European Board of Cardiothoracic Surgery

Syllabus
ADULT CARDIAC SURGERY

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1. PREOPERATIVE AND POSTOPERATIVE CARE

A. Preoperative patient evaluation

• UNIT OBJECTIVE
At the end of the unit the resident has knowledge of preoperative risk factors and how to manage these factors

• CONTENTS
1. Preoperative medication
2. Physical examination
3. Preoperative hemodynamics
4. Management of preoperative risk factors

B. Postoperative care

• UNIT OBJECTIVE:
At the end of this unit the resident understands the postoperative management of patients undergoing cardiothoracic surgery and understands postoperative care of patients having palliation or correction of congenital cardiac anomalies and manages all aspects of their postoperative care.

• CONTENTS
1. Hemodynamic monitoring
   A. Non-invasive monitoring
   B. Invasive monitoring
   C. Cardiac output measurements
2. Circulatory management
   A. Inotropic/vasodilator
3. Complications
   A. Cardiac tamponade
   B. Renal failure
   C. Dialysis
      1) Indications
      2) Complications
      3) Types
   D. Congestive heart failure
   E. Cardiac dysrhythmias
   F. Management of bleeding and transfusion
   G. Sepsis
   H. Wound infection
4. Central Venous Lines, Arterial Lines and Pulmonary artery catheter
C. Fluids, Blood and Coagulation Management

- UNIT OBJECTIVE:
  At the end of this unit 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:
  At the end of the unit the resident:
  1. Understands pathophysiology of clotting
  2. Understands the specific haemorrhagic and thrombotic complications of cardiac surgery and their management;
  3. Understands the use of specific blood components to treat abnormalities of red cell quantity and quality, platelet quantity and quality, and coagulation function;
  4. Knows the preoperative risk factors for excessive blood loss and blood utilization;
  5. Understands the operative and postoperative techniques to ensure blood conservation.

- CONTENTS:
  1. Blood characteristics
     A. Pathophysiology of clotting
     B. Drugs that affect clotting and platelet function
  2. Haemorrhagic and thrombotic complications of cardiac surgery
     A. Diagnosis
     B. reoperative, 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. Haemoconcentration
     E. Pharmacologic manipulation

2. ETHICS, RESEARCH AND OUTCOMES

- UNIT OBJECTIVE:
  At the end of this unit the resident understands the non-clinical elements of a cardio-thoracic surgical practice, 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 completion of this unit the resident:

1. Understand the ethical components of surgical practice;
2. Understands the scientific method as it applies to basic and clinical research
3. Knows how to access the literature including computerized and conventional library searches
4. Is able to interpret published material critically and will be able to use clinical database and outcome analysis in surgical practice;
5. 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
6. Understands the role of power, significance, and sample size in interpreting data
7. Knows how to develop and design a research proposal and complete the process of solving a problem scientifically

• **CONTENTS:**

1. Fundamental elements of ethical practice
   A. Informed consent
   B. Primum non nocere
2. Clinical database and outcome analysis
   A. Data collection
   B. Risk stratification
   C. Statistical analysis
   D. Regular review of data
   E. Comparative analysis

3. **PULMONARY EMBOLISM**

• **UNIT OBJECTIVE:**

At the end of this unit the resident understands the pathophysiological aspects of pulmonary embolism and the surgical and non-surgical management.

• **CONTENTS:**

1. Incidence
2. Risk factors
3. Pathogenesis
   A. Deep vein thrombosis
4. Clinical manifestations
   A. Symptoms
   B. Arterial blood gases
   C. Electrocardiogram
   D. Chest x-ray
   E. Diagnosis
   F. Pulmonary angiography
   G. Transoesophageal echocardiography
   H. MRI-scan
   I. CT-scan
   J. Ventilation-perfusion scanning
5. Treatment
   A. Anticoagulation
   B. Trombolysis
   C. Surgery
   D. Cava interruption

6. Prognosis

7. Prevention

4. MECHANICAL CIRCULATORY SUPPORT

A. Physiology of Extracorporeal Bypass
   • UNIT OBJECTIVE:
     At the end of this unit 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 completion of the unit 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. Understands the basic design and function of ventricular support devices.

   • CONTENTS:
     1. Membrane oxygenators
        A. Physiology
        B. Design
        C. Complications
     2. Roller head pumps
        A. Design
        B. Safety measures
        C. Complications
     3. Vortex pumps
        A. Mechanism and design
        B. Safety measures
        C. Complications
     4. Extracorporeal circuits
        A. Set-up
        B. Types of tubing, filters, haemoconcentrators
        C. Safety measures
        D. Blood and artificial surface interaction
     5. Perfusion solutions
        A. Prime solutions
        B. Haemodilution
        C. Oxygenators (types, indications, benefits, disadvantages)
        D. Venous reservoir
        E. Cardiotomy reservoir
        F. Tubing (choice of adequate internal diameter)
        G. Blood gas control
6. Manipulation of:
   A. Flow
   B. Pressure
   C. Temperature

**B. Techniques of Extracorporeal Bypass**

- UNIT OBJECTIVE:
At the end of this unit the resident understands the techniques of extracorporeal bypass and their application to solve specific clinical problems.

