SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore-35

Affiliated to The Dr.M.G.R Medical University, Chennai

DEPARTMENT OF RADIOGRAPHY AND IMAGING TECHNOLOGY III YEAR

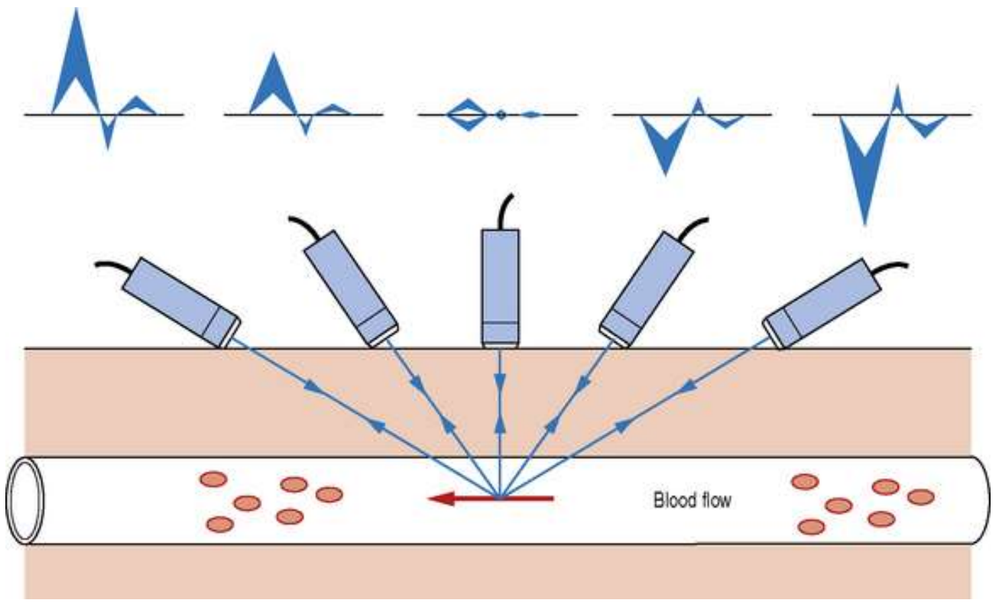
COURSE NAME : EQUIPMENTS OF ADVANCED IMAGING MODALITIES

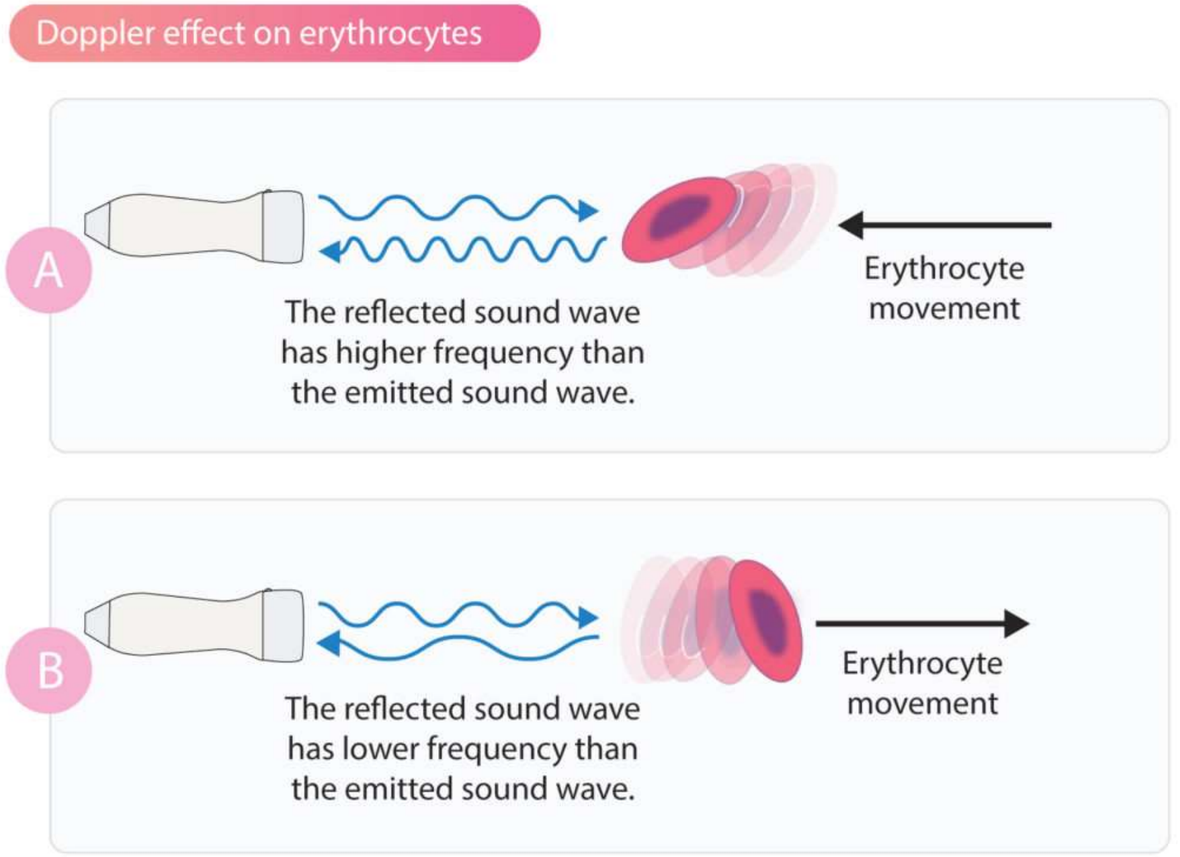
TOPIC : DOPPLER ULTRASOUND

Doppler Effect

- Doppler Effect is used in ultrasound to examine the movement of blood
