Non-invasive methods of blood pressure measurement

Arterial blood pressure curve

Blood pressure (BP): pressure on vascular vall (continual variable)

Mean arterial pressure (MAP) : mean value of blood pressure in the inter-beat interval (IBI)

- **area under MAP = area above MAP**
- **aproximation: MAP≈ DBP + 1/3 PP (PP = SBP – DBP)**

Definition:

SBP - maximum of BP in the inter-beat interval

DBP – minimum of BP in the inter-beat interval

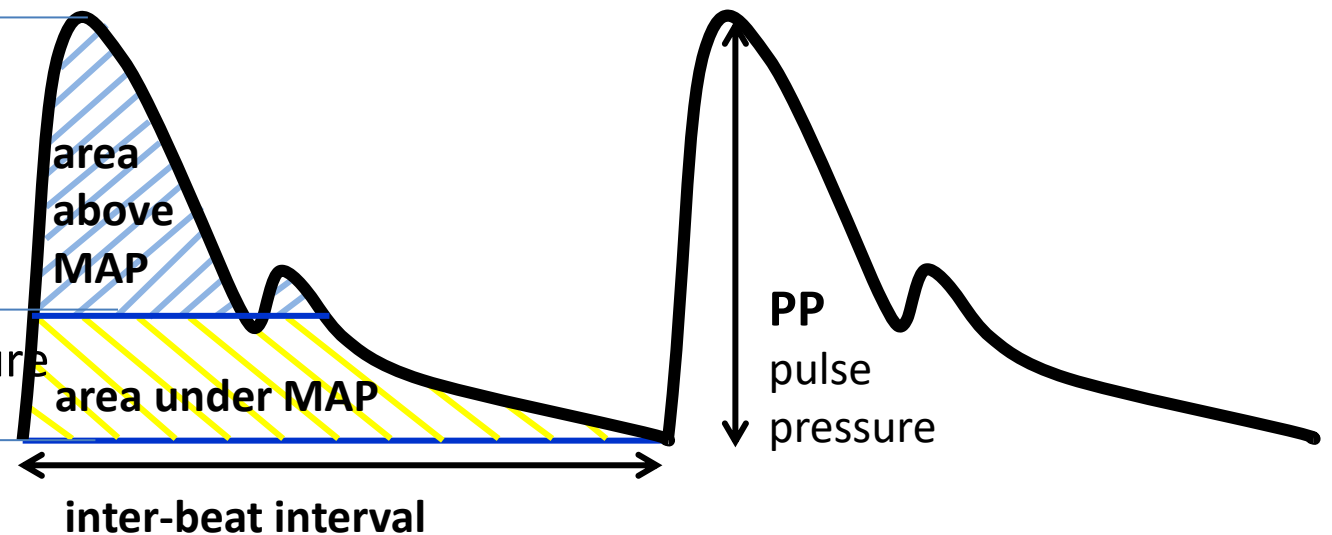Attention: Values of SBP and DBP varies in different parts of cardiovascular system
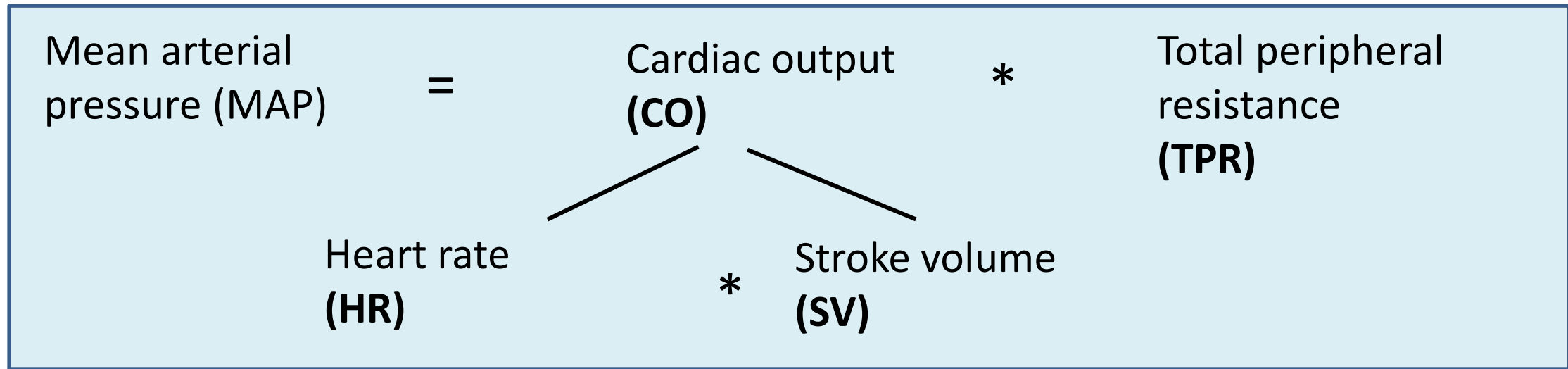
SBP
Systolic blood pressure

area above MAP

MAP
Mean arterial pressure

area under MAP

DBP
Diastolic blood pressure

inter-beat interval

PP
pulse pressure

MAP is a function of cardiac output and total peripheral resistance

Mean arterial pressure (MAP) $=$ Cardiac output **(CO)** $*$ Total peripheral resistance **(TPR)**

