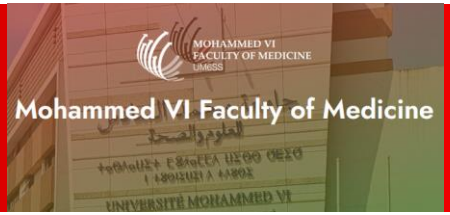
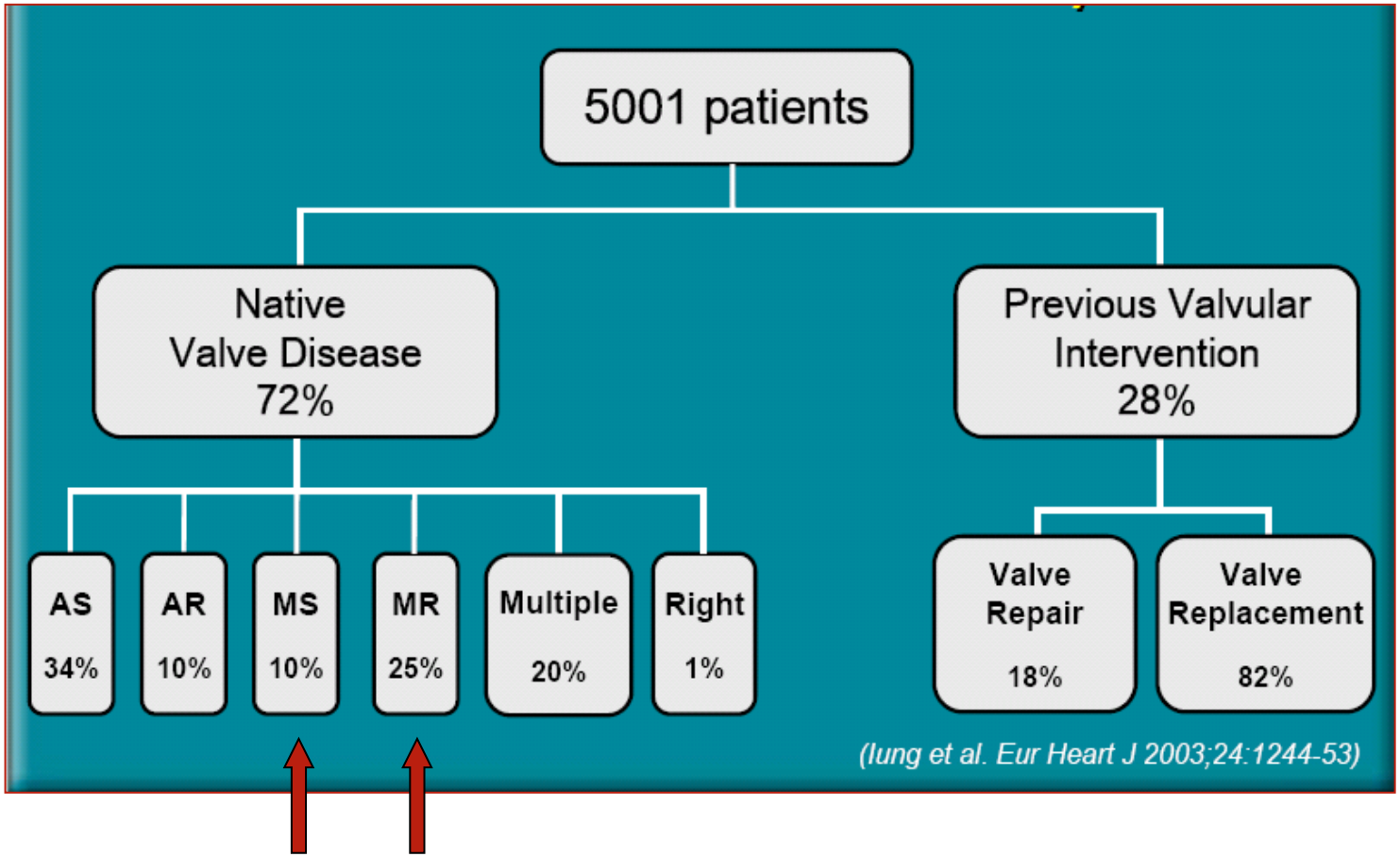


Mitral *(and other)* ***valves disease***

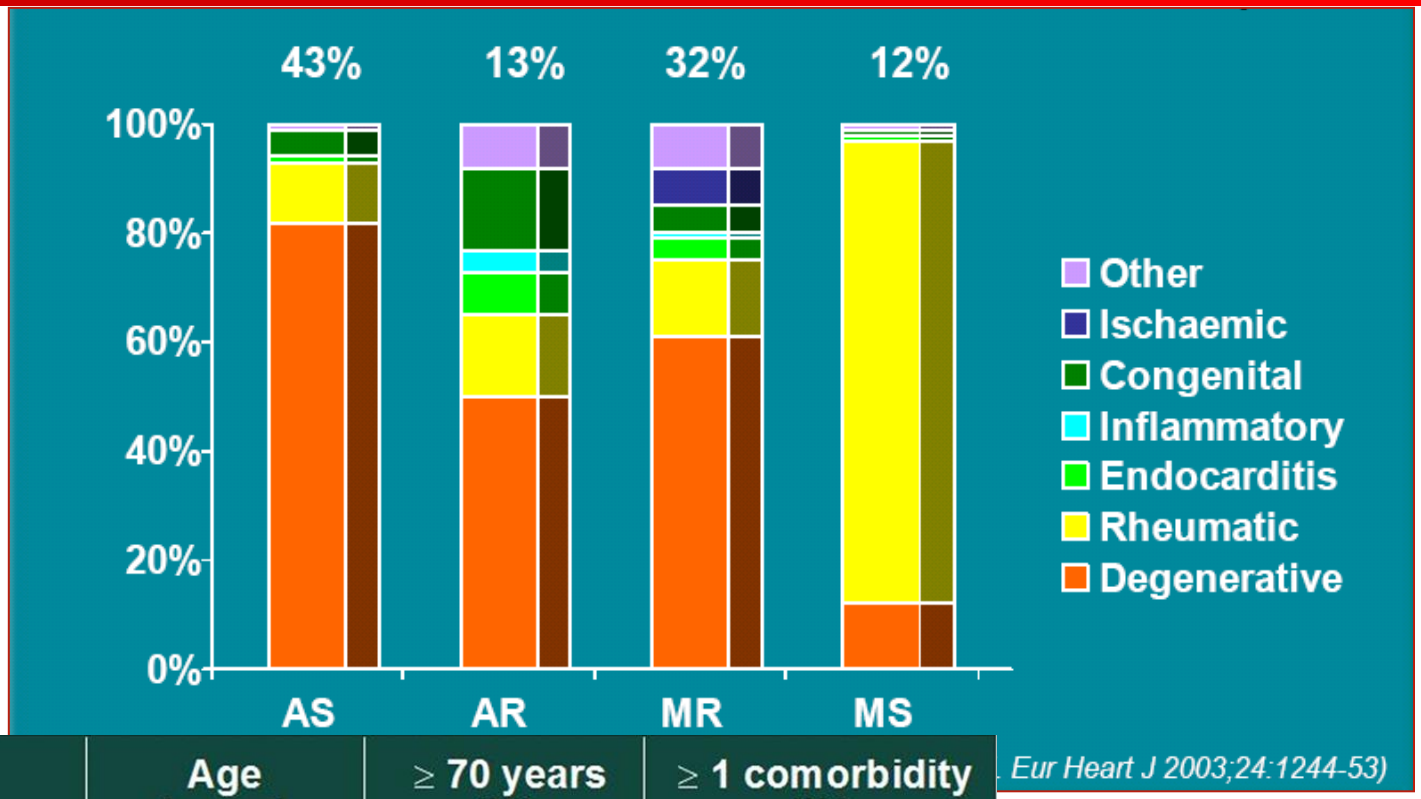
Prof Stéphane Carlier

Department of Cardiology, UMons

Valvular pathologies



Valvular pathologies



. Eur Heart J 2003;24:1244-53)

	Age (years)	≥ 70 years (%)	≥ 1 comorbidity (%)
AS	69±12	56	36
AR	58±16	25	26
MS	58±13	18	22
MR	65±14	44	42

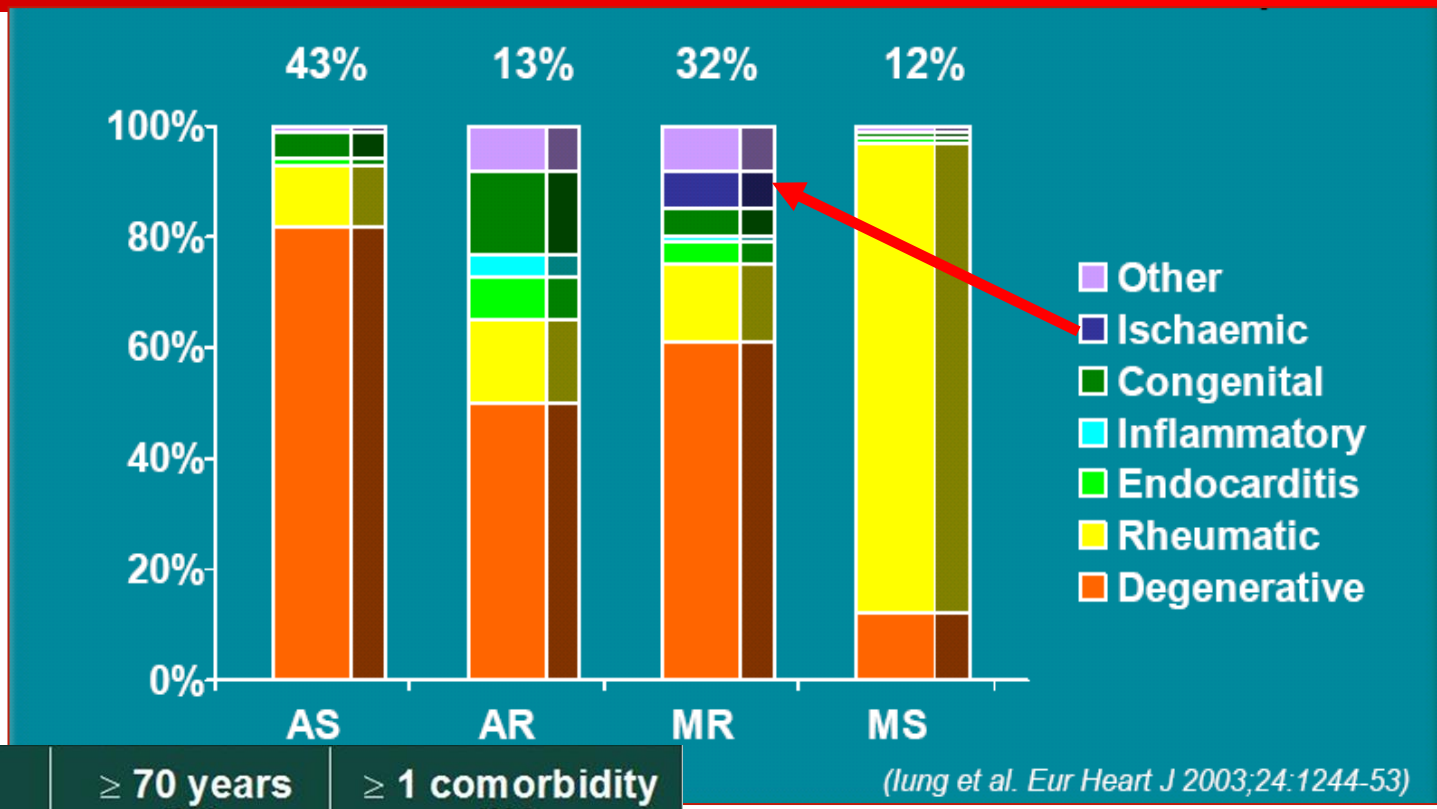
OBJECTIVES

MITRAL REGURGITATION

TO KNOW

- Diagnose mitral regurgitation
- Therapeutic approach and follow-up of the patient

Pathologies valvulaires



(Iung et al. Eur Heart J 2003;24:1244-53)

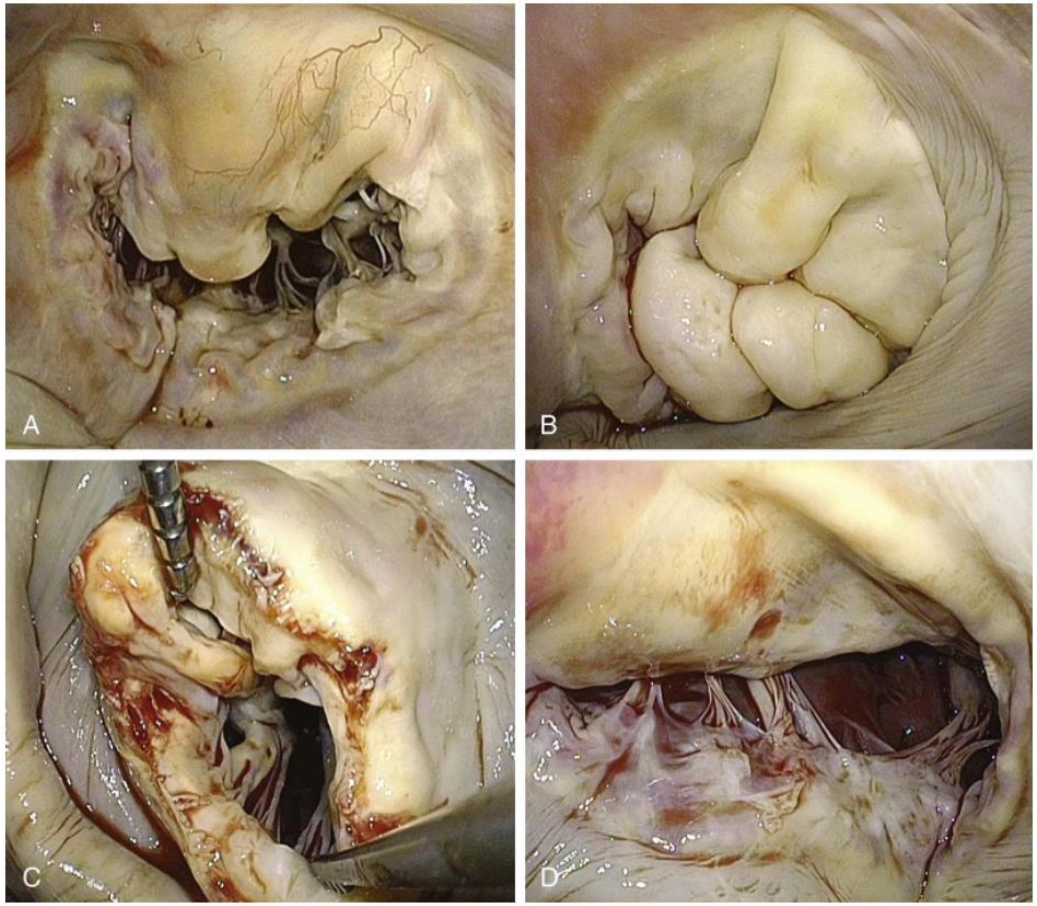
	Age (years)	≥ 70 years (%)	≥ 1 comorbidity (%)
AS	69±12	56	36
AR	58±16	25	26
MS	58±13	18	22
MR	65±14	44	42

Mitral Regurgitation (MR)

Definition

- Abnormal (and turbulent) flow of blood from the left ventricle to the left atrium during systole
- Acute and chronic MIs are important to be differentiated

Mitral Regurgitation (MR)

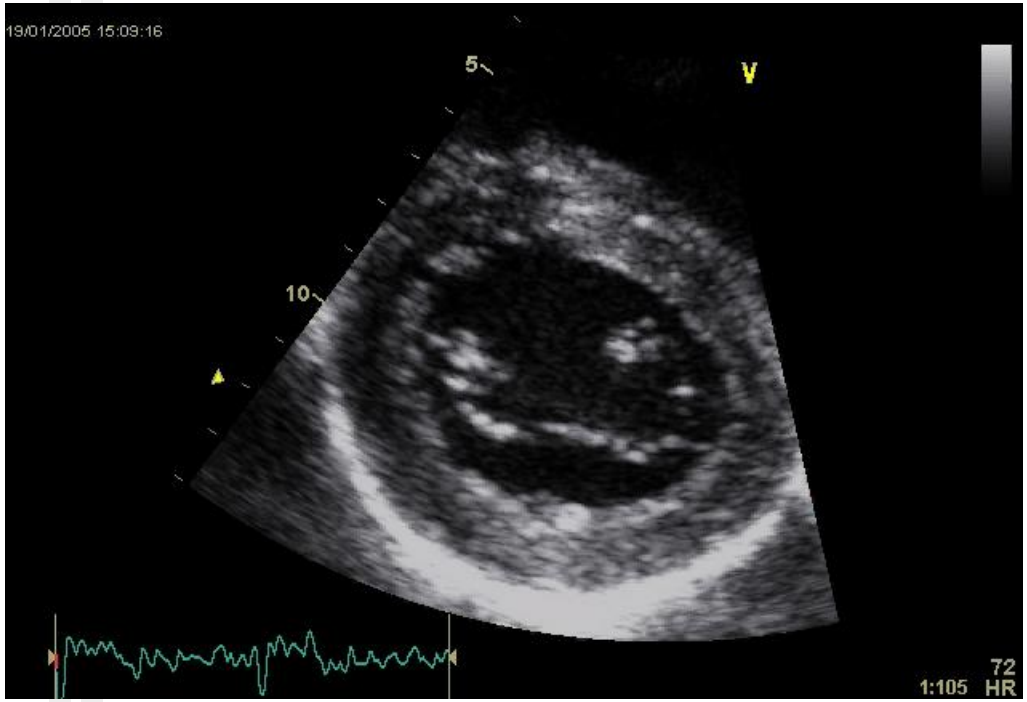


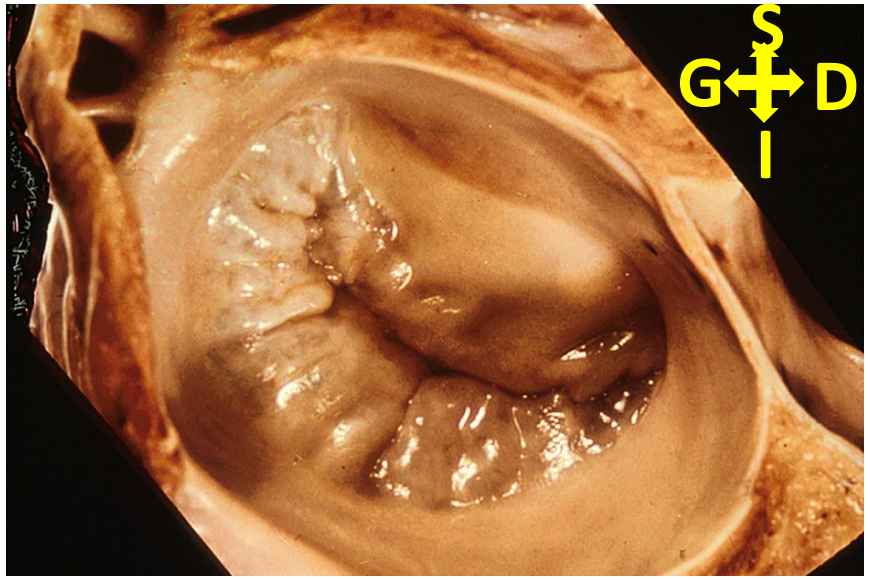
A: MR on annular dilatation; B: Severe myxomatous (Barlow);

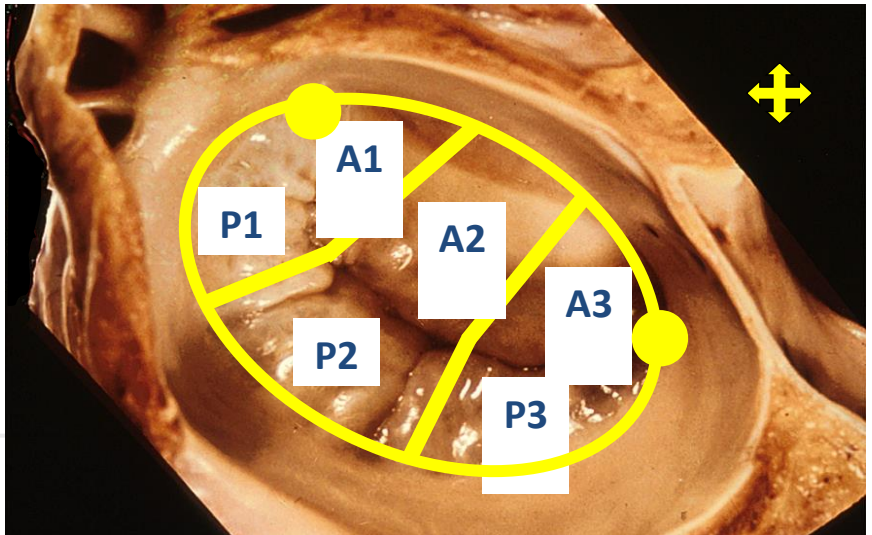
C: Rheumatic; D:tethering of P3 scallop < ischemia

Mitral Regurgitation (MR)

Anatomy

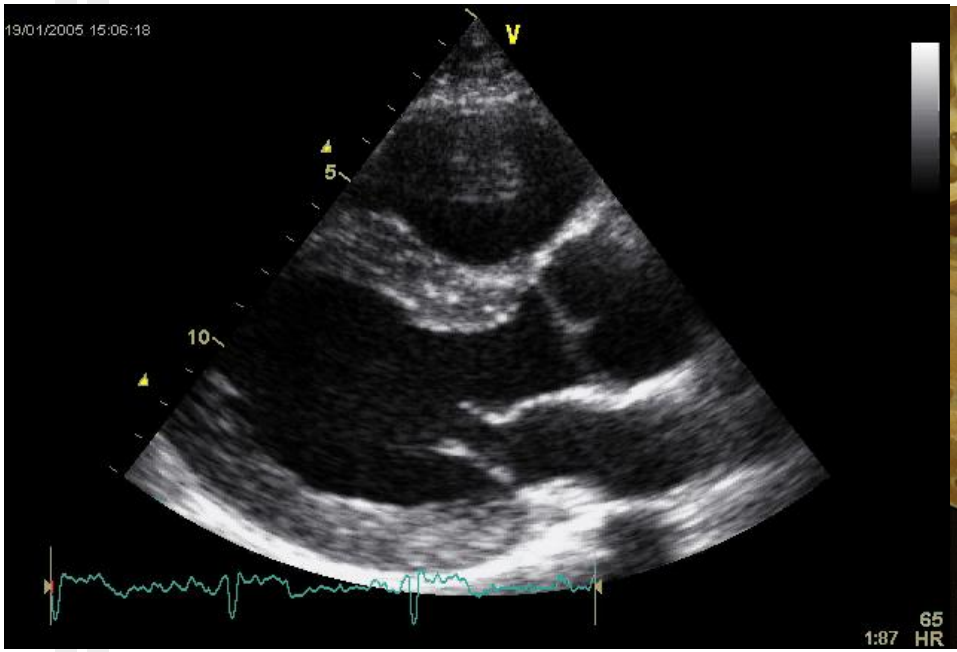


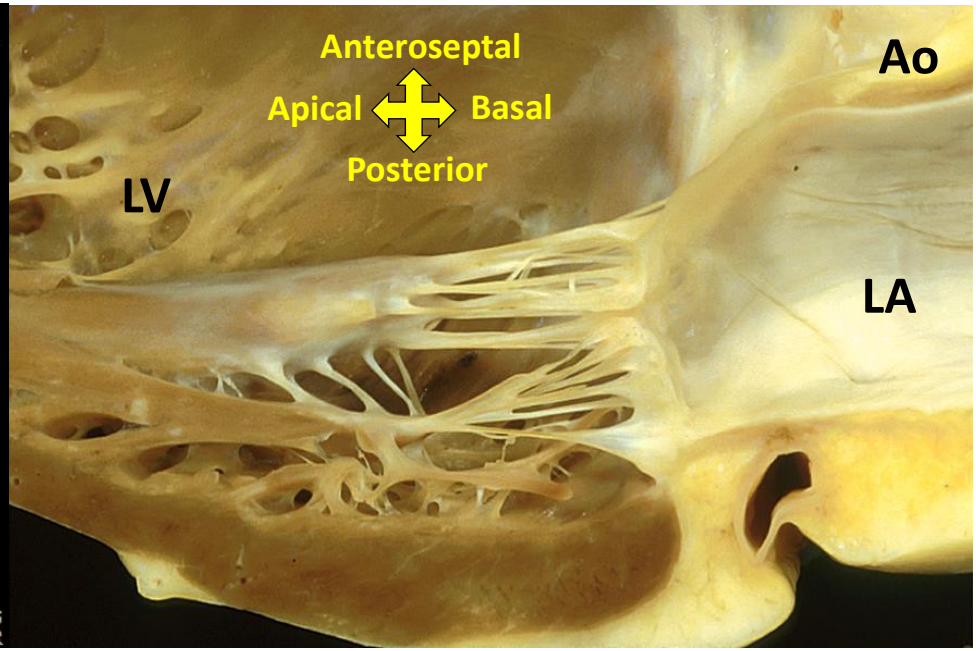




Mitral Regurgitation (MR)

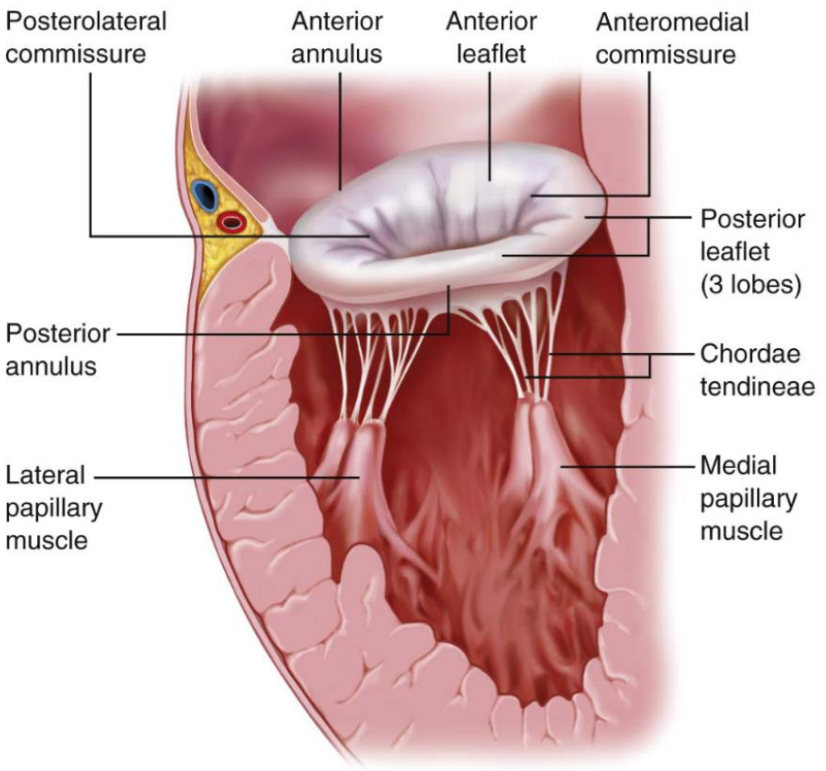
Anatomy





Carpentier's Classification

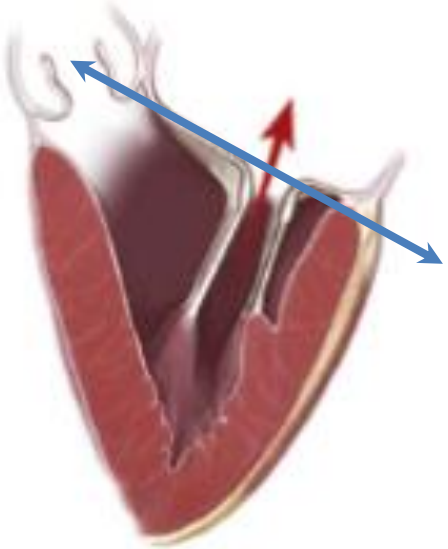
- **Physiologically, during systole, the two leaflets of the mitral valve across from of each other in the plane of the annulus.**
- **Carpentier's classification is based on the position of the leaflets in systole:**
  - **type I**
  - **type II**
  - **type III**



Carpentier's Classification

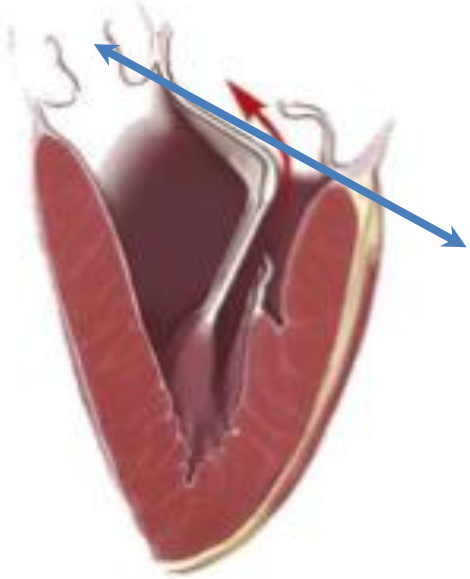
Type I: the leaflets remain in the plane of the ring during ventricular systole.

