Special Lecture – Heart Failure
11/15/2013

Dr. HN Mayrovitz

Heart Failure = Pump Failure

Can Develop Rapidly ('Acute')

- **M.I.**
- **Infection**
- **Post bypass surgery**

Heart Failure = Pump Failure

Can Develop Rapidly ('Acute')

- **M.I.**
- **Infection**
- **Post bypass surgery**

Can Develop Over Time ('Chronic')

- **Pressure / Volume Overload**
  HTN/AS / AR/AS
- **Adaptive Remodeling**
- **Functional Decline**

Heart Failure = Pump Failure

Myocardial Damage

Coronary Artery Disease

↓

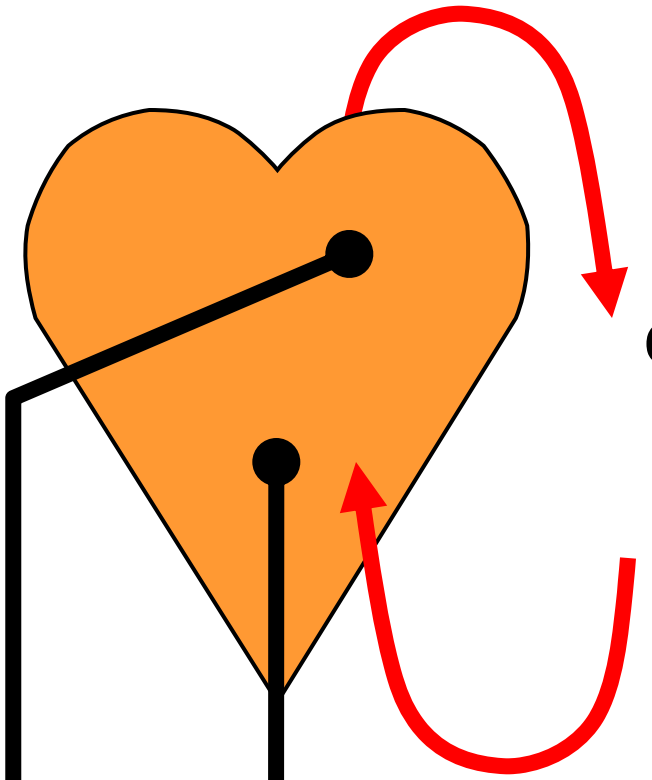
Ischemia

↓

Necrosis/ Fibrosis

↓

Diminished Function



Systolic Failure

Can't Pump Enough

Can't Fill Enough

Diastolic Failure