Heart rate **(HR)** $*$ Stroke volume **(SV)**

- SBP is given mainly by CO
- DBP is given mainly by TPR

Methods of the arterial blood pressure measurement

In practicals:

Auscultatory
(sphygmomanometer,
stethoscope)

Palpatory
(sphygmomanometer)

Oscillometric

Another approaches:

24-hour blood pressure monitoring

Photoplethysmografic (volume-clamp method, Peňáz)

Laminar / turbulent flow, Korotkoff sounds

$$Re = \frac{v \cdot S \cdot \rho}{\eta}$$
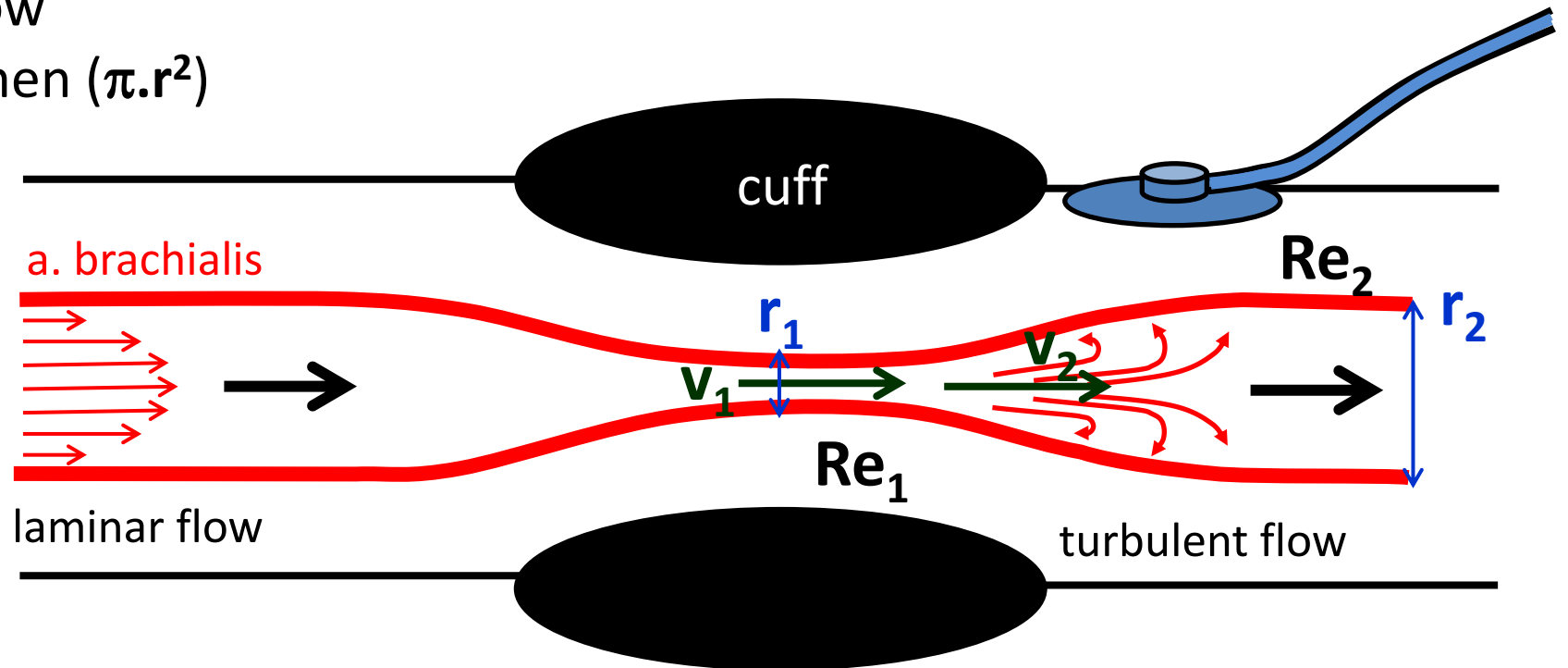
laminar flow Re < 2000
turbulent flow Re > 3000

