

Cardiothoracic surgery

A SIMPLIFIED APPROACH

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Part 1

Cardiac surgery

Cardiac surgery includes:

Surgery for congenital heart diseases, surgery for valvular heart diseases, surgery for coronary artery diseases, surgery for the aorta, surgery for cardiac arrhythmias, surgery for cardiac tumors, and heart transplantation.

Part II

Thoracic surgery

Thoracic surgery includes:

Surgery for all thoracic contents which are; chest wall, pleura, lung, mediastinum, airway, esophagus, and diaphragm.

Lesions in need for surgery may be inflammatory, infective, congenital, traumatic, or malignant.

Bronchogenic carcinoma

Carcinoma of the lung is the leading cause of cancer death in the United States and around the world among all cancers as more people die annually from lung cancer than die from cancers of the colon, breast, and prostate combined.

Etiology

Tobacco is a major etiologic factor in lung cancer. Passive smokers who inhale other people tobacco smoke are also at increased risk. Other risk factors include occupational or environmental exposure to various carcinogens as well as small genetic predisposition.

Pathology of Carcinoma of the Lung

Non-small-cell lung cancer

Squamous cell carcinoma
Adenocarcinoma
large cell Undifferentiated carcinoma
Adenosquamous carcinoma

Small-cell lung cancer

Diagnosis of Bronchogenic carcinoma

(1) Clinical Presentation of Lung Cancer

As one of the most common malignancies in the world, lung cancer presents with widely varied signs, symptoms, and syndromes. Most lung cancer patients present with symptoms except early-stage lung cancer which is rarely symptomatic. Even when symptoms of early cancer are present, they are generally not specific and frequently mimic more common disease

The symptoms and signs of lung cancer can be categorized as:-

1-Bronchopulmonary Symptoms as cough, hemoptysis, dyspnea, and pulmonary infection.

2-Extrapulmonary intrathoracic as hoarsness of voice, chest pain, pleural effusion, dysphagia, Horner's syndrome, Pancoast syndrome and superior vena cava syndrome.

3-Extrathoracic metastatic due to distant metastasis to the brain, bone, liver, adrenal gland or other sites.

4-Paraneoplastic Syndrome (extrathoracic non metastatic); Metabolic, Neuromuscular, Skeletal, Hematologic, Cutaneous, and muscular.

(2) Investigations

1- **Radiological (non invasive)** for tumor localization and staging:-

A) chest X-ray

The first diagnostic step. Abnormal findings are due to the tumor itself, pulmonary changes distal to obstructed bronchus or extra pulmonary pathology. So radiographic findings may be opacities, luminal narrowing, atelectasis, cavitory lesion, mediastinal mass, pleural effusion, pericardial effusion and elevated hemidiaphragm.

B) computed tomography

It is the standard diagnostic procedure that demonstrates the tumor (size, site, borders, calcification, invasion, consistency, cavitations and relation to the surrounding structures), mediastinal LNs, unsuspected pleural effusion or pericardial effusion.

C) Other modalities as magnetic resonance imaging, ultra sonography, positron emission tomography and radionuclide study.

2- **Invasive maneuvers** for pathological evaluation:-

A) Bronchoscopy by means of endobronchial forceps biopsy, endobronchial brushing, bronchial washing, bronchoalveolar lavage, and transbronchial needle aspiration

B) Transthoracic fine-needle aspiration: CT-guided FNA is the most commonly used modality

C) Video-Assisted Thoracic Surgery: at present, it replaced the open thoracotomy technique as it enables the operator to take biopsy from peripheral pulmonary nodule, LN biopsy, pleural biopsy, and sample from pleural effusion.

D) Mediastinoscopy for evaluation of superior mediastinal lymph node metastases

Surgical Treatment of Non-Small-Cell Lung Cancer

Early non small cell lung cancer patients can be cured by resection as the definitive primary therapy. Late cases could be considered for multimodality therapy (chemotherapy and radiotherapy used singly, sequentially, or concurrently) . The goal of surgery is complete resection of the tumor and mediastinal LNs . The standard cancer resections include lobectomy, bilobectomy, bronchoplastic lobectomy, and pneumonectomy, based on the extent of disease. In some cases who can not tolerate major resection, an anatomic segmentectomy may be appropriate, nonanatomic or “wedge” resection should be considered only in the minority of patients.

Endoluminal management of malignant airway diseases includes mechanical debridement, electro surgery, cryo surgery, Laser, endobronchial brachytherapy, photodynamic therapy and endobronchial stents .

Before surgery, patient need to be evaluated for operability which is related to the stage (the ability of operation to cure the patient). Resectability is intraoperative finding related to the ability to dissect the tumor from the surrounding tissue or excised in conjunction with it as the chest wall. Small cell lung cancer is considered inoperable once diagnosed and need chemotherapy.

The prognosis of surgery is dependant on many factors specially the stage of the tumor and the complete resection of the tumor and lymphadenectmoy of mediastinal LNs , but generally it is not good like other tumors.

Congenital Heart Diseases

There are 2 main categories :-

1) Acyanotic CHD

Caused by either left to right shunt which may be at atrial level (ASD), ventricular level (VSD) or great vessels level (PDA), or stenoses which may be intracardiac (aortic stenoses , pulmonary stenoses , supramitral ring) or extracardiac (coarctation of the aorta)

2) Cyanotic CHD

Caused by either right to left shunt or abnormal mixing of blood (Fallot's tetralogy, Transposition of great arteries, Total anomalous pulmonary venous drainage, Tricusped atresia and Truncus arteriosus)

We will discuss some of these CHD in some details

(A) Patent Ductus Arteriosus (PDA)

Def: It is post natal persistence of the ductus arteriosus which connects the main pulmonary trunk with the descending aorta, distal to the origin of the left subclavian artery.

Clinical picture:

Depends on the magnitude of a left-to-right shunt, so small PDA may be asymptomatic while large one may cause congestive heart failure.

Natural history (complications of non operated PDA) :

Non operated PDA will result in heart failure , pulmonary vascular obstructive disease, infective endocarditis, calcification , aneurysm formation and rarely rupture.

Indication and timing for surgery:

All PDAs should be closed once diagnosed because of the risk of subacute bacterial endocarditis and other complications. In premature infants, indomethacin and ibuprofen are effective in closure of PDA. If the medical therapy fails, operation is considered for all symptomatic children. Surgery is contraindicated once pulmonary vascular obstructive disease developed.

Methods for closure:

The ductus is approached through a standard left thoracotomy through the fourth intercostal space. It could be approached via median sternotomy in case of other CHD correction.

The ductus is repaired by means of ligation, division, ligaclip occlusion, closure from inside the pulmonary artery, transcatheter closure and video-assisted thoracoscopic surgery (VATS)

Complications:-

- Bleeding at the time of operation
- Injury to the recurrent laryngeal nerve
- chylothorax
- Recanalization.

(B) Atrial Septal Defect

Types:-

Secundum ASD, primum ASD, coronary sinus ASD, sinus venosus defect and patent foramen ovale.

