Cardiac surgical disease

Objectives:

- **Basic consideration:** (Pathophysiological assessment, Assessment of risk, Specific aspect of surgical technique, Post-operative care)
- **Acquired cardiac disease**
- **Ischaemic heart disease:** (Coronary artery disease, Surgery for coronary artery disease complications)
- **Cardiac valvular disease:** (Assessment, Surgical management, Endocarditis, Aortic valve disease, Mitral valve disease, Tricuspid valve disease, Multiple and repeat valve procedures)
- **Aortic aneurysm:** (Tubulosaccular aneurysms, False "aneurysms", Aortic dissection, Aorto-annulo ectasia, Assessment, Surgery for aortic pathology)
- **Pericardial pathology:** (Pericardial effusion, Pericardial constriction)
- **Congenital cardiac disease:** (Atrial septal defect, Ventricular septal defect, Patent ductus arteriosus, Coarctation of the aorta, Tetralogy of fallot)

Resources:

- Davidson's.
- Slides
- Surgical recall.
- Raslan's notes.

Done by: Ali ALzahrani

Sub-leader: Nojood Alhaidri

Leaders: Abdulrahman Alsayyari & Monerah Alsalouli

Reviewed by: Ahmed Al Yahya & Luluh Alzeghayer

Focus of this lecture is on indication for cardiac surgery.

[Color index | Important | Notes | Extra]

[Editing file | Feedback | Share your notes | Shared notes]

Once you stop learning you start dying.

Cardiac surgery

- **Common Cardiac Operations**
  - **Coronary Artery Bypass Grafting** (**CABG**) (most common)
  - **Valve Replacement / Repair**
  - **Repair of congenital defects:** VSD or ASD
  - **Heart Transplantation**

- Lecturer talked mainly about:
  - The surgical **indications** (**classes**) for different cardiac issues.
  - How to **treat** those issues.
  - The surgical **Complications.**

First of all and to understand you have to know the **Classes of surgical indications:**

Classes	Explanations
Class I	There is **confirmed benefit** from surgery **We have to do surgery**
Class IIa	The studies which show **benefit** is more than studies show **no benefit**
Class IIb	The studies which show **no benefit** is more than studies show **benefit**
Class III	**No study shows benefit-Do not do it**

Class IIa is **not always** better than IIb but you have to take evidence and read about case to decide which is good for this case.

- If you do a cardiac surgery and you found any other abnormality you have to fix it in the same operation because performing another surgery will have a **high risk!**
- Proximal thrombus in coronary artery or its branches→ **larger** area of ischemia
- Distal thrombus in coronary artery or its branches → **smaller** area of ischemia

CABG

- **Indications of surgery:**
  - **Failure of medical therapy or percutaneous intervention.**
    - Percutaneous intervention: angioplasty, balloon dilatation and stenting.
  - **Left main coronary artery disease with narrowing more than 50% .**
    - this is the main artery of the left coronary circulation.
      If the blockage is before it branches to left anterior descending and circumferential artery then it's indicated for surgery.
  - **Proximal LAD & proximal Cx more than 70%.**
  - **Three-vessel disease with left ventricular dysfunction.**
  - **Mechanical complications of myocardial infarction**, include:
    cardiac Tamponade, Wall rupture, Chordae tendinae rupture, Valve weakening
    1. Mitral regurgitation 2. Septal rupture 3. Ventricular wall rupture 4. Left ventricular aneurysm
  - **Associated valve disease;** (patient with IHD + valve problems = refer to surgery.)

- **Indication for coronary artery diseases (CAD):**
- **Types of interventions:**
  - **Percutaneous coronary intervention (PCI)**
    - Usually used nowadays in CAD to relieve symptoms, **STEMI**[1]
  - **Coronary artery bypass graft** (**CABG**)
    - For extreme cases and severe CAD, not used as before.
- There are (indication for intervention itself) and (indication between different interventions).
- Patient will need intervention when there are significant symptoms and they are NOT relieved by medication:
  - Chest pain/ Shortness of Breath
  - Dropped in Ejection Fraction (EF)
  - Congestive Cardiac Failure
- We can go usually for **PCI** but for survival and long-term benefits sometimes we have to go for surgery (**CABG**) → **Depends on the American heart association Guidelines**

باختصار - متى نروح مباشرة للـ(CABG) بدلاً من الـ(PCI) ؟
نحدد هذا الشي عن طريق عاملين مهمين:
1-مقدار الضرر ونحدده عن طريق الـ(angiography) ونشوف ايش الشريان المتضرر و كم شريان متضرر وكم نسبة الانسداد.
2- حالة المريض و الـ(clinical features).