- LEARNER OBJECTIVES:
Upon completion of the unit the resident:
1. Understands the 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.
5. Understand the principles of use and the various types of cardioplegia.

- 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
      1) Cerebral protection
4. Cardioplegia
   A. Cold and warm crystalloid cardioplegia
   B. Cold and warm blood cardioplegia
   C. Crystalloid versus blood cardioplegia
   D. Routes of cardioplegia

**C. Mechanical Circulatory Support**

- UNIT OBJECTIVE:
At the end of this unit, the resident understands the indications for mechanical cardiac support, 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 completion of the unit 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 intra-pulmonary 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;

• CONTENTS:
1. Indications for mechanical support
2. Mechanical circulatory support devices
   A. Balloon pumping (left)
   B. Centrifugal devices
   C. Impeller devices
   D. Pulsatile devices
   E. Total artificial heart
3. Techniques of insertion
4. Complications
5. Anticoagulation

D. ECMO
• UNIT OBJECTIVE:
At the end of this unit, the resident understands the indications for ECMO, patient selection, device selection, recognition and treatment of the complications of the complications and methods for weaning the patient from ECMO.

• LEARNER OBJECTIVES:
Upon completion of the unit the resident:
1. Understands the indications for cardiac and/or respiratory support with ECMO;
2. Knows the techniques for inserting these ventricular support devices;
3. Recognizes complications of the devices;
4. Understands the principles of weaning patients from these devices;
5. Knows the requirements for anticoagulation and monitoring of blood trauma;

• CONTENTS:
1. Indications and contraindications
2. Types of support (respiratory, cardiac, cardiorespiratory)
3. Configurations (VA, VV, VAV)
4. Cannulation strategies (peripheral, central ..)
5. Support during ECMO (Haemodynamic, coagulation)
6. Implant and wearing
7. Withdrawal of support
5. VALVULAR HEART DISEASE

- UNIT OBJECTIVE:
  At the end of this unit, the resident knows the normal and pathologic anatomy of the cardiac valves. Understands their natural history, physiology, clinical assessment and surgical management

- LEARNER OBJECTIVES:
  Upon completion of the unit 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; knows the relative risks of operative and non-operative treatment for valvular heart disease in planning interventions and is familiar with the surgical indications according to the major guidelines
  4. Knows the theory of techniques for repair and replacement of cardiac valves;
  5. Knows the theory of the preoperative and postoperative management of patients with valvular heart disease including catheterizations and echocardiograms
  6. Knows alternative approaches for minimally invasive techniques

- GENERAL CONTENTS:
  1. Assessment of patients with valvular heart disease
     A. History and physical examination
     B. Echocardiogram
     C. Cardiac catheterization data
     D. Indications for surgery
  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
     F. Minimally invasive approaches
     G. Transcatheter prosthetic valves
     H. Sutureless prosthetic valves
  3. Long term complications of replacement devices
     A. Thrombosis
     B. Embolus
     C. Prosthetic dysfunction

- VALVE SPECIFIC CONTENTS
  1. Aortic valve
     A. Normal anatomy
     B. Normal function
     C. Aortic stenosis
        1) etiology and pathologic anatomy
        2) natural history and complications
        3) physiology (ventricular hypertrophy, mitral incompetence)
        4) non-operative therapy
        5) indications for operative intervention (risk stratification)
        6) techniques of valve replacement and repair
7) management of small aortic root
8) homograft and autograft valve replacement
9) perioperative care considerations
10) early and late results
11) patient-prosthesis mismatch

D. Aortic incompetence
1) etiology and pathologic anatomy
2) natural history and complications
3) physiology (LV dilatation and LV dysfunction)
4) non-operative treatment
5) indications for operative intervention

E. Indications for operative intervention in absence of clinical symptoms
1) when complicated by endocarditis
2) when complicated by aortic root aneurysm
3) techniques of valve repair and replacement
   i. with endocarditis and aortic root abscess
   ii. with ascending and root aneurysm
4) Perioperative care considerations
5) early and late results

2. Tricuspid valve
   A. Normal anatomy
   B. Normal function
   C. Tricuspid incompetence
      1) etiology and pathologic anatomy
      2) physiology
      3) indications for operation
      4) functional incompetence
      5) endocarditis
      6) techniques of repair, indications for replacement
      7) ring and suture annuloplasty
   D. endocarditis (valve excision vs. repair or replacement)
   E. perioperative care
      1) management of RV dysfunction
      2) interventions to decrease pulmonary vascular resistance
   F. early and late results
   G. Tricuspid stenosis
      1) etiology and pathologic anatomy
      2) physiology
      3) differentiation from constrictive pericarditis
      4) indications for operative repair vs. replacement
   H. techniques of repair and replacement
   I. early and late results

