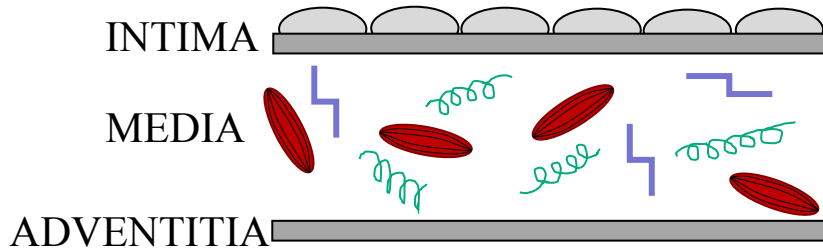




# Arterial stiffness



# COMPLIANCE

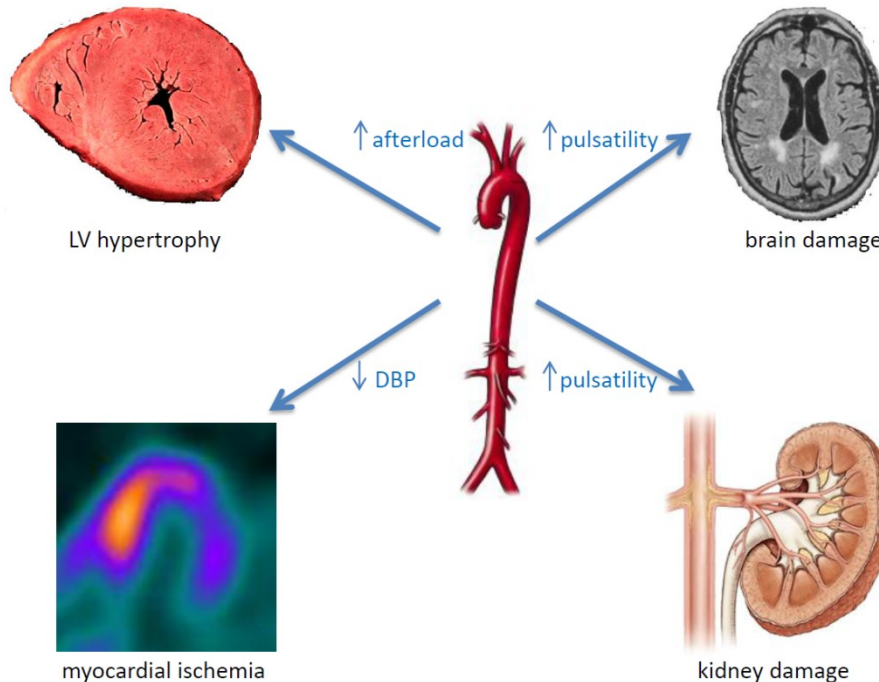


Compliance

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

MEDIA + ADVENTITIA - responsible for arterial stiffness

Stiffness is ability to resist distension when a force is applied to it.



# COMPLIANCE

## Endothelial cells:

- endothelial dysfunction
- ↑ permeability

## Intima:

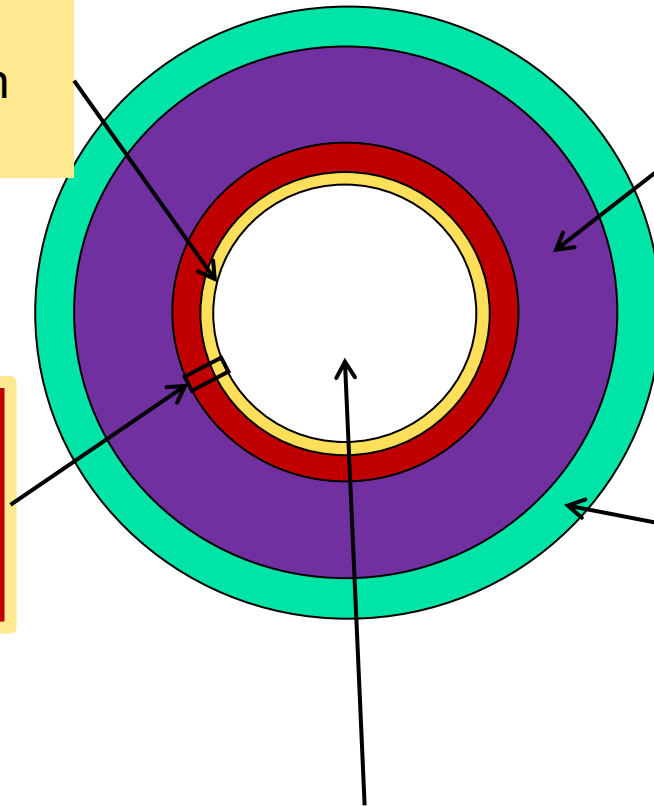
- ↑ collagen
- ↓ elastin
- ↑ AGE`s, TGF- $\beta$ ,  
VSMC

