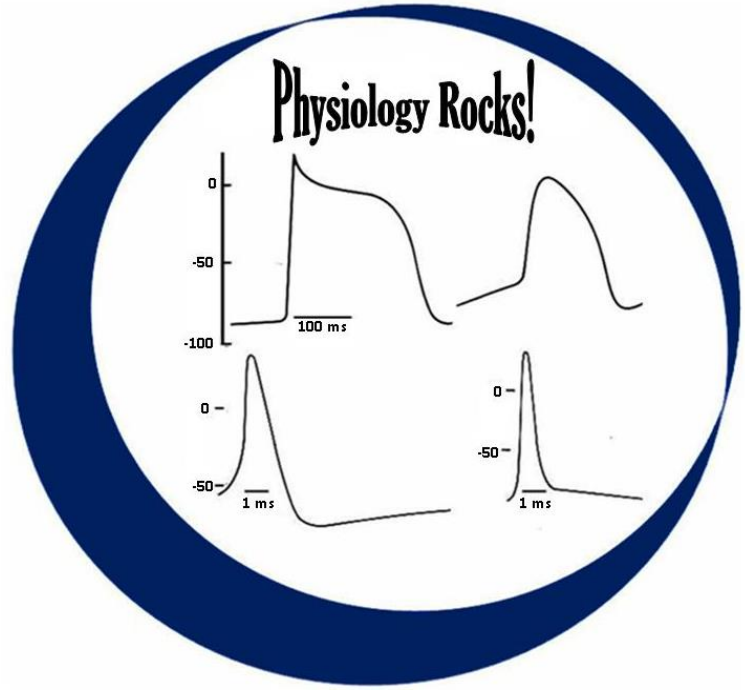
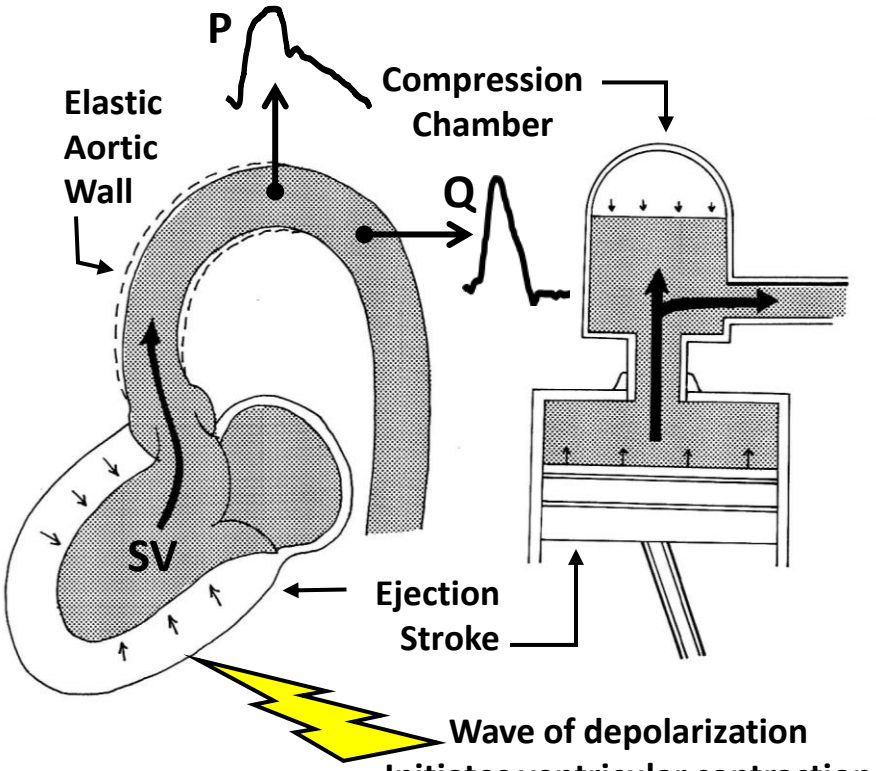
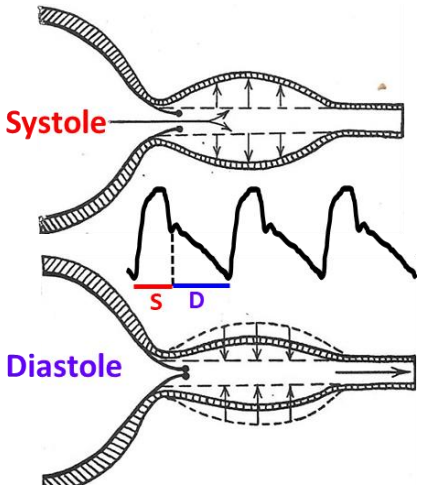
Lecture 29
Arterial Pressures