3. Mitral valve
   A. Normal anatomy
   B. Normal function
   C. Mitral stenosis
      1) etiology and pathologic anatomy
      2) natural history and complications
      3) physiology
      4) non-operative treatment
      5) indications for intervention (risk stratification)
6) merits of balloon valve dilation vs. operative repair or replacement
7) techniques of valve repair and replacement
8) intraoperative and postoperative complications and management
9) early and late results of operative and balloon valvulotomy

D. Mitral incompetence
1) etiology and pathologic anatomy
2) natural history and complications
3) physiology (mechanisms of incompetence)
4) non-operative treatment
5) for nonischemic etiology
6) for ischemic etiology
7) indications for surgical intervention (risk stratification)
8) techniques of valve repair
9) ring and suture annuloplasty
10) leaflet plication, excision
11) chordal/papillary muscle shortening
12) chordal transposition and artificial chordae
13) edge-to-edge technique
14) percutaneous techniques
15) perioperative care
16) early and late results of repair and replacement

4. Endocarditis
A. Etiology
B. natural history and complications
C. non-operative treatment
D. techniques of valve repair and replacement
   1) aortic root abscess
E. Outcome

5. Combined valve lesions
A. natural history and complications
B. physiology
C. non-operative treatment
D. indications for surgery (risk stratification)
E. techniques of valve repair and replacement
F. intraoperative and postoperative complications and management
G. early and late results of therapy

6. Percutaneous heart valves
A. Indications
B. Type of prosthesis
C. Surgical approaches (access)
D. Complications
6. CORONARY ARTERY DISEASE

- UNIT OBJECTIVE:
  At the end of this unit the resident understands the physiology of coronary circulation, the pathophysiologic causes and derangement of ischemic heart disease and the sequelae of coronary events.

- LEARNER OBJECTIVES:
  Upon completion of the unit 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.
  8. The residents knows how to evaluate patients with angina pectoris, unstable angina pectoris, and acute myocardial infarction;
  9. Can read and interpret invasive and non-invasive tests of patients with ischemic heart disease
  10. Has knowledge about the critical care management of preoperative and postoperative patients with ischemic heart disease;
  11. Knows how to evaluate exercise tolerance tests, echocardiograms, and cardiac catheterizations.
  12. Knows the new techniques in coronary surgery

- 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
  2. Radiographic cardiac and coronary anatomy
     A. Right anterior oblique views
     B. Left anterior oblique views
     C. Cranial view
     D. Ventriculography
  3. Pathologic development of atherosclerotic plaque
     A. Endothelial injury
     B. Platelet factors
     C. Cellular factors
     D. Serum factors
4. Coronary artery bypass grafting
   A. Rationale
   B. Conduits
   C. Techniques
   D. Technical considerations
   E. Myocardial protection
5. Preoperative evaluation
   A. Symptoms of cardiac ischemia
   B. Non-invasive testing
   C. Invasive testing
   D. Decision making
6. Postoperative care
   A. Intensive care
   B. Acute care
7. Long term management
   A. Late complications
   B. Outcome
   C. Expected operative mortality
   D. Long term results
   E. Complications of ischemic heart disease
8. Ischemic mitral insufficiency
   A. Ruptured papillary muscle (non-operative and operative management)
9. Ventricular septal defect (non-operative and operative management)
10. Cardiac rupture (non-operative and operative management)
11. Left ventricular aneurysm
12. Combined Coronary artery and carotid artery disease
13. New Techniques in coronary surgery
   A. Techniques of off-pump surgery (OPCAB)
   B. Pro’s and con ‘s of off pump surgery
   C. Minimal invasive coronary surgery (MIDCAB)
   D. Robotically assisted surgery

7. SURGERY FOR ATRIAL FIBRILLATION

   • UNIT OBJECTIVE:
     At the end of this unit the resident understands the etiology and physiology of atrial fibrillation, and
     operative and non-operative treatment.

   • LEARNER OBJECTIVES:
     Upon completion of the unit the resident:
     1. Understands the etiology of cardiac arrhythmias and underlying physiologic disturbances;
     2. Understands operative and non-operative management;
• CONTENTS:
1. Surgery for atrial fibrillation
   A. Energy sources for ablation of atrial fibrillation and the Gold Standard Cut-and-sew Cox Maze III
   B. Pulmonary vein isolation
   C. Left side lesions Maze lesions
   D. Right side lesions Maze lesions
   E. Surgery for lone atrial fibrillation
   F. Surgery for concomitant atrial fibrillation
   G. Surgical management of left atrial appendage

8. ABNORMALITIES OF THE AORTA
• UNIT OBJECTIVE:
At the end of this unit the resident understands the etiology and physiology of diseases of the aorta and the operative and non-operative treatment.