## Media:

- ↑ collagen
- ↓ elastin
- ↑ AGE`s, MMP, VSMC

## Adventicia:

- ↑ collagen
- fibroblasts



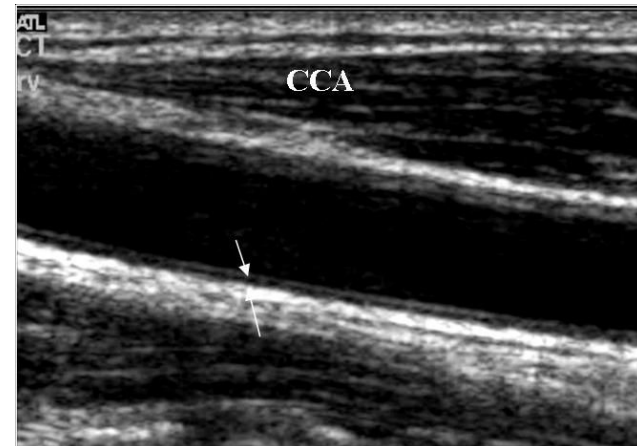
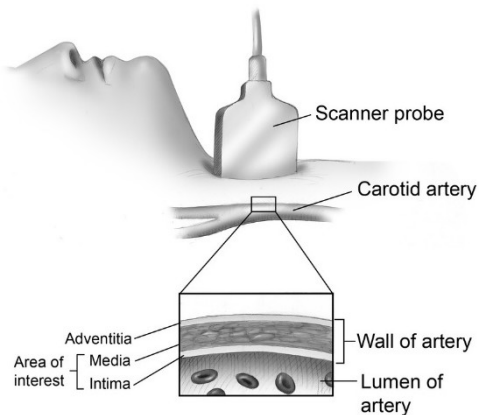
Extrinsic influences

# MEASUREMENT OF THE COMPLIANCE

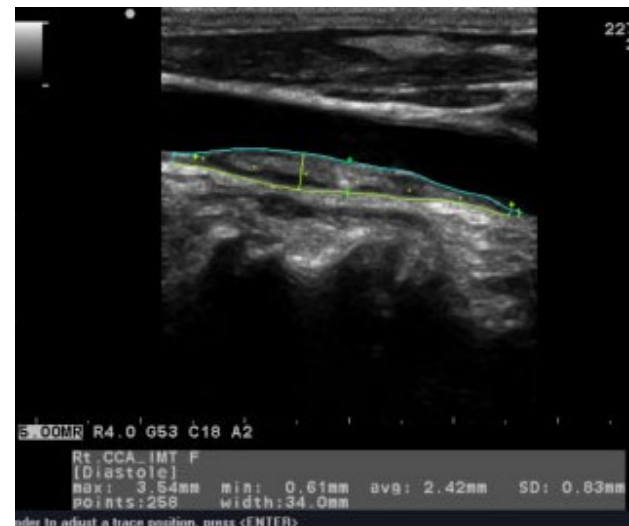
## Indirect ways

- Ultrasound
- Sphygmography (PWV a PWA)
- CAVI measurement
- Bioimpedance

## Intima Media Thickness (IMT)

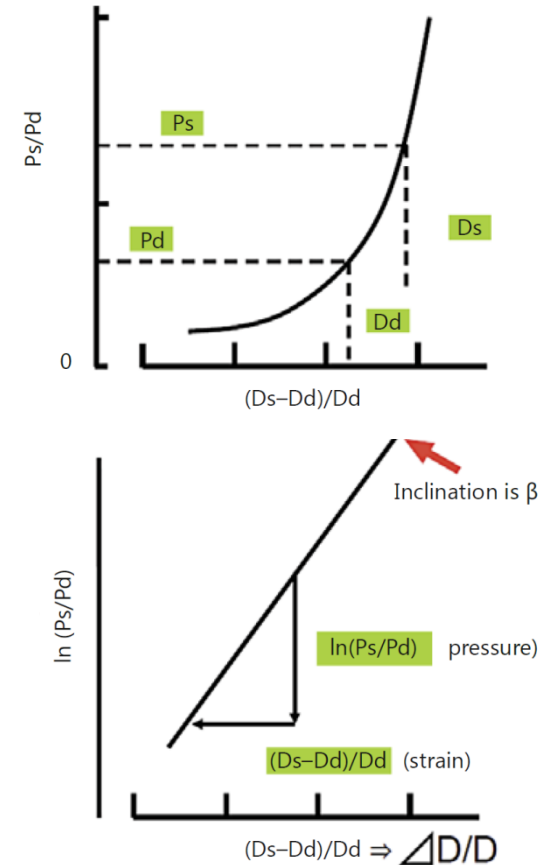
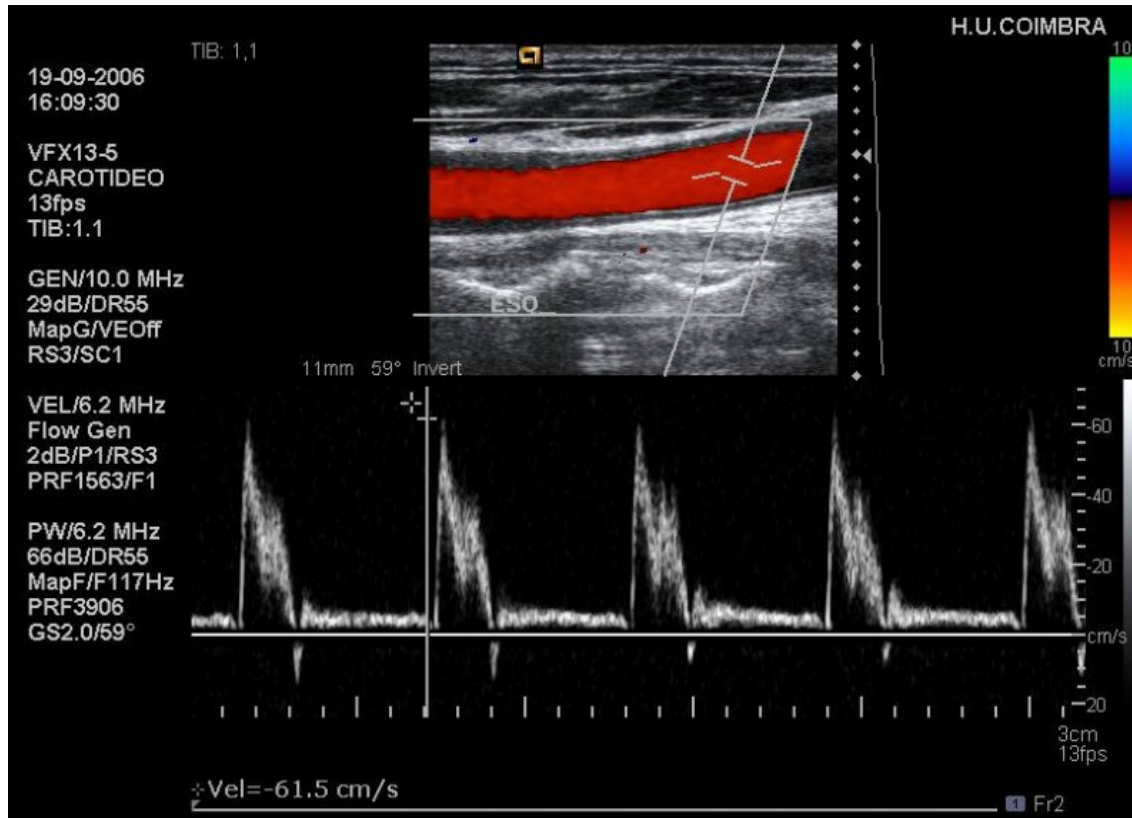


