

Valvular Heart Diseases

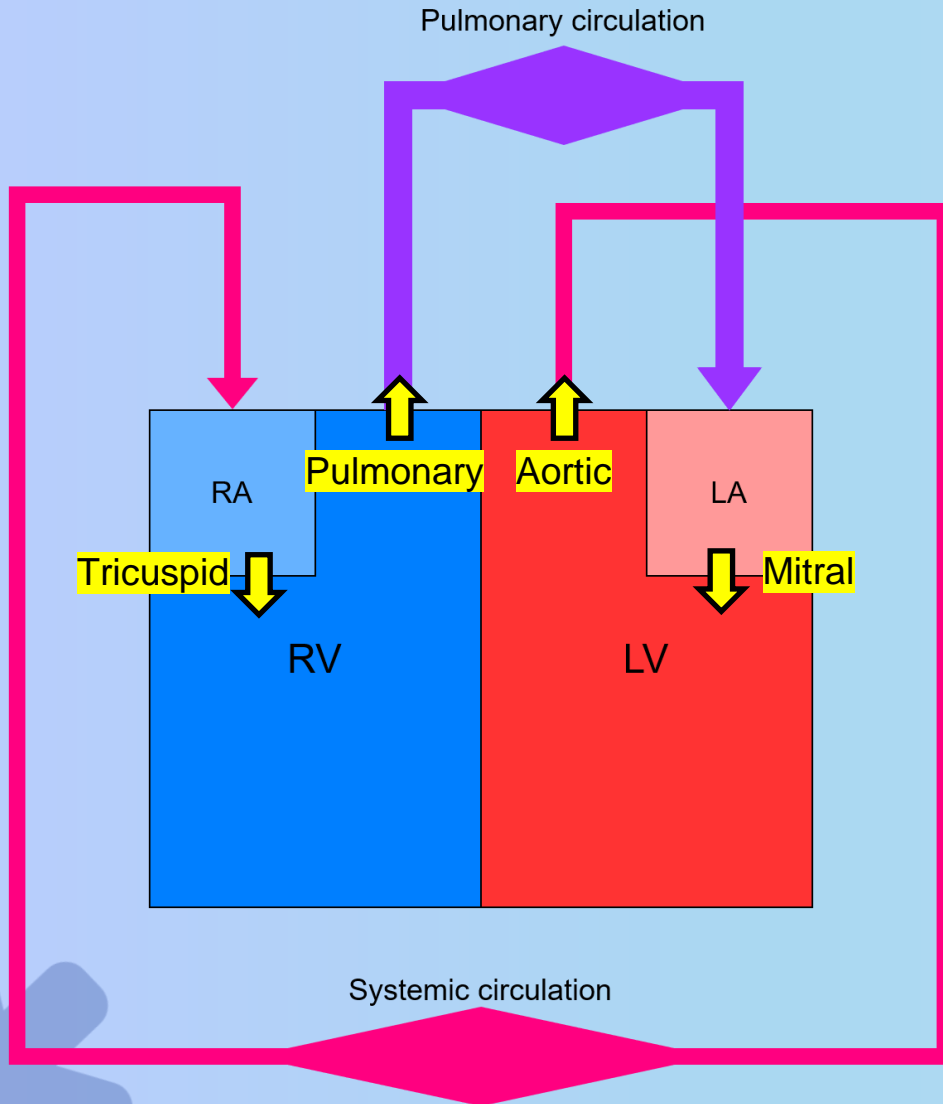
By Jakub Staniszewski

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- Normal valve functions
- Cardiac cycle (Pressure Volume Loop)
- Valve dysfunction
- Cardiac adaptations
- The valve defects
 - Aortic stenosis/regurgitation
 - Mitral stenosis/regurgitation
- Common causes of valve disease
 - Floppy
 - Stiff



Normal Valve Functions



- Valves only need to do two things correctly:
 - Allow adequate blood flow in the correct direction
 - Prevent backward blood flow
- AV valves:
 - Tricuspid = 3 leaflets
 - Mitral = 2 leaflets
 - Have chordae tendinae (derived from myocardium); supportive cords attached to papillary muscles.
- Semilunar valves: 3 crescent cusps.

