
   c. Indication for operation
   d. Operative approach
   e. Techniques of repair
   f. Delayed presentation
   g. Associated injuries
2. Penetrating trauma
   a. Signs and symptoms
   b. Radiologic findings
   c. Operative approaches and techniques of repair
   d. Management of associated injuries

Clinical Skills: During the training program the resident:
1. Performs emergency evaluation and diagnosis of diaphragmatic and associated injuries;
2. Performs operative repair of acute and chronic diaphragmatic and associated injuries;
3. Knows the presentation of delayed diaphragmatic injury, its diagnosis and management.

E. Cardiovascular Trauma

Program Objective: Upon successful completion of the residency program the resident understands the pathophysiology of thoracic trauma resulting in injury to the heart and great vessels, and diagnoses, resuscitates and treats patients with these injuries.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Evaluates patients who have sustained cardiovascular trauma;
2. Understands the physiology of deceleration injuries to the thoracic aorta;

Contents:
1. Cardiac contusion
   a. Pathophysiology
   b. Noninvasive diagnostic techniques
   c. Management
   d. Followup and outcomes
2. Penetrating cardiovascular injuries
   a. Major vessel laceration
   b. Penetrating cardiac trauma
   c. Laceration of coronary arteries
   d. Pericardial tamponade
   e. Diagnostic methods
   f. Management
      i. operative approaches for specific injuries
      ii. use of cardiopulmonary bypass or partial mechanical support
      iii. management of concomitant injuries
3. Postoperative management
   a. Outcomes
4. Traumatic aortic transection
   a. Pathophysiology
   b. Anatomic locations and operative approaches
   c. Operative management
   d. Management of associated injuries
   e. Outcomes

Clinical Skills: During the training program the resident:
1. Evaluates and treats cardiac contusion;
2. Performs or participates in emergency operations to repair penetrating injuries of the heart and thoracic great vessels, and provides postoperative management;
3. Performs emergency operations to repair traumatic transections of the thoracic aorta and provide postoperative management.

X. TRANSPLANTATION
A. Cardiac Transplantation

Program Objective: Upon successful completion of the residency program the resident knows the principles of organ preservation, immunosuppressive therapy, signs and treatment of rejection, and the indications for and techniques of cardiac transplantation.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the indications for cardiac transplantation;
2. Understands the management of immunosuppressive therapy in cardiac transplantation;
3. Knows the techniques of cardiac transplantation;
4. Recognizes the signs and symptoms of cardiac rejection and knows the appropriate management;
5. Understands the evaluation and management of organ donors;
6. Knows the methods of organ harvest and preservation;
7. Is familiar with the techniques and complications of endomyocardial biopsy.

Contents:
1. Indications for cardiac transplantation
   a. Patient evaluation
   b. Patient selection
   c. Informed consent
2. Immunosuppressive therapy in cardiac transplantation
   a. Evaluation of therapy
   b. Drugs
   c. Complications
3. Technique of cardiac transplantation
   a. Orthotopic
   b. Heterotopic
4. Donor preparation and organ harvest
   a. Brain death, legal and family-related issues
   b. Donor evaluation
   c. Methods of organ procurement and preservation
5. Cardiac rejection
   a. Signs and symptoms
   b. Endomyocardial biopsy
   c. Histologic evaluation
   d. Management
   e. Mechanical support and re-transplantation
6. Immunosuppressive therapy
   a. Immunosuppressive drugs and their side effects
   b. Polyclonal and monoclonal antibody therapy and side effects
   c. Complications

Clinical Skills: During the training program the resident:
1. Manages organ donors;
2. Performs organ harvest and preservation;
3. Performs cardiac transplantation;
4. Manages the cardiac transplant recipient preoperatively and postoperatively;
5. Participates in the immunosuppressive therapy for cardiac transplantation;
6. Evaluates transplant recipients for signs of rejection or infection and initiates appropriate therapy;
7. Performs endomyocardial biopsy.

B. Lung Transplantation

Program Objective: Upon successful completion of the residency program the resident understands the basic principles of lung preservation and immunosuppressive therapy, recognizes and treats rejection, and knows the indications for and performs lung transplantation.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the evaluation and management of organ donors;
2. Knows the indications for lung transplantation;
3. Understands the management of immunosuppressive therapy in lung transplantation;
4. Knows the techniques of single and double lung transplantation;
5. Recognizes the signs and symptoms of lung rejection or infection and knows the appropriate management;
6. Knows the methods for harvesting and preserving donor lungs;
7. Is familiar with the techniques and complications of bronchoscopy of the transplanted lung.