Ex: perforations, clefts, functional MI (ischemic heart disease)

Dysfunction	*Ventricular View*	*Atrial View*
Type I Normal leaflet motion		

Carpentier's Classification

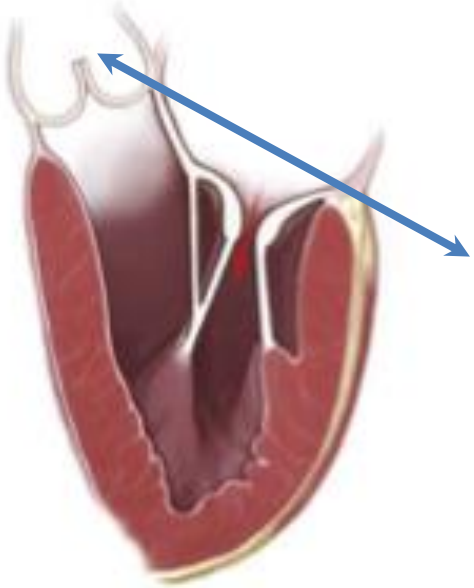
type II: At least one leaflet extends beyond the plane in systole. Valve motion is exaggerated. Typically, the case of dystrophic MR (Barlow, Marfan, etc.) with prolapse of at least one of the two leaflets, or secondary MR with pillar rupture (trauma, infarction, ,...)

Dysfunction	*Ventricular View*	*Atrial View*
Type II Increased leaflet motion (leaflet prolapse)		

Carpentier's Classification

type III: At least one leaflet remains below the plane of the valve annulus during ventricular systole. Valve motion is restricted.

Ex: post-rheumatic, post-radiation, lupus, carcinoid MR, ergotamine, hypereosinophilic syndrome…

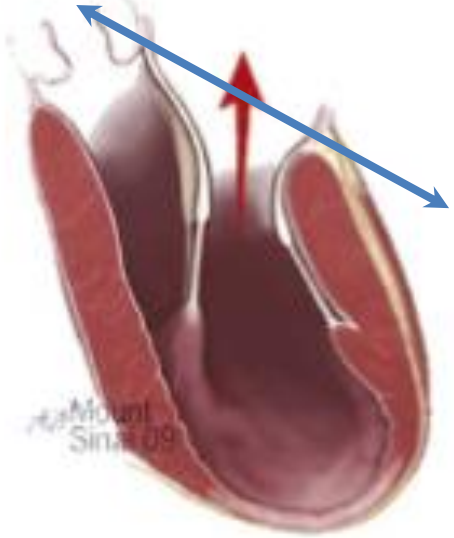
Dysfunction	*Ventricular View*	*Atrial View*
Type IIIA Restricted leaflet motion (restricted opening)		

Carpentier's Classification

type IIIb: Limited closure due to limitation of leaflet movements

Ex: Dilated cardiomyopathies

<> IIIa where there is essentially a defect in opening

Dysfunction	*Ventricular View*	*Atrial View*
Type IIIB Restricted leaflet motion (restricted closure)		

Mitral Regurgitation

Etiologies

1 - Rheumatic mitral regurgitation

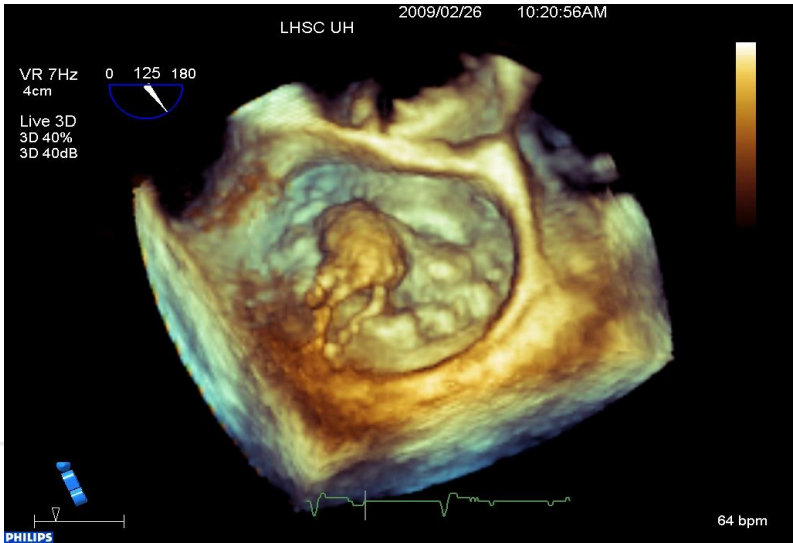
2 - Dystrophic mitral regurgitation

3 - Mitral regurgitation secondary to endocarditis

4 - Ischemic mitral regurgitation

5 - Functional mitral regurgitation

6 - Rare causes



Etiologies MR

Rheumatic mitral insufficiency

- Rare since the prevention of rheumatic fever.
- Often associated with mitral stenosis and aortic valve involvement.
- Valves thickened and retracted as well as subvalvular apparatus.
- "Restrictive" MR, Carpentier's type IIIa.
- Mitral stenosis and insufficiency = "mitral disease".

Dystrophic mitral regurgitation

- Very common etiology.
- Type II of Carpentier: elongation or rupture of chordae tendinae +- bloating of the valve tissue, responsible for mitral valve prolapse.
- May predominate over the small valve, the large valve, or both.
- There are two groups of lesions:
- "Myxoid degeneration"
- Fibroelastic degeneration

MR on Endocarditis

- >50%: < pre-existing lesion, mitral valve prolapse or MR of another etiology.
- Vegetation.
- Most commonly:
- rupture of chordae tendineae (Carpentier type II)
- valve perforations (Carpentier's type I).

Ischemic MR

Mechanisms

- rupture of the chordae (rare):

particularly severe, associated with a myocardial infarction. Partial or complete ruptures resulting in death without emergency surgery;

- Funtional MR (more frequently):

< dilated mitral annulus and spherical remodeling of the LV with apical and posterior displacement of the papillary muscles with traction on chordae preventing good coaptation (Carpentier type III).

Ischemic MI, even moderate, is an independent poor prognostic factor.

Functional MR

Mechanisms

- Frequent
- < mitral annulus dilation and left ventricular dilation (Carpentier type I)
- Encountered at an advanced stage of all heart diseases (ischemic or not) in case of dilation and overall impairment of systolic function.

Acute MR

Etiologies

- **Rupture of chordae Tendinae:**
  - Myxoid or fibroelastic degeneration
  - endocarditis
  - trauma
- **Rupture or dysfunction of papillary muscle:**
  - Myocardial infarction
  - trauma
- **Perforation < endocarditis**

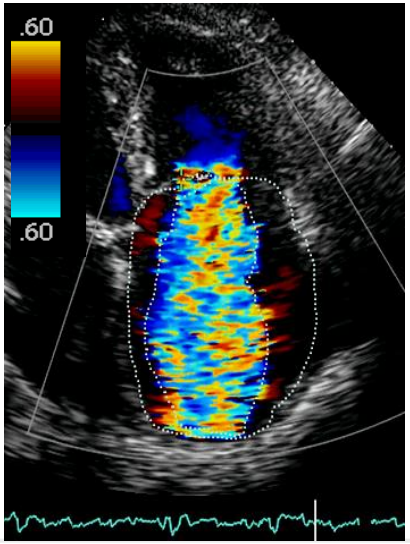
Mitral Regurgitation

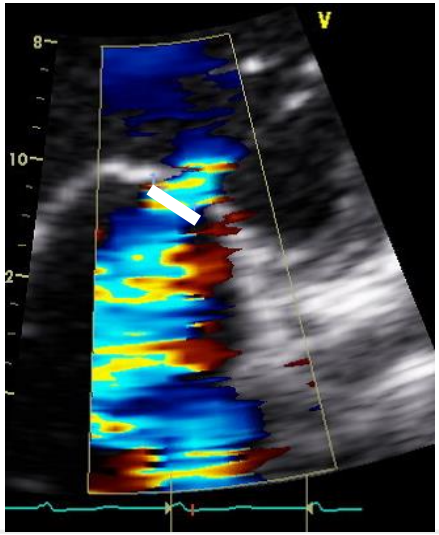
Pathophysiological mechanisms

Mitral regurgitation has both upstream and downstream consequences.

Regurgitated volume depends on three main factors:

- Size of the regurgitating orifice
- Pressure Gradient
- Duration of systole.

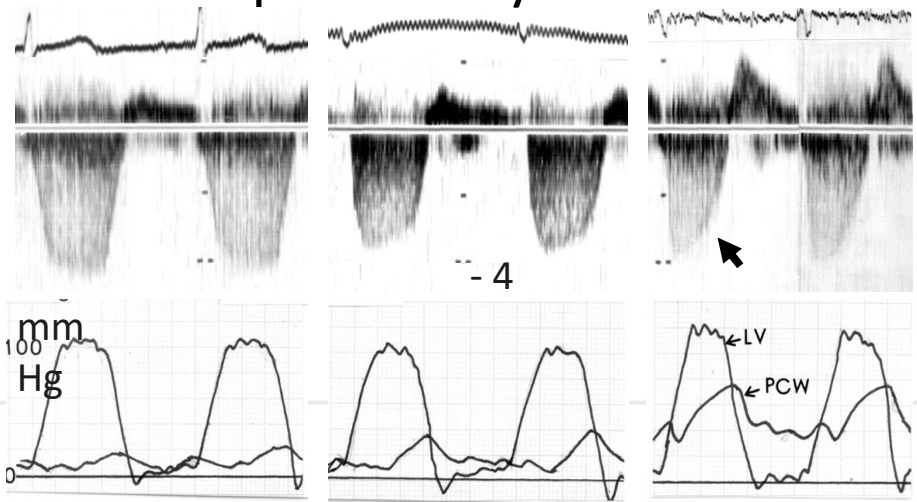




Mitral Regurgitation

Hemodynamic consequences

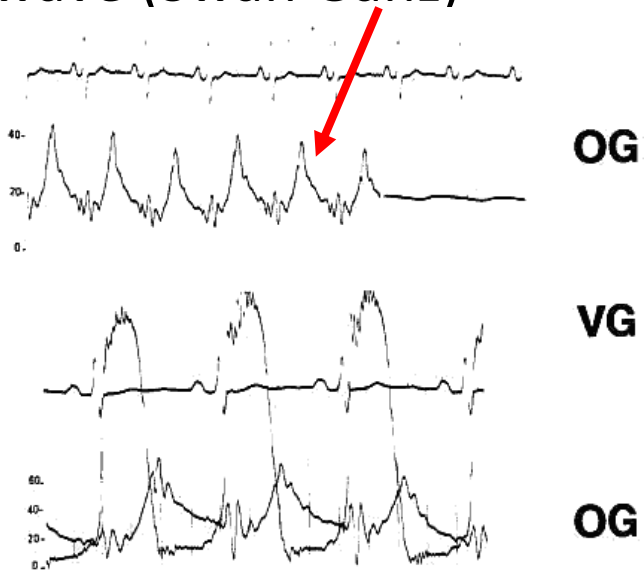
- **Downstream:** diastolic overload of the LV leading to its dilation
- On the long run, alteration of the intrinsic contractility of the LV (by chronic distension of the fibers + fibrosis)
- **Upstream:**
- Post-capillary pulmonary hypertension < elevated LA pressure
- elevation of PAP depends on regurgitated volume and compliance of the left atrium and pulmonary veins



Mitral Regurgitation

Hemodynamic consequences

- **Chronic MR:** very often the compliance of the LA adapts to maintain practically normal atrial pressure despite a relatively large regurgitant volume
- → Normal or low Pulmonary artery pressure.
- If regurgitated volume becomes too large, ↑ LA pressure and pulmonary arterial hypertension (PAH), v-wave (Swan Ganz)
- **Acute MR**: low LA compliance
  - → important rise in LA pressure
  - → acute pulmonary hypertension



Mitral Regurgitation

Diagnostic

- Discovery of a heart murmur during a checkup visit
- Functional signs
- Complication:

  Acute pulmonary edema

  Atrial fibrillation

  Fever (endocarditis)

Mitral Regurgitation

Diagnostic

2 - Functional signs

- Absent if moderate MR
- Exertional dyspnea
- Resting dyspnea
- Orthopnea
- Paroxysmal Nocturnal Dyspnea
- Acute Pulmonary Edema

Diagnosis of MR

Clinical Examination

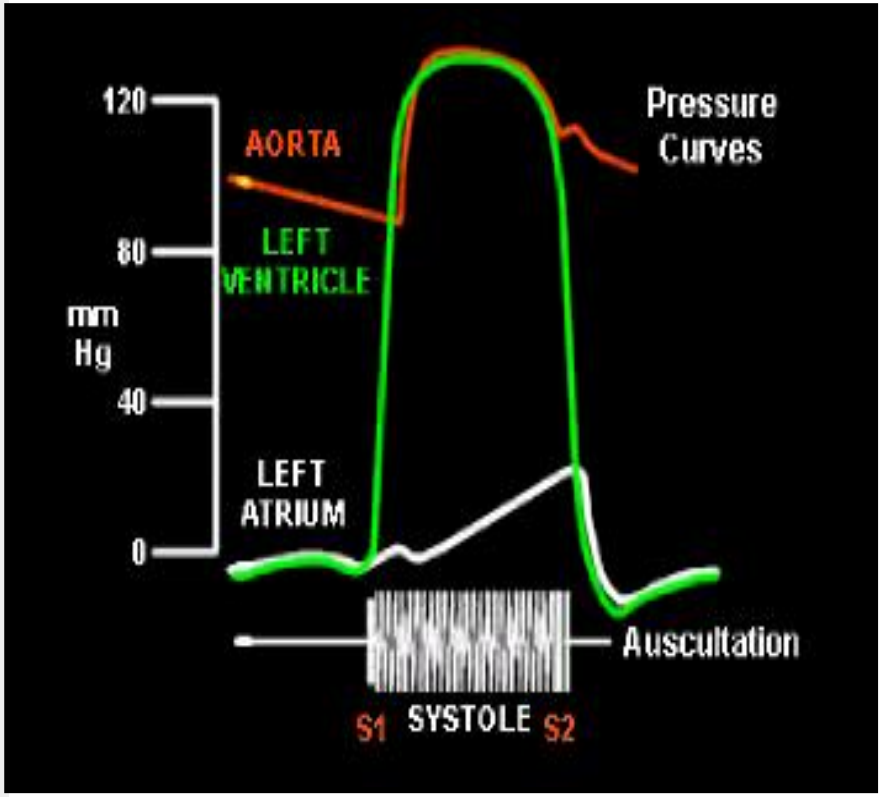
1 - Palpation

- Thrill at apex.
- Brisk cardiac impulse displaced to the left.

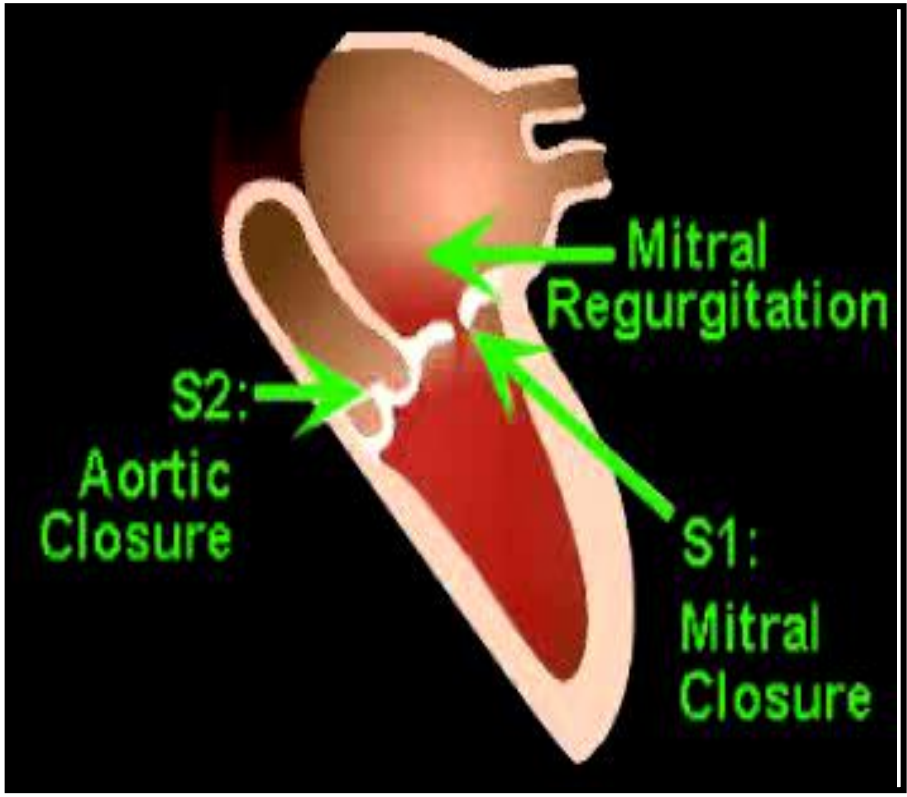
2 - Auscultation

- Systolic murmur.
- Maximum at apex.
- May radiate to the axillary region.
- In a "steam jet", gentle, sometimes harsh.
- Holostolic starting at B1 and continuing until B2.

Mitral regurgitation



- Continuous, holostolic
- High frequency



- Irradiated axillary area
- Severity: associated diastolic sounds

Diagnosis of MR

Clinical Examination

2 - Auscultation

Other signs (if significant MI):

- Protodiastolic third heart sound (S3) ;
- Diastolic murmur ;
- Increased pulmonary S2 (pulmonary hypertension);
- Tricuspid regurgitation murmur (advanced pulmonary hypertension and RV enlargment).

- **Pulmonary auscultation**: crackles.

Diagnosis of MR

Other Diagnostic Evaluation Modalities

1 - ECG

2 - Radiography

3 - Echocardiography

4 - Left ventricular angiography

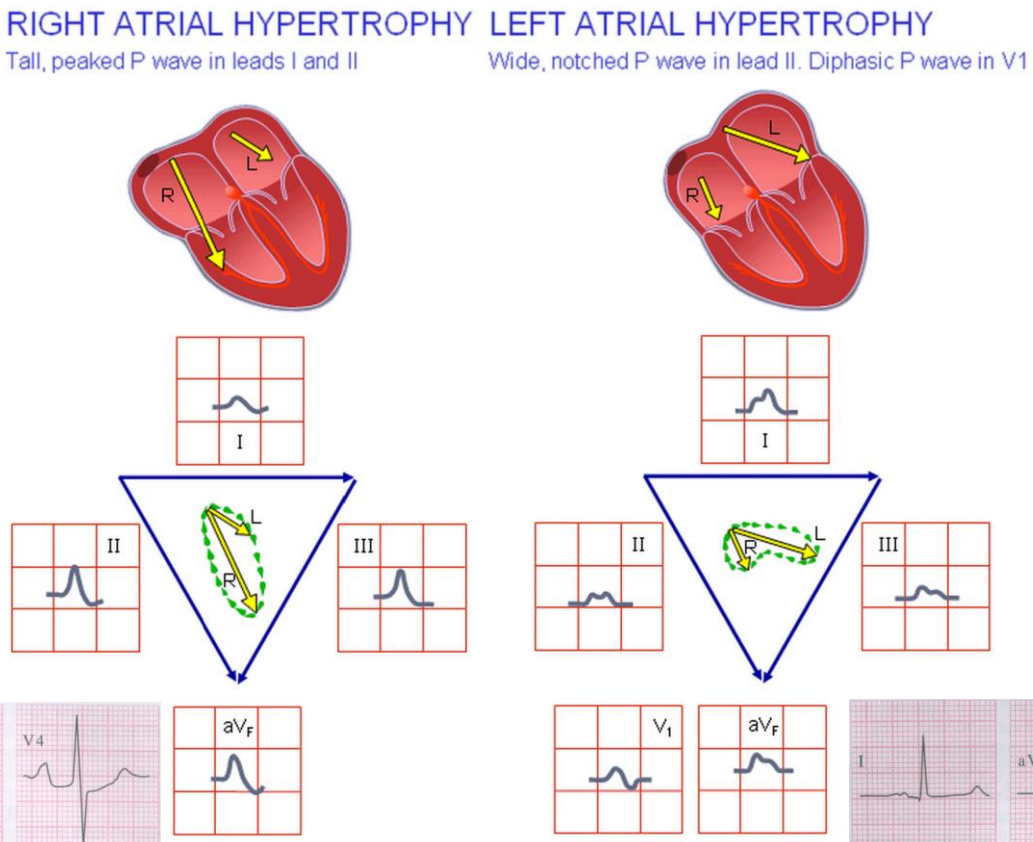
5 - Stress test

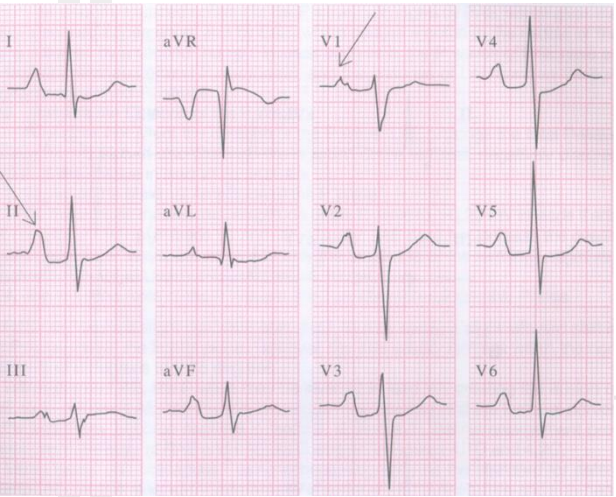
Diagnostic Evaluation Modalities

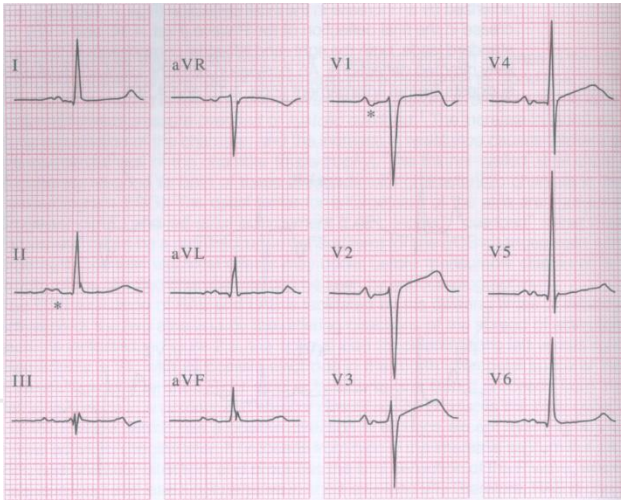
ECG

- Remains normal for a long time in moderate MR.
- Left atrial hypertrophy.
- Left ventricular hypertrophy, more of the "diastolic" type.
- Atrial fibrillation.
- Right ventricular hypertrophy of advanced MR with pulmonary hypertension

Left vs. Right Atrial Hypertrophy







Radiography in MR

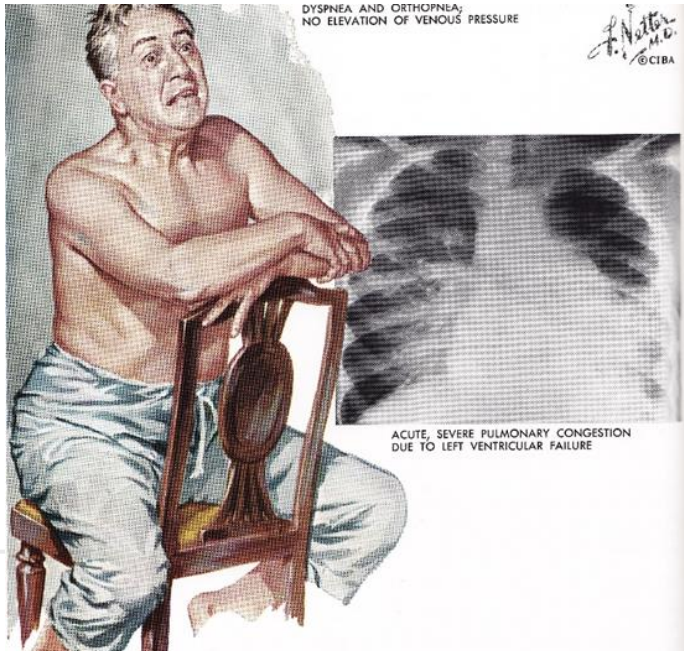
- Normal in minimal or moderate MR.
- Valve calcifications.
- LV dilation cardiomegaly in larger MR.
- Dilation of the left atrium (convex left middle arch).
- Signs of Pulmonary Hypertension in Chronic Advanced or Acute MI:

-dilation of the pulmonary arteries

-vascular redistribution to the summits

-Kerley-B lines at the bases

-alveolar edema

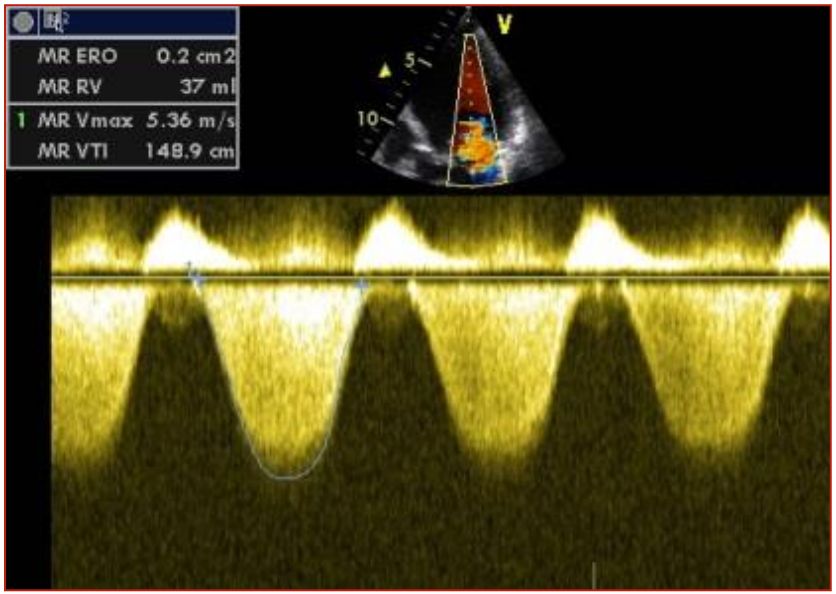


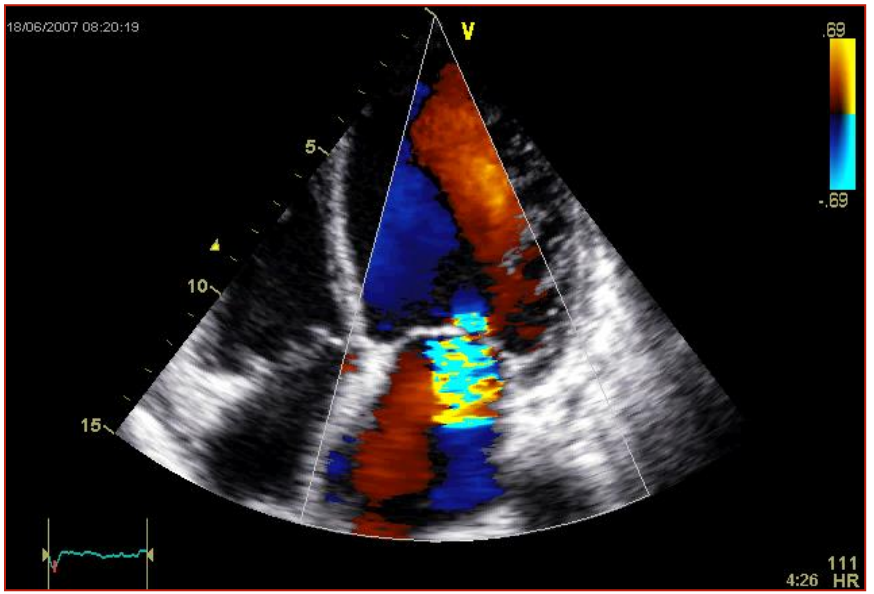
Paraclynical tests in MR

Cardiac Ultrasound

Key test!