Failure to relax properly

Overload

+Afterload

- ***HTN***
- ***AS***

Remodeling

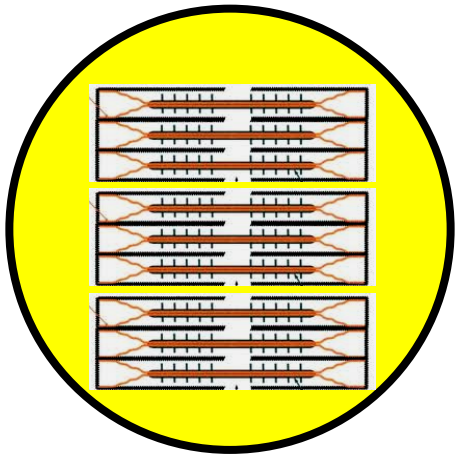
+Preload

- ***MR***
- ***AR***

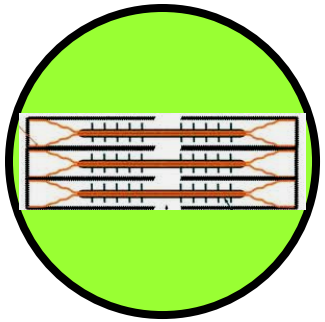
Adaptations / Remodeling

+ Afterload

Greater force needed to overcome greater load



Concentric

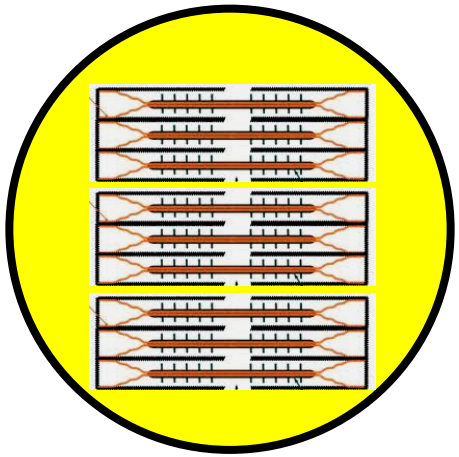


Normal

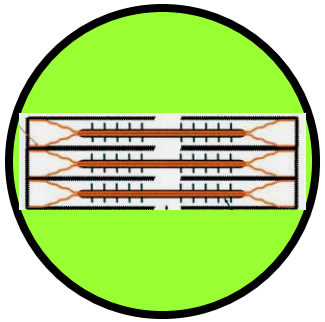
Adaptations / Remodeling

+ Afterload

Greater force needed to overcome greater load



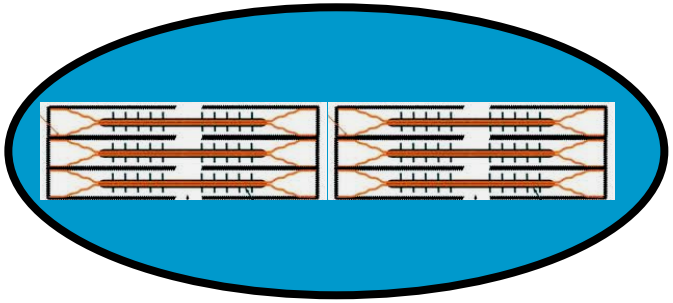
Concentric



Normal

+Preload

Chamber expands to accommodate larger volume



Eccentric

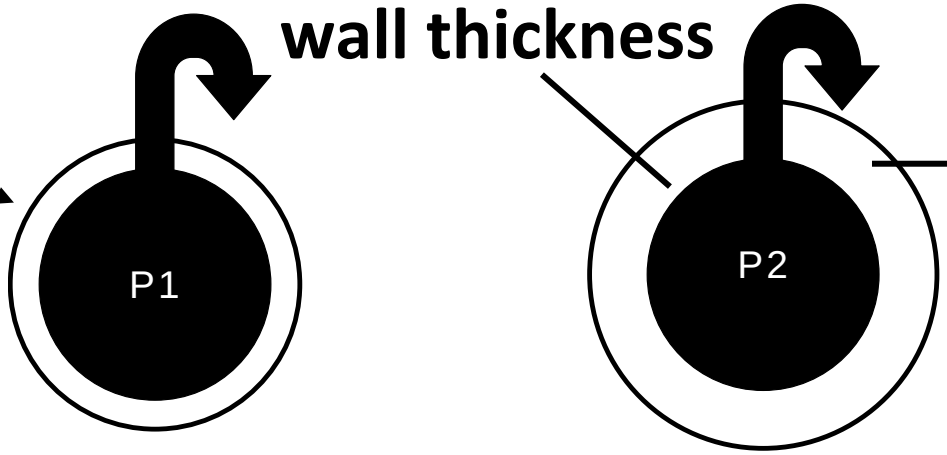
Impacts of Adaptations and Remodeling Process

