

The Doppler Effect

MUDr. Michal Jurajda

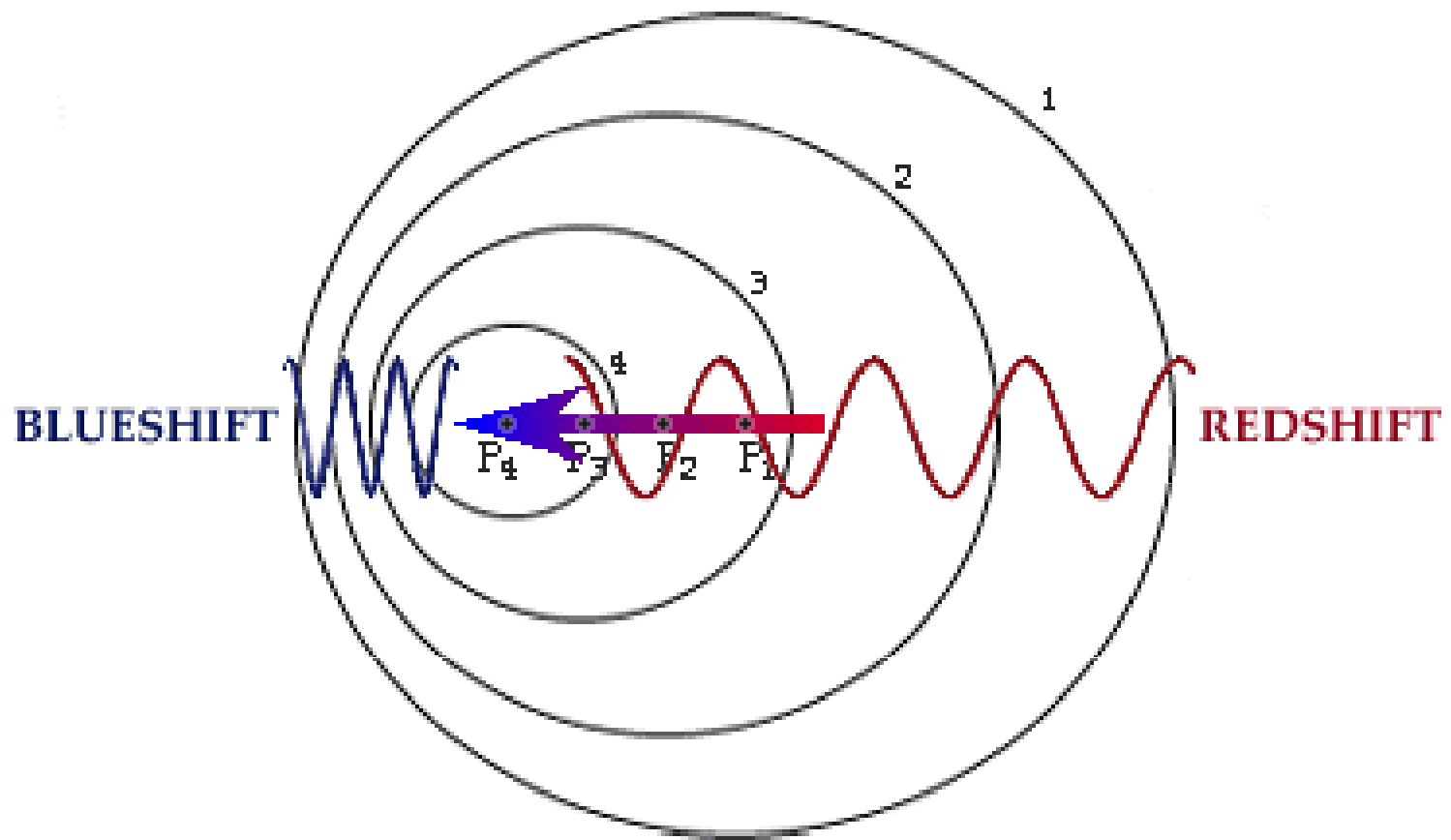
ÚPF LF MU Brno

Brief History

- The Doppler effect was stated by Austrian physicist and mathematician Christian Johann Doppler in 1842.
- Doppler was a professor at the Technical Institute of Prague and later at the Polytechnicum in Vienna