[1] b/c its fastest way to open an occluded vessels

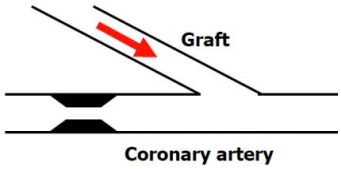
Condition	Indications for surgery: *important*
Left main stenosis more than 50%	- **CLASS I** -If you see it in angiography Go directly to surgery, no matter about symptoms or ECG or LV poor functions. - B/C left main coronary is suppling ⅔ of heart
Stenosis of proximal LAD[2] and proximal circumflex more than 70%	- **CLASS I** -If you see it in angiography Go directly to surgery, no matter about symptoms or ECG or LV poor functions. - They are the main left coronary branches.
Three vessels disease	- **CLASS I** -If you see it in angiography Go directly to surgery, no matter about symptoms or ECG or heart failure - **CLASS I** -If patient have (LV poor function+proximal LAD stenosis) B/C we put Internal mammary artery on LAD. - If patient have (LV poor function only)- either you put stent (PCI) or do surgery there are not significant differences.
Double and **single** artery disease	-If the patient have Double or single artery disease with proximal LAD then its **CLASS I** - B/C this is a large area damaged. -If the patient have Double or single artery disease without proximal LAD or with distal LAD then (PCI) or (CABG) are the same - B/C this is a small area damaged.

Revascularization	CABG			DES		
	No risk	DM	LVD	No risk	DM	LVD
1- vessel	N	N	N	Y	Y	Y
Proximal LAD	Y	Y	Y	N	N	N
2- vessel w/o LAD	N	N	N	Y	Y	Y
2- vessels w LAD	Y	Y	Y	Y	Y	Y
2-vessels + proximal LAD	Y	Y	Y	N	N	N
3- vessels	Y	Y	Y	C	C	C
3-vessels + proximal LAD	Y	Y	Y	N	N	N
LMC + other lesions	Y	Y	Y	N	N	N

N = DO NOT USE IT , Y = DO IT ! , C= Consultation ,
CABG= Coronary Artery Bypass Graft, DES= drug eluting stent

[2] Left Anterior Descending

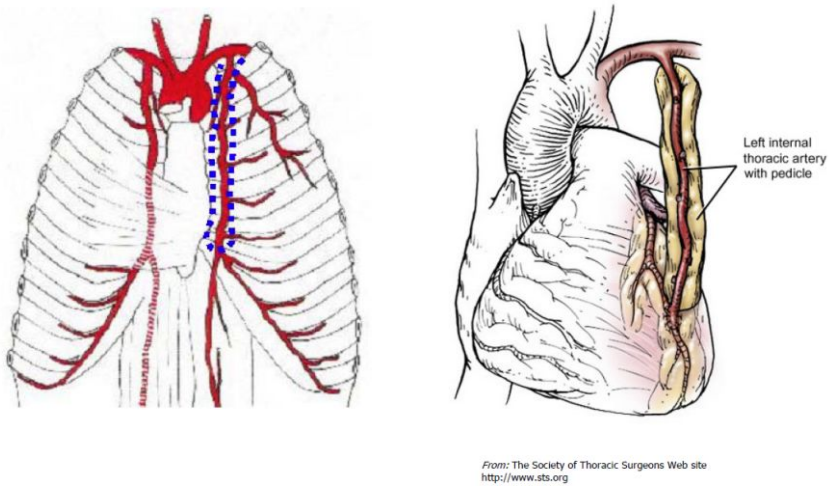
- **What is CABG?** video
  - A vascular graft that is sutured to the coronary artery beyond the stenosis.



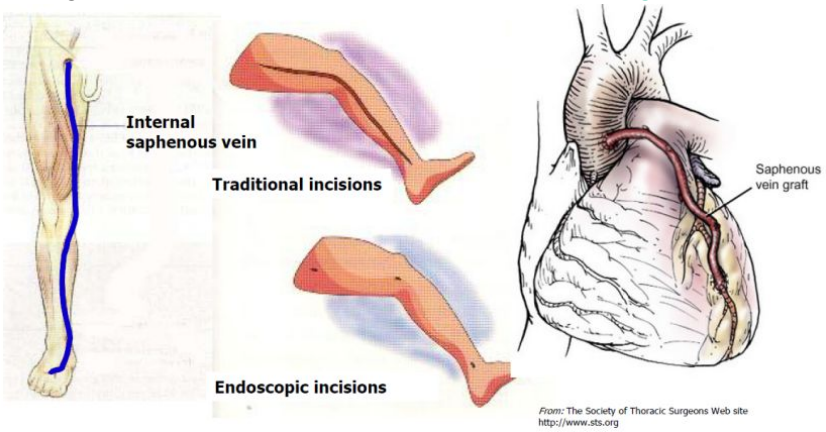
- **Coronary Conduits:**

The graft can be either:

- **Arterial**: left & right Internal thoracic (mammary) artery (most common in arterial grafts) (Radial artery also can be used)



- **Venous**: Long saphenous vein (most common in venous grafts)



  - Incisions are: traditional or endoscopic.

- **Arterial grafts are better than venous :** they have longer patency (In 10 years, 95% arterial grafts are patent, but only 50%-70% of veins remain patent.
- Veins are normally under low pressure, so if they are used as coronary grafts, they are prone to high pressure from the aorta and atherosclerosis.
- **The internal mammary artery is preferred** (it is a smooth muscle artery, as opposed to the radial artery which is a muscular artery and may undergo spasm, use radial artery only after Allen's test[3]: ulnar artery dominant→ you can use radial artery while if radial artery dominant→ don't use radial artery or ischemia will happen in hand).