Contents:
1. Indications for lung transplantation
   a. Patient evaluation
   b. Patient selection
   c. Informed consent
2. Immunosuppressive therapy in lung transplantation
   a. Evaluation of therapy
   b. Drugs
   c. Complications
3. Technique of single and double lung transplantation
   a. Left lung
   b. Right lung
   c. Extracorporeal bypass techniques and indications for their use
4. Donor evaluation
   a. History
   b. Physiology
   c. Radiology
5. Donor preparation and organ harvest
   a. Brain death, legal and family-related issues
   b. Organ procurement and preservation
   c. Pharmacologic and technical aspects of donor lung harvest operations
6. Pulmonary rejection
   a. Signs and symptoms
   b. Endobronchial biopsy
   c. Histologic evaluation of rejection
   d. Management of rejection
7. Immunosuppressive therapy  
   a. Immunosuppressive drugs and their side effects  
   b. Antibody therapy and side effects  
   c. Complications of immunosuppressive therapy  

Clinical Skills: During the training program the resident:
1. Performs or participates in donor evaluation and management;  
2. Performs or participates in donor lung harvest and preservation;  
3. Performs or participates in lung transplantation;  
4. Participates in the immunosuppressive therapy for lung transplantation;  
5. Manages the lung transplant recipient preoperatively and postoperatively;  
6. Evaluates transplant recipients for signs of rejection or infection, and initiates appropriate therapy;  
7. Performs transbronchial biopsy.  

C. Heart-Lung Transplantation  

Program Objective: Upon successful completion of the residency program the resident understands the principles of heart-lung preservation and immunosuppressive therapy, recognizes and treats rejection, and knows the techniques of heart-lung transplantation.  

Learner Objectives: Upon successful completion of the residency program the resident:
1. Knows the indications for heart-lung transplantation;  
2. Understands the management of immunosuppressive therapy of heart-lung transplantation;  
3. Knows the operative techniques of heart-lung transplantation;  
4. Recognizes the signs and symptoms of pulmonary rejection in cardiopulmonary transplantation;  
5. Recognizes infection and rejection, and knows the appropriate management of each;  
6. Understands the evaluation and management of heart-lung donors;  
7. Knows the methods for harvesting and preserving heart-lung blocs;  
8. Is familiar with the techniques and complications of radiologic and fiberoptic bronchoscopy of the transplanted lung in the heart-lung recipient.  

Contents:
1. Immunosuppressive therapy in cardiopulmonary transplantation  
   a. Evaluation of therapy  
   b. Drugs  
   c. Complications  
2. Technique of heart-lung transplantation  
3. Donor evaluation  
   a. History  
   b. Physiology  
   c. Radiology  
4. Donor preparation and harvest  
   a. Brain death, legal and family-related issues  
   b. Organ procurement and preservation  
   c. Pharmacologic and technical aspects of donor heart-lung harvesting  
5. Rejection in cardiopulmonary transplantation  
   a. Signs and symptoms  
   b. Frequency of cardiac rejection and indications for endomyocardial biopsy  
   c. Techniques for diagnosing lung rejection in the cardiopulmonary transplant patient  
   d. Histologic evaluation of pulmonary rejection in the cardiopulmonary transplant patient  
   e. Management of rejection in the cardiopulmonary transplant recipient  
6. Immunosuppressive therapy  
   a. Immunosuppressive drugs and their side effects  
   b. Monoclonal and polyclonal antibody therapy and their side effects  
   c. Complications  

Clinical Skills: During the training program the resident:
1. Participates in the evaluation and management of donors for cardiopulmonary transplantation;  
2. Performs heart-lung bloc harvesting and preservation;  
3. Performs heart-lung transplantation;  
4. Participates in immunosuppressive therapy for transplantation;  
5. Manages transplant recipients preoperatively and postoperatively;  
6. Evaluates transplant recipients for signs of pulmonary rejection and infection, and of cardiac dysfunction;  
7. Performs endobronchial biopsy, thoracoscopic biopsy of the lung, and endocardial biopsy of cardiopulmonary transplantation patients, as indicated.
XI. EXTRACORPOREAL BYPASS AND COAGULATION - BLOOD PRODUCTS

A. Physiology of Extracorporeal Bypass

Program Objective: Upon successful completion of the residency program the resident understands the physiology and pathologic derangements of pulsatile and non-pulsatile extracorporeal bypass, and has a working knowledge of oxygenators, perfusion systems, and ventricular support devices as they apply to adult patients.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the physiology and mechanics of membrane and bubble oxygenators;
2. Understands the mechanics and operation of roller and vortex pumps;
3. Understands the physiology of various extracorporeal bypass circuits and the derangements caused by their use;
4. Knows the coagulation system and alterations of blood elements;
5. Understands the basic design and function of ventricular support devices.