Clinical picture:

The condition is usually asymptomatic and discovered accidentally by the presence of murmur . Rarely, it can cause congestive heart failure in infancy, non operated cases will develop arrhythmias, heart failure and pulmonary vascular obstructive disease in adult life.

Indication and timing for surgery:

Significant secundum ASD should be closed in children preferably before patients reach school age. If there is a significant RV volume overload, ASD must be closed at earlier age . Pulmonary vascular obstructive disease is contraindication for surgery. Patent foramen ovale needs no surgery . Other types are to be operated.

Methods for closure:

Repair of ASD is done by open cardiac surgery on cardiopulmonary bypass via median sternotomy. The repair is done by direct closure or patch closure (pericardium) through the right atrium.

Complications:-

- Air embolism.
- Arrhythmias.
- Infection.

(C) **Ventricular Septal Defect**

Types:-

Simply, VSD can be classified as perimembranous, inlet, outlet and muscular or trabecular.

Clinical picture:

More aggressive than ASD, patient may present with congestive heart failure in early infancy, Eisenmenger syndrome develops at earlier age. Subacute bacterial endocarditis is a complication of tiny VSD.

Indication and timing for surgery:

Asymptomatic patients or those controlled by medical treatment can be followed up hoping for spontaneous closure. Elective complete repair is recommended in most institutions by 1 year of age. Symptomatic patients with congestive heart failure caused by significant left to right shunt have to be operated before the development of pulmonary vascular obstructive disease . There is controversy about surgery for small VSD but if infective endocarditis occurs , surgery is indicated.

Methods for closure:

Repair of VSD is done by open cardiac surgery on cardiopulmonary bypass via median sternotomy. The repair is done by direct closure for tiny VSD or patch closure (synthetic) through the right atrium or rarely through the right ventricle. Pulmonary artery banding is indicated as preliminary step for infants with multiple VSDs and infants with very low body weight who are not fit for cardiopulmonary bypass.

Complications:-

- Residual VSD.
- Air embolism .
- Conduction Disturbances and Arrhythmias.
- Infection.
- Acute aortic regurge.

(D) Coarctation of the aorta

Def: It is a congenital narrowing of the aorta, usually situated beyond the origin of the left subclavian artery.

Types:-

- 1) Infantile or preductal type characterized by an elongated and diffuse narrowing of the aorta proximal to the ductus arteriosus.
- 2) Adult or postductal type consisting of a sharp constriction in the area of aortic insertion of the ductus.

Clinical picture:

There are 2 extreme forms:-

- Neonates with severe congestive heart failure. They are often in critical condition.
- Older children or adults are asymptomatic and often first recognized during routine physical examination.

Indication and timing for surgery:

Critical neonates are operated emergently after resuscitative measures and accurate diagnoses. Asymptomatic older patients need surgical treatment as soon as the diagnosis of significant narrowing is made (pressure gradient more than 50mmHg).

Methods of repair:

The coarctation is approached through a standard left thoracotomy through the fourth intercostal space.

Many methods are available as none of them is ideal 100% :-

- a- Resection and end-to-end anastomosis.....restenoses.
- b-Patch graft aortoplasty.....aneurysm formation so obsolete.
- c-Subclavian flap aortoplasty.....arm ischemia.
- d-Interpositin tube graft.....suitable for adults with long segment.
- e-Extended resection with end-to-end anastomosis.....best technique at present.
- f-Balloon angioplasty.

Complications:-

Early

- 1- Bleeding.
- 2- Paradoxical or Rebound Hypertension.
- 3-Paraplegia.
- 4- Renal Failure.
- 5- Chylothorax.

Late

- 1 Re-coarctation.
- 2- Hypertension.
- 3- Aneurysm.

(E)Tetralogy of Fallot

Def: The classic components of the defect are a ventricular septal defect (VSD), right ventricular outflow tract obstruction, aortic override and right ventricular hypertrophy. All of these components result from one basic morphological abnormality: anterior and left-ward displacement of the infundibular septum.

NB) In pentalogy of Fallot, there is superadded ASD.

Clinical picture:

- Cyanosis which tends to become significant within the first 6–12 months of life.
- Cyanotic spells.

Indication and timing for surgery:

All cases are in need for surgery once hypoxemia and cyanosis develop, spells are indication for early surgery. The elective complete repair was recommended in most institutions by 1 year of age, but most institutions now prefer surgery at earlier age for better postoperative results.

Method of repair:

VSD closure, relief of the right ventricular outflow tract obstruction by means of pulmonary valvotomy, division or excision of the obstructing infundibular muscles and there may be need for augmentation of the outflow tract by pericardial patch.

Complications:-

Early

- 1-Arrhythmias.
- 2-Residual outflow tract obstruction .
- 3-Residual VSD.
- 4-Tricuspid insufficiency.

Late

- 1-Right ventricular failure.
- 2- Arrhythmias.
- 3- Pulmonary regurge.

Palliative Procedures in CHDs :-

Not all patients with CHD are fit for one stage corrective surgery because of their low weight, institutional abilities and the presence of complex or multiple CHDs.

In general, CHDs can result in pulmonary hyper perfusion or pulmonary hypo perfusion. Pulmonary hyper perfusion results from left to right shunt which may be not tolerated as in case of complete AV canal and multiple or large VSD. Pulmonary artery banding is commonly used as a palliative procedure to reduce pulmonary arterial pressure and blood flow in this age group.

Pulmonary hypo perfusion occurs in cyanotic CHDs causing hypoxia . Creating a shunt between a systemic artery and the pulmonary artery improves pulmonary perfusion and decreases the degree of cyanosis.

Types of Systemic-to-Pulmonary Artery Shunts:-

- 1) Classical Blalock–Taussig Shunt.
- 2) Modified Blalock–Taussig Shunt.
- 3) Potts Shunt.
- 4) Waterston Shunt.

Surgery for Valvular Heart Diseases

Indications for valve replacement:-

Valve stenosis, valve regurge, Infectivus endocarditis and malfunctioning valve prosthesis.

Preoperative requirements :-

Full history taking, chest radiography, ECG, detailed echocardiography and full laboratory investigations.

The maneuver :-

Open heart surgery is a major surgical procedure performed under general anesthesia in a well equipped hospital. The surgeon opens the chest wall by cutting through the sternum (median sternotomy) to expose the heart. The systemic and pulmonary circulations are replaced by means of Cardiopulmonary bypass machine. The heart is stopped with cold, high potassium solution which protects the heart muscle from damage while it is arrested. Once the heart is stopped, the procedure can be done in a bloodless motionless environment.

Prosthetic valves:-

Prosthetic valves are either designed from synthetic material (mechanical prosthesis) or fashioned from biological tissue . Biological valves are either xenografts or homografts. The three main designs of mechanical valves are: the caged ball valve, the tilting disc (single leaflet) valve, and the bileaflet valve. The main advantage of mechanical valve is its durability, the main drawback is the need for life long anticoagulant. Bioprosthetic (xenograft) valves are made from porcine valves or bovine pericardium. Homografts or preserved human aortic valves are used in a minority of patients. Biological valve are silent, inert, needs no anticoagulant but not durable as calcification and degeneration will occur.