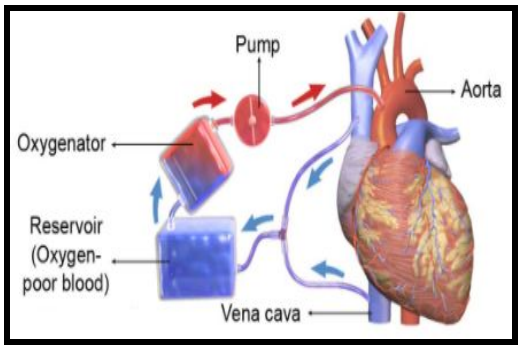
[3] Wikipedia

- Venous graft patency may be improved by using antiplatelet medication and statins. But they are still not as patent as the internal mammary artery.
- (arterial is better for patient; while venous is easier to take)
- Aim for surgery: look for the **long term patency** of graft you use.

- **Types of surgery:**

1- Cardiopulmonary bypass (with Cardioplegic arrest): under ECC

1. Venous blood is drained via cannulae inserted into the right atrium or venae cavae and passes to a reservoir.
2. It is then pumped through an oxygenator (ECC[4]), which adds O_2 and removes CO_2.
3. Finally, the blood is returned to the arterial circulation via a cannula in the ascending aorta or other suitable artery (femoral, axillary).



- **Complications**: Not common but it may cause:
  1. Renal and cerebral dysfunction/Cerebral damage (due to intracerebral bleeding).
  2. Embolization of microbubbles or arterial debris,or inadequate cerebral perfusion.
  3. Subtle deterioration in cerebral function.
  4. Coagulopathy and haemolysis (Prolong bypass)

2- Off pump (beating heart surgery): Without ECC

- **Benefits:**
  1. reduced incidence of stroke & cognitive dysfunction
  2. lesser renal dysfunction
  3. reduced inflammatory response
  4. lesser coagulopathy & requirement of blood transfusion
  5. Reduced length of stay
  6. Reduced mortality and mortality rates
- Off Pump CABG surgery can be done but it is more demanding;(beating heart surgery is more demanding than arrested heart surgery) but at the same time, you have to stabilize the area you are doing your anastomosis on.
- Less complications coming from heart-lung machine,, used on high risk borderline patients.

[4] extracorporeal circulation

Valvular Heart Diseases

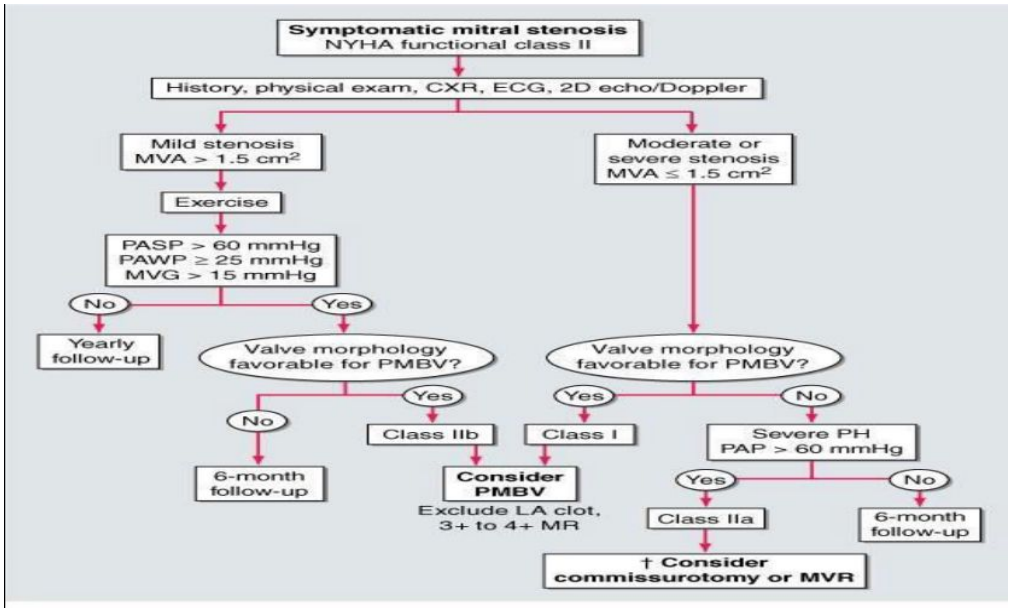
Mitral stenosis, Mitral regurgitation, Aortic stenosis, Aortic regurgitation

Mitral Stenosis

- First line treatment for MS is by PCI (**Balloon valvuloplasty**[5]) **or commissurotomy**[6]for patient who candidate it.

Class I (PMBV)	Moderate to severe stenosis with valve morphology that favor PMBV[7] Symptomatic[7], pt w/ Afib + pulmonary HTN - Surgical replacement for patient not candidate for PCI.
Class IIa (commissurotomy or MVR[8])	Severe PH, PAP[9] > 60 mmHg
Class IIb	Mild stenosis with valve morphology that favor PMBV

- **Treatment:**
  - Medical
  - Balloon valvuloplasty (dilatation in stenosis without regurgitation) common
    - Criteria for balloon: 1.No atrial thrombus 2.No mitral regurgitation 3.Valve is pliable and not calcified.
  - Closed mitral commissurotomy (doesn't need heart-lung machine) not done anymore
  - Open mitral commissurotomy (needs heart-lung machine)
  - Mitral valve replacement



Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: http://www.accessmedicine.com

