

# Congestive Heart Failure

Heart can't supply enough blood.

- can't fulfill demand

[DEPTH OF BIOLOGY]

SHF

Either the heart's ventricles can't pump the blood hard enough during systole called

Systolic Heart Failure

[DEPTH OF BIOLOGY]

DHF

During Diastole heart can't fill enough blood in auricles called as

Diastolic Heart Failure.

[DEPTH OF BIOLOGY]

In both cases blood backs up into the lungs causing congestion or fluid build up.

also known as CHF

- This can affect millions of people around world.
- It can ultimately lead to death.

[DEPTH OF BIOLOGY]

Isthemia + Valvular Disease → Heart Failure

## Systolic Heart Failure

- Total vol. → 100 ml • the other 40 ml kind on lungs in the left ventricle until until the next beat.
- Stroke vol. → 70 ml

Normal ,

Ejection fraction  $\rightarrow \frac{70\text{ml}}{110\text{ml}} \rightarrow$  stroke vol.  
 110ml  $\rightarrow$  Total vol. in left ventricle.  
 . or about 64%.

Normal ejection fraction  $\rightarrow 50 - 70\%$ .

Baseline  $\xrightarrow{\text{[DEPTH OF BIOLOGY]}}$  40-50%.

Systolic heart failure  $\rightarrow \leq 40\%$

SHF  $\rightarrow$  So, in our eq. total vol. of the left ventricle was 110ml but only 44ml was pumped out with each beat. [DEPTH OF BIOLOGY]

(Abnormal)  $\rightarrow \frac{44\text{ml}}{110\text{ml}}$   $\therefore$  in this case, can't pump the blood.

Ejection fraction = 40%.

Person with systolic heart failure.



• Diastolic Heart Failure → In this case stroke volume is low but the ejection fraction normal.

How?

Now, → well it's not filling enough so there is how total volume say about 69 ml instead 110 ml.

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Ejection Fraction →

$$\frac{44}{69 \text{ ml}} \rightarrow \text{S.V} \quad 64\%$$

↓

$$110 \text{ ml} \rightarrow \text{T.V}$$

Because this is what is being filled.

→ In this situation the failure caused by abnormal filling of the ventricle.



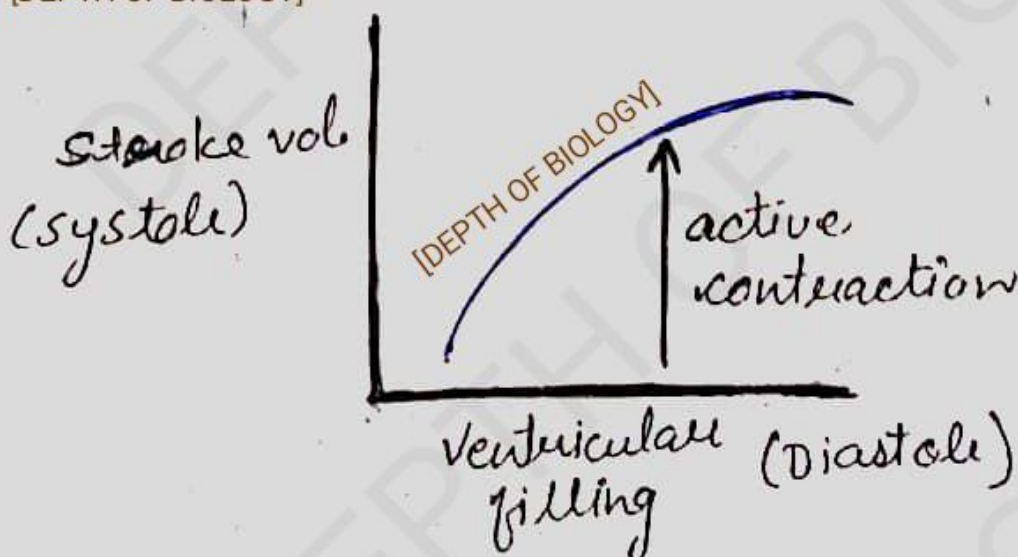
So, the chamber doesn't get fully loaded or stretched out in the first place

• Another term for this is a Reduced preload.  
(blood in ventricle before contraction)

Frank-Starling Mechanism

Imp. relationship b/w systolic and diastolic function

[DEPTH OF BIOLOGY]





OK →

So, heart failure can affect the right ventricle or the left ventricle or both ventricle

[DEPTH OF BIOLOGY]

↓  
So, someone have Right sided heart failure or left sided heart failure or both which is called **Biventricular heart failure**.

# Usually →

left side heart failure is caused by systolic (or pumping) dysfunction

↓  
This is due to some kind of damage in myocardium or the heart muscle

↓  
can't contract forcefully and pump blood as efficiently

## **Ischemic Heart Disease**

[DEPTH OF BIOLOGY]

caused by coronary Artery Atherosclerosis or plaque build up is the most common cause

↓  
In this case less blood and oxygen.

↓  
gets through the coronary artery to the heart tissue which damages the myocardium.

• If coronary artery is blocked completely - the person has a heart attack.

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long standing hypertension  $\rightarrow$  is another cause of heart failure.

This is because Arterial pressure  $\uparrow$  in the systemic circulation, it get harder to the left ventricle to pump blood out.

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To compensate, the left ventricle actually buck up and its muscle shows hypertrophy or grow so that the ventricle can contract with more force.

Increase in muscle mass (hypertrophy) also mean there is greater demand for oxygen.

