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DA SEICENTO ANNI GUARDIAMO AVANTI.



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TOPIC : Cardiogenic Shock



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What is *shock*?

Shock is a condition of “inadequate tissutal perfusion”.

“**inadequate perfusion**”: cells don't receive or don't utilise oxygen

Stop producing energy by *aerobic way-right way*

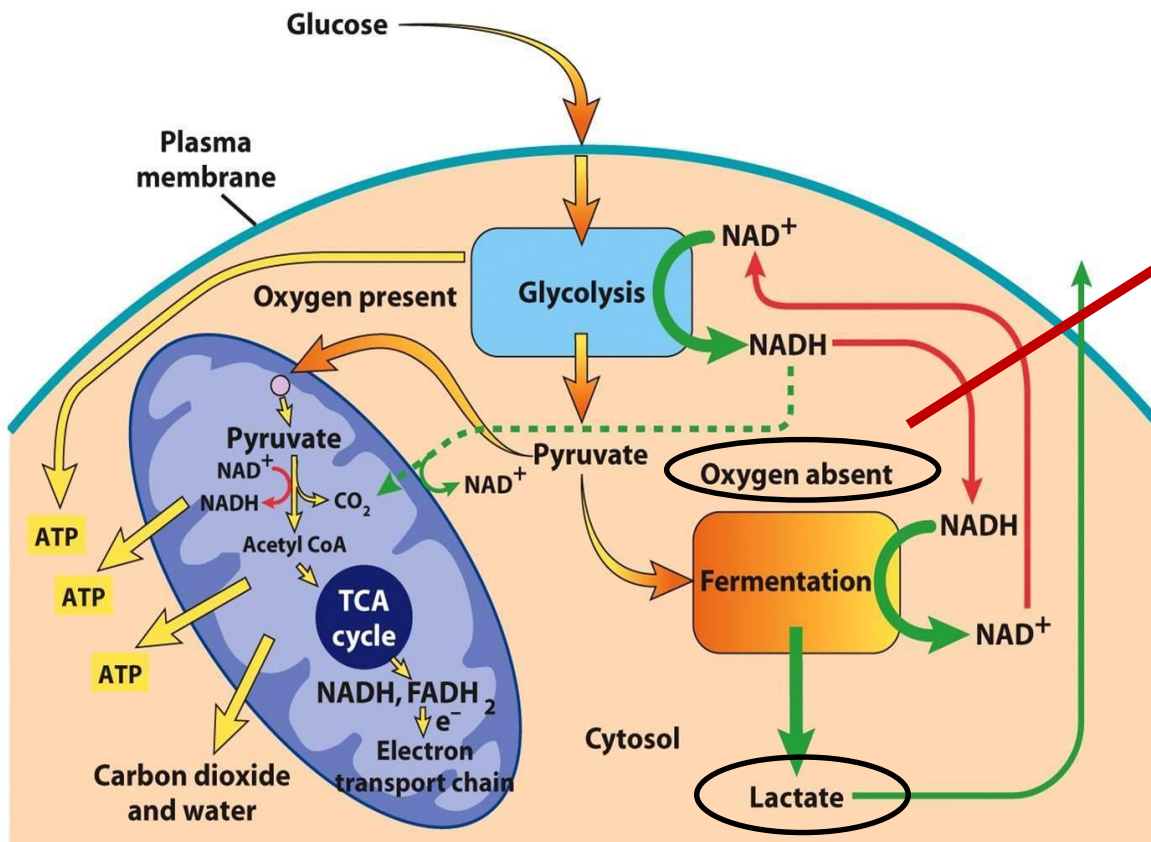
Start producing energy by *anaerobic way-wrong way*

long standing *anaerobic way*-poor energy production

Cell deaths-Organ failure



Energy cellular production



If shock



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How a cardiac matter can drive in a shock condition?

