



The Doppler Effect

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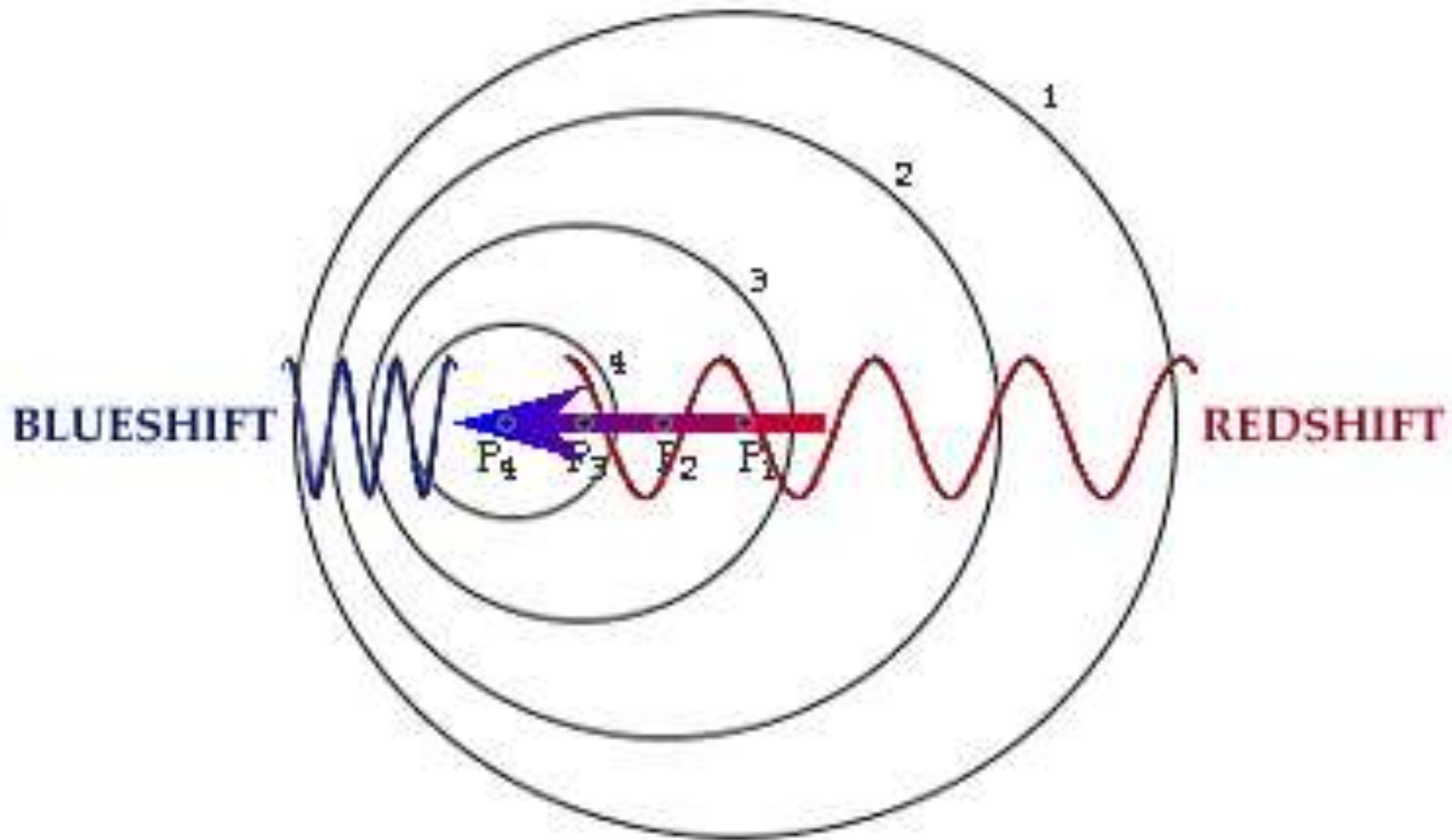
Brief History

