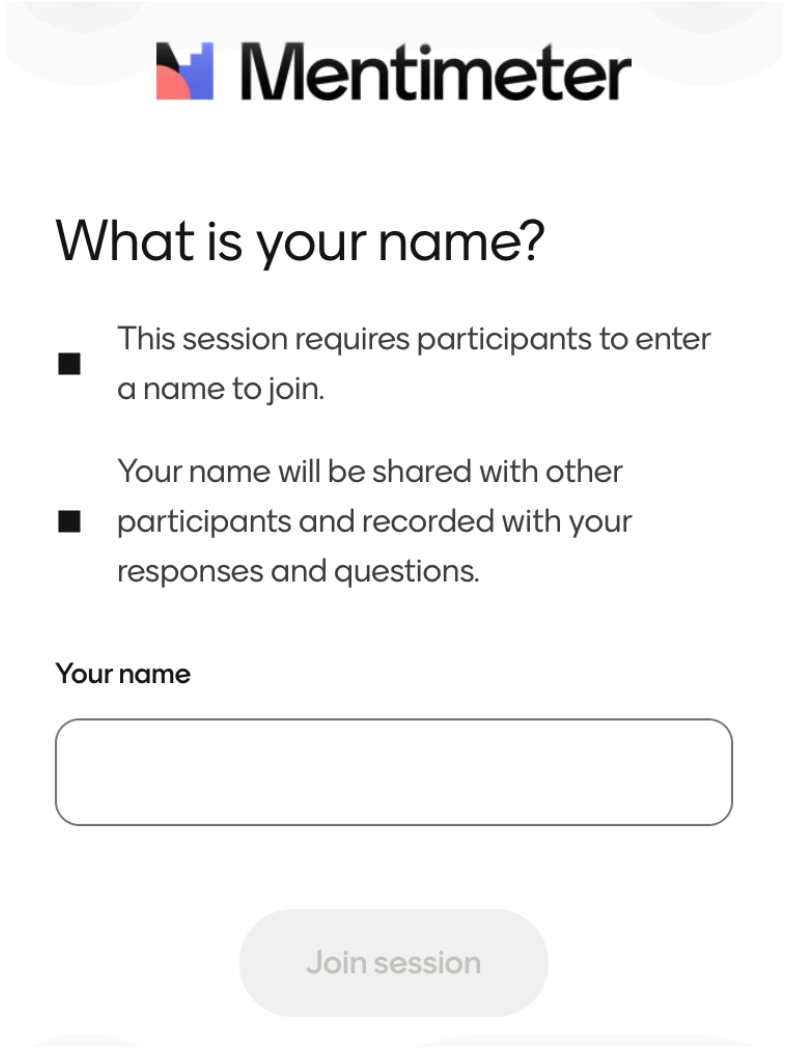
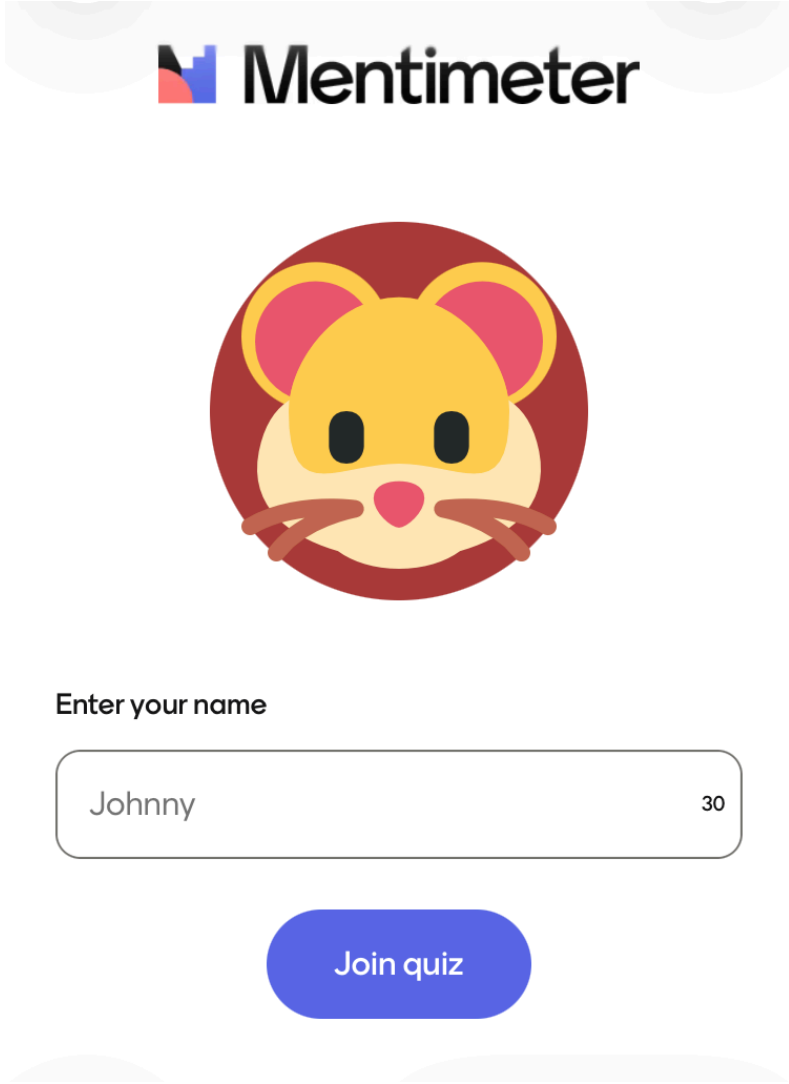
JCM QUIZ
August 2026

North Lantau Hospital

Dr Amy Ng
Dr Jessica Lau





Enter your name in the following format **for both stages**:
Chan Tai Man PMH trainee

Case 1

A 72-year-old male

- Presented with sudden, severe, ripping tearing back pain radiating to the flanks and groin.
- Past medical history: hypertension, coronary artery disease, current smoker

- Vitals signs:
  - Temperature 37.2’C
  - HR 112 bpm
  - BP 94/56 mmHg
  - RR 20 bpm
  - SpO_2 96% RA
- P/E:
  - Abdomen: a prominent, tender, pulsatile mass palpated in the periumbilical region
  - Cool, clammy extremities with diminished femoral peripheral pulses

- Q1a. What is the most likely diagnosis in this patient?

The most likely diagnosis is:

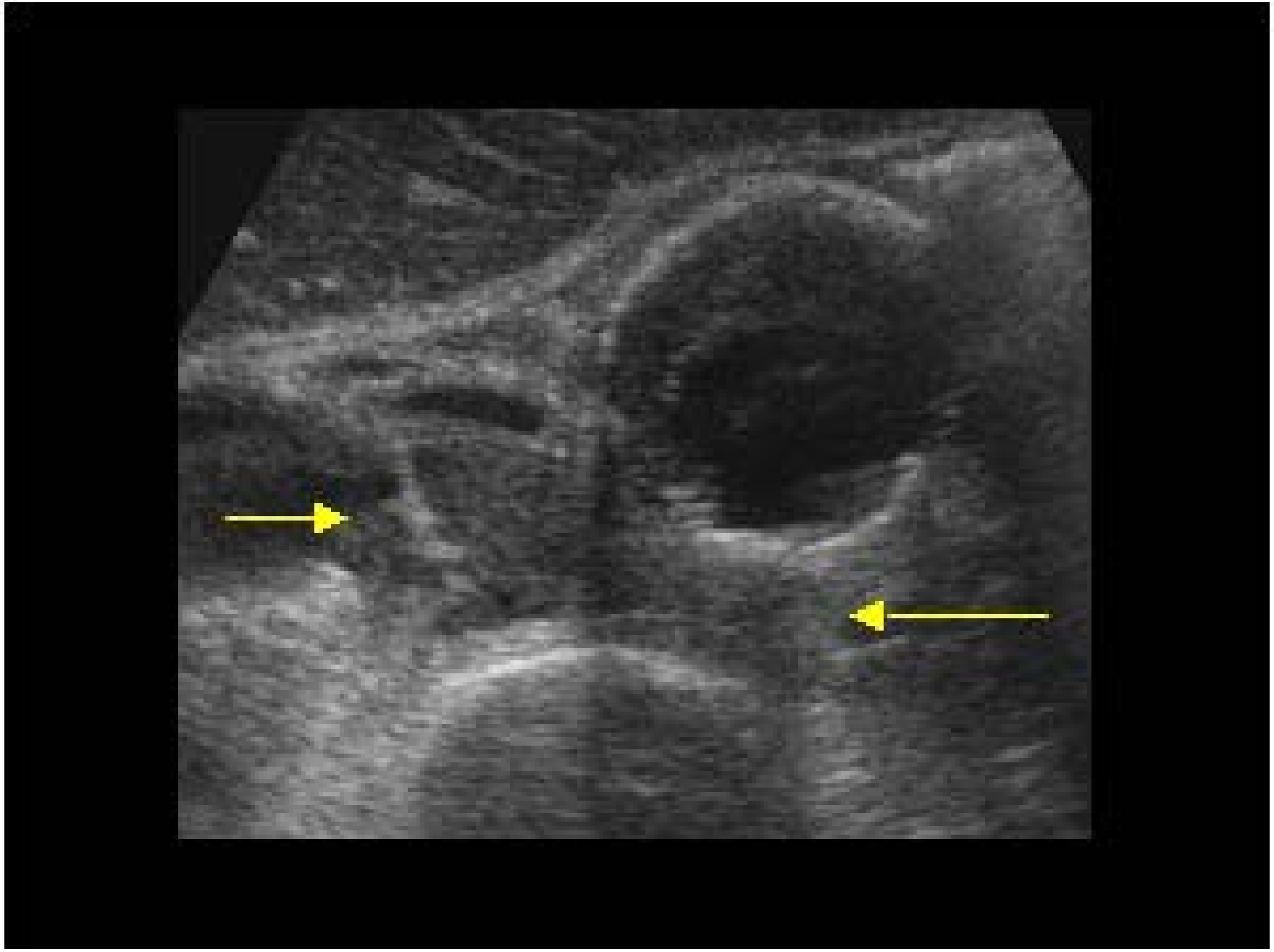
- Impending rupture of abdominal aortic aneurysm

Q1b. List 3 risk factors for this condition.