The regurgitation is confirmed by a holosystolic Doppler signal posterior to the mitral floor recorded in continuous and color Doppler.





Cardiac Ultrasound in MR

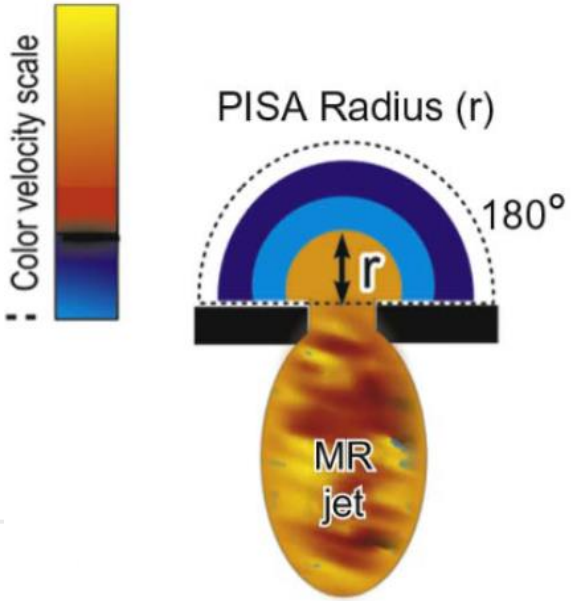
The Carpentier mechanism/classification identified by TTE and TEE

TEE remains fundamental for the diagnosis:

- vegetation is sometimes very fine and impossible to see on TEE
- Diagnosis of partial chordae tendinae rupture
-segments of the mitral leaflets affected in case of prolapse

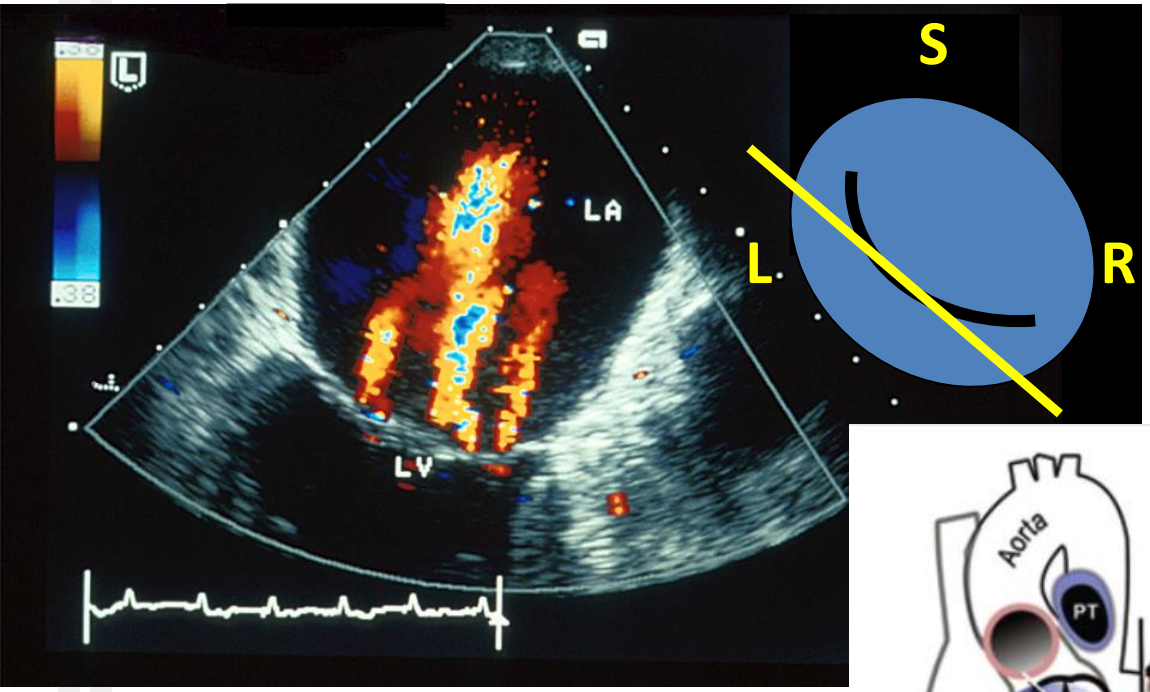
Quantification of regurgitation:

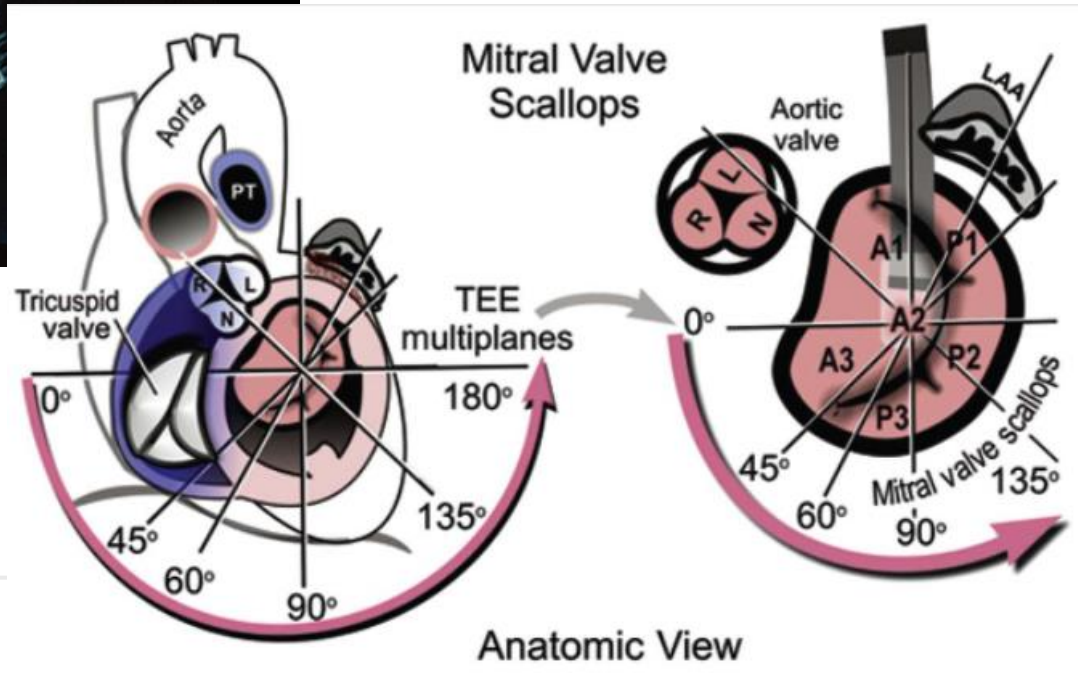
-the density of the regurgitating Doppler signal
- the width of the regurgitating spray
-Calculation of regurgitated volume (proximal isovelocity surface area-PISA)
-the surface of the regurgitating orifice



Cardiac ultrasound for MR

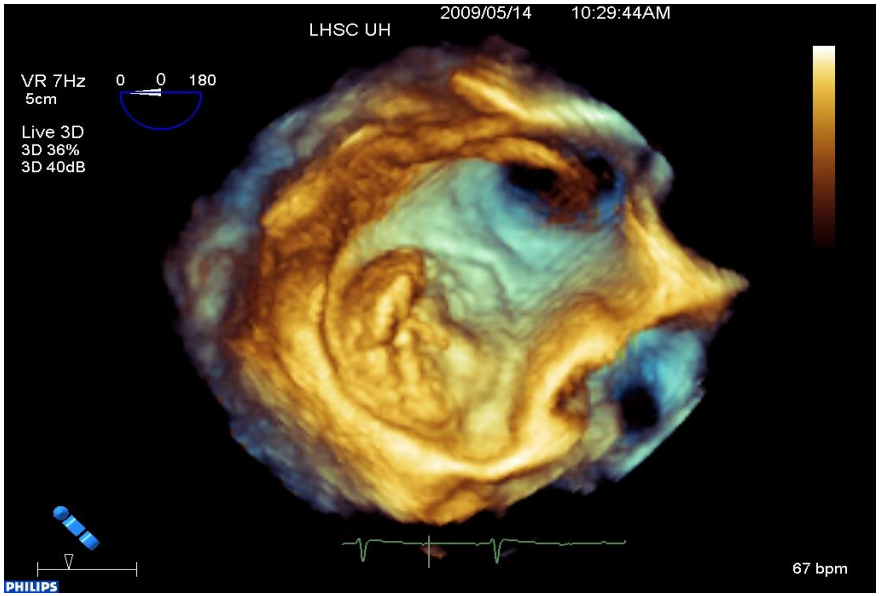
TEE : Transesophageal echocardiogram





Echocardiographie pour IM

4D



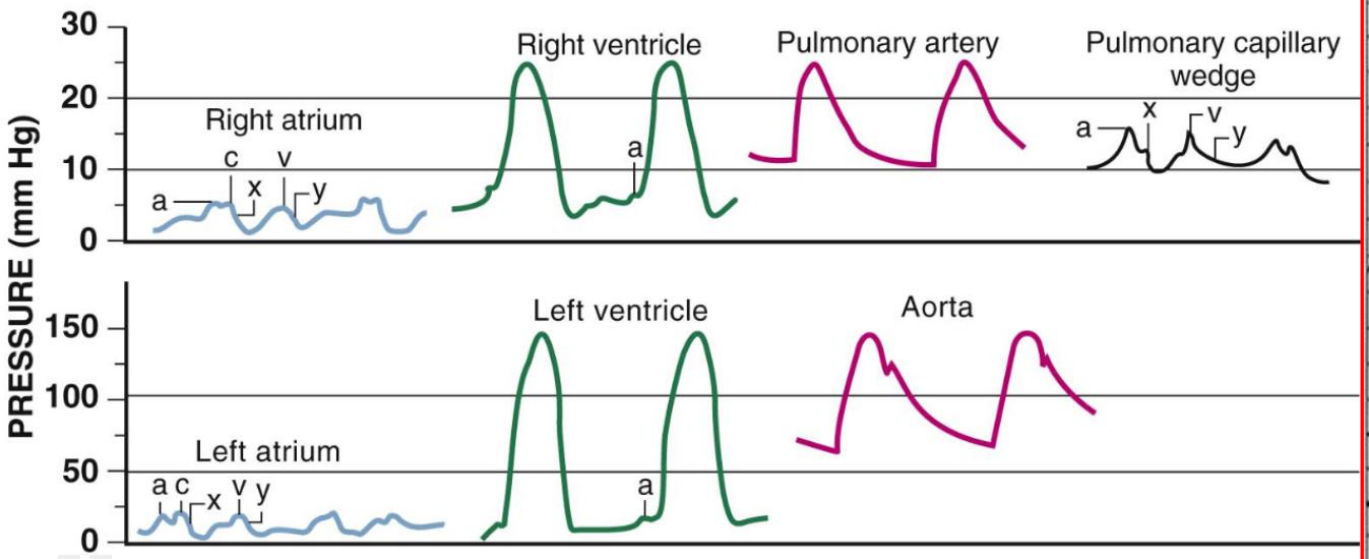
Barlow MV Enface view

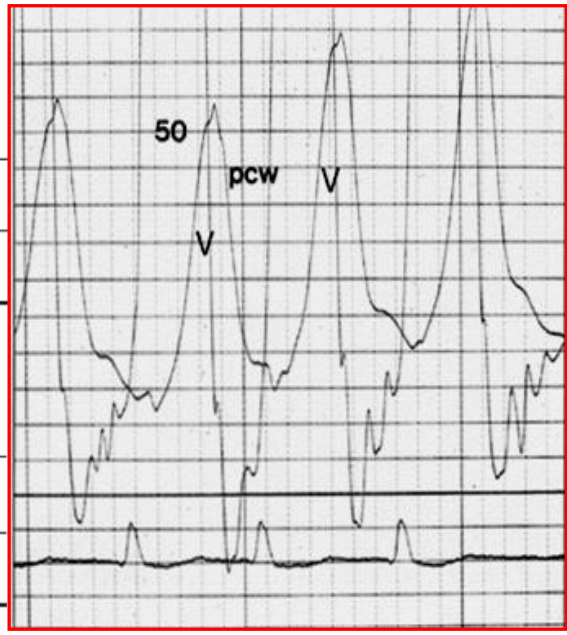
Surgeon's view

Paraclinical tests in MR

Cardiac catheterization

Invasive test - lost much of its usefulness in view of TTE/TEE.





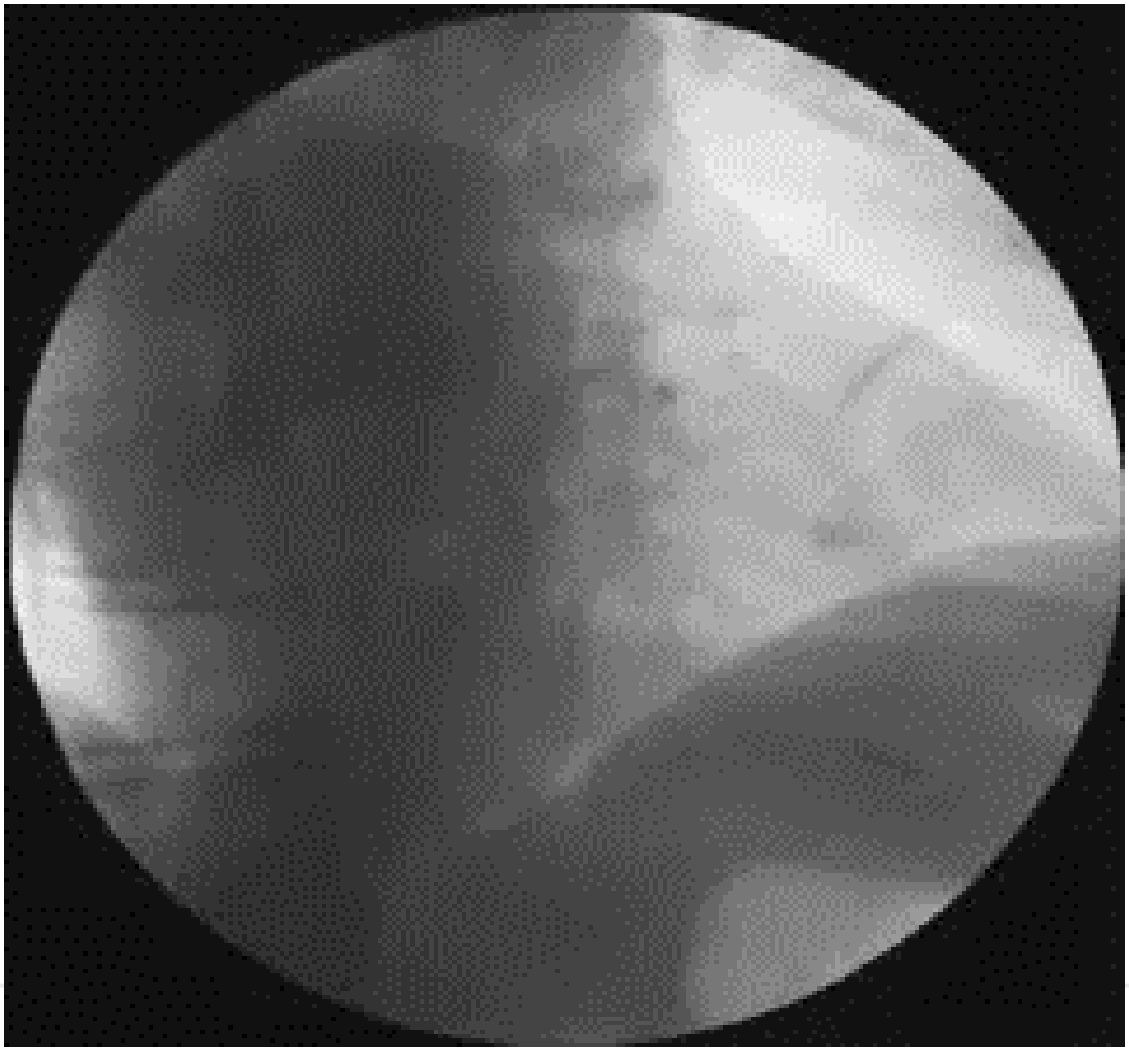
Right heart catheterization allows the measurement of cardiac output by thermodilution and the measurement of right pressures (capillary (wedge) and pulmonary pressures).

V wave:

Severe MR

Cardiac catheterization

Diagnosis and severity of mitral insufficiency



Paraclinical tests in MR

Cardiac Catheterization: Indications

Coronary angiography is routine if:

- **Angina**
- **Patient > 50 years of age**
- **Risk factors**

Alternative in young patients without risk factors: CT-angiography scan

Paraclinical tests in MR

Stress Test

Allows for a better assessment of the patient's functional capacity.

Especially useful for "asymptomatic" patients

Signs of poor tolerance to MR:

- absence of physiological elevation of BP during exercise
- Maximum low O2 consumption< 15 mL/kg/min

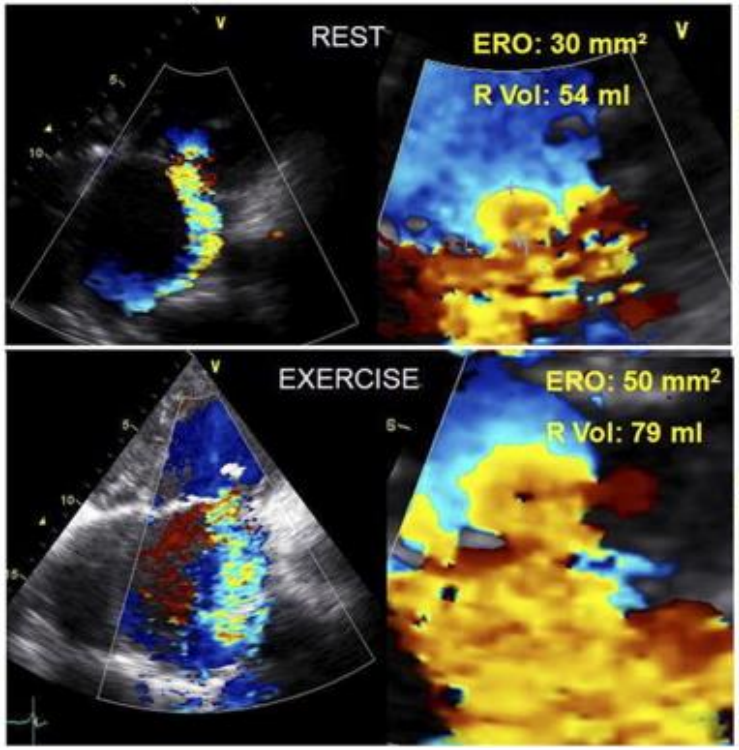
Echocardiography combined with exercise:

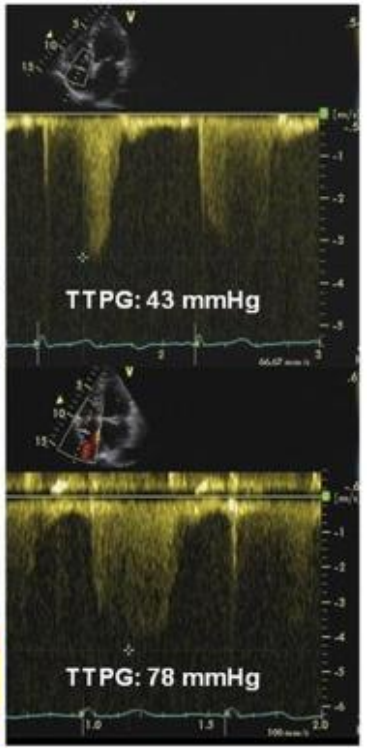
The degree of mitral regurgitation at rest does not predict the changes induced by exertion. For the same MR grade under rest conditions, the severity of MR is highly variable with exercise from one patient to another. The quantification of MR during exercise has an independent prognostic value.

Paraclinical tests in MR

Stress Test

La table d'effort permet de diagnostiquer le volume de régurgitation mitrale.

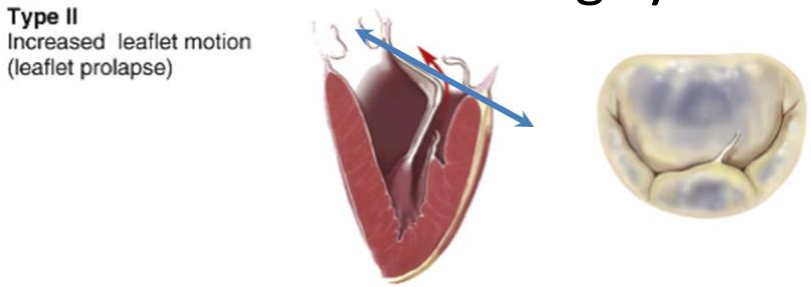




The Emerging Role of Exercise Testing and Stress Echocardiography in Valvular Heart Disease. E Picano, P Pibarot, P Lancellotti, JL Monin, R Bonow J Am Coll Cardiol. 2009;54(24):2251-2260

Mitral valve prolapse

A syndrome characterized by a more or less complete prolapse of one or both mitral valve leaflets in the left atrium during systole.



- primary (myxoid or mitral fibroelastic degeneration)
- associated with:
- Marfan disease or Ehlers-Danlos disease
- Atrial septal defect
- Ischemic heart disease
- Obstructive cardiomyopathy
- Predominantly female

Mitral valve prolapse

Signs

Can be:

- Totally absent
- MR signs

Other signs commonly seen in patients with MVP include:

anxiety

Palpitations

atypical chest pain

Near syncope

Mitral valve prolapse

Diagnostic

4 - Physical exam

- Apical mid- or late-systolic click
- Mid- to late crescendo systolic murmur
- Always check for signs of other associated pathologies (ex. : Marfan syndrome).

Mitral valve prolapse

Diagnostic

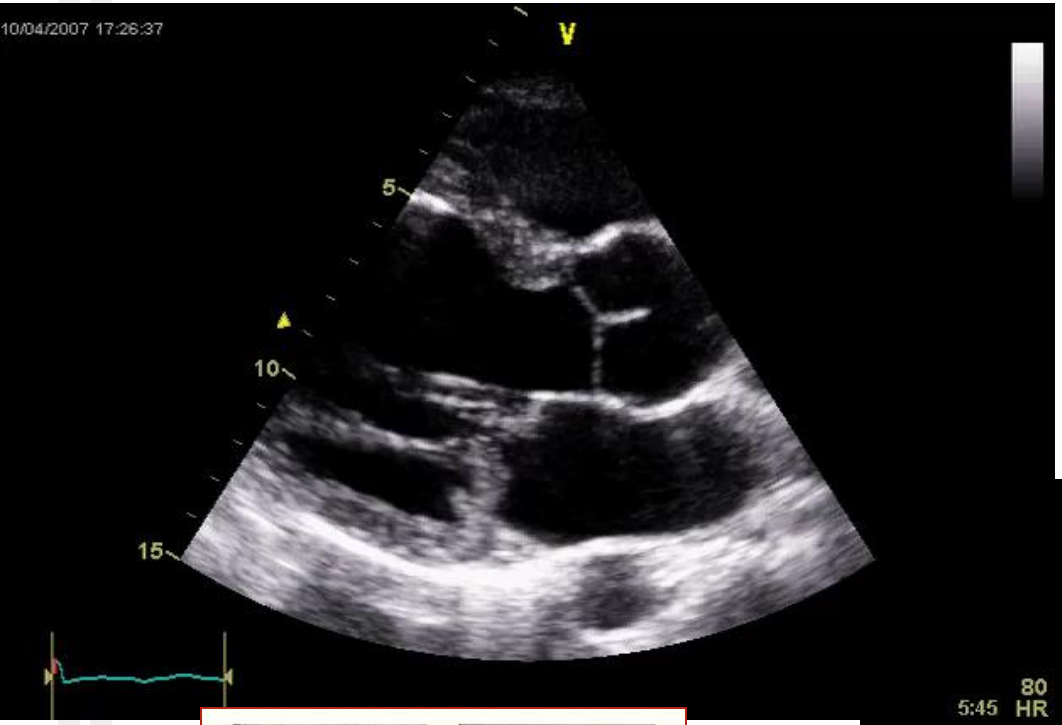
5 - Additional tests: echocardiography!

