

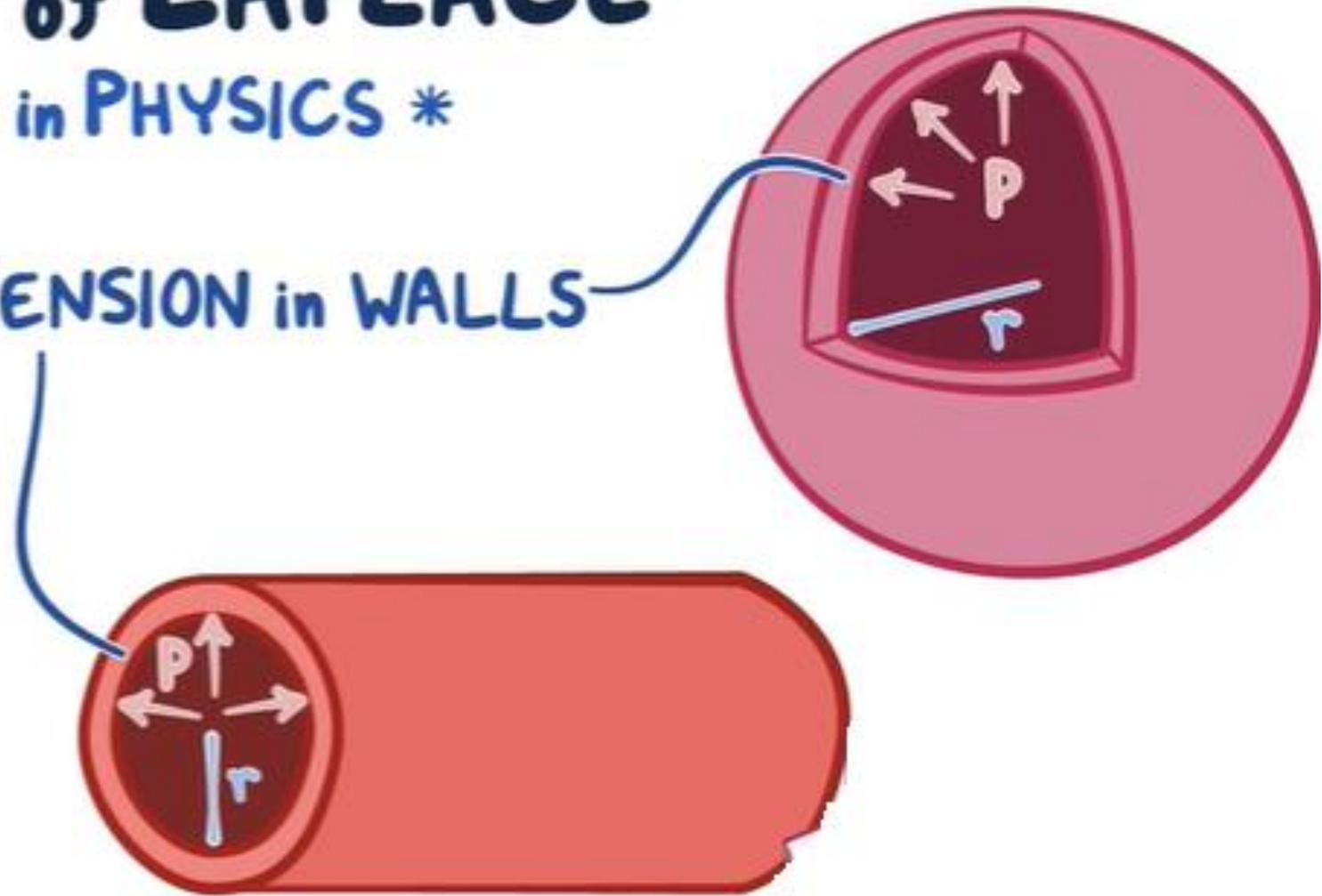
Capacitances and Laplace law

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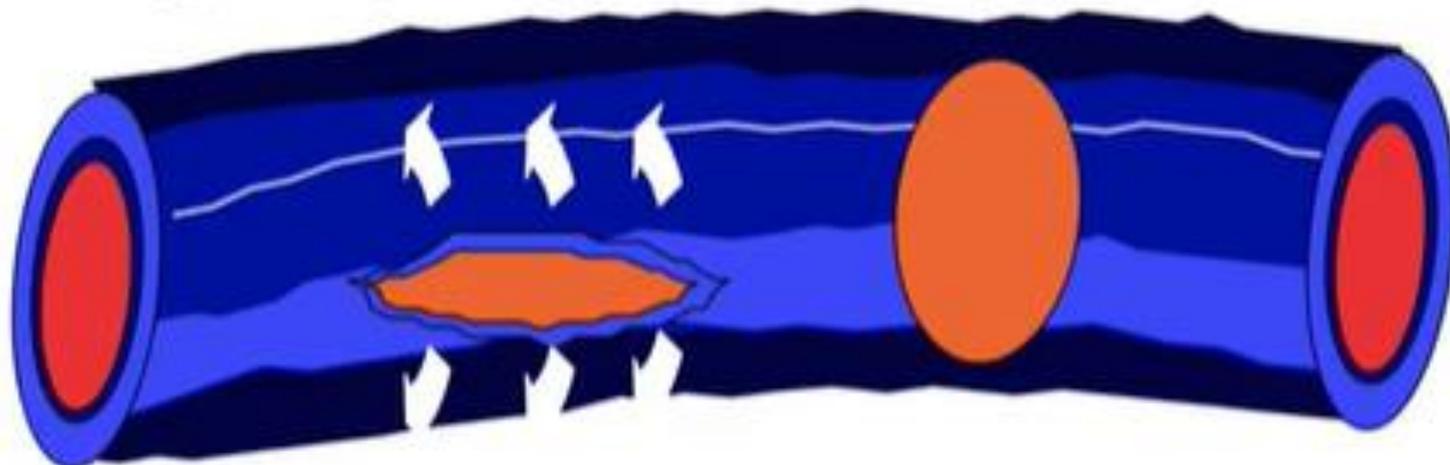
LAW of LAPLACE

* in PHYSICS *

TENSION in WALLS



$$\text{TENSION (dynes/cm)} = \text{PRESSURE (dynes/cm}^2\text{)} \times \text{RADIUS (cm)}$$