- ♫ **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.**

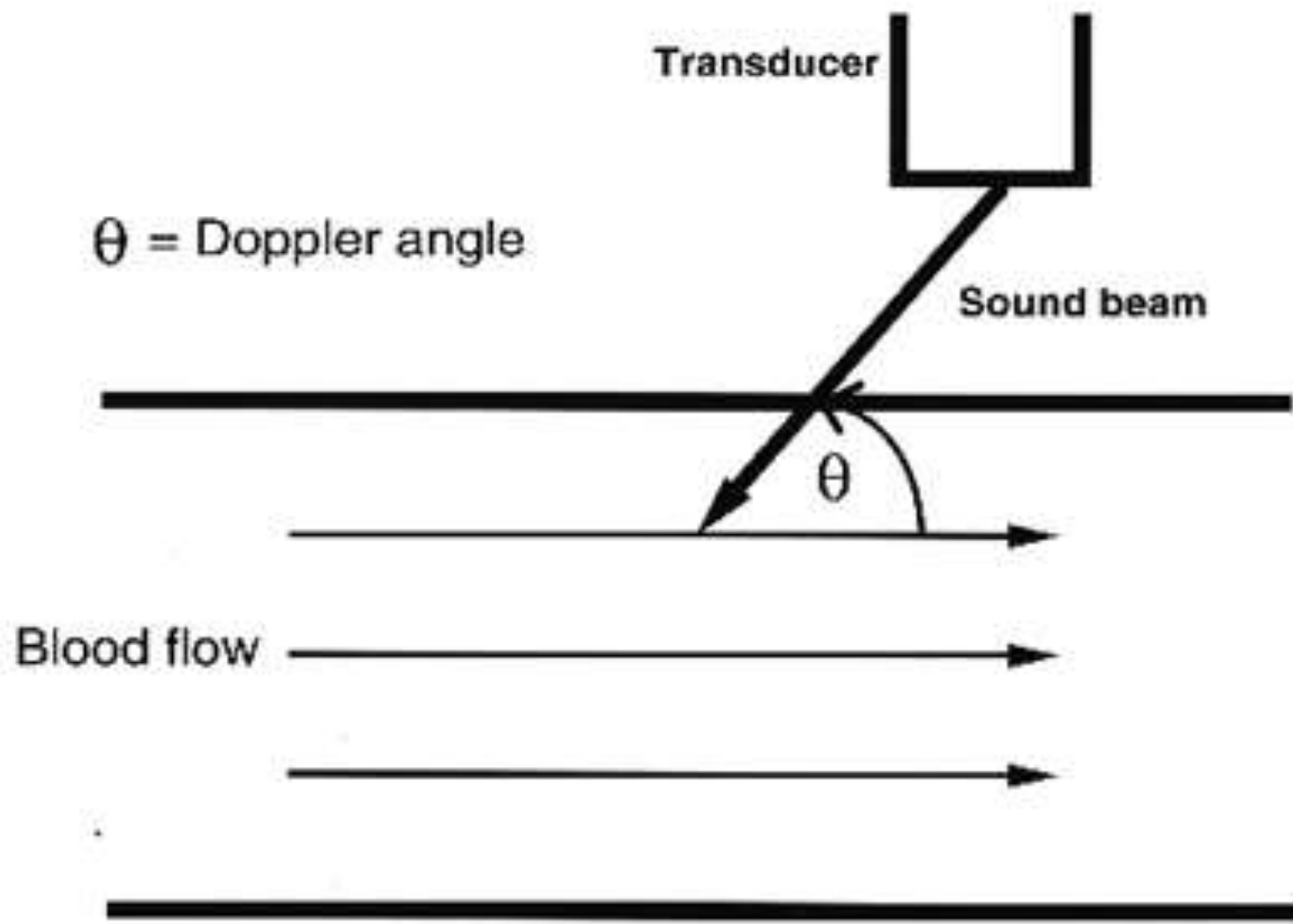


[Java applet](#)



