L-28

Last lecture Dr.Arwa

LAW OF LAPLACE

*Laplace's law, the tension upon the muscle fibers in the heart wall is the pressure within the ventricle multiplied by the radius within the ventricle divided by the wall thickness.

T = P x r/wt

This ratio is the other factor in setting the afterload.

- Exercise affect stroke volume :-

Exercise→ increase venous return to heart→ increase end diastolic volume (EDV)→ increase stroke volume→ increase heart rate.

Isometric contraction (length-tension relationship)

****The Frank-Starling mechanism**: occurs as the result of the length-tension relationship observed in striated muscle, including skeletal muscles and cardiac muscle.

As a muscle fiber is stretched, active tension is created by altering the overlap of thick and thin filaments. The greatest isometric active tension is developed when a muscle is at its optimal length.

****In most relaxed skeletal muscle fibers,**
passive elastic properties maintain the muscle fibers length near optimal, as determined usually by the fixed distance between the attachments points of tendons to the bones at either end of the muscle.

****the relaxed sarcomere length of cardiac muscle cells,**
in a resting ventricle, is lower than the optimal length for contraction.
There is no bone to fix sarcomere length in the heart (of any animal) so sarcomere length is very variable and depends directly upon blood filling and thereby expanding the heart chambers.

-Isometric contraction in skeletal muscle will not cause an observe shortening in the whole muscle fiber, but the microscopic filaments (actin , myosin) will overlap upon each other.

-The force of exercising is very high compare to tension.

-Isometric contraction in skeletal muscle fiber will maintain their length near optimal.

-Cardiac muscle fibers has no optimal length (variable in length), because there is no bone to fix sarcomere length.

***Cardiac hypertrophy:** is an adaptive process which occurs as a result of increased stress endured by the heart

***Concentric hypertrophy:** is associated with increased left ventricular wall thickness; an increase in pressure, common in hypertension or resistance training. May have a lower afterload.

*** Eccentric hypertrophy** is characterized by dilatation of the left ventricular chamber; an increase in volume, common endurance training. Has a higher afterload.

*However, there occurs a general increase in the overall size of cardiomyocytes under both conditions.

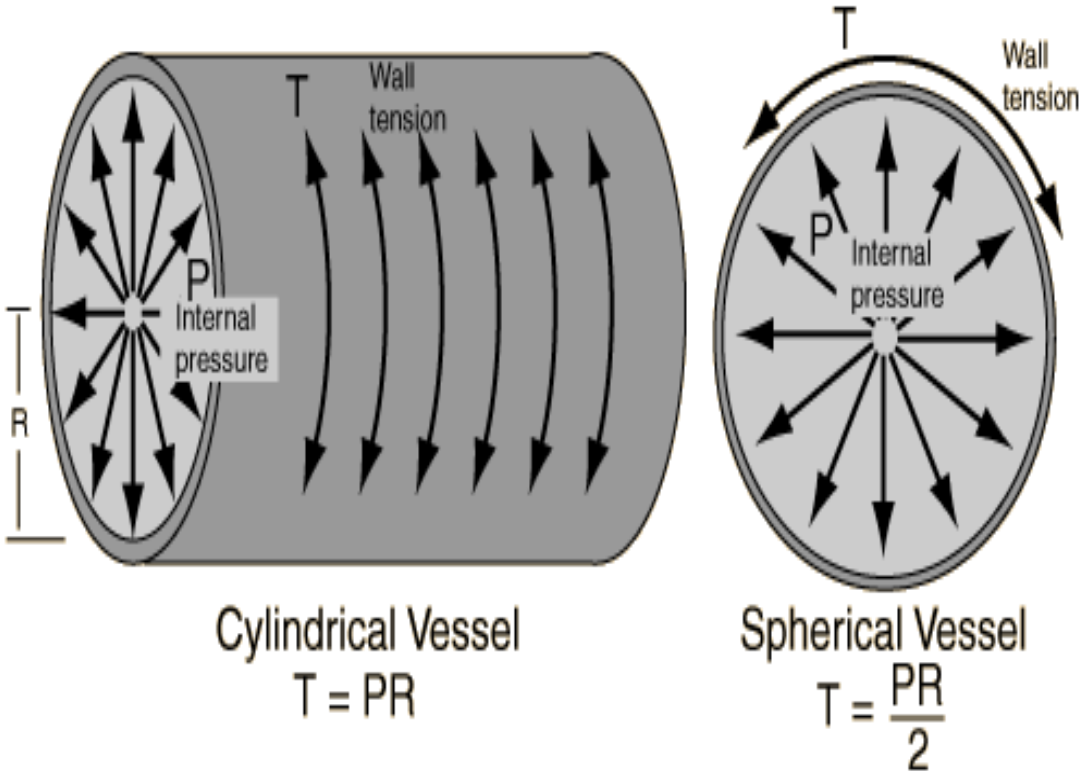
****Concentric hypertrophy:**
main reason (increase in blood pressure) because of increasing the wall thickness.
So, This will cause low after load because decreasing of (end diastolic volume) and increasing in(tension).
-The pumping of blood is less than normal
- (iron pumping muscle is in resistance training).