věk		IMT <sub>R</sub> (mm)	IMT <sub>L</sub> (mm)
25-35	Mean	0.39±0.07	0.40±0.07
	V%	18.26	17.37
	CI	0.36 <x< 0.42	0.38 <x< 0.42
35-45	Mean	0.43±0.07	0.46±0.09
	V%	15.15	18.59
	CI	0.41 <x< 0.45	0.43 <x< 0.49
45-55	Mean	0.47±0.08	0.50±0.11
	V%	17.49	21.18
	CI	0.44 <x< 0.50	0.47 <x< 0.54
55-65	Mean	0.52±0.11	0.54±0.11
	V%	21.01	20.89
	CI	0.48 <x< 0.56	0.50 <x< 0.58
65-75	Mean	0.55±0.09	0.57±0.09
	V%	16.65	14.60
	CI	0.53 <x< 0.59	0.55 <x< 0.61



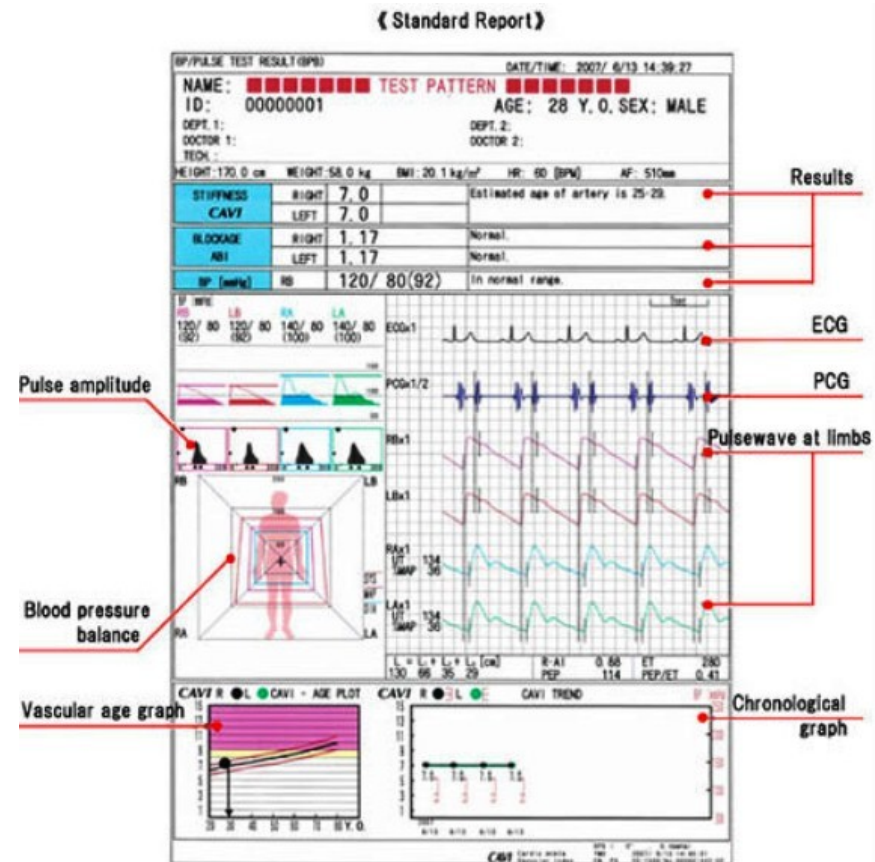
$\beta$  – index measurement