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

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

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



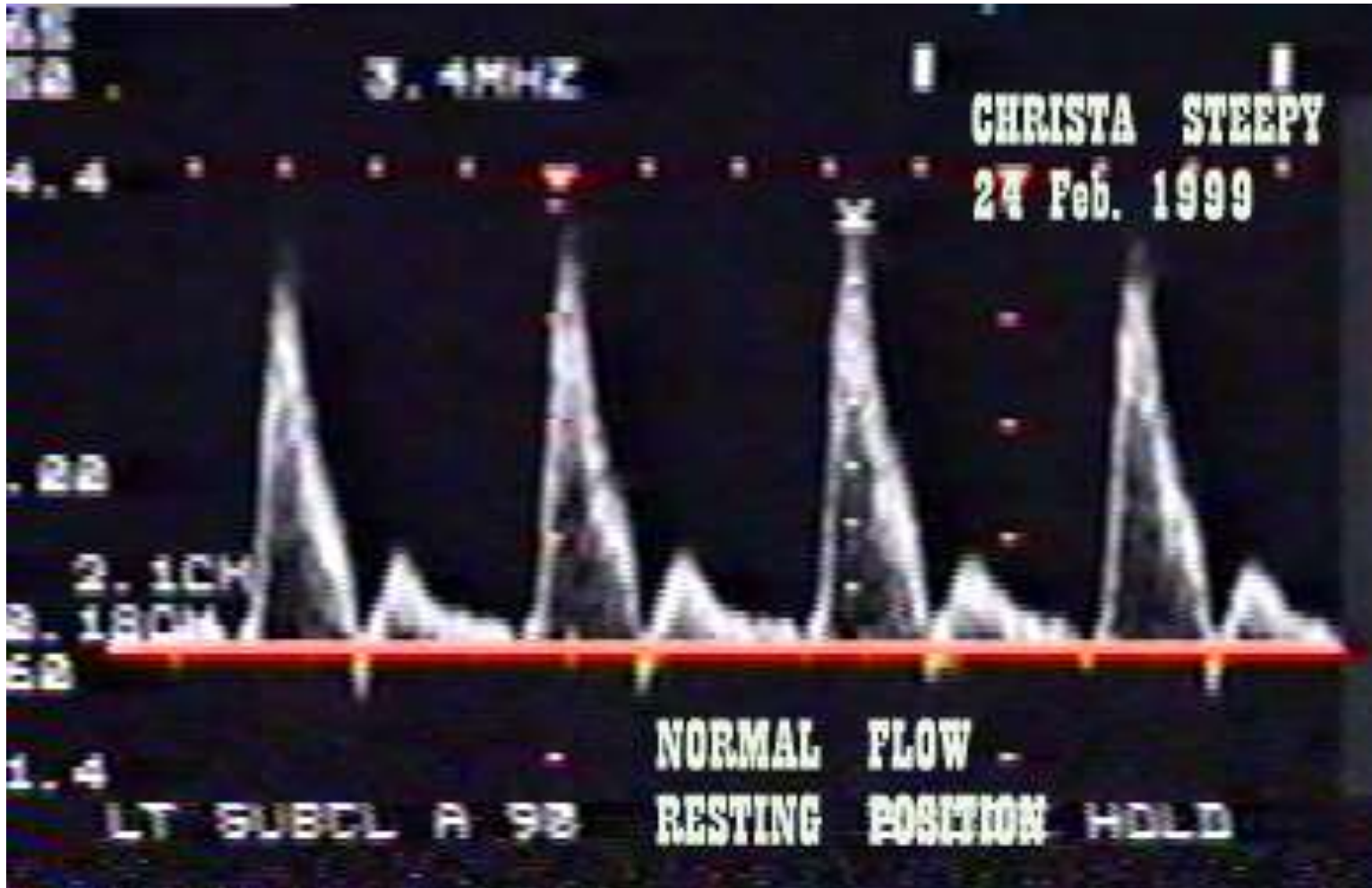