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Normal Cardiac Cycle

Pressure Volume Loop

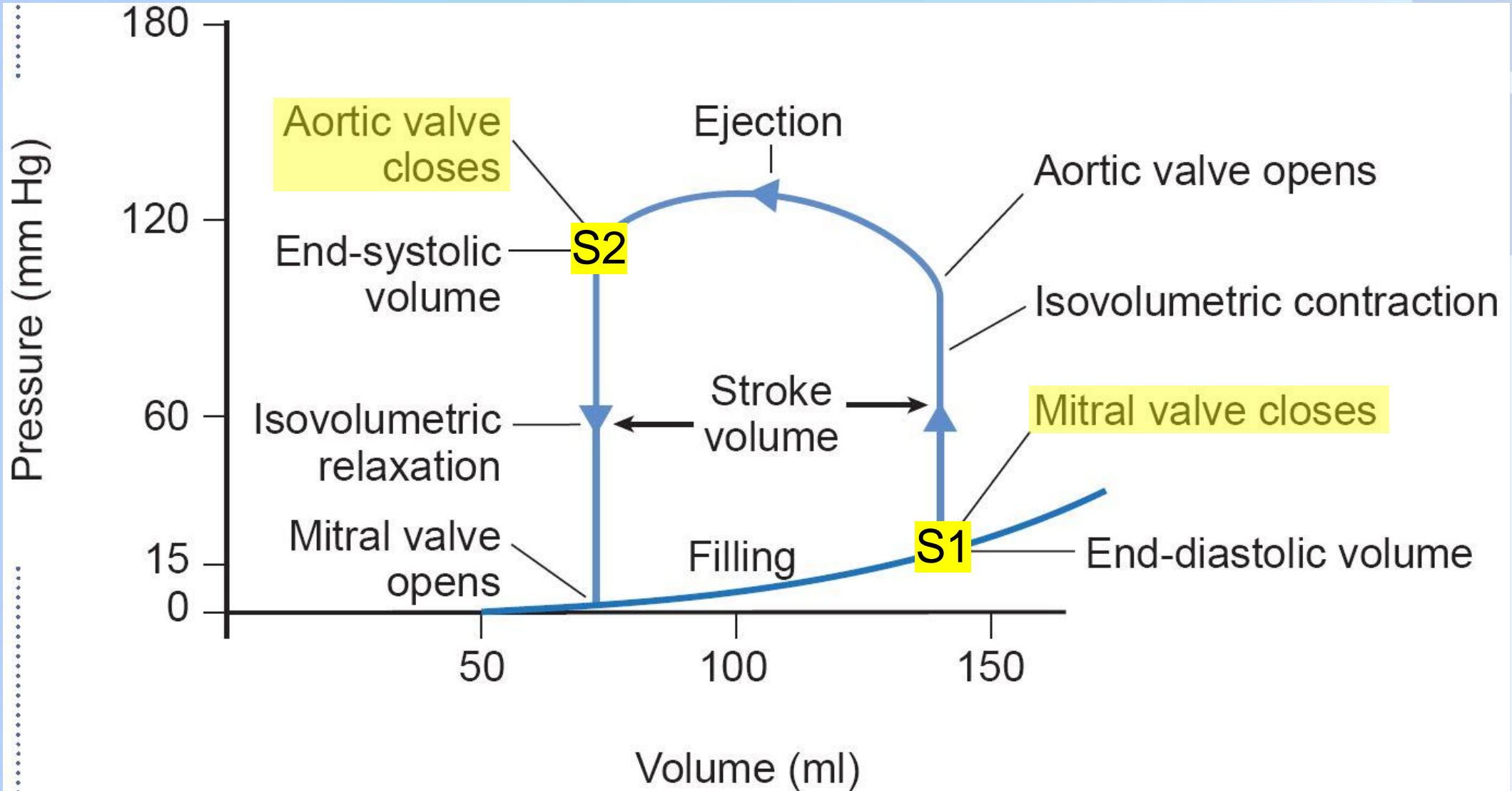


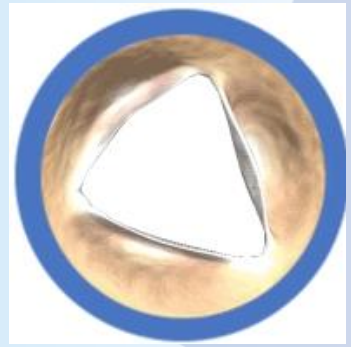
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Valve dysfunction



Stenosis

- Smaller cross sectional area of valve, decreased rate of flow across valve.
- Pressure overload occurs in the prior chamber.
- Creates a murmur due to turbulent flow across the valve.
- Chronic valve disease, or
- Can occur due to LVOTO (left ventricle outflow tract obstruction).

Regurgitation

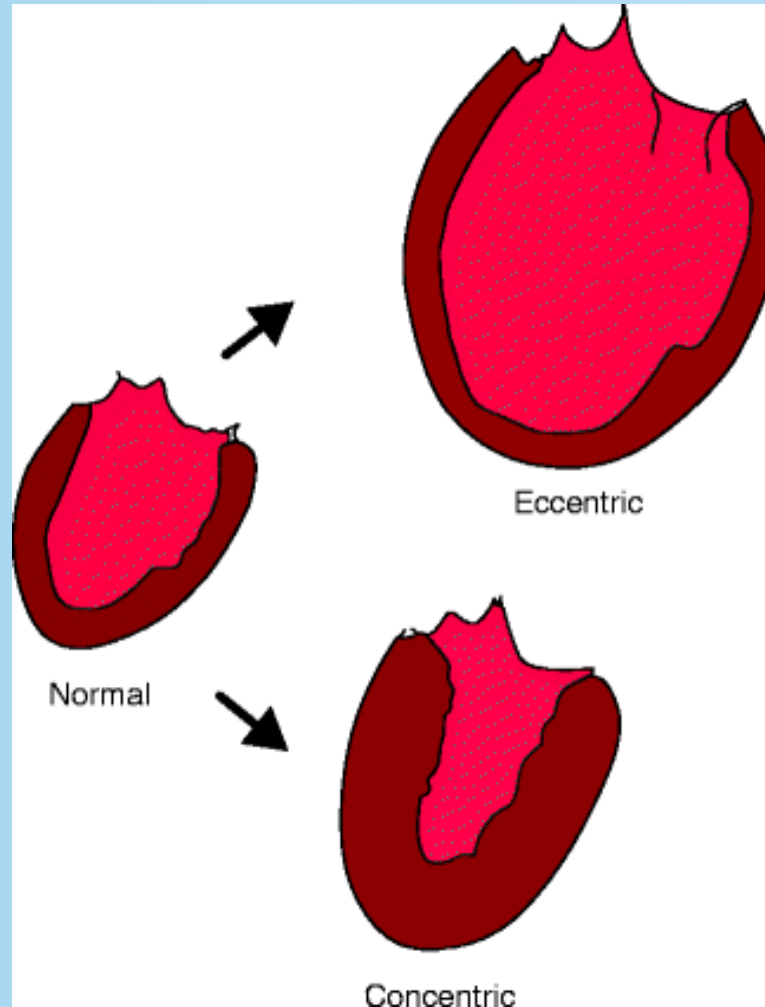
- The valve does not close fully, blood flows backwards.
- Volume overload occurs in the prior chamber.
- Creates a murmur due to turbulent flow.
- Can be acute or chronic valve disease.
- Can occur due to chamber dilation which stretches the valve.