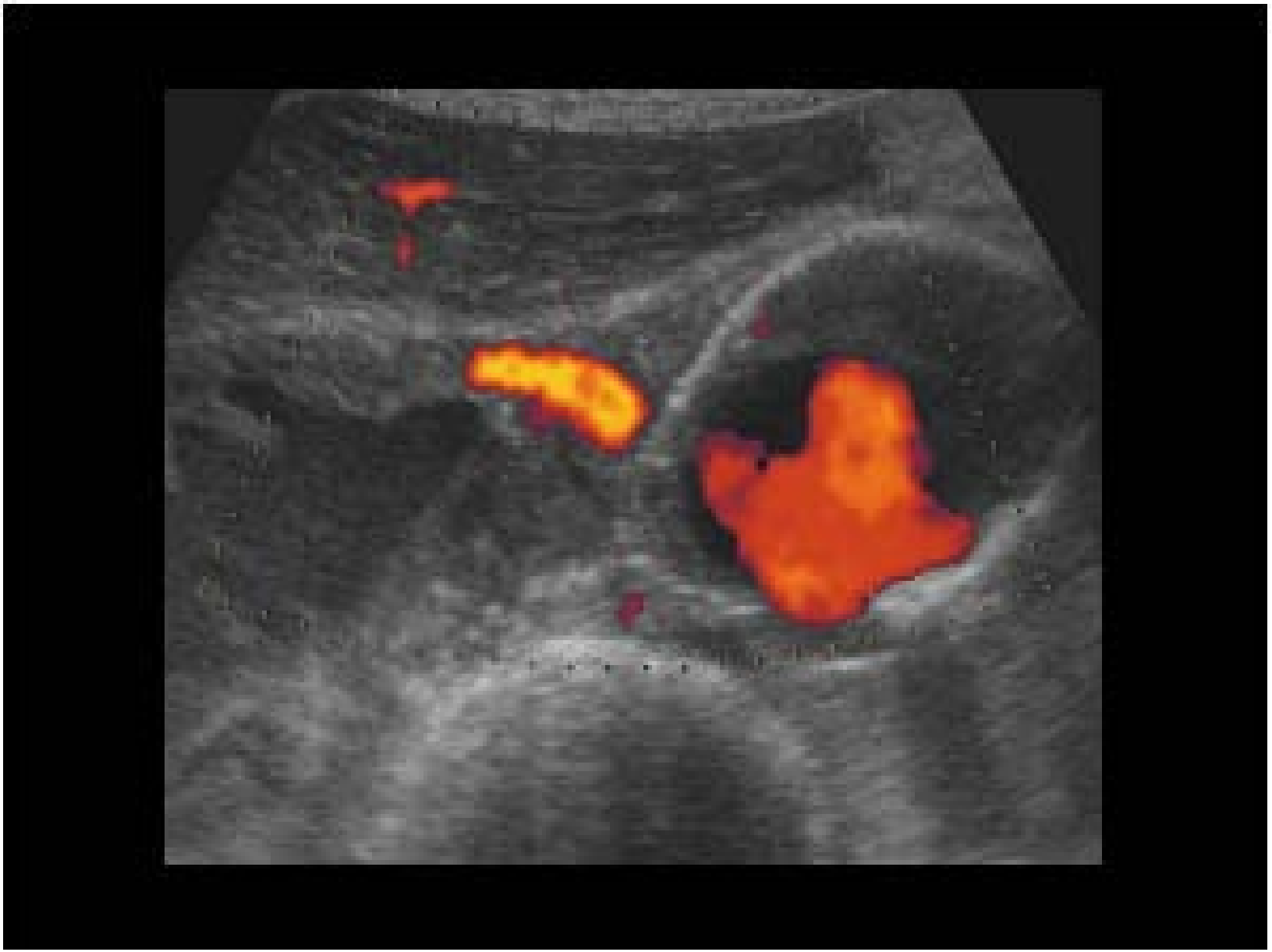
Risk factors for AAA

- Age > 60 years old
- Male (4-5 times greater risk than female)
- Family history
- Genetic factors
  - Connective tissue disorder: Marfan syndrome, Ehlers-Danlos syndrome, Turner’s syndrome, polycystic kidney disease
  - Congenital defects – bicuspid aortic valve, coarctation of aorta
- High blood pressure
- High cholesterol
- Diabetes
- Smoking
- Obesity

Q1c. List 2 important sonographic signs in this condition that directly points to clinical severity.



- Leaking from the aortic aneurysm
- Retroperitoneal hematoma next to the aortic aneurysm



- Doppler signals of leakage from the aortic aneurysm

- Q1d. Name 2 emergency department management for this condition.

Emergency department management

- **Fluid resuscitation at the same time permissive hypotension**
- **Balanced transfusion of RBC, plasma, plt in 1:1:1 ratio**
- **Urgent surgical consultation**

- Q1e. What is the risk score to predict mortality in this condition?

Case 1

- **Harborview Risk Score**
  - Predict 30-day mortality in patients with ruptured AAA
  - 1 point of each of preoperative characteristics
    - Age > 76 years
    - pH < 7.2
    - Creatinine level > 176.8 umol/L
    - SBP < 70 mmHg
  - Mortality: 0 – 14.6%; 1 – 35.7%; 2 – 68.4%; 3 to 4 – 100%

Case 2

58-year-old man

- Complains of sudden onset agonizing chest and back pain that started 45 minutes ago
- The patient was lifting heavy boxes when he experienced an abrupt, "tearing" sensation.
- Pain score 10/10
- Past medical history: long standing essential hypertension, hyperlipidaemia, active smoker

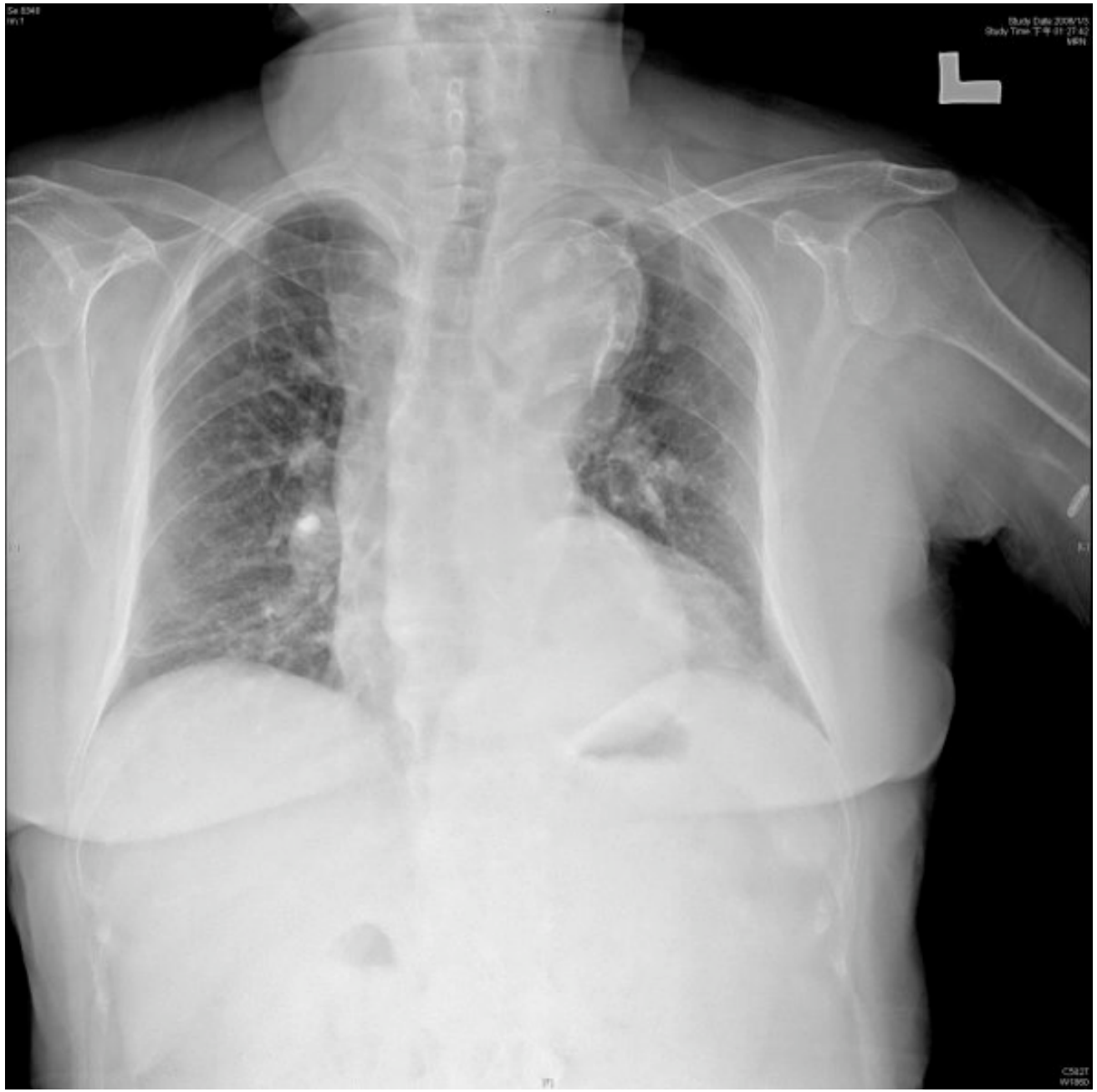
- Vital signs
  - Temperature 36.8’C
  - BP:
    - Right arm: 195/102 mmHg
    - Left arm: 170/95 mmHg
  - HR 102 bpm
  - RR 22 bpm
  - SpO_2 96% RA

Q2a. Name 3 differential diagnoses.

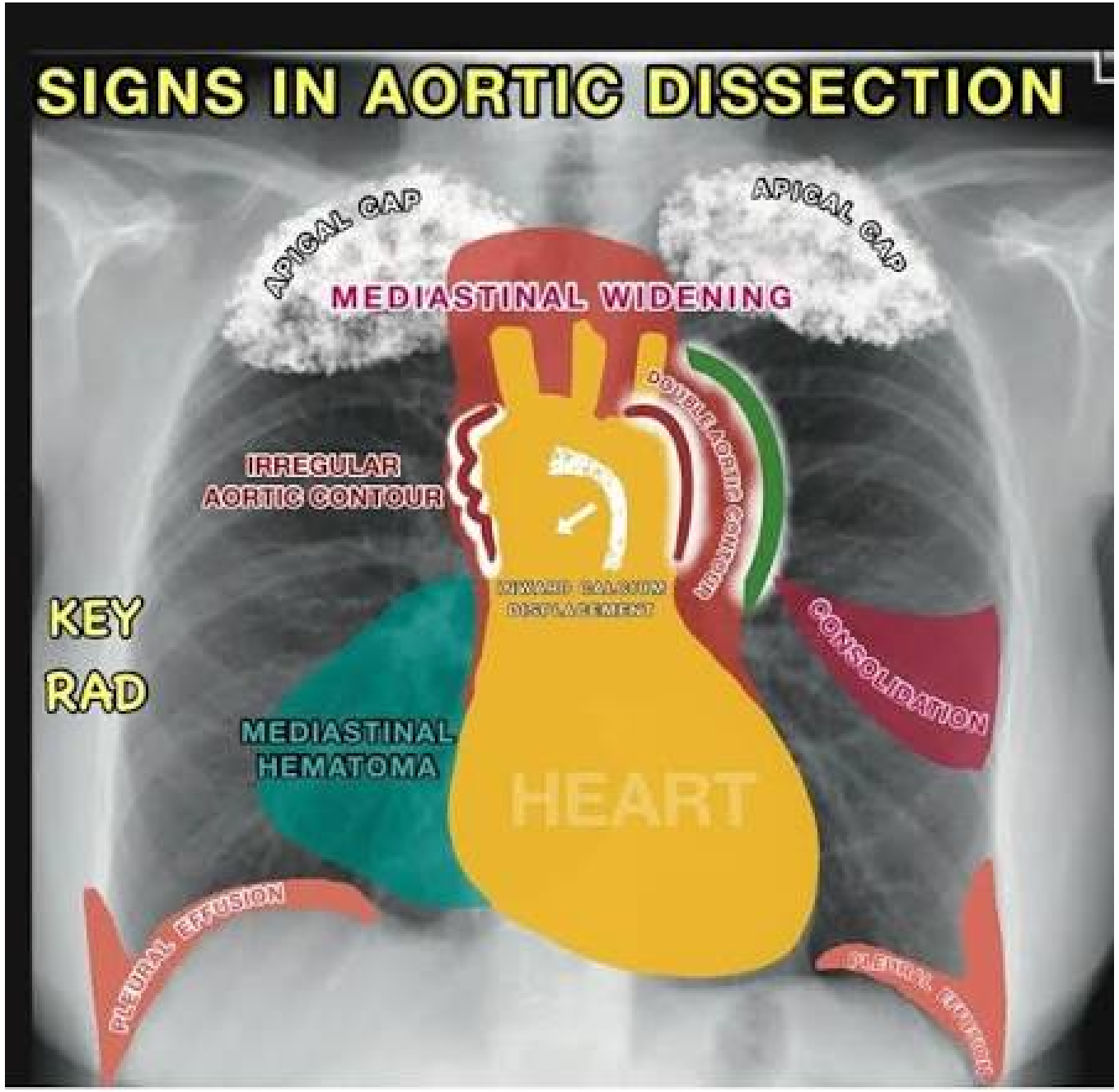
Case 2

- The provisional differential diagnoses are:
  - Acute aortic syndrome
  - Acute myocardial infarction
  - Pneumothorax
  - Pneumomediastinum

Q2b. A chest x-ray was done. Name 3 abnormalities.