The Doppler effect

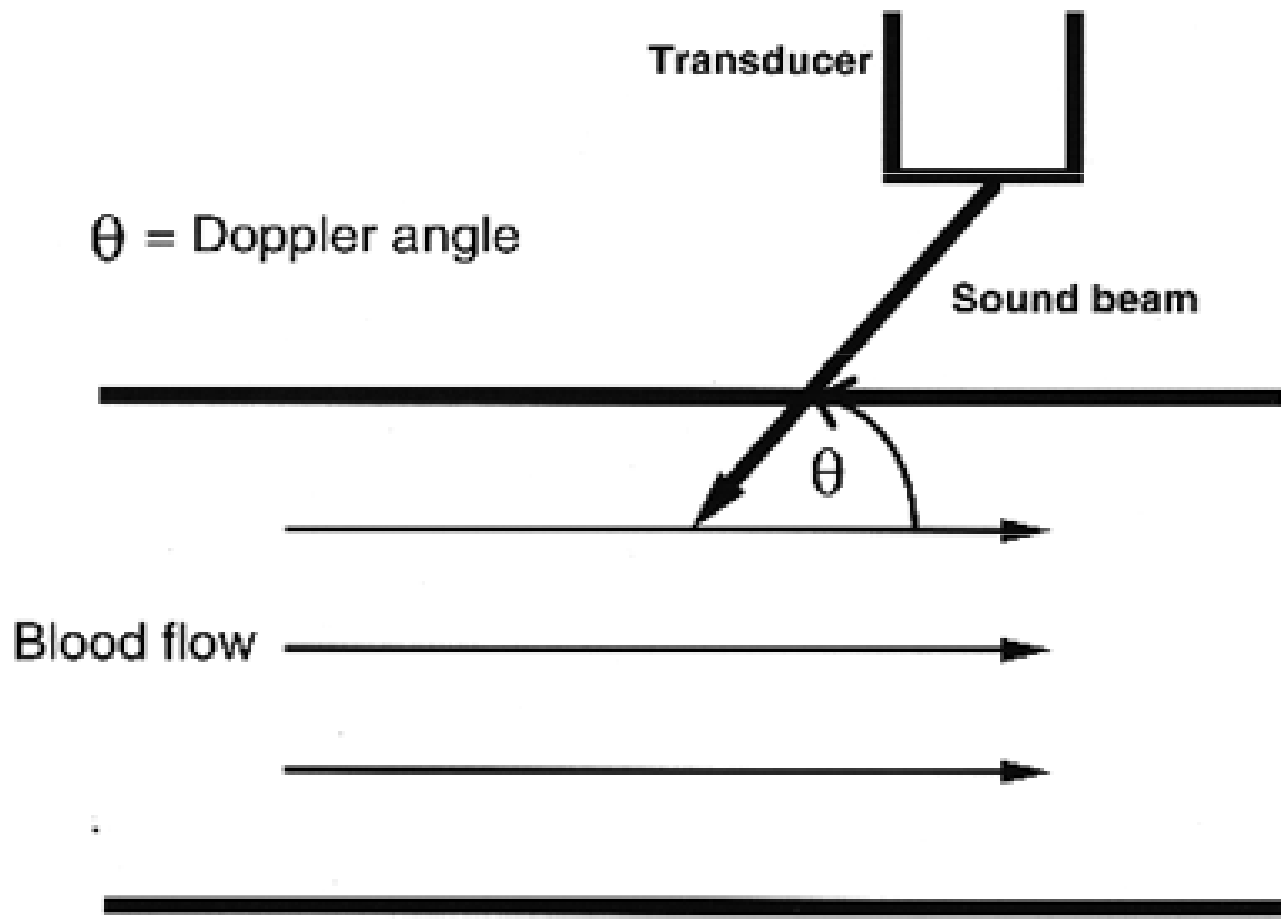
- The Doppler effect describes a change in the frequency of a wave, resulting from motion of the wave source or receiver, or in the case of a reflected wave, motion of the reflector.