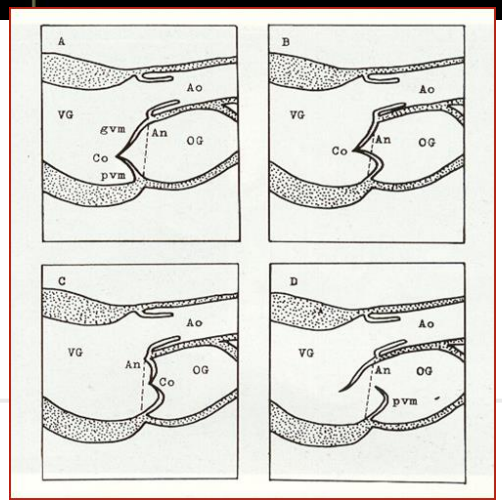
Definite diagnosis: end-systolic mitral valve recoil

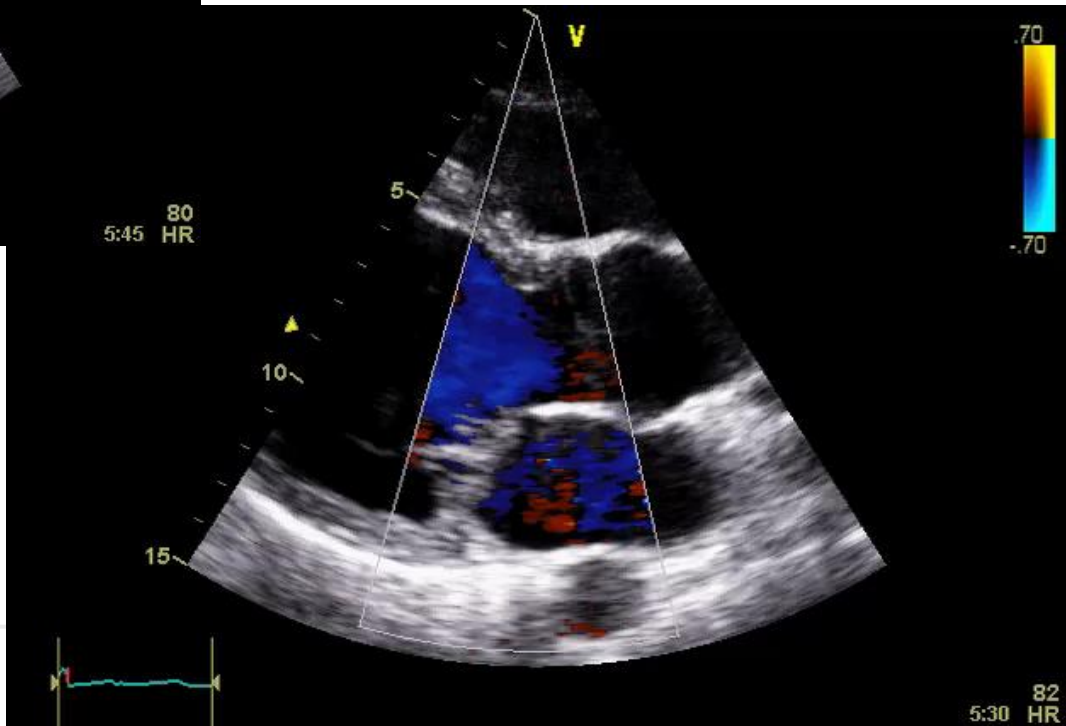
Distinguishing between primary and secondary prolapse

Evaluate and quantify MR

Echocardiography in MVP







Mitral valve prolapse

Evolution

Usually benign.

Possible complications:

- Chordae rupture→ significant MR poorly tolerated
- infective endocarditis, rare, especially if echo thickened valve
- Atrial and ventricular arrhythmias
  - supraventricular tachycardias, ventricular extrasystoles, or ventricular preexcitation (Wolff, Parkinson White syndrome) → HOLTER ECG
- Peripheral arterial embolism
- Sudden death due to ventricular arrhythmias (Exceptional)

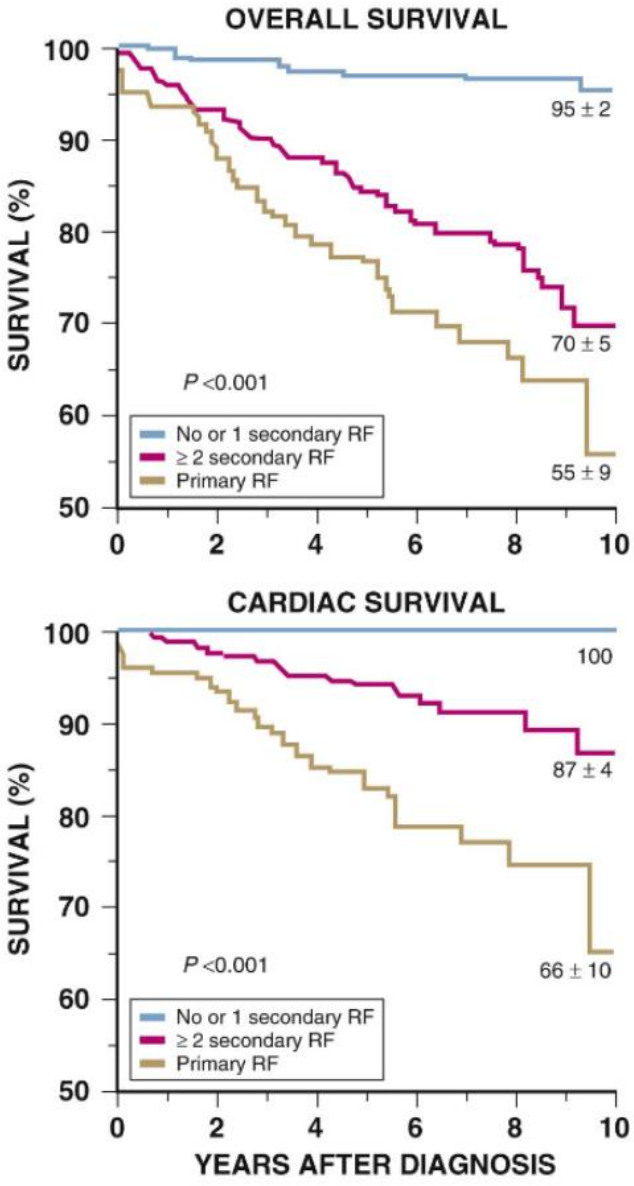
Mitral valve prolapse

Evolution

Excellent if no risk factors

- **Primary**:
  - Moderate to severe MR
  - EF<50%

- **Secondary**:
  - Mild MR
  - Left atrial dilatation > 40 mm
  - Valve malcoaptation
  - A-fib
  - Age>50



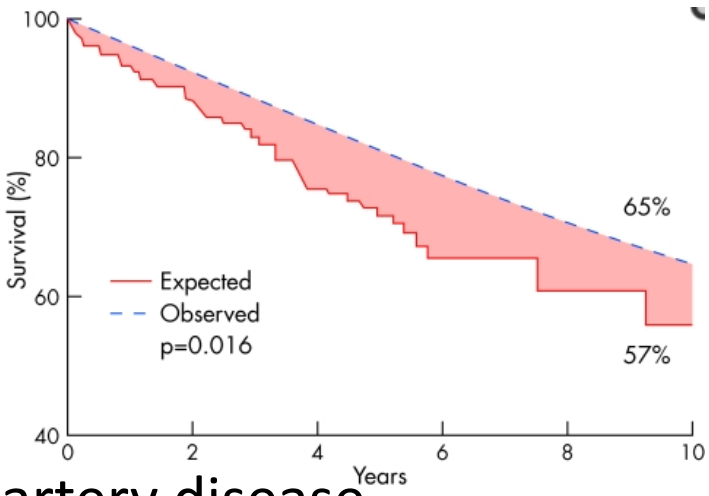
(Modified from Avierinos JF, Gersh BJ, Melton LJ, et al: Natural history of asymptomatic mitral valve prolapse in the community. Circulation 106:1355, 2002.)

Mitral Regurgitation

Natural Evolution

It depends on:

- Regurgitation volume
- Etiology
- MR progression time
- LVEF
- associated lesions, especially coronary artery disease

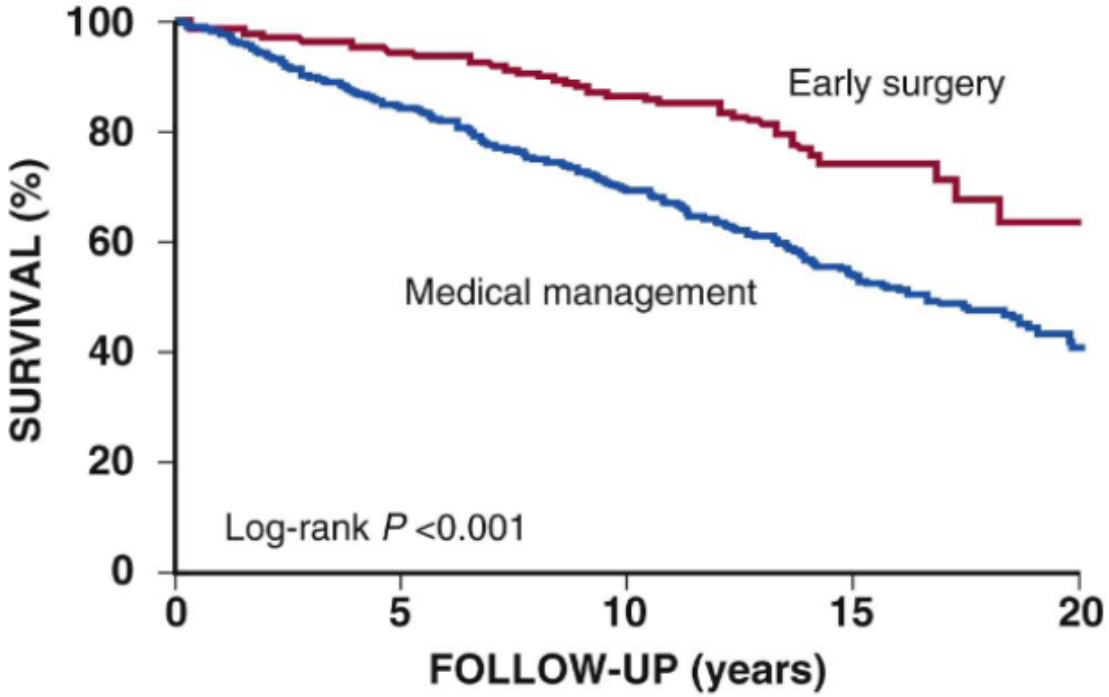


In general, moderate, progressive MRs are well tolerated for a long time and signs of heart failure do not appear until late.

On the other hand, MRs with sudden onset (chordae rupture, endocarditis, MR following MI) are poorly tolerated and rapidly progress to pulmonary edema.

Mitral Regurgitation

Natural Evolution vs. Early Surgery



No. at Risk					
Medical management	575	477	296	126	42
Early surgery	446	412	203	41	10

(From Suri RM, Vanoverschelde JL, Grigioni F, et al: Association between early surgical intervention vs watchful waiting and outcomes for mitral regurgitation due to flail mitral valve leaflets. JAMA 310:609, 2013.)

Mitral Regurgitation

Complications

- **Infective endocarditis**
- **Atrial fibrillation** or atrial flutter: can lead to heart failure. Favored by the dilation of the left atrium
- **Ventricular arrhythmias**, reflect a deterioration in ventricular function
- **Heart failure:**
- generally late-onset in chronic MIs
- can occur quickly in acute MI

Mitral Regurgitation

Complications

- **Thromboembolic complications:**
- Thrombosis in OG/atrial often asymptomatic
- Peripheral embolism
- Promoted by atrial fibrillation and/or dilation of the left atria
- Pulmonary embolism in advanced IM with dilated LV and low flow

MR treatment and follow-up

1 - Monitoring

- Mild to moderate MR (grade I ou II).
- Clinical and echographic reassessment.
- Endocarditis prevention.

Monitoring with echo every 6 months grade III or IV and surgery if:

- Onset of MR impact
- Onset of symptoms (Exertional dyspnea).

2 - Medical treatment

- If heart failure: diuretics, vasodilators, ACE-inhibitors, and digitalis if AFib.
- If acute MR: Acute pulmonary edema treatment and shock → surgery
- Oral anticoagulation for atrial fibrillation.
- Beta blockers in case of Marfan syndrome.

Patient-centred evaluation for intervention

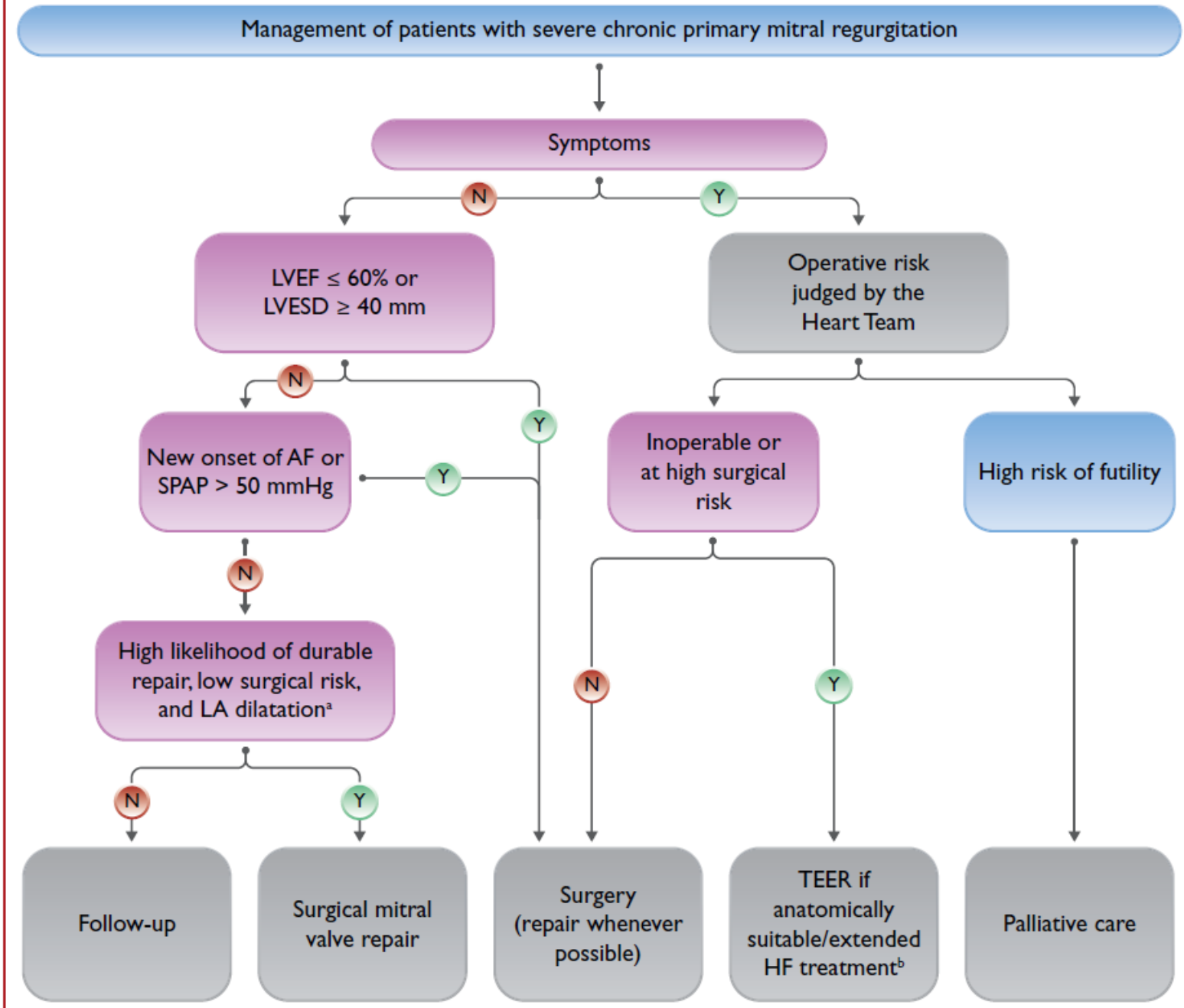
Network
Medical departments, referring cardiologists and primary care physicians

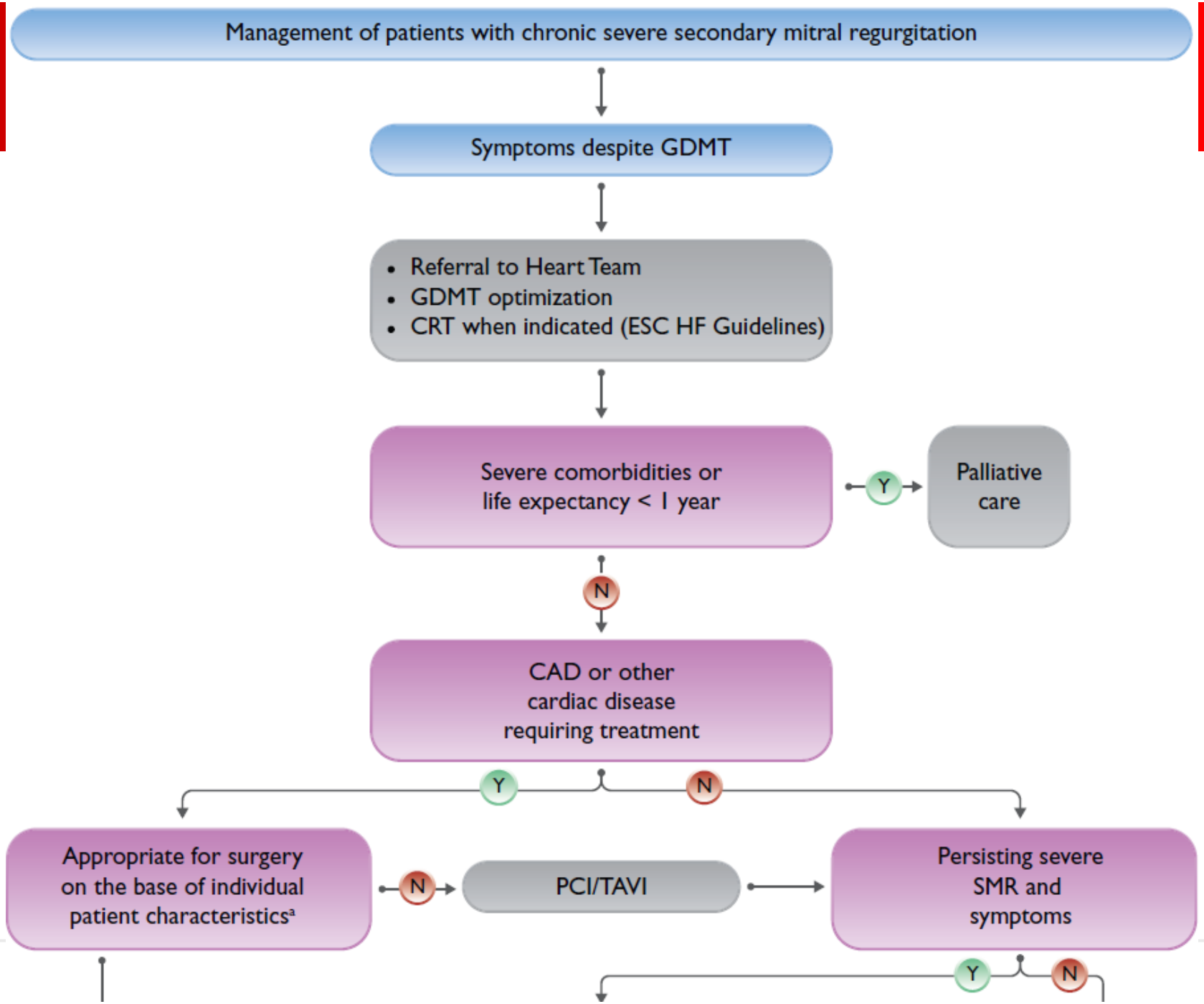
Heart Valve Centre
Centre of excellence in the treatment of VHD

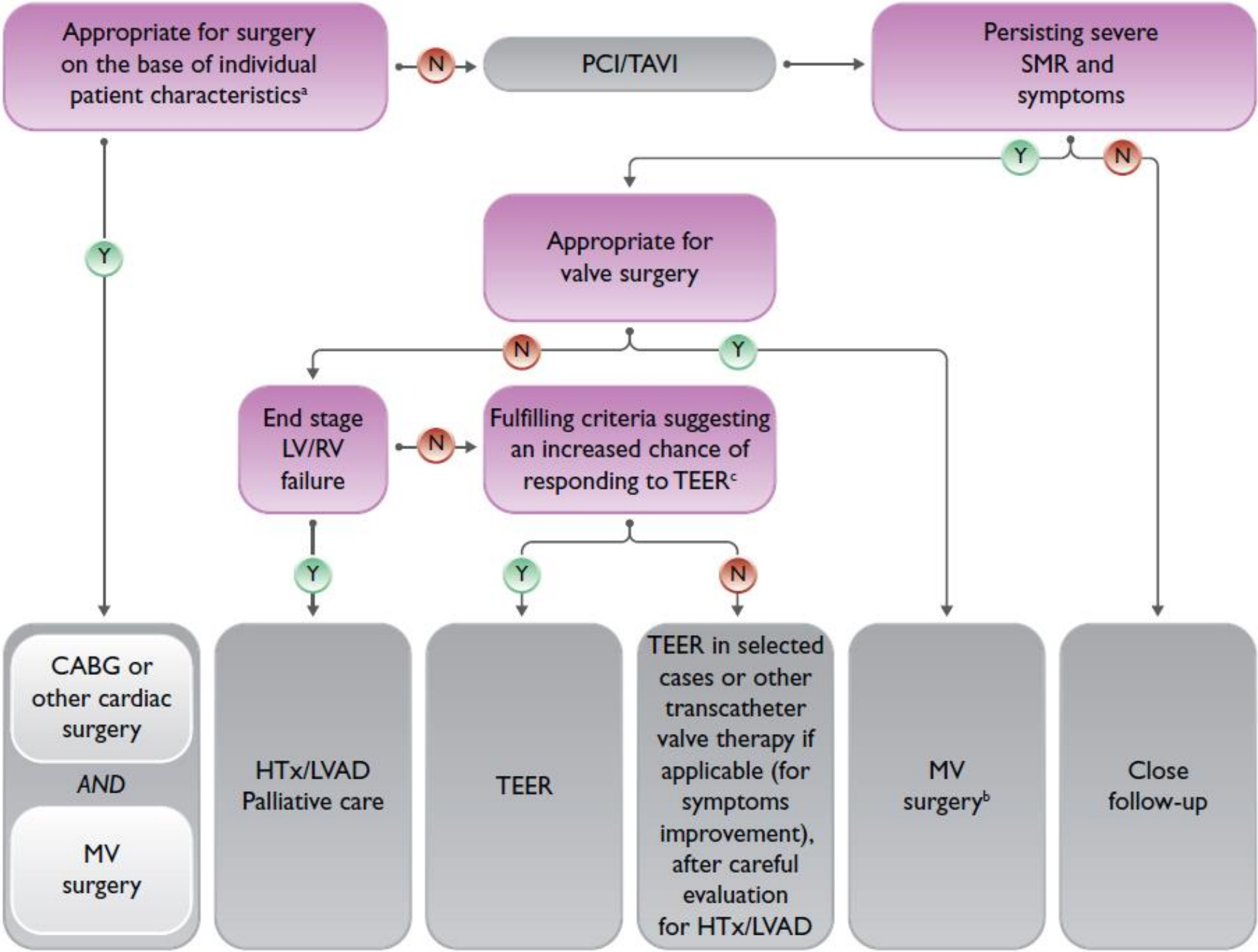
Heart Valve Clinic
Standardized organisation of care providing guideline-directed treatment of VHD

Clinical and imaging assessment

Symptoms related to VHD	Clinical evaluation, biomarkers, stress testing in asymptomatic patients
Aetiology, lesion and mechanisms of VHD	Echocardiography (TTE and TOE), CCT
Severity of VHD	Integrative echocardiography, CCT CMR, stress testing
Life expectancy and quality of life	Age/estimated life expectancy, sex, country, comorbidities


Management of patients with severe chronic primary mitral regurgitation
Symptoms
N
Y
LVEF ≤ 60% or LVESD ≥ 40 mm
Operative risk judged by the Heart Team
N
Y
New onset of AF or SPAP > 50 mmHg
Y
Inoperable or at high surgical risk
High risk of futility
N
High likelihood of durable repair, low surgical risk, and LA dilatation[a]
N
Y
N
Y
Follow-up
Surgical mitral valve repair
Surgery (repair whenever possible)
TEER if anatomically suitable/extended HF treatment[b]
Palliative care


Management of patients with chronic severe secondary mitral regurgitation
Symptoms despite GDMT
• Referral to Heart Team
• GDMT optimization
• CRT when indicated (ESC HF Guidelines)
Severe comorbidities or life expectancy < 1 year
Y
Palliative care
N
CAD or other cardiac disease requiring treatment
Y
N
Appropriate for surgery on the base of individual patient characteristics[a]
N
PCI/TAVI
Persisting severe SMR and symptoms
Y
N


Appropriate for surgery on the base of individual patient characteristics[a]
N
PCI/TAVI
Persisting severe SMR and symptoms
Y
N
Y
Appropriate for valve surgery
N
Y
End stage LV/RV failure
N
Fulfilling criteria suggesting an increased chance of responding to TEER[c]
Y
Y
Y
N
CABG or other cardiac surgery
AND
MV surgery
HTx/LVAD Palliative care
TEER
TEER in selected cases or other transcatheter valve therapy if applicable (for symptoms improvement), after careful evaluation for HTx/LVAD
MV surgery[b]
Close follow-up

Mitral Regurgitation

Surgical treatment

1 - Annuloplasty = « ideal » treatment

- Primary advantage principal : No need for anticoagulation
- Preserves the subvalvular system with less LV dysfunction
- ↓ Long term morbidity and mortality
- ↓ Infective endocarditis risk
- Indicated in prolapse with or without ruptured tendinae
- Possible in some cases of post-rheumatic MR if the valve is not overly diseased and in some cases of ischemic MR.
- Requires significant experience and not always possible
- Risk of long-term MR recurrence → reintervention

Mitral Regurgitation

Surgical treatment

2 - Valve replacement if annuloplasty is not possible on overly diseased valve and subvalvular apparatus:

- Mechanical prosthesis:

-requires anticoagulant therapy

-Long life span

-indicated if patient < 70 years of age

-indicated if anticoagulant therapy is needed (atrial fibrillation)

Mitral Regurgitation

Surgical treatment

2 - Valve Replacement

- biological prosthesis (bioprosthesis):

-Does not require long-term anticoagulant therapy,

-Risks of long-term dehiscence,

-indicated if patient > 65–70 years of age,

-indicated if contraindications to anticoagulants.

Percutaneous treatment mitral regurgitation

- ***Percutaneous mitral valve repair:***

TEER (Transcatheter edge-to-edge repair)

Principle of Edge-to-Edge Repair:

- ***Alfieri's surgical technique***: Suturing the edges of the two leaflets of the mitral valve, resulting in a reduction of abnormal blood reflux.
- A metal clip is advanced percutaneously from the femoral vein into the right atrium and then into the left atrium through the interatrial septum.