Complications:-

These complications include primary valve failure, prosthetic valve endocarditis, prosthetic valve thrombosis, thromboembolism, mechanical hemolytic anemia and anticoagulant-related hemorrhage .

Follow up:-

Valve function is typically assessed by history, physical examination, and echocardiography. A complete history and physical examination should be performed monthly in patients with prosthetic heart valves. Particular attention should be given to ask patient about new symptoms, auscultation of click of prosthetic cardiac valve, new murmur, heart rate , blood pressure and the degree of anticoagulation assessed by INR estimation.

Surgery for the mitral valve

1) Mitral stenosis

Definition :-

Mitral stenosis (MS) refers to narrowing of the mitral valve orifice, resulting in impedance of filling of the left ventricle in diastole.

Etiology:-

It is usually caused by rheumatic heart disease. Less common causes include severe calcification of the mitral annulus, infective endocarditis, systemic lupus erythematosus, rheumatoid arthritis, and carcinoid heart disease.

Pathophysiology and Natural History:-

Patients typically present after a latent period of many years after an episode of rheumatic fever. Recurrent bouts of rheumatic carditis cause progressive thickening, scarring, and calcification of the mitral leaflets and chordae. Fusion of the commissures and chordae decreases the size of the mitral opening. This obstruction causes an elevation in left atrial pressure leading to left atrial enlargement, predisposing the patient to atrial fibrillation and arterial thromboembolism. Elevated pulmonary venous pressure results in pulmonary congestion and pulmonary edema.

Signs and Symptoms:-

Patients with mitral stenosis may present with exertional dyspnea, fatigue, atrial arrhythmias, embolic events. Previously asymptomatic or stable patients may decompensate acutely during exercise, emotional stress, pregnancy, infection, or with uncontrolled atrial fibrillation. The characteristic findings on auscultation are an accentuated first heart sound, an opening snap, and a mid-diastolic rumble.

Diagnosis:-

On chest x-ray, the characteristic findings are pulmonary congestion, enlargement of the main pulmonary arteries, and enlargement of the left atrium. An electrocardiogram (ECG) may reveal evidence of left atrial enlargement and atrial fibrillation. The diagnostic test of choice is echocardiography.

Medical Treatment:-

Medical treatment is directed toward alleviating pulmonary congestion with diuretics, treating atrial fibrillation, and anticoagulants for patients who are at increased risk of

embolic events. Antibiotic therapy is important for the secondary prevention of rheumatic carditis, preferentially with penicillin for all patients with a history of rheumatic fever or suspected rheumatic valve disease.

Surgery:-

The following invasive options are available for patients with MS:-

1- Percutaneous balloon mitral valvotomy (PBMV).

2- Surgical mitral commissurotomy.

3- Mitral valve replacement (MVR).

4- Closed mitral valvotomy.

Balloon valvotomy or closed mitral valvotomy should not be performed in patients who have more than moderate mitral regurgitation because the degree of mitral regurgitation usually increases following the procedure. Severe valve calcification or significant involvement of the subvalvular apparatus are also contraindications as it opens the valve in other planes rather than the commissures resulting in acute mitral regurge. Valvotomy for patient with history of embolization or AF or proved to have left atrial thrombus can result in systemic embolization.

Surgery is indicated for moderate to severe mitral stenosis in symptomatic patients (NYHA III or IV) where PMBV is unavailable or contraindicated , and patients with severe MS and severe pulmonary hypertension even with mild symptoms.

2) *Mitral regurgitation*

Definition :-

Mitral regurgitation (MR) is leakage of blood from the left ventricle into the left atrium during systole.

Causes:-

The most common causes of mitral regurgitation are rheumatic heart disease, myxomatous degeneration, chordal rupture, infective endocarditis, coronary artery disease, and cardiomyopathy. These diseases affect one of the components of the mitral valve apparatus which are; valve leaflets, annulus, chordae tendinea, papillary muscles, and left ventricular wall.

Pathophysiology and Natural History:-

Significant MR leads to volume overload of the left ventricle. To compensate, the left ventricle dilates and becomes hyperdynamic. Progressive left ventricular dilation leads to contractile dysfunction, and heart failure. Left atrial enlargement predisposes the patient to atrial fibrillation and thromboembolism. In long-standing MR, patients may develop pulmonary hypertension and right-sided heart failure.

Signs and Symptoms:-

Patients may remain asymptomatic for years. When symptoms develop, the most common are dyspnea, fatigue, orthopnea, paroxysmal nocturnal dyspnea, and palpitations. The characteristic finding is a blowing holosystolic murmur best auscultated at the cardiac apex. When ventricular enlargement is present, the apical impulse may be diffuse and laterally displaced, and a third heart sound may be heard.

Diagnosis:-

The chest x-ray demonstrates left atrial enlargement and cardiomegaly. An electrocardiogram (ECG) may reveal evidence of left atrial enlargement, left ventricular enlargement or atrial fibrillation. Two-dimensional and Doppler echocardiography is indicated to confirm MR presence and determine its severity .

Medical Treatment:-

MR is primarily treated medically with angiotensin-converting enzyme inhibitors (ACE) as a vasodilator to decrease the regurgitated volume, beta blockers and lanoxin to control heart rate, diuretics to relieve pulmonary congestion, and antianginal therapies when mitral regurgitation is caused by acute ischemia. Antibiotic prophylaxis for endocarditis is recommended.

Surgery:-

The following invasive options are available for patients with MR:-

1-Mitral valve replacement (MVR).

2-Mitral valve repair.

Mitral valve repair. preserve patient own valve with no need for anticoagulant, but patient with rheumatic activity will develop valve destruction again.

Surgery is indicated for patients with acute severe MR emergently, symptomatic patients with severe chronic MR, and mildly symptomatic patients with severe chronic MR and evidence of LV dysfunction .

Surgery for the aortic valve

1) Aortic stenosis

Definition:-

Aortic valve stenosis is defined by restricted systolic opening of the valve leaflets leading to obstruction of flow at the level of the aortic valve.

Causes:-

Calcific aortic stenosis , congenital bicuspid aortic valve leading to stenosis, rheumatic aortic stenosis and congenital aortic stenosis.

Pathophysiology and Natural History:-

Valvular aortic stenosis results in chronic left ventricular pressure overload. Some patients might experience exertional syncope. Eventually, left ventricular hypertrophy develop leading to myocardial oxygen demands in excess of supply with the onset of angina. Hypertrophy also causes diastolic dysfunction with the onset of congestive symptoms lately.

Signs and Symptoms:-

The onset of any of the classic symptoms of left ventricular outflow obstruction as syncope, angina, or heart failure in a patient with valvular aortic stenosis indicates advanced valve disease . On physical examination, the harsh systolic murmur of aortic stenosis, loudest at the base of the heart and radiating to the apex and carotids, is often prominent.

