



Sir William Osler (1849-1919)

The Osler Institute

*Excellence in Continuing Medical
Education*

Thoracic Surgery Syllabus

Disc 1

Disc 2

Disc 3

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Thoracic Surgery Disc 1 Notes

Thoracic Aorta

Thoracic Trauma

Pulmonary Infections

Pulmonary Neoplasm

Transfusions and Coagulation
Disorders

Trachea

Esophagus

Mitral Valve Disease

Aortic Valve Disease

Thoracic Aorta

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I. Aortic Aneurysm

- Marfan syndrome
- 1;5000
- Annuloaortic ectasia; Dilatation of the aortic root ,
- Aortic Regurgitation, Mitral valve prolapse, Dysarrhythmia
- Other manifestations; skeletal and ocular deformities
- Aortic Dissection
- More common than AAA rupture
- Intimal tear ,blood splits the media into an outer (false) lumen which is thin and liable to rupture + inner(true) lumen
- Dissection; acute(first 2 weeks) – Chronic (more than 2 weeks)
- Chronic dissection may expand the weakened wall o cause an aneurysm
- Risk of rupture in Thoracic aortic aneurysm
- 1 year rupture;
- 80% for > 8cm
- 43% for > 6cm
- 4% for 5cm
- Dissecting aneurysm median time of rupture is 3 days

II. Clinical Diagnosis of Thoracic aorta aneurysm

- Commonly Asymptomatic
- Murmur of Aortic regurgitation
- Pressure on Left recurrent laryngeal nerve
- CXR
- CT scan is OK except for aortic valve
- TEE will determine aortic valve ,but not good for arch or below diaphragm
- Angiography will determine coronary and renal vessels

III. Indications for surgery in Ascending aortic aneurysm

- > 5 cm
- > 4 if associated with Aortic regurgitation or in Marfan syndrome
- Enlarging Aneurysm

IV. Surgical techniques

- Median sternotomy
- Cannulation options;
- Ascending aorta (if aneurysm allows)
- Femoral artery ,axillary
- 2 venous cannula
- Total bypass
- Cardioplegia (Ante/retrograde)

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- Composite valve graft
- NB; if the aortic valve is normal ,but just dilated, it could be preserved by resuspension e.g. Aortic dissection
- Methods of Reimplanting the coronaries
- Modified Bentall ; Direct anastomosis of the coronaries to the graft ,using an island of tissue around
- Cabrol; a tube graft 6mm is sutured to the aortic graft . The coronaries are then sutured to the 6mm graft to avoid tension which was associated with pseudoaneurysm and bleeding

V. Open Technique – No clamp = deep hypothermia

- In cases of acute dissection of ascending aorta or in cases on aneurysm extending to the arch , It is not feasible to clamp→
- Deep hypothermia circulatory arrest with retrograde cerebral perfusion
- Cool down to 15c
- EEG is isoelectric
- Remove all blood except for 500 cc. Withdraw all lines e.g Swan
- Flow of 0.5 l/minute is enough at this temp
- Start retrograde perfusion up the SVC by a Y connection . Keeping the pressure low and suction all debris returning via brachiocephalic
- Leave an island of the arch branches to be reattached to the graft
- Open the Aneurysm , perform the distal anastomosis first , then clamp the graft and put an antegrade aortic cannula and start antegrade perfusion
- DHCA is safe for 30 minutes
- In cases of aneurysm extending into descending aorta → 2 stages elephant trunk
- The second stage is done 8 weeks later with a left thoracotomy . Proximal control is by clamping the distal end of the graft
- The elephant trunk length up to 7 cm
- Transverse aneurysm is repaired ,if more than 5 cm in size
- Median sternotomy

A. Descending aneurysm .indications of surgery are:

- Symptomatic
- > 6 cm size
- Enlarging aneurysm

VI. Surgery for descending aorta

- Left thoracotomy
- Or Thoracoabdominal

A. Complications

- Paraplegia
- 5%. But recent improvement are due to CSF drainage, distal aortic perfusion

- Anterior spinal artery of variable origin ,arises from left sided intercostal arteries or lumbar arteries in 80%
- 75% is located between T9 and T12
- 10% between L1- L2 ,15% T5- T8
- Factors affecting Paraplegia
- Duration of clamp
- Distal perfusion pressure
- What is spinal cord perfusion pressure = Mean distal aortic pressure - cerebral spinal fluid pressure
- Value of reimplanting intercostal is questionable
- Renal dysfunction
- May not be affected by clamp duration , but may be more related to distal aortic perfusion pressure
- Keep left renal artery temperature <15c