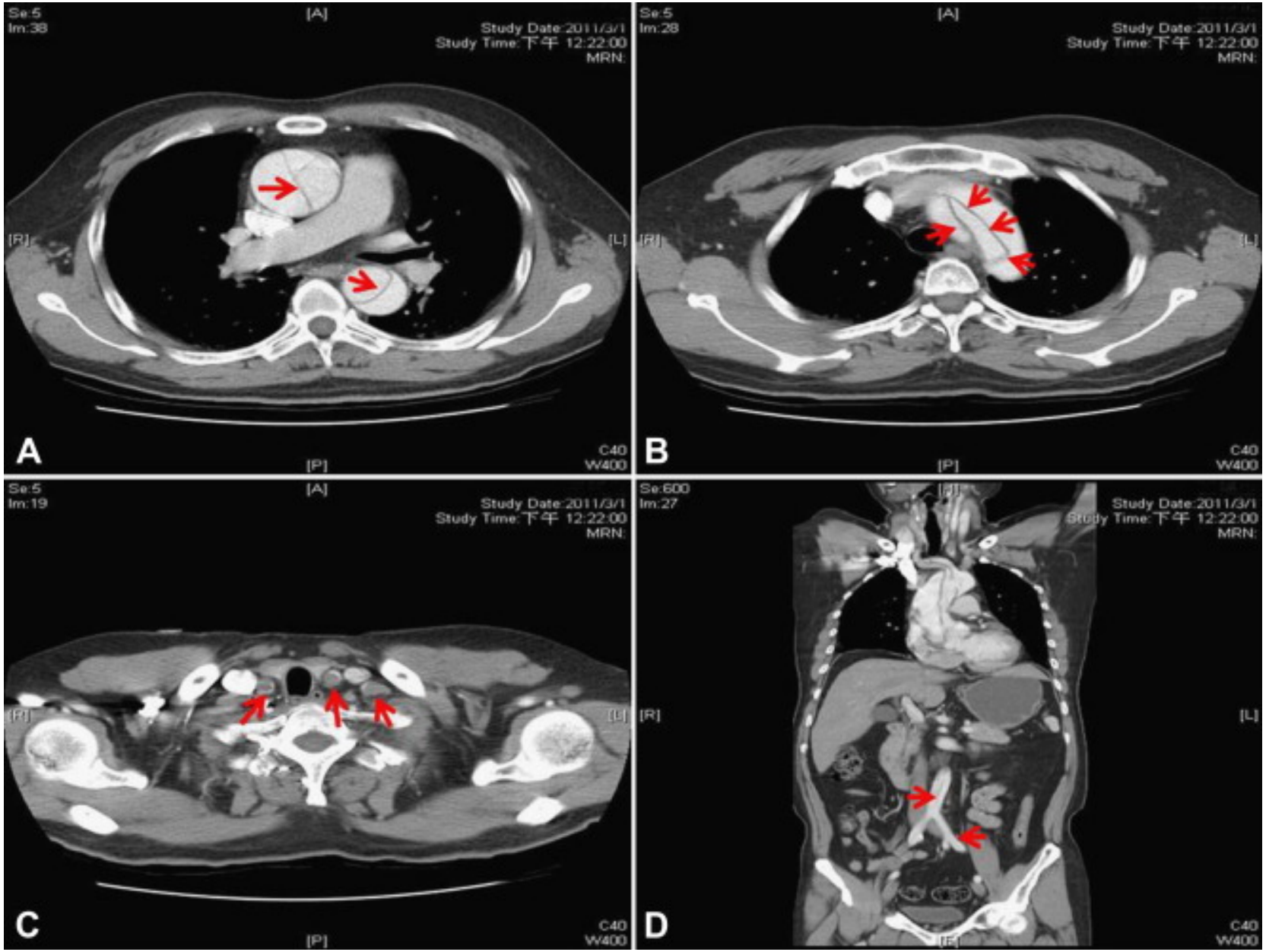
- What are the abnormalities in this chest X-ray?
  - Widen mediastinum > 8 cm
  - Blurring of aortic knob
  - Double Calcium sign



- Other radiological signs for aortic dissection
  - Tracheal or esophageal deviation
  - Left apical pleural cap
  - Distortion of left main bronchus
  - Pleural effusion

Case 2

- A CT Aortogram was done for the patient.
- Showed the dissection involved the ascending, descending aorta, and the aortic arch.



Q2c. Name 4 possible echocardiographic signs in acute aortic dissection

Echo signs of aortic dissection

- Dilated aortic root > 3.5-4cm, highly suspicious
- aortic flap in suprasternal notch view or parasternal long-axis view
- aortic valve regurgitation
- any pericardial effusion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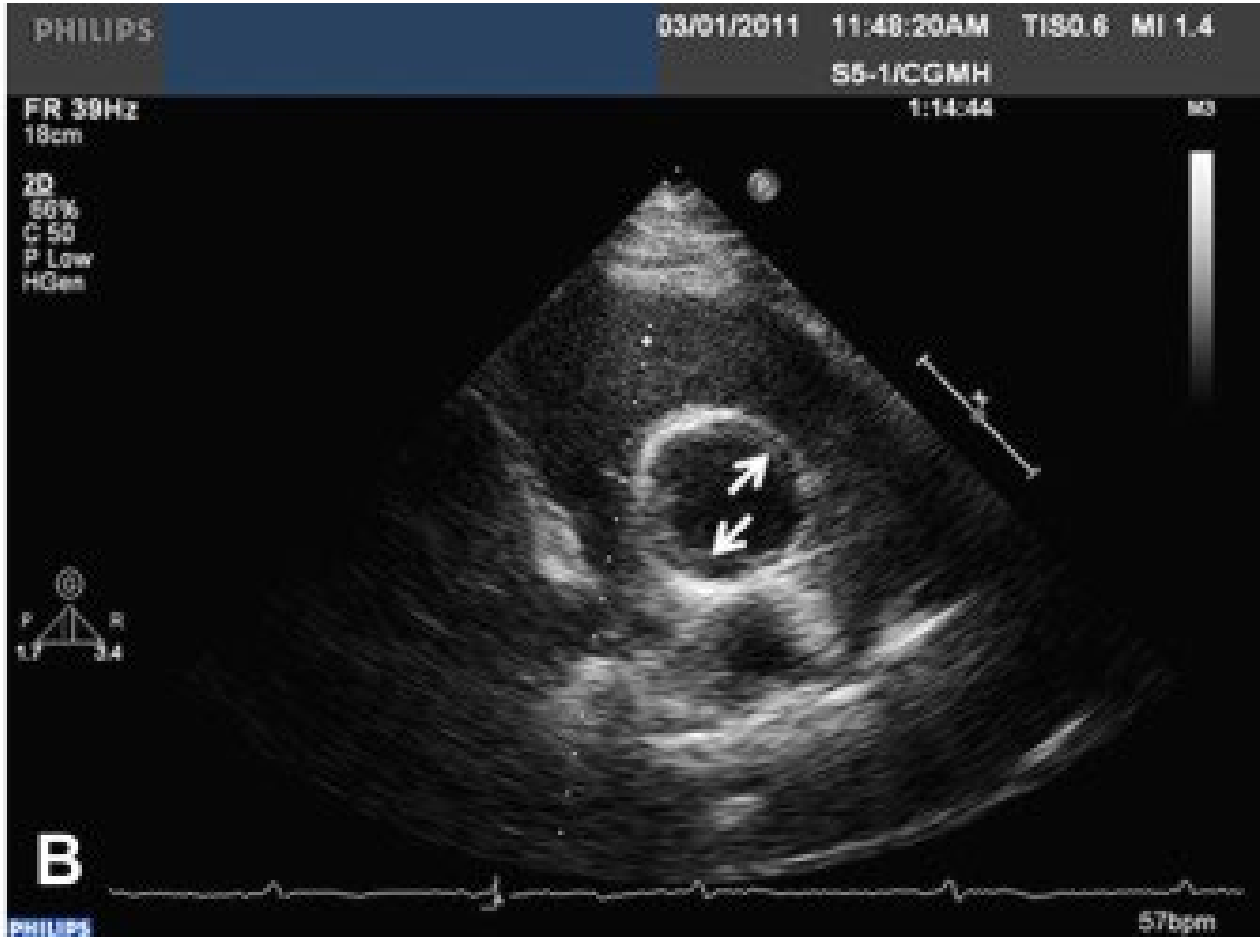
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Q2d. Name 3 specific management in emergency department.

ED management

- **Anti-Impulse Therapy**
  - Heart rate < 60 bpm and blood pressure < 120/80 mmHg
  - Decrease aortic wall shear stress and minimize the tendency for the dissection to propagate
  - B-blocker: esmolol and labetalol
  - Calcium channel blocker if beta-blocker not tolerated
  - TNG or nitrite can be used only after beta-blocker
- **Pain control**
  - Adequate pain control can aid in the control of heart rate and blood pressure
- **Urgent cardiothoracic surgery consultation**

Q2e. The patient has to be transferred to cardiothoracic unit in another hospital. Name 5 things (equipment/ medications) that you will prepare before transfer.

- The preparation for transport
  - **Adequate and experienced staffs**
  - **Adequate hemodynamic monitoring**
    - Continuous ECG monitoring
    - Consider arterial lines for continuous blood pressure monitoring or frequent NBP monitoring
    - Perfusion monitoring with peripheral oxygen saturation or urine output
  - **Adequate medications with secure IV access**
    - Anti-hypertensive medication
    - Inotropes/ vasopressors
    - Analgesics

Arterial Cannulation for Continuous Blood Pressure Monitoring

Q3a. What are the indications for arterial line catheterization?

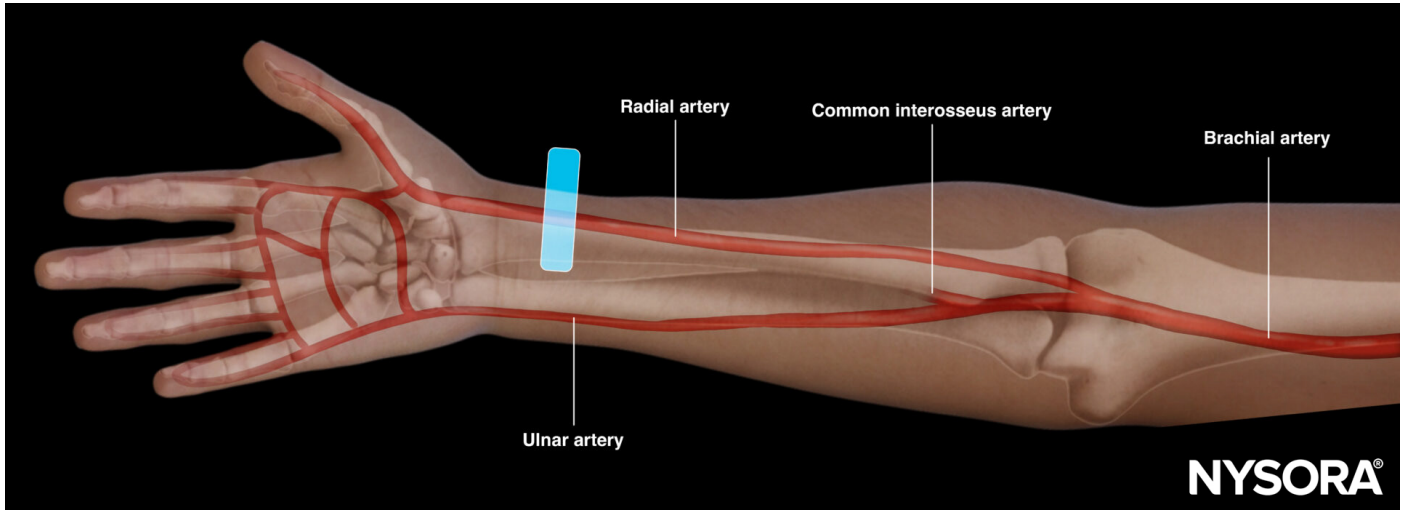
What are the indications for an arterial line?