Reynolds number Re: predicts the transition from laminar to turbulent of flo

v: velocity of blood flow

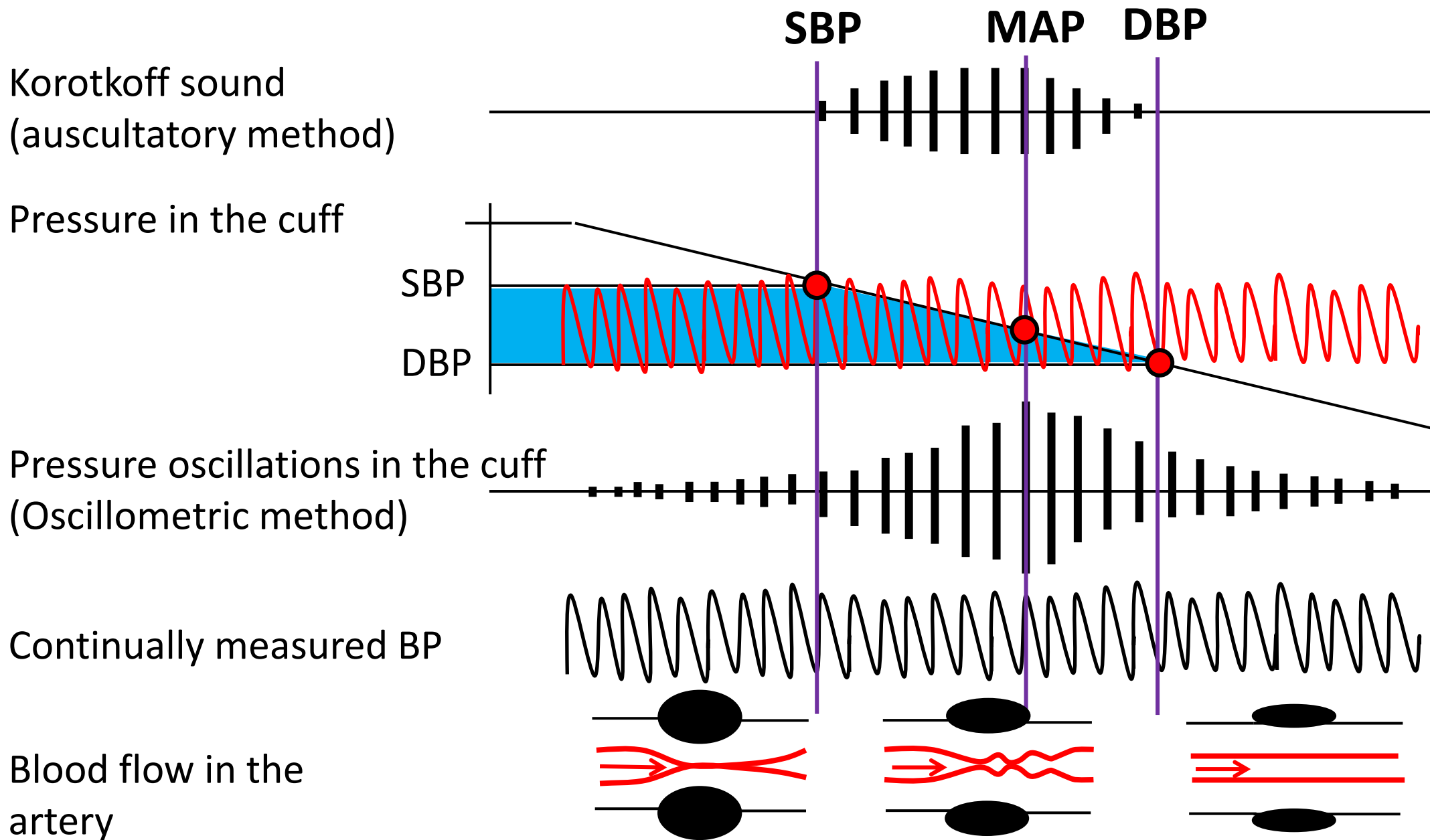**S**: area of vascular lumen ($\pi.r^2$)

ρ: density of blod

η: viskosit of blood
(higher in anemy)

cuff

a. brachialis

Re_2

r_1

r_2

v_1

v_2

Re_1

laminar flow

turbulent flow

closely behind narrowing of the artery: $S_1 < S_2$ **a** $v_1 \approx v_2$ → $Re_1 < Re_2$ → turbulent flow

Principles of blood pressure measurement

During BP measurement following rules must be observed

- Patient is sitting for a few minutes before the measurement.
- Only validated apparatus must be used.
- Perform at least two measurements in the course of 1–2 minutes.
- Use cuff of standard size (12–13 cm width and 35 cm length); however smaller and bigger cuffs must be available for patients with smaller or bigger size of arm, respectively.
- Cuff must be always at the level of heart of examined person.
- Pressure in the cuff must be decreased slowly: 2mmHg/s.

methods	advantages	disadvantages	measured value
auscultatory	• exact estimation of SBP/DBP • easy, it doesnt require electricity	• subjective, experience is necesary • SBP/DBP from differen IBI	STK a DTK
oscillometric	• exact estimation of MAP • automatic, fast • BP can be measured by layman, cheap (home measurement)	• DBP/SBP is calculated (dependence on model, influence on shape of puls wave) • SBP/DBP from different IBI • false values during arrhytmia	MAP, sometimes SBP (it depends on device)
24 – hour BP monitoring	• BP record from whole day • diagnosis of white-coat hypertension	• disruptive influence of measuring (during sleeping) • SBP/DBP from different IBI	BP is mesured each 15 – 60 min
photople-thysmographic (Peňáz)	• continual BP record • possibility of beat-to beat SBP/DBP calculation (BP variability analysis)	• measuring on the finger, brachial BP recalculating • expensive device	continual BP record