Diagnosis:-

The chest radiograph is not helpful, although occasionally shows heavy calcification of the valve or poststenotic ascending aortic dilation. The electrocardiogram (ECG) often shows left ventricular hypertrophy. Two-dimensional and Doppler echocardiography have become the tests of choice in the evaluation of patients with suspected AS to detect its presence and severity .

Medical Treatment:-

Non specific and consisted of treating concomitant hypertension, ischemia, and arrhythmia.

Surgery:-

Indications for aortic valve surgery include symptomatic patients (i.e., those with angina, syncope, or dyspnea) or those with high pressure gradient across the stenotic aortic valve. Patients with AS undergoing coronary artery bypass grafting or surgery on the aorta or other heart valves need concomitant AVR.

2)Aortic regurgitation

Definition:-

Aortic regurgitation is defined by incompetence of the aortic valve, so a portion of the left ventricular stroke volume returns to the left ventricle during diastole.

Causes:-

The etiology can be at valvular level or aortic root level. The most common causes are rheumatic aortic regurge, congenital bicuspid aortic valve, infective endocarditis, annuloaortic ectasia, long standing hypertension, familial aortic aneurysmal disease, and hereditary diseases of connective tissue, such as Marfan syndrome.

Pathophysiology and Natural History:-

Chronic aortic regurgitation results in volume overload of the left ventricle. The volume overload usually is well tolerated for long periods. The sequelae of aortic regurgitation include left ventricular dilation and hypertrophy. With time, the ventricle dilates more and finally fail.

Signs and Symptoms:-

Patients remain asymptomatic for a long time. Symptoms of aortic regurgitation often begin with nonspecific fatigue, palpitations is an early complaint, with further progression, typical heart failure symptoms follow. Typically, there is wide pulse pressure with all related signs.

Diagnosis:-

The chest radiograph shows the characteristic left ventricular hypertrophy. The electrocardiogram demonstrates left ventricular hypertrophy with generous voltage and upright T waves in the lateral chest leads. In addition, premature ventricular contractions may be present. Echocardiography will evaluate the functional anatomy of the valve and aortic root, and help assess the severity of regurgitation.

Medical Treatment:-

AR is primarily treated medically with angiotensin-converting enzyme inhibitors (ACE) as a vasodilator to decrease the regurgitated volume and also help reducing the high systolic pressure. Medical treatment is directed also to control symptoms of heart failure, arrhythmias, or angina.

Surgery:-

Surgery is indicated if the patient developed symptoms (NYHA III or IV). Asymptomatic patient requires surgery if there is drop of his left ventricular functions or there is significant left ventricular enlargement. Acute AR needs emergent surgery.

Surgery For Coronary Artery Diseases

The revascularization procedures have been formulated to improve survival and/or symptoms in patients with coronary artery diseases.

Indications for CABG:-

- 1) Left main stenosis >50%.
- 2) Stenosis of proximal LAD or proximal circumflex >70%.
- 3) 3-vessel disease.
- 4) Disabling angina .
- 5) Ongoing ischemia in the setting of a non-ST segment elevation myocardial infarction that is unresponsive to medical therapy .
- 6) CABG may be performed as an emergency procedure in the context of myocardial infarction in cases where it has not been possible to perform percutaneous coronary intervention (PCI) or where this procedure has failed and there is persistent pain and ischemia threatening a significant area of myocardium despite medical therapy.
- 7) Surgical complications of MI are Other indications for CABG :- ventricular septal defect related to myocardial infarction, papillary muscle rupture, free wall rupture, and ventricular pseudoaneurysm, also life-threatening ventricular arrhythmias, and cardiogenic shock.

NB. CABG could be done in patients with low ejection fraction as long as there is still viable myocardium.

Preoperative requirements :-

Full history taking, chest radiography, ECG, detailed echocardiography, coronary angiography and full laboratory investigations.

The maneuver :-

Standard surgical approach has included the use of cardiac arrest coupled with CPB thereby optimizing the conditions for construction of vascular anastomoses to all diseased coronary arteries without cardiac motion or hemodynamic compromise. Off-pump CABG is performed on the beating heart with the use of stabilizing devices

Bypass Graft Conduit:-

Arteries (internal mammary, radial, gastroepiploic, and inferior epigastric) or **veins** (greater and lesser saphenous) may be used as conduits for CABG.

Complications:-

These complications include neurological complications, renal failure, perioperative myocardial dysfunction, perioperative dysrhythmias and mediastinitis.

Follow up:-

As the procedure is not a curative one, so control of the risk factor is a must. Postoperative antiplatelet therapy, management of hyperlipidemia, smoking cessation and control of blood glucose level are to be done. Patient need follow up ECG and if symptoms recur, coronary angiography must be done.

The future of CABG:-

Minimally invasive techniques, with the use of robotics and anastomotic connectors, hybrid coronary revascularization (defined as the planned combination of CABG and PCI), protein and gene therapy and off-pump CABG are all techniques used and still growing aiming to achieve the best postoperative results with elimination of the drawbacks of cardiopulmonary bypass.

The Pleura

Definition

The pleura is a thin tissue covered by a layer of mesothelial cells that surrounds the lungs and lines the inside of the chest wall. The pleura is composed of visceral and parietal serous membranes. The lungs and interlobar fissures are invested in the visceral pleura, whereas the parietal pleura lines the ribs, diaphragm, and mediastinum. The pleural space is the area between the lungs and the chest wall. It is normally at subatmospheric pressure, which keeps the lungs inflated. The normal pleural space has only a few milliliters of liquid, which helps lubricate the normal "to and fro" motion of the lungs during breathing.

Pleural diseases

Includes diseases of the pleura itself (inflammation, infection, and tumors) or abnormal contents of the pleural space (pleural effusion, hemothorax, pneumothorax, empyema, and chylothorax).

Pleural effusion

The pleural cavity contains a relatively small amount of fluid. Pleural fluid volume is maintained by a balance between fluid production and removal, and changes in the rates of either can result in the presence of excess fluid. Pleural effusions could be classified into two general categories: transudative or exudative. A basic difference is that transudates, in general, reflect a systemic disease, whereas exudates usually signify underlying local disease.

Transudative causes include; congestive heart failure, hypoalbumenemia, nephritic syndrome, and atelectasis. Exudative causes include; infection (bacteria, viruses, fungi, tuberculosis, or parasites), pulmonary embolism, subdiaphragmatic abscess, and malignancy.

Clinical picture

Many patients are asymptomatic initially. When present, symptoms are usually due to the underlying disease process. Pleuritic chest pain indicates inflammation of the parietal pleura. Other symptoms include dry cough and dyspnea. Physical examination reveals reduced tactile fremitus, dull note on percussion, and diminished or absent breath sounds on auscultation.

Diagnosis

- 1- Radiological by chest x-ray (opacity rising to the axilla), ultrasound, and CT chest.
- 2- Laboratory investigations of the aspirated fluid for physical, chemical, culture and sensitivity, and for cytological evaluation.
- 3- Invasive procedures as pleural biopsy using Abrams needle to obtain specimens from the parietal pleura, or thoracoscopy.