Contents:

1. Membrane oxygenators
   a. Physiology
   b. Design
   c. Complications
2. Bubble oxygenators
   a. Physiology
   b. Design
   c. Complications
3. Roller head pumps
   a. Design
   b. Safety measures
   c. Complications
4. Vortex pumps
   a. Mechanism and design
   b. Safety measures
   c. Complications
5. Extracorporeal circuits
   a. Set-up
   b. Types of tubing, filters, hemoconcentrators
   c. Safety measures
   d. Blood and artificial surface interaction
6. Perfusion solutions
   a. Prime solutions
   b. Hemodilution
   c. Oxygenators (types, indications, benefits, disadvantages)
   d. Venous reservoir
   e. Cardiotomy reservoir
   f. Tubing (choice of adequate internal diameter)
   g. Osmotic pressure, oncotic pressure (use of mannitol, albumin)
   h. Blood gas control
7. Manipulation of:
   a. Flow
   b. Pressure
   c. Temperature

Clinical Skills: During the training program the resident:
1. Uses knowledge of the effects of extracorporeal bypass to ensure its safe use;
2. Recognizes the correct and incorrect set-up and operation of an extracorporeal circuit;
3. Plans and uses extracorporeal circuits in clinical practice;
4. Understands and treats physiologic derangements caused by blood-artificial surface interaction;
5. Plans and uses ventricular support devices in clinical practice.

B. Techniques of Extracorporeal Bypass

Program Objective: Upon successful completion of the residency program the resident understands the techniques of extracorporeal bypass and their application to solve specific clinical problems.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the standard techniques for extracorporeal bypass;
2. Understands the techniques for left heart bypass and right heart bypass for the treatment of specific clinical problems;
3. Understands the techniques of cannulation for extracorporeal bypass;
4. Oversees the management of patients undergoing extracorporeal bypass.

**Contents:**
1. Standard cardiopulmonary bypass
   a. Routes for cannulation (arterial and venous)
   b. Types of extracorporeal circuits
   c. Monitoring
   d. Complications
2. Anticoagulation for cardiopulmonary bypass
   a. Heparin and other agents
   b. Monitoring
   c. Reversal
   d. Complications
3. Special situations
   a. Left and/or right heart bypass
   b. Profound hypothermia and circulatory arrest

**Clinical Skills:** During the training program the resident:
1. Performs cannulation for extracorporeal bypass using appropriate access routes;
2. Uses appropriate types of extracorporeal bypass to solve specific clinical problems;
3. Uses left and right heart bypass.

**C. Mechanical Support**

**Program Objective:** Upon successful completion of the residency program the resident understands the indications for mechanical cardiac support and ECMO, patient selection, device selection, recognition and treatment of the complications of mechanical support, methods for weaning the patient from support, and “bridging” to transplantation.

**Learner Objectives:** Upon successful completion of the residency program the resident:
1. Understands the indications for cardiac support with mechanical devices or ECMO;
2. Understands alternatives to mechanical support (e.g., intra-aortic and intrapulmonary balloon pumping);
3. Knows the techniques for inserting these ventricular support devices;
4. Recognizes complications of the devices;
5. Understands the principles of weaning patients from these devices;
6. Understands the use of mechanical devices as a “bridge” to transplantation;
7. Knows the requirements for anticoagulation and monitoring of blood trauma;
8. Understands Federal regulations that apply to the use of these devices.