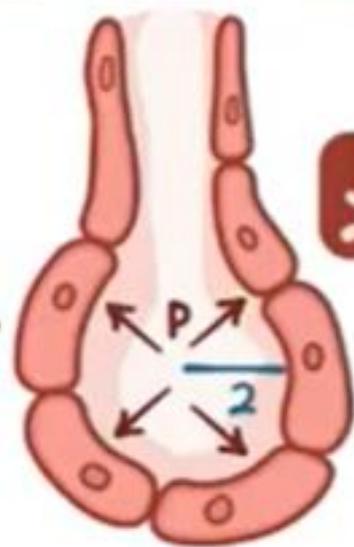
↑ PRESSURE → ↑ TENSION → ↓ RADIUS
(to maintain tension constant)

↓ PRESSURE → ↓ TENSION → ↑ RADIUS
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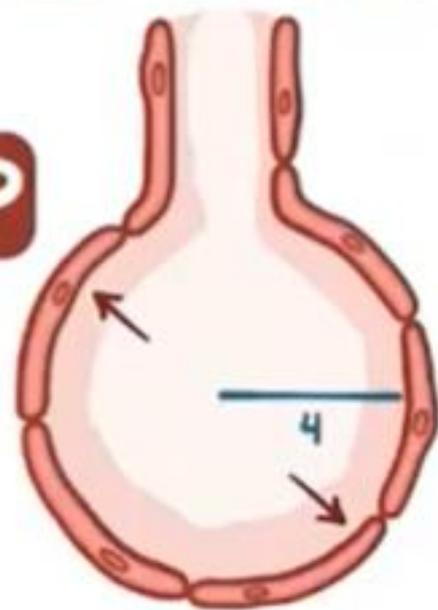
WALL TENSION \propto PRESSURE (P) \times RADIUS (r)

