BLOOD PRESSURE

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OBJECTIVES

- ***Identify Systolic BP***
- ***Identify Diastolic BP***
- ***Identify Resistance***
- ***Identify Velocity and Flow***
- ***Identify Cross- Sectional area***
- ***Identify Perfusion pressure***

BLOOD PRESSURE

- Blood pressure =cardiac output X total peripheral resistance

$$\boldsymbol{BP = CO\ \ X\ TPR}$$

First, we want to decide what CO and TPR is , then we get to the right meaning of BP

- Cardiac output (Flow)= Heart rate X Stroke volume

$$\boldsymbol{CO\ (F) = \ HR\ X\ SV}$$

ml/min= Beat/min X ml/ Beat

CARDIA OUT PUT

HR

- PSNS -
- SNS +
- Hormones (EPI, NE) +
- IONS: Ca++, Na+ , K+ dependents on their level increase or decrease

SV

+ Preload ; Increase the blood volume returns increase diastolic volume

+ Contractility ; SNS (EPI,NE+), Hormones (glucagon,T3 and T4), IONS like Ca++

- Afterload; Hypertension, Atherosclerotic plaques , TPR

CONTINUED CARDIA OUTPUT

- Anther formula relate to CO

1 ml= 1 Cm3

Flow = Cm3/min

- Anther formula relate to flow

Velocity (Cm2/min)= Flow (cm3/min)

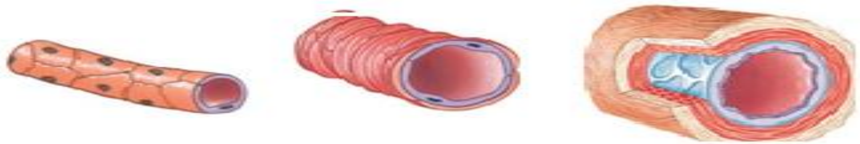
Cross sectional area (Cm2)

V= F/A

- How to relate this to cardiac output

- Increase Flow (CO)   Increase V
- Cross sectional area; measured in units of bier square because the blood vessels are cylinder in shape