**Contents:**
1. Indications for mechanical support
   a. Deterioration of an established prospective transplant recipient
   b. Patient unable to be weaned from cardiopulmonary bypass but is a candidate for “postcardiotomy” usage or “bridging” to transplantation
   c. Acute myocardial infarction with balloon-dependent left heart failure
2. Respiratory failure
   a. Indications for ECMO
   b. Alternatives to ECMO
3. Alternatives to mechanical devices
   a. Balloon pumping (left and right)
   b. Centrifugal devices
   c. Impeller devices
   d. Pulsatile devices
   e. Total artificial heart
4. Techniques of insertion
   a. Cardiac
   b. ECMO
5. Complications
   a. Blood trauma
   b. Thrombosis
   c. Bleeding
   d. Infection
6. Weaning the patient from support devices and the use of mechanical devices to “bridge” to transplantation
   a. Hemodynamic parameters used in weaning from cardiac support, criteria for weaning and rate of weaning
   b. Concept of “rehabilitation” of the bridging patient and modification of transplantation criteria for the bridging patient
7. Anticoagulation
   a. Requirements for various mechanical devices
   b. Detection of blood trauma
   c. Early detection of thrombotic problems

Clinical Skills: During the training program the resident:
1. Evaluates and participates in the preoperative and postoperative management of patients requiring mechanical support;
2. Uses appropriate mechanical cardiac support and ECMO;
3. Manages the complications from the use of mechanical support and ECMO;
4. Weans patients from mechanical support and ECMO;
5. Manages patients bridging to transplantation;
6. Manages the anticoagulation of patients on mechanical support and ECMO.

D. Fundamentals of Coagulation Management and Blood Component Therapy

Program Objective: Upon successful completion of the residency program the resident knows the physiology, methods, and techniques to manage the coagulation and fibrinolytic systems, and uses component therapy to treat specific clinical problems.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the major blood groups, the clotting cascade, and the pathophysiology of clotting (e.g., abnormal clotting, activation of complement, Kallikrein, prostanoids);
2. Understands the specific hemorrhagic and thrombotic complications of cardiac surgery and their management;
3. Understands the methods used in blood component storage and the measures taken to ensure a safe blood supply;
4. Understands the use of specific blood components to treat abnormalities of red cell quantity and quality, platelet quantity and quality, and coagulation function;
5. Knows the preoperative risk factors for excessive blood loss and blood utilization;
6. Understands the operative and postoperative techniques to ensure blood conservation.

Contents:
1. Blood characteristics
   a. Blood groups and specific antigens
   b. Cellular elements
   c. Clotting cascade
   d. Pathophysiology of clotting
   e. Drugs that affect clotting and platelet function
2. Hemorrhagic and thrombotic complications of cardiac surgery
   a. Diagnosis
   b. Preoperative, intraoperative, and postoperative management
   c. Heparin, Protamine
   d. Cardiac and vascular prostheses
3. Component therapy
   a. Packed red blood cells
   b. Fresh frozen plasma
   c. Platelets
   d. Cryoprecipitate
   e. Specific clotting factors
4. Blood conservation
   a. Indications for transfusion
   b. Autotransfusion
   c. Cell-plasma salvage
   d. Hemoconcentration
   e. Pharmacologic manipulation

Clinical Skills: During the course of the program, the resident:
1. Evaluates patients requiring component therapy and develops management strategies to correct abnormalities of the coagulation system;
2. Uses appropriate tests to ensure the safety of blood and blood components;
3. Uses appropriate blood conservation techniques.
XII. MINOR PROCEDURES
A. Bronchoscopy
Program Objective: Upon successful completion of the residency program the resident understands the indications, patient preparation, and techniques of rigid and/or fiberoptic bronchoscopy, and performs these procedures under local, regional, or general anesthesia.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the indications, techniques, and complications of rigid and fiberoptic bronchoscopy of the larynx and tracheobronchial tree.
Contents:
1. Rigid bronchoscopy
   a. Indications
   b. Patient selection
   c. Instrumentation
   d. Techniques under local and under general anesthesia
   e. Biopsy and brushing techniques
   f. Complications
2. Fiberoptic bronchoscopy
   a. Indications
   b. Patient selection
   c. Instrumentation
   d. Techniques under local and under general anesthesia
   e. Biopsy and brushing techniques
   f. Complications
3. Laser techniques
   a. Safety measures
   b. Types of application
   c. Delivery systems
Clinical Skills: During the training program the resident:
1. Evaluates and manages patients requiring bronchoscopy;
2. Performs rigid and fiberoptic bronchoscopy using various anesthetic techniques;
3. Obtains diagnostic material using various biopsy techniques;
4. Uses laser techniques via bronchoscopy;
5. Uses stents via bronchoscopy.