HN Mayrovitz PhD
mayrovit@nova.edu
drmayrovitz.com

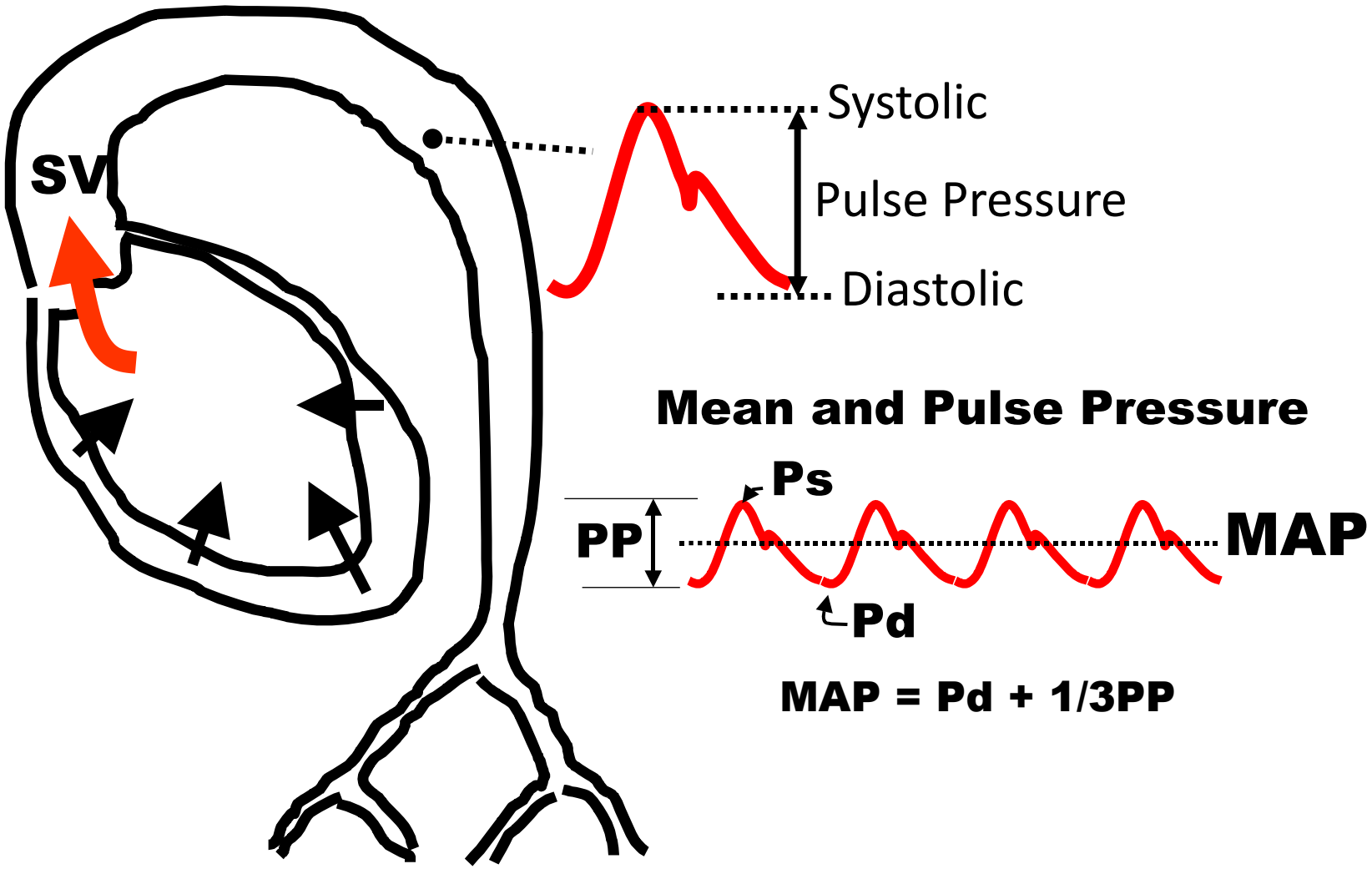
Cardiac Ejection Generates Pressure and Flow



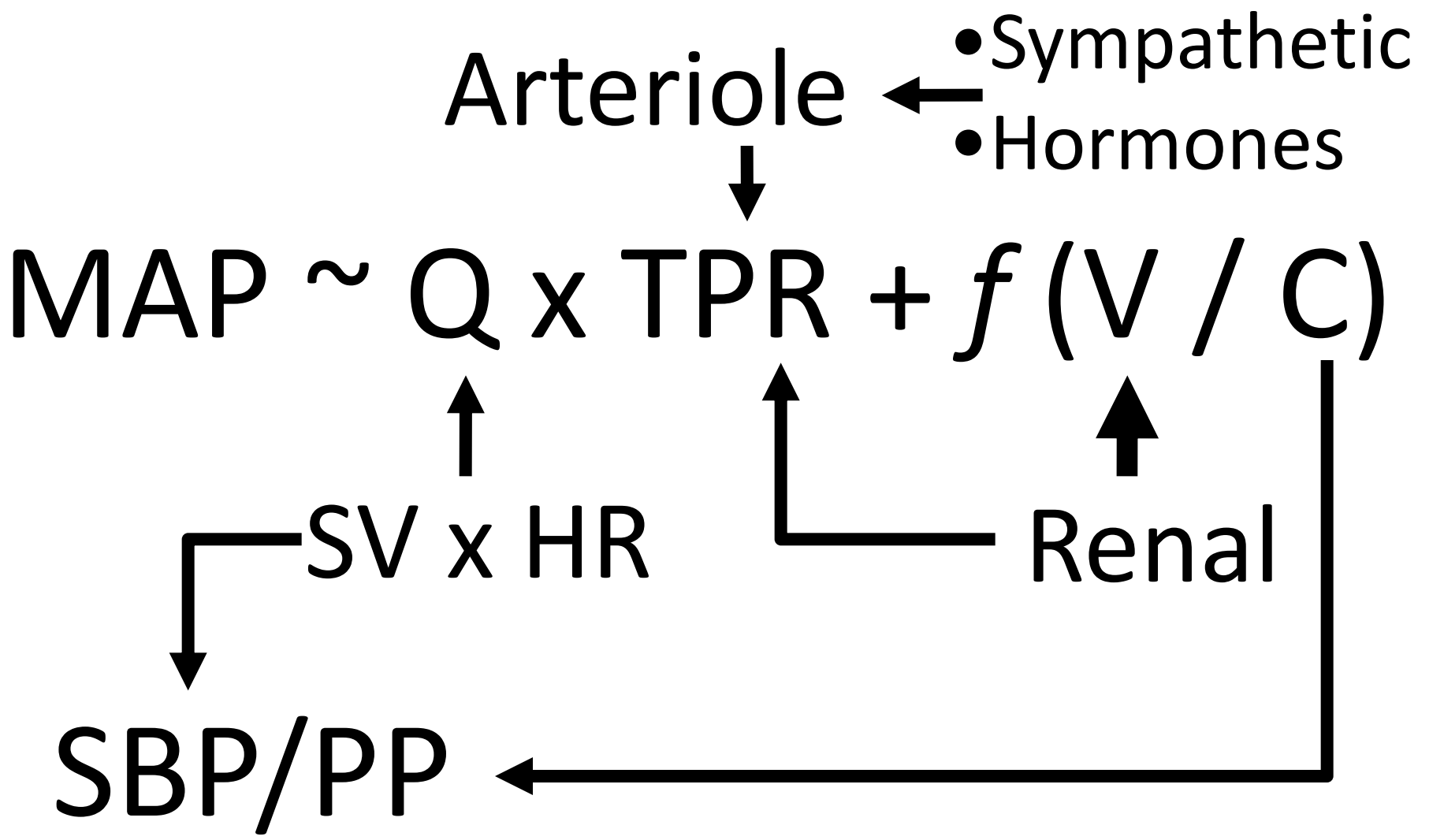


- **Excitation** causes ventricular **contraction**
- Ejected volume = **Stroke Volume**
- Ejected **volume/time** is pulsatile aortic blood flow that **rapidly rises**
- Volume entry into aorta → **Aortic BP**
- Elastic aorta absorbs volume → **Expands transiently**
- Aortic wall acts like a compression chamber that **initially expands during systole** and then in response to stretch helps **propel volume distally during diastole**
- Heart is a pump governed by two parameters **RATE** and STROKE or Heart Rate (**HR**) and Stroke Volume (**SV**)
- **HR x SV = Cardiac Output (L/min)**
- After passing through the organs and supplying their needs blood returns to the heart and the cycle repeats