Treatment

It includes treatment of the primary disease which will result in absorption of the fluid. In case of failed medical treatment or development of dyspnea, other lines of treatment include:

- 1- Therapeutic thoracentesis: no more than 1 L to 1.5 L of fluid should be removed in one setting to avoid re-expansion pulmonary edema and post-thoracentesis shock. The maneuver can be repeated.
- 2- Pleural sclerosis and fibrinolytics: the use of a sclerosing agent to produce a fibrosis of the pleura is indicated in recurrent symptomatic malignant effusions. All fluid must be drained initially and that full expansion of the underlying lung is essential before proceeding with sclerosis. Fibrinolytic therapy helps in cases of loculated effusion and parapneumonic effusion.
- 3- Surgery: thoroscopic surgery (VATS) and thoracotomy are acceptable approaches to manage patients with complicated pleural effusions. Parietal pleurectomy and decortication of the visceral pleura are definitive procedures with excellent response rates.

Intercostal chest tube

Used to drain abnormal contents of the pleural space as in cases of hemothorax, pneumothorax, hemopneumothorax, empyema, chylothorax, some cases of effusion, and postoperatively in thoracic surgeries. It can be curative alone or need other modalities as pleurodesis in spontaneous pneumothorax, fibrinolytic therapy in loculated effusion or empyema, and thoracotomy in case of significant air leak or hemothorax. As it is invasive maneuver, so it can be complicated by many complications as; pain, wrong insertion, empyema, prolonged air leak, frozen shoulder, pneumothorax, and atelectasis.

The Mediastinum

Anatomy:-

The mediastinum is that part which lies between the right and left pleura in the median sagittal plane of the chest. It extends from the sternum in front to the vertebral column behind. It is divided into two parts (by a slightly oblique plane passing backward from the junction of the manubrium and body of the sternum to the lower part of the body of the fourth thoracic vertebra): an upper portion which is named the superior mediastinum, and a lower portion. This lower portion is again subdivided into three parts, that in front of the pericardium, the anterior mediastinum; that containing the pericardium and its contents, the middle mediastinum; and that behind the pericardium, the posterior mediastinum.

The superior mediastinum contains the remains of the thymus, the aortic arch, the great vessels, the superior vena cava, the vagus, phrenic, and left recurrent nerves; the trachea, esophagus, thoracic duct; and some lymph glands.

The anterior mediastinum contains loose areolar tissue, some lymphatic vessels, two or three anterior mediastinal lymph glands, and the small mediastinal branches of the internal mammary artery.

The middle mediastinum contains the heart enclosed in the pericardium, the ascending aorta, the lower half of the superior vena, the bifurcation of the trachea and the two bronchi, the pulmonary artery dividing into its two branches, the pulmonary veins, the phrenic nerves on both sides of the pericardium.

The posterior mediastinum contains the thoracic part of the descending aorta, the azygos and the two hemiazygos veins, the vagus and splanchnic nerves, the esophagus, the thoracic duct, and some lymph glands.

Mediastinal masses:-

Differ according to age group: tumors of the posterior mediastinum predominates in pediatrics and they are mainly neurogenic tumors. Lymphoma is the second most common tumor in pediatrics and is located in the anterior mediastinum. In adults, anterior mediastinal tumors specially thymoma predominates, followed by lymphoma. Other lesions include germ cell tumors, endocrine tumors, mediastinal cysts, aortic aneurysm, and retro sternal goiter.

Diagnoses

Clinically, these lesions may be asymptomatic and discovered accidentally if benign. Malignant tumors are usually symptomatic. Symptoms may be due to compression of tubular structures (SVC, trachea, and esophagus), invasion of mediastinal structures (vocal cord paralysis, Horner's syndrome, arrhythmia, and pericardial effusion), systemic hormonal activity, and systemic disorders (myasthenia gravis, weight loss, and anorexia).

Radiologically by means of chest x-ray, CT chest, contrast studies, and radioisotope scanning. Tissue diagnosis by needle aspiration, scalene LN biopsy, mediastinoscopy, anterior mediastinostomy, and thoracotomy.

Treatment

Benign lesion may be in need for follow up, aspiration of its contents, or surgery. Malignant conditions need surgical excision with complimentary chemotherapy, radiotherapy, or hormonal therapy.

Surgery for Pulmonary TB

Tuberculosis is one of the oldest diseases and still a major health hazard causing considerable morbidity and mortality. Historically, the field of thoracic surgery was born with surgery for TB.

Pathology

Mycobacterium tuberculosis is the infectious agent of TB. Infection occurs when a susceptible person inhales droplet nuclei that contain tubercle bacilli.

Postprimary TB occurs in a person who has previously been infected and has retained a degree of acquired immunity; it can result from endogenous reactivation or, less commonly, exogenous reinfection

Clinical picture

The clinical signs and symptoms of pulmonary TB in an infected adult are often nonspecific. Systemic manifestations include low-grade fever, anorexia, fatigue, night sweats, and weight loss that may persist for weeks to months. Cough is the most frequent symptom. Other less frequent pulmonary symptoms are dyspnea, wheezes and hemoptysis.

Diagnosis

- 1- History of postprimary or progressive primary TB with TB pneumonia, pleurisy, pleural effusion, mediastinal lymphadenitis or miliary TB.
- 2- Clinical and radiological findings by chest x-ray and CT chest.
- 3- Identification of the organism by smear, culture and ZN stain.
- 4- Skin test using purified protein derivative (PPD).
- 5- Bronchoscopy, mediastinoscopy, and thoracoscopy.

Indications for surgery

TB is a medical problem but surgery is indicated in the following conditions; multi drug resistant TB with lobe destruction, massive hemoptysis(more than 600cc in 24 hours), bronchopleural fistula, bronchial stenosis, empyema, , leaking LN, bronchiectasis, and to rule out malignancy.

Preoperative preparation

Good nutrition for those nutritionally depleted patients. Intensive course of drug therapy for at least 3 months. Aggressive pulmonary physiotherapy (encourage coughing, deep breathing, postural drainage, and spirometry) and cessation of smoking.

Operative techniques

Some points are important during the procedure. First, bronchoscope has to be done after induction of anesthesia. Double lumen endotracheal tube helps single lung ventilation during the maneuver. The approach is through the standard posterolateral thoracotomy. Muscle flaps are needed for some cases as latissimus dorsi, pectoralis major, rectus abdominis, and serratus anterior muscles. The most difficult step is freeing the lung because there is usually extensive adhesions. Resection is then done for the involved lobe or lung. Chest tubes are inserted for drainage of blood and air leak.

Some patients are in need for other surgical modalities as drainage therapy (chest tube and open drainage) and collapse therapy (artificial pneumothorax, pneumoperitoneum, and thoracoplasty).

Postoperative complications

Complications occur more in these patients due to nature of the disease. These complications include; bronchopleural fistula, pulmonary edema, empyema, wound infection, and bleeding.