• LEARNER OBJECTIVES:
Upon completion of the unit 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. Evaluates and interprets plain radiography, echocardiography, CT scans, MRI, and contrast studies for diseases of the aorta;
4. Develops knowledge on operative and non-operative management of thoracic aortic disease, including aneurysms, acute and chronic dissections, and occlusive disease;
5. Has knowledge on the use of extracorporeal bypass, hypothermia, and circulatory arrest for aortic diseases;
6. Develops knowledge on preoperative and postoperative care of patients with aneurysms, dissections, and occlusive disease of the aorta.
7. Knows the relevance of bicuspid aortic valves and connective tissue disorders

• CONTENTS:
1. Aortic aneurysms (atherosclerotic, aortic dissections)
   A. Ascending
   B. Transverse
   C. Descending
   D. Abdominal
   A. Ascending
   B. Transverse
   C. Descending
   D. Abdominal
3. New techniques in treatment of aortic disease
   A. EVAR and Hybrid therapies. Indications
9. CARDIAC TUMORS

- UNIT OBJECTIVE:
  At the end of this unit the resident understands the pathophysiology of primary and metastatic tumors, their natural history and operative/non-operative management

- LEARNER OBJECTIVES:
  Upon completion of the unit the resident:
  1. Understands the types of cardiac tumors (frequency, anatomic location, physiologic and pathologic derangements, diagnostic methods and surgical management;)
  2. Knows how to perform operative excision of cardiac tumors

- CONTENTS
  1. Tumors
     A. Types, pathology
     B. Location
     C. Physiology
     D. Primary vs. metastatic
     E. Malignant pericardial effusion
     F. Surgical management

10. MYOCARDITIS, CARDIOMYOPATHY, HYPERTROPHIC OBSTRUCTIVE CARDIOMYOPATHY

- UNIT OBJECTIVE:
  At the end of this unit the resident understands the pathology and etiology of diseased myocardium, the natural history of the diseases and physiologic alterations, and understands operative and non-operative management.

- LEARNER OBJECTIVES:
  Upon completion of the unit the resident:
  1. Understands myocarditis (causes, physiologic changes, treatment, prognosis, and radiographic, EKG and echocardiographic changes)
  2. Understands hypertrophic cardiomyopathy (genetic linkage, pathologic and anatomic changes, physiologic derangements, clinical features, diagnostic tests, natural history, medical and surgical treatment)
  3. Knows the types of cardiomyopathies (causes, natural history, diagnostic methods, operative and nonoperative treatment)
  4. Knows how to perform operations for the treatment of HCM

- CONTENTS
  1. 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
   1) echocardiography
   2) cardiac catheterization
H. Mitral valve
   1) systolic anterior motion
   2) mitral regurgitation
I. Treatment
   1) mitral valve replacement
   2) myectomy and myotomy
   3) pacing
J. Outcome
   1) complications
   2) long-term results

2. Cardiomyopathy
   A. Dilated
   B. Restrictive
   C. Causes
   D. Pathology
   E. Pathophysiology
   F. Diagnosis
      1) echocardiography
      2) endomyocardial biopsy
   G. Clinical course
   H. Treatment
   I. Outcome

3. Myocarditis
   A. Pathologic changes
   B. Etiology
   C. Clinical findings
   D. Treatment
   E. Outcome

11. CARDIOVASCULAR TRAUMA

   • UNIT OBJECTIVE:
     At the end of this unit the resident understands the pathophysiology of thoracic trauma resulting in injury to the heart and great vessels, and knows how to diagnose, resuscitate and treat patients with these injuries.

   • LEARNER OBJECTIVES:
     Upon completion of the unit 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. Non-invasive diagnostic techniques
   C. Management
   D. Follow-up 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
3. Operative approaches for specific injuries
   A. use of cardiopulmonary bypass or partial mechanical support
   B. management of concomitant injuries
4. Postoperative management
   A. Outcomes
5. Traumatic aortic transection
   A. Pathophysiology
   B. Anatomic locations and operative approaches
   C. Operative management
   D. Management of associated injuries
   E. Outcomes

12. INTRA-THORACIC ORGAN TRANSPLANTATION

A. Cardiac Transplantation
   • UNIT OBJECTIVE:
   At the end of this unit, 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 completion of the unit the resident:
   1. Knows the indications for cardiac transplantation;
   2. Knows the techniques of cardiac transplantation;
   3. Recognizes the signs and symptoms of cardiac rejection and knows the appropriate management;
   4. Understands the evaluation and management of organ donors;
   5. Knows the methods of organ harvest and preservation;

   • CONTENTS:
   1. Indications for cardiac transplantation
      A. Patient evaluation
      B. Patient selection
   2. Technique of cardiac transplantation
      A. Orthotopic
   3. Donor preparation and organ harvest
   4. Cardiac rejection
B. Lung Transplantation

- **UNIT OBJECTIVE:**
  At the end of this unit, the resident knows the principles of organ preservation, immunosuppressive therapy, signs and treatment of rejection, and the indications for and techniques of lung transplantation.