A (πr2); Increase A   Decrease V

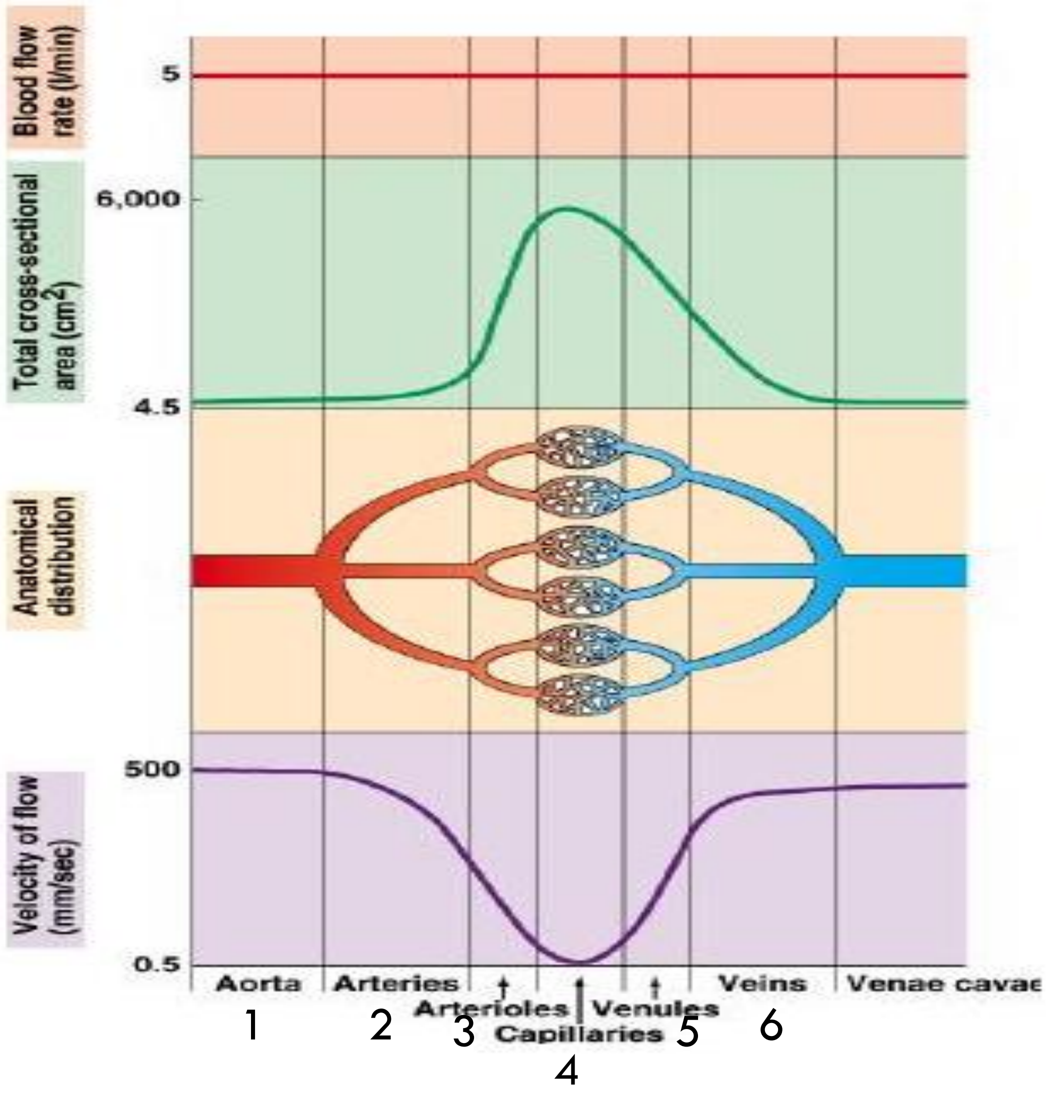


VELOCITY AND CROSS-SECTIONAL AREA

- The cross-sectional area for the aorta is going to be very very small as you start to move toward arterioles to capillaries it is going to start rising
- As you get towards the venules it starts decreasing again and comes back down
- You have noticed so far that the aorta and arteries don't change much they change a just little bit
- But once you hit the arterioles that's when the actual specifically the cross-sectional area increases

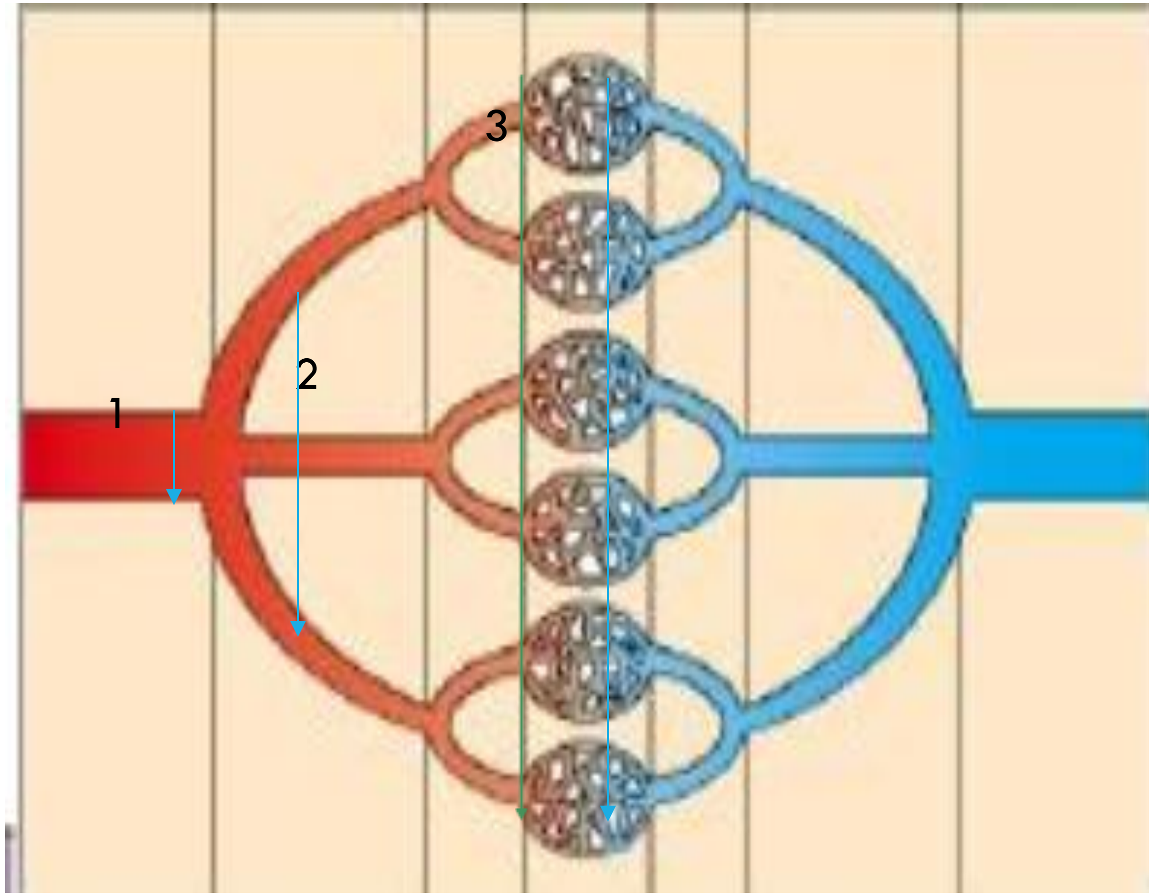
<u>But we have said that the aorta has a vey big diameter??</u>