- When ultrasound is reflected from a moving surface of blood cells, the frequency of the ultrasound is changed. The change in frequency depends upon the velocity of moving objects.
- If the object is moving toward the transducer, it creates high frequency, and if the object is moving away from the transducer, it creates a low frequency
- The Doppler ultrasound measures the rate of blood flow by calculating the frequency of reflected echoes.

Doppler Effect





Doppler Ultrasound

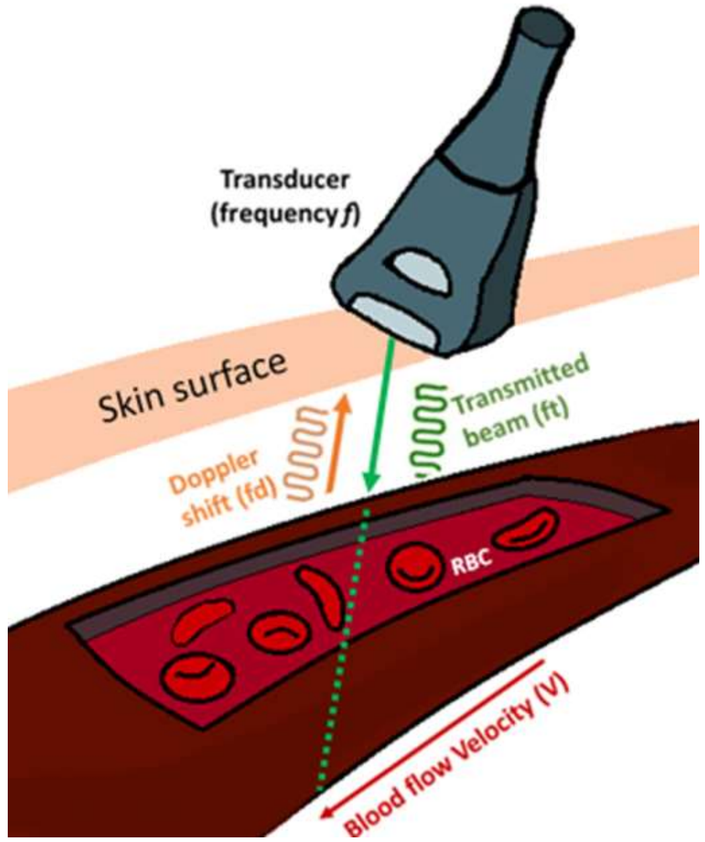
The Doppler ultrasound is used to diagnose-