- **LEARNER OBJECTIVES:**
  Upon completion of the unit the resident:
  1. Knows the indications for lung transplantation;
  2. Understands the management of immunosuppressive therapy in lung transplantation;
  3. Knows the techniques of lung transplantation;
  4. Recognizes the signs and symptoms of lung rejection and knows the appropriate management;
  5. Understands the evaluation and management of organ donors;
  6. Knows the methods of lung harvest and preservation;
  7. Is familiar with the techniques and complications of lung biopsy.

- **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 lung transplantation
  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. Lung rejection
     A. Signs and symptoms
     B. Lung biopsy
     C. Histologic evaluation
     D. Management
     E. Ventilatory 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
13. ABNORMALITIES OF THE PERICARDIUM

- UNIT OBJECTIVE:
  At the end of this unit the resident understands pericardial diseases and knows how to perform operative and non-operative management.

- LEARNER OBJECTIVES:
  Upon completion of this unit 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.
  4. Understands abnormal physiologic findings to diagnose pericardial pathology;
  5. Knows how to evaluate and manage patients with pericardial cysts or tumors;

- 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
CONGENITAL HEART DISEASE

1. ANATOMY

- UNIT OBJECTIVE:
  At the end of the unit 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, angiography, and other imaging techniques.

- LEARNER OBJECTIVES:
  Upon completion of the unit the resident:
  1. Knows the embryology and anatomy of the normal heart
  2. Knows the embryology and anatomy of major cardiac anomalies
  3. Interprets angiography, echocardiograms, and imaging modalities and is able to correlate these with normal and abnormal cardiac anatomy and function
  4. Aware of the evolution of congenital cardiac surgery, its current scope and limitations

2. PHYSIOLOGY AND PHYSIOLOGIC EVALUATION

- UNIT OBJECTIVE:
  At the end of this unit the resident understands development, perinatal and postnatal cardiovascular physiology and the physiologic consequences of congenital heart disease.
  The resident understands the appropriate use, interpretations and limitations of invasive and non-invasive tests to define structural abnormalities and uses them in planning patient management.

- LEARNER OBJECTIVES:
  Upon completion of the unit the resident:
  1. Understands normal fetal circulation
  2. Understands the transitional nature of the post-natal circulation
  3. Understands the significance of intra- and extracardiac shunts, obstructive lesions, abnormal morphology and position of the heart, and of combinations of these anomalies in the fetus, neonate, and child.

3. CARDIOPULMONARY BYPASS FOR OPERATIONS ON CONGENITAL CARDIAC ANOMALIES

- UNIT OBJECTIVE:
  At the end of this unit 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 hypothermia and circulatory arrest in the infant and child.
• **LEARNER OBJECTIVES:**
Upon completion of the unit the resident:
1. Knows the indications for and benefits of 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 principles of myocardial protection in the neonate and young infant;
4. Understands the significance of haemodilution and coagulation management;
5. Understands perfusion flow and pressure control;
6. Knows the methods of body temperature manipulation, and the indications for and techniques of hypothermia with and without circulatory arrest.

4. **LEFT-TO-RIGHT SHUNTS**
• **UNIT OBJECTIVE:**
At the end of the unit the resident understands the diagnosis and treatment of left-to-right shunts

• **LEARNER OBJECTIVES:**
Upon completion of the unit 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.

A. **Atrial septal defect**
• **CONTENTS**
1. Anatomy
   A. types of atrial septal defects and key landmarks of the right atrium.
2. Clinical features
   A. natural history, indications for operation
   B. clinical signs and symptoms, physical exam
   C. chest x-ray and ECG
   D. echocardiogram and cardiac catheterization
3. Operative repair and complications
   A. cardiopulmonary bypass and myocardial protection
   B. incisions in the heart
   C. techniques for defect closure
   D. treatment of associated anomalies (e.g., cleft mitral valve)
   E. complications of closure (e.g., air embolism, conduction abnormalities, residual defects)
4. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
B. Ventricular septal defect

- CONTENTS

1. Anatomy
   A. types

2. Clinical features
   A. clinical signs and symptoms, physical exam
   B. echocardiogram and cardiac catheterization
   C. chest x-ray and ECG
   D. natural history
   E. indications, contraindications, timing of operation (e.g., total repair vs. pulmonary artery banding)

3. Operative repair and complications
   A. cardiopulmonary bypass and myocardial protection
   B. surgical approaches and closure techniques
   C. treatment of associated anomalies (e.g., atrial septal defect, right ventricular muscle bands)
   D. complications (rhythm disturbances, residual defects, air)
   E. indications for and techniques of PA banding
   F. hybrid approaches to VSD closure