[5] Percutaneous Mitral Balloon Valvuloplasty
[6] Open heart surgery direct the mitral valve for ppl who aren't candidate for Balloon valvuloplasty
[7] Angina, Heart murmur, Palpitation, Dyspnea worse when lying down. Dysphagia, hoarseness.
[8] Mitral Valve Replacement
[9] Pulmonary Hypertension, Pulmonary Arterial Pressure

Wilkin's score: <8 favor for PMBV, >8 favor for commissurotomy

Score	Leaflet mobility	Valve thickness	Subvalvular thickening	Valvular calcification
1	Highly mobile with little restriction	Normal thickness (4-5mm)	Minimal chordal thickening	A single area of calcification
2	Decreased mobility in midportion and base of leaflets	Midleaflet/marginal thickening	Chordal thickening 1/3 up chordal length	Confined to leaflet margins
3	Forward movement of valve leaflets in diastole	Total leaflet thickening (5-8mm)	Chordal thickening 2/3 up chordal lenth	Up to mid-leaflet
4	No or minimal forward movement of leaflets in diastole	Severe thickening (≥8mm)	Complete chordal thickening to papillary muscle	Throughout most of the valve leaflets

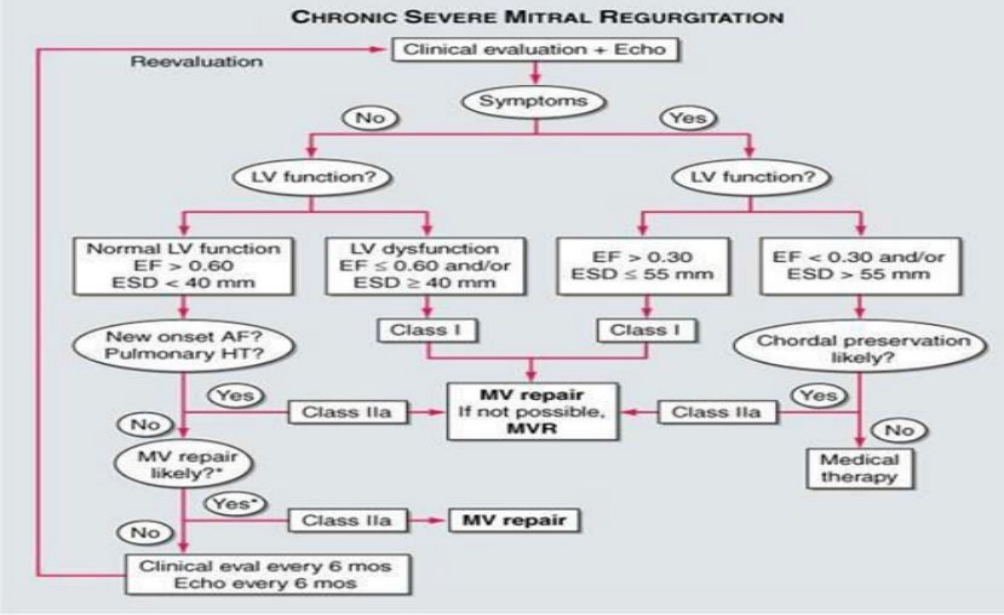
Mitral regurgitation

- Why we do intervention for MR? → prevent LV remodeling+relief symptoms.

CLass I	-Symptoms[10] -When put patient on treadmill and BP↓ -EF dropped by 60% -LV dysfunction/ LV dilation(size).
Class IIa	Atrial fibrillation or pulmonary hypertension. CLASS IIa are Asymptomatic b/c no change in LV size.

- **Treatment:**

- Medical
- Mitral valve repair
- Mitral valve replacement (if repair is not possible)



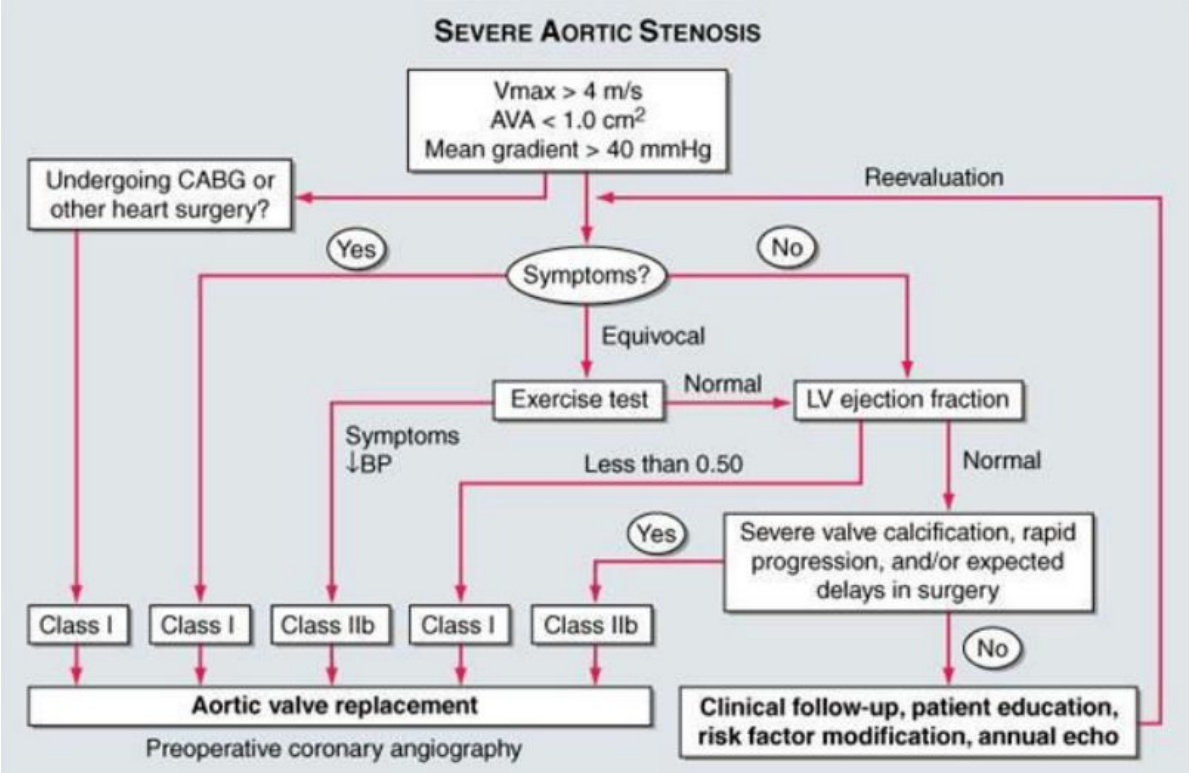
- In MR once you have decreased LV function this means it is an advanced stage in MR.