[Java applet](#)

Medical Doppler ultrasound

- Doppler ultrasound is used to detect and measure blood flow, and the major reflector is the red blood cell.
- The Doppler shift is dependent on the insonating frequency, the velocity of moving blood, and the angle between the sound beam and direction of moving blood



Equations

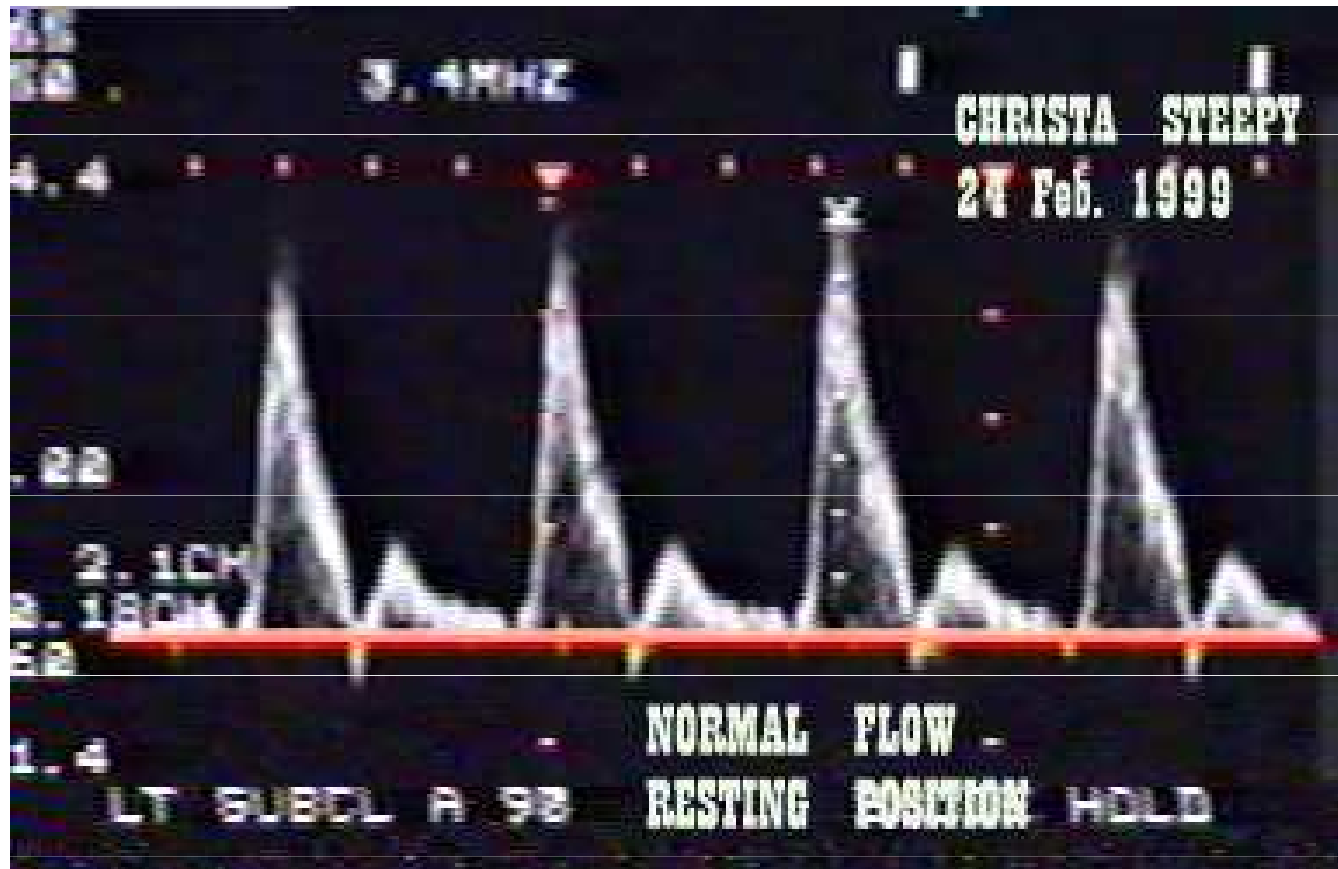
$$df = \frac{2 \cdot f \cdot v \cdot \cos \theta}{c}$$