But the coronary artery gets squeezed out but this extra muscle so that even less blood delivered to tissue.

[DEPTH OF BIOLOGY]

More demand + reduced supply  $\rightarrow$

means some of the ventricular muscle

weaken contraction

leads to systolic failure.

## Another cause  $\rightarrow$  Dilated cardiomyopathy.

• when the heart chamber dilates or grows in size

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$\downarrow$



To attempt to fill up the ventricle with larger and larger vol. of blood. [DEPTH OF BIOLOGY]



and stretch out the muscle walls and ↑ re-contraction strength.

→ This can work for a little while, overtime



The muscle wall get thinner and weaker



It leads to systolic heart failure.

Diastolic heart failure or filling dysfunction can also happen.

In Hypertension [DEPTH OF BIOLOGY]

left ventricle hypertrophied is concentric, which means that the new sarcomere are generated is parallel with the existing ones.

This means when the heart muscle wall enlarges it into the ventricular chamber space [DEPTH OF BIOLOGY]

resulting in less room for blood.

Hence, hypertension can also cause diastolic heart failure. [DEPTH OF BIOLOGY]



# also caused by **aortic stenosis** [DEPTH OF BIOLOGY]

- narrowing in the aortic valve opening
- cause concentric hypertrophy

as well as by hypertrophic cardiomyopathy and Restrictive cardiomyopathy are another cause.

In this case the heart muscle get stiffer and less compliant and therefore left ventricle can't easily stretch out and filled with much blood [DEPTH OF BIOLOGY] leads to diastolic heart failure.

# when the heart doesn't pump much blood

↓  
↓ se Blood flow to the kidneys

↓  
which activates Renin angiotensin aldosterone system.

↓ [DEPTH OF BIOLOGY]  
ultimately causing fluid retention

↓  
which fills heart bit more during diastole and ↑ se preload which ↑ se contraction strength

↓  
Again by the **Frank-Starling Mechanism** [DEPTH OF BIOLOGY]



# Major clinical sign → heart being not able to pump enough blood forward to body.

↓  
Is that blood starts to backup into lungs.

[DEPTH OF BIOLOGY]

Now,

backed up blood in pulmonary vein and capillary bed can rise the pressure in the pulmonary artery.

↓  
and can also results in fluid moving from the blood vessel to the interstitial space causing pulmonary edema or congestion. [DEPTH OF BIOLOGY]

↓  
Now exchange of gasses become harder ∴ fluid (wide layer of) takes more time  $\text{CO}_2$  and  $\text{O}_2$  to diffuse through.

[DEPTH OF BIOLOGY]

and therefore patient have dyspnea troubled breathing or orthopnea.

→ This extra fluid in the lungs causes crackling sound to be heard on auscultation of heart or lungs while the patient breathe.

[DEPTH OF BIOLOGY]

→ If enough fluid filled some capillaries in the lungs ruptures leaking blood into the alveoli.

↓  
Alveolar macrophages then eats up these RBC's.



## Left sided Heart failure

[DEPTH OF BIOLOGY]

Medications — (1) ACE Inhibitors  
(2) Diuretics

## Right sided heart failure

• is Biventricular as both ventricles affected.

[DEPTH OF BIOLOGY]

This due to —————> atrial septal defect  
—————> ventricular septal defect.  
—————> chronic lung disease.

↑ left high pressure —————> Right low pressure (↓)

leads to increase pressure in right side and lead to concentric hypertrophy of the right ventricle

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↓  
making it more prone to Ischemia (systolic dysfunction) and smaller volume (Diastolic dysfunction).

## Chronic lung Disease

—————> ↓ O<sub>2</sub>

—————> Hypoxia

—————> pulmonary arterioles constrict

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↓  
raises the pulmonary BP.

↓  
Hypertrophy and failure

In right side of heart its known as COP Pulmonate



and when the Right-sided failure, blood BACK TO THE BODY

[DEPTH OF BIOLOGY]

Systemic vein congestion

- One common manifestation of this is
- Jugular vein Distention — (enlarge and extended) in the neck. [DEPTH OF BIOLOGY]

• and when liver and spleen

prolonged congestion

It swells up and called

cirrhosis and liver failure

Hepatosplenomegaly.

painful.

called cardio cirrhosis

→ In leg it cause pitting edema. [DEPTH OF BIOLOGY]

• Treatment of Right sided heart failure —

- ① ACE Inhibitors
- ② Diuretics



# Heart Failure [DEPTH OF BIOLOGY]

muscle wall stretch and thin out. → Thickens and becomes Ischemic

Heart cells gets irritated

Heart Arrhythmia  
Heart beat becomes irregular

↓  
In this condition ventricle don't contract anymore,

↓  
So blood pump decreases or less.

# Patient treated with Cardiac Resynchronization Therapy ↓ [DEPTH OF BIOLOGY]

This stimulate the ventricle to contract

# or Implant VADs

At end stage of heart failure → Heart Transplant

# Sign and Symptoms →

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→ Fatigue

→ Swelling

→ Shortness of breath

→ Sweating

→ Nausea

→ Increased urination



- ~~#~~ Diagnosis → chest x-ray  
→ Ejection fraction  
→ stress Test  
→ Blood Test  
→ Cardiac MRI

~~#~~ P.O. Treatment →

[DEPTH OF BIOLOGY]

- ACE Inhibitors
- B-Blockers
- Pacemaker
- Bypass surgery.

[DEPTH OF BIOLOGY]