$$\underline{8} = \underline{4} \times \underline{2}$$

$$\underline{8} = \underline{2} \times \underline{4}$$



NEED
>4P **>2P**
to INFLATE

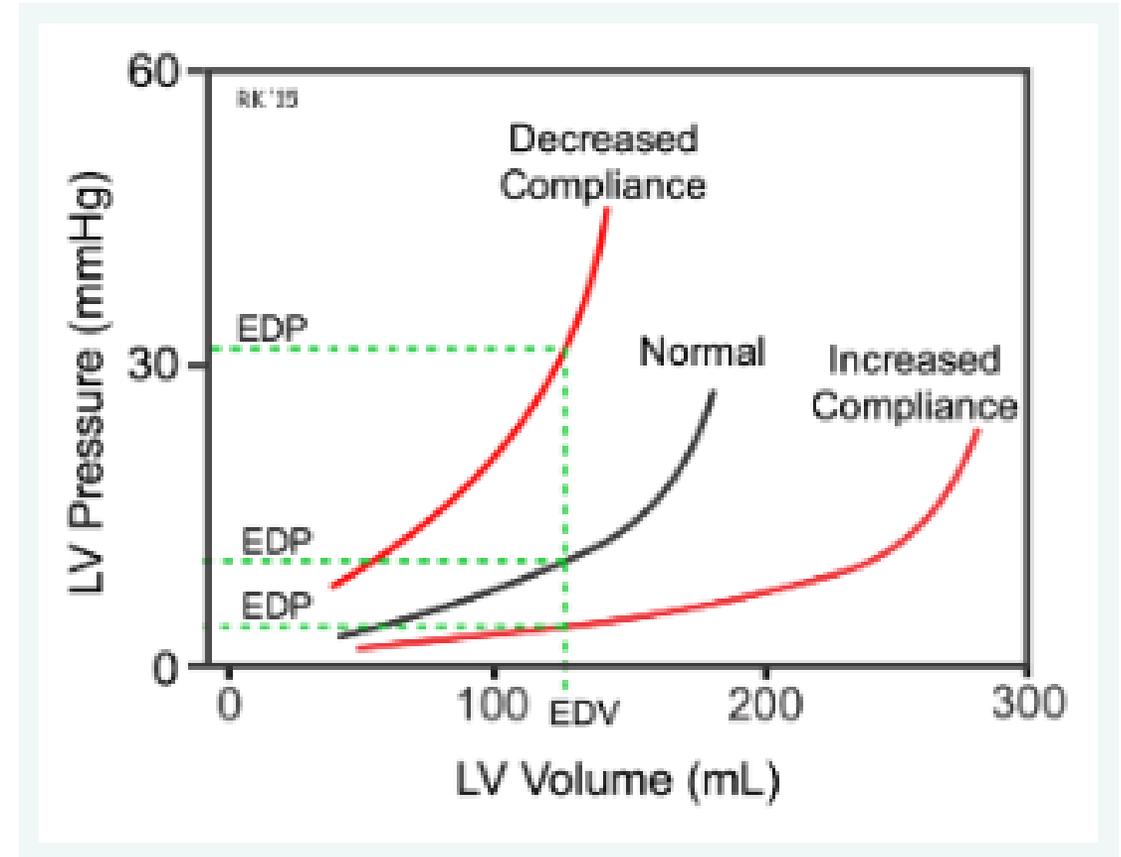


$$\text{WALL STRESS} = \frac{\text{PRESSURE} \times \text{RADIUS} \downarrow}{2 \times \text{WALL THICKNESS} \uparrow}$$



Ventricular Compliance

- As the ventricle fills with blood, the pressure and volume that result from filling are determined by the compliance of the ventricle. Normally, compliance curves are plotted as the change in volume (ΔV) over the change in pressure (ΔP). Therefore, the slope of the relationship is the reciprocal of the compliance, which is sometimes referred to as ventricular "stiffness."
- As the ventricle fills with blood and its volume increases, the pressure within the ventricular chamber passively increases (see the Normal filling curve in the figure). The relationship is not linear, particularly at higher volumes, because the compliance of the ventricular wall decreases ("stiffness" increases) the more the ventricular wall is stretched. This occurs in most biological tissues.
- in ventricular hypertrophy the ventricular compliance is decreased (i.e., the ventricle is "stiffer") because the thickness of the ventricular wall increases; therefore, ventricular end-diastolic pressure (EDP) is higher at any given end-diastolic volume (EDV)
- In a disease state such as dilated cardiomyopathy, the ventricle becomes very dilated without appreciable thickening of the wall. This dilated ventricle will have increased compliance as shown in the figure; therefore, although the EDV may be very high, the EDP may not be greatly elevated.



“Conductance” of blood in a vessel and Its relation to resistance

Conductance (C_L) is a measure of the blood flow through a vessel for a given pressure difference. .

$$C = \frac{\Delta V}{\Delta P}$$

This is generally expressed in terms of milliliters per second per millimeter of mercury pressure, but it can also be expressed in terms of liters per second per millimeter of mercury or in any other units of blood flow and pressure.

It is evident that conductance is the exact reciprocal of resistance in accord with the following equation:

$$\mathbf{Conductance = 1/Resistance}$$

The vascular compliance is proportional to the vascular distensibility and vascular volume of any given segment of the circulation. The compliance of a systemic vein is 24 times that of its corresponding artery because it is about 8 times as distensible, and it has a volume about 3 times as great.