VII. Aortic Dissection

A. Stanford

- A; involves ascending aorta ,regardless of involvement or not of the descending aorta
- B, not involving the ascending aorta
- Type A
- Longitudinal dissection and false lumen occupy the right anterior portion of the ascending aorta and the medial half of the ascending aorta remains uninvolved
- Distally, it goes along the greater arch
- In the descending aorta =anterolateral
- R coronary artery. >left
- Aortic Regurgitation from dissection into the commissures, detaching the valve → prolapse
- Type A is an emergency ,rupture is high and pericardial tamponade is the result

B. C/P

- Substernal pain ,tearing ,persistent
- Absent unilateral femoral pulse
- Sudden death
- Median sternotomy
- Use of Deep hypothermic arrest with retrograde cerebral perfusion
- Type B Dissection
- Pain is felt at the back (between the scapula)
- Treatment is medical control of BP
- Surgery for extension of dissection into the renal arteries, visceral circulation ,lower limb circulation
- Paraplegia is a contraindication for surgery

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Thoracic Trauma

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I. Specific cardiac injuries

- Ventricular Aneurysm
- Very rare. If the coronaries are normal then the injury is in the myocardium and not secondary to coronary injury

A. Traumatic Septal defects ;

- Located in muscular septum near apex
- New systolic murmur+Heart failure
- Dx : Echo . TEE. TTE
- Oxygen saturation step up of more than 20 mmhg between right atrium and R ventricle is diagnostic of left to right shunt
- Repaired all the times ,unless the shunt is small (less than 1.5 to 1)
- IABP helps to decrease the shunt

B. Aortic valve injury

- The most common injured valve
- Mechanisms; avulsion of commissures – extension of blunt traumatic aortic rupture at aortic root when falling from a height
- Aortic regurgitation picture
- Resuspension of the valve in commissure disruption by pledget sutures
- Leaflets injury usually needs replacement and can not be repaired
- In case of dissection with valve injury a composite graft may be needed with coronaries implantation

C. Mitral valve

- Rare
- Chordal or papillary muscle rupture
- TEE , TTE
- IABP
- Replacement is usually the rule

D. Tricuspid valve

- More common than mitral ,because is more anterior location
- Right bundle branch block ,cardiomegaly without signs of left ventricle failure
- In delayed cases , atrial hypertension develops with time → Right to left shunt via foramen ovale
- Presentation is usually delayed with progressive symptoms
- Treatment ; many do not require treatment
- But in young active patients ,Replacement rather than repair may have to be done

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E. Great vessels Injury

- Approach ;
- Median sternotomy
- Innominate artery is most commonly injured
- Left Subclavian artery

F. Cardiac trauma

- 10% of penetrating chest trauma involves the heart
 - Right ventricle is the most commonly injured in stab wounds
1. Diagnosis;
 - Suspect in any injury near the heart (precordium-epigastrium-superior mediasti)
 - Patient may present with hypotension, and shock, haemothorax or in tamponade)
 - Beck triad ; distended neck veins- muffled heart sounds – hypotension
 2. Shock with elevated CVP;
 - Tamponade # tension PNX
 - Difference > Air way pressure
 - Patient may present with hypotension, and shock, haemothorax or in tamponade)
 - Beck triad ; distended neck veins- muffled heart sounds – hypotension
 3. Shock with elevated CVP;
 - Tamponade # tension PNX
 - Difference > Air way pressure
 4. Echocardiogram
 - Looks promising . Should be available in the ER . > 90 % sensitivity and specificity
 5. Pericardiocentesis
 - Not a diagnostic test, only done for temporary relief of blood in the way to the OR . Blood is not clotted
 6. Subxiphoidal exploration
 - Definitive diagnostic test in stable patient
 - Good test to rule out tamponade in patients who do not have tamponade
 - Positive pericardiocentesis or window =
 - Blood = median sternotomy
 - Most 95% cardiac injuries are repaired without Bypass

II. ER (Resuscitative Thoracotomy)

A. Indications

1. Penetrating chest injuries with failure of aggressive resuscitation to raise BP >80% (12% survival)
2. Penetrating chest or abd injuries who lost vitals during transfer
3. Blunt injuries who had vitals before arrival (3% survival)
 - Left anterolateral thoracotomy down to the table
 - Control obvious source of bleeding e.g left hilum