- Sustained hypotension
- Vasoactive medications
- Continuous BP monitoring
- Frequent blood sampling

Q3b. Name 2 common sites for arterial line insertion.

Where are the common sites for arterial line?

- **Radial artery**
- **Dorsalis Pedis artery**
- Brachial artery
- Femoral artery



Q3c. Name 5 complications of arterial line insertion.

Complications from arterial cannulation

- Pain and swelling
- Thrombosis
- Embolization
- Hematoma
- Hemorrhage
- Limb ischemia
- Catheter-related infection
- Pseudoaneurysm

Q3d. What is the physical principle behind non-invasive blood pressure monitoring?

A. Korotkoff principle

B. Oscillometric principle

C. Piezoelectric principle

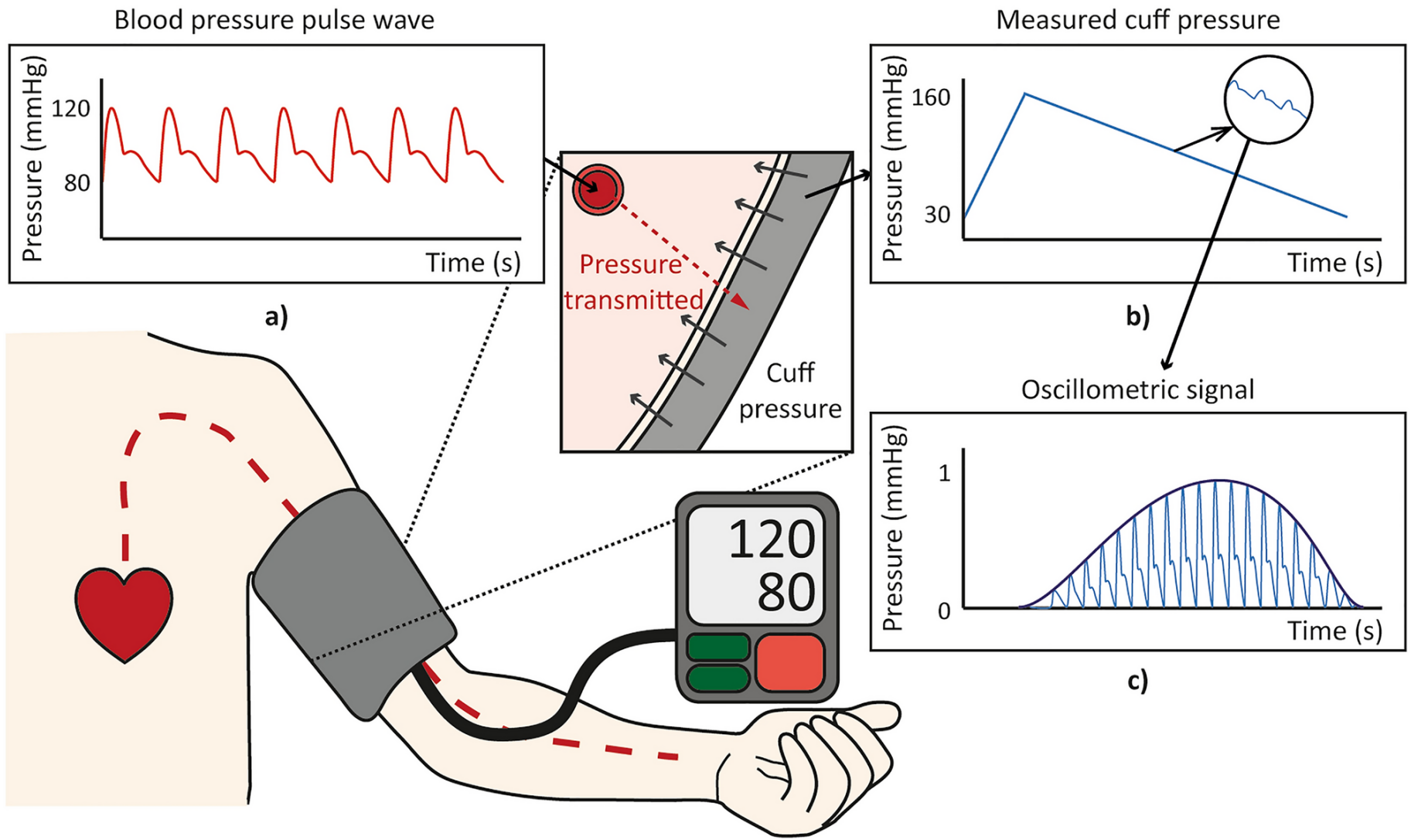
D. Venturi principle

The Principle of Non-Invasive Blood Pressure

The automatic NIBP is based on the **oscillometric principle**

- Detects blood pressure by measuring small pressure oscillations inside an inflatable cuff caused by arterial wall vibrations as blood flows through
- **Mean Arterial Pressure (MAP)** - found at the point where the wave oscillations reach the maximum size
- **Systole Pressure** – calculated by the device algorithm when oscillations start to rise sharply
- **Diastolic Pressure** – calculated when oscillations drop off and level out as flow becomes smooth

Non-Invasive Blood Pressure



Q3e. What is the physical principle behind invasive blood pressure monitoring?