$$\beta = \left( \ln \frac{P_s}{P_d} \right) \left( \frac{D}{\Delta D} \right)$$





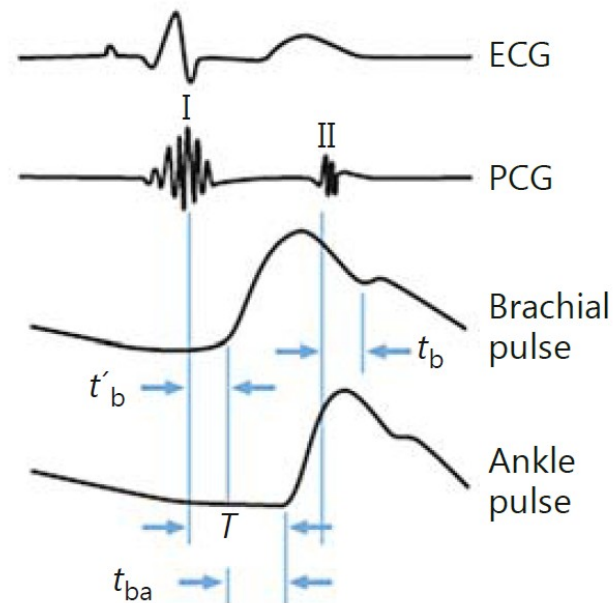
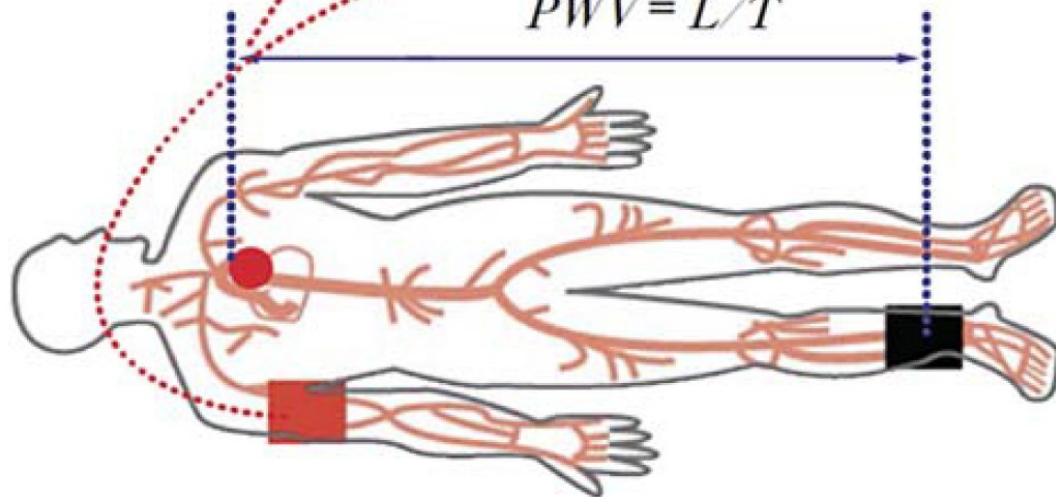
# CAVI MEASUREMENT



# CAVI MEASUREMENT

$$CAVI = a \left[ \frac{2\rho}{\Delta P} \left[ \ln \frac{P_s}{P_d} \right] PWV^2 \right] + b$$

$$PWV = L/T$$

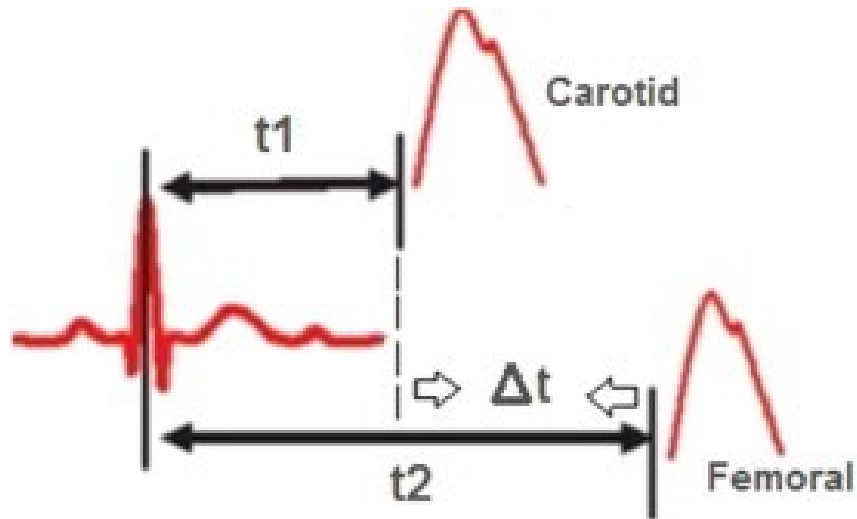


## ● Reference value of CAVI

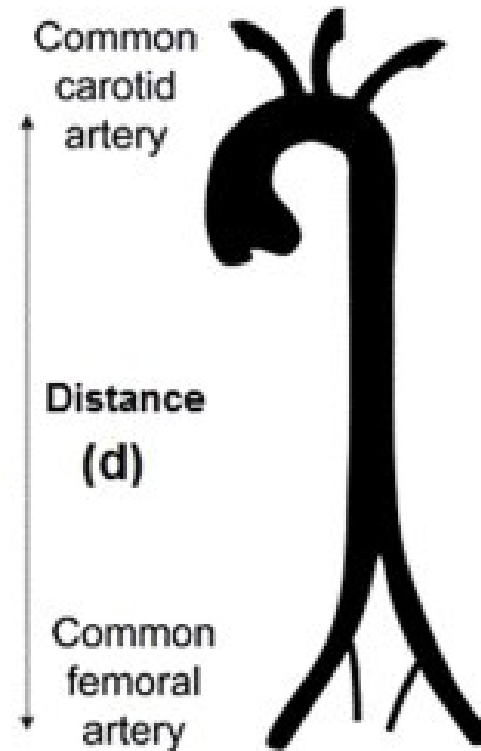
CAVI < 8.0	Normal range
8.0 ≤ CAVI < 9.0	Borderline
9.0 ≤ CAVI	Arteriosclerosis suspected