Chest Trauma

Trauma is the leading cause of death before 40 years old .

Types of trauma

- 1) Blunt trauma as motor vehicle accidents and fall from height.
- 2) Penetrating trauma as gunshots and stab wounds
- 3) Iatrogenic trauma as occurring during endoscopy, needle biopsy and barotrauma.

Evaluation and Management

The priority is to assess and deal with life threatening conditions related to airway, breathing and circulation.

Some critical conditions could be encountered in chest trauma and need to be dealt with emergently such as tension pneumothorax, significant hemothorax, cardiac tamponad, injury to great vessels, myocardial contusion, pulmonary contusion, air embolism and ruptured diaphragm.

After stabilization of the patient, patient is evaluated by history, clinical and radiological maneuvers.

Results of chest trauma

- 1) Rib fractures.
- 2) Flail chest.
- 3) Sternal fracture.
- 4) Pneumothorax.
- 5) Hemothorax.
- 6) Pulmonary contusion.
- 7) Air way injury.
- 8) Cardiac and great vessels injury.

Rib fractures

Are either simple or complicated (associated injuries of the pleura, lung, airway, great vessels, heart, esophagus, and diaphragm according to the site of fractured rib). Fractured ribs can be diagnosed clinically by the severe pleuritic chest pain, localization of the fracture by palpation, and radiologically by chest x-ray.

Management of rib fracture is to abolish chest pain and encourage physiotherapy to prevent lung atelectasis. Control of pain can be achieved by strong analgesics, intercostals nerve block, thoracic epidural analgesia and intrapleural catheter analgesia. In some situation, surgical fixation of fractured rib is needed.

Flail chest

It is a life-threatening condition that occurs when a segment of the rib cage breaks under extreme stress, so multiple adjacent ribs are broken in multiple places, separating a segment, so a part of the chest wall moves independently.

Flail chest leads to paradoxical respiration, mediastinal flutter, deterioration of blood gases, impedance of venous return and finally hemodynamic instability and death.

Beside good analgesics and respiratory physiotherapy, fixation of the flail segment is achieved by external fixation (adhesive plaster), internal fixation (mechanical ventilation) or surgically by rib fixation.

Pneumothorax

Pneumothorax is the collection of air in the pleural space—that is, between the lung and the chest wall. Pneumothoraces are classified as spontaneous and non spontaneous . Pneumothorax is classified further as open or closed, depending on the presence or absence of air leak at the time of presentation and intervention . The accumulation of air in the pleural space interfere with lung movement and when severe , causes lung collapse and mediastinal shift with resultant hemodynamic insufficiency

Tension pneumothorax occur when the amount of air in the chest increases markedly when a one-way valve is formed by an area of damaged tissue.

The symptoms of pneumothorax can be vague and inconclusive, symptoms typically include chest pain and dyspnea. In contrast, tension pneumothorax is a medical emergency and may be treated before imaging especially if there is severe hypoxia, very low blood pressure, or an impaired level of consciousness. In traumatic pneumothorax, chest tubes are usually inserted. Tension pneumothorax is usually treated initially with urgent needle decompression. Spontaneous_pneumothorax_can be treated conservatively.

Hemothorax

Accumulation of blood in the pleural space due to injury of intercostals vessels, pulmonary vessels, pulmonary parenchyma, heart or great vessels.

Management is directed to stop bleeding by hemostatics, restoration of blood loss by blood transfusion and drainage of collected blood by chest tubes. Thoracotomy is required for some cases either emergently or later on to deal with complications.

Invasive procedures in chest trauma

1) Intercostal chest tube

Used for derainage of collected intrapleural air, blood, chyle, effusion, or pus. Such drainage is curative in most cases and in some cases it help monitoring the degree of collection prior to thoracotomy.

2) Bronchoscopy

To exclude air way injury, to remove aspirated FB as broken teeth, evaluate patient with hemoptysis, clear secretions and help in difficult intubation.

3) Exploratory thoracotomy

In cases with significant hemothorax (initial drainage of 1.5 liters blood or continous drainage of 2 ml per kg per minuet for 2-4 hours), traversing injury through the mediastinum, persistant massive air leak, and tamponad. Exploration is through the 5th intercostals space via posterolateral thoracotomy. Other forms of thoracotomy include anterolateral thoracotomy, axillary thoracotomy and thoracosternotomy.

Late complications of thoracic trauma

- 1- Empyema.
- 2- Clotted hemothorax.
- 3- Chylothorax.
- 4- Bronchopleural fistula.
- 5- Bronchial stenosis.
- 6- Constrictive pericarditis.

Surgical maneuvers

- 1) Control of bleeding and repair pulmonary tear.
- 2) Pulmonary resection.
- 3) Evacuation of clotted hemothorax.
- 4) Decortication.
- 5) Open drainage.
- 6) Bronchial repair.
- 7) Pericardiectomy.

Suppurative lung syndrome

Definition

It is syndrome in which there is paroxysmal coughing and expectoration of copious, fetid sputum usually related to posture.

Causes of suppurative lung syndrome:-

It includes the following:

- 1- Bronchiectasis.
- 2- Lung abscess.
- 3- Infected cystic lung.
- 4- Empyema with bronchopleural fistula.

Bronchiectasis

Definition

It is localized, irreversible dilation of part of the bronchial tree caused by destruction of the muscle and elastic tissue. Involved bronchi are dilated, inflamed, and easily collapsible, resulting in airway obstruction and impaired clearance of secretions.

Causes

Bronchiectasis has both congenital and acquired causes. Acquired bronchiectasis is often caused by recurrent inflammation or infection plus obstruction of the airways. It may begin in childhood as a complication from infection or inhaling FB. Congenital causes include cystic fibrosis, Kartagener syndrome and primary immunodeficiency.

Diagnosis

Clinically there is repeated episodes of respiratory tract infection with cough of mucopurulent and tenacious secretions lasting months to years. Occasionally there is hemoptysis, dyspnea, wheezing, and pleurisy. Radiological diagnosis is by chest x-ray and CT chest. Bronchoscope can not reach distal bronchi but it helps in diagnoses.

Treatment of Bronchiectasis

Medical management includes prevention, appropriate antibiotic therapy, and postural drainage. Surgical management of bronchiectasis is based on that the disease is localized and unilateral and complete resection of all disease is possible, and prevents recurrence.

Lung Abscess

Definition

Lung abscess is pus-filled cavity within the pulmonary tissue caused by microbial infection resulting in necrosis and formation of cavities containing necrotic debris or fluid.

Causes

Either primary or secondary. Primary lung abscess is usually caused by bacteria that normally live in the mouth or throat and that are aspirated into the lungs. Infection occurs primarily when a person is unconscious or very drowsy because of sedation, anesthesia, alcohol or drug abuse, or a disease of the nervous system. Secondary lung abscess occurs in case of bronchial obstruction, necrotizing tumor or due to septic pulmonary emboli.