- Detection of flow in a vessel
- Detect direction of flow
- Detect type of flow

Arterial or Venous

Normal or Abnormal

- Movement velocity of flow



Doppler Shift

- When the ultrasound interacts and reflects from the moving surface of blood cells, the frequency of the ultrasound is changed.
- This change in frequency is called the Doppler shift.
- So the Doppler shift is a difference between the transmitted and received frequencies

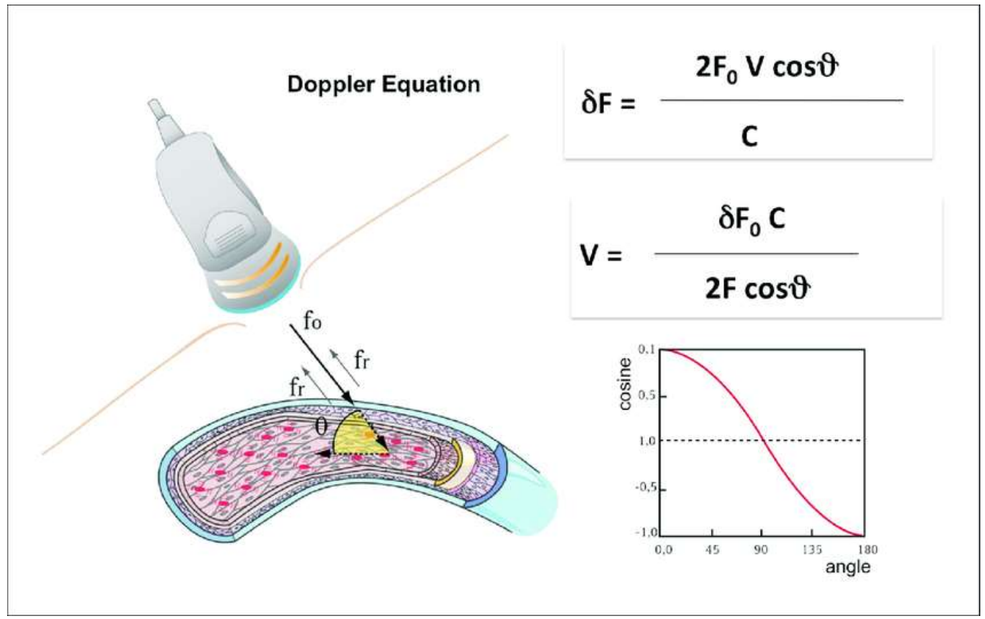
Doppler Shift

Doppler Shift = 2 x Velocity of Blood x Transducer Freq x Cos / Propagation Velocity of Sound

Doppler shift increases with-

Increasing source velocity v

- Increasing transducer frequency, f
- Doppler shift is maximum at = 0° and minimum at 0 = 90°.



Doppler Ultrasound

Doppler Patterns – There are three types of Doppler patterns, which includes

- Continuous Wave Doppler
- Pulsed Wave Doppler
- Color Flow Doppler
- Duplex Doppler
- Power Doppler

Continuous-Wave Doppler

- Continuous-wave Doppler continuously transmits and receives ultrasound waves using two piezoelectric elements in the transducer—one for transmission and one for reception.
- It accurately measures high blood velocities but cannot pinpoint their location.
- It is commonly used in cardiology to assess high velocities in the aorta, LVOT, RVOT, and valves.