Doppler systems

Ω **Simple Doppler**

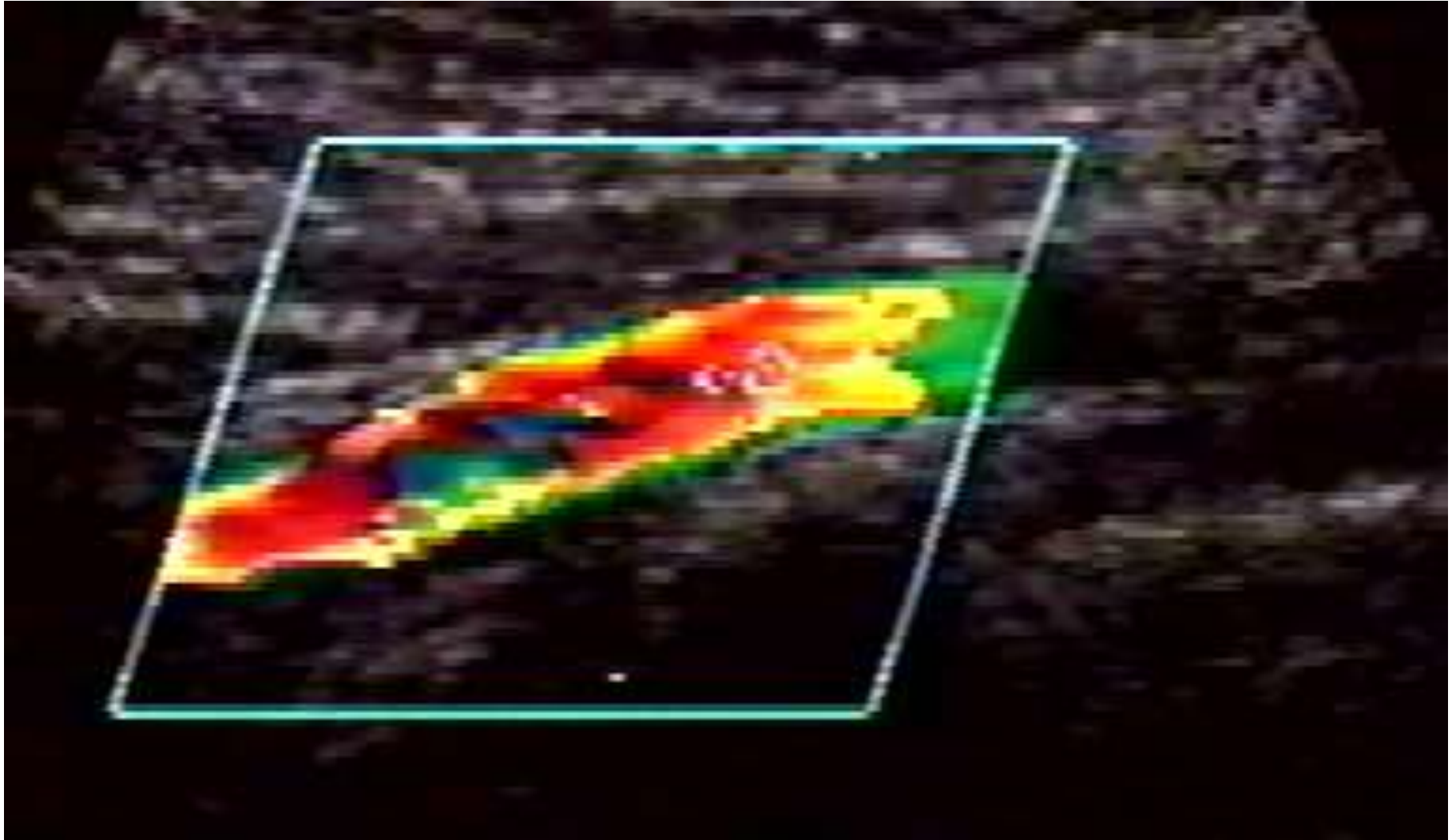
Ω **Duplex systems**

- **colour Doppler**
- **pulsed Doppler**

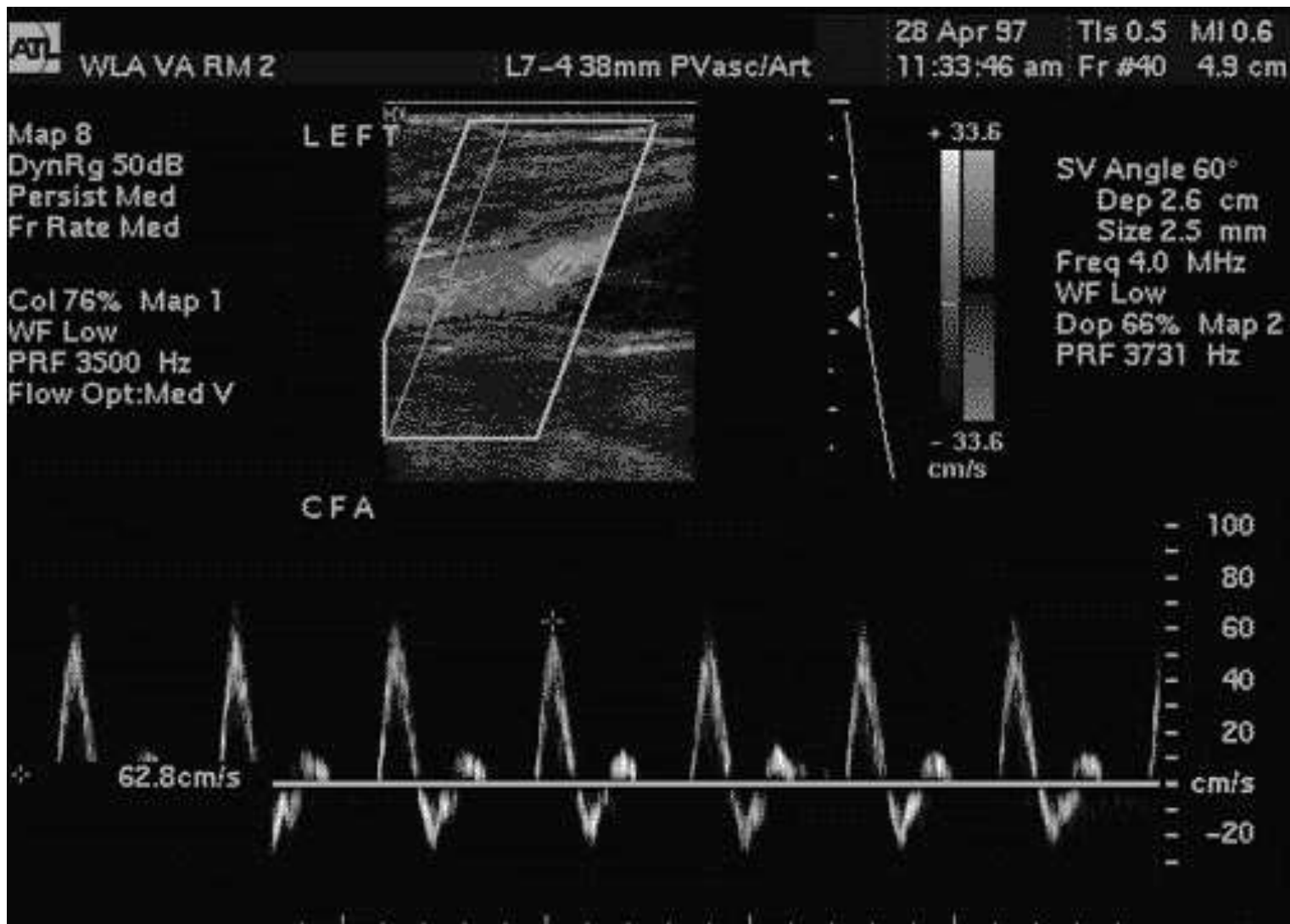