Diagnosis

Clinically, there is acute pneumonia that do not resolve and followed by intermittent febrile course with weight loss, night sweats, cough, and the production of purulent sputum. The patient may have foul breath and often appears quite ill. Many people have these symptoms for weeks or months before seeking medical attention. Radiological diagnosis is by chest x-ray and CT chest. Presence of air-fluid levels in chest x-ray implies rupture into the bronchial tree.

Treatment of Lung Abscess

Medical management include antibiotics according to sputum culture and sensitivity, postural drainage, and good nutrition. Bronchoscope is done repeatedly to aspirate pus. Surgery is needed in case of failed medical treatment to resolve x-ray findings, persistent symptoms and signs, suspicion of carcinoma, development and recurrence of complication as bronchopleural fistula, empyema or bleeding.

Endoscopy in cardiothoracic surgery

Chevalier Jackson who is known as the father of American bronchoscopy defined bronchoscopy as a “procedure using a tube that serves as a speculum for the examination of the interior of the bronchi”.

Endoscopes used in cardiothoracic surgery

- 1- Bronchoscope either rigid or fiberoptic.
- 2- Esophagoscope.
- 3- Mediastinoscope.
- 4- Thoracoscope.

Bronchoscopy

Indications

- 1) Diagnostic
 - Persistent symptoms as unexplained cough, hemoptysis, and unilateral wheezes.
 - Abnormal radiographic finding.
 - Suspected airway stricture.
 - Suspected airway injury.
 - Diagnoses and staging of lung cancer.
- 2) Therapeutic
 - Removal of FB.
 - Remove secretions or mucus plugs from the airway.
 - Dilate an airway stenosis.
 - Treat cancer using a number of different techniques.
 - Drainage of lung abscess.

Advantages and disadvantages of bronchoscopes

Rigid bronchoscopes have wider lumen so there is greater ease of retrieval of FBs, improved airway vision and ventilation at the expense of patient comfort and need for general anesthesia. Fiber optic bronchoscopes on the other hand need only local anesthesia with greater comfort for patient. It enable the operator to visualize segmental bronchi and take distal biopsies. Its drawbacks are the narrow lumen with difficult ventilation and smaller biopsies.

Bronchoscopic modalities for diagnoses of lung cancer

- 1- Washing by instillation of saline into the bronchial tree and aspirating it.
 - 2- Brushing by rubbing the brush on the surface of the lesion.
 - 3- Biopsy by means of forceps for the tumor or US guided needle biopsy for LNs.
-

Bronchoscopic modalities for treating lung cancer

- 1- Extraction of the tumor and dilatation of stenosed airway.
- 2- Destruction of the tumor by means of laser, brachytherapy, electrotherapy, and cryotherapy.
- 3- Airway stents.

Most of these methods are palliative to improve the quality of patient life except in benign conditions.

Thoracoscopy

Definition

Thoracoscopy involves a percutaneous approach to placement of an endoscopic instrument within the pleural space.

Indications

The VATS approach was initially used for simple diagnostic and therapeutic procedures involving the pleura, lungs, and mediastinum. Nowadays, there is an increasing role in the diagnosis and treatment of a wide range of thoracic disorders that previously required sternotomy or open thoracotomy. These disorders include, for example, pleural effusion, mesothelioma, peripheral lung cancer, and TB. VATS operations can be used for all structures in the chest, and are not limited to the lungs, pleura, and mediastinum but also the heart, great vessels, the esophagus, and diaphragm.

Advantages of thoroscopes

The potential advantages of video-assisted thoracic surgery include less postoperative pain, fewer operative complications, shortened hospital stay, and reduced costs.

Foreign body inhalation

It is a major problem in our locality leading to significant morbidity and mortality. The nature of aspirated foreign bodies has certain geographic and cultural variability. All varieties of FB could be encountered . They may be organic as ; melon seeds, peanuts, orange seeds, vegetable fragments, or non-organic as pins, screw, buttons, coins, part of dental plate, toys, or even tracheostomy tubes.

The predominance of aspirated foreign bodies occurs in children. The most common anatomic site for foreign body lodgment in adults is the right bronchial tree.

In our locality , there is predominance for vegetable FB aspiration in children related to ignorance and bad care , and pins inhalation in young females. Inhalation occurs if the person is excited while there is anything in the mouth . As the larynx is opened during crying or coughing, the FB enters the larynx by gravity and by suction .

Patient may present with no symptoms but with history of choking and persistent cough, or with chest x ray with radio-opaque FB or pulmonary changes related to the FB effect as atelectasis or emphysema. Children with organic FB inhalation may present with dyspnea , wheezing , non resolving chest infection, or present at the emergency department with stridor or cardiac arrest due to air way obstruction as the air way in children is narrow and organic FB absorbs water and increases in size . Many children supposed to be asthmatics or bronchiectatic are actually victims of unsuspected FB . Neglected FB may eventually result in complications that may require pulmonary resection.

Management of FB inhalation starts from the society who need to be aware of such problem and how to avoid . Mothers must not leave theirs kids alone playing with objects which could be swallowed or aspirated , workers must avoid the habit of retaining foreign objects in their mouth .

In case of patient distress due to air way obstruction , application of sudden forceful compression of the abdominal wall can save the patient life as the sudden increase of the intra abdominal pressure will result in elevation of the diaphragm , increase intra thoracic pressure leading to expulsion of the FB .

Rigid bronchoscopy and removal of the FB is the principal method of therapy. Patient may present urgently , occasionally a period of preoperative preparation with antibiotics may be needed in delayed cases . Bronchoscopy is done under general anesthesia . This requires skill for the passage of the instrument and for manipulation of various forceps . Bronchoscopy has to be done once there is history of inhalation even if equivocal .

The Diaphragm

Definition

The diaphragm is a modified half-dome of musculo-fibrous tissue that separates the thorax from the abdomen. It is the main muscle of respiration.

Function

During inhalation, the diaphragm contracts, thus enlarging the thoracic cavity, so creates suction that draws air into the lung. When the diaphragm relaxes, air is exhaled by elastic recoil of the lung and the chest wall. The diaphragm is also involved in non-respiratory functions, helping to expel vomit, urine, and feces from the body by increasing intra-abdominal pressure.

Origin

Its peripheral muscular part takes origin from the circumference of the inferior thoracic aperture. The muscular origin of the diaphragm is from the lower 6 ribs bilaterally, the posterior xiphoid process, the external and internal arcuate ligaments, and vertebral origin from the the body of L1,2(left), L1-3(right) by 2 crurae.

Insertion

All muscle fibers converge to be inserted into the central tendon which is a thin strong aponeurosis situated near the center but somewhat closer to the front than to the back of the chest.

Openings

A number of different structures traverse the diaphragm, but 3 distinct apertures allow the passage of the aorta, esophagus, and vena cava. The aortic aperture lies at the level of the 12th thoracic vertebra and transmits the thoracic duct, the azygous and hemiazygous veins. The esophageal aperture is surrounded by diaphragmatic muscle and lies at the level of the 10th thoracic vertebra and transmits the anterior and posterior vagal trunks and some esophageal arteries. The vena caval aperture lies at the level of the thoracic vertebra and transmits branches of the right phrenic nerve.