Continuous-Wave Doppler

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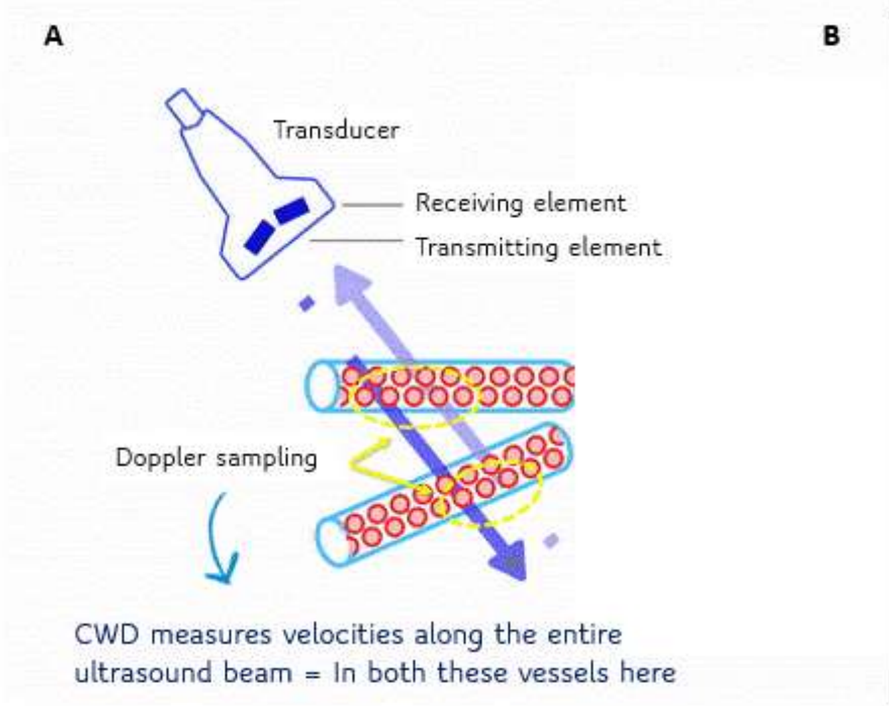