Cardiac adaptations

Valve Stenosis

Pressure overload

Concentric
hypertrophy



Valve
Regurgitation

Volume overload

Eccentric
hypertrophy

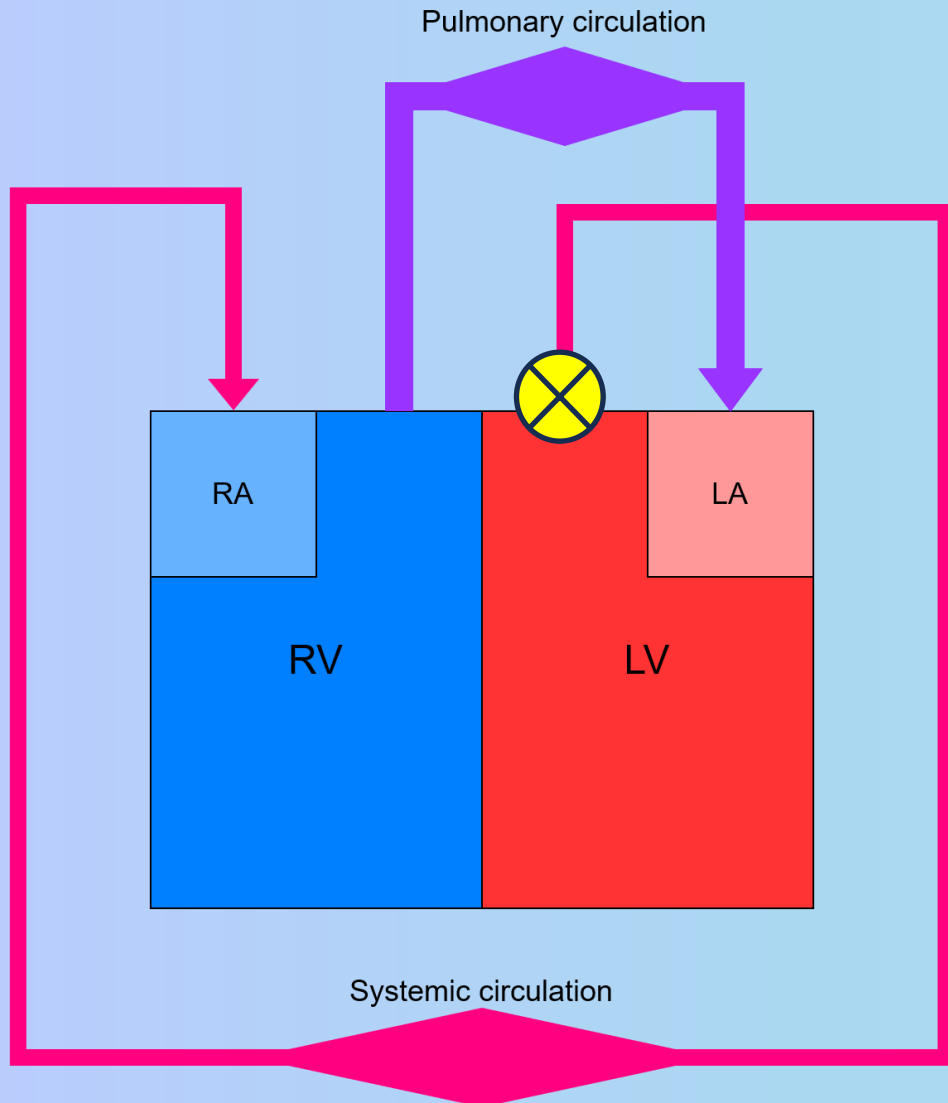
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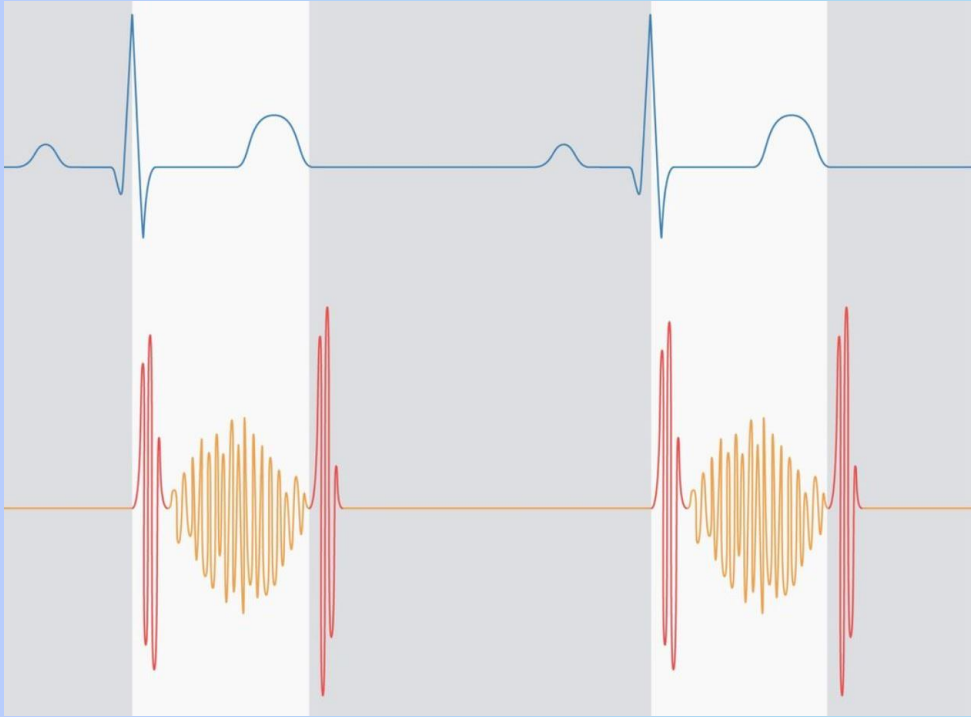
Aortic Stenosis

$$SV = EDV - ESV$$

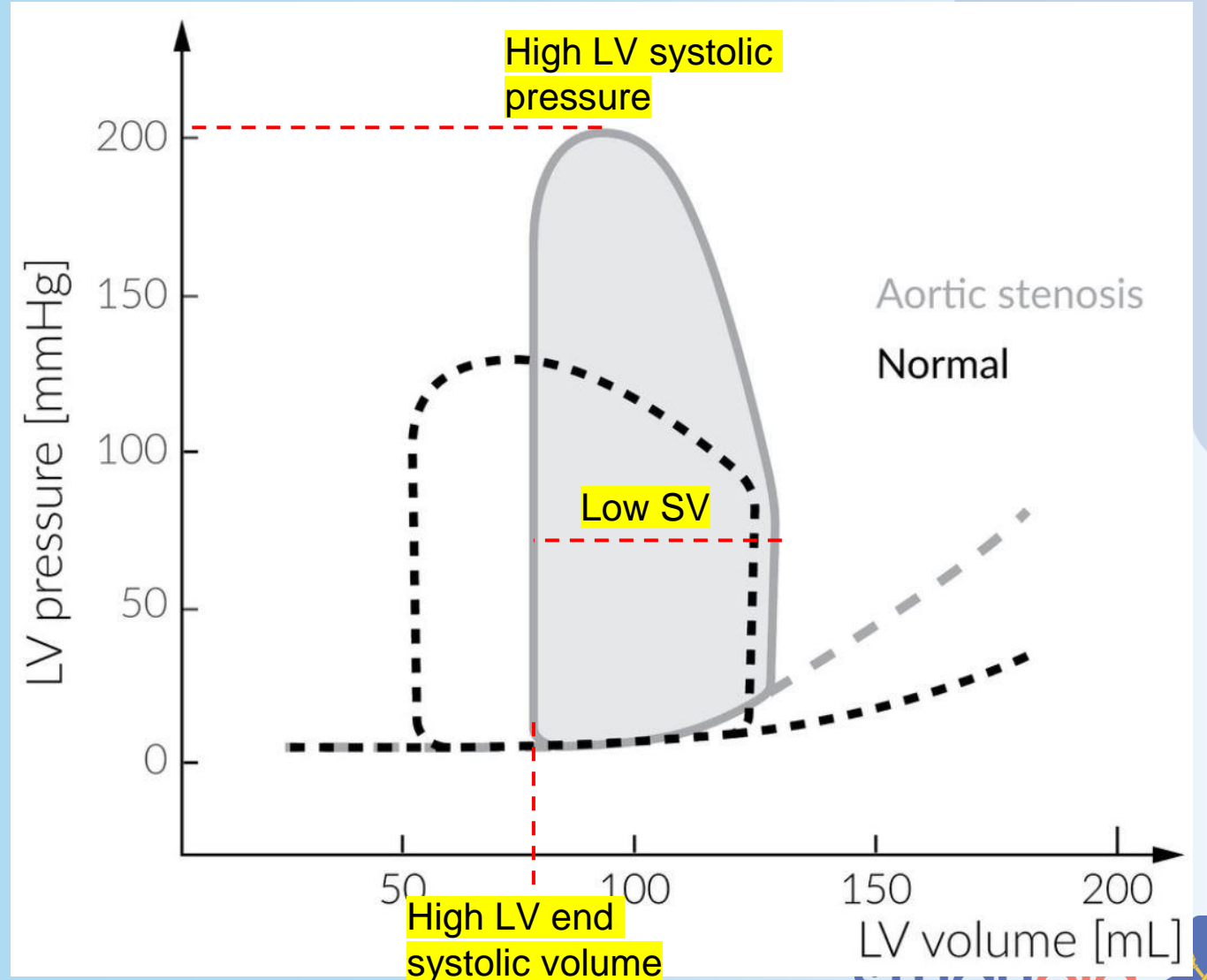


- Blood leaving the left ventricle during systole is obstructed by the stenotic aortic valve.
- LV pressure > Aortic pressure in systole.
- The LV must work harder to push blood into aorta.
- Higher EDV means a lower stroke volume.
- **Weaker and delayed distal pulses (pulsus parvus et tardus).**
- LV compensates with concentric hypertrophy.
- Presents with **SAD: syncope, angina, dyspnea.**