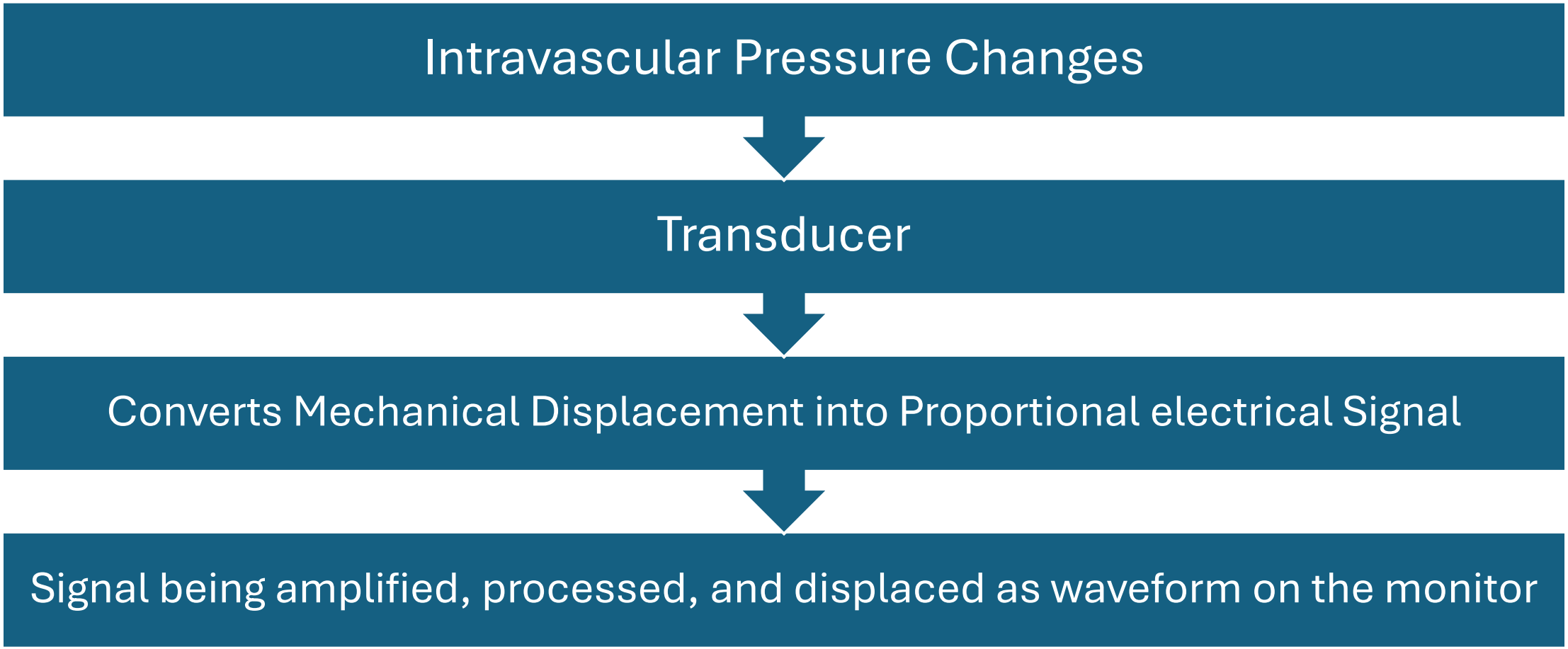
A. Electromagnetic coupling

B. Fourier coupling

C. Hydraulic coupling

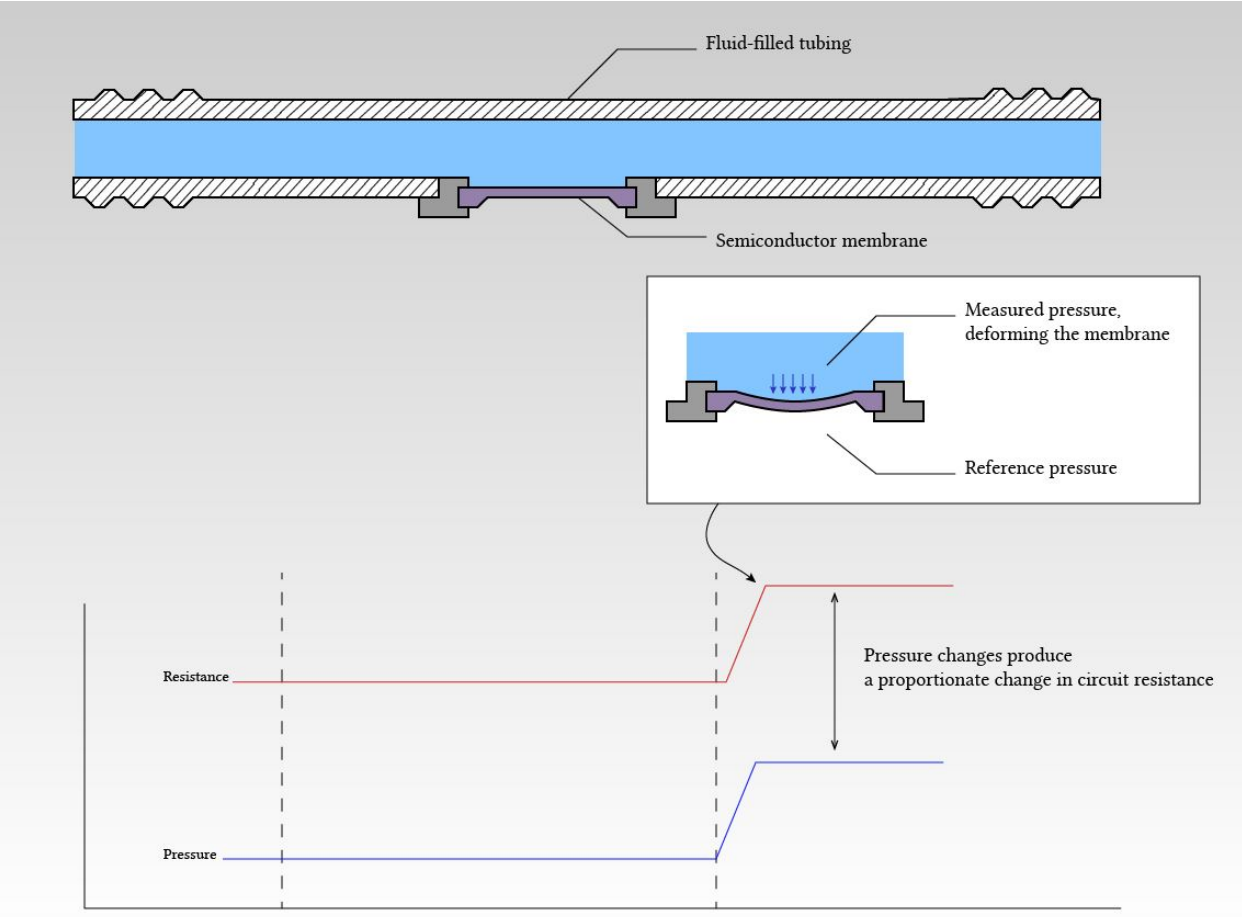
D. Pulse contour coupling

Principle of Arterial Blood Pressure Measure



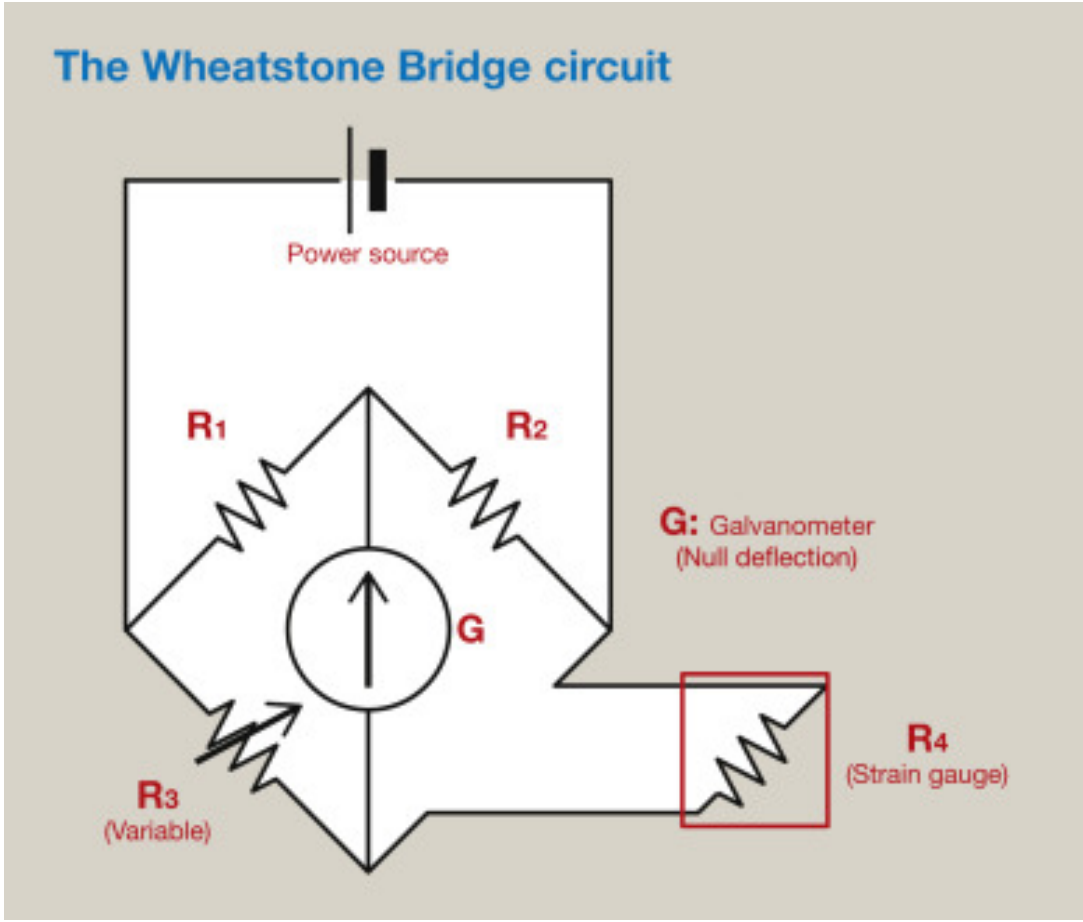
Principle of Arterial Pressure Transducer

- Invasive arterial pressure monitoring uses **a fluid-filled catheter** to transmit arterial pulsation to **a silicon diaphragm (Piezoresistive strain gauge sensor)**



Principle of Arterial Pressure Transducer

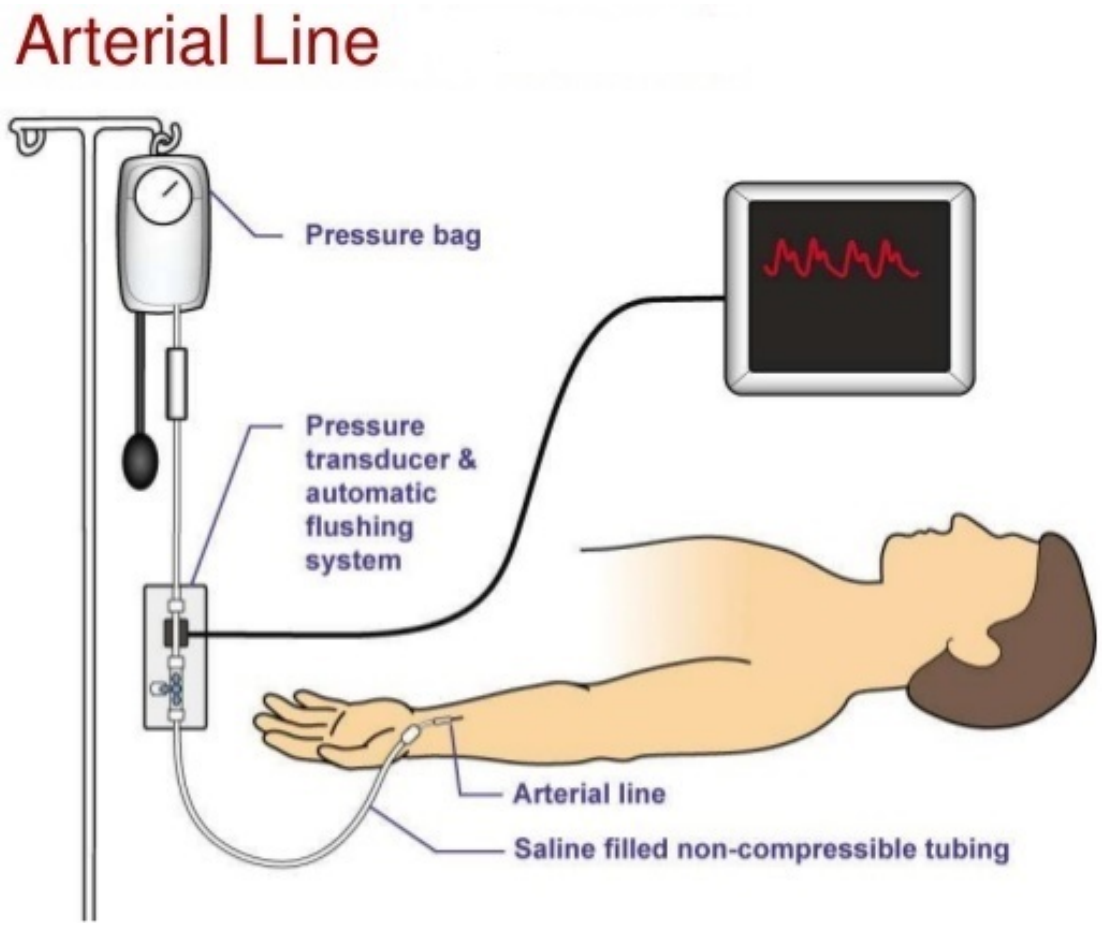
- The mechanical deformation alters the electrical resistance of the gauges on the **Wheatstone bridge circuit**, converts into a measurable voltage proportional to the blood pressure.



Q4a. What are the component of an intra- arterial blood pressure measuring system?

Arterial Line Setup

- **Catheter**: access to the arterial system
- **Fluid-Filled Tubing**: fluid column in the tubing system carries the mechanical signal created by the pressure wave to the diaphragm of the electrical pressure transducer
- **Transducer**: connects the fluid-filled tubing system and the electronic system

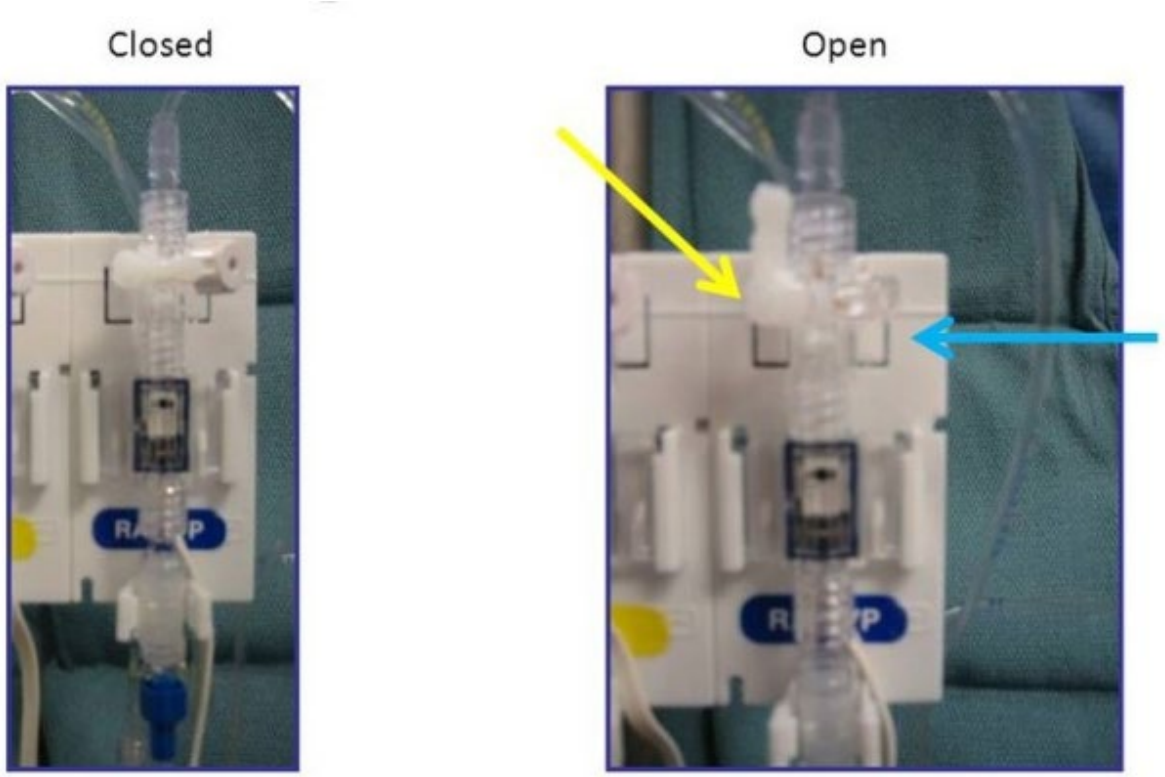


Q4b. What does zeroing of intra-arterial blood pressure measuring system mean?