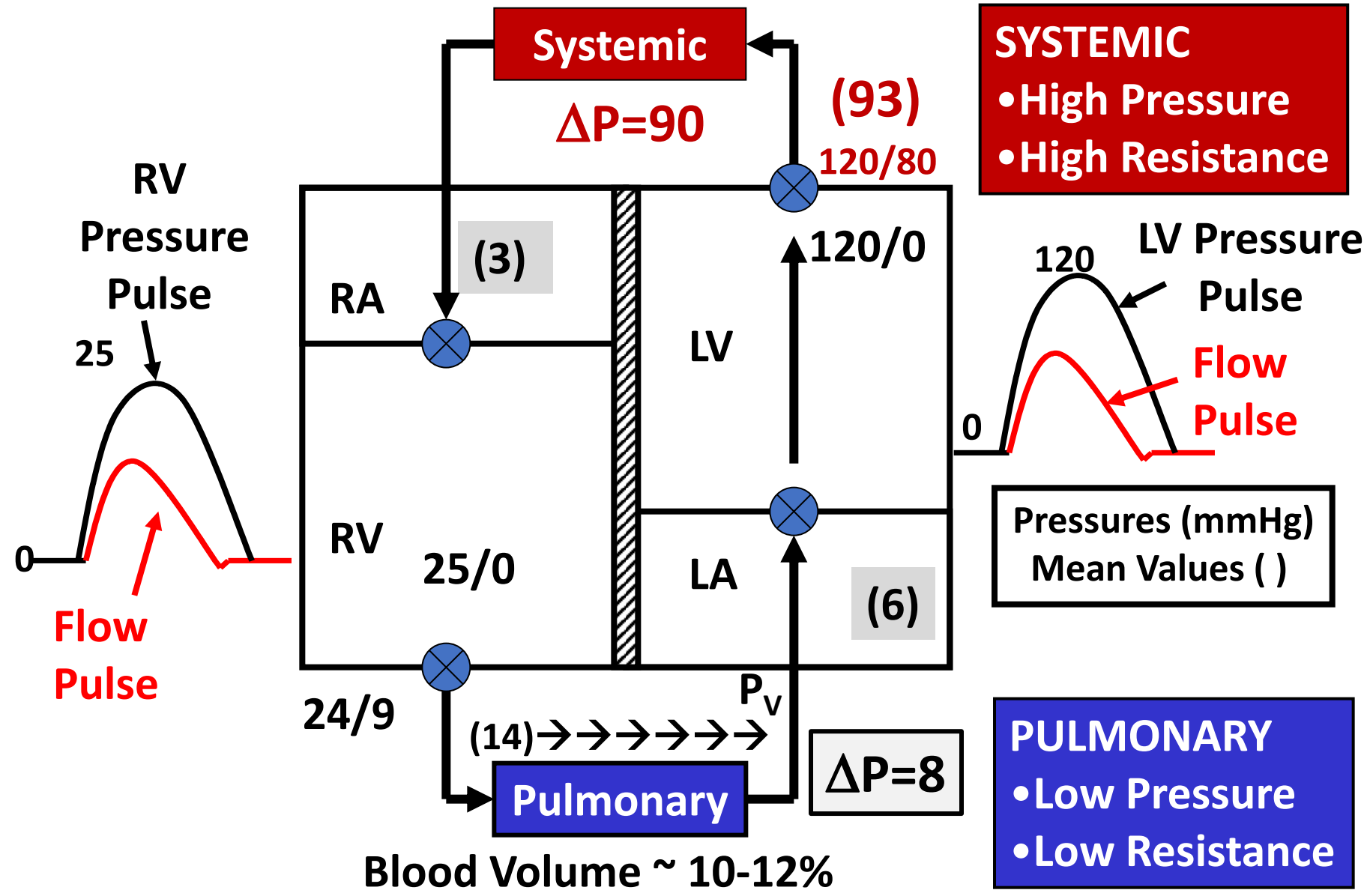
Arterial Blood Pressure Basics



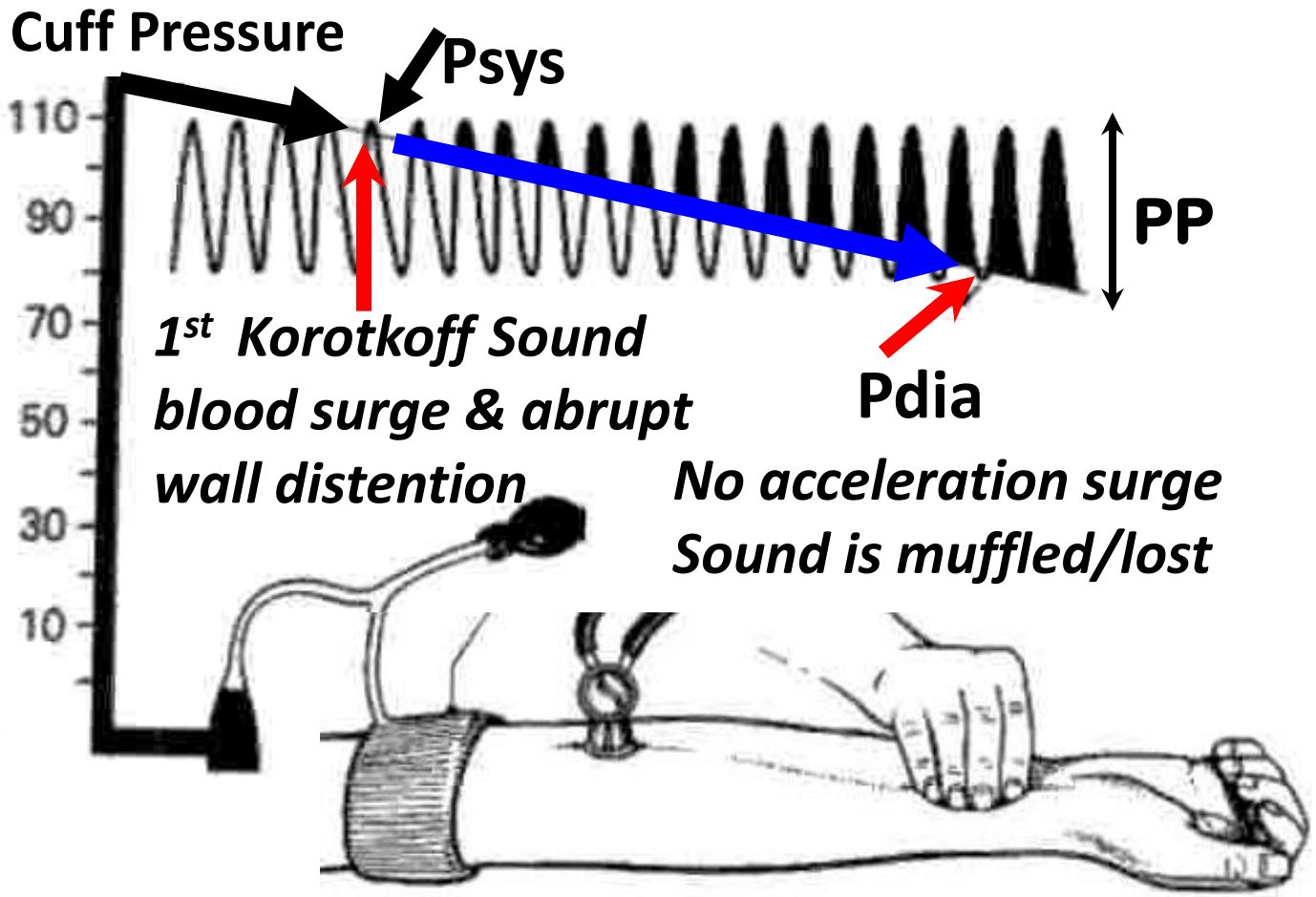