- Open pericardium ,watch phrenic nerve
- If no injury is seen ,extend to the right chest
- Open cardiac massage . Clamp the Aorta

B. Blunt cardiac injury (myocardial contusion)

- Incidence; unknown . Most are asymptomatic
- May range from benign arrhythmia to fatal ventricular fibrillation . Myocardial rupture and death
- ST , T changes and sinus tachycardia are the most common EKG changes
- Tests of DX ;
- Stable → EKG monitor for 12-24 h
- Unstable ; + Echo → to look for pericardial fluid or other injuries e.g valve rupture ..
- Treatment is supportive

C. Traumatic Rupture of Aorta

- Rapid deceleration injury with shearing force
 - Most common site is just distal to the left subclavian 60%. Followed by distal thoracic aorta 20%
 - 60% die at the scene. 40 % make it to the hospital, third of which die during initial resuscitation
1. Clinical presentation
 - Free rupture, death shortly after injury
 - Contained rupture; detected on CXR
 - Chronic rupture;(rare) chest pain ,back pain , hoarseness of voice years later
 - Examination ;shock . Look for associated injuries
 2. Diagnosis of Ruptured aorta
 - CXR ; wide mediastinum > 8cm transverse
 - Normal CXR does not r/o rupture
 - Aortography ;still gold standard . Always needed before surgery
 - CT scan , MRA ; CT is good for a patient with normal looking CXR , a mechanism of injury and requires CT for other lesions . If a mediastinal haematoma is seen → angio
 - Helical CT / reconstruction views are to be tested
 - Transoesophageal Echo (TEE)
 - Can be done in OR / ICU..only good for typical location . PNX may limit its value
 3. Treatment of aortic rupture
 - Preoperative preparation; A line , control the shearing force(BP /HR); Nipride. If tachy --.Esmolol
 - ? Simple clamp and repair
 - Partial By pass from left atrium to descending aorta or to Femoral artery → no need for oxygenator. No full heparin
 - Paraplegia 10% regardless. Ant spinal art
 - Clamp time >30 min

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Lung Inflammatory Disease

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I. Overview

- Actinomycosis and nocardial infections
- Pulmonary fungal infections
- Lung abscess
- Bronchiectasis
- TB disease of the chest
- Lung amebiasis

A. Actinomycosis

- It is a chronic suppurative and granulomatous infection that forms multiple sinus tracts that produce “sulfur granules.”
- Can invade and destroy bone
- Actinomyces is a part of the natural flora of mammalian mucous membrane.
- Infection happens when there is a break in the oral mucosa or when the organism is aspirated.
- Filamentous bacteria that display lateral and dichotomous branching** Look at the histology.
- Gram positive, anaerobic or microaerophilic bacteria that fragment to both bacillary and coccoid elements
- Routine cultures often do not grow the organism and this leads to a delay in diagnosis.
- Therapy is with high doses of penicillin, up to one year.

B. Nocardiosis

- Acute or chronic suppurative disorder
- More prevalent in immunocompromised patients
- Dissemination is most prevalent with pulmonary disease with CNS involvement in 30% of patients (brain abscess).
- If inadequately treated, pulmonary fibrosis may occur.
- Treatment is antibiotics, sulfa drugs up to one year.

C. Fungal infections

1. Pathogenic
 - Histoplasmosis
 - Coccidiomycosis
 - Blastomycosis
2. Opportunistic
 - Aspergillosis
 - Candidiasis
 - Mucormycosis
 - Cryptococcosis
3. Histoplasmosis
 - Most common cause of pulmonary fungal disease
 - Most infections are self limited except in the immunocompromised.