B. Esophagoscopy
Program Objective: Upon successful completion of the residency program the resident understands the indications, patient preparation, and techniques of rigid and fiberoptic esophagoscopy, and performs these procedures under local, regional, or general anesthesia.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the indications, techniques, and complications of rigid and fiberoptic esophagoscopy.
Contents:
1. Rigid esophagoscopy
   a. Indications
   b. Patient selection
   c. Instrumentation
   d. Techniques under local and under general anesthesia
   e. Biopsy and brushing techniques
   f. Complications
2. Fiberoptic esophagoscopy
   a. Indications
   b. Patient selection
   c. Instrumentation
   d. Techniques under local and under general anesthesia
   e. Biopsy and brushing techniques
   f. Complications
3. Laser techniques
   a. Safety measures
   b. Types of application
Clinical Skills: During the training program the resident:
1. Evaluates and manages patients requiring esophagoscopy;
2. Performs rigid and fiberoptic esophagoscopy using various anesthetic techniques;
3. Obtains diagnostic material using various biopsy techniques;
4. Uses laser techniques via esophagoscopy;
5. Uses stents via esophagoscopy.

C. Permanent Pacemakers
Program Objective: Upon successful completion of the residency program the resident understands the indications, implantation techniques, and complications and performs permanent pacemaker implantation.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the indications and contraindications for permanent cardiac pacing;
2. Knows the techniques and complications of epicardial and transvenous cardiac pacemakers;
3. Understands phrenic nerve pacing;
4. Understands cardiomyoplasty pacing techniques.

Contents:
1. Indications for pacemakers
   a. Sick sinus syndrome
   b. Heart block
   c. Hypertrophic obstructive cardiomyopathy
   d. Other
2. Techniques of pacemaker implantation
   a. Transvenous (single chamber and dual chamber)
   b. Epicardial (single chamber and dual chamber)
   c. Phrenic nerve pacing
   d. Cardiomyoplasty pacing
3. Types of pacemakers
   a. Single chamber
   b. Dual chamber
   c. Specialized applications
   d. Phrenic
   e. Cardiomyoplasty
4. Pacemaker complications
   a. Infections
   b. Pacing thresholds
   c. Exit block
   d. Pacemaker programming
   e. Lead fracture

Clinical Skills: During the training program the resident:
1. Performs transvenous and epicardial pacemaker insertion using single and dual chamber pacemakers;
2. Manages complications of pacemakers (e.g., infections, programming problems, lead fractures);
3. Implants diaphragmatic pacemakers.

D. Tube Thoracostomy
Program Objective: Upon successful completion of the residency program the resident understands the indications, complications, and techniques and performs tube thoracostomy.
Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the indications and contraindications for tube thoracostomy;
2. Knows the techniques and complications of tube thoracostomy and their management.

Contents:
1. Indications for tube thoracostomy
   a. Pleural spaces
   b. Pleural effusions and empyema
   c. Lung parenchymal air leaks
2. Insertion techniques
   a. Instrument placement
   b. Trocar placement
   c. Direct vision (e.g., thoracotomy)
   d. Local, regional or general anesthesia
3. Complications
   a. Lung parenchymal injury
   b. Neurovascular intercostal injury
   c. Infection
   d. Post chest tube pneumothorax

Clinical Skills: During the training program the resident:
1. Evaluates patients for tube thoracostomy;
2. Performs tube thoracostomy under local, regional and general anesthesia;
3. Treats the complications of tube thoracostomy.

E. Central Venous Lines and Arterial Lines

Program Objective: Upon successful completion of the residency program the resident understands the indications, contraindications, management, and complications of central venous lines and arterial lines, and performs placement.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the indications, contraindications, management and complications of central venous lines and arterial lines.

Contents:
1. Central venous lines
   a. Indications
   b. Contraindications
   c. Complications
   d. Catheter types, including pulmonary artery catheters

2. Arterial lines
   a. Indications
   b. Contraindications
   c. Complications
   d. Catheter types

Clinical Skills: During the training program the resident:
1. Performs central venous line insertions by appropriate techniques (e.g., internal jugular vein, subclavian vein, femoral vein);
2. Performs arterial line insertions by appropriate techniques (e.g., radial, brachial, femoral and pedal arteries);
3. Manages complications of central venous and arterial lines.

XIII. THORACIC SURGERY AND RESEARCH

Note: The knowledge and skills described in this section may be developed before or during clinical training in thoracic surgery. The program does not presuppose an interruption of clinical training. These skills may be strengthened and augmented by laboratory training, courses, and formal education in clinical or laboratory research.