A. Zero air bubbles in the system
B. Zero against atmospheric pressure
C. Zero against ground level
D. Zero with regards to absolute zero pressure

Zeroing the transducer

- Zeroing: zeroed against atmospheric pressure (760mmHg)



Q4c. In intra-arterial blood pressure monitoring system, where should the pressure transducer be placed?

A. level of 4th intercostal space at mid-axillary line

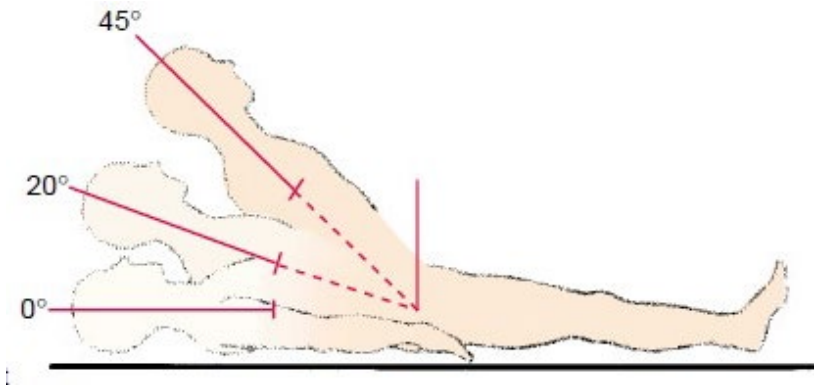
B. level of external auditory meatus

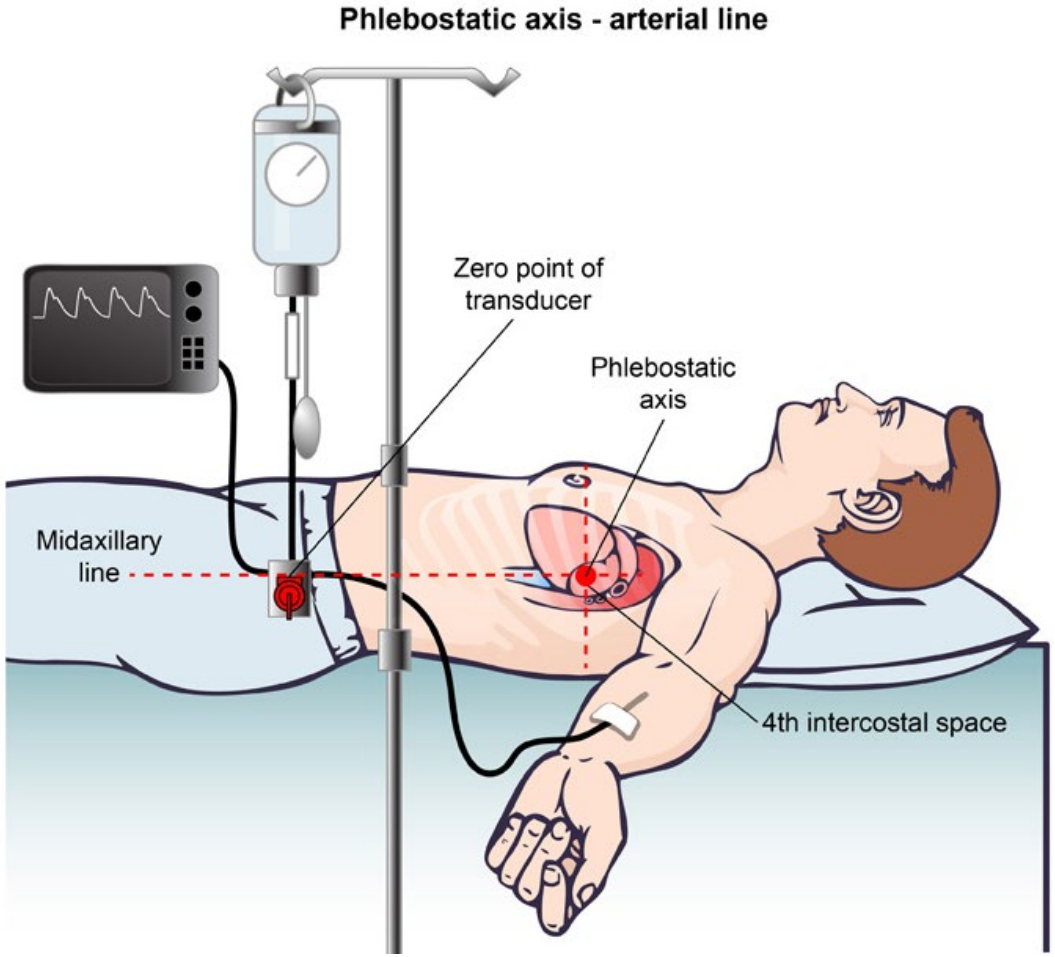
C. level of sternal angle

D. same level as the saline bag

Leveling the transducer

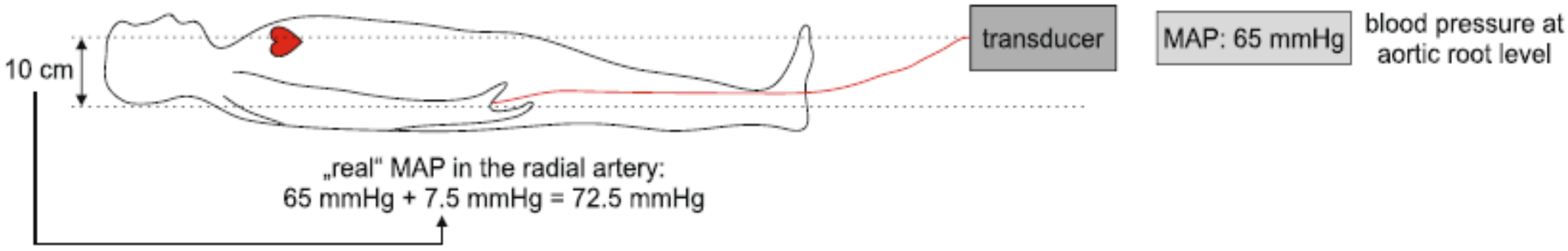
- Phlebostatic axis: 4th intercostal space at mid-axillary line
- ~ aortic root level



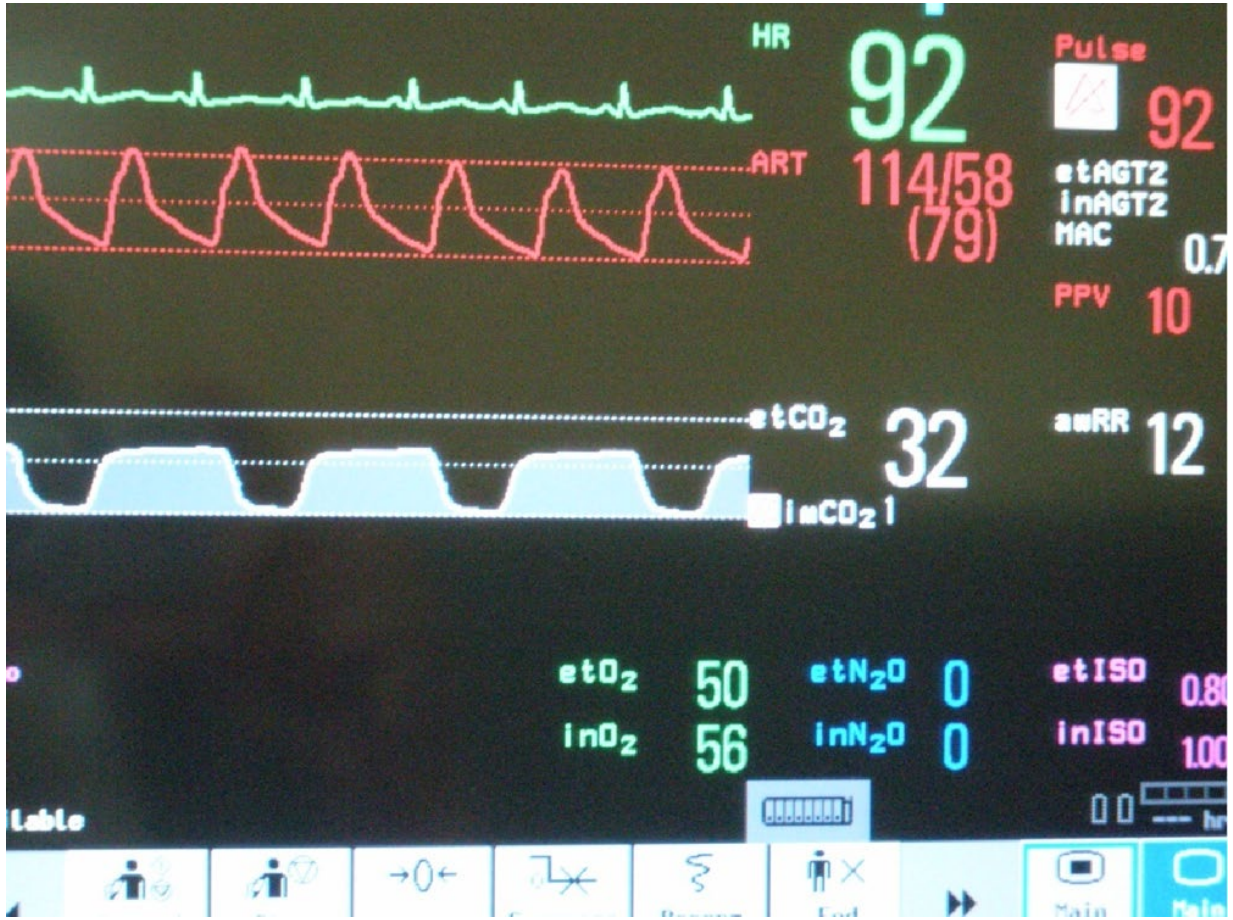


Leveling the transducer

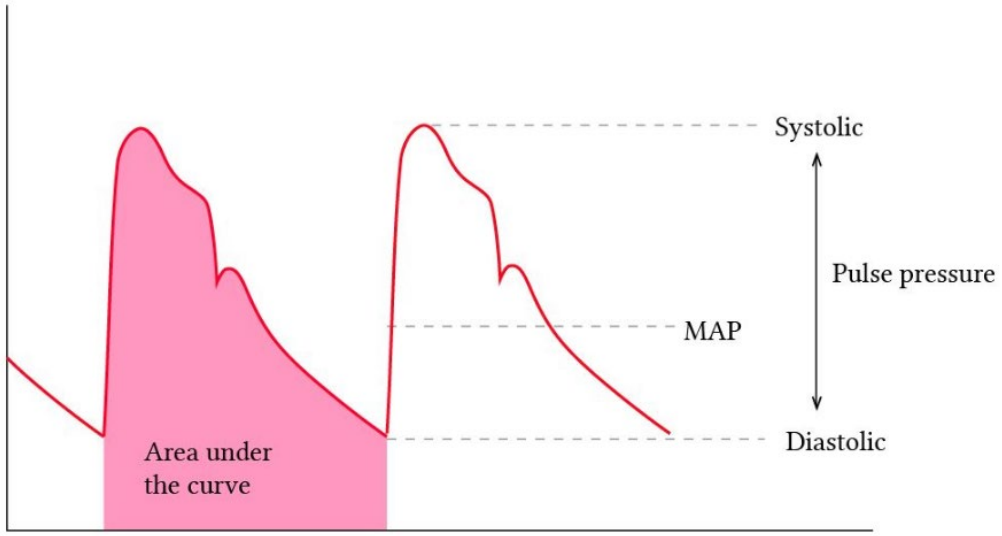
- For every 10 cm below phlebostatic axis, A-line will add 7.4mmHg of pressure (hydrostatic pressure)