- We are going to compare between each one of theses vessels
- We are going to take these numbers and correlate what we are going to talk in the next slide



CONTINUED CROSS –SECTIONAL AREA AND VELOCITY

- *This big one here is aorta (1) then the aorta splits it gives off arteries (2) then arterial branches (3) and then capillary branches ten to hundred per capillary bed (4) and after drain from the capillary bed then they go to what called venules (5) and from the venules they come eventually into the veins (6) and again to vena cava system*
- *compare the cross sectional are the capillary and cross-sectional area aorta and velocity*
- *As you increase the cross-sectional area the velocity decrease*
- *The velocity is the slowest in the capillaries and faster in the aorta*



RESISTANCE

How to relate TPR to blood pressure

$$F = \Delta P/R$$

$$CO = \Delta P/TPR$$

$$R = 8nl/\pi r4 \quad Poiseuille's\ law$$

$$n\ \alpha\ R$$

$$n = \ viscosity$$

Polycythemia (high Hct)$\alpha\ n$; a lot of friction between the layers, because whenever blood is flowing it flows in layers when there is a lot of friction rubbing up against between those layers because increase in viscosity and slow the flow down

Anemia $\frac{1}{\alpha} n$

$$L\ \alpha\ R$$

Increase in Weight and height increases in L

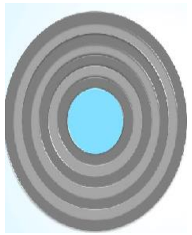
$r = 1/\alpha\ R$ **the most important factor that affecting the R because it is raised to power 4**

Vasodilation increase in r

Vasoconstriction decrease in r

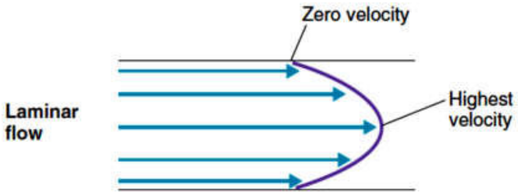
BLOOD FLOW

Laminar flow : normal blood flow in the blood vessels (physiological)



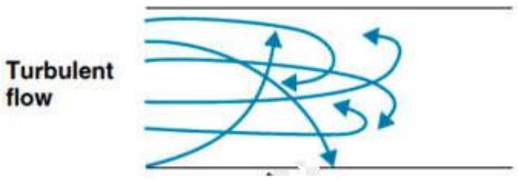
- *As you go toward the edges the velocity the blood is going to be slower and the velocity in the middle is highest*