Program Objective: Upon successful completion of the residency program the resident understands the application of the scientific method to thoracic surgery, is able to describe problems in research terms and to design a scientific approach to the solution of an unsolved problem in thoracic surgery. The resident becomes facile in the interpretation and critical evaluation of the thoracic surgery literature.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understands the scientific method as it applies to basic and clinical research;
2. Knows how to access the literature including computerized and conventional library searches;
3. Is able to interpret published material critically;
4. Understands the role of statistics in validating scientific inferences, including the appropriate application of statistical tests commonly used in the thoracic literature, their limitations and deficiencies;
5. Understands the role of power, significance, and sample size in interpreting data;
6. Knows how to develop and design a research proposal and complete the process of solving a problem scientifically.

Contents:
1. Review of the literature
   a. Technique of performing a literature review
   b. Critical analysis of published material

2. Scientific basis of practice
   a. The basis of current knowledge and beliefs
   b. How new knowledge is generated
   c. Valid comparisons
   d. Inferences from data
3. Scientific method
   a. Description of a researchable problem
   b. Formulation of a testable hypothesis
   c. Data collection and analysis
   d. Validation of a hypothesis using statistical methods

Research Skills: During the training program the resident:
1. Reads published material and listens to presentations critically;
2. Demonstrates understanding of the essential steps of the research process by preparing and submitting a manuscript for publication in a peer-reviewed journal or gives a presentation at Grand Rounds which meets the satisfaction of his/her teachers. Either an oral or a written presentation is appropriate.
3. Demonstrates competence by:
   a. Defining an analyzable problem or scientific question
   b. Assembling an appropriate literature review
   c. Synthesizing and analyzing available data
   d. Formulating an informed and insightful discussion
   e. Composing a properly constructed, critically reviewed bibliography or list of literature citations
4. Shows an understanding of the appropriate application of statistical tests to the problem;
5. Demonstrates an understanding of the appropriate application of other commonly used statistical tests such as univariate analysis, multivariate analysis, analysis of variance, and the use of T-tests for paired data and multiple comparisons. (Residents should know the limitations, deficiencies and proper applications of these commonly used statistical tests);
6. Shows evidence of ability to critically analyze major clinical research papers in the thoracic literature which guide practice;
7. Applies knowledge of the scientific method to design and execute at least one formal analysis to solve a problem related to thoracic surgery.

XIV. NON-CLINICAL ELEMENTS OF THORACIC SURGICAL PRACTICE

Program Objective: Upon successful completion of the residency program the resident understands the non-clinical elements of a thoracic surgical practice.

Learner Objectives: Upon successful completion of the residency program the resident:
1. Understand the ethical components of surgical practice;
2. Understands and will be able to use clinical database and outcome analysis in surgical practice;
3. Knows the medico-legal aspects of surgical practice;
4. Understands critical pathways and cost-benefit analysis in clinical decision making;
5. Understand organizational structure and mechanics of solo practice, group specialty practice, multi-specialty practice, and academic practice;
6. Knows the structure, responsibilities and requirements of managed care, capitation payment, contractual agreements, physician-hospital organizations, and independent Practice agreements;
7. Understands the time constraints imposed by the responsibilities of practice and the need for effective time management.

Contents:
1. Fundamental elements of ethical practice
   a. Hippocratic oath
   b. Primum non nocere
   c. Personal responsibility
   d. Honest and open communications
   e. Critical self analysis
2. Clinical database and outcome analysis
   a. Data collection
   b. Risk stratification
   c. Statistical analysis
   d. Regular review of data
   e. Comparative analysis
3. Cost factors and clinical outcome
   a. Analysis of redundancy, waste, inefficiency
   b. Entrepreneurial approach to cost and quality
4. Practice arrangements
   a. Administration of practice (e.g., fees, collections, insurance, billing, overhead, office management)
   b. Advantages and disadvantages of different practice arrangements
5. External economic forces
   a. Managed care
   b. Medicare, Medicaid, Champus
   c. PROs, IPAs
   d. Contracts
   e. Capitation

6. Medico-legal factors
   a. Prevention of litigation
   b. Record keeping
   c. Response to malpractice lawsuit
   d. Expert witness testimony

7. Time management
   a. Family needs
   b. Practice needs (e.g., patients, administration, associates)
   c. Community responsibilities
   d. Personal needs (e.g., continuing education, personal growth, life outside medicine)

V. GERIATRICS AND THE THORACIC SURGERY PATIENT

Program Objective: Upon successful completion of the residency program the resident will understand the effect of aging on determining preoperative risk assessment and postoperative management in the elderly.