$$v = \frac{df \cdot c}{2f \cdot \cos \theta}$$

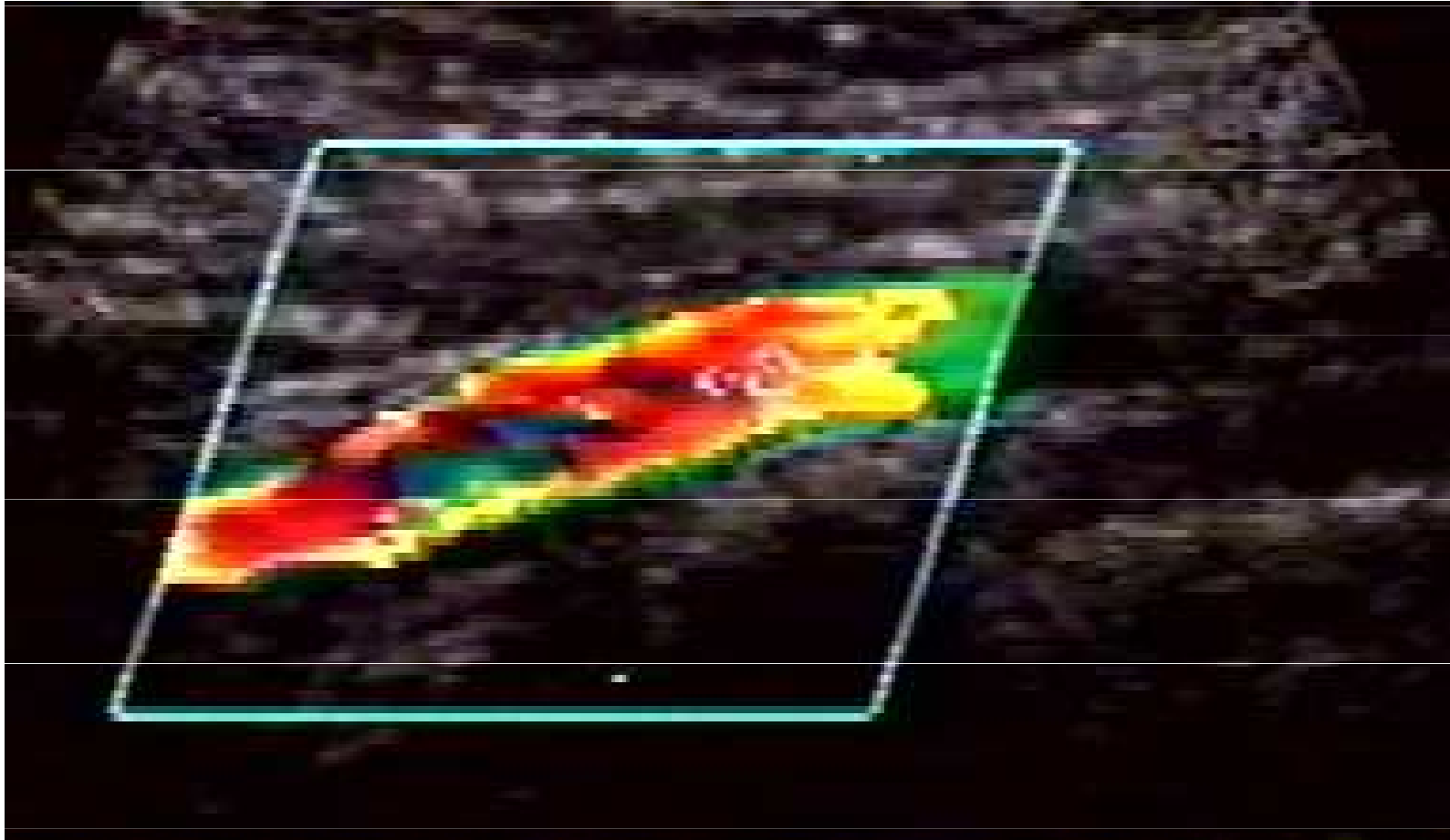
Doppler systems

- Simple Doppler
- Duplex systems
 - colour Doppler
 - pulsed Doppler

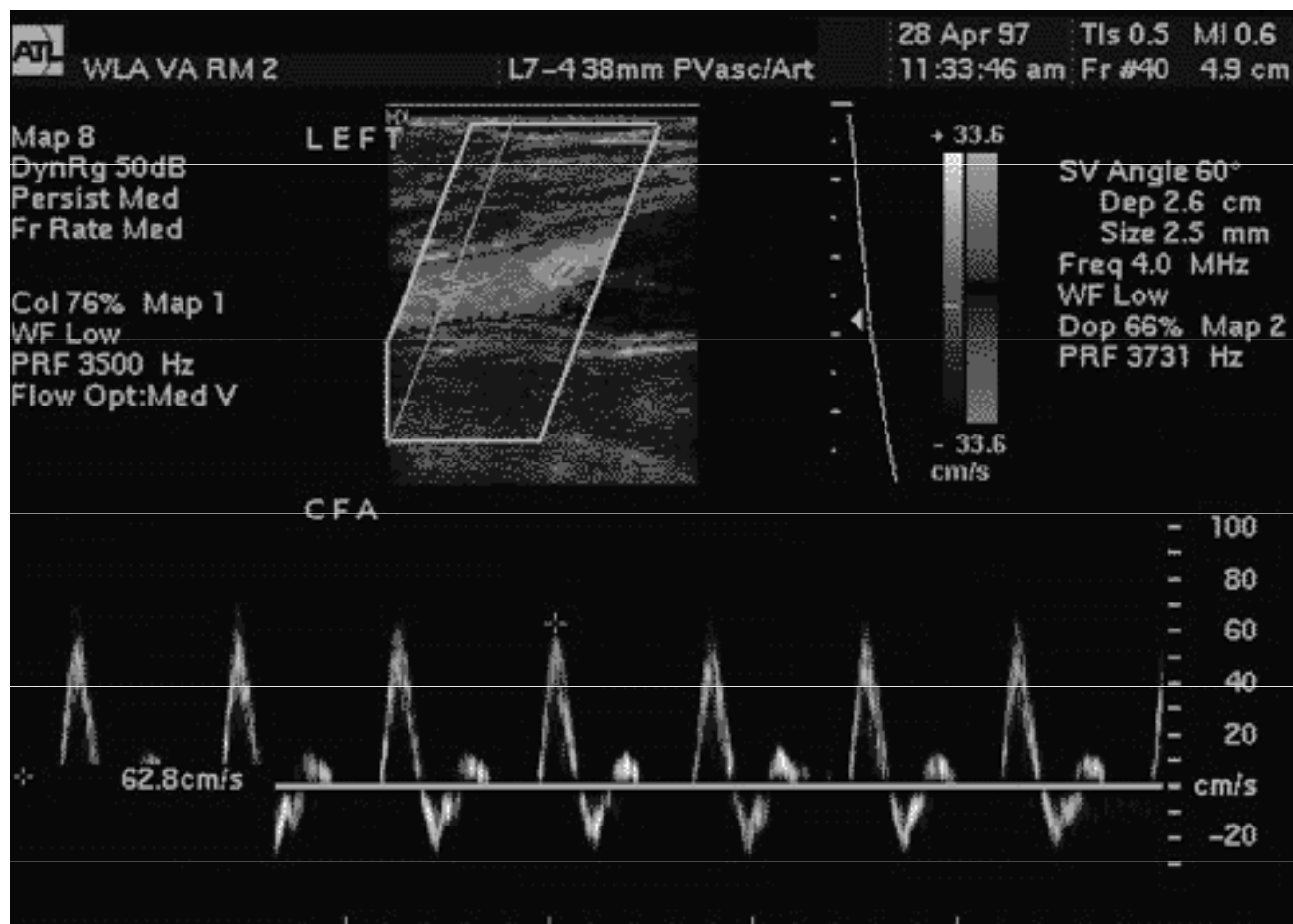
Simple Doppler



Colour Doppler



Pulsed Doppler



Measurement

- Aproximate artery localization
- gel - ultrasound conducting medium
- Transducer positioning
- Signal reading (hearing)

Clinical use

- Stenosis detection
- Blood flow direction detection
- Blood flow character assesment (laminar/turbulent)
- Detection of venous flow