[10] Dyspnea,Heart murmur, Rapid Palpitation.

- **Indication for Aortic valve:**
  - **Aortic Stenosis**
    - **Indications for surgery:**
      - 1.Symptoms 2.Severe aortic stenosis (assessed by echo)

CLASS I[11]	• **Symptomatic**[12] • **history of CABG or other surgical disease** • **EF dropped < 50% (LV dysfunction)**
Class IIa	LV dilation (size) or pulmonary hypertension.
- **CLASS IIb**	when put patient on treadmill >↓BP. Or severe valve calcification and rapid progression.

    - **Treatment:**
      - Medical
      - Aortic valve replacement

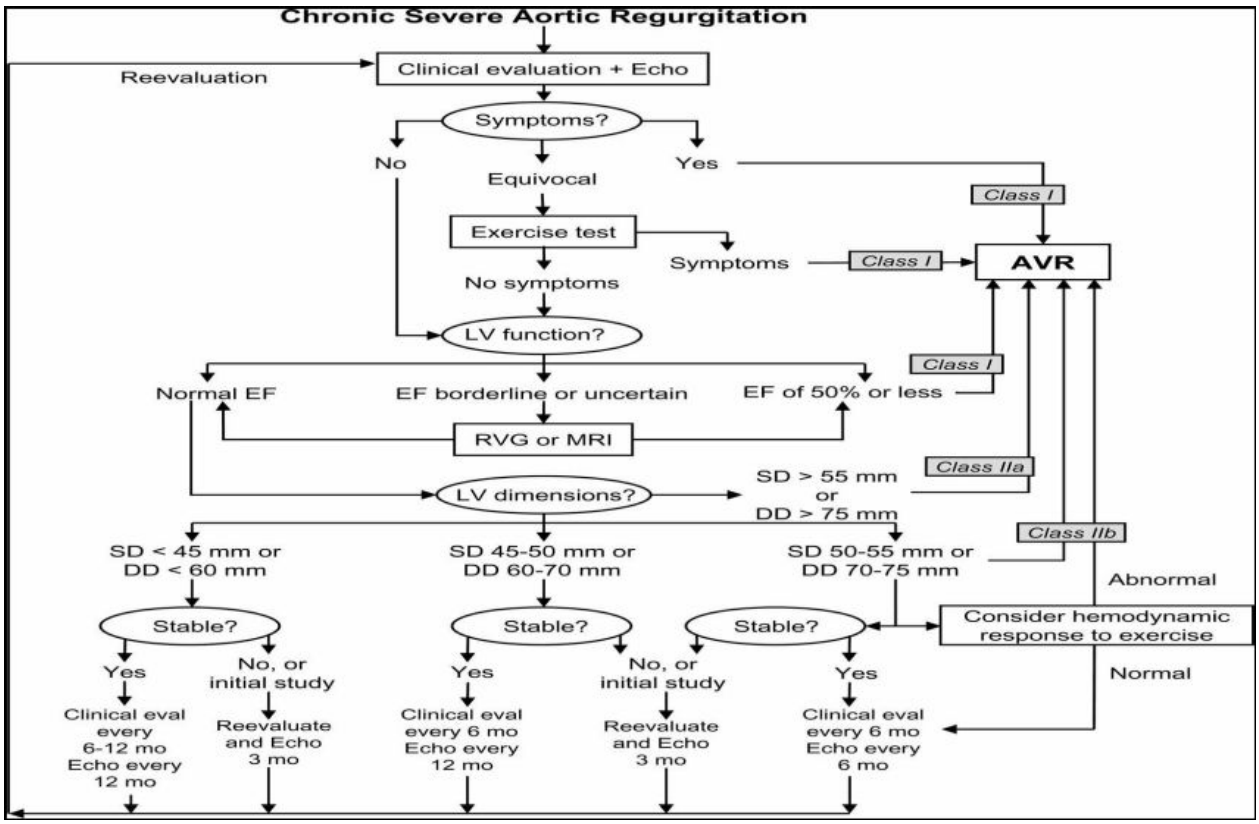


In Aortic stenosis, aortic valve can be replaced by the conventional way (either mechanical or tissue valve); or we can perform percutaneous aortic valve implantation→ called TAVI which you don't need to *"open"* so it can be used in old patients with high risk for surgery.