Adaptation to +Afterload – Concentric LVH

Hypertension
Aortic Stenosis

Increased # of
Parallel sarcomeres

Increased
wall thickness



Decreased
Ventricular
Compliance

$C = dv/dp$

$C = 1/[E \times (w/r)]$

Wall stress tends
to be maintained

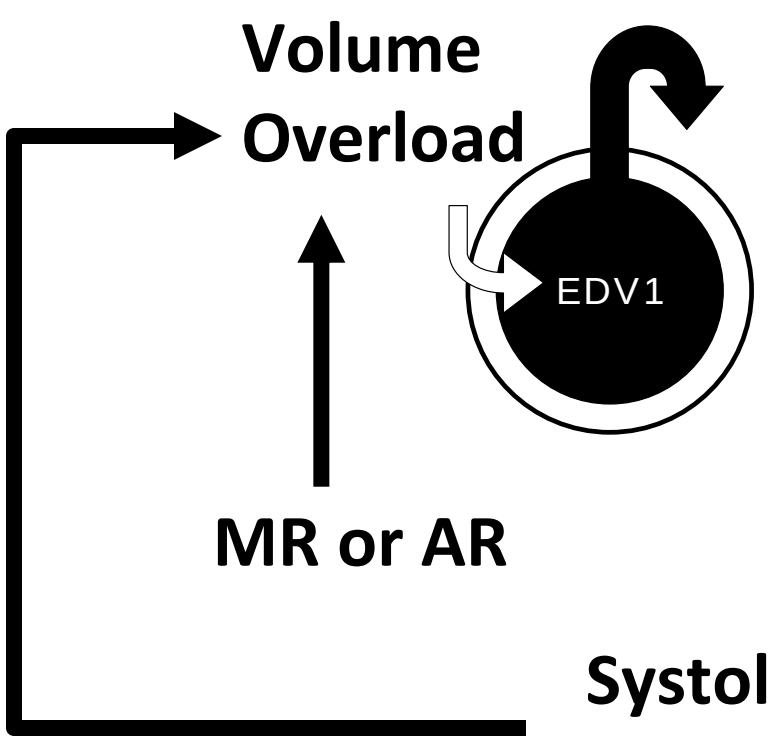
$\sigma = pr/w$

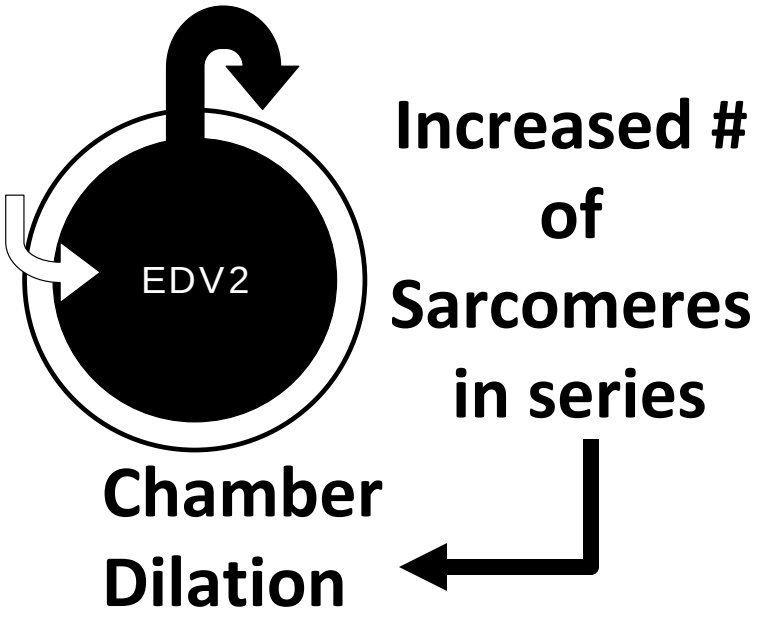