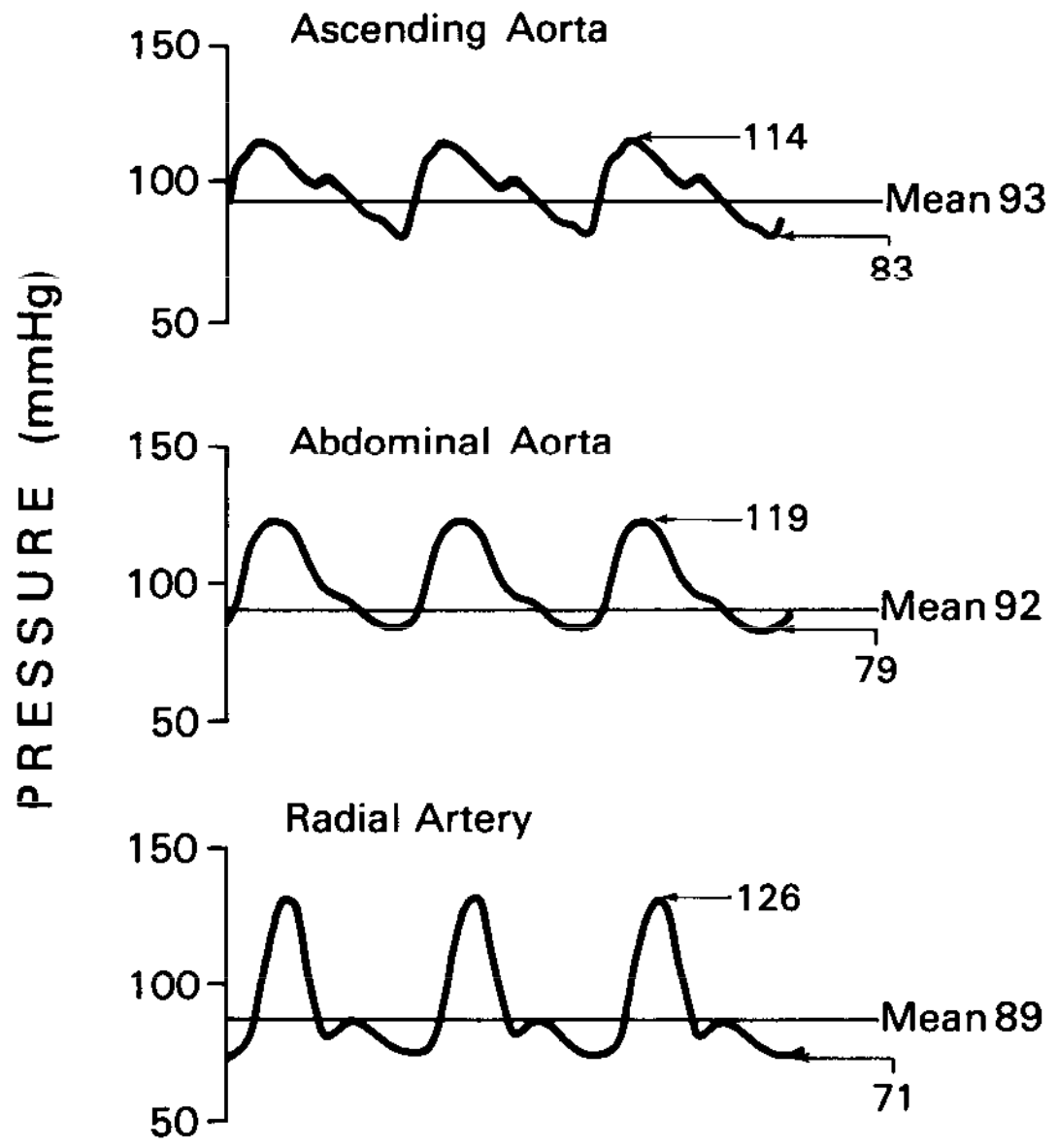
Stenosis detection

Stenosis detection

- segmental pressures
- color-assisted duplex sonography

Systolic amplification

- Systolic pressure normally increases as the pressure wave travels distally, due to reflection of waves and high peripheral resistance, a process known as systolic amplification. Therefore, the systolic pressure measured at the ankle is normally slightly higher than in the arm.