[11] In valves class 1 means replacement (except mitral stenosis, where the first line is PMBV)
[12] syncope, angina, Heart murmur, Palpitations. HF symptoms

- ## Aortic Regurgitation
  - ### Indications for surgery:
    - Symptomatic patients - progressive left ventricular dilatation.

- **CLASS I**	• **Symptomatic**[13] • when put patient on treadmill and BP↓ • **EF dropped < 50% (LV dysfunction)**
- **CLASS IIa**[14]	LV dilation(large size) or pulmonary hypertension.
- **CLASS IIb**	LV dilation(size)-not as large as IIa class.



In aortic regurgitation we can either replace (mechanical or tissue) or repair (in selected cases)

[13] Dyspnea, angina, Heart murmur, Palpitation worse when lying down. cyanosis
[14] At this stage, if you replace the valve, the heart can go back to its normal shape

Surgical valve treatment	
Aortic Stenosis	- DO the replacement by two modality: **1-open surgery**: first line. - All patient go for surgery except those with high risk of surgery (mortality risk >10%) **2-transcutaneous aortic valve implantation (TAVI)** - Risk of stroke is 10%
Aortic/Mitral Regurgitation	- Done by replacement or repair.
Mitral Stenosis	- First line treatment for MS is by PCI (**Balloon valvuloplasty or commissurotomy**) for patient which candidate it . - Surgical replacement.

• Prosthetic valves: Types, Merits and Demerits

1-Mechanical Valves

- An artificial heart **valve** is a device implanted in the heart of a patient with valvular heart disease.
- Anticoagulation for life.
- Prolonged durability. Lasts >20 years
- Click sound
- Below 60 years because we expect the patient's life span to be longer.

2-Tissue Valves (Bioprosthesis)

Tissue valves are most often made with tissues from porcine (pig) heart valves or bovine (cow) cardiac tissue.

- No need to use long term anticoagulation. only aspirin
- Limited and unpredictable durability. Lasts 8-10 years
- No click
- **When to use tissue valves :**
  - Old patients above 60, we can use it for young patients if they choose that.
  - Patient with contraindication to anticoagulants i.e. bleeding disorders
  - Non-compliant patients to anticoagulants e.g. psychiatric patients
  - Pregnant woman due to the teratogenic effect. (females in childbearing age because of the teratogenic effect of anticoagulants during pregnancy)

Complications of prosthetic valves

1. Thrombosis (e.g. no compliance with usage of anticoagulants)
2. Bleeding complications (e.g. overdose of anticoagulants)

(1,2 Anticoagulant related complications)

3. Infective endocarditis
4. Paravalvular leak (infection→ eat up suture, patient calcified)
5. Degeneration of biological valve (after 8-10 years replace after regeneration)

Endocarditis

Indication for Endocarditis:

- It does not only mean to be on heart valves only, it could be in the vein or graft or in the Aorta.
- **Which patient** should be operated ?and **when**?
- When patient comes with endocarditis we do not start surgery directly, Give him antibiotic for (Left sided - 6 weeks, right sided - 2-4 weeks) after that if vegetation go away no abscess and symptoms relief then no need for surgery.
- If not relieved by Antibiotic then we start surgery for mainly 4 cases:
  1-Heart failure.
  2-Uncontrolled Infection (**enlarged vegetation**,abscess)
  3-Prevent Embolism.

Table 2. Indications for and Timing of Surgery in Patients with Left-Sided, Native-Valve Infective Endocarditis.*

Indication	Timing of Surgery†
Heart failure	
Aortic or mitral-valve infective endocarditis with severe acute regurgitation or obstruction causing refractory pulmonary edema or cardiogenic shock	Emergency
Aortic or mitral-valve infective endocarditis with fistula into a cardiac chamber or pericardium causing refractory pulmonary edema or cardiogenic shock	Emergency
Aortic or mitral-valve infective endocarditis with severe acute regurgitation or obstruction and persistent heart failure or signs of poor hemodynamic tolerance (early mitral-valve closure or pulmonary hypertension)	Urgent
Aortic or mitral-valve infective endocarditis with severe regurgitation and heart failure easily controlled with medical treatment	Elective
Uncontrolled infection	
Locally uncontrolled infection (abscess, false aneurysm, fistula, enlarging vegetation, or dehiscence of prosthetic valve)	Urgent
Persistent fever and positive blood cultures for >5–7 days	Urgent
Infection caused by fungi or multidrug-resistant organisms, such as *Pseudomonas aeruginosa* and other gram-negative bacilli	Elective
Prevention of embolism	
Aortic or mitral-valve infective endocarditis with large vegetations (>10 mm in length) after one or more embolic episodes, despite appropriate antibiotic therapy, especially during the first 2 weeks of therapy	Urgent
Aortic or mitral-valve infective endocarditis with large vegetations (>10 mm) and other predictors of complicated course (heart failure, persistent infection, or abscess)	Urgent
Isolated, very large vegetations (>15 mm); surgery may be preferred if a procedure preserving the native valve is feasible	Urgent