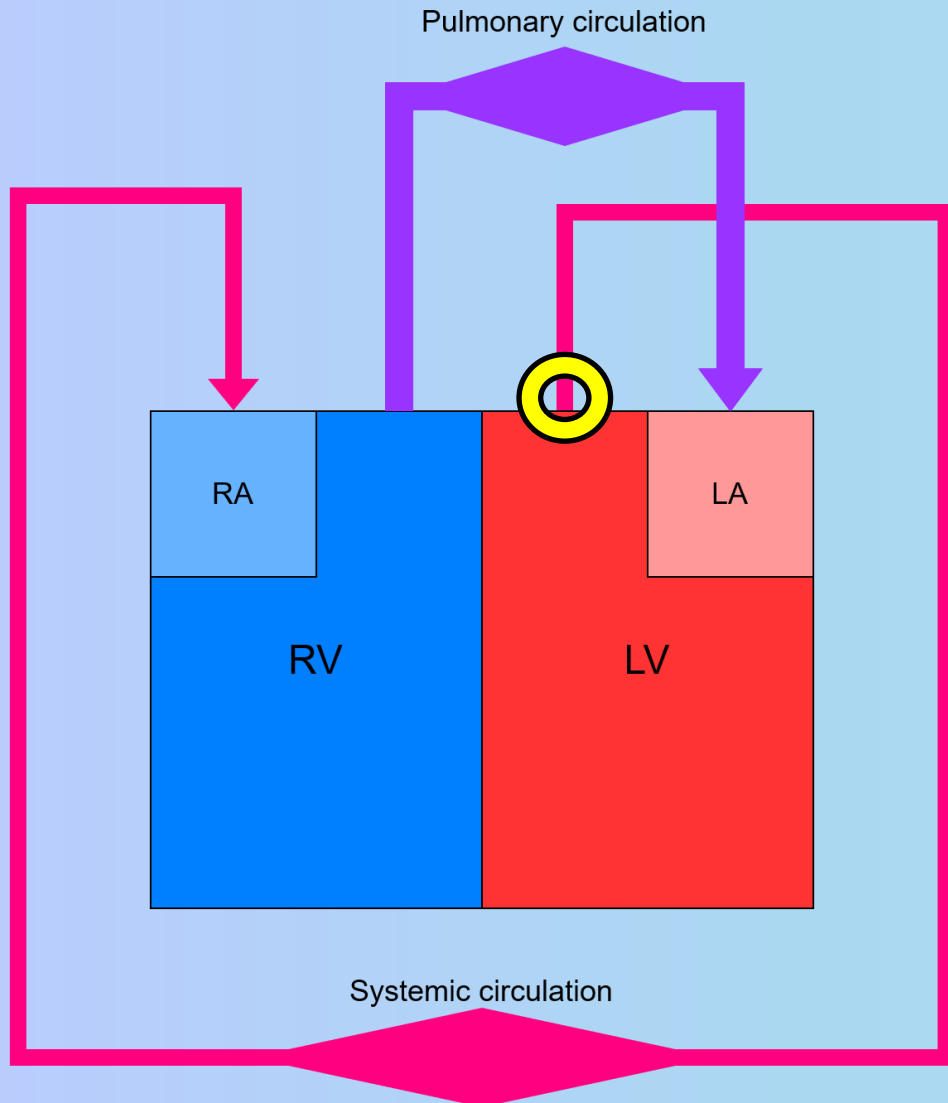
Aortic Stenosis



- Harsh crescendo-decrescendo, late systolic ejection murmur.
- Radiates to both carotids
- Handgrip decreases murmur intensity (afterload)



Aortic Regurgitation



- Blood returns to the LV during diastole through the regurgitant aortic valve.
- In diastole, the LV fills with both blood from the left atrium and regurgitant blood.
- This creates a much higher EDV. **Higher SV.**
- LV compensates with eccentric hypertrophy.
- Pressure backs up into the pulmonary circulation.

Aortic Regurgitation

Clinical features

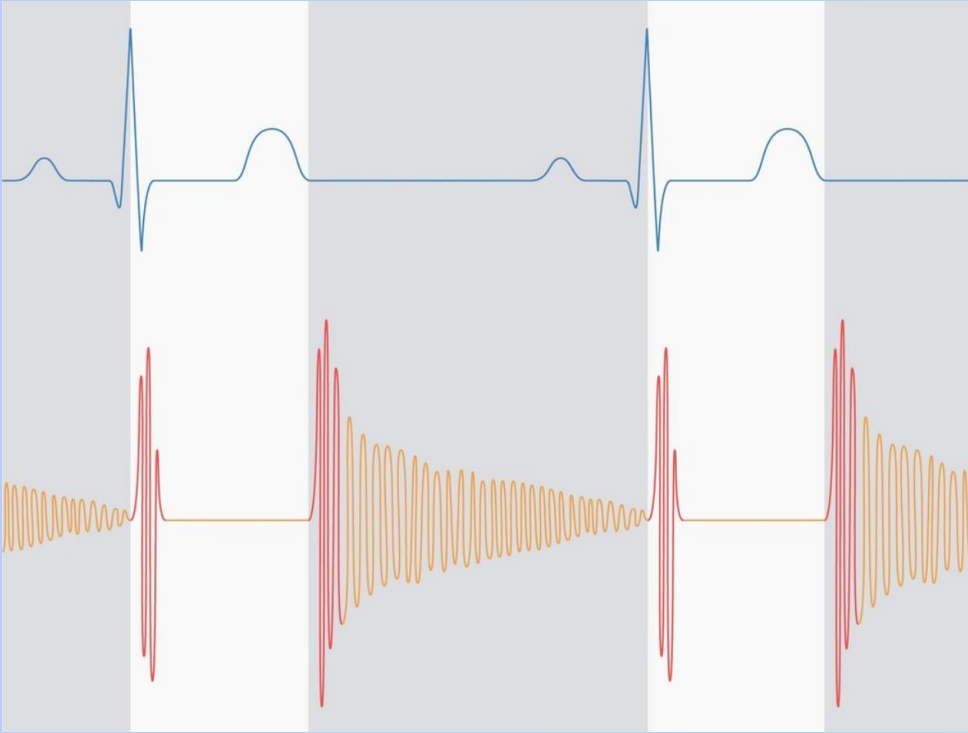
Acute AR

- Rapid congestion of pulmonary vessels
- Fluid builds in the lungs
- Presents as sudden severe dyspnea
- **Pulmonary edema**

Chronic AR

- Asymptomatic for a long time as LV compensates
- **Water hammer pulse** (high pulse pressure)
- Signs of **left heart failure**
 - Exertional dyspnea
 - Angina, Syncope

Aortic Regurgitation



- High-pitch, blowing, decrescendo early diastolic murmur
- Worsens with handgrip (afterload)
- S3 is a sign of volume overload