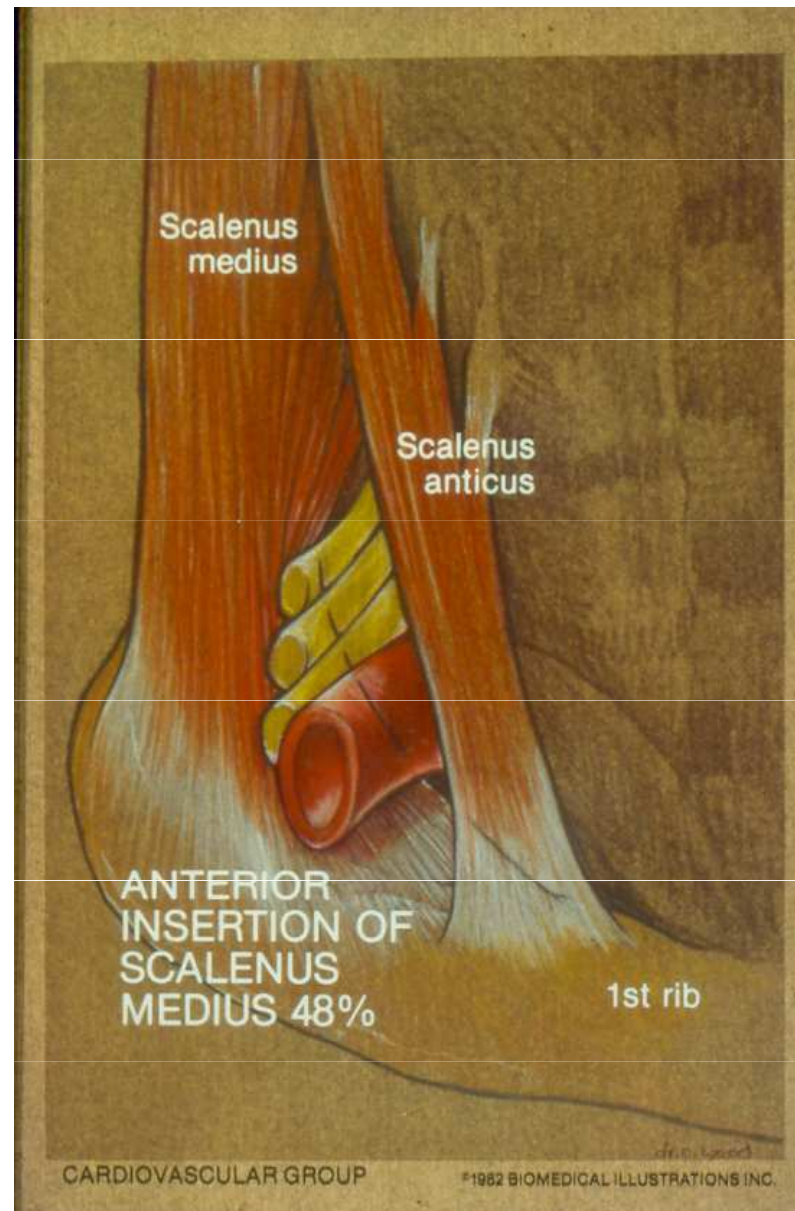
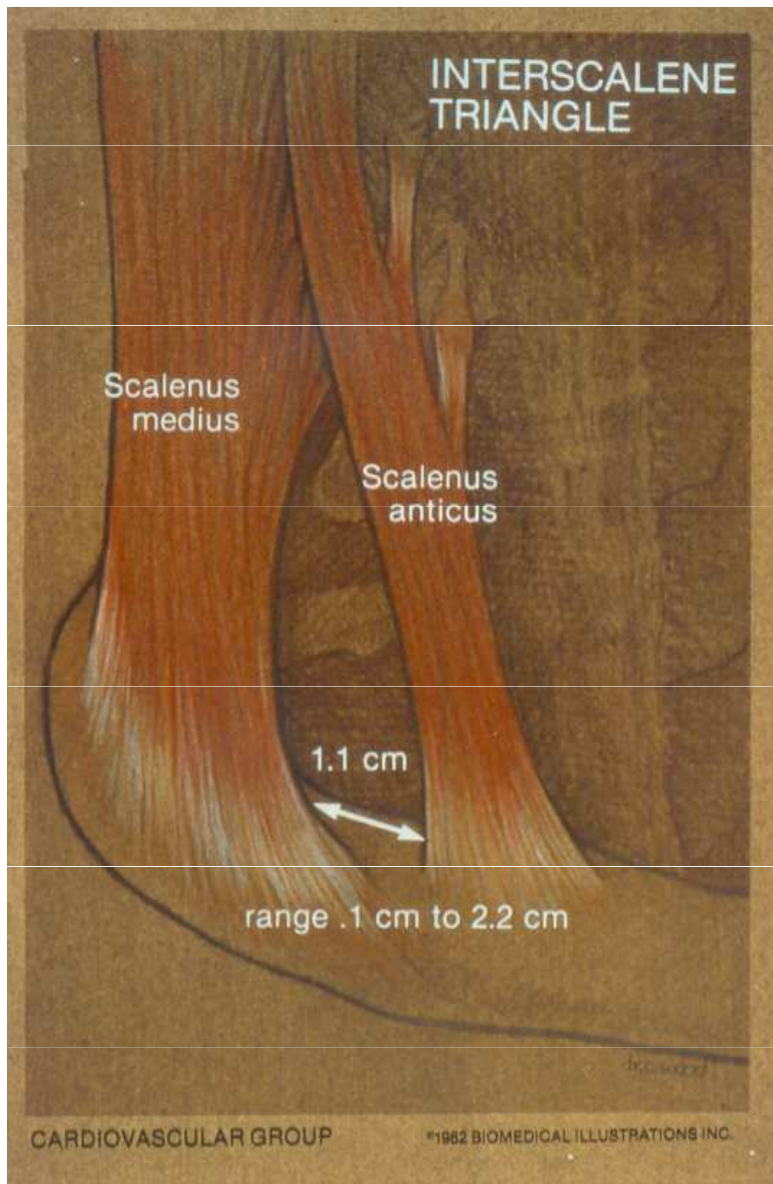
Segmental pressure