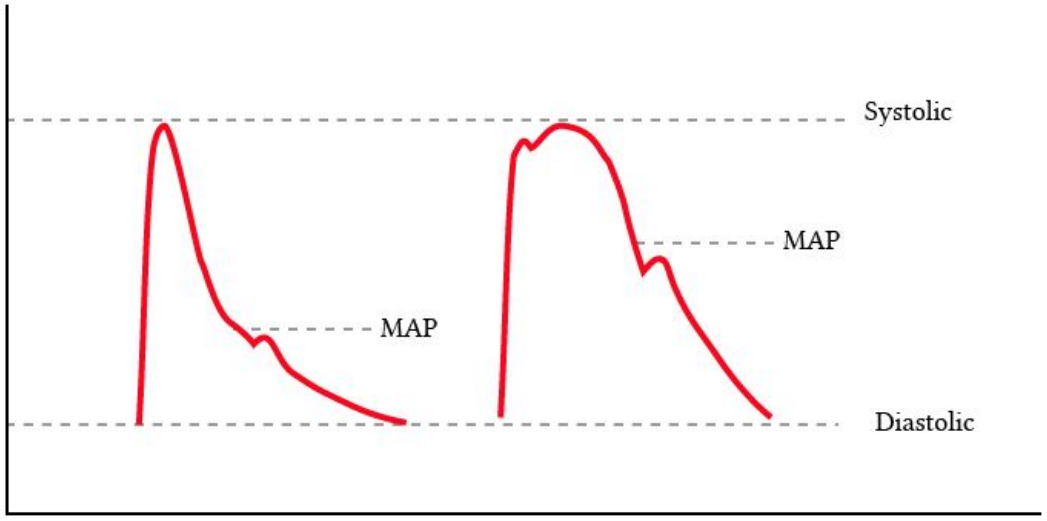


Q4d. This picture shows an arterial blood pressure waveform, how is the mean arterial pressure measured?



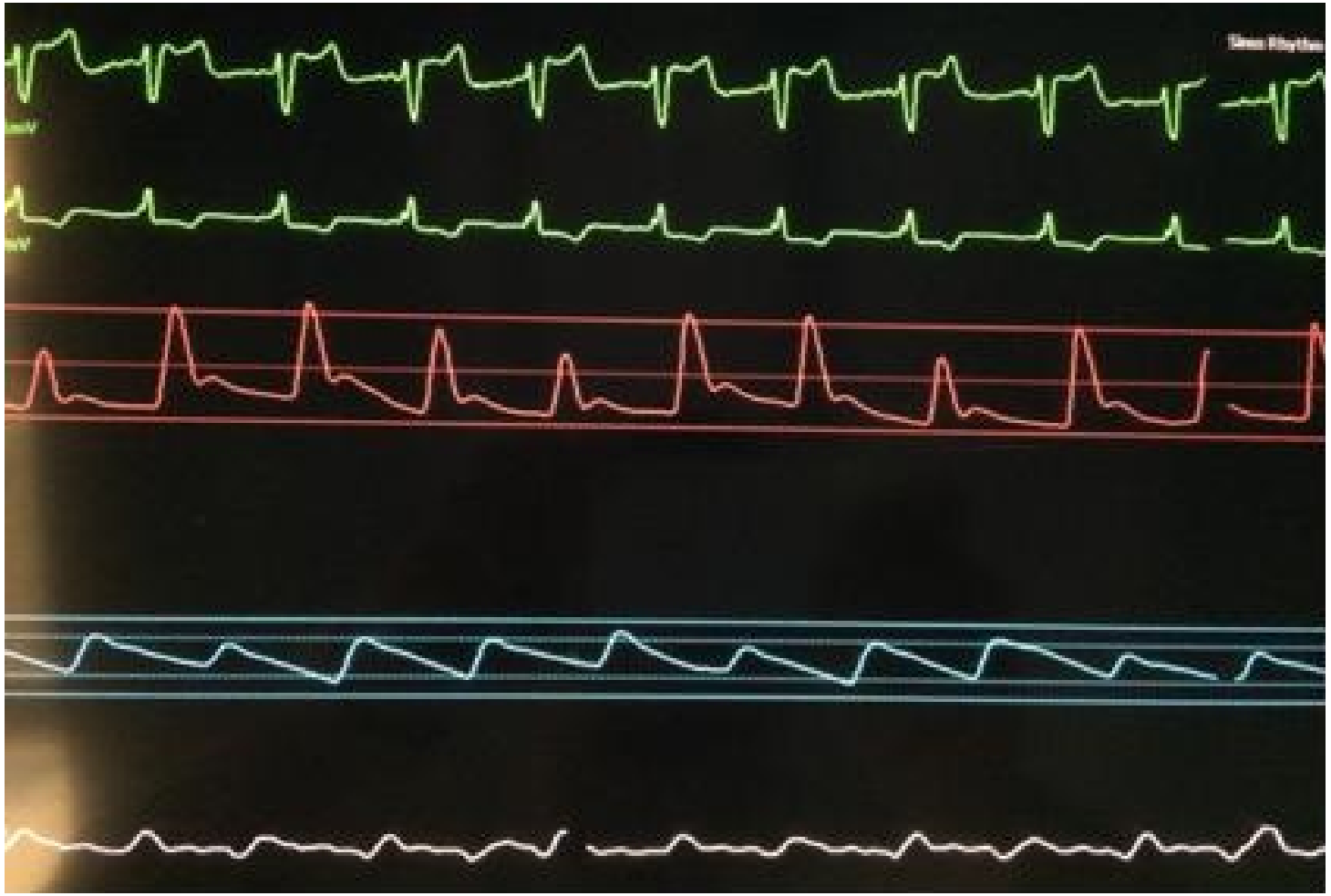
Arterial line waveform – MAP



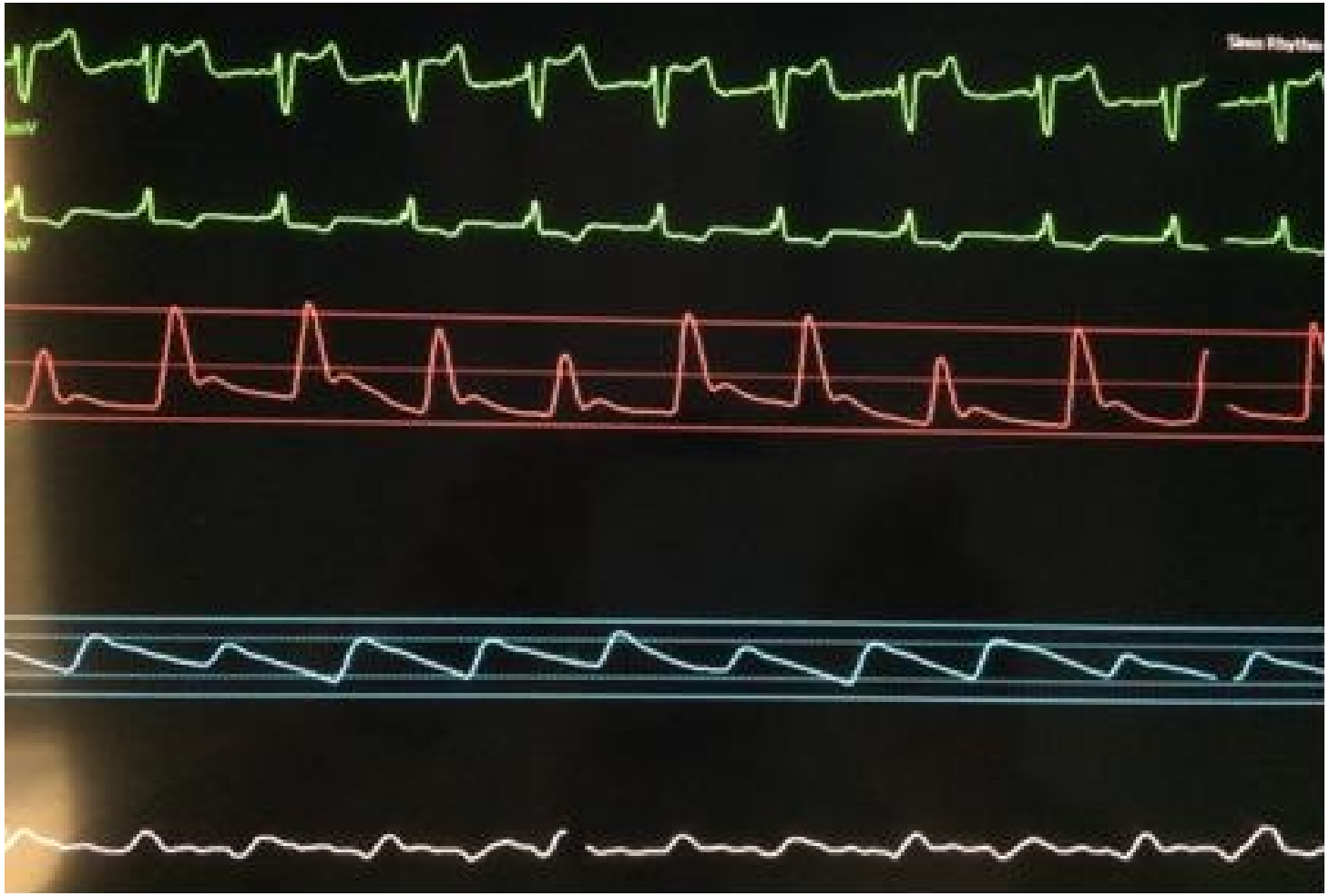


mean arterial pressure (MAP) is calculated from the area under the pressure curve

Q4e. Name 2 potential causes of this arterial pressure waveform.



Q4e. Name 2 potential causes of this arterial pressure waveform.



- Hypovolemia
- Cardiac tamponade (pulsus paradoxus)

Q4f. Name the diagnosis in this arterial pressure waveform.

Pulsus alternans

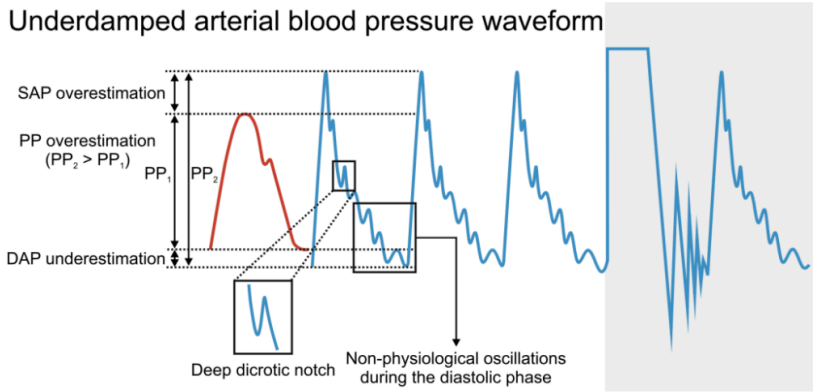
- Alternating strong and weak heart beat
- Severe left ventricular systolic dysfunction
- Starling mechanism:
  - Low EF → ↑end diastolic volume → ↑ stroke volume → next cardiac cycle → ↓ end diastolic volume → ↓ stroke volume
- delayed intracellular calcium cycling leading to rhythmic fluctuations in excitation-contraction coupling