Heart pumps oxygenated blood towards organs and acts a paramount role in oxygen delivering

Oxygen delivering:

Cardiac Output X Oxygen Arterial Content: near 20 ml/dl/min

If heart doesn't work, oxygen is not carried to cells and it starts an anaerobic cellular metabolism that is the leading cause of a shock state - named cardiogenic in this case -



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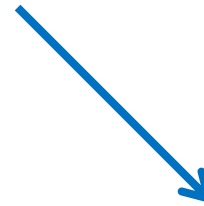
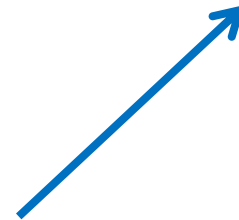
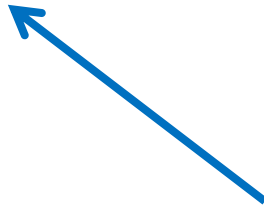
preload

afterload

Determinant of cardiac output

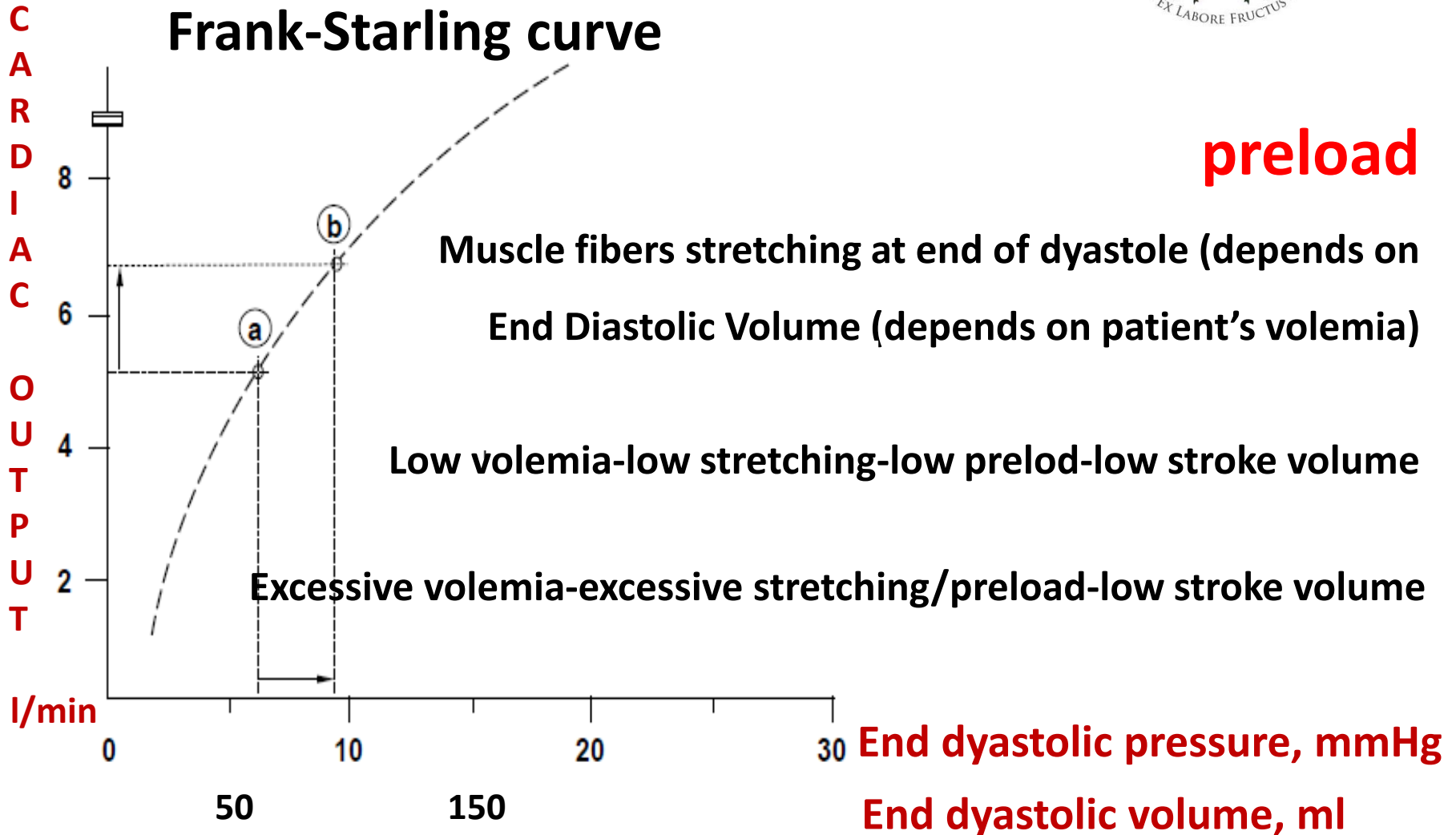
heart rate

contractility





Frank-Starling curve





what affects preload?