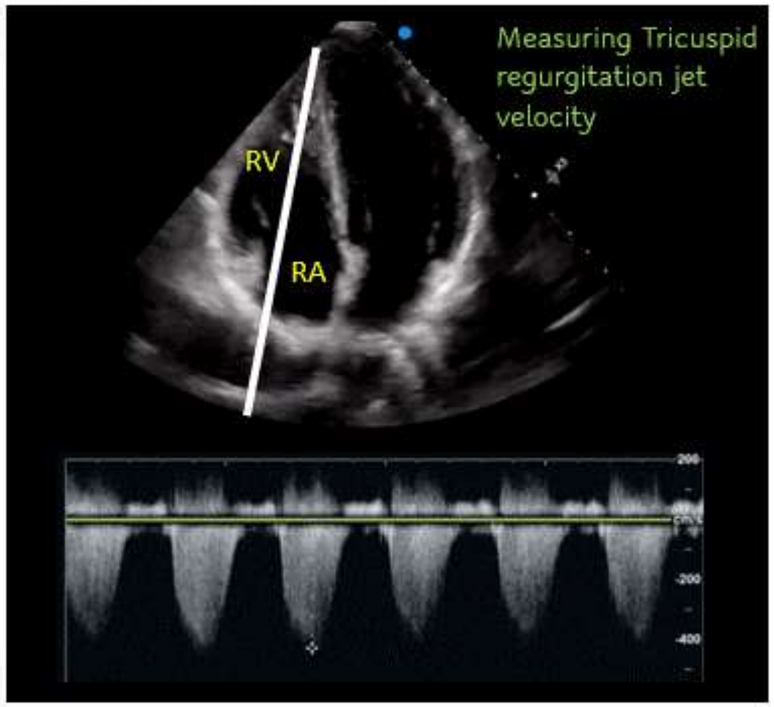

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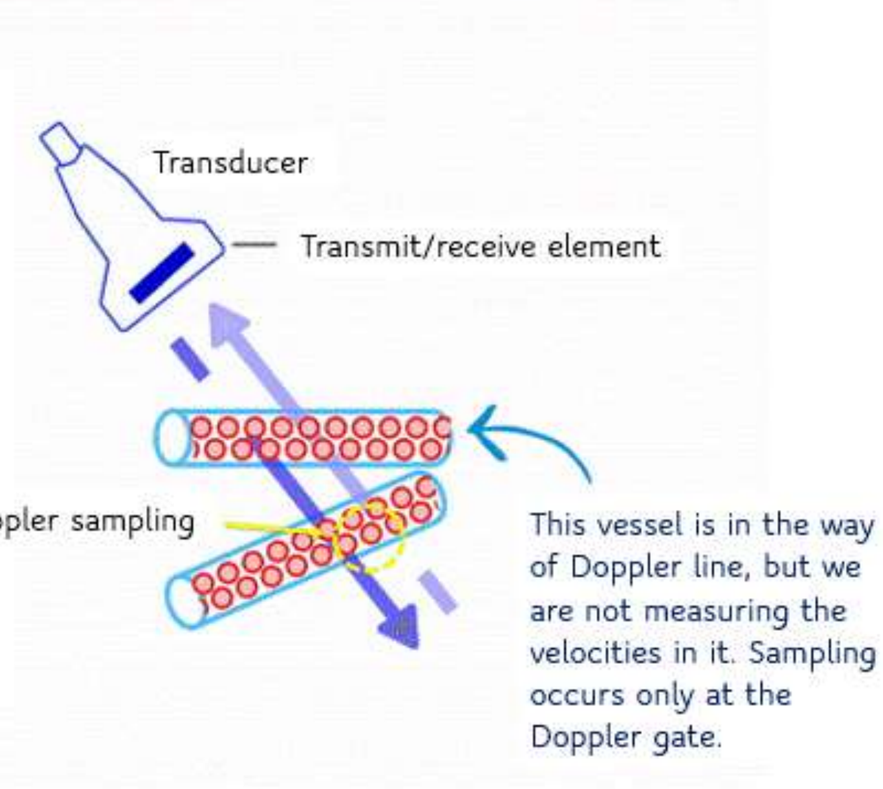
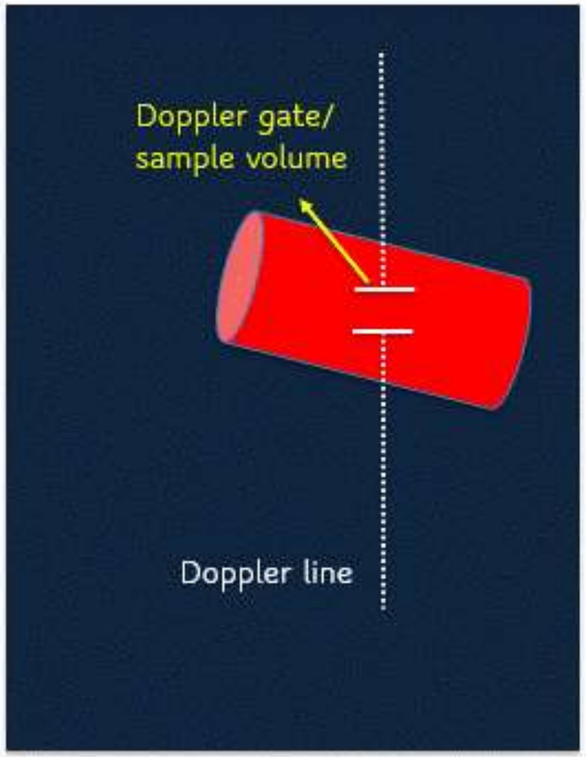
Pulse Wave Doppler