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- Characteristically, this is a solitary pulmonary nodule that grows slowly and calcifies.
 - Other forms include chronic cavitory disease, mediastinal granuloma and fibrosing mediastinitis.
 - Mediastinal lymph nodes may calcify and erode into the adjacent mediastinal structures, leading to severe hemoptysis and obstructive pneumonia.
 - Histoplasma antigen can be found in the blood, urine, or bronchoalveolar lavage fluid.
 - Treatment is with Amphotericin B and then Itraconazole.
 - Surgery is indicated in middle lobe syndrome, esophagotracheal fistula, bronchostenosis and hemoptysis.
4. Coccidiomycosis
- Cause serious infection in immunocompromised patients
 - Fever, cough, chest pain
 - Predominantly affects the upper lobes
 - Diagnosis with fungal cultures
 - Solitary nodule, for which resection is required to r/o neoplastic process
 - Amphotericin B, then converted to itraconazole
5. Blastomycosis
- Acute and chronic pulmonary infections, cutaneous involvement and disseminated disease
 - Cough, dyspnea, chest pain and weight loss
 - Upper lobe predominance
 - Single or multiple nodules that may require resection to r/o cancer+
 - Serology is unreliable, have to culture.
 - Amphotericin B in fulminant disease
6. Aspergillosis
- a. Immunocompromised patients are at high risk for invasive and pulmonary infections.
 - b. Three forms of disease, aspergilloma, invasive infection, non-invasive bronchial allergies
 - c. Aspergilloma
 - Treatment is surgical, specially in recurrent hemoptysis – 30% progress to life threatening hemoptysis with 25% mortality
 - Occurs in previously injured lung, TB cavities
 - d. Invasive pulmonary aspergillosis
 - Chest pain, cough, hemoptysis
 - Usually occurs in immunocompromised patients
 - Focal or diffuse infiltrates, nodular lesions, or wedge shaped infarcts
 - Amphotericin B is the treatment of choice.
 - Surgery is not indicated.

7. Candidiasis
 - Second most common opportunistic fungal infection of the lungs
 - Difficult to distinguish between colonization and tissue invasion
 - Candida sepsis therapy is aimed at removal of any potential catheter source and is with amphotericin B.
8. Mucormycosis
 - Uncommon pulmonary fungal infection
 - Occurs in the immunocompromised
 - Inhaled spore penetrated the bronchial walls and invades the pulmonary vessels, causing thrombosis and hemoptysis
 - Diagnosis is made on the tissue biopsies, no serological test available.
 - All patients are started on amphotericin B.
 - a. Surgery indicated when no response after 72 hrs of therapy
 - If limited involvement, do lobectomy
 - Endobronchial involvement, do YAG laser debridement
 - b. With aggressive treatment survival is 50%: if inoperable survival is 10%.
9. Cryptococcosis
 - Uncommon pulmonary infection, occurs in the immunocompromised
 - The lower lobes mostly affected
 - **Manifests most commonly as meningitis
 - Diagnosed by sputum culture or biopsy specimen
 - Surgery for solitary nodule to r/o CA
 - Amphotericin B therapy in the above population

D. Lung abscess

1. Treatment of abscess cavities involving the parenchyma is primarily medical.
2. Surgery indicated when
 - Medical therapy fails
 - Presence of large abscess
 - Complications like massive hemoptysis or empyema occur
3. Prognosis for primary lung abscess is excellent.
4. Factors associated with high mortality are
 - Abscess size (> 6cm)
 - Location (right lower lobe)
 - Immune deficiency
 - Organism type: *pseudomonas* > *Staph aureus* > *Klebsiella pneumoniae*

E. Bronchiectasis

1. Develops as a result of an inflammatory response of the bronchi to an infectious insult

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2. This response damages the bronchial wall permanently.
3. The injured bronchial wall is retracted secondary to the surrounding atelectatic lung, in which the secretions get trapped with persistent dilation and chronic relapsing infection.
4. Complications after Abx era are
 - Recurrent pulmonary infections
 - Hemoptysis, lung abscess, empyema, respiratory failure, cor pulmonale
5. Treatment is centered around airway management (secretions) and control of recurrent infections (bacterial).
6. Surgery indicated for medical failure and life threatening complications (must be complete)

F. Tuberculous disease of the chest

1. Primary therapy is medical with full course multi drug regimens.
2. Surgical intervention indicated in many cases
 - Failed medical treatment with resistant strains
 - Complications of the disease
3. Parenchyma is usually diseased and preoperative assessment is crucial – surgery geared towards the patient's risk category and lung functional status.

G. Lung amebiasis

1. Parasitic disease, endemic in tropical countries
2. Cough and pleuritic pain, high fever and diarrhea
3. Dx: measurement of serum indirect hemagglutination antibody
4. TX is mainly medical with Metronidazole.
5. Surgical treatment indicated if
 - The lung cannot be reexpanded.
 - Presence of a persistent bronchobiliary fistula
 - Uncontrollable superinfection
 - Damaged pulmonary tissue: persistent lung abscess, bronchiectasis, or fistula

H. Exam focus

- This is the most heavily tested topic on the written thoracic boards.
- Look at the CXR, CT and histologies.

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