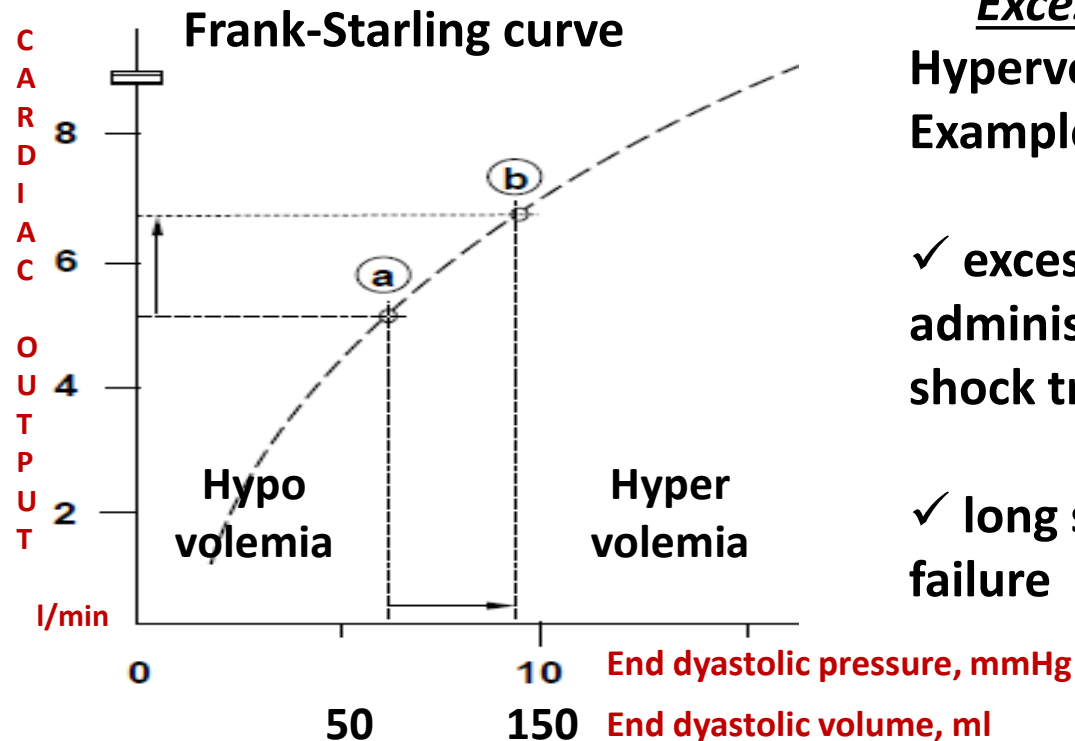
Low preload

Hypovolemia,

example:

✓ Bleeding

✓ Septick
shock



Excessive preload

Hypervolemia

Example:

✓ excessive fluid
administration for
shock treatment

✓ long standing heart
failure

If low or excessive preload → Low cardiac output →

shock



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Arterial hypertension

Aortic stenosis

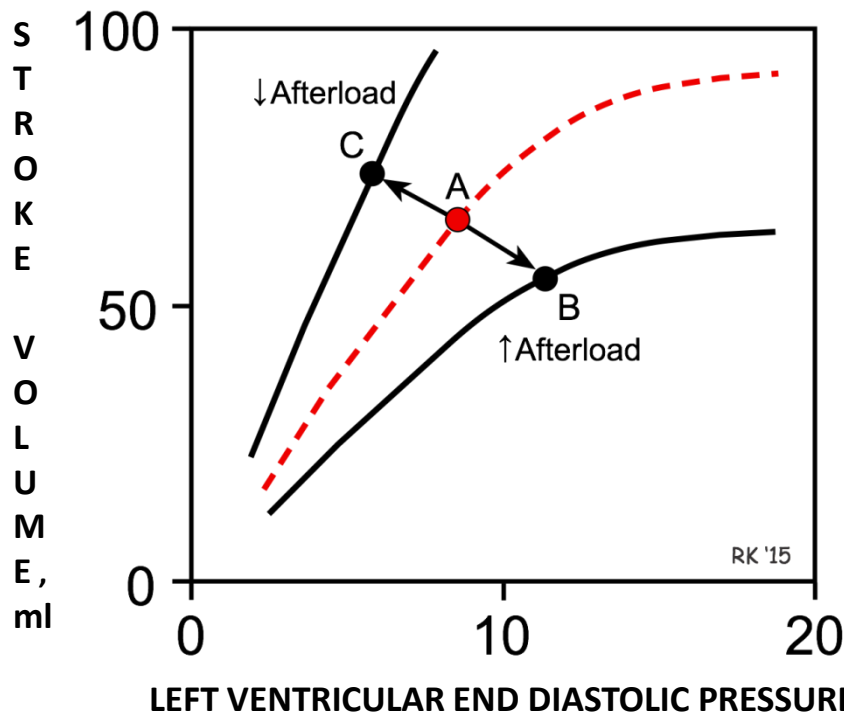
**Left outflow obstruction tract
(if heart hypertrophic)**

Afterload:

**forces that oppose to right or left
ventricular outflow**

**Pulmonary hypertension
(if severe hypoxemia, hypercapnia,
positive thoracic pressure in mechanical ventilation)**

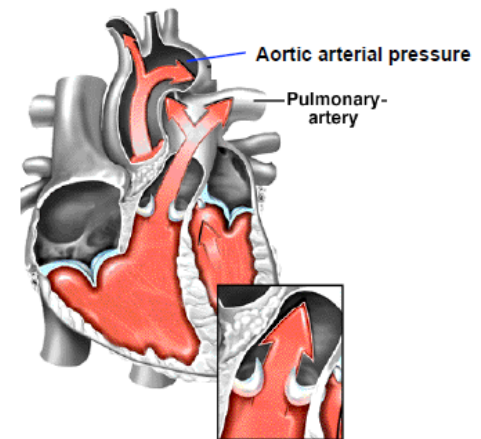
Pulmonary embolism



Afterload to left ventricle: *aortic arterial pressure*

Afterload to right ventricle: *pulmonary arterial pressure*

Afterload to the left ventricle is greater than that to the right ventricle.



✓ If afterload increase (hypertensive peak, pulm. embolism) → stroke volume decreases

✓ If afterload is normal (normal vascular tone) → stroke volume is normal

✓ If afterload decrease (low vascular tone for septic shock) → stroke volume decrease



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Heart rate: normal value 60-90 bpm