Diastolic
Dysfunction

Filling Problems
Further elevation
In EDP

Heart
Failure

Adaptation to +Preload (+ EDV) –Eccentric LVH





Systolic
Dysfunction

Ischemia
Infarction
Myopathies
Other

Abnormally
Decreased
Contractility

Wall stress tends to increase

$\sigma = pr/w$

- Increased O_2 demand
- Reduced EF
- Heart Failure

Pressure/Volume Overload

↓

Adaptive Hypertrophy

↓ ↓

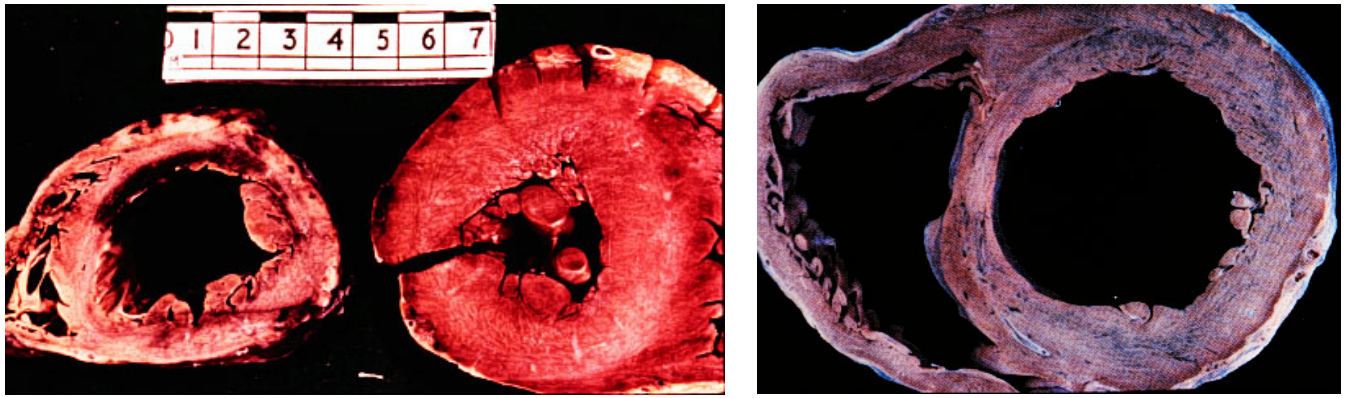
PRESSURE
+Muscle Mass

VOLUME
+Chamber Size

↓ ↓

Concentric Hypertrophy

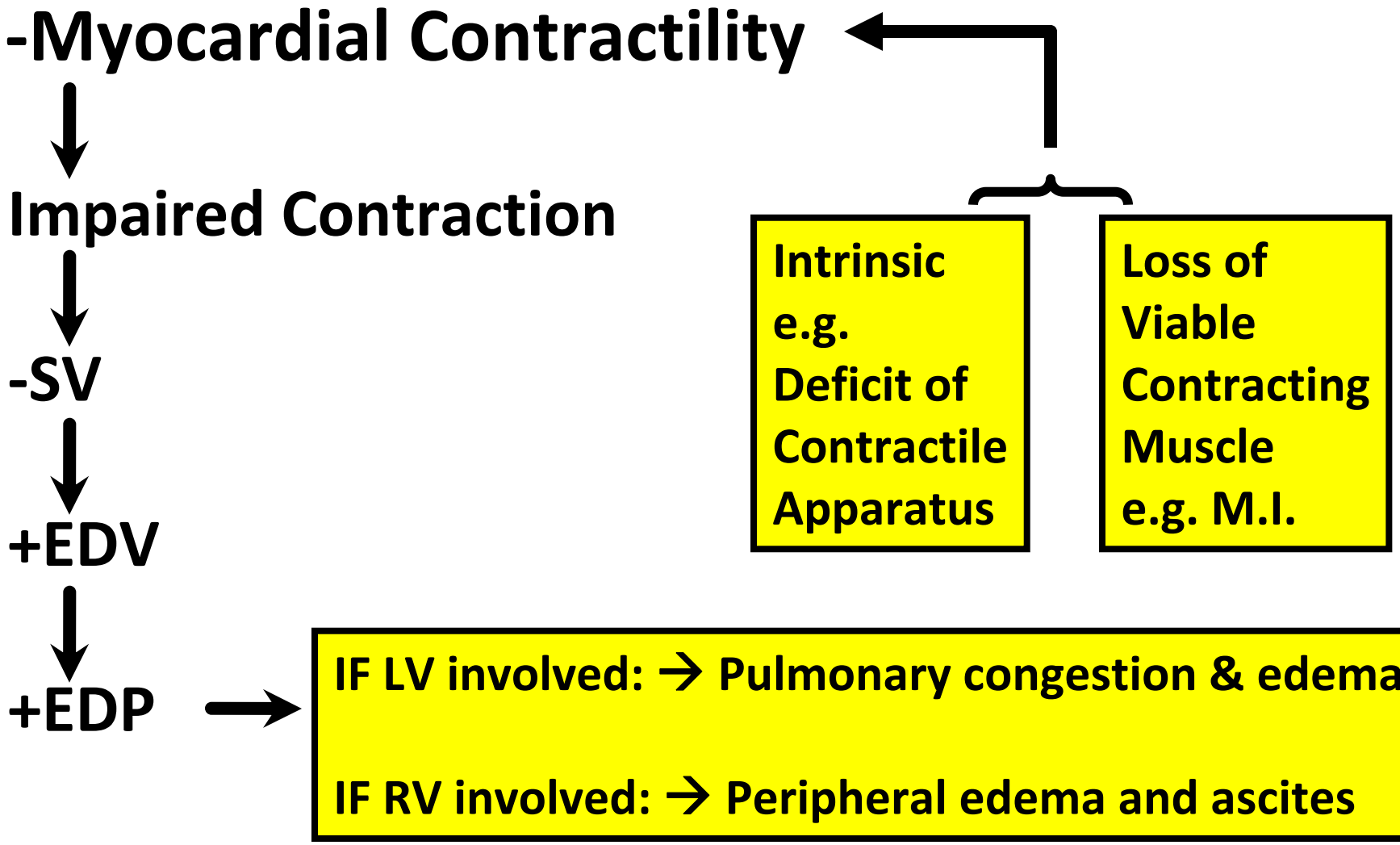
Eccentric Hypertrophy



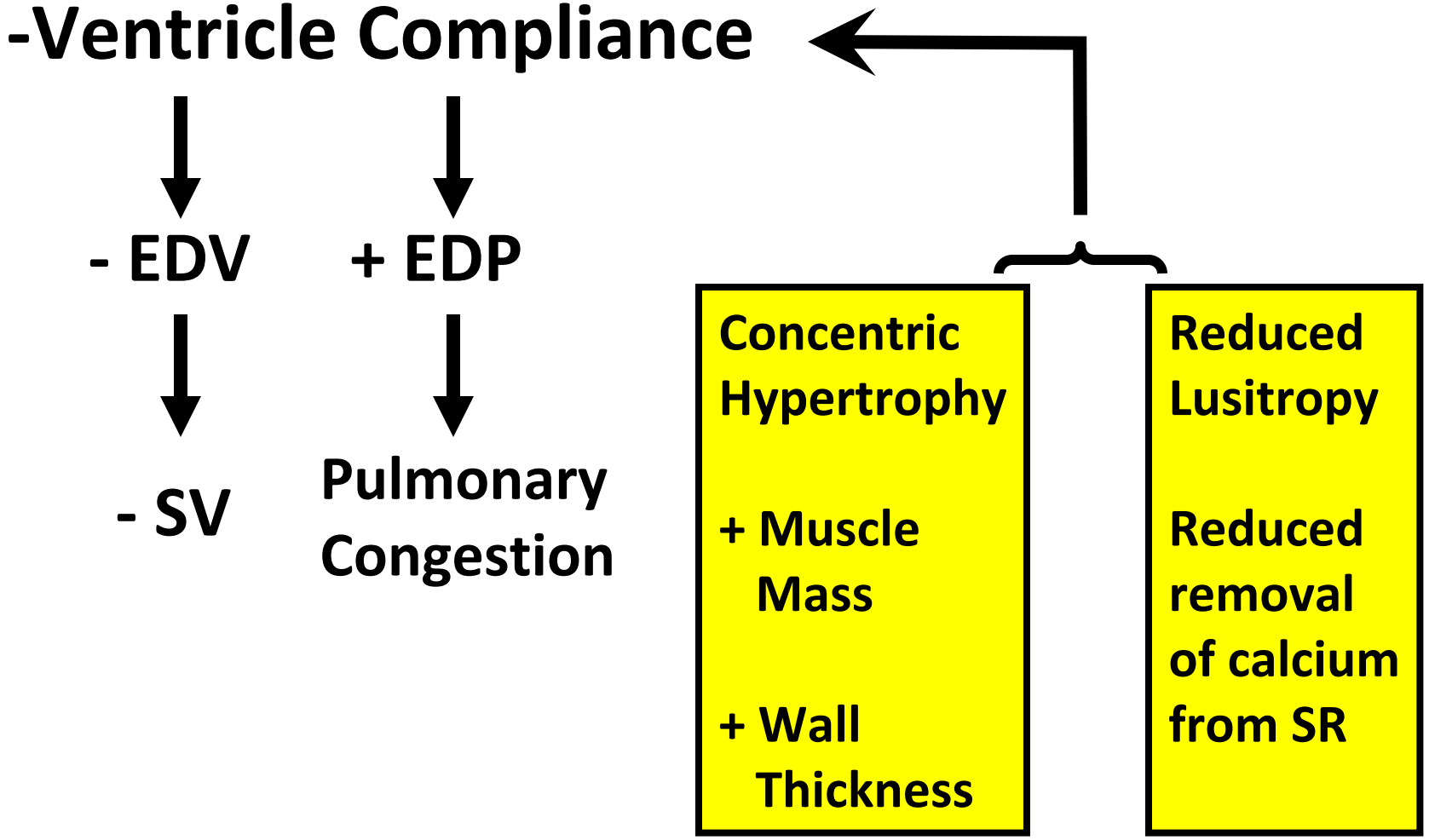
Normal **LVH (AS)** **Dilated (AR)**

Systolic and Diastolic Dysfunction Summary

Systolic Dysfunction