4. Outcomes
   A. expected operative mortality
   B. long-term results
   C. complications

C. Patent ductus arteriosus

1. Anatomy
2. Physiology
   A. neonate vs. older child
   B. effect of prostaglandin and prostaglandin inhibitors

3. Diagnosis and clinical features
   A. symptoms and physical findings
   B. echocardiogram and cardiac catheterization
   C. chest x-ray and ECG
   D. natural history (neonate vs. older child, endocarditis)
   E. indications for operation
   F. associated anomalies (e.g., ductus-dependent conditions)

4. Operative repair and complications
   A. operative techniques for simple ductus
   B. management of the difficult ductus
   C. complications of operative repair

5. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
D. Atrioventricular septal defect

1. Anatomy
   A. types (complete, transitional, ostium primum ASD)
   B. atrioventricular valve pathologic anatomy

2. Physiology
   A. shunts and resistance calculation
   B. complete vs. incomplete

3. Diagnosis and clinical features
   A. Symptoms and signs (infant vs. older patient, physical exam)
   B. echocardiogram, angiocardiogram, cardiac catheterization
   C. chest x-ray and ECG
   D. natural history (development of Eisenmenger’s syndrome)
   E. indications for and timing of operation (size of shunt, endocarditis risk, total repair vs. pulmonary artery banding)

4. Operative repair and complications
   A. cardiopulmonary bypass and myocardial protection
   B. operative techniques
   C. complications (residual defects, residual atrioventricular valve insufficiency, heart block)

5. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications

5. CYANOTIC ANOMALIES

   - UNIT OBJECTIVE:
     At the end of this unit 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 completion of the unit the resident:
     1. Knows the anatomy and physiology of each of the below anomalies;
     2. Aware of common diagnostic modalities;
     3. Understands the role of medical management and interventional cardiology as treatment options;
     4. Appreciates 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

A. Tetralogy of Fallot

1. Anatomy and embryology
   A. embryology of malaligned ventricular septal defect
   B. levels of right ventricular outflow tract obstruction

2. Physiology
   A. pathogenesis of “tet spells” and infundibular spasm
   B. factors which affect degree of right-to-left shunting
   C. associated anomalies
3. Clinical features
   A. symptoms and physical findings
   B. echocardiogram, angiography
   C. chest x-ray, ECG
   D. natural history
   E. indications for and timing of operation

4. Operative repair and complications
   A. role of palliation with systemic-to-pulmonary artery shunt or transcatheter stent vs. total repair
   B. types of aortic-to-pulmonary artery shunts
   C. extracorporeal bypass and myocardial protection
   D. ventricular septal defect closure by transventricular or transatrial approach
   E. techniques for relief of right ventricular outflow tract obstruction and indications for transannular patching
   F. indications for conduit repair

5. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications

B. Transposition of the great vessels (TGA)

1. Anatomy
   A. simple TGA
   B. complex TGA (ventricular septal defect, pulmonary stenosis)

2. Physiology

3. Concept of circulations in parallel and mixing

4. Clinical features
   A. symptoms and physical findings
   B. echocardiogram, angiocardiogram, cardiac catheterization
   C. chest x-ray, ECG
   D. natural history, role of balloon atrial septostomy
   E. indications for and timing of operations

5. Operative repair and complications
   A. Indications for percutaneous Rashkind balloon atrial septostomy
   B. cardiopulmonary bypass and myocardial protection
   C. operative techniques for anatomical and physiological repair (arterial switch, atrial switch including Mustard and Senning)
   D. palliative operations (PA band, systemic-to-pulmonary artery shunt)

6. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
   D. arrhythmias after atrial repairs
   E. semi-lunar valve insufficiency, PA stenosis, coronary problems after arterial switch

C. Truncus arteriosus

1. Anatomy
   A. types of truncus arteriosus
   B. associated anomalies (VSD, left ventricular outflow tract obstruction, arch interruption, DiGeorge syndrome)
2. Clinical features
   A. symptoms and physical findings
   B. echocardiogram, angiography
   C. chest x-ray, ECG
   D. natural history (development of pulmonary vascular obstructive disease)
   E. indications for and timing of operation

3. Operative repair and complications
   A. cardiopulmonary bypass and myocardial protection
   B. principles of operative repair

4. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications

D. Tricuspid atresia
   1. Anatomy and physiology
      A. subtypes with right-to-left shunt
      B. subtypes with left-to-right shunt
   2. Clinical features
      A. symptoms and physical findings
      B. echocardiogram, angiography, cross-sectional imaging
      C. chest x-ray, ECG
      D. natural history, role of balloon atrial septostomy
      E. indications for and timing of operation
      F. role of palliative operations (systemic-pulmonary artery shunts, PA banding, bidirectional Glenn, Fontan, other right heart bypass operations)