# PWV MEASUREMENT

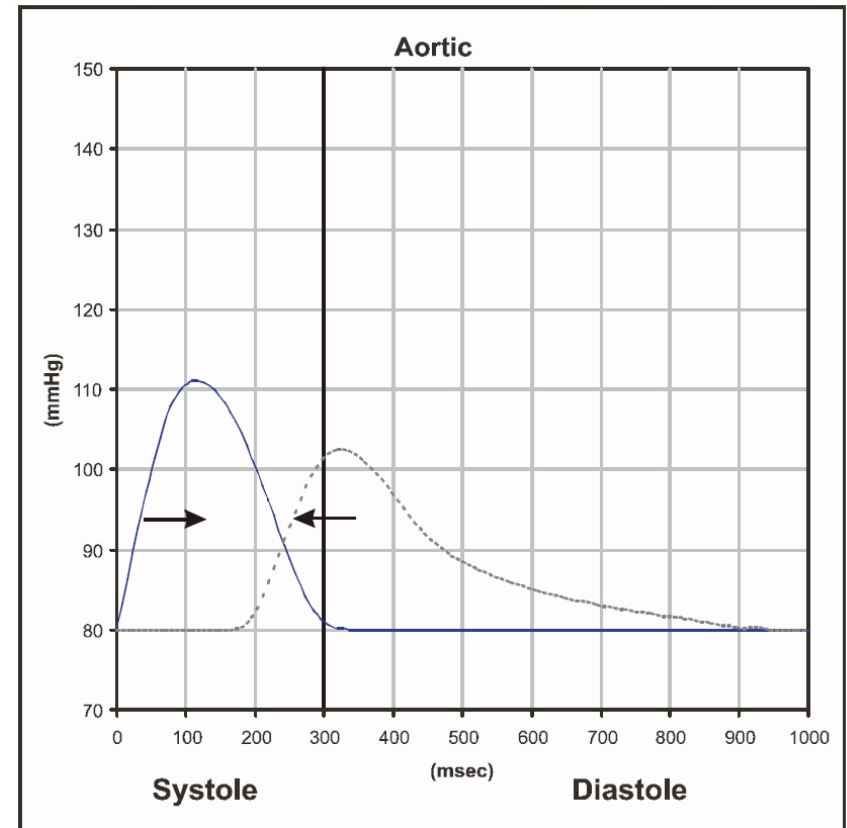
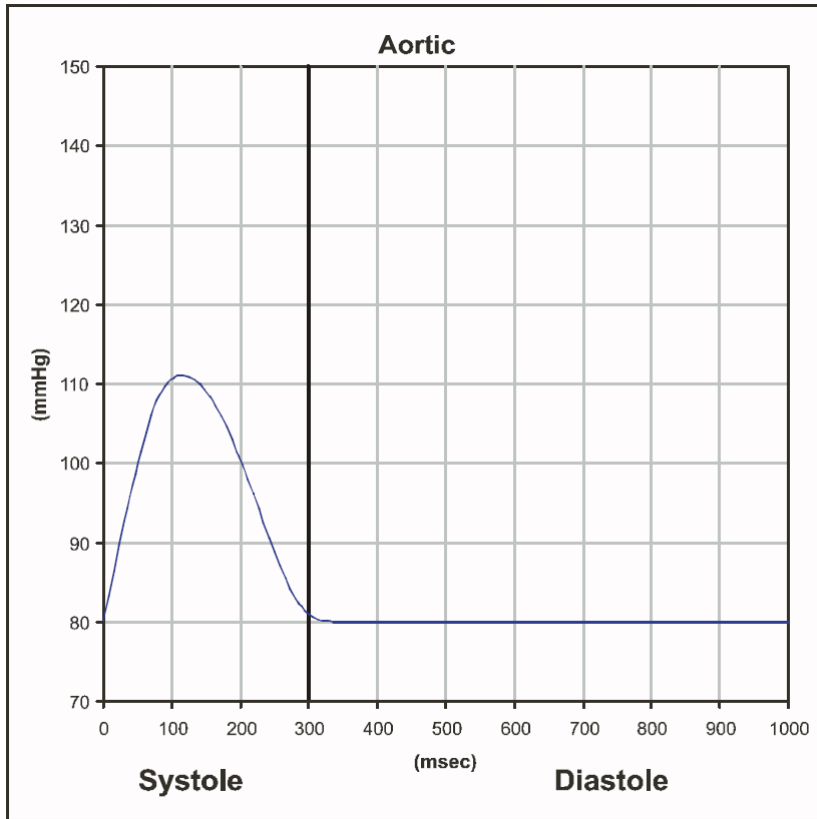