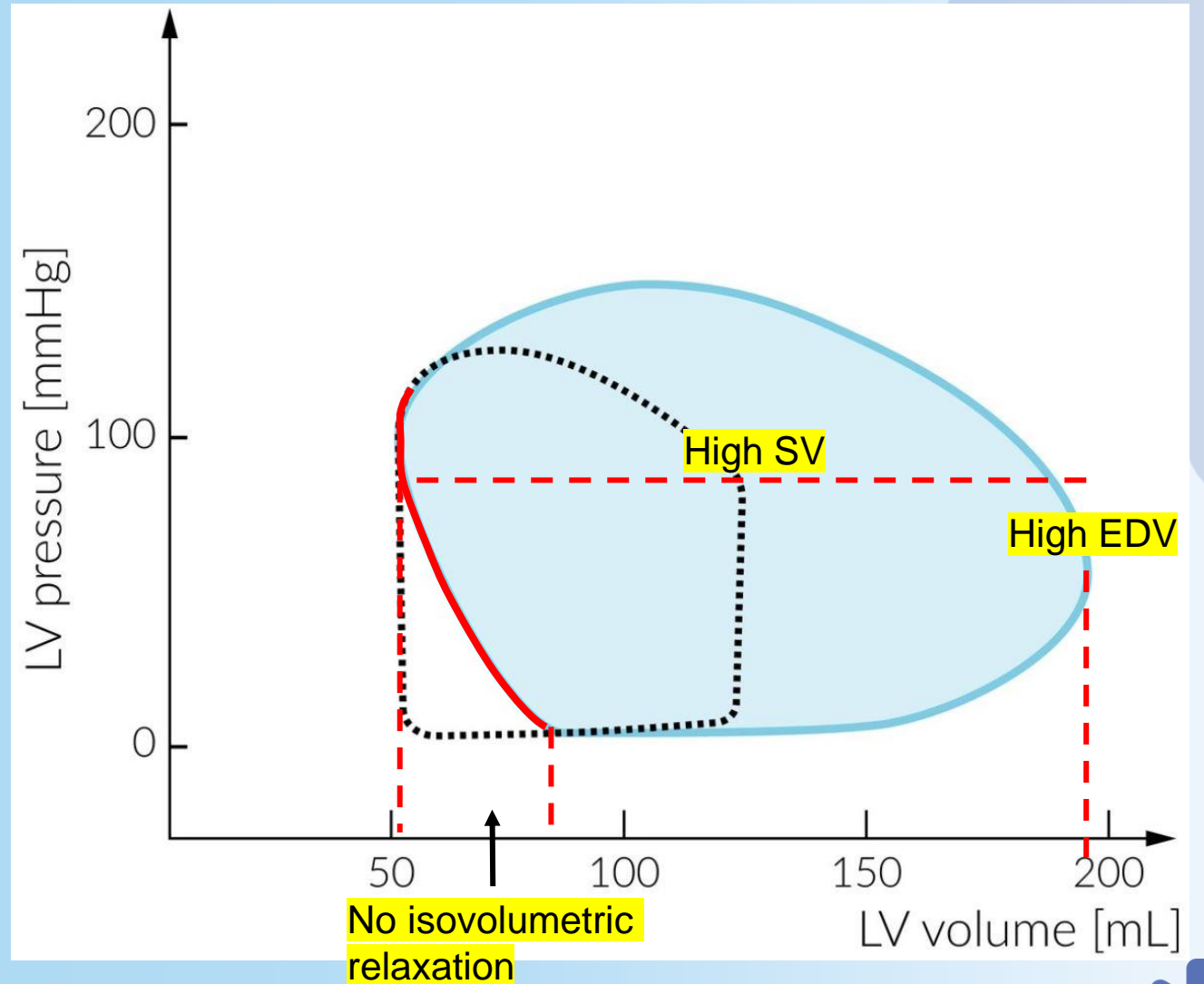


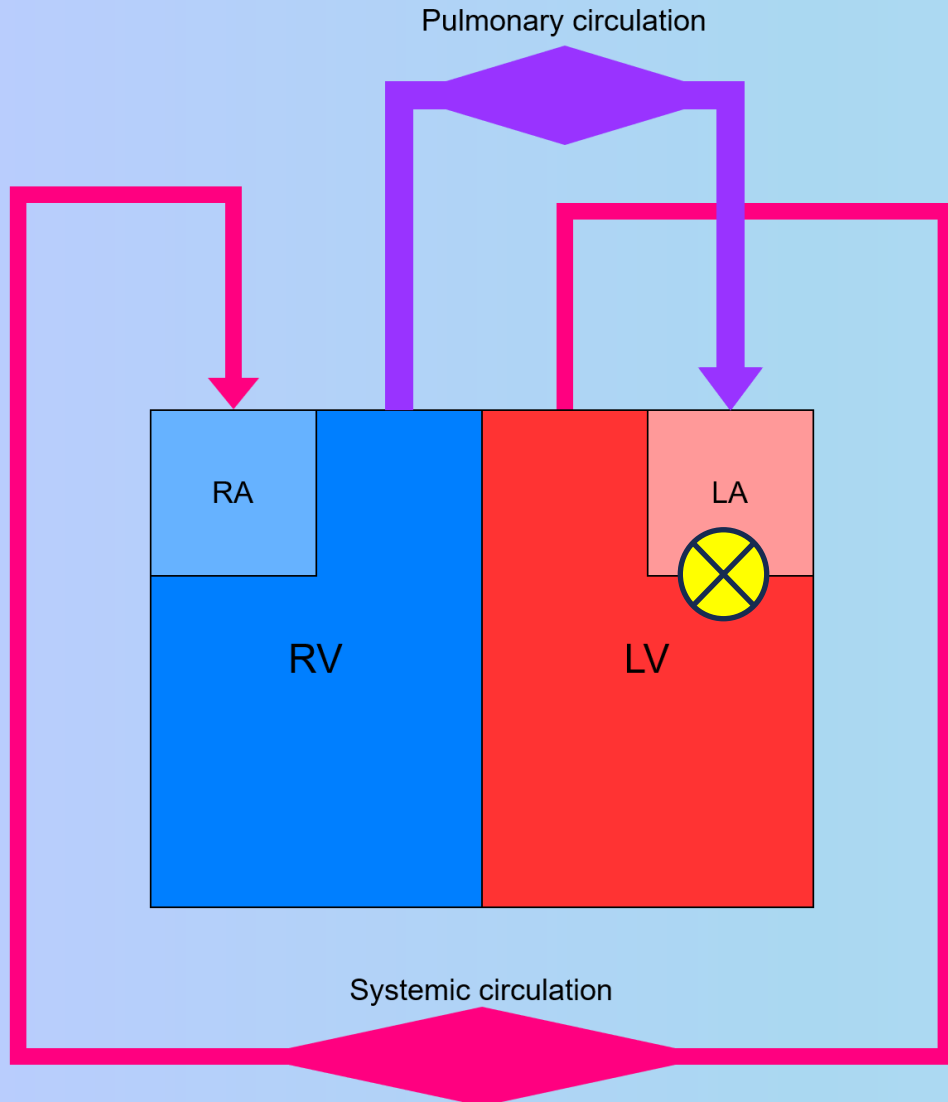
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