Arterial Blood Pressure (ABP): Major Factors



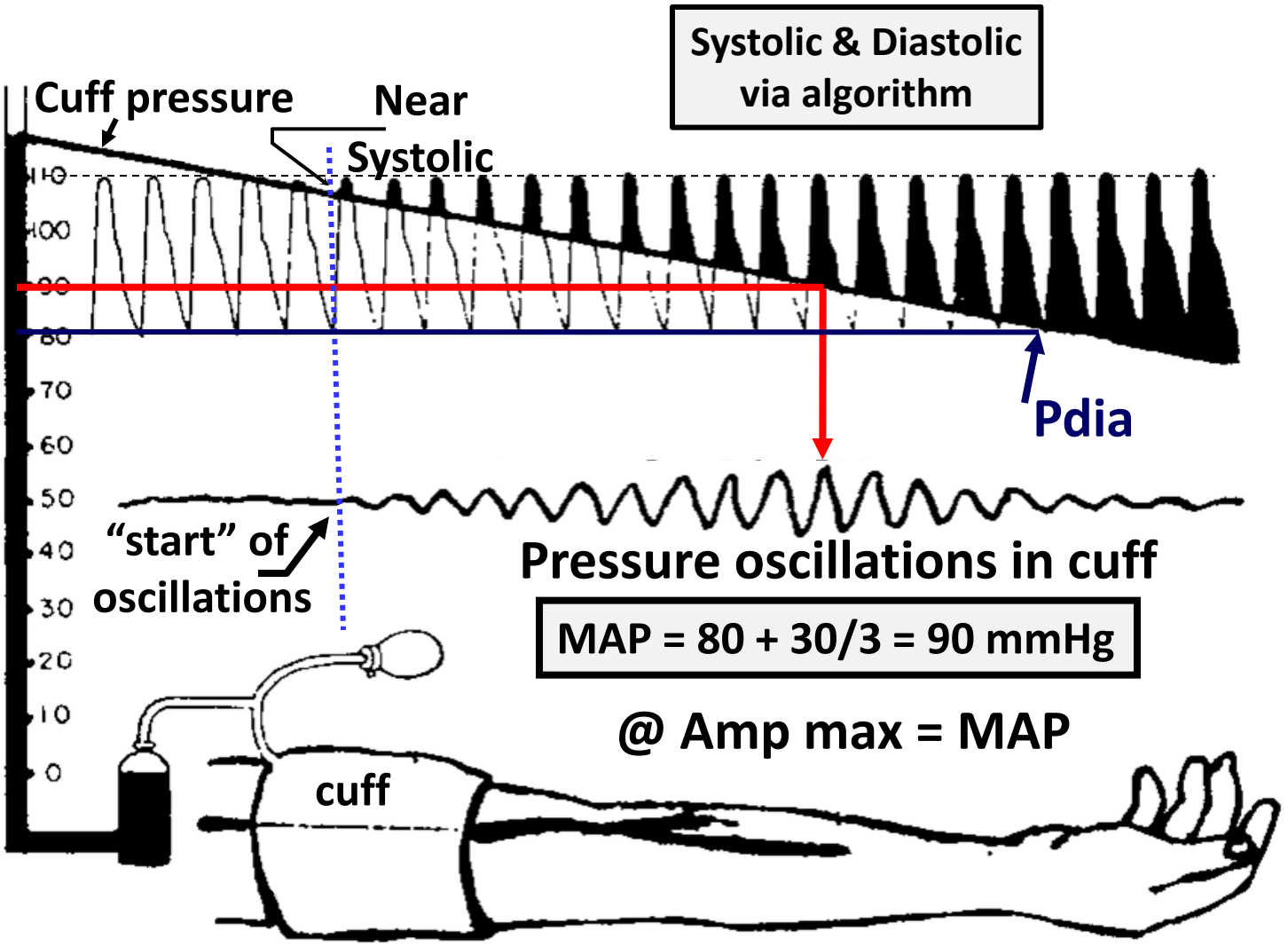
Systemic vs. Pulmonary Hemodynamic Features