**PWV = distance (m) / transit time (s)**  
**transit time = t2 – t1**

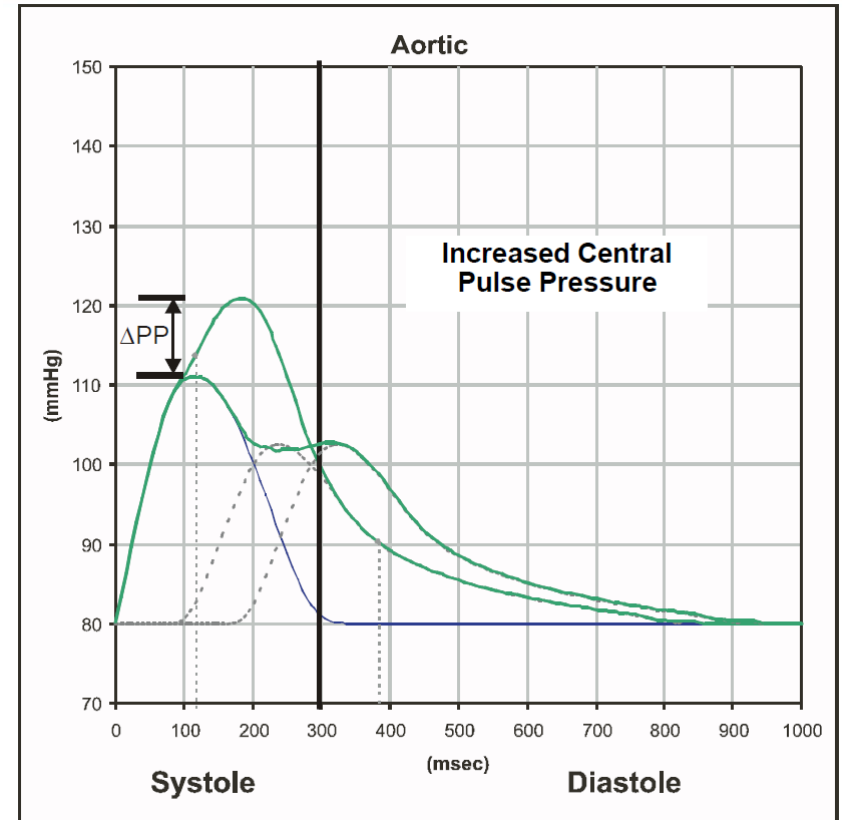
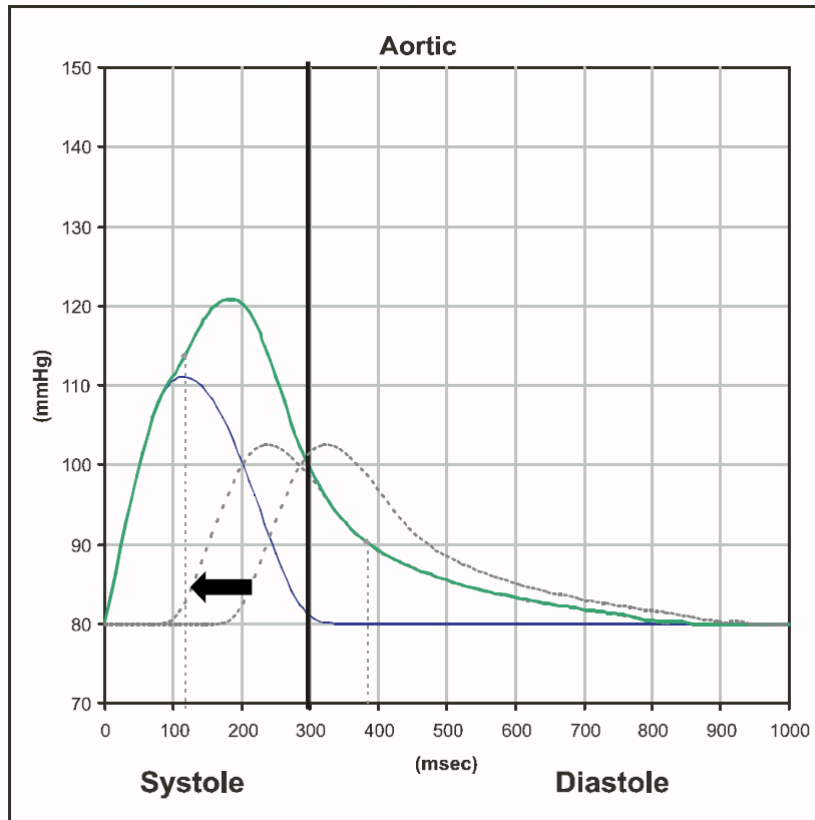


A highly compliant aorta has a relatively low PWV (< 6 m/s)

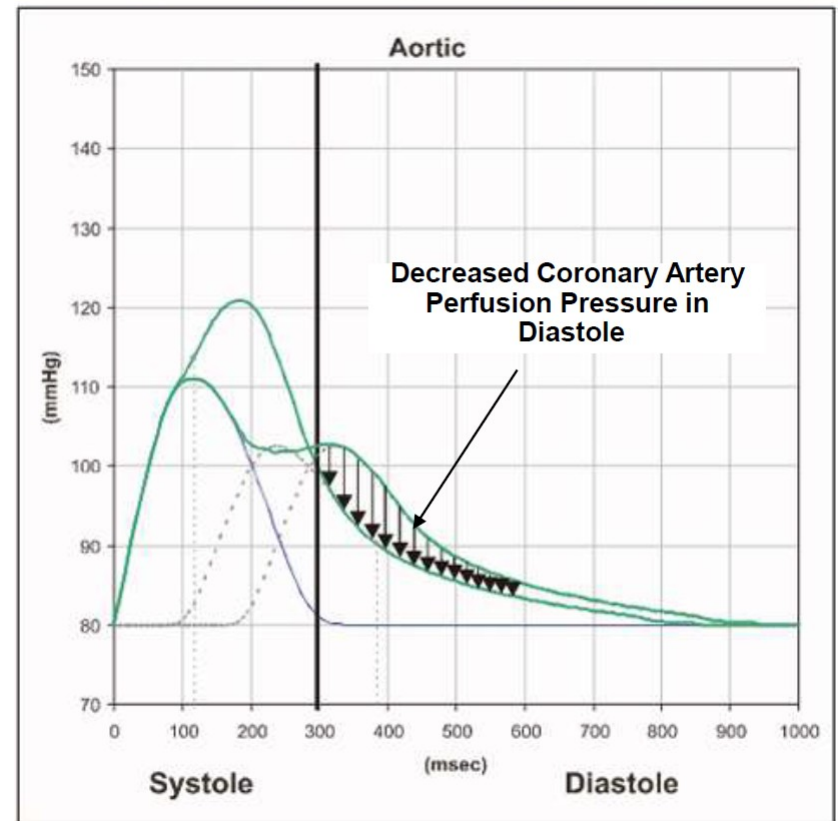
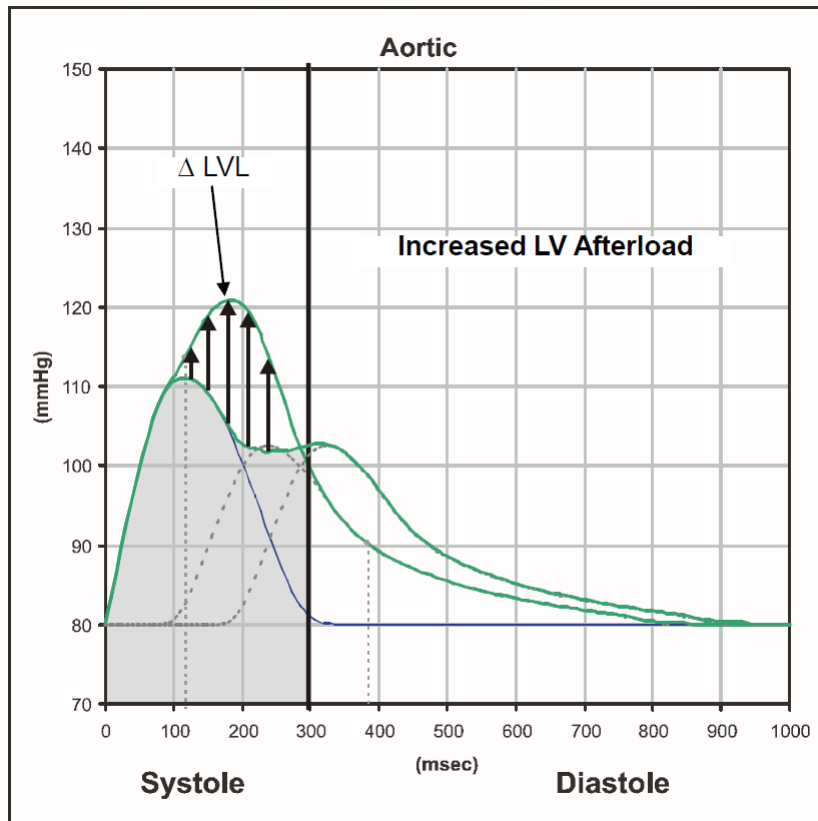
# PULSE WAVE