- *So imagine you are looking to blood vessels as a circle, and you are looking at the flow from the back you are going to notice that is flow is very concentric and this type of flow is silent*



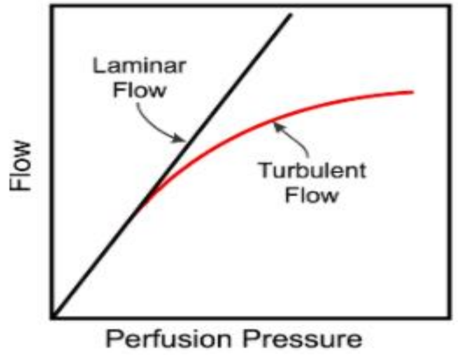
Turbulent flow : pathological and physiological one

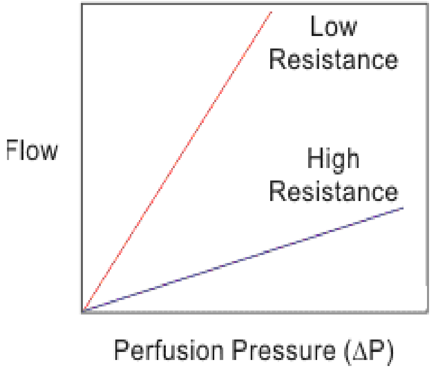
- *Inside our heart you have a valves mitral valve and aortic valve whenever blood is being pumped upward right it can hit mitral valve as it hits mitral valve it can develop turbulent flow*



- *Imagine a blood vessels and plaques inside ; as the normal flow gets to the occlusion it start developing a turbulence and that gives a lot of heat and changes the action of perfusion pressure and produce what called brutes and can be heard at carotid artery so if you take a stethoscope and put it over carotid artery you can hear it is actual sounds that caused by turbulent flow. It also can produce murmurs*

If you look at the graph here ; as you increase the pressure the flow is increasing in normal or laminar flow, but you get to the point where the flow veers off and the flow start decreasing as the perfusion pressure start increasing





If there is a turbulent flow it decreases the actual flow the volume of blood that circulating through an area of blood vessel per a minute and increase the perfusion pressure and the resistance is going to be very high

PERFUSION PRESSURE

Perfusion pressure (∆p) = Mean arterial pressure (MAP) – the central venous pressure(CVP)

The central venous pressure (CVP) determines the right atrial pressure (RAP)

The volume of blood pumped toward heart is your central venous pressure and the venous pressure affect your right atrium pressure and it is about 3-8mmHg; it is small we don't even consider it often

So what we say that the

*(∆**p**) = Mean arterial pressure (MAP) what does that mean???*

Systolic pressure

When ever the heart contracting it pumping the blood outside the heart ; the force at which we are trying to push the blood out of the heart and into the actual major arteries is the systolic pressure (left ventricles to aorta) and on average it is a bout 120mmHg

When ever the blood comes into the aorta it stretches the wall of the aorta so the wall of the aorta is going to be stretched now this is not that is stretching the walls is the systolic pressure but what happens is eventually; the actual aorta is very elastic and wants to recoil and squeeze the blood downwards or upwards to the head and the neck

Diastolic blood pressure

Whenever the aorta is coming back to it is natural size the point when is relaxing and going back to its normal size original size ; this is called the diastolic blood pressure and on average it is about 80mmHg

MEAN ARTERIAL BLOOD PRESSURE

$$MAP = diastolic\ pressure + 1/3\ pulse\ pressure = 93mmHg$$

Pulse pressure

The difference between systolic and diastolic pressure which is 40mmHg on average

- *To calculate a mean arterial pressure, double the diastolic blood pressure and add the sum to the systolic blood pressure. Then divide by 3. For example, if a patient's blood pressure is 83 mm Hg/50 mm Hg, his MAP would be 61 mm Hg. Here are the steps for this calculation:*

$$MAP = \frac{SBP + 2\,(DBP)}{3}$$

the ventricles spend approximately one-third (1/3) of their time in systole, and two-thirds (2/3) in diastole

It is so important because it determines the actual pressure by which will propel the substances out of the capillary beds into the tissues