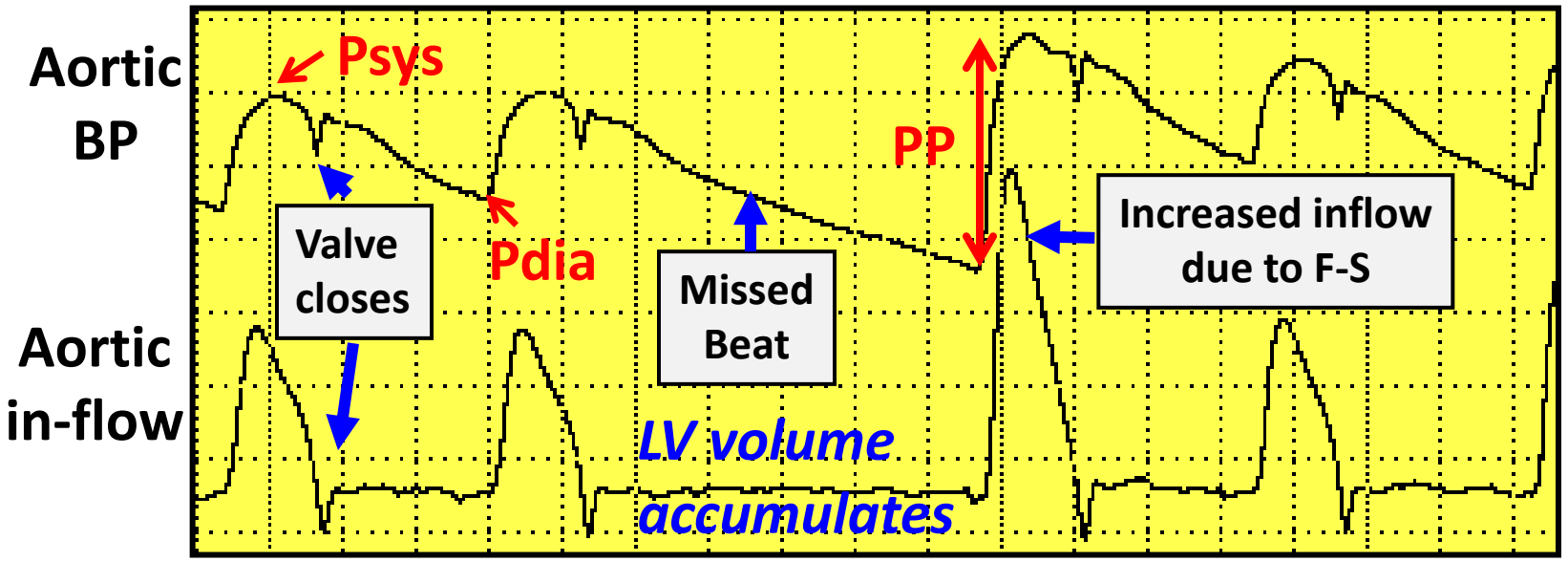
BP Measurement: Sphygmomanometer



BP Measurement: Oscillographic Method



Pulse Pressure Determinants



Increase in pulse pressure (PP)

- Increased rate of LV ejection → + dV/dt
- Increased stroke volume → + SV
- Decreased aortic compliance → - C

Hypertension = High Blood Pressure

So ……. What's High?

Hypertension

BP CLASSIFICATION	SBP (mmHg)	DBP (mmHg)
Normal	< 120	AND <80
Elevated	120-129	AND < 80
Stage 1 Hypertension	130 - 139	OR 80 - 89
Stage 2 Hypertension	>= 140	OR >= 90
Hypertensive Crisis	> 180	AND/OR > 120

If DBP is normal but SBP is high then may be called Isolated Systolic Hypertension (e.g. 145/75, also stage 2 HTN)

→ *Decreased Arterial Compliance*

Hypertension

- **Secondary (Known organ dysfunction related)**
- **Primary (Essential Hypertension – HTN)**

+ TPR

- **Vasoconstriction**
- **Structural wall changes**
- **Microvessel Rarefaction**

+ CO → Early phase of HTN

- Compliance → Systolic HTN

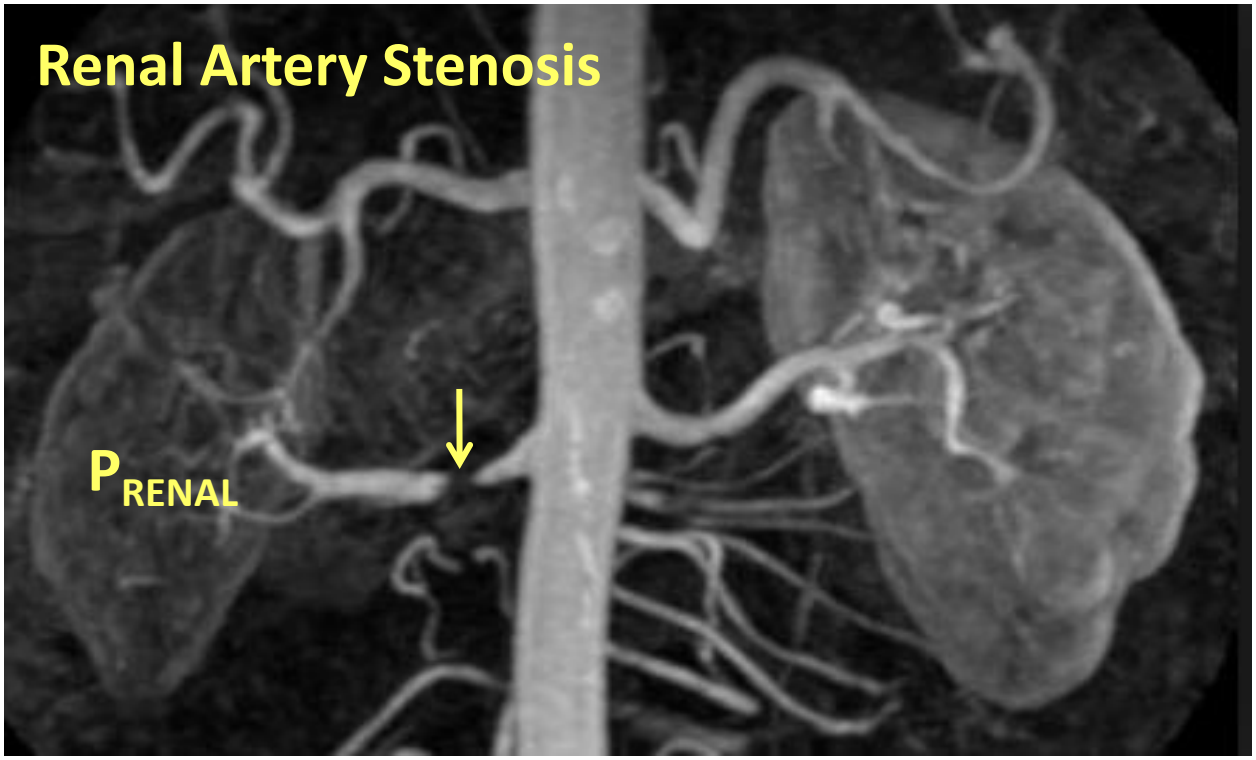
Secondary Hypertension

~ 5 - 15 % of Hypertension Patients

- **Renal artery stenosis (kidney*)**
- **Chronic renal disease (kidney)**
- **Primary hyperaldosteronism (adrenal cortex)**
- **Hyperthyroidism/Hypothyroidism (thyroid gland)**
- **Pheochromocytoma (adrenal medulla)**
- **Preeclampsia / Gestational (pregnancy)**