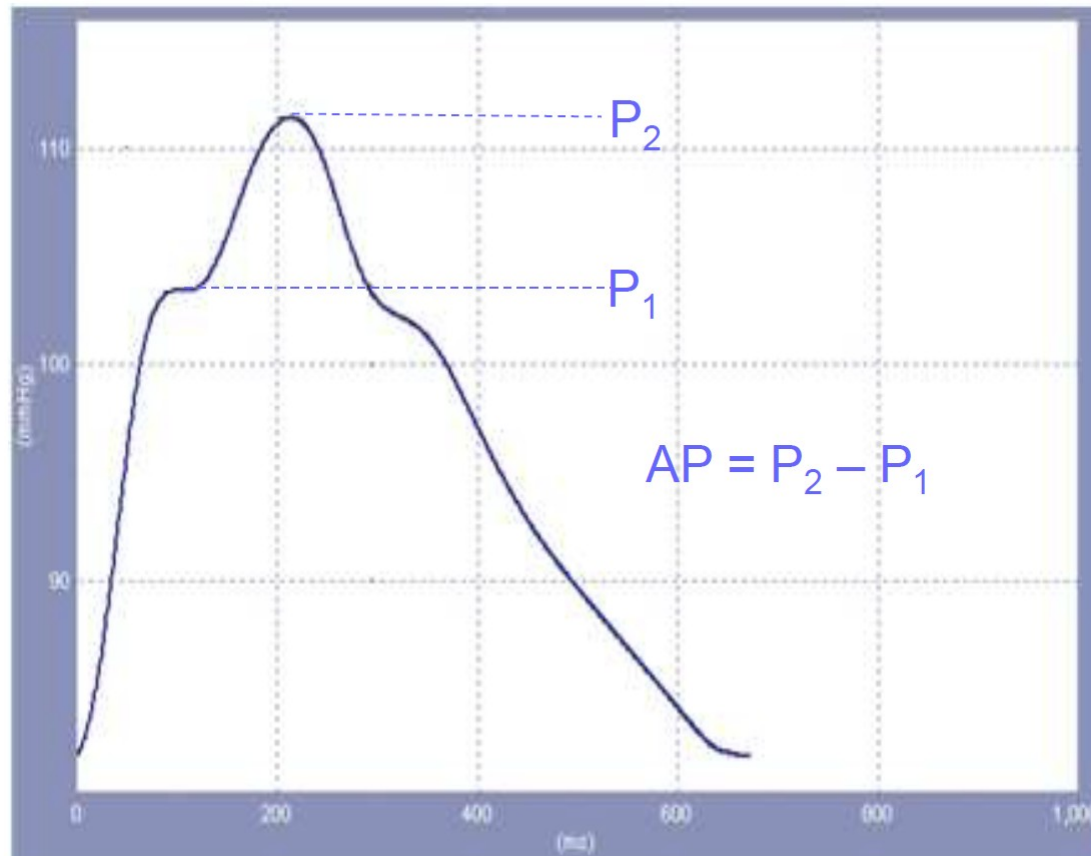
# PULSE WAVE



# PULSE WAVE



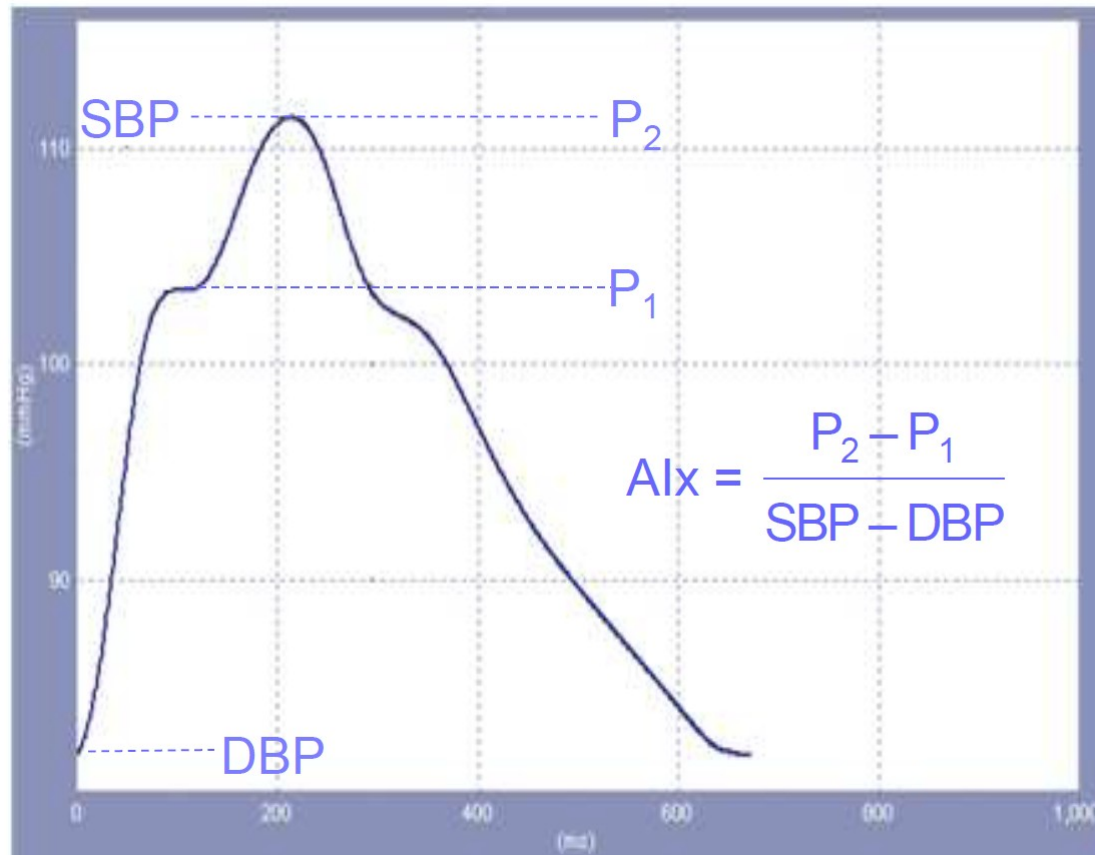
# PULSE WAVE ANALYSIS



**P<sub>1</sub>** corresponds to the pressure at peak systolic flow and is usually identified by the first shoulder of the pressure wave.

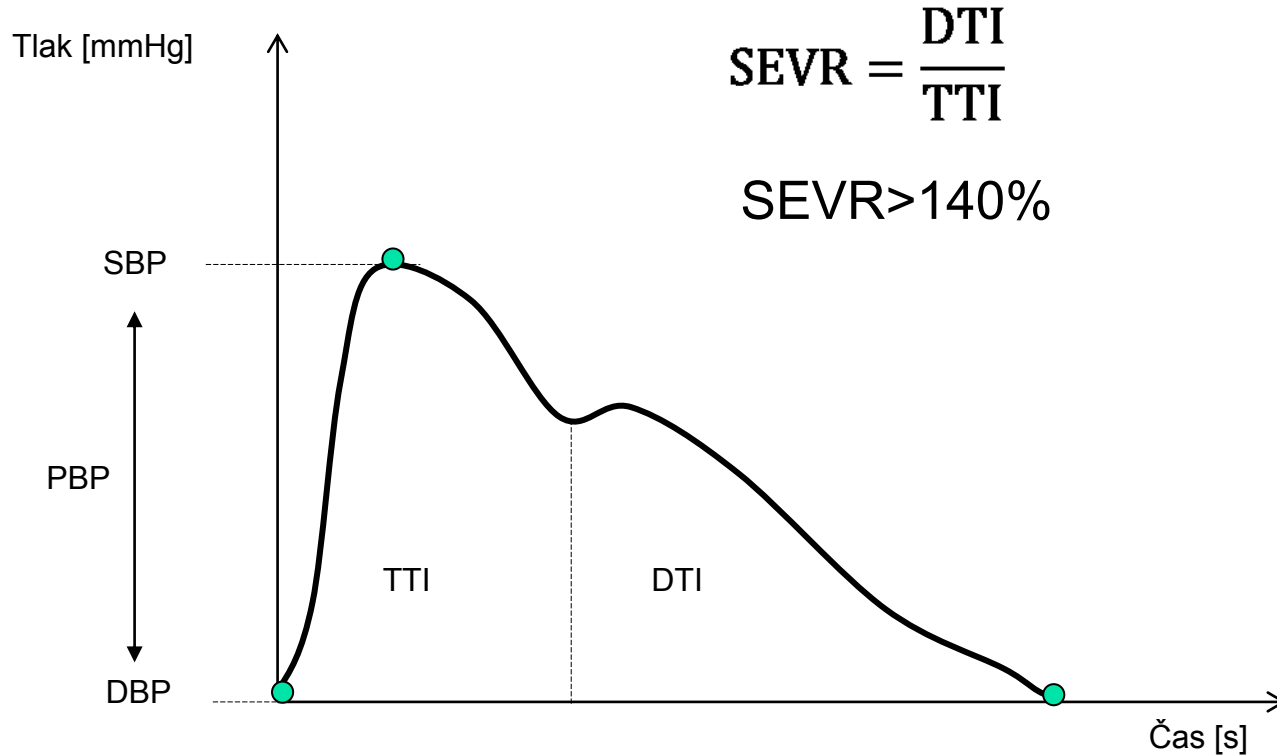
**P<sub>2</sub>** corresponds to the peak of the reflected wave and is usually identified by the peak of the pressure wave after the first shoulder.

# PULSE WAVE ANALYSIS



Higher values of AP and Alx indicate increased wave reflection from the periphery and/or early return of the reflected wave as a result of **increased pulse wave velocity** (due to increased arterial stiffness)

# PULSE WAVE ANALYSIS



TTI - Tension Time Index (area under systolic part of the pulse curve)

DTI - Diastolic Time Index (area under diastolic part of the pulse curve)

SEVR - Buckberg Sub-Endocardial Viability Ratio – subendocardial blood supplying

# PULSE WAVE ANALYSIS