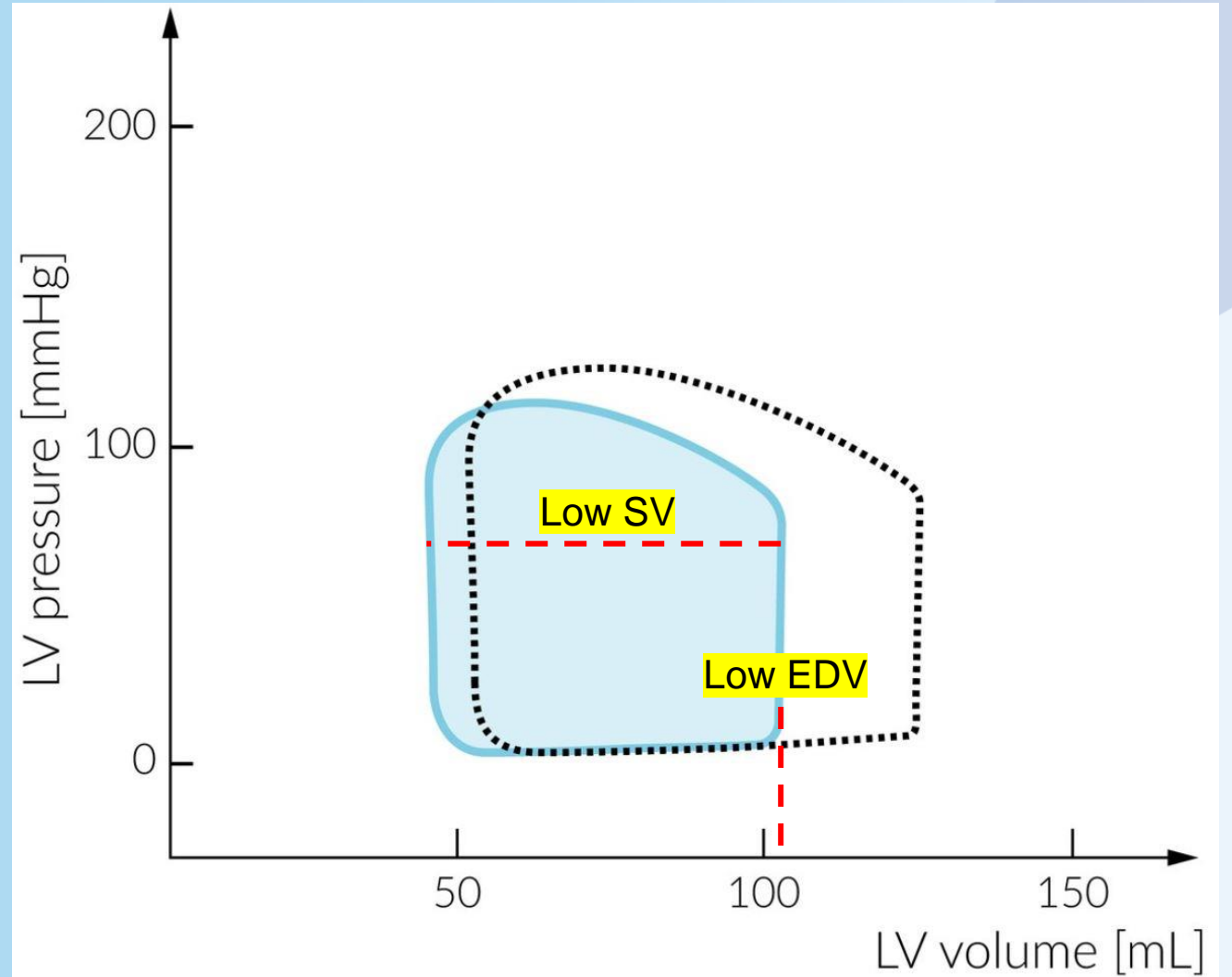
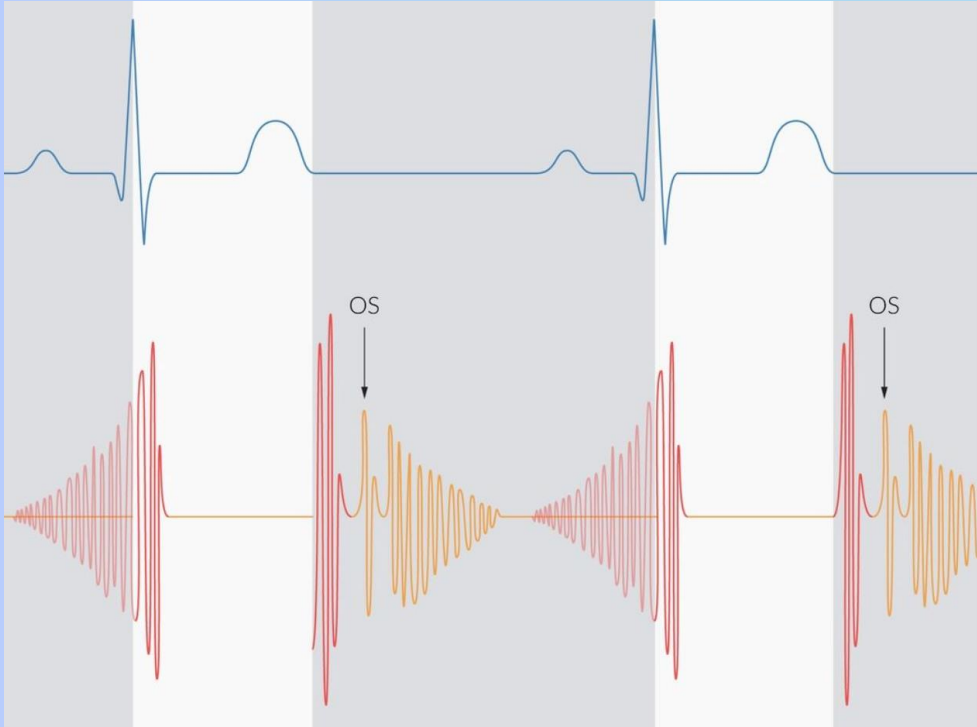
Mitral stenosis