Simple Doppler



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**

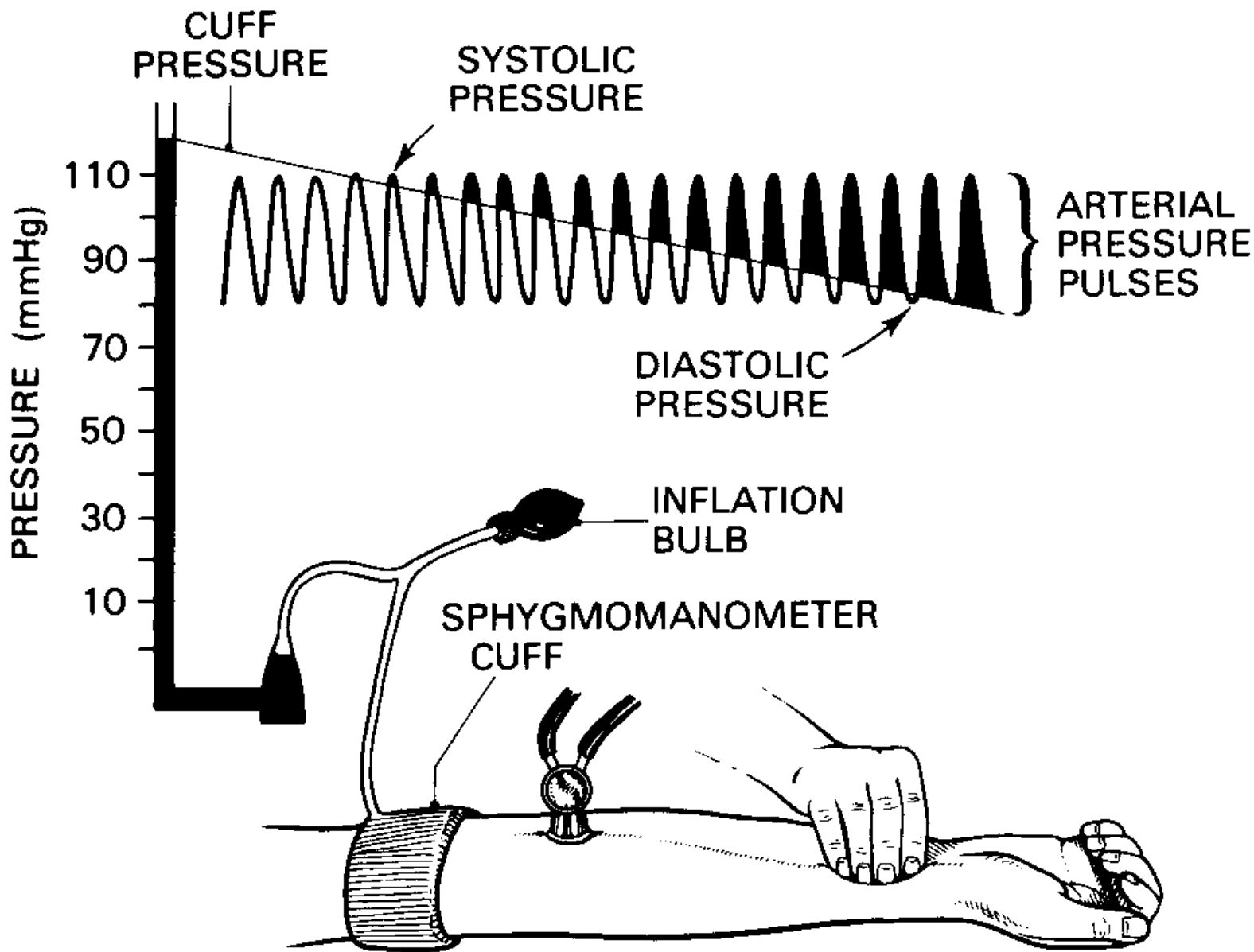


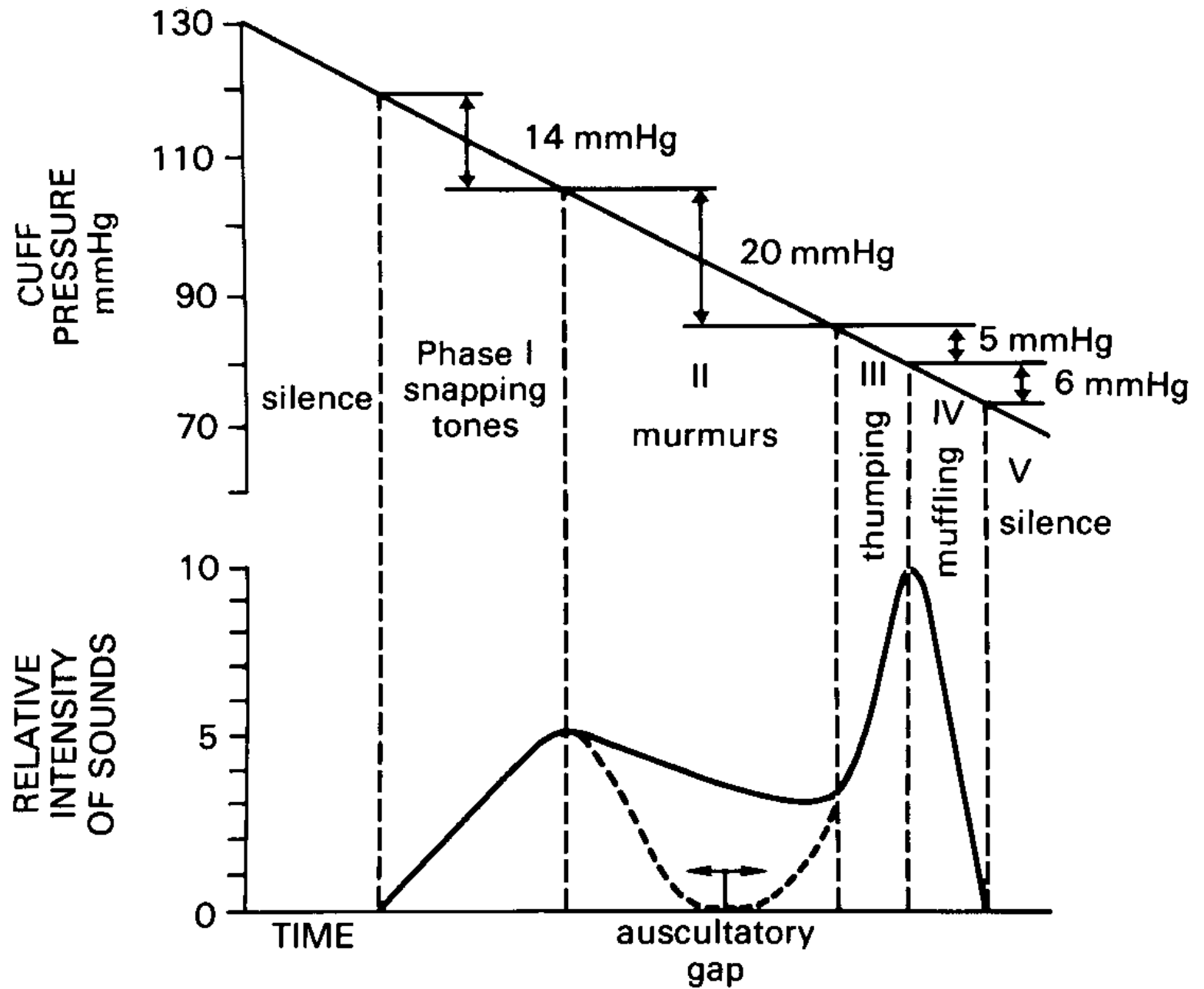
Stenosis detection

∩ **segmental pressures**