3. Operative repair and complications
   A. palliative operations
   B. operations for right heart bypass (bidirectional Glenn, Fontan)

4. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications

E. Total anomalous pulmonary venous connection
   1. Anatomy
      A. supracardiac, cardiac, infracardiac, mixed
   2. Physiology
      A. obstructive vs. nonobstructive
   3. Clinical features
      A. symptoms and physical findings
      B. echocardiogram, angiography
      C. chest x-ray, ECG
      D. natural history
      E. indications for and timing of operation
4. Operative repair and complications  
   A. cardiopulmonary bypass, myocardial protection  
   B. operative techniques for different subtypes  

5. Outcome  
   A. expected operative mortality  
   B. long-term results  
   C. complications  

F. Ebstein’s anomaly  
1. Anatomy  
2. Physiology  
   A. concept of atrialized ventricle  
   B. right ventricular outflow tract obstruction  
3. Clinical features  
   A. symptoms and physical findings  
   B. echocardiogram, angiography and MRI  
   C. chest x-ray, ECG  
   D. natural history  
   E. associated lesions (e.g., Wolf-Parkinson-White syndrome)  
   F. indications for and timing of operation  

4. Operative repair and complications  
   A. cardiopulmonary bypass and myocardial protection  
   B. principles of reparative techniques (tricuspid valve repair, reduction of the atrialized ventricle)  
   C. technique of tricuspid valve replacement  

5. Outcome  
   A. expected operative mortality  
   B. long-term results  
   C. complications  

6. OBSTRUCTIVE ANOMALIES  
   • UNIT OBJECTIVE:  
     At the end of this unit 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 completion of the unit 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:

A. LVOT obstruction

1. Anatomy
   A. supravalvular, valvular, subvalvular (including subtypes)
2. Physiology
3. Associated anomalies (e.g. Williams syndrome)
4. Clinical features
   A. symptoms and physical findings
   B. cardiac catheterization, echocardiogram, angiocardiogram
   C. chest x-ray, ECG
   D. natural history
   E. Indications for and timing of operation
5. Operative repair and complications
   A. cardiopulmonary bypass, myocardial protection
   B. operative techniques
6. Specific techniques
   A. Patching configurations for supravalvular stenosis
   B. techniques of aortic valvotomy
   C. managing the small aortic root (e.g., Konno type procedures, Ross procedure)
   D. technique of apical aortic conduit
   E. myomectomy and myotomy for subaortic obstruction
7. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications

B. Pulmonary stenosis

1. Anatomy
   A. Valvular and supravalvular
   B. associated anomalies (e.g., atrial septal defect, ventricular septal defect, branch pulmonary artery stenosis, Noonan’s)
2. Clinical features
   A. symptoms and physical findings
   B. echocardiogram, angiography
   C. chest x-ray, ECG
   D. natural history; role of balloon valvuloplasty
   E. Indications for and timing of operation
3. Operative repair and complications
   A. cardiopulmonary bypass, myocardial protection
   B. incisions in the heart and great vessels
   C. operative considerations (technique of valvulotomy, indications for transannular patching, division of right ventricular muscle bands)
   D. complications (residual obstruction)
4. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
C. Coarctation of the aorta

1. Anatomy
   A. relationship to the ductus arteriosus
   B. associated anomalies (e.g., hypoplasia of transverse aorta, patent ductus arteriosus, LVOT obstruction)

2. Physiology
   A. infant vs. older child
   B. preductal vs. paraductal vs. postductal
   C. assessment of adequacy of collateral circulation

3. Clinical features
   A. symptoms and physical findings (neonate with a closing ductus vs. older infant and child)
   B. echocardiogram, angiogram, cardiac catheterization
   C. chest x-ray, ECG
   D. natural history
   E. Indications for and timing of operation
   F. role of prostaglandins in stabilizing neonates
   G. effect of associated anomalies (e.g., patent ductus arteriosus, aortic stenosis, ventricular septal defect)

4. Operative repair and complications
   A. methods of repair (end-to-end vs. patch vs. subclavian turn-down)
   B. methods of arch reconstruction
   C. complications (residual obstruction, paraplegia, chylothorax)
   D. cardiopulmonary bypass, shunts in the absence of adequate collateral circulation

5. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
   D. re-coarctation

D. Interrupted aortic arch

1. Anatomy
   A. types A, B, and C
   B. associated anomalies (e.g., DiGeorge syndrome, VSD, systemic outflow tract obstruction)

2. Physiology
   A. role of ductal patency, prostaglandin

3. Clinical features
   A. symptoms and physical findings
   B. echocardiogram, angiocardiogram, cardiac catheterization
   C. chest x-ray, ECG
   D. natural history
   E. indications for and timing of operation
   F. the role of prostaglandins in preoperative stabilization
   G. DiGeorge syndrome (hypocalcemia, need for irradiated blood)