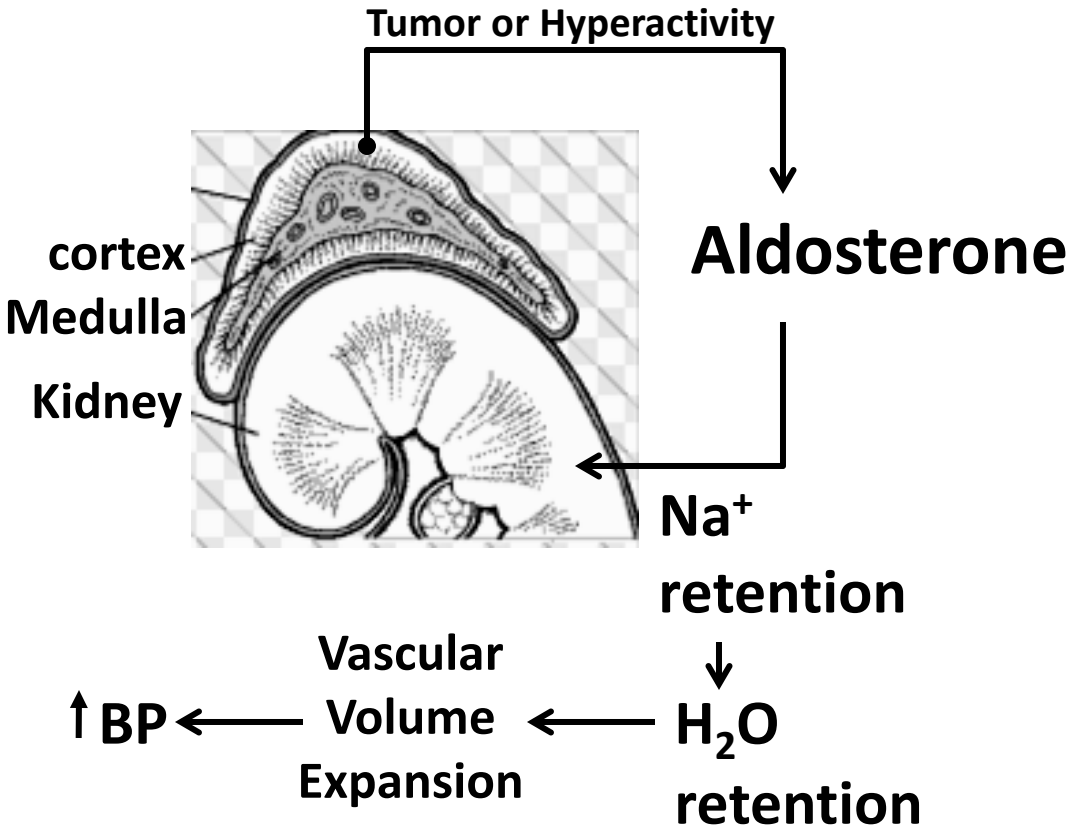
Remainder → Essential HTN

Renal Artery Stenosis → Hypertension

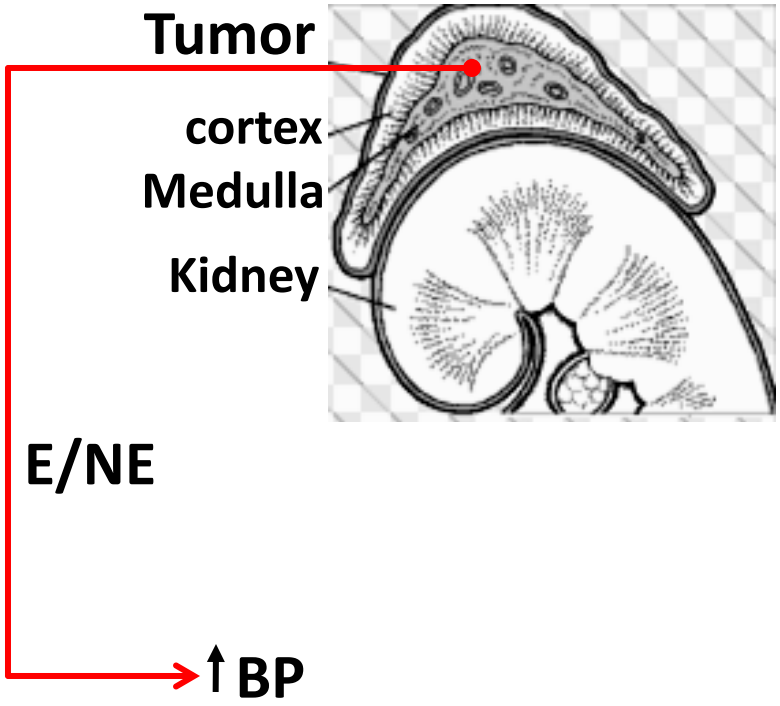


$\downarrow P_{RENAL} \rightarrow \uparrow Renin \rightarrow \uparrow Angiotensin\ II \rightarrow \uparrow TPR$

Primary Hyperaldosteronism → Hypertension



Pheochromocytoma → Hypertension



Interactive Questions

Which (is) are normotensive?