∩ **color-assisted duplex sonography**

SYSTEMIC ARTERIAL PRESSURE

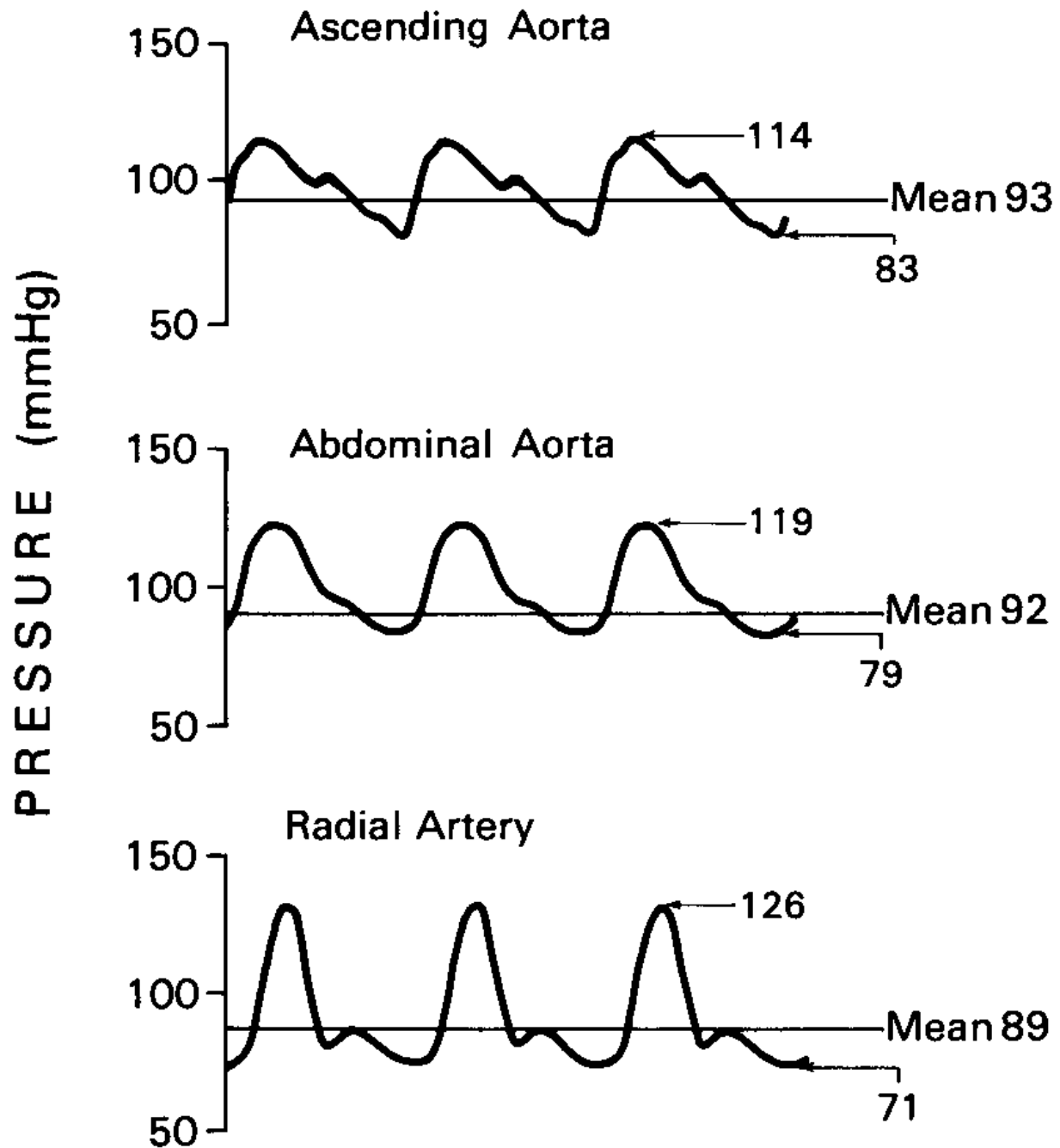






Systolic amplification

- ∩ **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