Heart Rate x Stroke Volume (volume for each
systole): **Cardiac Output**

60-90 beat by minute x 50-150 ml : 4-8 l/minute

HR

SV

CO



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Heart rate disturbances

sec

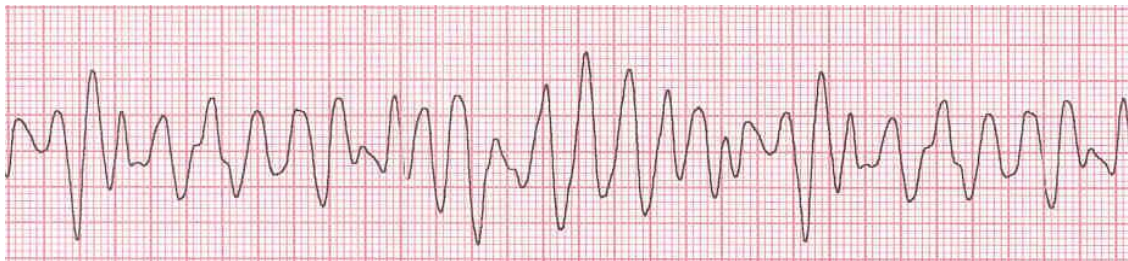


Low heart rate-

low number of SV-

low cardiac output-

cardiogenic shock



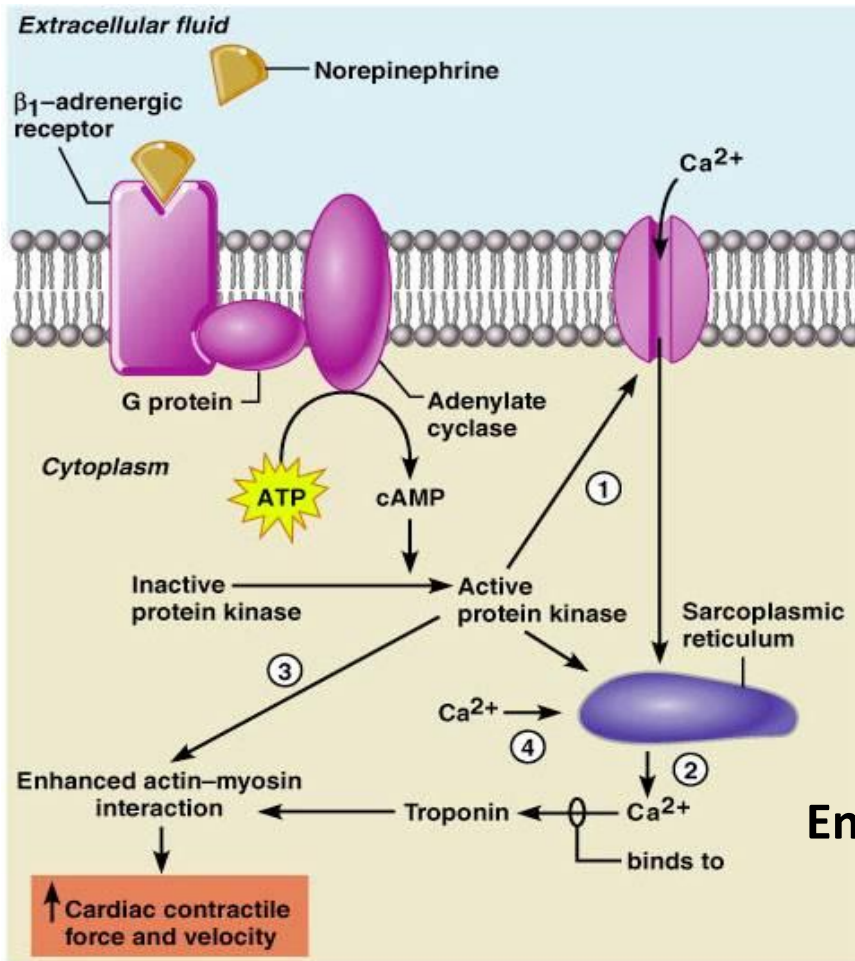
Too high heart rate-

Short diastole and short filling of
ventricule-

Short systole and short emptying
of ventricule-

Low stroke volume-

Cardiogenic shock



Contractility:

the amount of work that heart can perform at a given load

What is *heart work*?

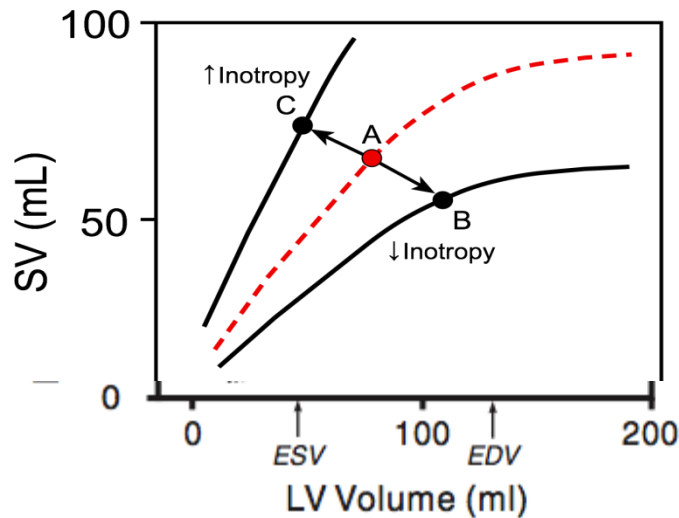
It is pressure that drive a stroke volume out of ventricle