4. Operative repair and complications
   A. cardiopulmonary bypass +/- hypothermic arrest
   B. median sternotomy vs. left thoracotomy
   C. arch reconstruction techniques (e.g., patch augmentation or direct anastomosis)
   D. complications (e.g., residual obstruction, recurrent laryngeal nerve injury, chylothorax)
   E. repair of associated anomalies
5. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
   D. reoperation
   E. management of DiGeorge syndrome

E. Vascular ring

1. Anatomy
   A. double aortic arch, anomalous subclavian artery, unusual rings, pulmonary artery sling

2. Physiology
   A. compression of airway and esophagus

3. Clinical features
   A. signs and symptoms
   B. contrast swallow, endoscopy and cross-sectional imaging

4. Operative repair and complications
   A. techniques for exposure by left thoracotomy, indications for other approaches

5. technique for correction of each type

6. role of aortopexy

7. complications (e.g., recurrent laryngeal nerve palsy, chylothorax, residual tracheobronchomalacia)

8. Outcome
   A. expected operative mortality
   B. long-term results
   C. complications
   D. residual tracheobronchomalacia
1. PRE-OPERATIVE ASSESSMENT

- UNIT OBJECTIVE:

- LEARNER OBJECTIVES:

- CONTENTS:

2. NON-NEOPLASTIC LUNG DISEASE

- UNIT OBJECTIVE:
  At the end of this unit the resident understands infectious, inflammatory, and environmental injuries of the lung and knows how to perform operative and non-operative management.

- LEARNER OBJECTIVES:
  Upon completion of this unit, 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;
  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. 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

3. NEOPLASTIC LUNG DISEASE
   • UNIT OBJECTIVE:
     At the end of this unit the resident understands the natural history, types, evaluation, and management of lung neoplasms, and knows how to perform operative and non-operative treatment.

   • LEARNER OBJECTIVES:
     Upon completion of this unit 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 complications of pulmonary resection and their management;
     6. Understands the role of adjuvant therapy for lung neoplasms;
     7. Understands the indications for resection of benign lung neoplasms;
     8. 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)

4. DISEASES OF THE PLEURA
   • UNIT OBJECTIVE:
     At the end of this unit the resident understands the benign and malignant abnormalities of the pleura, pleural effusions, and the evaluation and treatment of pleural diseases.
   • LEARNER OBJECTIVES:
     Upon completion of this unit 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., tube thoracostomy, decortication, rib resection, repair of bronchopleural fistula)

5. CHEST WALL

A. Anatomy and Physiology
   • UNIT OBJECTIVE
     During the training program the resident:
     1. Learns the normal and abnormal anatomy of the chest wall;
   • CONTENTS:
     1. Chest wall anatomy
        A. Skeletal
        B. Muscular
        C. Neural
        D. Vascular
        E. Relationships to adjacent structures
2. Diagnostic tests to define chest wall anatomy
   A. Chest x-ray
   B. CAT scans
   C. MRI scans
   D. Nuclear scans
   E. Pulmonary function tests

3. 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

6. THORACIC TRAUMA

A. Trauma of the Chest Wall
   • UNIT OBJECTIVE:
     At the end of this unit the resident understands the pathophysiology of chest wall injury, and knows how to diagnose, resuscitate and treat trauma patients.

   • LEARNER OBJECTIVES:
     Upon completion of this unit 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. Associated injuries
     2. Pneumothorax
        A. Simple
        B. Tension
        C. Diagnosis and treatment
     3. Hemothorax
        A. Diagnosis
        B. Operative and non-operative management
B. Tracheobronchial and pulmonary trauma

- UNIT OBJECTIVE:
  At the end of this unit the resident understands the pathophysiology of tracheobronchial and pulmonary trauma, and diagnoses, resuscitates and treats patients with these injuries.

- LEARNER OBJECTIVES:
  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

C. Diaphragmatic Trauma

- UNIT OBJECTIVE:
  At the end of this unit the resident understands the pathophysiology of diaphragmatic trauma, and diagnoses, resuscitates, and treats patients with these injuries.

- LEARNER OBJECTIVES:
  Upon completion of this unit 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

6. ACQUIRED ABNORMALITIES OF THE MEDIASTINUM

• UNIT OBJECTIVE:
  At the end of this unit the resident understands acquired mediastinal abnormalities and knows how to perform operative and non-operative treatment.

• LEARNER OBJECTIVES:
  Upon completion of this unit 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;

• 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)
   D. Diagnostic tests

5. Plain radiographs
   A. CT scans
   B. MRI
   C. Contrast studies
   D. Radionucleotide studies
   E. Ultrasound

6. Fine needle aspiration
7. Core biopsy
8. Mediastinoscopy
9. Serologic tests