INTERSCALENE TRIANGLE

Scalenus medius

Scalenus anticus

1.1 cm

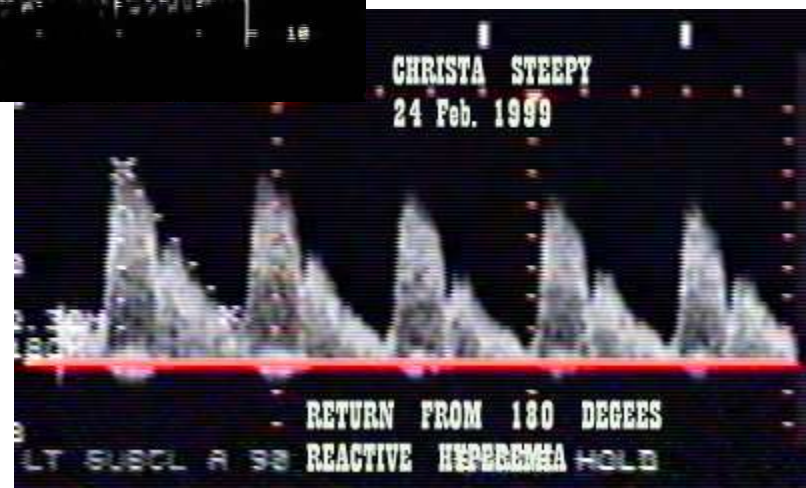
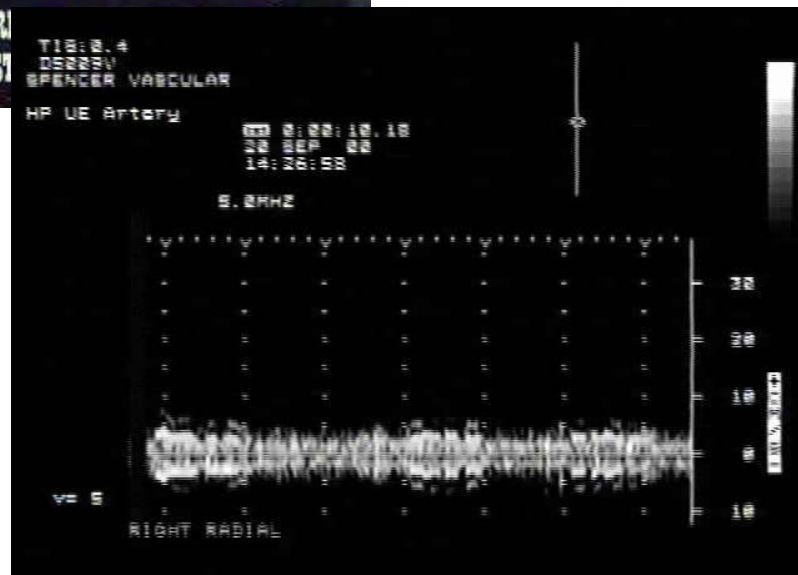
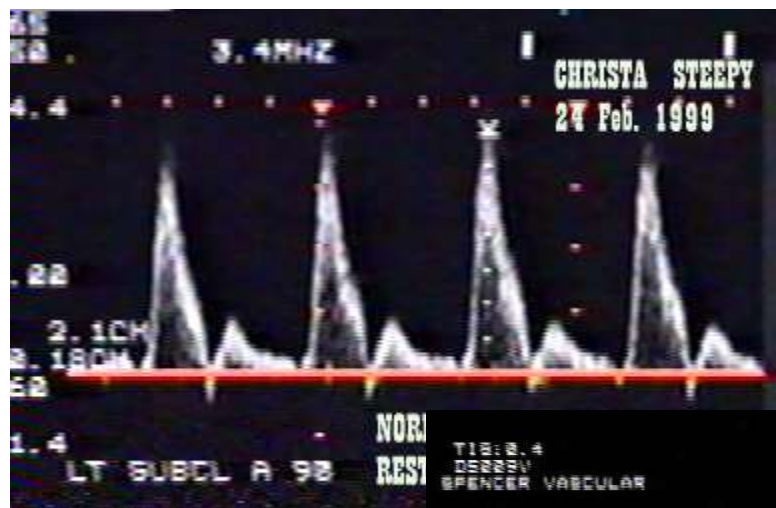
range .1 cm to 2.2 cm

Scalenus medius

Scalenus anticus

ANTERIOR INSERTION OF SCALENUS MEDIUS 48%

1st rib





Steal phenomenon



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**