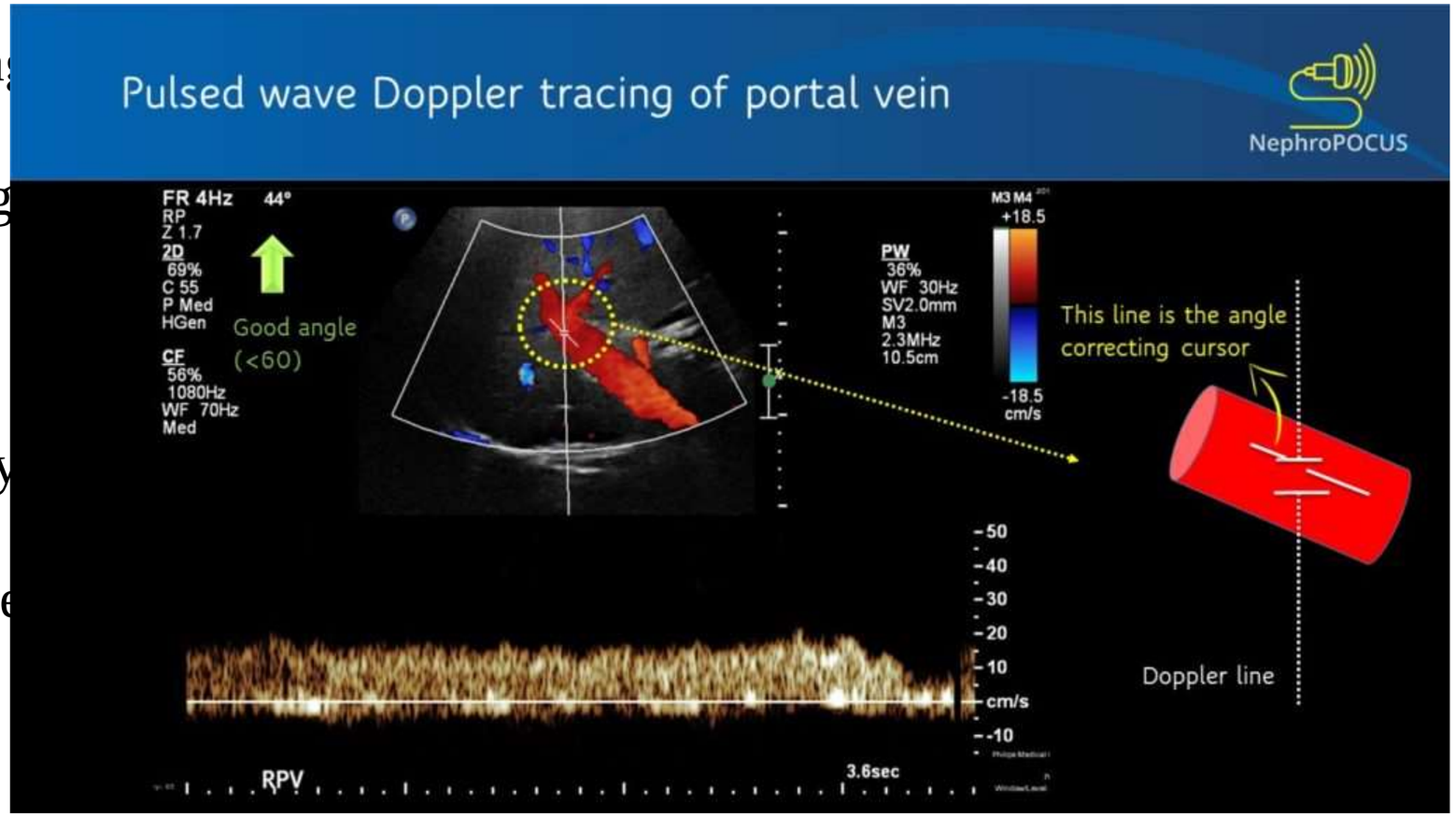
- Produ
- Alter
- Pulse
- Meas
- Provi
- Produ





Pulse Wave Doppler

- Limitations – Aliasing
- Limited in measuring
- Aliasing:
- Occurs when velocity
- Leads to inaccurate re