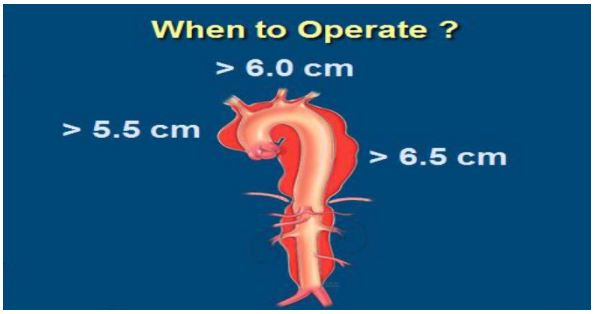
- You should know **when to intervene**:
  - Depends on the patient, presence or absence of heart failure, presence or absence of conduction defect
  - **Emergency**: Severe acute aortic regurgitation
  - **Urgent**: Recurrent embolisation despite treatment
  - **Elective**: Can be controlled with medication; you can prepare patients 2-4 weeks with antibiotics and then intervene electively later on.

Thoracic Aortic Disease

Thoracic Aortic aneurysm:

- Any dilatation of artery→double the size of normal (normal = 2.5cm, will be aneurysm if size is 5cm or more).
- We don't treat until the size become doubled (CT with contrast to asses the size)

- **When do we intervent? (risk of rupture)**
  - **Ascending** aorta aneurysm → more than 5.5 cm
  - **Arch** of aorta aneurysm → more than 6 cm(now it's 5.5)
  - **Descending** aorta aneurysm → more than 6.5 cm



High risk patients	**Low** risk patients
- Aorta will rapture earlier than normal value (4-5 instead of 5.5) - Because their aneurysm will progress faster than normal. 1. Marfan syndrome. 2. Connective tissue disease. 3. Bicuspid aortic valve. 4. Ehlers-Danlos syndromes. 5. genetic predisposition (family history).	- Normal healthy people who don't have genetic predisposition.

- **Aortic artery treatment:**
  - You replace aneurysm or area dissected in aorta by tube graft.
  - PCI→then STENT.
  - OPEN surgery

Cardiac tumors

- **Indications for Cardiac tumors:**
  - Most cardiac tumors are benign.
  - Most common benign → Myxoma →remove it.
  - Most common malignant → Angiosarcoma → do not operate. (heart transplant)
  - Secondary malignant tumors are more common than primary malignant tumors.

Heart Failure

- **Indication for Heart Failure:**
  - End stage heart failure will be the indication for heart transplant + patient does not have contraindication.
  - You have to read these two pictures very carefully..
  - Heart failure: heart transplant or ventricular assist device
  - Ventricular assist device is considered when a donor isn't available, and requires anticoagulation.

Indications for Heart Transplant:

- Cardiogenic shock requiring mechanical assistance.
- Refractory heart failure with continuous inotropic infusion.
- NYHA functional class 3 and 4 with a poor 12 month prognosis.
- Progressive symptoms with maximal therapy.
- Severe symptomatic hypertrophic or restrictive cardiomyopathy.
- Medically refractory angina with unsuitable anatomy for revascularization.
- Life-threatening ventricular arrhythmias despite aggressive medical and device interventions.
- Cardiac tumors with low likelihood of metastasis.
- Hypoplastic left heart and complex congenital heart disease.

Ventricular Assist Devices:

Indications	Absolute Contraindications
Frequent hospitalisations for HF	Irreversible hepatic disease
Intolerance to neurohormonal antagonists	Irreversible renal disease
NYHA IIIb–IV functional limitations despite OMT	Irreversible neurological disease
End-organ dysfunction owing to low CO	Medical nonadherence
Increasing diuretic requirement	Severe psychosocial limitations
CRT nonresponder	
Inotrope dependence	
Low peak Vo_2 (<14mL/kg/min)	

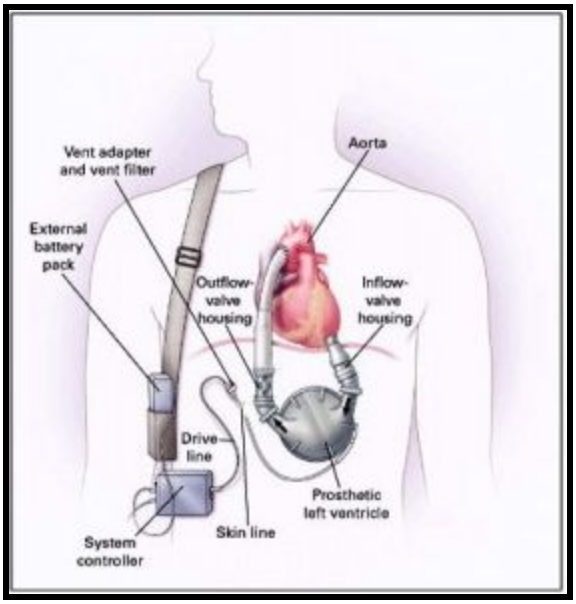
HF = Heart failure; OMT = optimal medical therapy; NYHA = New York Heart Association; CO = cardiac output; CRT = cardiac resynchronisation therapy. Adapted from Peura et al.[11] and published with the permission of the American Heart Association.