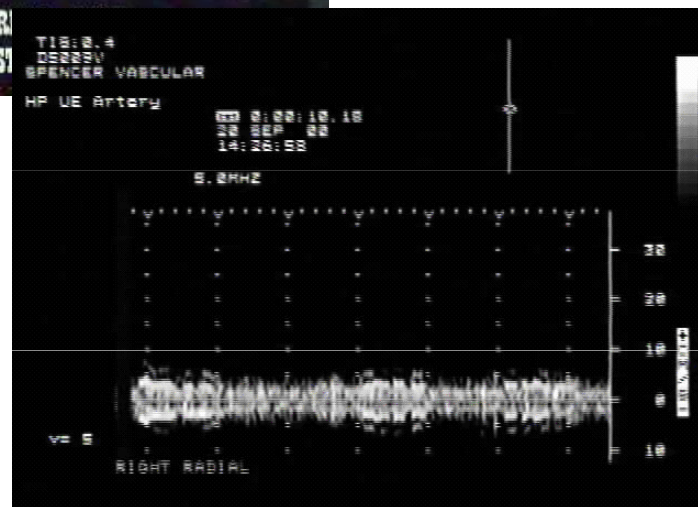
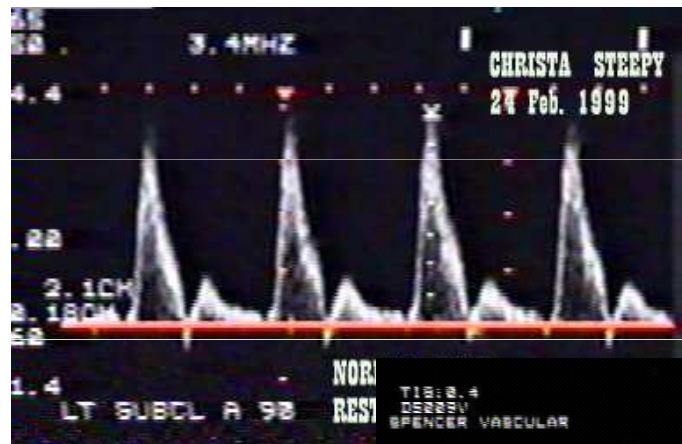


- Ankle/Brachial Index
- normal >1.0

TOS

Thoracic outlet syndrom





Steal fenomen

Steal phenomenon

- Redirection of the blood flow in the collateral artery.
- e.g. subclavian steal

Practical training

- Segmental pressure
- TOS
- Steal phenomenon
- Blood flow in the veins

SYSTEMIC ARTERIAL PRESSURE