Learner Objectives: Upon successful completion of the residency program the resident:

1. Understands the effect of aging on the major organ systems;
2. Recognizes the increased mortality of thoracic surgery procedures in the age groups of patients over 65;
3. Has an understanding of the more frequent morbidities that the elderly experience during the postoperative period;
4. Is competent to manage common postoperative complications, including delirium, in the elderly;
5. Understands the principles of decubitus ulcer prophylaxis in the postoperative period given the increased predisposition of the elderly to decubiti;
6. Understands the principles of end of life decision making (living wills, durable power of attorney).

Contents:
1. Methods to determine nutritional status
2. Tools for the evaluation of functional capacity and activities of daily living
3. Simple methods to measure cognitive function
4. Dementia
   a. Recognizing the major types of dementia
   b. Understanding the stages of progressive dementia
5. Measurements that identify other significant risks besides dementia for increased morbidity
   a. Cardiac dysfunction
   b. Renal dysfunction
   c. Obstructive uropathy
   d. Pulmonary dysfunction
   e. Depression
   f. Malnutrition
   g. Immobility
   h. Multiple medications
6. Postoperative delirium
   a. Diagnosis
   b. Risk Factors
   c. Prevention
      i. AVOID
         Infection
         Hypoxia
         Anemia
         Congestive heart failure
         Medications that can cause delirium
         Sleep deprivation
         Dehydration
         Mechanical restraints
ii. ENCOURAGE
Repeted orientation to time and place
Sensory input and cognitive stimulation
  o Vision aids
  o Hearing aids
  o Nonpharmacologic sleep protocol
  o Early mobilization, recognition & treatment of dehydration

7. Discharge planning
   a. Home care resources and conditions that can be managed at home
   b. Nursing home indications for skilled, subacute care
   c. Rehabilitation facilities often under physical medicine

8. Pharmacology Dosing and common side effects in the elderly for:
   a. Digoxin (dose usually halved)
      i. Mental status change
      ii. GI
      iii. Arrhythmia
   b. Calcium channel blockers (need long acting agents at lower doses)
      i. Bradyarrhythmias
      ii. Constipation
      iii. Congestive heart failure
      iv. Dependent edema
   c. Beta blockers (dose halved)
      i. Depression
      ii. Cognitive decline
      iii. Bradyarrhythmias
      iv. Hypoglycemic risk from diabetes treatment
      v. Worsening of ventilation in COPD
   d. Antiarrhythmic agents
      i. Lidocaine
         Confusion with toxic levels
      ii. Procainamide
         Torsade de Pointe
         Hypotension
         Lupus-like syndrome with extended use
      iii. Quinidine (rarely used)
         Diarrhea
         Torsade de Pointe
         Thrombocytopeniae
      iv. Amiodarone
         Nausea and vomiting
         Anorexia
         Instability of coumadin treatment
         Pulmonary toxicity
         Thyroid dysfunction
         Hepatic damage
         Neuropathy (tremors)

9. Prevention and treatment of decubitus ulcer in elderly patients with limited mobility and/or malnutrition
   a. Use of heel protective devices
   b. Prevention of sacral decubitus ulcer – repositioning, low-impact mattress
   c. Treatment
      i. Debridement
      ii. Barrier dressings
      iii. Nutrition
      iv. Low-impact mattress

10. End of life decision making
Clinical Skills: During the training program the resident:
   1. Participates in the preoperative assessment of elderly patients;
   2. Carries out discussions with the patient and families about the operative risks and postoperative course;
   3. Prevents and manages common postoperative complications of:
      a. Delirium
      b. Prolonged intubation
c. Decubitus ulcer
d. Sepsis
e. Low output state
f. Adverse drug effects
g. Depression
h. Immobility, deconditioning, functional decline
i. Falls, fractures
j. Dehydration
k. Incontinence and UTI

4. Participates in postoperative discussions both for patients doing well and for the complicated postoperative course including discussions about withdrawal of support systems.

5. Works with the discharge planning team in effecting a successful setting for patient discharge.

6. Participates in post-hospital discharge care in order to experience common problems of medication side effects, anorexia, arrhythmias and fluid imbalance