Contraindication for heart transplantation:

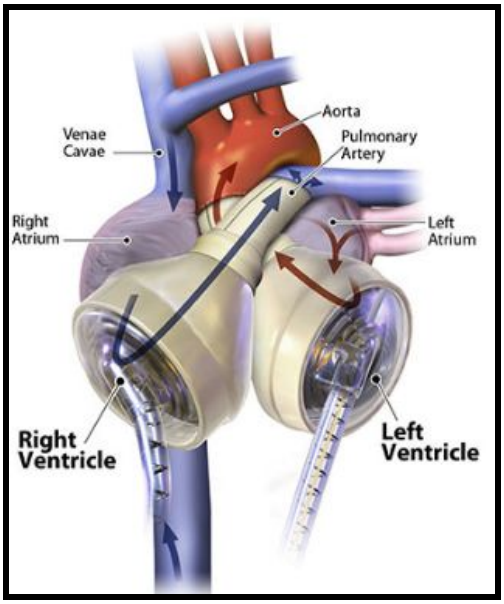
- Pulmonary hypertension Pulmonary HTN is not contraindicated by itself but its value is very imp
- Active infection bc of immunosuppression
- Systemic disease
- Elevated creatinine > 200 µmol/L Bc those who have renal disease will have hypercalcemia & pulmonary vascular resistance
- Psychosocial (substance abuse, smoking, medical noncompliance)
- Malignancy (within 5 years)
- Morbid obesity >140% ideal body weight If he's going to die from another comorbidity, there's no reason to transplant نعطي القلب لواحد اولى منه
- Marked cachexia <60% ideal body weight
- Osteoporosis immunosuppression will make osteoporosis worse
- Diabetes mellitus with end organ damage
- Peripheral or cerebrovascular disease

- the idea here is before going to transplant, make sure that transplantation will be successful the pt has reason to live for 4- 6 years

Heart failure treatment:



Left sided failure



Biventricular failure

- Heart Transplantation →leave Origin Of (Aorta +Ivc + Svc+Pulmonary Trunk)

Arrhythmia

Recommendations	Class[a]	Level[b]
Surgical ablation of AF should be considered in patients with symptomatic AF undergoing cardiac surgery.	IIa	A
Surgical ablation of AF may be performed in patients with asymptomatic AF undergoing cardiac surgery if feasible with minimal risk.	IIb	C
Minimally invasive surgical ablation of AF without concomitant cardiac surgery is feasible and may be performed in patients with symptomatic AF after failure of catheter ablation.	IIb	C

- **Indications for Arrhythmia:**
  - Only for **Atrial fibrillation** (by ablation)
  - Arrhythmias has role in surgery; patient with atrial fibrillation specially with mitral valve disease we can ablate left atrium and right atrium to abolish atrial fibrillation which may help patient avoid anticoagulants and avoid formation of left atrial thrombi.
  - You can notice there is no class I because benefit is not confirmed.

Recall:

What is the treatment of coronary artery disease?
Medical therapy (β -blockers, aspirin, nitrates, HTN medications), angioplasty (PTCA[15]), $\pm$ stents, surgical therapy: CABG
What is CABG?
Coronary Artery Bypass Grafting
What are the indications?
- Left main disease
- $\geq$ 2-vessel disease (especially diabetics)
- Unstable or disabling angina unresponsive to medical therapy/PTCA

[15] Percutaneous Transluminal Coronary Angioplasty (balloon angioplasty)

- Post infarct angina
- Coronary artery rupture
- dissection
- thrombosis after PTCA

CABG vs. PTCA ±stents?

- **CABG =** Survival improvement or diabetics and ≥ 2-vessel disease, ↑ short-term morbidity
- **PTCA =** ↓ short-term morbidity, ↓ cost, ↓ hospital stay, ↑ reintervention, ↑ postprocedure angina

What procedures are most often used in the treatment?

Coronary arteries grafted (usually 3–6): internal mammary pedicle graft and saphenous vein free graft are most often used (IMA 95% 10-year patency vs. 50% with saphenous)

What other vessels are occasionally used for grafting?

Radial artery, inferior epigastric vein

What are the possible complications?

- Hemorrhage
- Tamponade
- MI, dysrhythmias
- Infection
- Graft thrombosis
- Sternal dehiscence
- Postpericardiotomy syndrome[16], stroke

What medications should almost every patient be given after CABG?

Aspirin, β -blocker

Can a CABG be performed off cardiopulmonary bypass?

Yes, today they are performed with or without bypass

Recall:

What is artificial valve placement?

Replacement of damaged valves with tissue or mechanical prosthesis

What are the types of artificial valves?

Tissue and mechanical

What are the pros and cons:

Tissue? > NO anticoagulation but shorter duration (20%–40% need replacement in 10 years); good for elderly

Mechanical? > Last longer (>15 years) but require ANTICOAGULATION

Contraindications for tissue valve?

Dialysis (calcify), youth

Contraindications for mechanical valve?

Pregnancy (or going to be pregnant due to anticoagulation), bleeding risk (alcoholic, PUD)

What is the operative mortality?

From 1% to 5% in most series

What must patients with an artificial valve receive before dental procedures? Antibiotics

[16] Pericarditis after pericardiotomy (unknown etiology), occurs weeks to 3 months postoperatively