Which (is) are stage 1 hypertension

Which (is) are isolated systolic hypertension

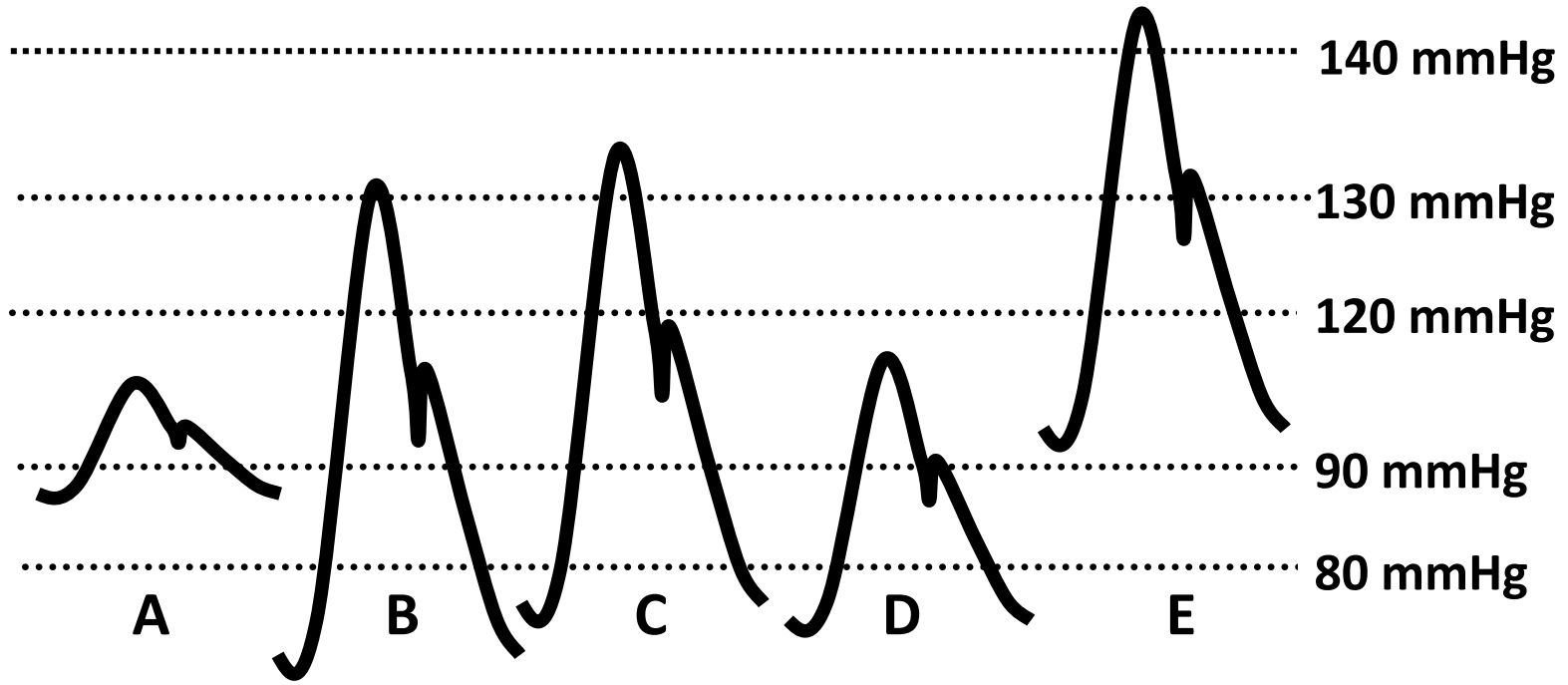
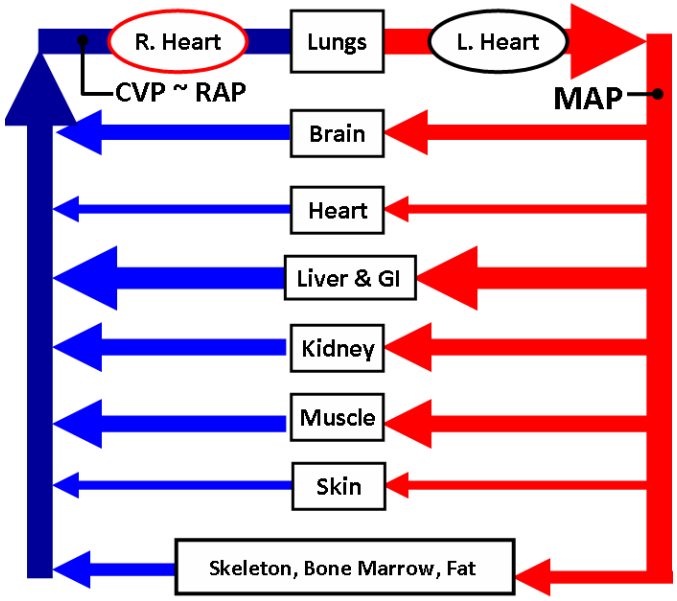


Figure shows artery Pulses of 5 patients

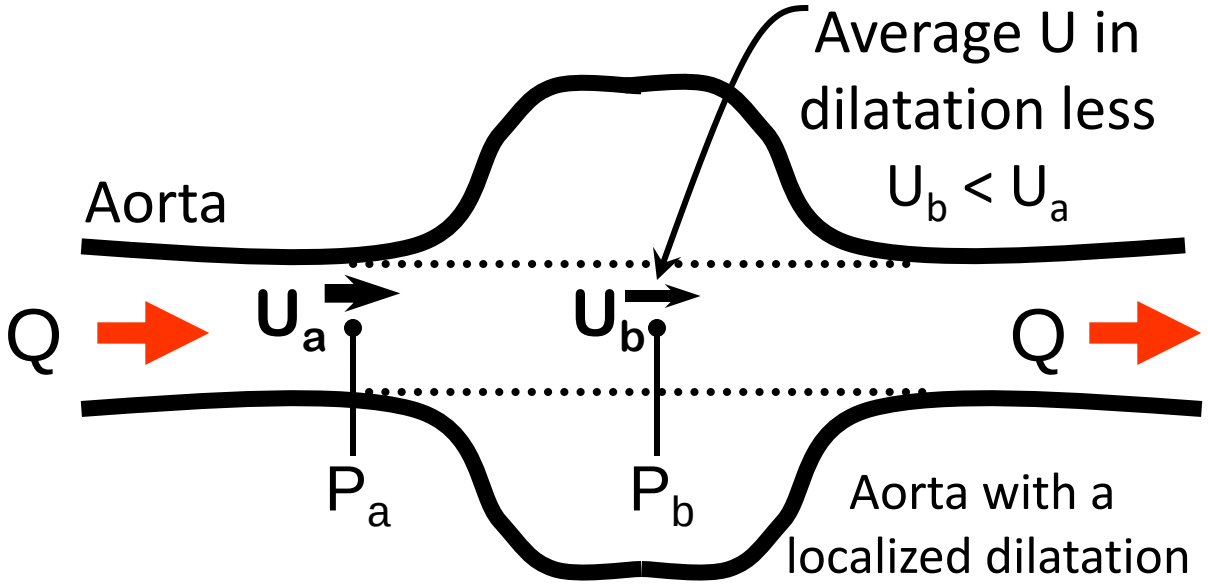
Interactive Question



Bill has the following hemodynamic data
Arterial Blood Pressure = 150/60 mmHg
Central venous pressure (CVP) = 3 mmHg
Stroke Volume (SV) = 100 ml
HR = 50

What is his TPR in Wood units?