Diaphragmatic hernia

Definition

It is a defect or hole in the diaphragm that allows the abdominal contents to move into the chest cavity.

Types

- 1) Congenital diaphragmatic hernia.
- 2) Traumatic diaphragmatic hernia.
- 3) Hiatus hernia.

Types of Congenital diaphragmatic hernia

- a) Morgagni Hernia.
- b) Bochdalek.

Types of traumatic diaphragmatic hernia

- a) Blunt or penetrating trauma.
- b) Iatrogenic injury.
- c) Spontaneous diaphragmatic rupture during pregnancy.

Diagnosis

The diagnosis of diaphragmatic hernia needs high degree of suspicion. Blunt trauma usually affect the left side with herniation of any of the following; omentum, stomach, colon, spleen, or left lobe of the liver. Clinically, patient with blunt trauma usually suffer from injuries related to the trauma. Chest symptoms usually include dyspnea caused by lung compression, associated lung injury, or mediastinal shift. Patient with penetrating injury to the lower chest or upper abdomen may develop diaphragmatic tear which is small initially, but healing don't occur and gradual herniation of abdominal viscera follow over many months or years until it become diagnosed accidentally or because of development of symptoms or complications. Radiological methods include chest x-ray, abdominal US, contrast studies, and CT chest.

Treatment

Diaphragmatic hernia is a surgical problem needs surgery after stabilization of patient. The diaphragm can be approached through thoracotomy or laparotomy. Repair is done by heavy non absorbable interrupted sutures in 2 layers.

Chest Wall Tumors

Neoplasms of the chest wall are uncommon. They form about 2% of all body tumors and 5% of all thoracic malignancies. Metastatic tumors outnumber the primary rib tumors. Primary chest wall tumors may originate from:

- 1- Soft tissue : superficial or deep.**
- 2- Bone and cartilage.**

Most of soft tissue tumors are benign as; lipoma and hemangioma. Half of skeletal tumors are malignant as rhabdomyosarcoma. Sternal tumors are considered malignant until proved otherwise.

Benign tumors occur in young adults, primary malignant tumors during the middle age, and metastatic tumors in elderly. They are more in males than in females.

The most common primary benign tumors are cartilegenous tumors, fibrous dysplasia, and desmoid tumors. The most common primary malignant tumors are chondrosarcoma, malignant fibrous histiocytoma, and rhabdomyosarcoma.

Clinical presentation :

Tumors may be asymptomatic and discovered accidentally in chest x-ray or CT chest. Most tumors present with painless mass. Pain is usually a sign of malignancy due to invasion of the cortex or periosteum. Some malignant tumors have general symptoms as Ewing sarcoma.

Diagnosis :

- 1- Radiological by means of chest x-ray, CT chest, MRI, and radioisotope study.
- 2- Pathological by biopsy which may be; excision biopsy for small tumors, incisional biopsy for large tumors, cutting needle biopsy, and needle aspiration cytology.
- 3- Laboratory investigations as elevated ESR, tumor markers and immunohistological studies.

Treatment :

All tumors of the chest should be considered malignant until proved otherwise. All of them should be widely resected. Small benign tumors need excision only, while large ones need complimentary chest wall reconstruction. Non metastatic malignant tumors need pre and postoperative chemo or radiotherapy and chest wall reconstruction. Malignant metastatic tumors need palliative treatment.

Chest wall reconstruction:

Material used are either autogenous tissues (fascia lata, ribs, or bone grafts) or meshes

(Prolene, PTFE, or Marelex) or metals.

Soft tissue reconstruction is always by autogenous tissues as Latissimus dorsi, pectoralis major, rectus abdominis, serratus anterior, external oblique, and trapezius muscle or omentum.

Prognosis:

Prognosis depends on the cell type of the tumor, degree of resection of all malignant tissue, condition of the chest wall defect as site, size, and depth, efficacy of complimentary chemo and radiotherapy, and general condition of the patient.

Short questions

- 1- Define & classify suppurative lung diseases.
- 2- List causes of chronic lung abscess.
- 3- List types of bronchiectasis.
- 4- Outline therapeutic & diagnostic indications of bronchoscopy.
- 5- Describe arrangement of mediastinal compartments with structures related.
- 6- Enumerate mediastinal lesions.
- 7- List indications of ICT.
- 8- Describe anatomy of MV complex.
- 9- List causes of various valve lesions.
- 10- Describe types of pulmonary resection.
- 11- Name myocutaneous flaps used in chest wall reconstructions.
- 12- Define & classify cyanotic and acyanotic heart diseases.
- 13- Enumerate components of TOF.
- 14- Describe distribution of coronary arteries.
- 15- Name conduits used in CABG.
- 16- List causes of pleural effusion.
- 17- List causes of pneumothorax.
- 18- Describe anatomy of diaphragm with mentioning diaphragmatic opening & structures passing through.
- 19- Describe types of thoracotomies.
- 20- Summarize causes of chronic lung abscess.
- 21- Explain symptomatology of bronchiectasis.
- 22- Give examples of endoscopes of value in thoracic surgery.
- 23- Identify most common tumor in anterosuperior mediastinum.
- 24- Identify most common tumor in posterior mediastinum.
- 25- Explain complications of ICT.
- 26- Explain complications of CMV.
- 27- Explain complications of MV repair.
- 28- Explain complications of PTCA.
- 29- Explain complications of AVR.
- 30- Explain complications of biological prosthetic valve replacement.
- 31- Explain complications of surgery in pulmonary TB.
- 32- Explain complications of Pulmonary resections in .
- 33- Explain auscultatory triad of MS .
- 34- Explain complications of blunt multiple fracture ribs.
- 35- Explain complications of penetrating chest injuries.
- 36- Predict sources of bleeding in traumatic hemopericardium .
- 37- Predict sources of bleeding in hemothorax.
- 38- Early predict bronchogenic carcinoma.
- 39- Identify most common causes of rib tumor (Bn & Mg).
- 40- Explain complications of PDA.
- 41- Explain indications of CABG.
- 42- Outlines emergency management of tension pneumothorax.
- 43- Explain types of diaphragmatic hernia.
- 44- Explain manifestations of mediastinal compression.
- 45- Categorize advantages and disadvantages of FOB.
- 46- Categorize advantages and disadvantages of rigid bronchoscope.

- 47- Manage a patient with ICT.**
- 48- Categorize surgical options of MV lesions.**
- 49- Explain complications of mechanical prosthetic cardiac valves.**
- 50- Explain complications of biological prosthetic cardiac valves.**
- 51- Explain methods of fixation of flail chest.**
- 52- Manage a case with simple single fracture rib.**
- 53- Illustrate bronchoscopic findings in bronchogenic carcinoma.**
- 54- Illustrate radiological signs in bronchogenic carcinoma.**
- 55- Outline methods of pathological diagnosis of bronchogenic carcinoma.**
- 56- Explain complications of acute myocardial infection.**