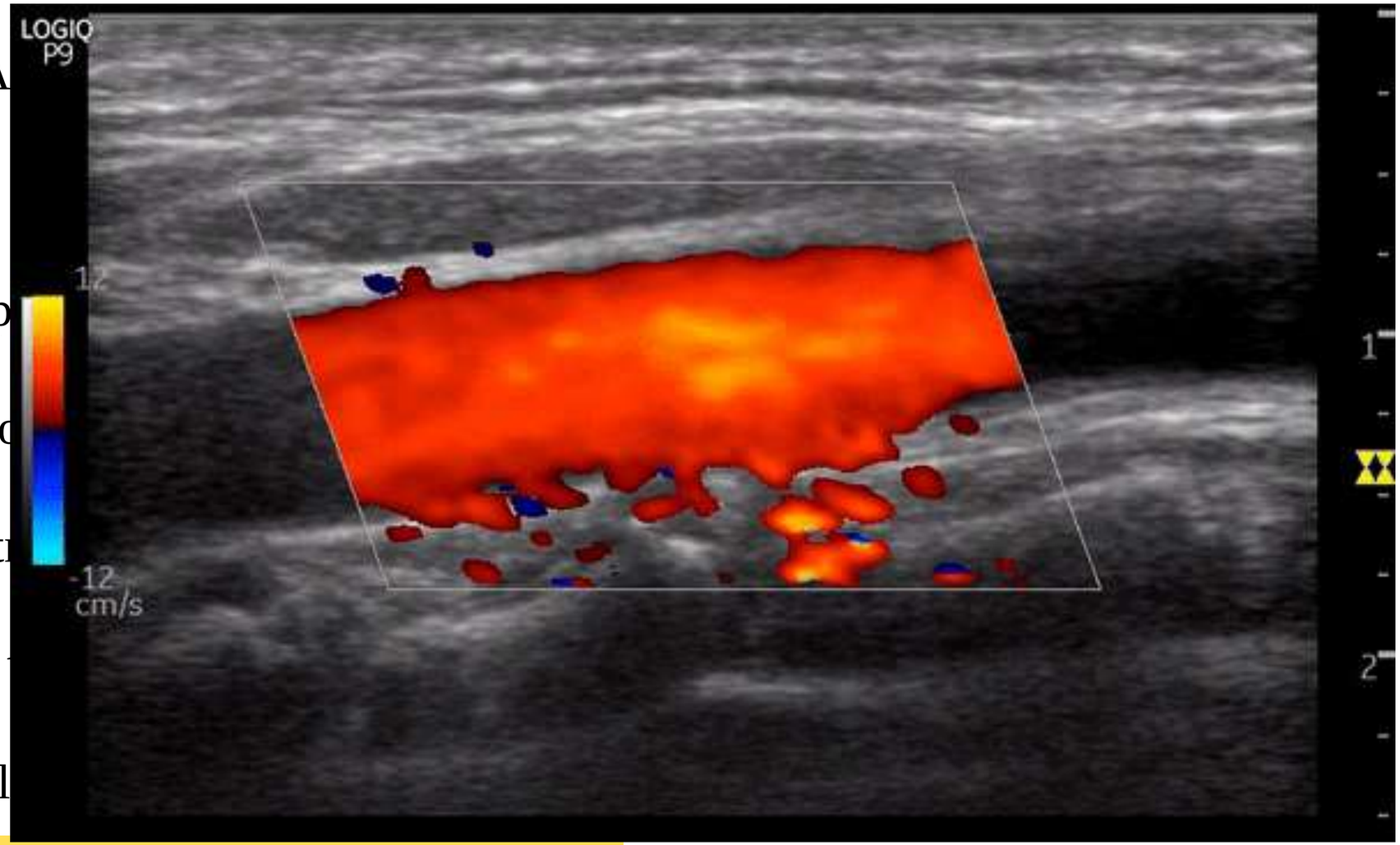


Color wave Doppler

- Color Flow Imaging: A

Image Composition:

- Black-White Part: Disp
- Color Part: Encodes blo
- Red: Flow toward the t
- Blue: Flow away from
- Black: Represents no fl



Color wave Doppler

Functions:

Real-time visualization of blood movement.

- Identifies blood vessels.
- Determines flow direction.
- Measures flow velocity.

3D Ultrasound

It is a technique that combines multiple 2D images from various angles using specialized software to create a real-time, three-dimensional image of tissues and organs.

Applications:

Detect tumors and breast lesions.

Examine the prostate gland.

Monitor fetal development and visualize fetal face/limbs.

Assess heart function (3D Echocardiography).

Evaluate uterine abnormalities

4D Ultrasound

4D Ultrasound captures real-time motion images of the fetus, typically performed between 26-30 weeks of pregnancy.

- It integrates rapid sequences of 3D images into a motion picture, allowing visualization of the baby's shape and organ movements in the womb.
- Unlike 3D ultrasound (still images), 4D provides dynamic motion pictures.

REFERENCE

- Basic Radiological physics (2nd edition) by Kuppusamy Thayalan.