Percutaneous treatment mitral insufficiency

Mitraclip ® *(CE marked 2008, FDA en 2013)*

Implantable clip

Swivel sleeve

Drop Catheter

Percutaneous treatment mitral regurgitation

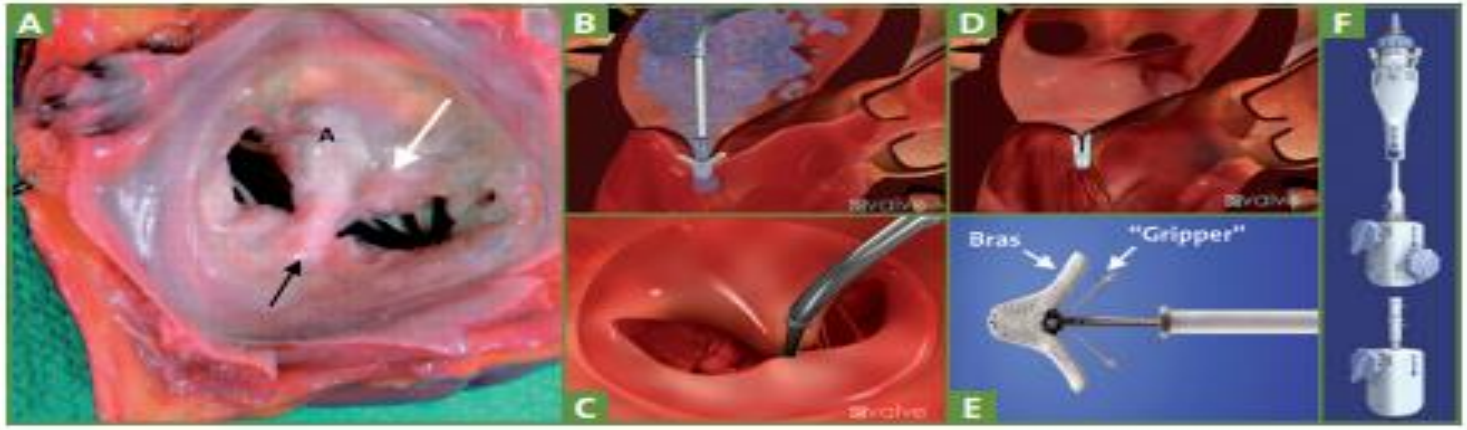


Fig. 1 : Réparation mitrale bord à bord. **A :** intervention d'Alfieri : suture bord à bord du bord libre des feuillets mitraux créant à terme un pont fibreux entre les valves (flèche) et 2 hémi-orifices. **B :** système MitraClip positionné au niveau des feuillets mitraux, en position de capture. **C :** vue auriculaire de la valve mitrale après capture des feuillets mitraux par le système MitraClip, avant le largage du clip. **D :** clip largué après capture des feuillets mitraux. **E :** vue du clip composé de 2 "grippers" et de 2 bras. **F :** vue d'ensemble du système MitraClip.

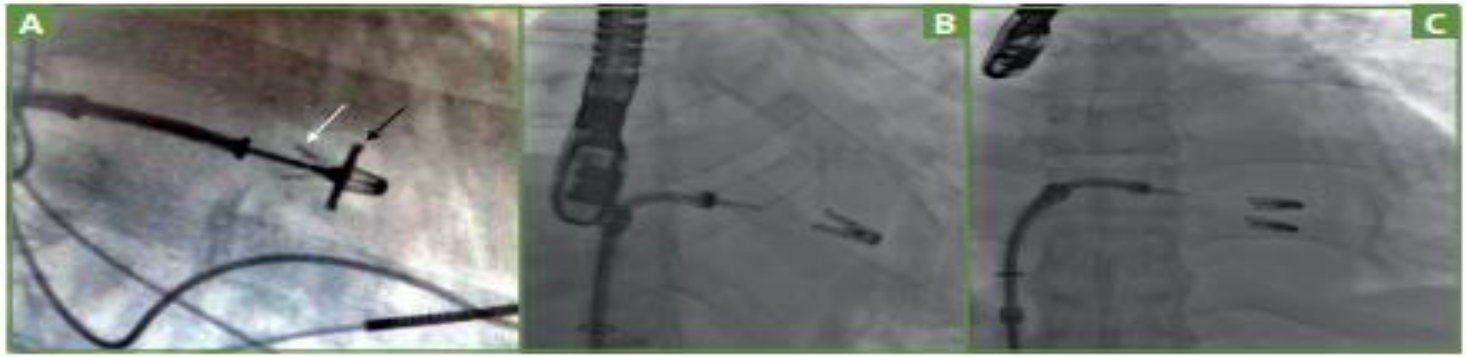
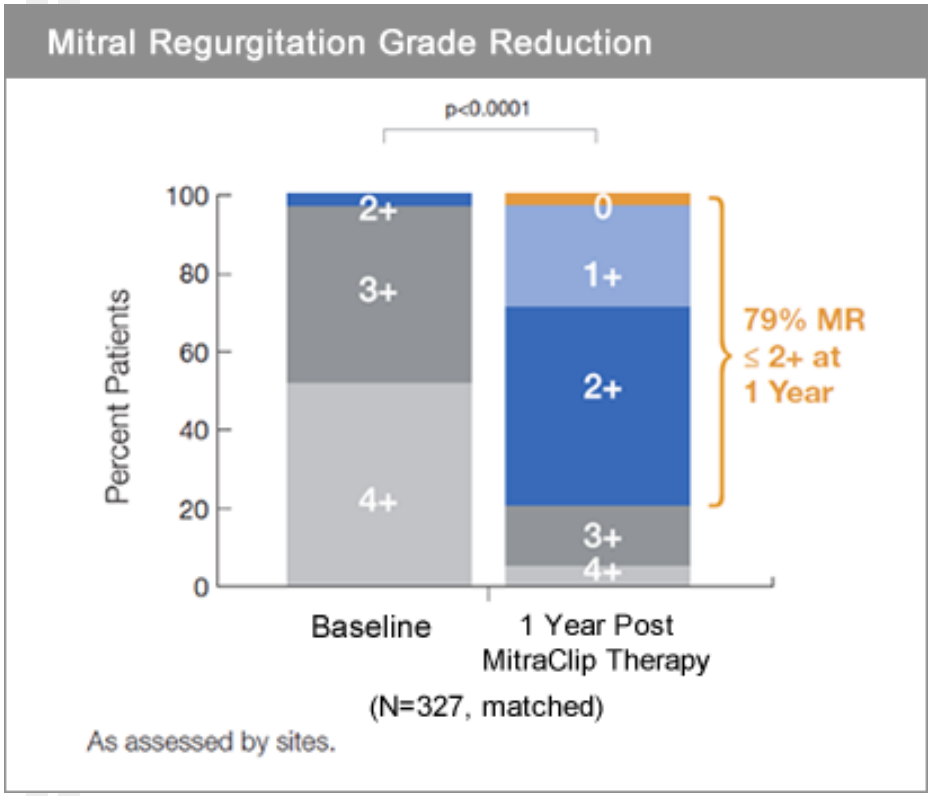
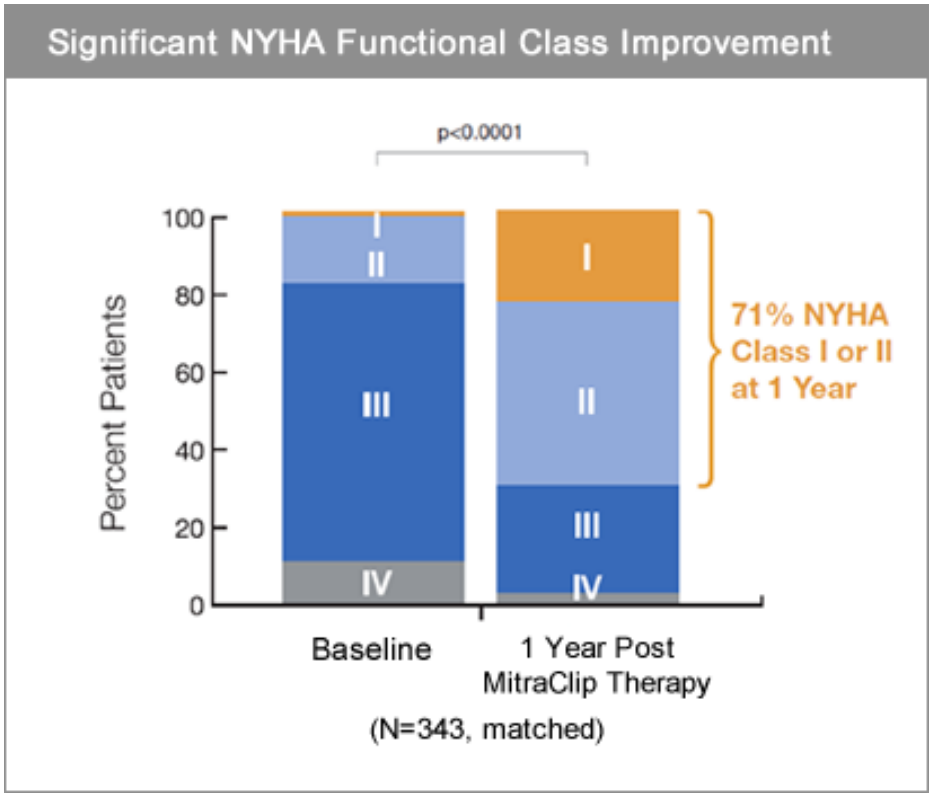


Fig. 2 : Réparation mitrale bord à bord, fluoroscopie. **A :** fluoroscopie, clip en position de capture : "grippers" en position haute (flèche blanche), bras en position horizontale 180° (flèche noire). **B :** fluoroscopie, clip après capture des feuillets et largage. **C :** fluoroscopie, 2 clips en place.

Percutaneous treatment mitral regurgitation

Percutaneous treatment mitral regurgitation





Schillinger, W. ACCESS-EUROPE Phase I: A Post Market Study of the MitraClip System for the Treatment of Significant Mitral Regurgitation in Europe: Analysis of Outcomes at 1 Year. ESC 2012; August 25-29, 2012; Munich, German

Long-term follow-up of percutaneous treatment mitral regurgitation

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Five-Year Follow-up after Transcatheter Repair of Secondary Mitral Regurgitation

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ABSTRACT

BACKGROUND

Data from a 5-year follow-up of outcomes after transcatheter edge-to-edge repair of severe mitral regurgitation, as compared with outcomes after maximal doses of guideline-directed medical therapy alone, in patients with heart failure are now

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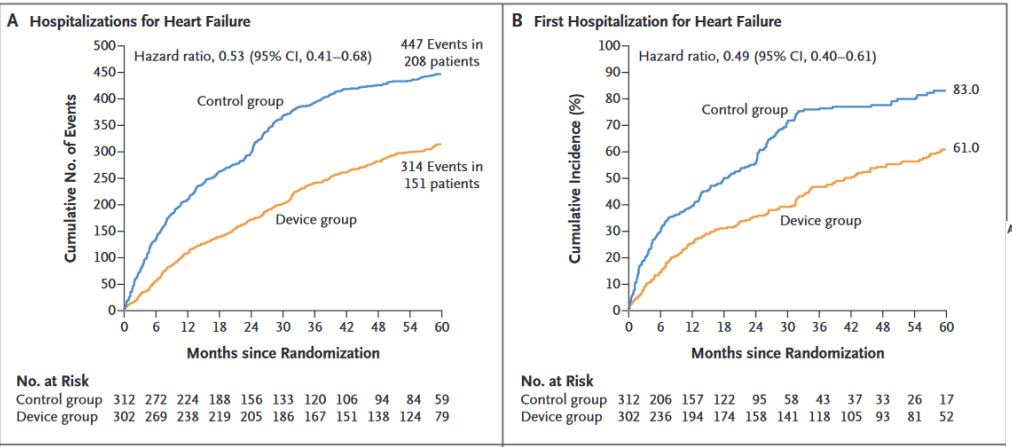
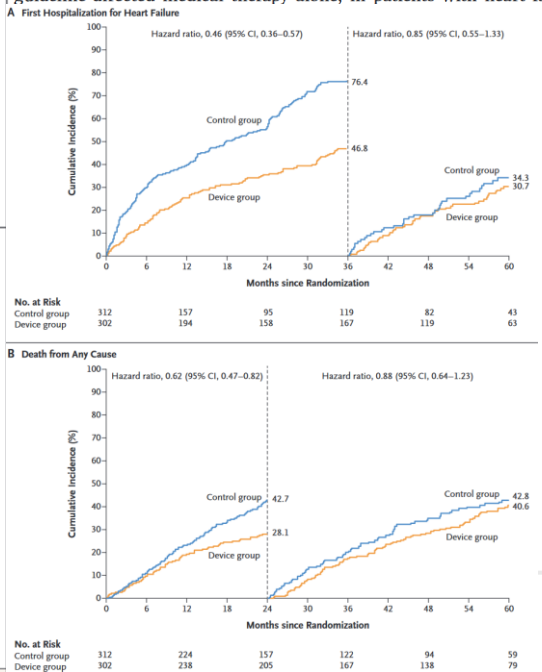


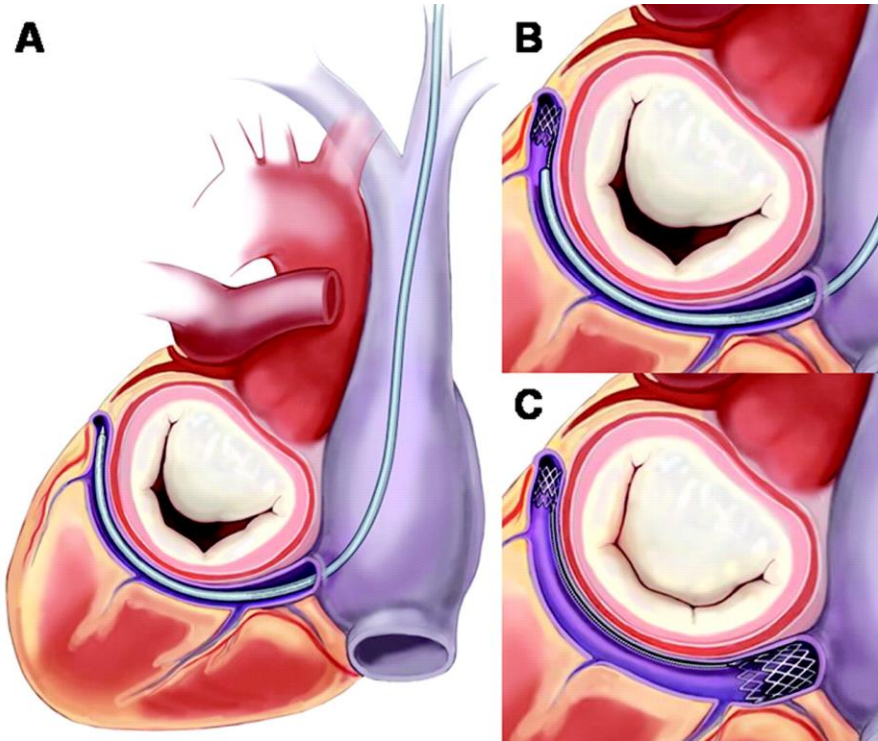


Percutaneous treatment mitral regurgitation

- ***Other Percutaneous Mitral Valve Repair Modalities:***

- Indirect annuloplasty (through the coronary sinus).
- Direct annuloplasty.

Under development



Rheumatic fever (RF)

Rheumatic fever (RF) is the almost exclusive cause (99%) RA
RAA is an inflammatory complication that occurs after an untreated infection with group A β-hemolytic streptococcus: Angina, Scarlet fever**..**

Affects children from the age of 4, adolescents and young adults

Rheumatic fever (RF)

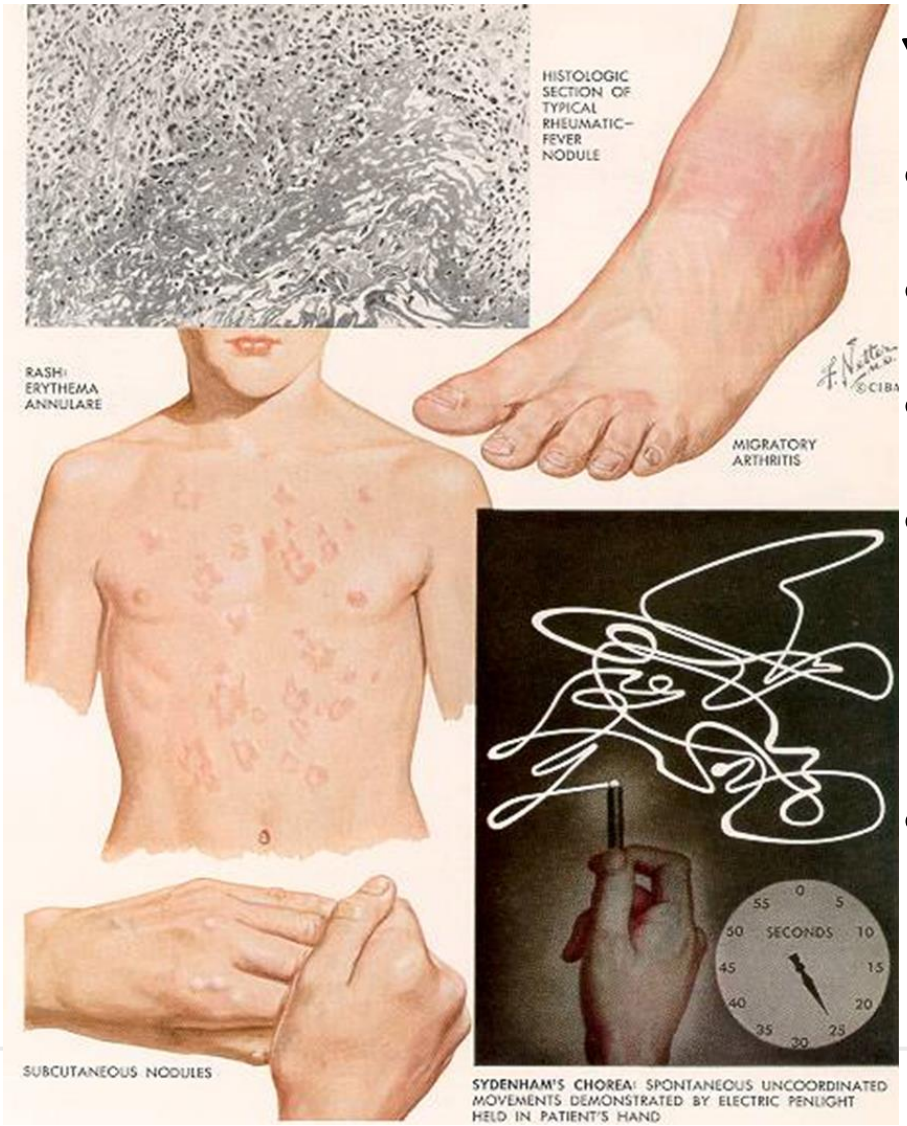
Joint, neurological, cutaneous and cardiac manifestations:

- ***Rheumatoid polyartritis:*** painful, red, hot and swollen joints (essentially: ankles, knees, elbows, wrists)
- ***Sydenham's Chorea:*** Involuntary rapid movements that can affect all muscles (except the oculomotor muscles) that disappear during sleep.
- ***Subcutaneous nodules:*** Painless and transient.
- ***Erythema marginatum :*** transient, painless (disappears without scarring).

Erythema marginatum

Subcutaneous nodules

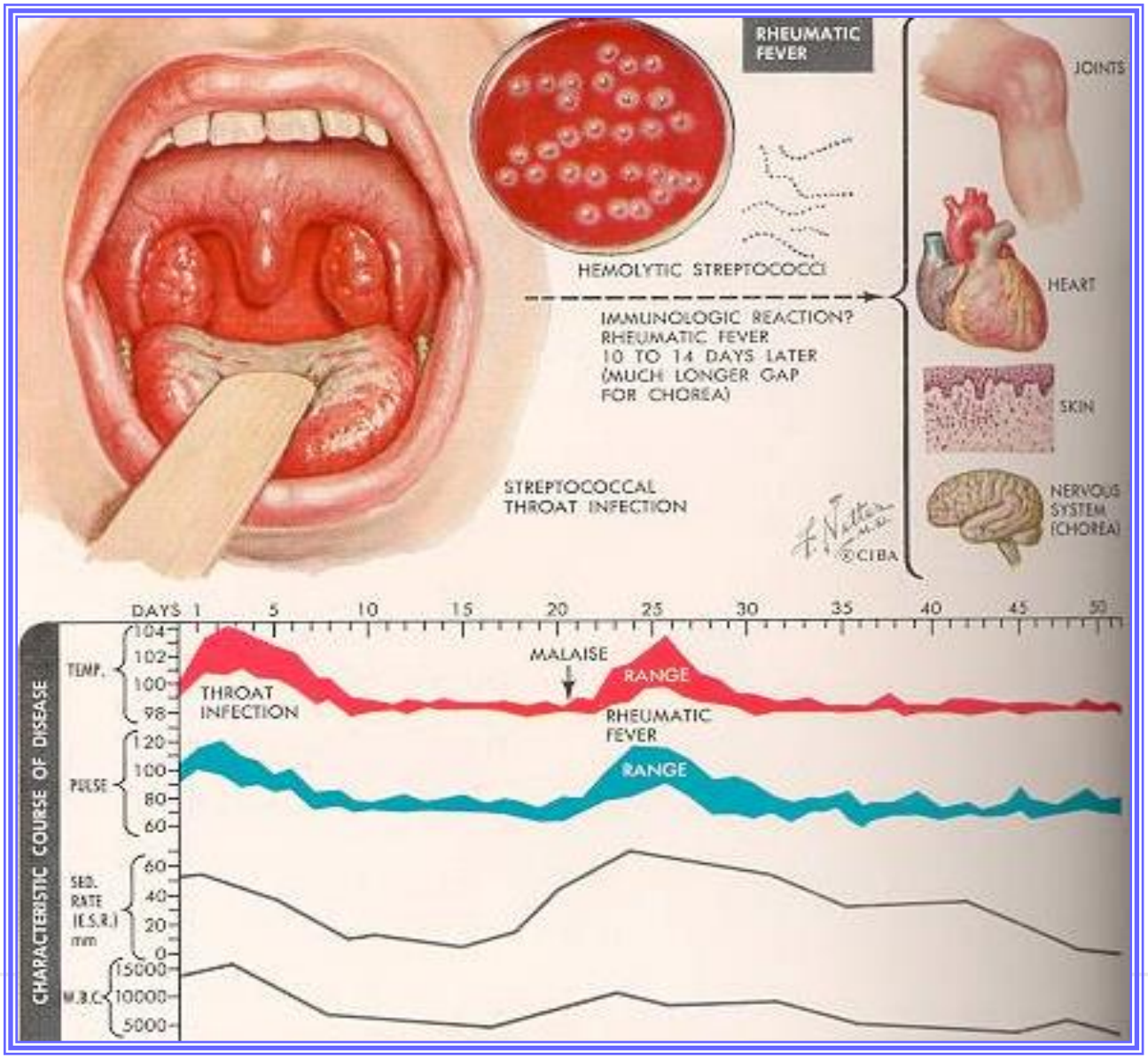
Classical clinical presentation



Young teen with:

- Joint pain
- Cutaneous rash
- Nodules
- 3-4 weeks after "flu"
  - Fever
  - Sore throat
- RF!

Clinical presentation



Rheumatic fever

Cardiac Involvement in RF: pancarditis: affects the pericardium (pericarditis), myocardium (myocarditis) and valves++

Cardiac involvement is asymptomatic in 50% of cases and is limited to auscultation of a cardiac murmur.

Symptoms: range from mild dyspnea to severe heart failure.

Autoimmune hypothesis (similarities between Strep B proteins and valve tissue) attempts to explain valve involvement during RF, but this mechanism is not clearly elucidated.

Rheumatic valve disease appears years after RF.

Rheumatic fever

Treatment:

- Primary prevention = Antibiotic treatment of streptococcal infections.
- Non-steroidal anti-inflammatory therapy (NSAIDs) according to clinical manifestations.
- Secondary Prevention of Secondary Valvular Heart Disease:
  (benzathine benzyl) penicillin 1,2M UI/21 days up to the age of 25

Epidemiology:

- Endemic in developing countries or countries with poor health systems: 35/100,000 inhabitants
- Exceptional and almost eradicated in developed countries: 1/100,000 inhabitants.

Mitral stenosis

Fusion commissurale

Fusion et raccourcissement des cordages mitraux

Calcification des feuillets mitraux

Mitral stenosis

Definition:

- **Mitral stenosis is when the surface area is reduced to less than 2 cm^2**
- Severe mitral stenosis if < 1.5 cm^2

Epidemiology:

- Disease of young women of childbearing age (4:1 ratio F:M).
- Endemic: developing countries.
- Rare: Europe and North America.

Mitral stenosis

Rare etiologies of mitral stenosis:

- Congenital mitral stenosis
- Systemic lupus erythematosus
- Rhumatoïde arthritis
- Fabry disease
- Whipple's disease
- Certain mucopolysaccharidosis.

Pathology of mitral stenosis

- Damage to the valvular system occurs 5 to 15 years after RF.
- Affects valve leaflets, commissures, and cords:

Comissural symphysis+++

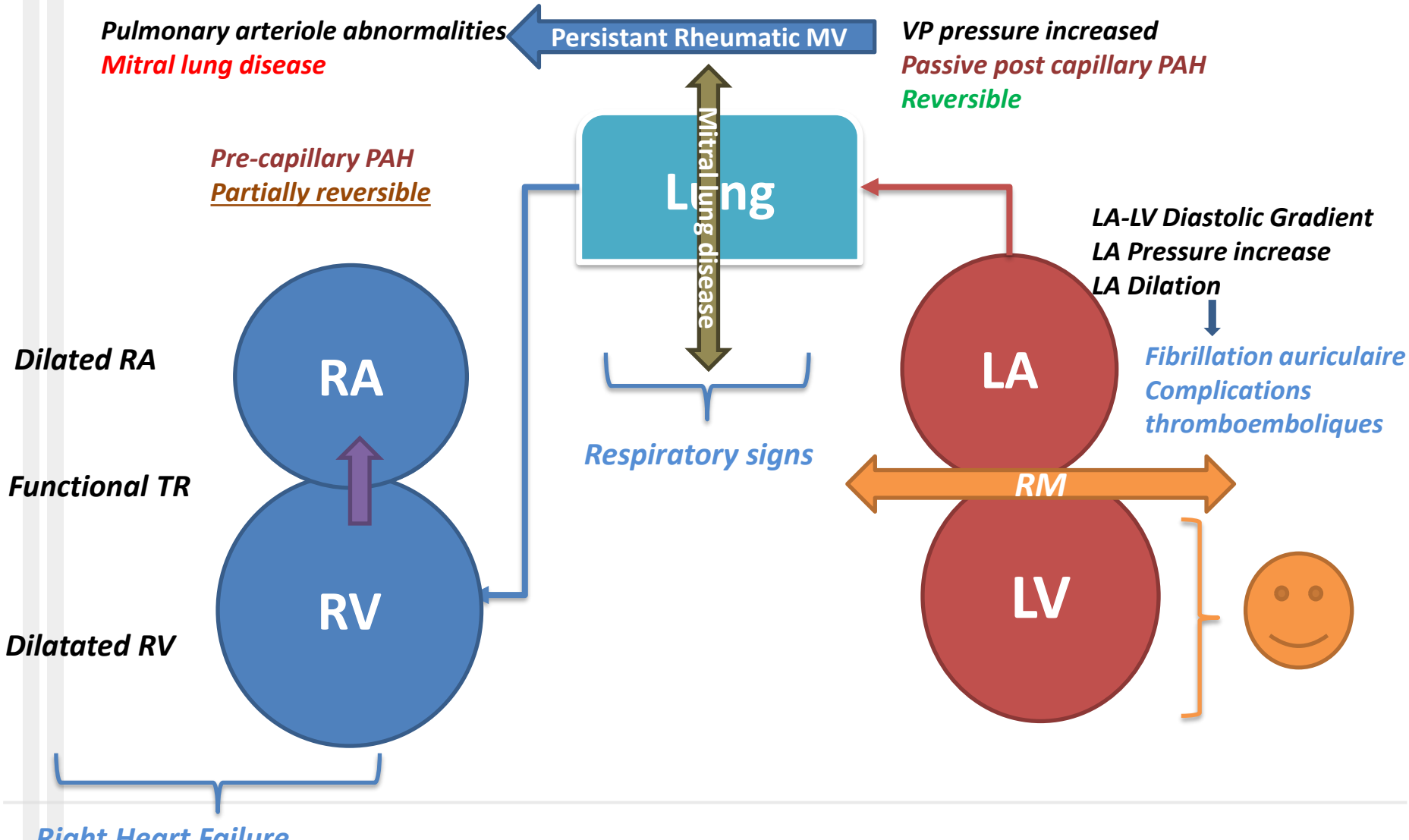
Valve leaflets thickened, fibrous, retracted, sclerotic, and calcified.