****Eccentric hypertrophy:**
increase in venous return to increase in blood volume > increase in tension on ventricle wall > dilatation of ventricle wall.

****3rd and 4th heart sounds are heard in abnormal situations.**

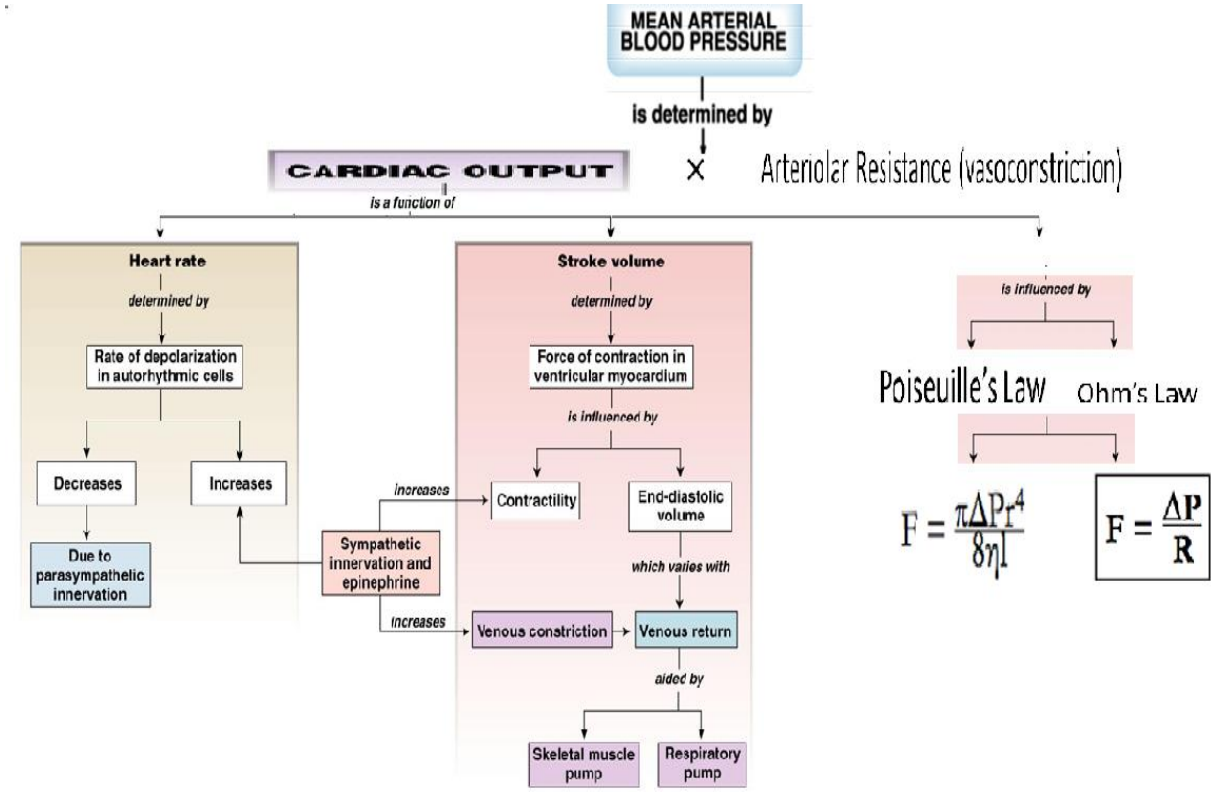
**** increase in blood volume in (pathological situation) »»» (failure of ventricle systole) » producing 3rd heart sound**

****INCREASE IN BLOOD PRESSURE IN (PATHOLOGICAL SITUATION) » PRODUCE 4TH HEART SOUND**



*The tension in cylindrical vessel is higher (pressure and radius are higher) than spherical vessel.

Summary of blood pressure and flow regulation



*sympathetic and parasympathetic regulate the heart rate in normal range.

*They are not response to brady/tachy cardia.

*Tachy/brady cardia are happening in pathological cases, and they are part of heart arrhythmia.

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