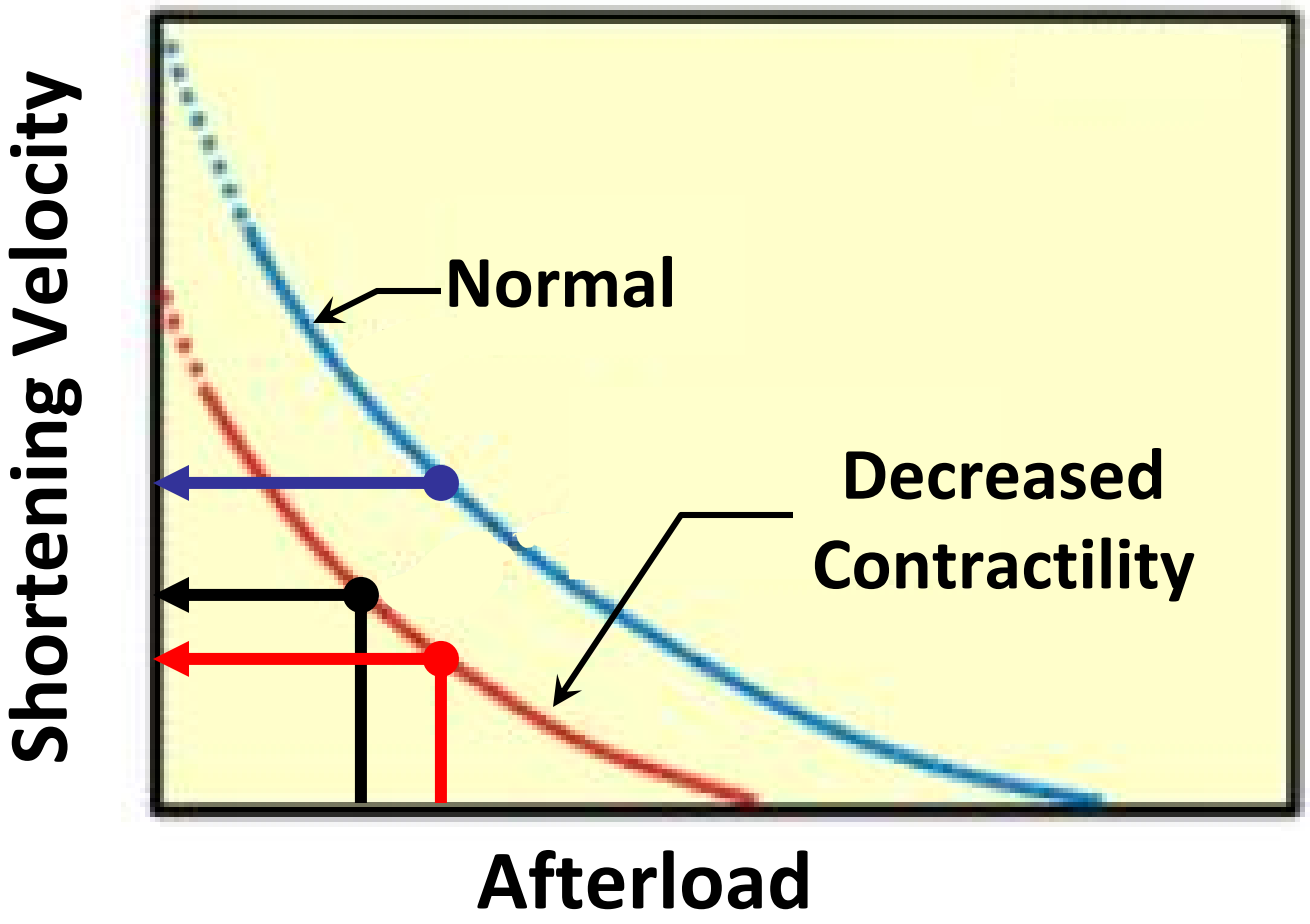
Diastolic Dysfunction



Review of Physiological Processes and Underpinnings

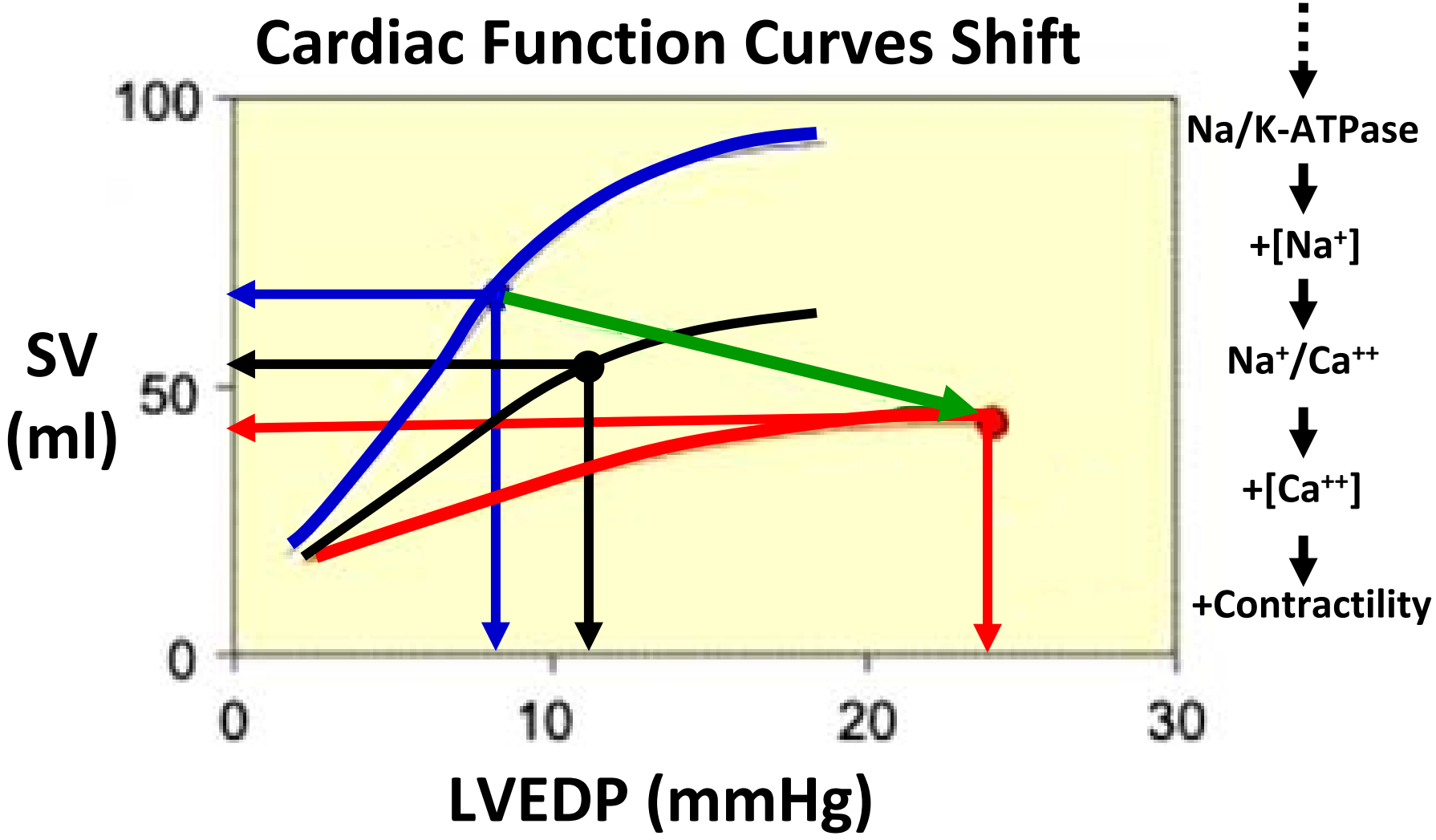
Decreased Contractility → Reduced Velocity

Tx → Reduce Afterload → Vasodilator



Decreased Contractility → Increased Preload

Tx → +Inotropy → Cardiac Glycoside (digitalis)