Subvalvular Apparatus: Fused Retracted chordae

Rheumatic MV in diaphragm = Commissural fusion, valve and subvalvular apparatus slightly diseased

Funneled Rheumatic MV= Lower apex cone, valve and subvalvular apparatus heavily diseased

Pathophysiology of mitral stenosis



Clinical signs of mitral stenosis

- **History:**

  Past Medical History :

  RF

  Recurrent angina.

  Functional Complaints:

  Exertional dyspnea +++

  Hemoptysis

  Palpitations

  Liver pain during the late stage of right heart failure

Mitral stenosis

- **Physical signs:**

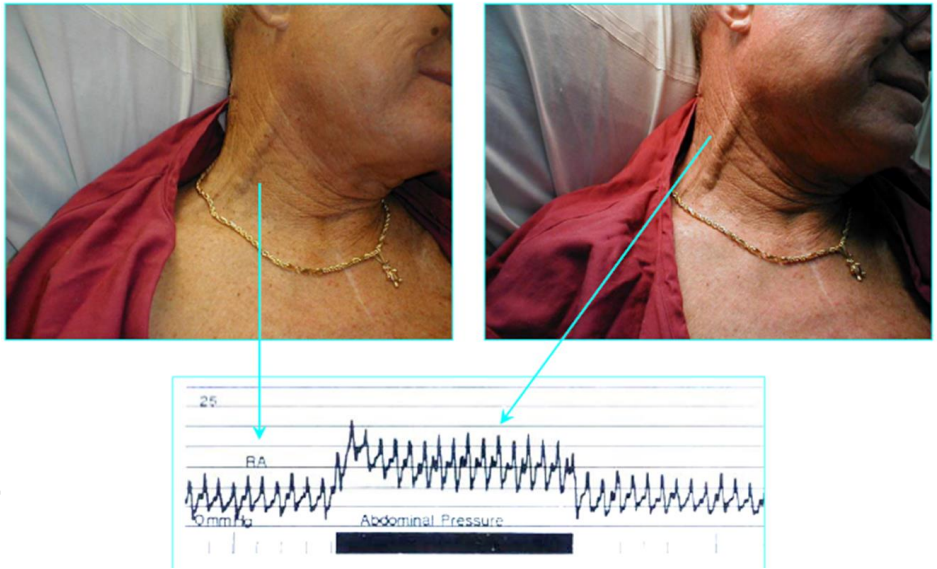
Inspection

Mitral facies: Erythrema of the cheekbones +/- cyanotic
Mitral dwarfism

Mitral stenosis

Diastolic thrill palpable at the apex in severe forms

Painful hepatomegaly, hepatojugular reflux and sign of ***Harzer*** (Advanced right HF: palpation of a apical pulse at the level of the epigastrium < hypertrophy of the right ventricle)



Mitral stenosis

Auscultation:

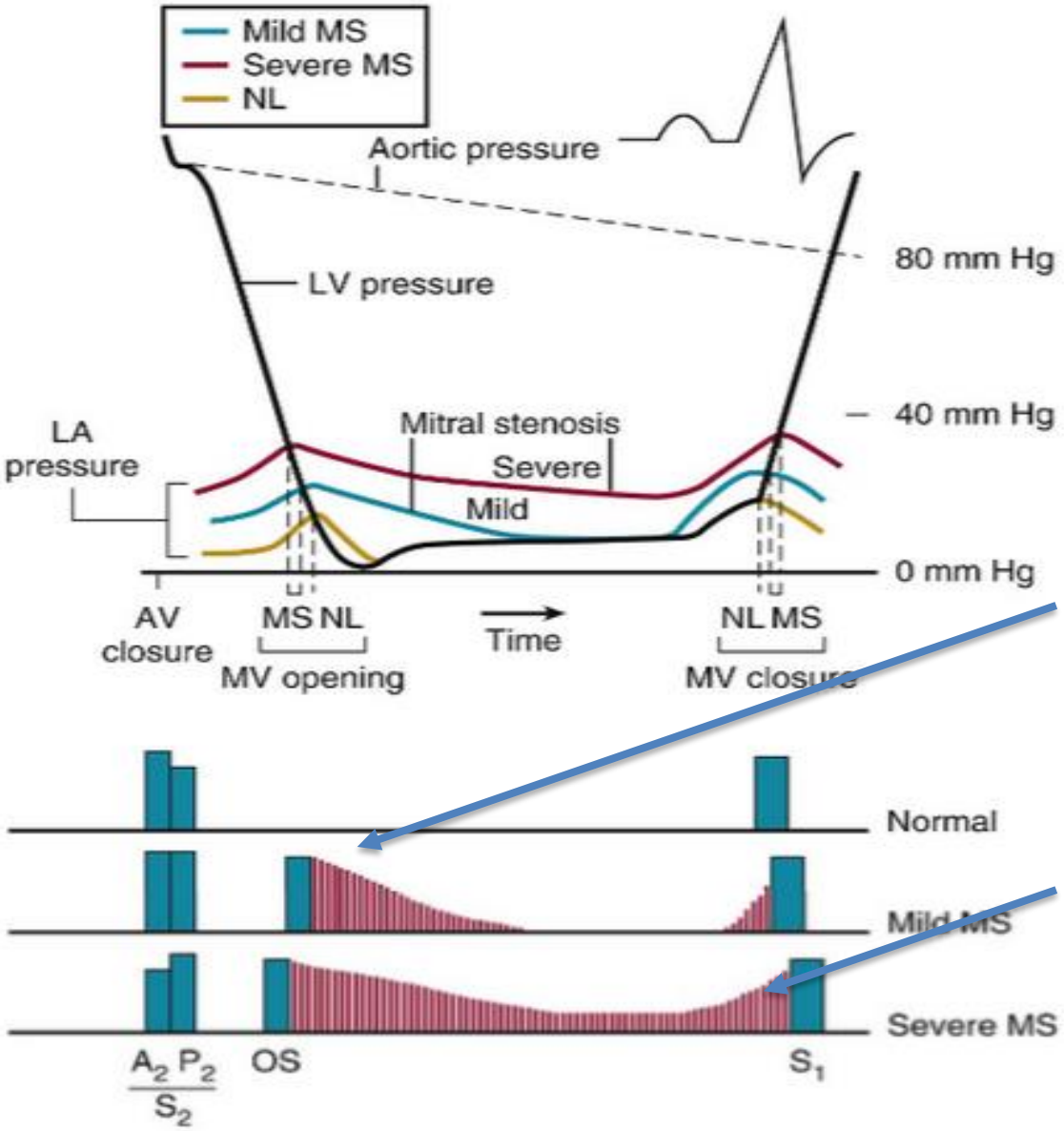
Left lateral recumbent patient with expiratory apnea:

Mitral focus: The classic ***Durozier triad:***

1. ***Mitral opening snap***
2. ***Diastolic rumble***
3. ***Prominent S1***

- *Prominent S2 and systolic murmur at the pulmonary focus if PAH*
- *Systolic TR, accentuated on deep inhalation (Carvalho's sign).*

Auscultation of mitral stenosis



Earlier mitral opening slamming if severe MR

Diastolic rumble with pre-systolic reinforcement only sinus rhythm

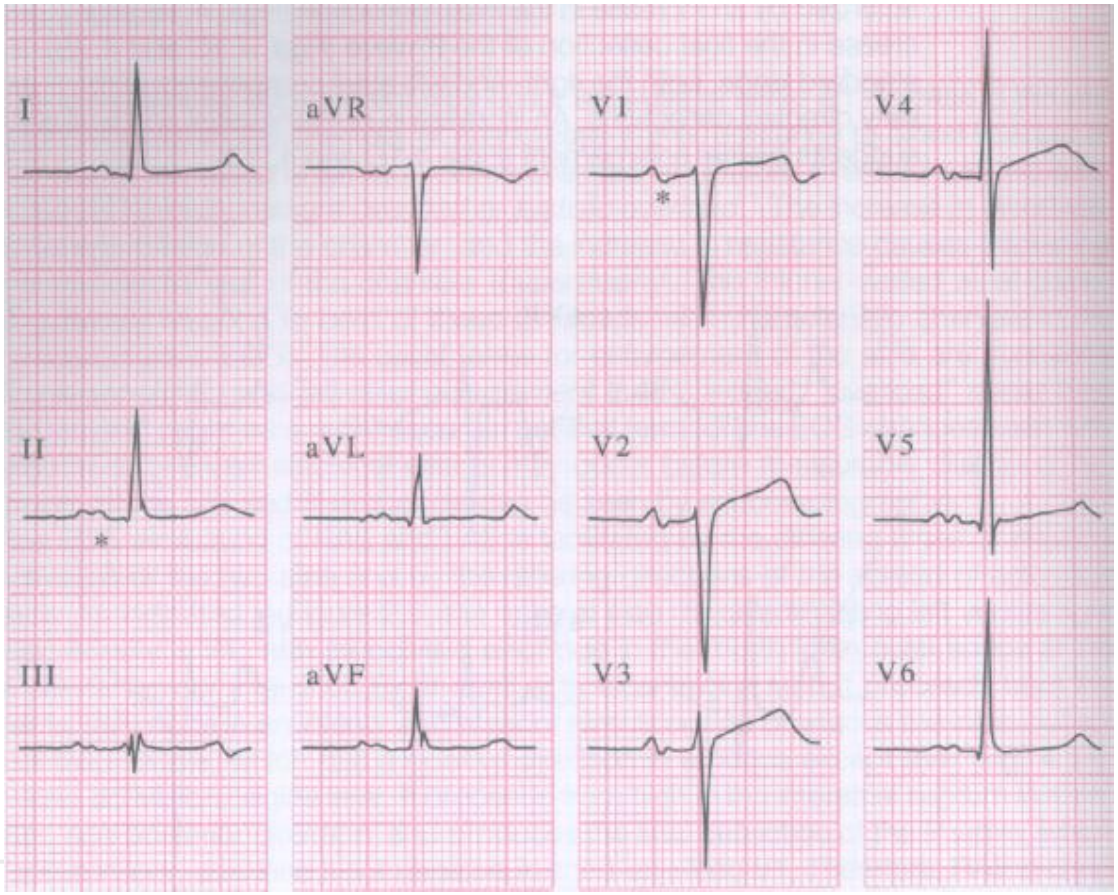
Paraclinical Signs of Mitral Stenosis

- **ECG:**

Left atrial hypertrophy

Broad P-wave(>120 ms)
Bifid in D2
Biphasic in V1

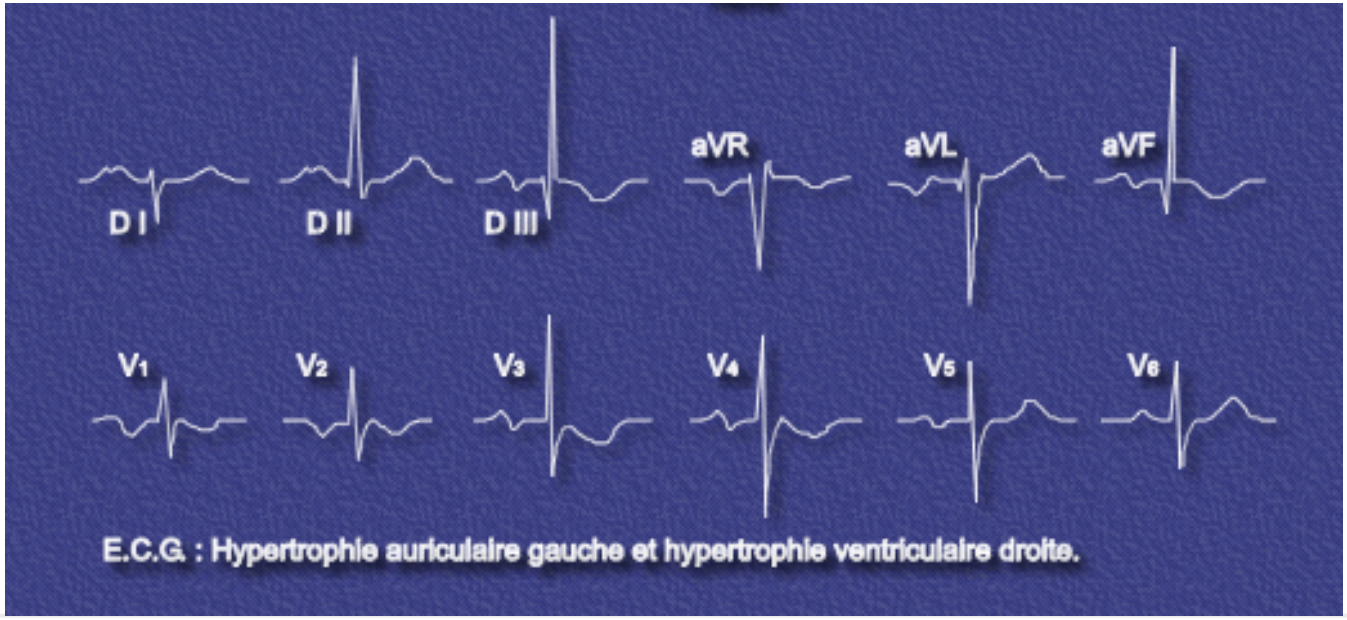
Atrial extrasystoles



Mitral stenosis ECG (II)

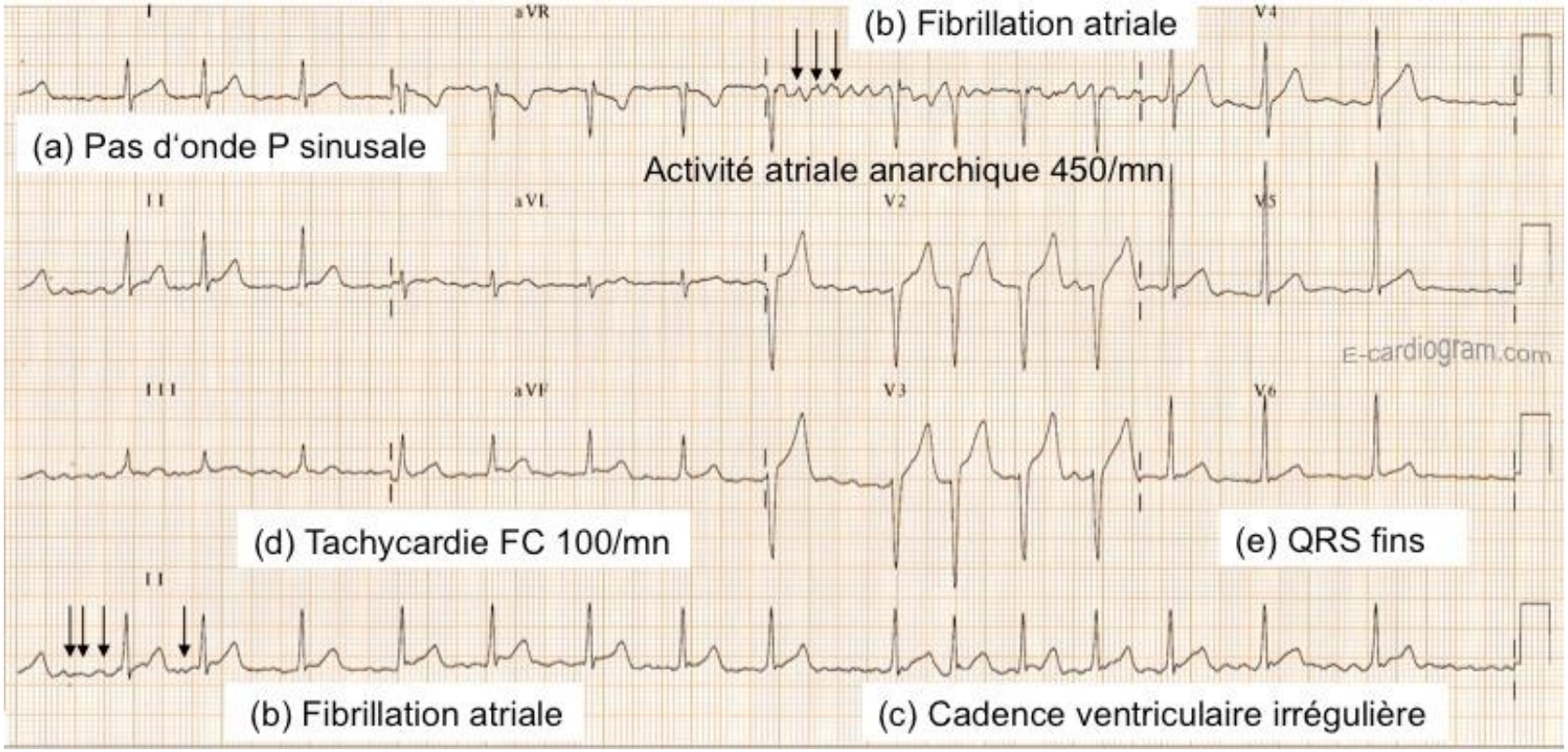
- ***Right ventricular hypertrophy***

  Right axial deflection
  S1Q3 Appearance
  Predominant R wave in the right precordial leads
  Predominant S in the left precordial leads



Mitral stenosis ECG (III)

- *Atrial fibrillation*



Chest X-ray, mitral stenosis

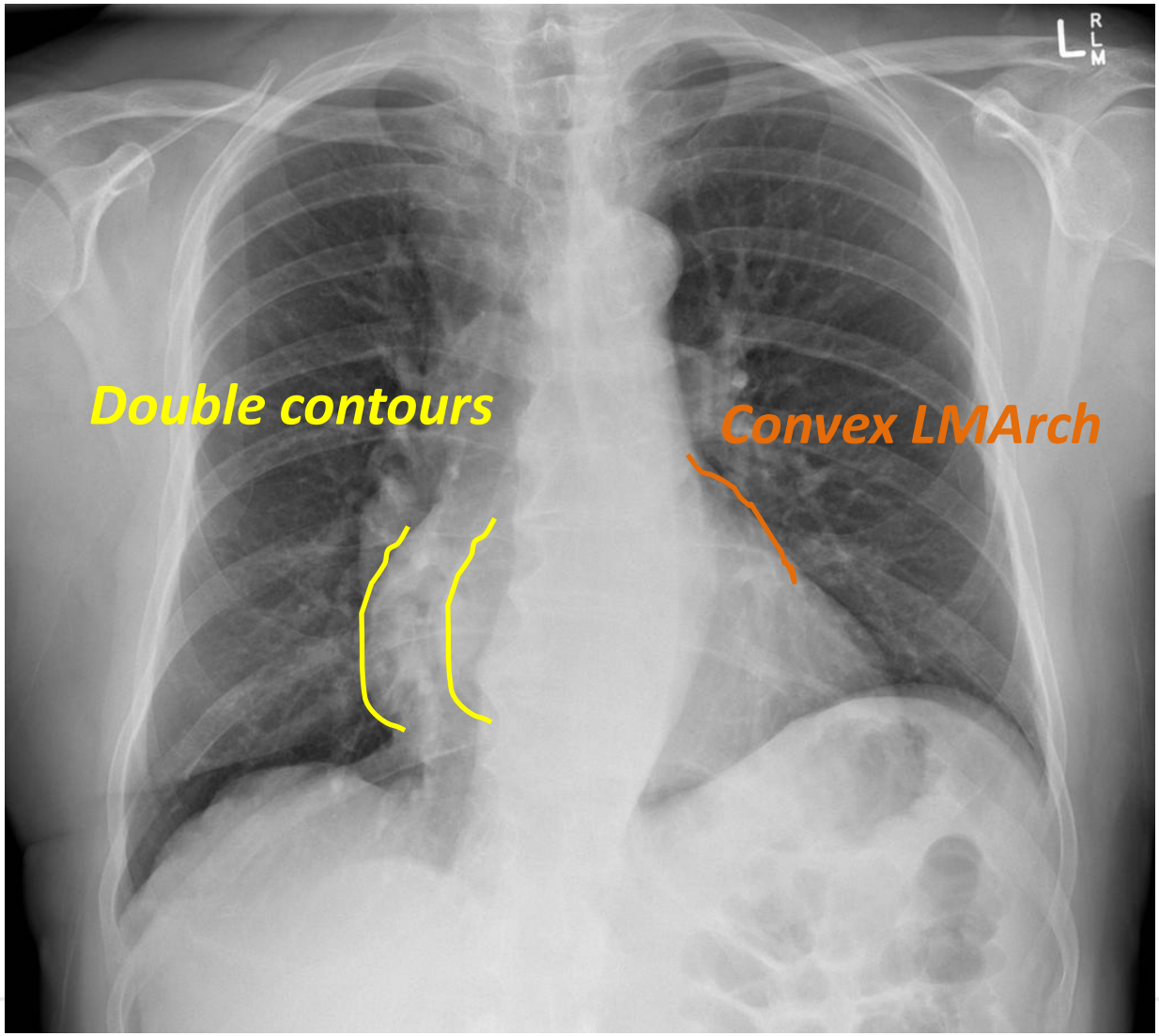
The mitral silhouette

- Normal left inferior arc
- LMA loses its concave shape, becomes straight or convex with sometimes a double hump appearance
- Double-contoured appearance of the lower right arch
- Valve calcifications
- Right extension if impact on straight cavities.

Mitral lung

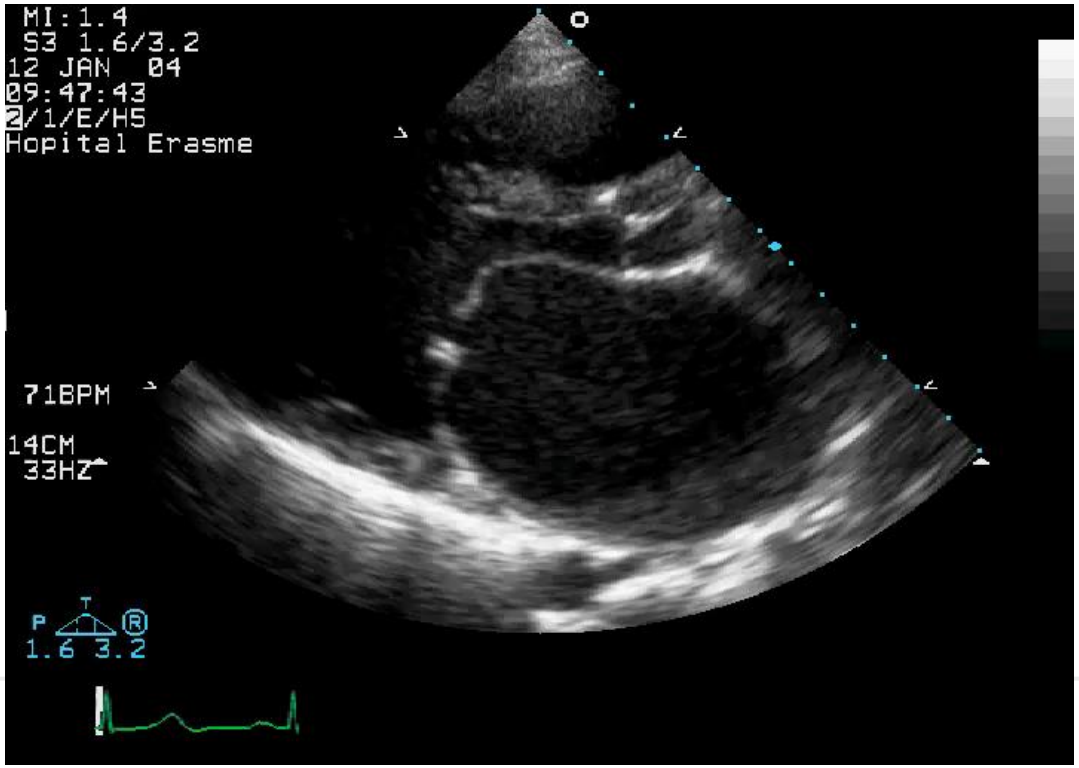
- Ambiguous perihilar and reticulonodular opacities at the bases
- Kerley lines for interstitial edema.

Chest X-ray, mitral stenosis



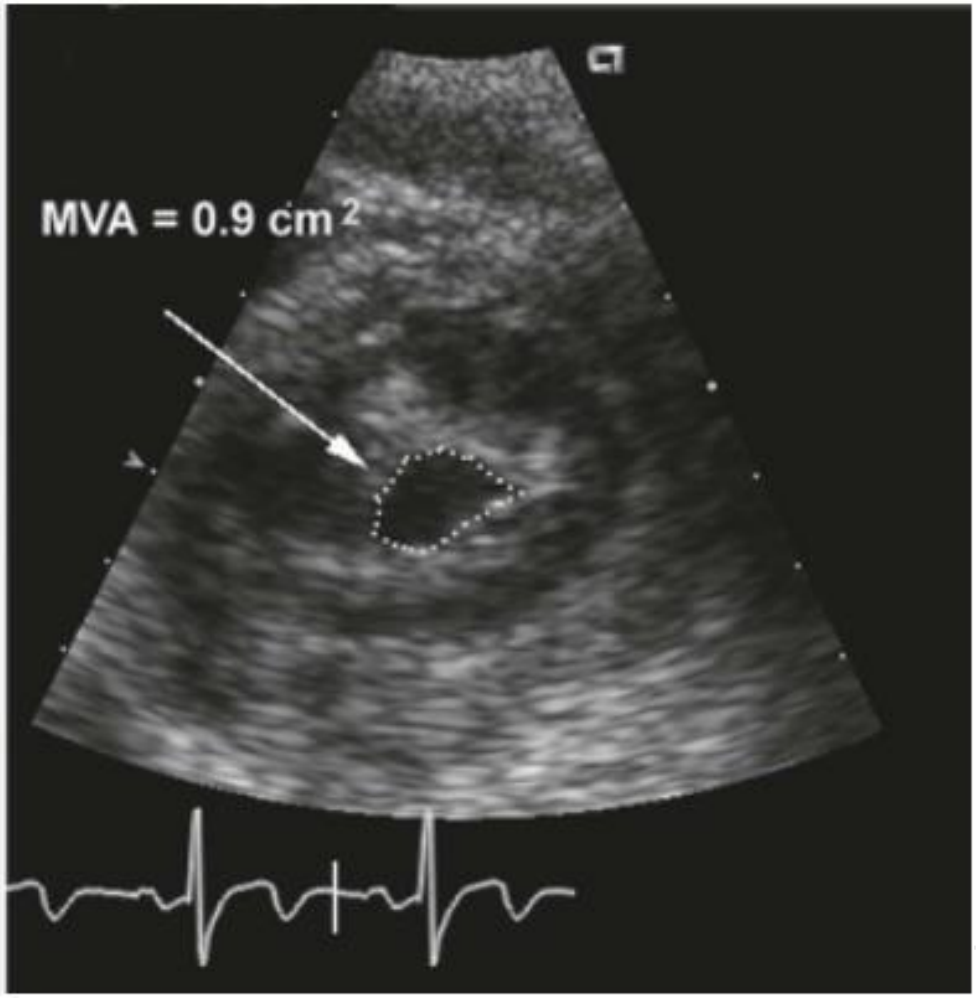
Cardiac Ultrasound mitral stenosis

- The large valve is deformed into a "flexed knee/golf club" separated from the small valve by a reduced orifice.
- The small valve is retracted, with little or no movement.
- The subvalvular apparatus is altered with dense echoes of the cordae, sometimes fused into a fibrous or fibro-calcareous mass.
- Dilated left atrium, possible site of thrombus.