More **adrenergic stimulation**

More **ATP**-more cytosol **calcium**

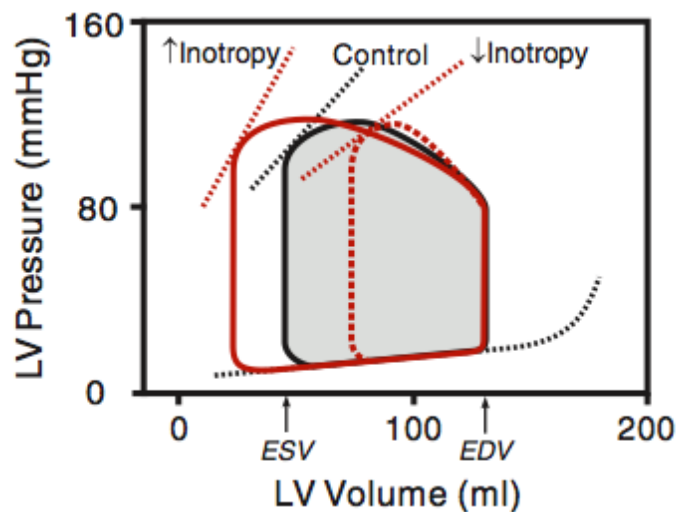
Enhanced **interaction actin-troponin-myosin**

More **cardiac force** and **contractil velocity**



at a same preload-end systolic volume:
If high contractility-inotropism: high stroke volume

If low contractility-inotropism: low stroke volume



at a same preload-end systolic volume:

**If high contractility-inotropism:
high driving pressure- stroke volume**

**If low contractility-inotropism:
low driving pressure-stroke volume**



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Acute myocardial infarction

regional alteration of contractility

Myocarditis

global alteration of contractility

contractility impairment


Too much contractility impairment?

too low cardiac output and **cardiogenic shock**

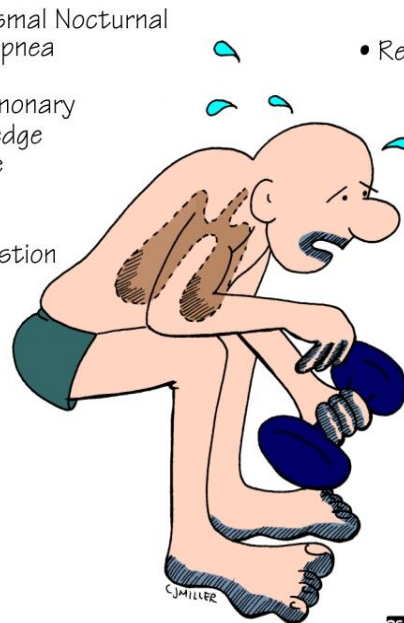


Whatever would be the origin of cardiogenic shock...

RIGHT SIDED FAILURE (Cor Pulmonale)

- 
- Fatigue
 - ↑ Peripheral Venous Pressure
 - Ascites
 - Enlarged Liver & Spleen
 - May be secondary to chronic pulmonary problems
 - Distended Jugular Veins
 - Anorexia & Complaints of GI Distress
 - Weight Gain
 - Dependent Edema

LEFT SIDED FAILURE

- 
- Paroxysmal Nocturnal Dyspnea
 - Elevated Pulmonary Capillary Wedge Pressure
 - Pulmonary Congestion
 - Cough
 - Crackles
 - Wheezes
 - Blood-Tinged Sputum
 - Tachypnea
 - Restlessness
 - Confusion
 - Orthopnea
 - Tachycardia
 - Exertional Dyspnea
 - Fatigue
 - Cyanosis



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Memento:

Neurological sign:
✓ confusion or coma

shock is ipoperfusion

Renal sign:
✓ oliguria-anuria

**not necessary
ipotension**

Biochemical sign:
✓ high lactate
✓ Low central venous saturation
 $ScVO_2 < 55\%$ (if cardiogenic)



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cardiogenic shock treatment:

recognize the cause

and remove that

Low preload: give fluid

High preload: give diuretic or hemofiltration

Low afterload: start noradrenaline infusion

High afterload: give antypertensive drug

Low rate: give atropine or start pacing

High rate: give fluid or give antyaritmics or
administred electrical shock

Low contractility: revascularize myocardium or
start infusion of inotropic drugs (dobutamine,
levosimendamide)