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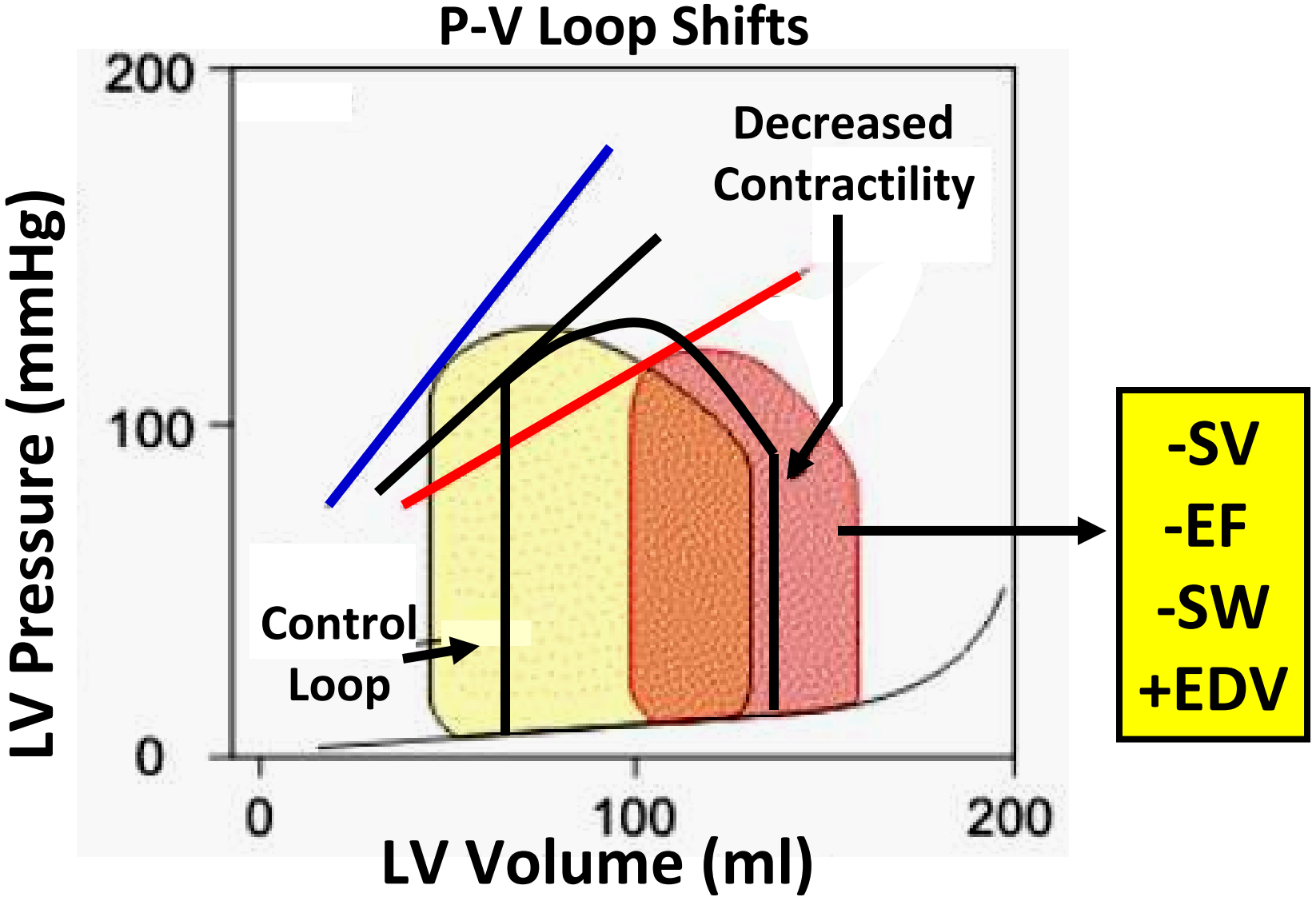
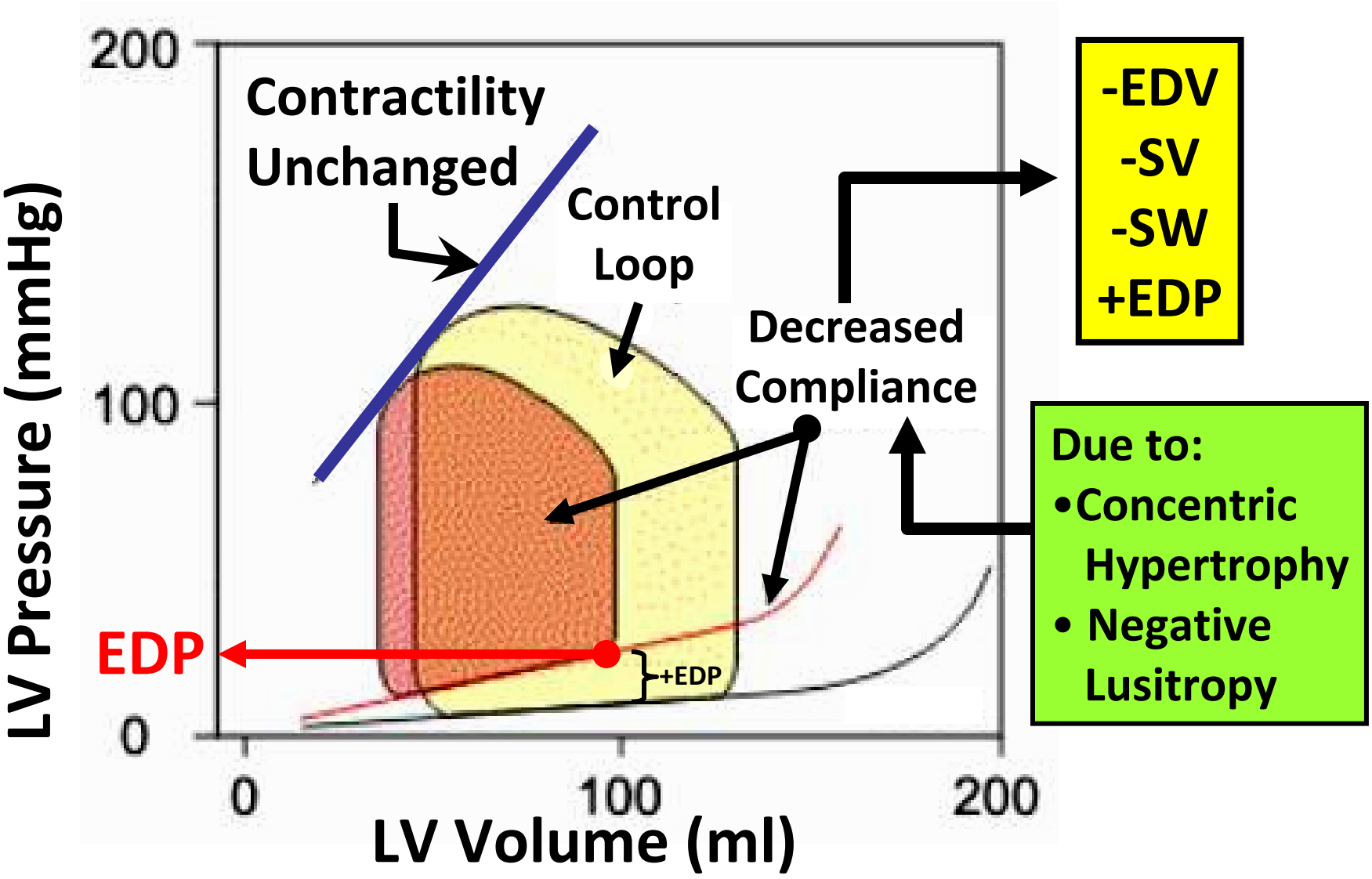
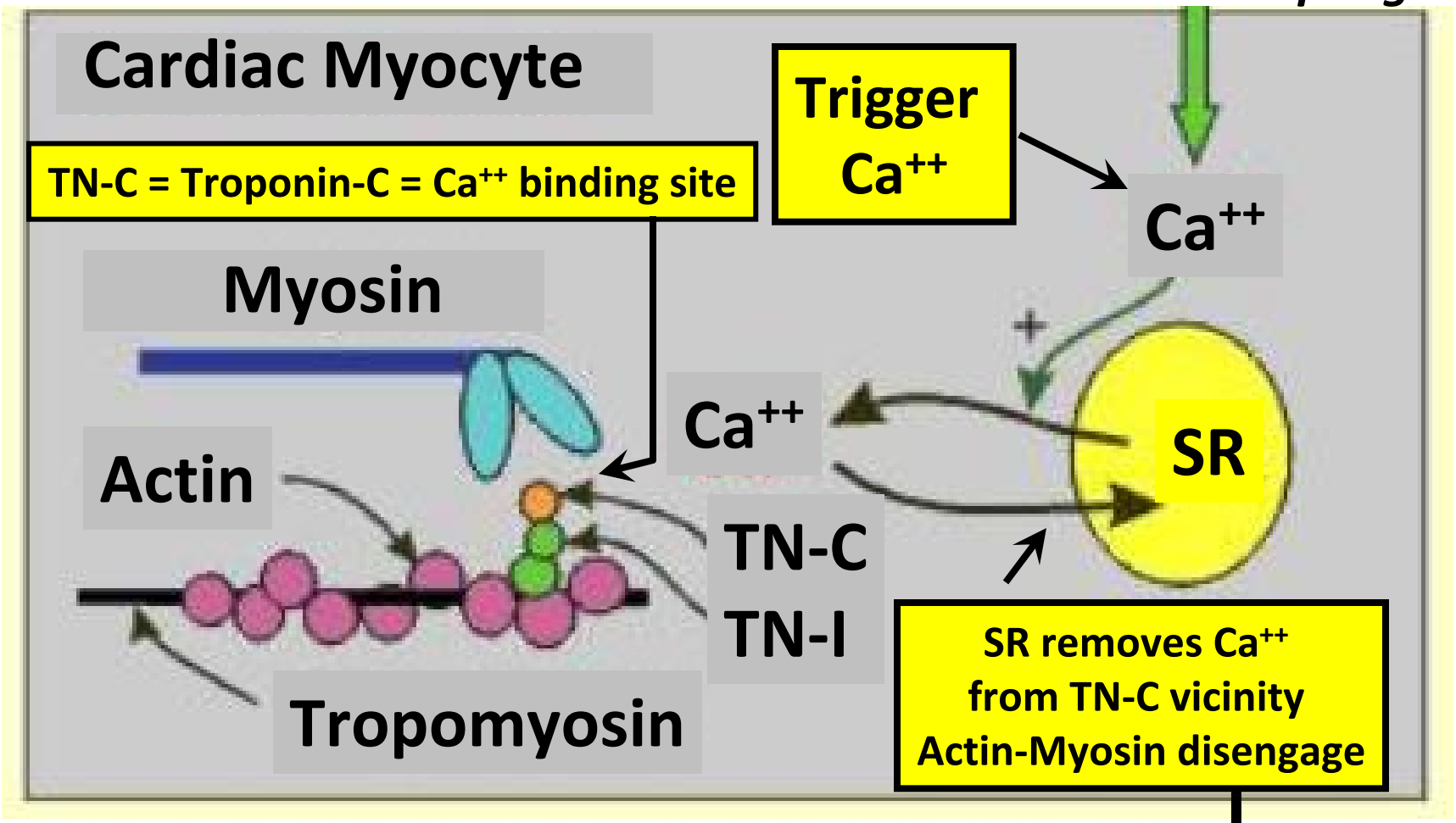


Diastolic Dysfunction→ Reduced Compliance



Reduced Lusitropy → Decreased Compliance

Excitation-Contraction Coupling



Reduced Ca^{++} removal rate and/or amount reduces relaxation rate and/or amount

Ventricular Relaxation

Thanks for your attention!
QUESTIONS?