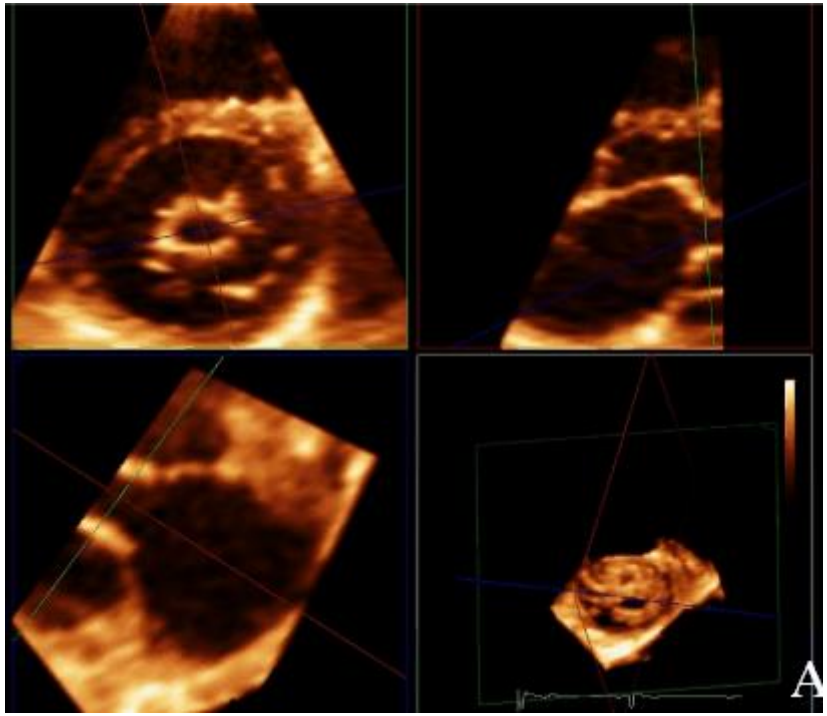


Planimetry ultrasound mitral stenosis

Classical 2D Ultrasound



3D Ultrasound



Doppler mitral stenosis

- Transmitral flow is used to calculate the transmitral gradient
- Mitral flow decay slope (pressure half time PHT) allows estimation of the mitral surface

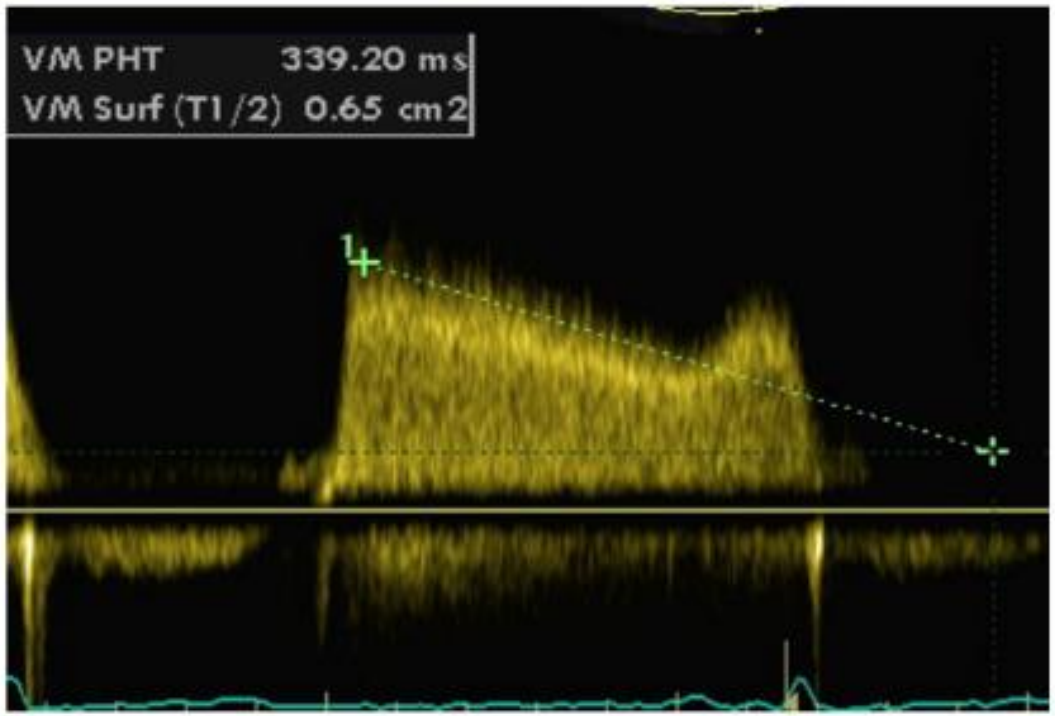


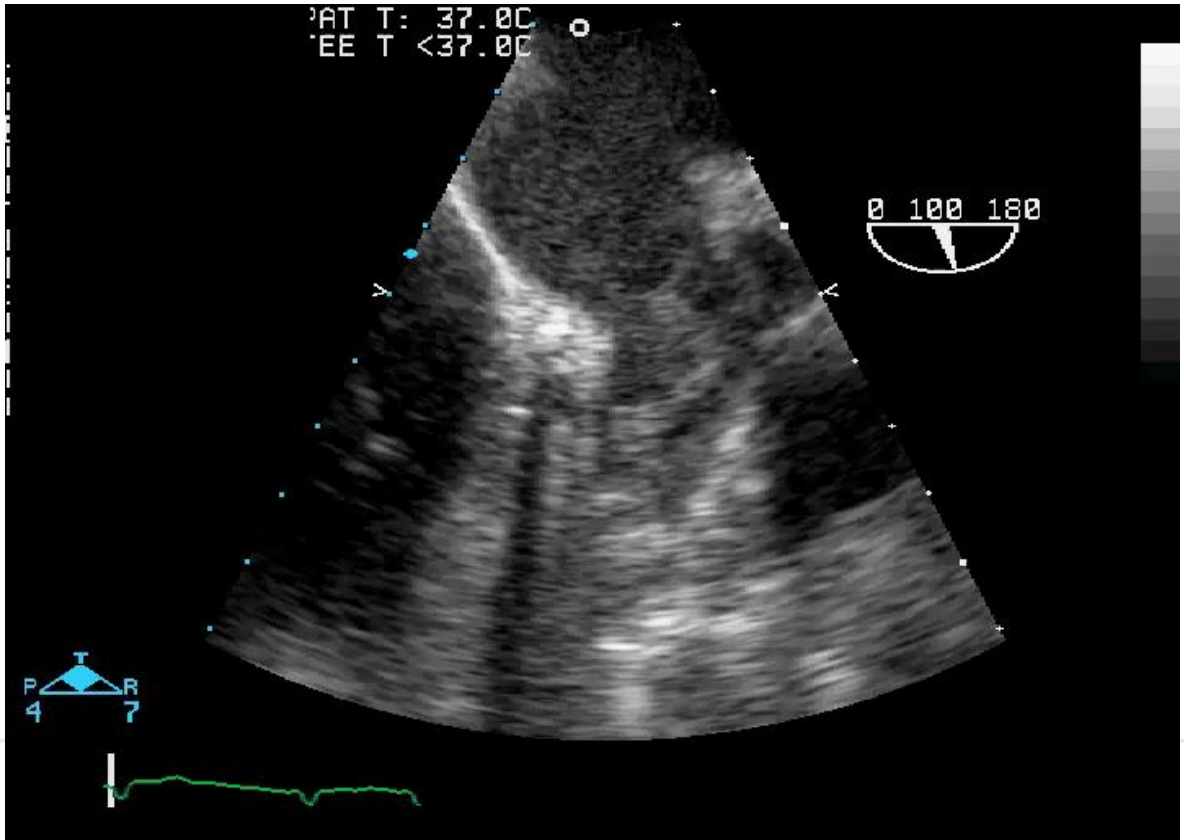
Figure 5. Mesure de la surface mitrale par le PHT.

Mitral stenosis

- **Transesophageal echocardiography (TEE):**

Essentially to look for a possible left atrial/appendage thrombus.

For therapeutic purposes during percutaneous mitral dilatation.



Mitral stenosis

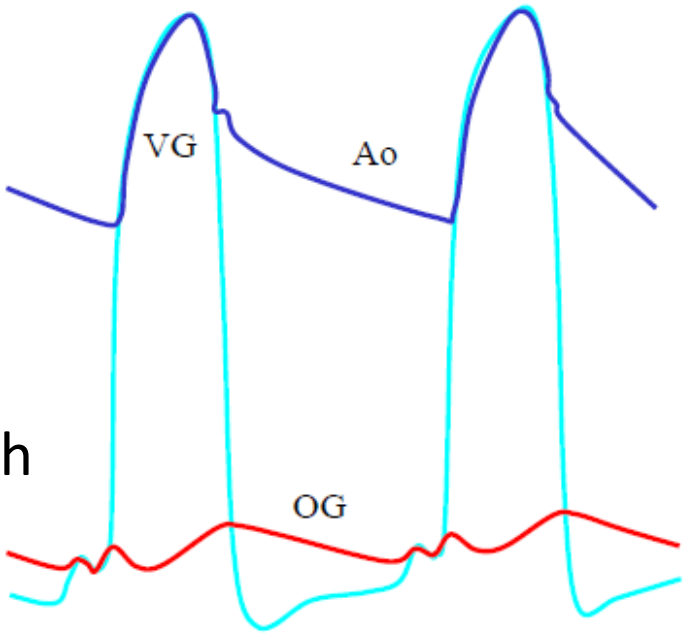
Echocardiography can also be used to:

- To look for associated valve involvement (MR, aortic valve disease..)
- Repercussions on the right cavities (RV expansion, functional TR)
- Assessing the degree of PAH
- Estimate the technical feasibility of possible percutaneous mitral dilation (Wilkins score):
  - Mobility, thickening, calcifications…

Mitral stenosis

Role of cardiac catheterization:

- Exceptionally indicated for diagnostic purposes
- Used to measure the LA-LV diastolic gradient
- Measuring pulmonary pressures
- Coronary angiography is part of the preoperative assessment in patients with cardiovascular risk factors who have an indication for surgical mitral valve replacement.



Mitral Stenosis: Complications

Complications can reveal the disease:

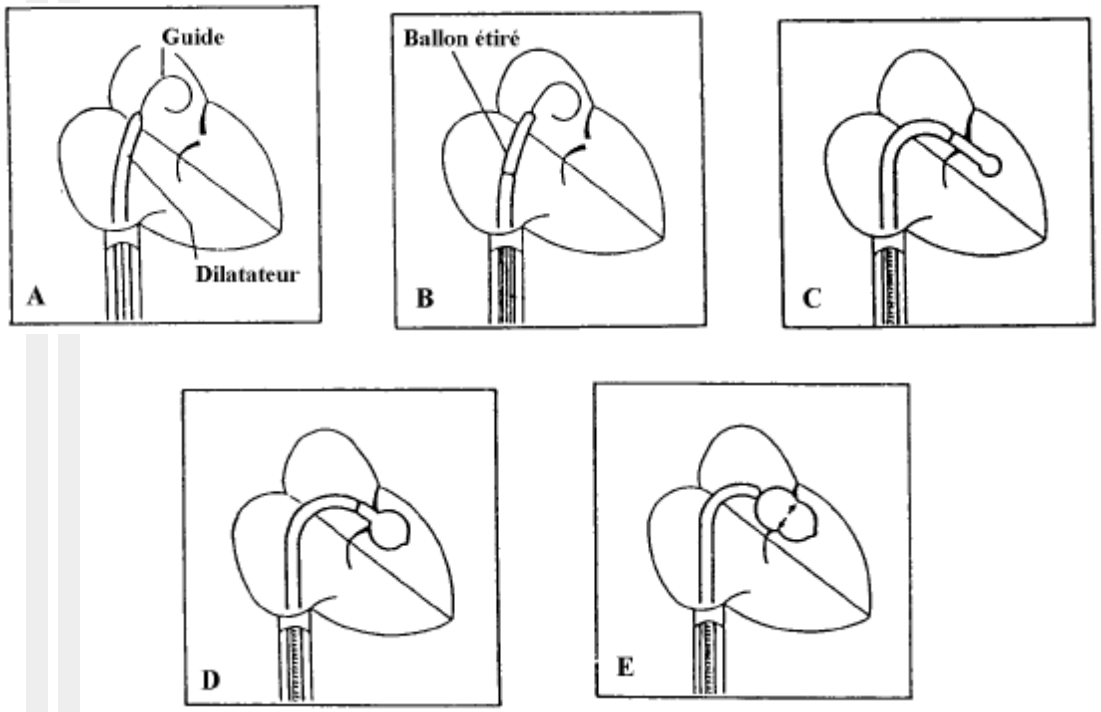
- ***Thromboembolic complications***
  - mainly cerebral (especially when returning to sinus rhythm after AFib)
- ***Rhythmic complications:*** Atrial fibrillation
- ***Pulmonary complications***: Acute pulmonary edema, hemoptysis, recurrent pneumonia.
- ***Hemodynamic complications:*** Right HF.
- ***Infectious complications:*** endocarditis (rare).

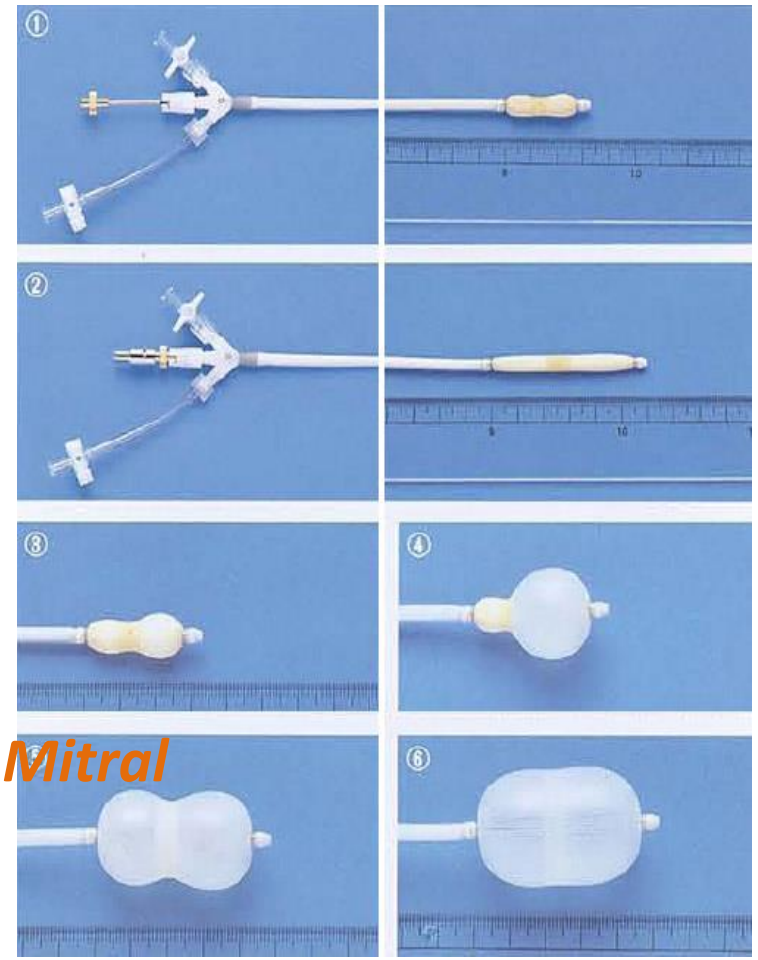
Treatment of mitral stenosis

Medical treatment: palliative, treating complications:

- Diuretics if left cardiac decompensation.
- VKA if fibrillation or thromboembolic complications (target INR = 3).
- Slowing down rapid AFib (digitalis, amiodarone, b-blockers, verapamil...)
- Cardioversion of AFib (after confirmation of absence of LA thrombus)
- RF prophylaxis
- Antibiotic prophylaxis for infective endocarditis is no longer indicated

Percutaneous mitral dilation of MS

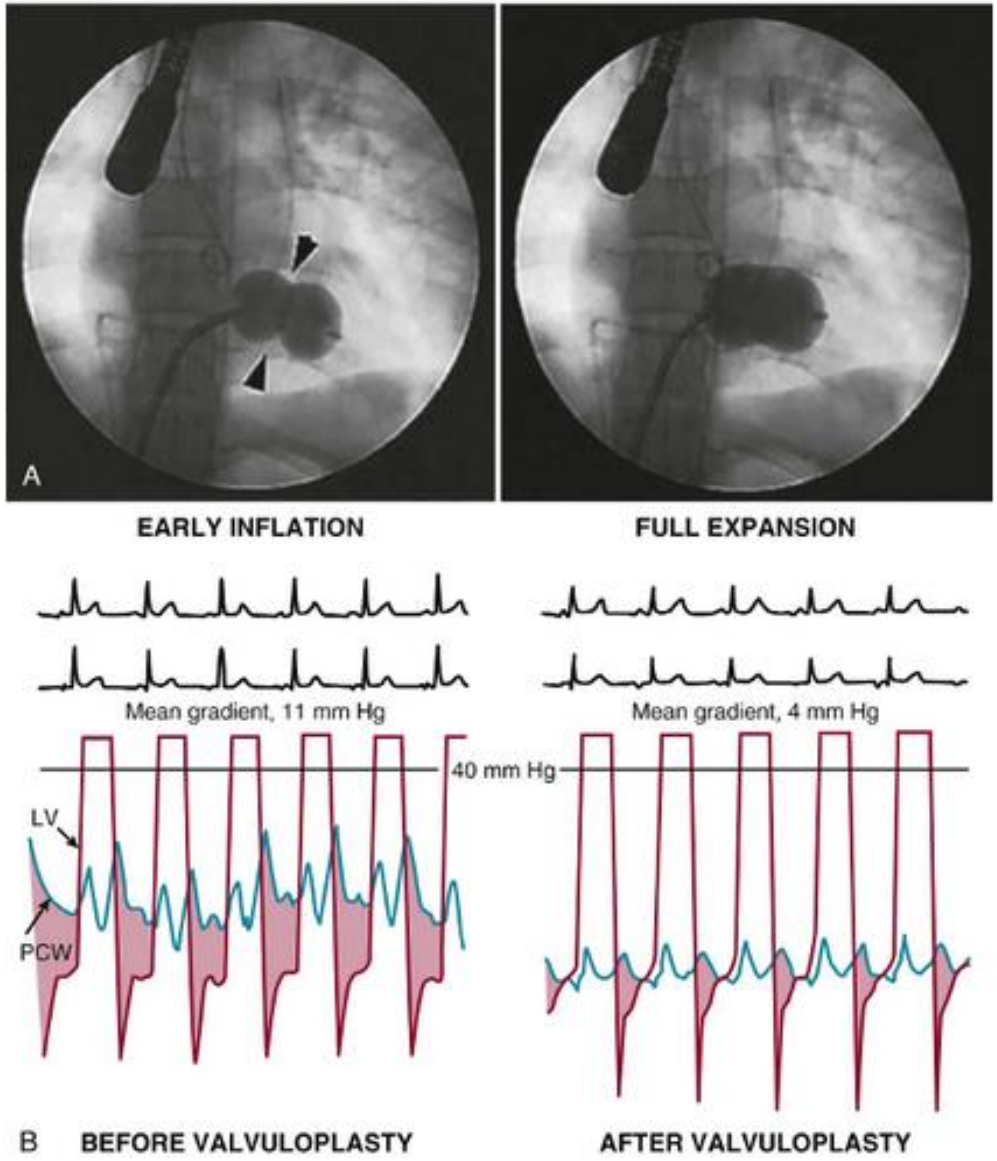


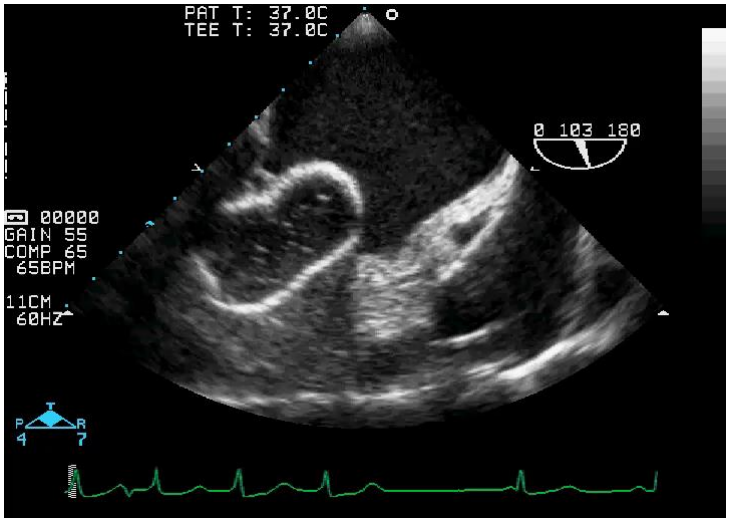


Reference Curative Treatment of Tight Mitral Stricture

- Common femoral vein access
- Transseptal Catheterization
- Progressive inflation of the Inoué balloon (TEE))

Percutaneous mitral dilation of MS





Surgical Treatment of Mitral Stenosis

Conservative

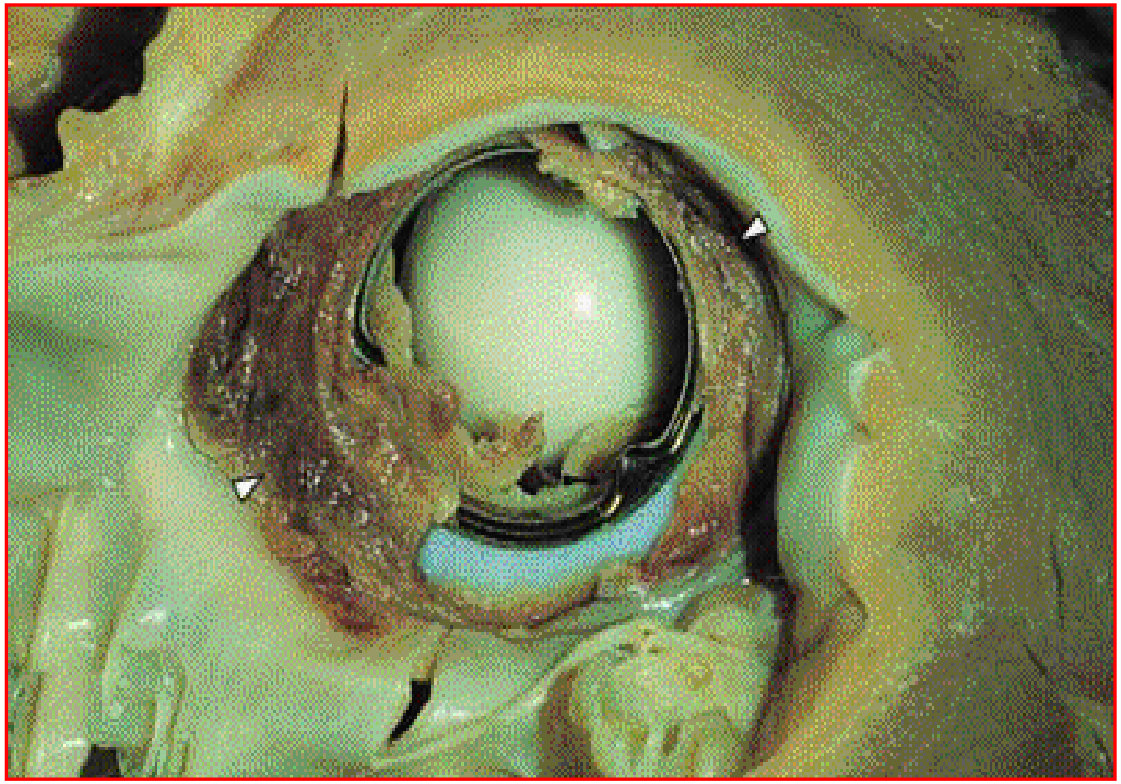
Open-heart commissurotomy in relatively young patients with a contraindication to percutaneous mitral dilation due to unfavorable anatomy of the valvular system

Radical with surgical mitral valve replacement

- If contraindicated to percutaneous dilation or correction of other valvular heart or coronary artery disease
- Mechanical prosthesis (age < 65 years): requires anticoagulation
- Biological prosthesis if age > 65, especially if permanent sinus rhythm.