Can be an emergency during A-fib



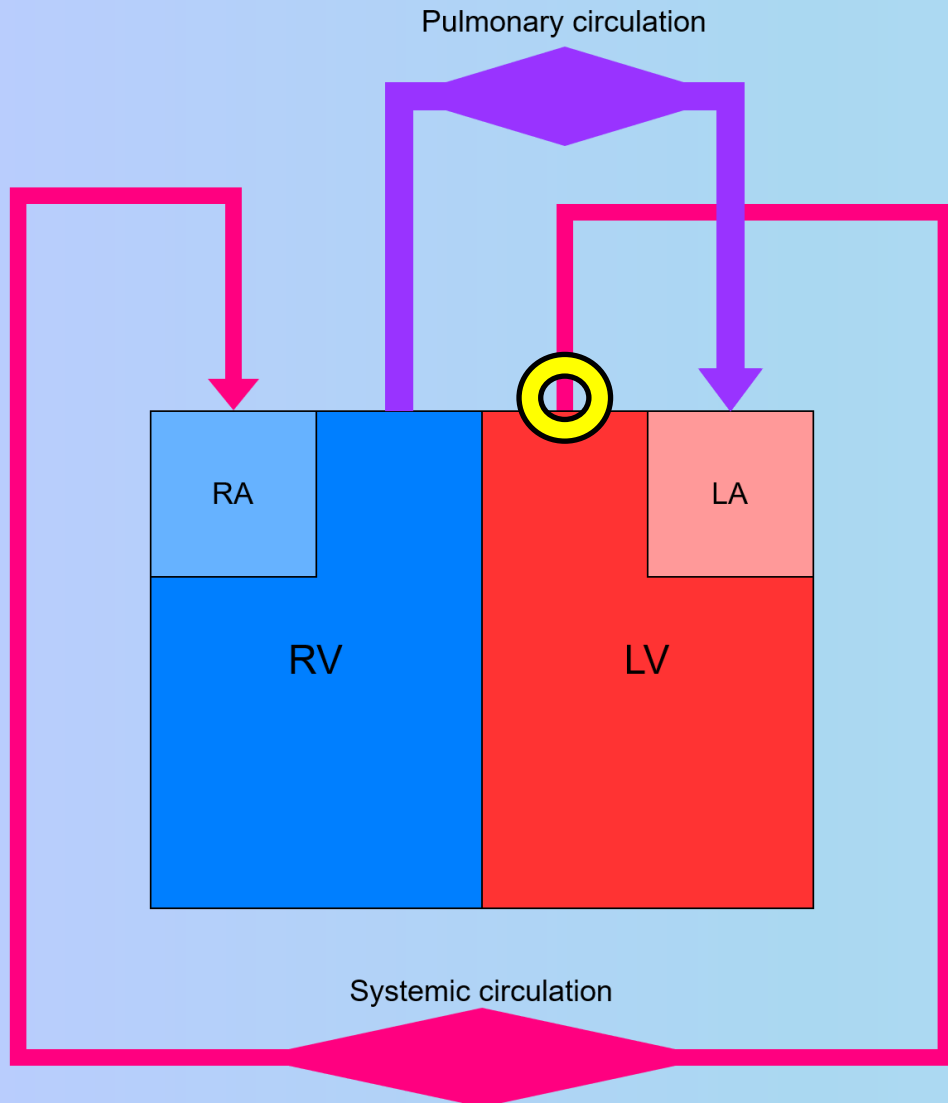
- Blood leaving the left atrium during diastole is obstructed by the stenotic mitral valve.
- LA pressure > LV pressure during diastole
- The LV cannot adequately fill with blood during diastole.
- The result is a lower EDV and lower SV.
- LA pressure is translated back to the pulmonary circulation.
- Typically presents with dyspnea.

Mitral stenosis



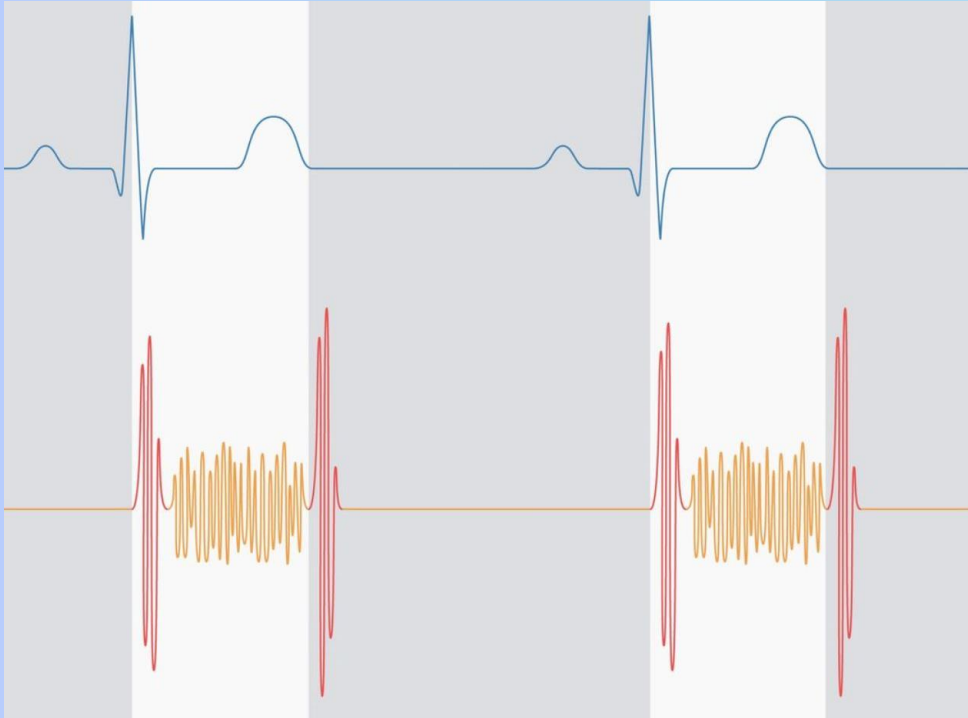
- Diastolic murmur with opening snap
- Loud S1
- Short S2 → OS interval indicates severe disease

Mitral regurgitation



- Blood returns to the LA during systole through the regurgitant mitral valve.
- In diastole, the LV fills extra blood that was returned to the LA during systole.
- This creates a much higher EDV. **Higher SV.**
- The LA dilates, pressure backs up into the pulmonary circulation.
- Presents with dyspnea, palpitations, left-sided heart failure.

Mitral Regurgitation



- Holosystolic murmur, high-pitched, radiates to left axilla.
- Handgrip increases regurgitation.