"Lossless" Pressure Energy Conversion



If "lossless" total E conserved

$$E = P + 1/2\rho u^2 + \rho gh = K$$

$$P_b = P_a + 1/2\rho(u_a^2 - u_b^2)$$

$$P_b > P_a$$

So - P within expansion is greater than upstream
A case where flow is not from higher to lower pressure

Interactive Question

Reynolds Number:

A. Has the units of inverse seconds

B. Is an index of resistance to flowing blood

C. Is directly proportional to the viscosity of flowing blood

D. Is an index of inertial to viscous forces that operate in flowing blood

E. Assumes a high value in capillaries because of their small diameter

Interactive Question

If all arterioles of an organ vasoconstrict then:

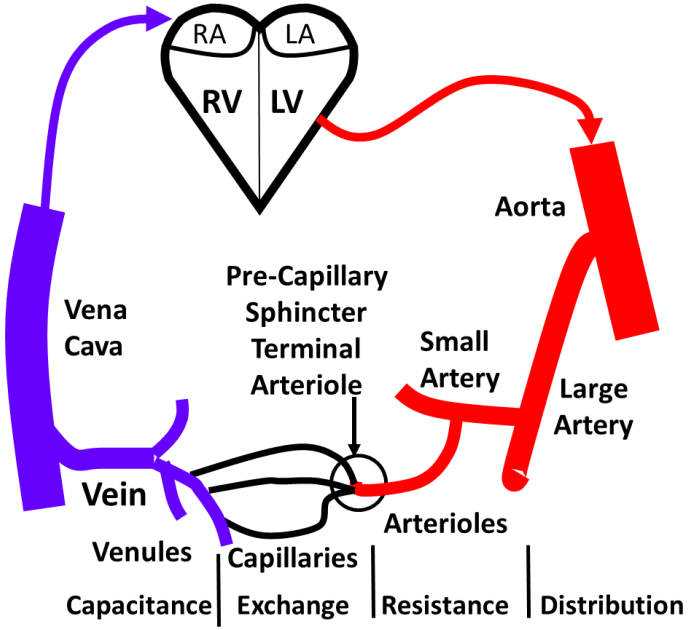
A. Blood flow to the organ increases

B. Blood pressure in the organ's capillaries decreases

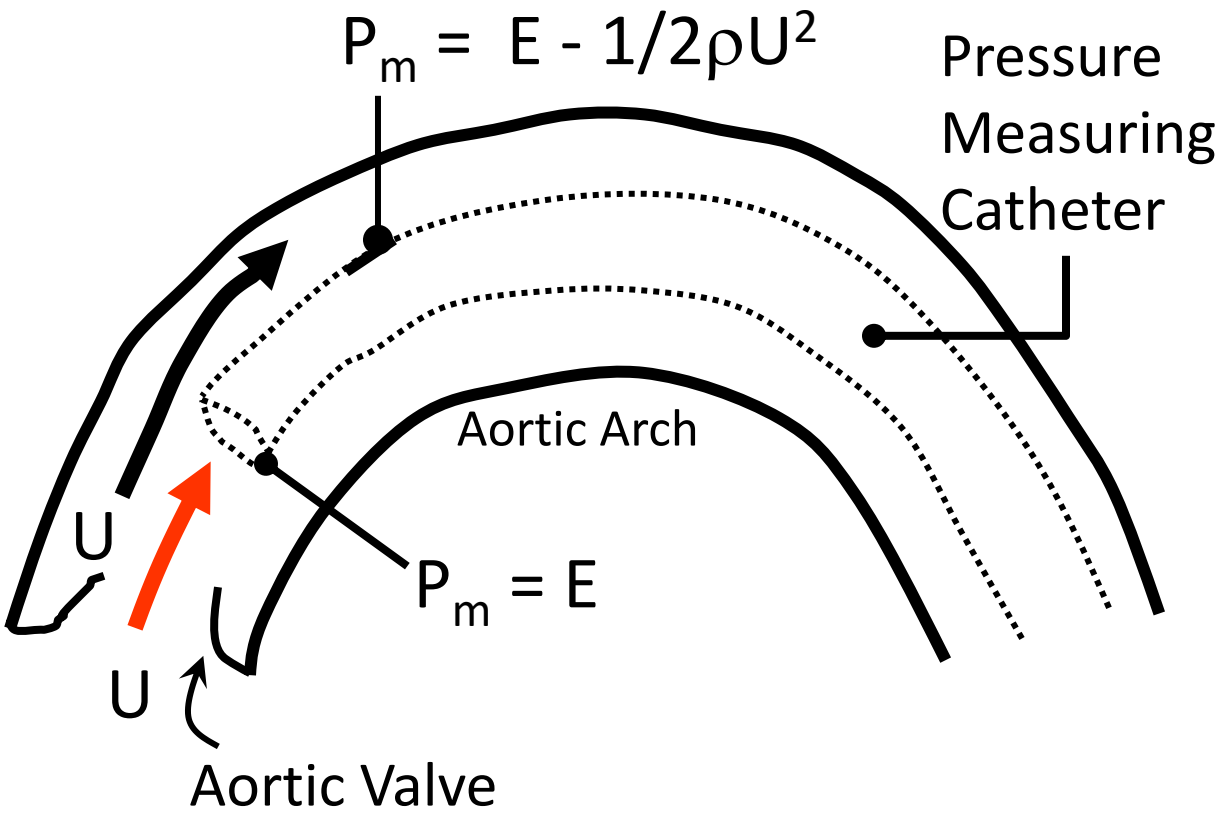
C. Total resistance of the organ decreases

D. Blood flow within arterioles increases

E. Total peripheral resistance decreases



Measuring Aortic Pressure



Measuring "end" pressure gives a pressure value that is higher than aortic wall truly experiences

End of Lecture 29