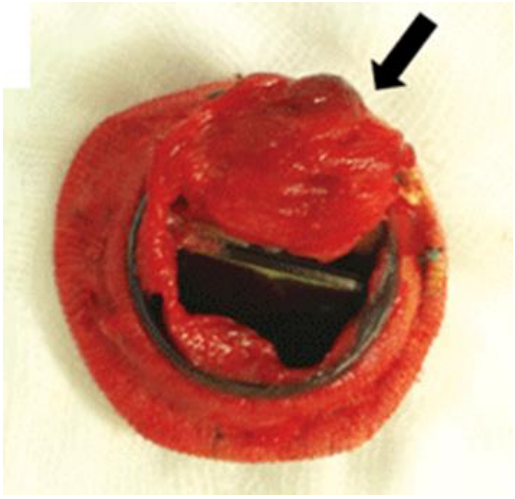
Complications of prosthetic valves

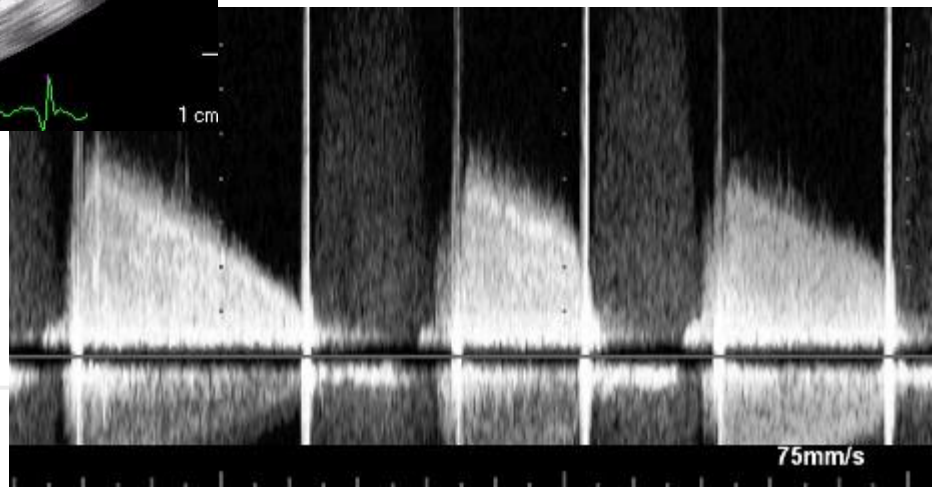
Obstructive thrombosis



Complications of prosthetic valves

Systemic embolisms





Prosthetic valves

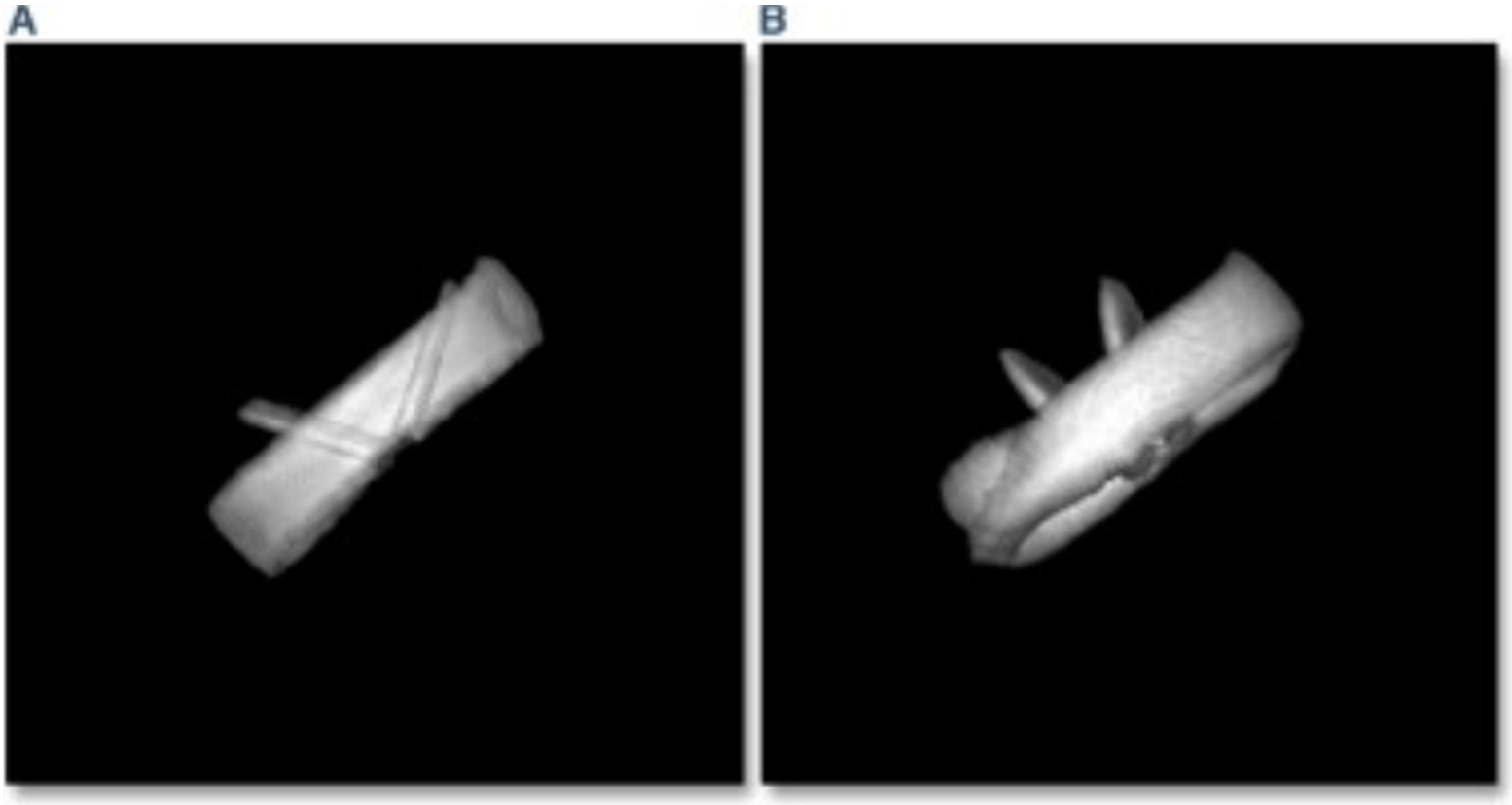
Evaluation of disc movements by CT scan

CT

Reduced discs opening due to thrombosis

CT

Improvement of discs motion after thrombolysis



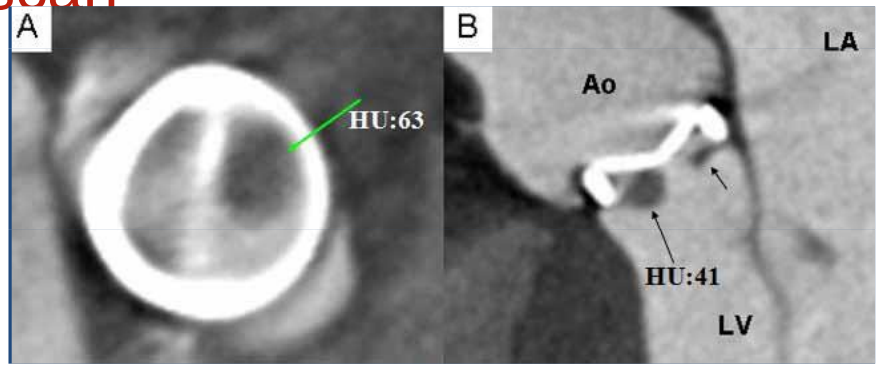
J Am Coll Cardiol Img. 2012;5(9):956-961

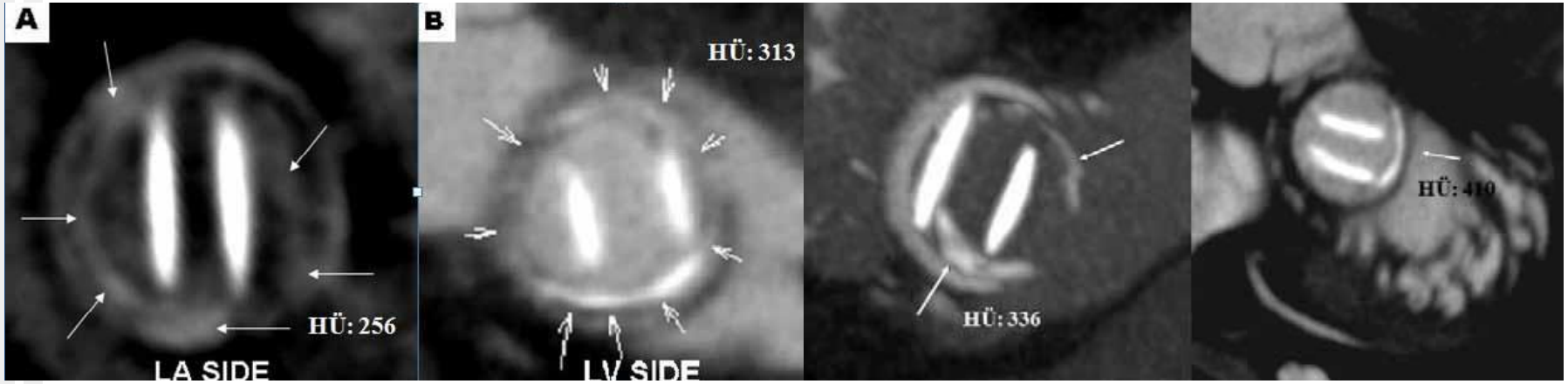
Prosthetic valves

Pannus vs Thrombus Evaluation on Prosthesis with CT-scan

CT

- **Thrombus: low tomographic density (< 150 HU)**
- **Pannus: high density (> 200 HU)**





Biteker, AJR 2008
Gunduz, Circ 2008
Ozkan, Eur Radiol 2009

Prosthetic valves

Postoperative biological monitoring

Discontinuation of anticoagulant therapy:

Anticoagulant therapy should never be interrupted, Unless immediate life-threatening haemorrhage.

Reversal of AVK required with administration of fresh plasma and vitamin K(0,5 à 2 mg).

Tooth extraction: outpatient treatment with INR between 2 and 2,5.

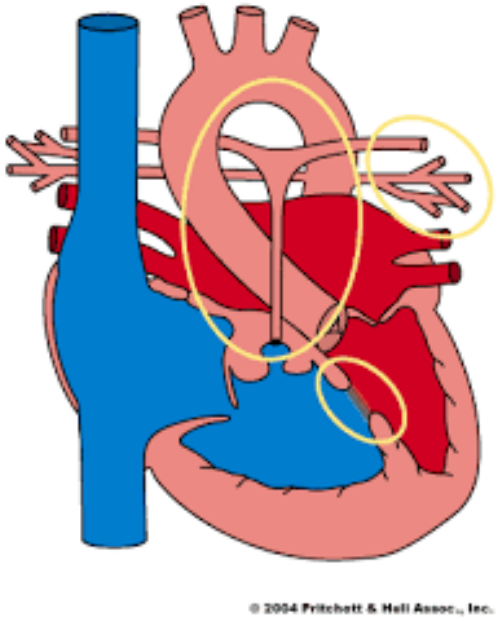
Extracardiac surgery: VKA discontinuation to achieve INR of 1 and unfractionated heparin is given for APP x 2

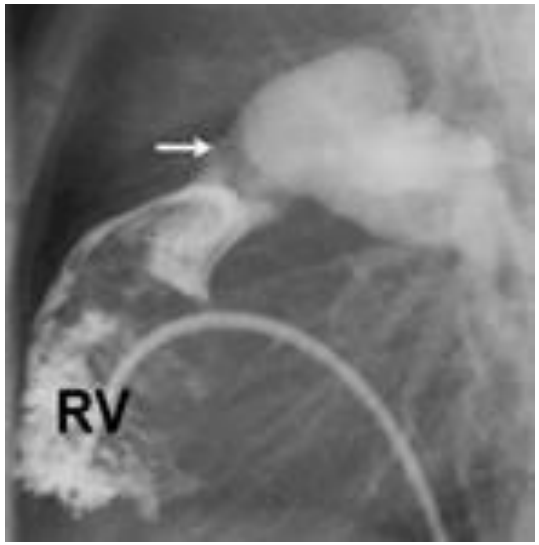
Pulmonary valve stenosis

Birth defect

Moderate: no symptoms, auscultatory murmur children

Tight stenoses treated by percutaneous dilation





Pulmonary valve regurgitation

Trace PR exists in almost everyone on TTE

Important PR are secondary to:

- surgery (tetralogy of Fallot)
- PAH
- Endocarditis
- Carcinoid syndrome

Clinically: left lower sternal border diastolic murmur, P2 increased

Causal treatment

Prognosis depends on etiology

Tricuspid stenosis

Quite rare, most often in the RF setting with involvement of other valves, especially the mitral.

More rarely: **Carcinoid syndrome**

- **Primary:** carcinoid tumor< serotonin-secreting enterochromaffin (EC) cells. Richly vascularized tumors found in the digestive tract

  Flush on histamine release

  Diarrhea... →metastasis/obstruction

- **Secondary to drugs:**
  - Parkinson's: dopamine agonists, pergolide, cabergoline
  - Weight loss: fenfluramine (serotonergic anorectic withdrawn US market 1997), benfluorex (Mediator)

SIGNS OF RIGHT HEART FAILURE

Increased RV and RA pressures with venous increased pressure and decreased cardiac output responsible for:

- Hepatomegaly, cardiac liver with cytolysis, cholestasis, ± hepatocellular insufficiency
- Hepatojugular reflex + jugular veins distention
- Renal stasis with RAAS activation → fluid retention
- increased hydrostatic pressure with edema of the lower limbs (± pleural effusions ± ascites)

Tricuspid stenosis

Treatment:

Mostly related to that of the mitral valve

(few isolated tricuspid valves are operated)

- Commissurotomy
- Valve Replacement

Tricuspid regurgitation

Definition:

Regurgitation of blood from the right ventricle into the atrium

Etiologies:

The most common: pathology of the left heart with the development of pulmonary hypertension (PAH), dilation of the right ventricle and secondary tricuspid regurgitation

More rarely:

- Ebstein's disease (congenital pathology)
- RF
- Carcinoid syndrome
- endocarditis (drug addicts)

Tricuspid regurgitation

Symptoms:

Well tolerated if no PAH

If PAH: Right Cardiac Decompensation Table with

- Hepatalgia secondary to liver stasis
- Lower limb edema
- Fatigue
- Dyspnea

Clinical signs:

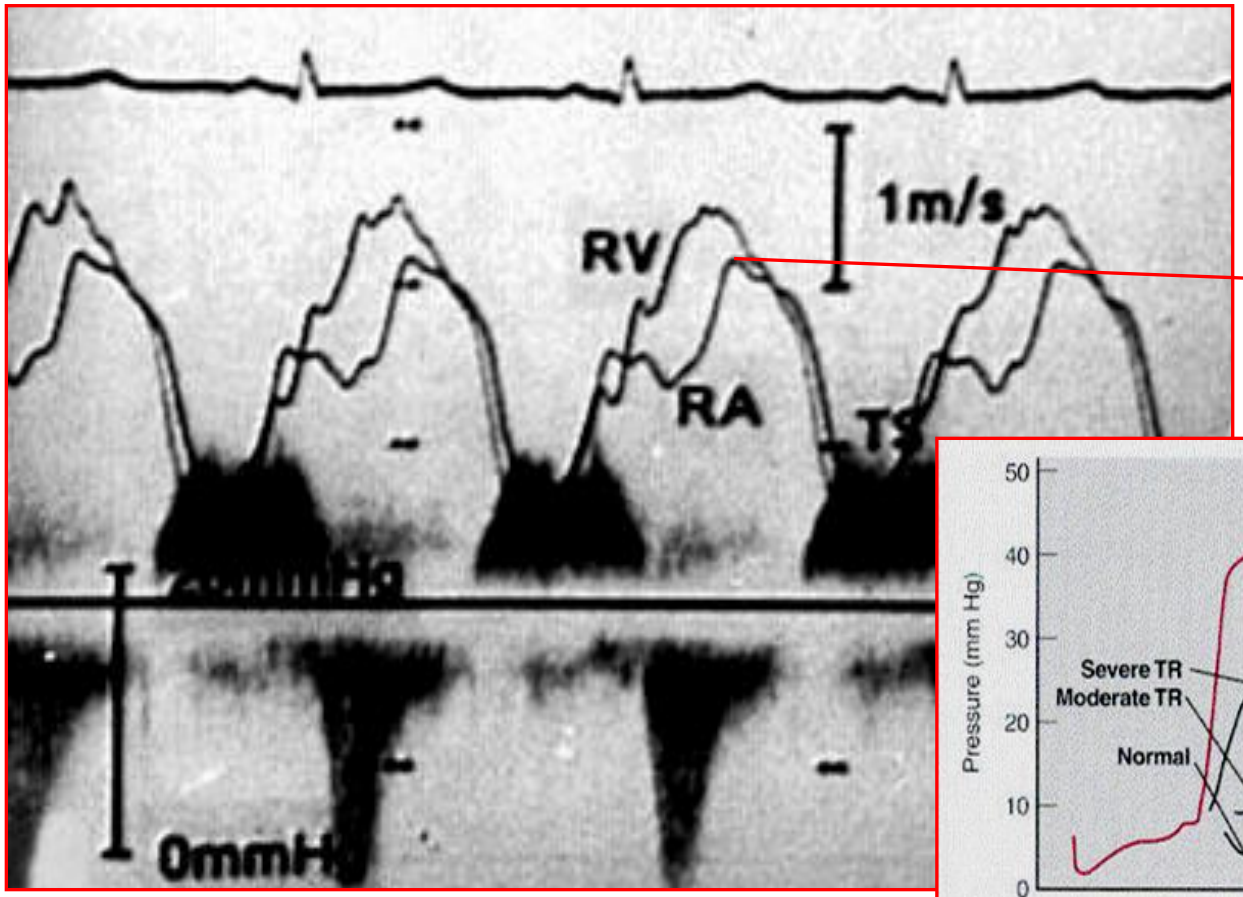
Elevation of jugular pulse

Holosystolic murmur and S2 accentuation

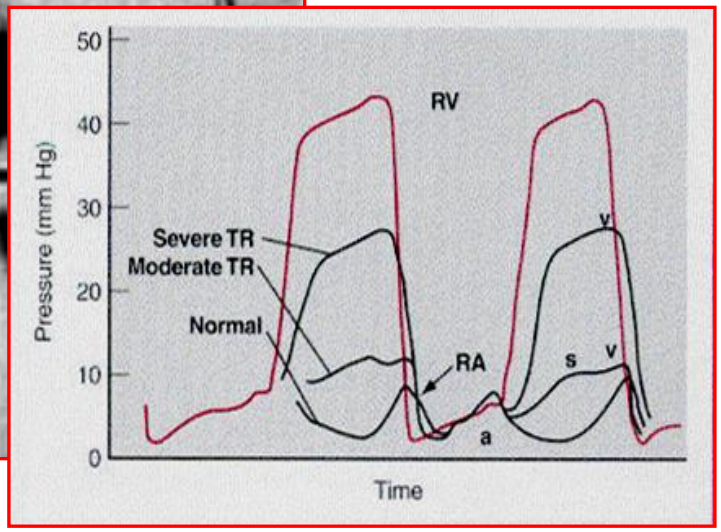
Respiratory variations

S3

Tricuspid regurgitation



V-wave



RA: Right atrium

RV: Right ventricule

Tricuspid regurgitation

Prognosis:

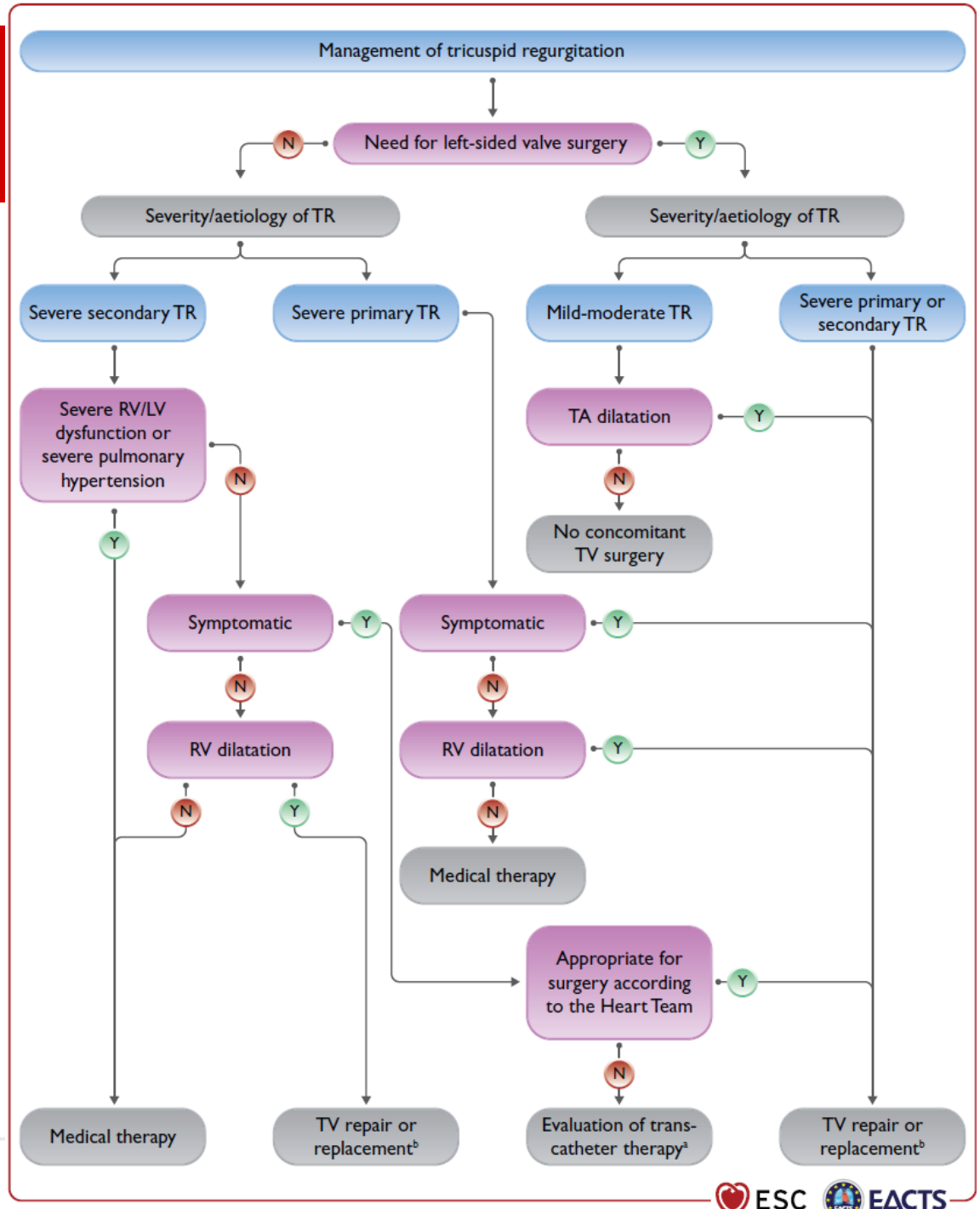
Depends on the underlying pathology causing the TR

Treatment:

Annuloplasty of tricuspid valve associated with Ao/Mi repair

If:

- Severe TR (echo quantification)
- symptomatic
- asymptomatic with RV dysfunction


Management of tricuspid regurgitation
Need for left-sided valve surgery
N
Y
Severity/aetiology of TR
Severity/aetiology of TR
Severe secondary TR
Severe primary TR
Mild-moderate TR
Severe primary or secondary TR
Severe RV/LV dysfunction or severe pulmonary hypertension
TA dilatation
No concomitant TV surgery
Symptomatic
Symptomatic
RV dilatation
RV dilatation
Medical therapy
Appropriate for surgery according to the Heart Team
Medical therapy
TV repair or replacement[b]
Evaluation of trans-catheter therapy[a]
TV repair or replacement[b]

Tricuspid regurgitation

Transcatheter Repair for Patients with Tricuspid Regurgitation

Paul Sorajja, M.D., Brian Whisenant, M.D., Nadira Hamid, M.D., Hursh Naik, M.D., Raj Makkar, M.D., Peter Tadros, M.D., Matthew J. Price, M.D., Gagan Singh, M.D., Neil Fam, M.D., Saibal Kar, M.D., Jonathan G. Schwartz, M.D., Shamir Mehta, M.D., Richard Bae, M.D., Nishant Sekaran, M.D., Travis Warner, M.D., Moody Makar, M.D., George Zorn, M.D., Erin M. Spinner, Ph.D., Phillip M. Trusty, Ph.D., Raymond Benza, M.D., Ulrich Jorde, M.D., Patrick McCarthy, M.D., Vinod Thourani, M.D., Gilbert H.L. Tang, M.D., Rebecca T. Hahn, M.D., and David H. Adams, M.D., for the TRILUMINATE Pivotal Investigators*

ABSTRACT

BACKGROUND

Severe tricuspid regurgitation is a debilitating condition that is associated with substantial morbidity and often with poor quality of life. Decreasing tricuspid regurgitation may reduce symptoms and improve clinical outcomes in patients with this disease.

METHODS

We conducted a prospective randomized trial of percutaneous tricuspid transcatheter edge-to-edge repair (TEER) for severe tricuspid regurgitation. Patients with symptomatic severe tricuspid regurgitation were enrolled at 65 centers in the United States, Canada, and Europe and were randomly assigned in a 1:1 ratio to receive either TEER or medical therapy (control). The primary end point was a

RESULTS

A total of 350 patients were enrolled; 175 were assigned to each group. The mean age of the patients was 78 years, and 54.9% were women. The results for the primary end point favored the TEER group (win ratio, 1.48; 95% confidence interval, 1.06 to 2.13; P=0.02). The incidence of death or tricuspid-valve surgery and the rate of hospitalization for heart failure did not appear to differ between the

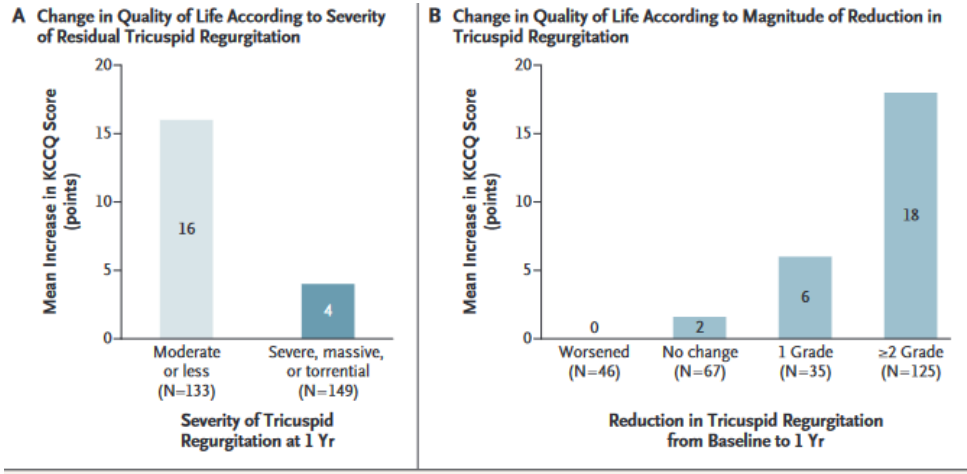
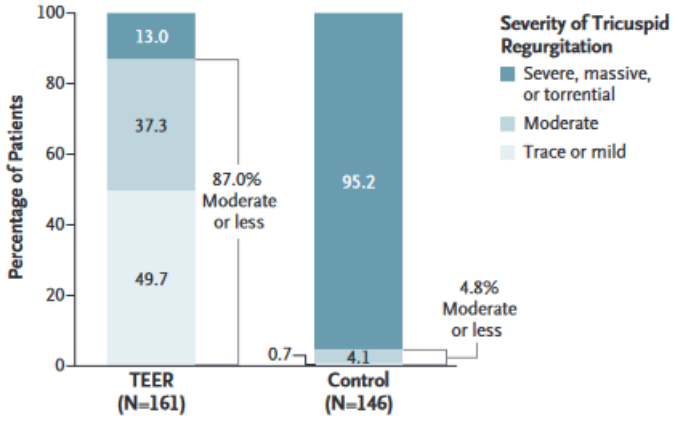


Figure 2. Changes in Quality of Life from Baseline to 1 Year, Stratified According to the Severity of Residual Tricuspid Regurgitation and the Magnitude of the Reduction in Tricuspid Regurgitation.



Severity of Tricuspid Regurgitation at 30 Days.

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