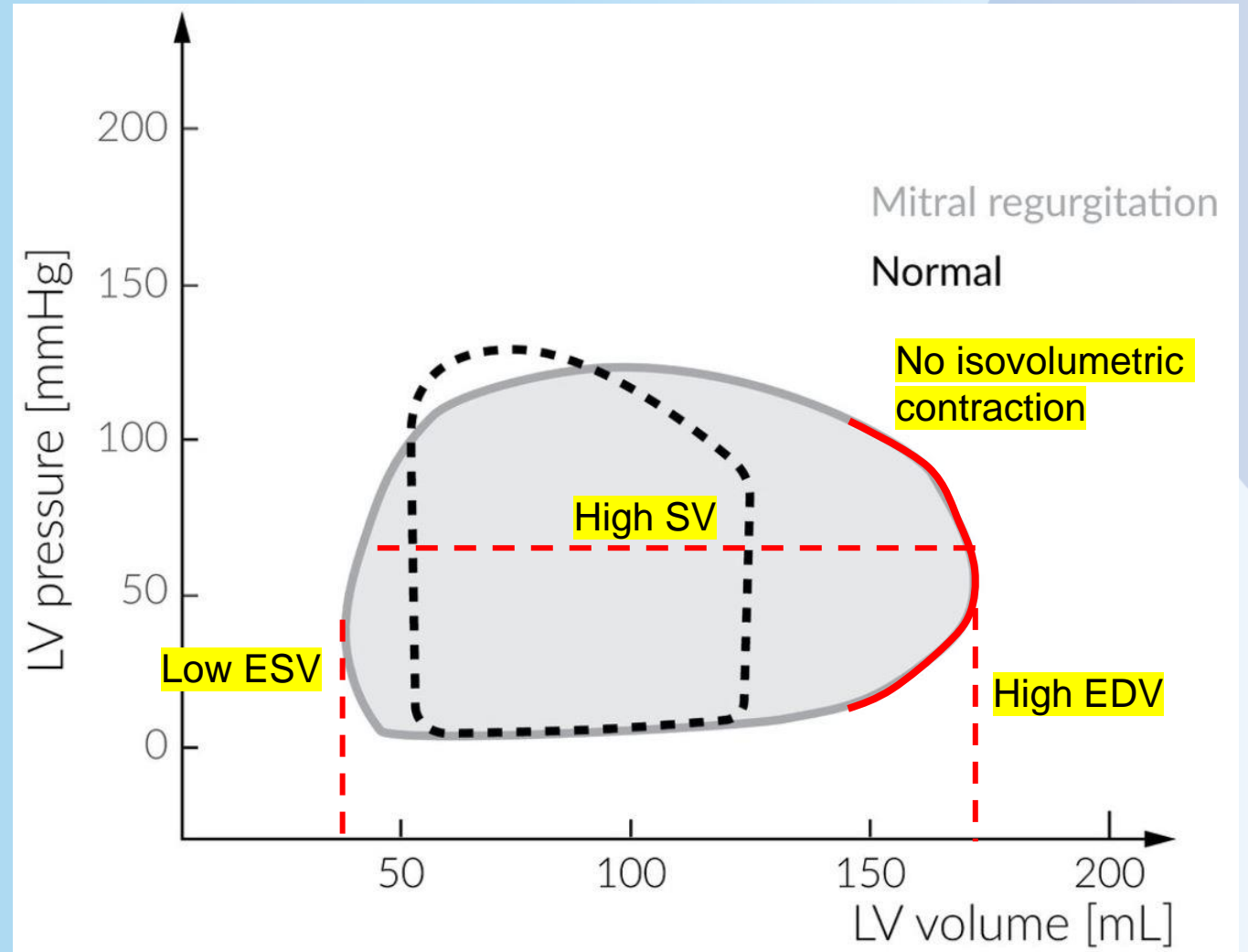


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Etiology of regurgitant valves

- Common reasons that regurgitation occurs:
 - Valve orifice is dilated due to an external change.
 - The valve becomes floppy due to leaflet dysfunction or chordae tendinae dysfunction.

Aortic regurgitation

- BEAR
 - Bicuspid aortic valve
 - Endocarditis
 - Aortic root dilation
 - Rheumatic fever (Acute)

Mitral regurgitation

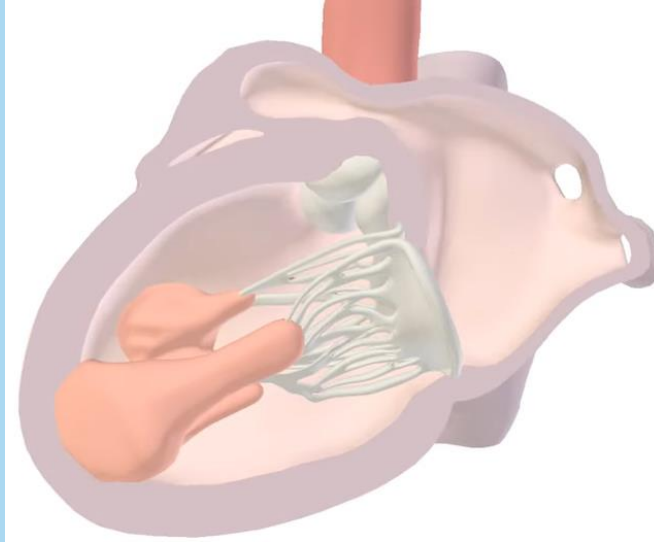
- Endocarditis
- Rheumatic fever (Acute)
- Ischemic heart disease (MI)
- Mitral valve prolapse
- LV dilatation

Tricuspid regurgitation

- Endocarditis
- Rheumatic fever (Acute)
- RV dilatation

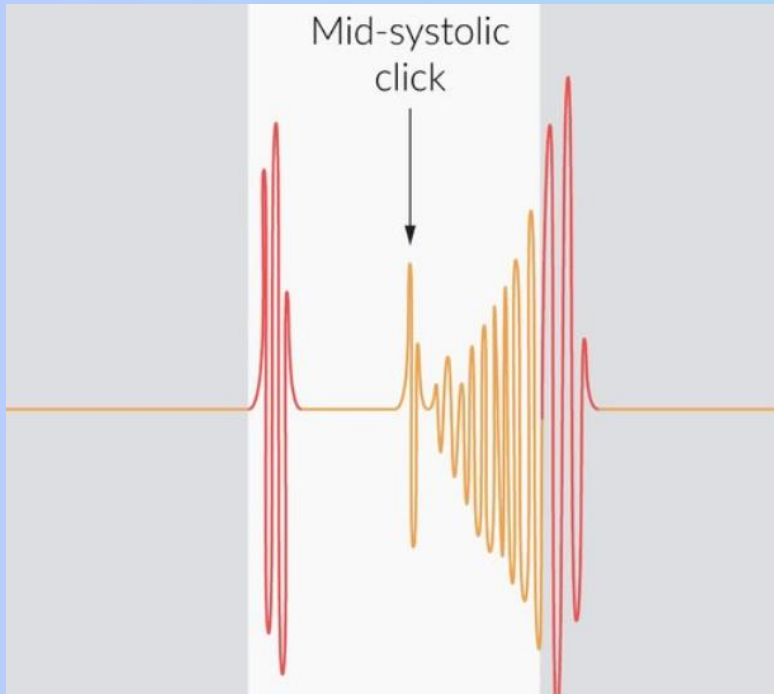
Mitral valve prolapse

- Common cause of mitral regurgitation
- Bulging of leaflets into the LA during systole.



Etiology

- Idiopathic
- Connective tissue disease
 - Marfan syndrome
 - Ehlers-Danlos syndrome
- Infarction of papillary muscles
- Acute rheumatic fever
- Endocarditis



- Midsystolic click
- Mid-to-late systolic murmur
- Increased preload delays the prolapse (tenses the chordae tendinae).
 - Squatting

Usually, asymptomatic... but can cause severe MR!

Acute rheumatic fever

What?

- Inflammatory complication of group A streptococcus infection.
- Causes many different symptoms (J<3NES criteria)

How?

- Molecular mimicry between streptococcal M protein and cardiac myosin protein. **Friendly fire!**

J<3NES?

- **Joints** (migratory arthritis)
- **<3** (Pancarditis and valvular lesions)
- **Nodules** (subcutaneous nodules)
- **Erythema marginatum** (centrifugal rash)
- **Sydenham chorea**

Mitral regurgitation



Mitral stenosis

Etiology of stenotic valves

- Stenosis is generally a chronic process.
- Can occur due to calcification or fibrosis.

Aortic stenosis

- Age-related calcification of normal valve
- Early-onset calcification of bicuspid valve

Mitral stenosis

- Late complication of chronic rheumatic fever
- Calcification of valve annulus

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