Dynamic Accuracy of Arterial Line

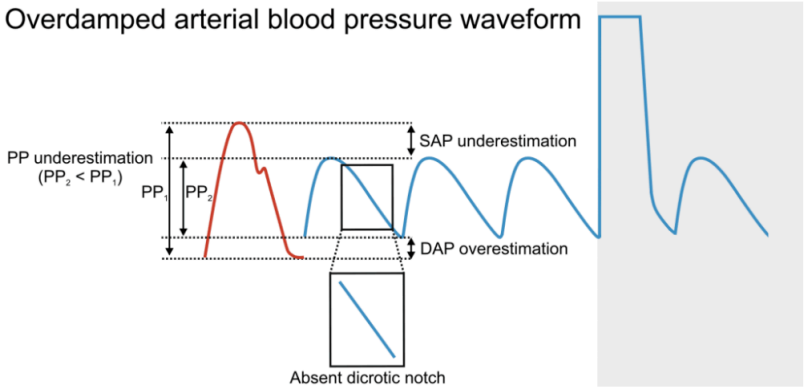
- The dynamic accuracy depends on the fluid-filled monitoring system’s ability to faithfully reproduce the true intravascular pressure waveform without distortion.
- Accuracy depends on the following factors
  - **Natural frequency of the system**
    - Frequency at which the system oscillates when stimulated
  - **Damping characteristic**
    - How quickly an oscillating system comes to rest

Dynamic Accuracy of Arterial Line

- Dynamic Response Testing
  - **Fast-Flush Test (Square wave test)**
  - **Underdamped systems** will display >= 3 oscillations after a flush and have a natural frequency that is too slow
  - **Overdamped systems** will return to baseline immediately
  - Optimal damped system shows 1-2 oscillations



Underdamped Arterial Waveform (Image from [4])

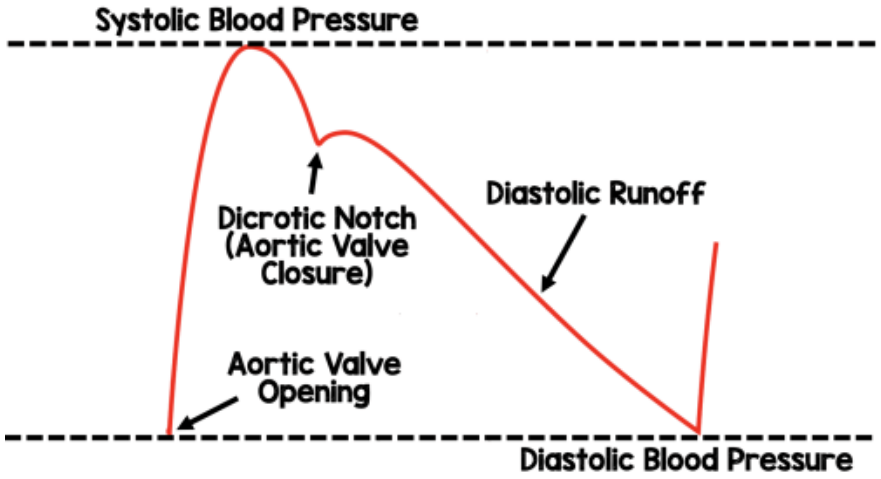


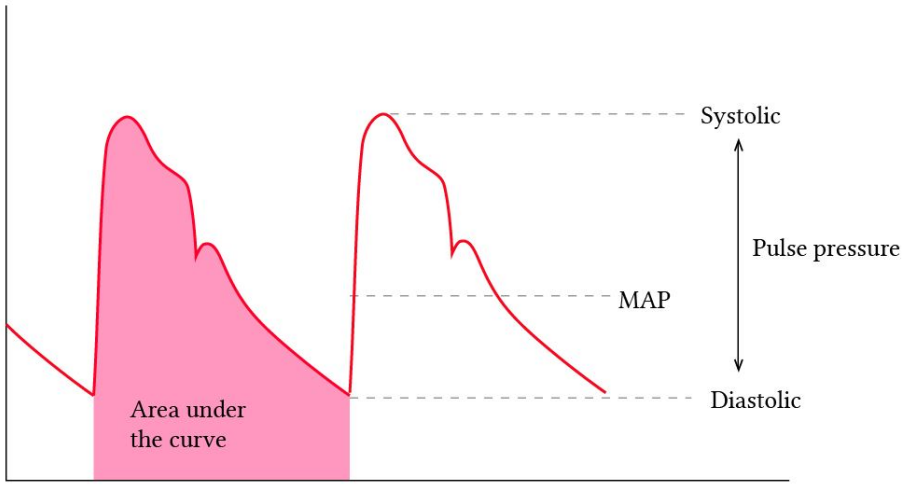
Overdamped Arterial Waveform (Image from [4])

Damping

- Underdamping causes
  - Artifact from catheter (catheter whip)
  - Tachydysrhythmias
- Overdamping causes
  - Air/air bubbles in tubing
  - Kinks in tubing
  - Clots in tubing
- Underdamping will overestimate the SBP and underestimate the DBP
- Overdamping will underestimate the SBP and overestimate the DBP

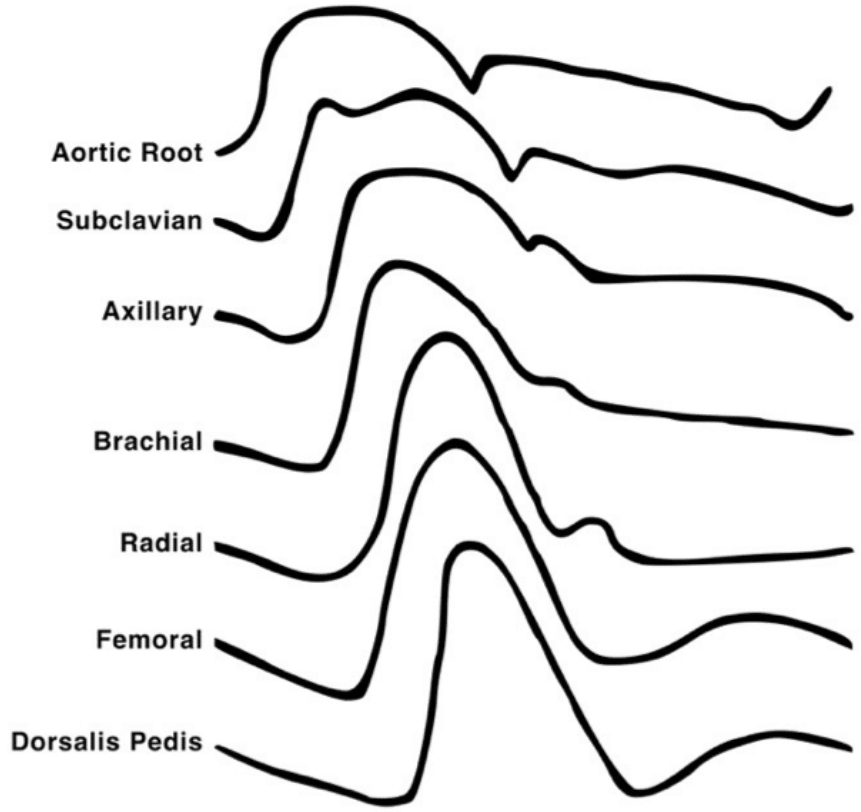
Arterial Waveform





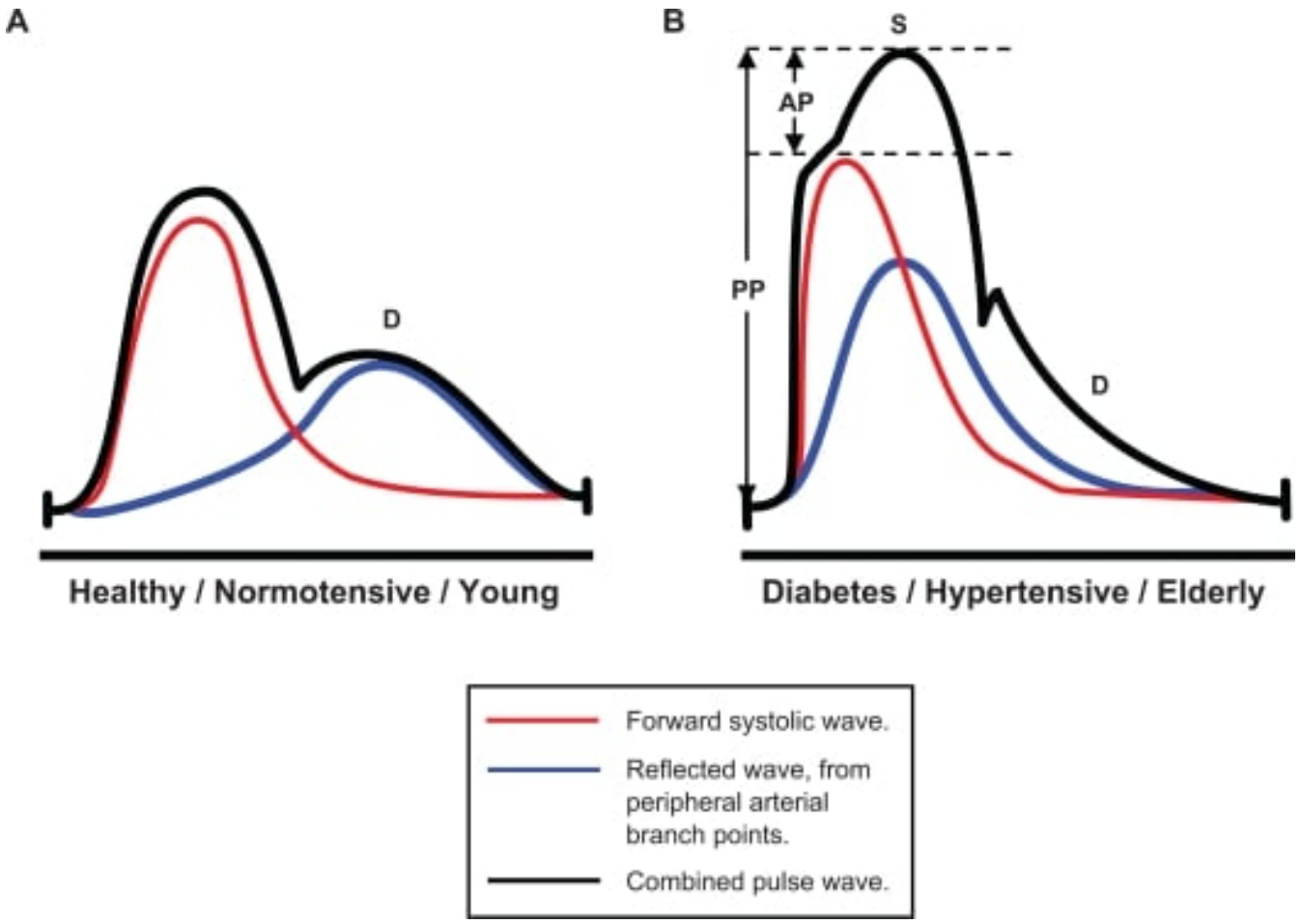
- Peak of the upstroke is the systolic blood pressure
- Dicrotic Notch: closure of the aortic valve and subsequent retrograde flow
- Bottom of downstroke: diastolic blood pressure
- The mean arterial pressure (MAP) is calculated from the area under the pressure curve.

Distal Pulse Amplification



- Distal pulse amplification is the physiological phenomenon where systolic blood pressure and pulse pressure widen as the pulse wave travels further from the heart.

Pulse Wave Reflection



- Pulse wave reflection is **a cardiovascular phenomenon** where blood pressure waves generated by the heart travel down the arterial tree and bonce back when they hit points of resistance.
- The reflected wave's return time provides direct insights into vascular health.
- The reflected wave signifies the arteries being stiffen due to aging or diseases like atherosclerosis.

Take Home Messages

- Arterial line provides a continuous blood pressure monitoring for hemodynamically unstable patient.
- Arterial line requires a fluid-filled catheter connected to a transducer with appropriate leveling and zeroing to provide an accurate continuous blood pressure reading.
- Arterial waveform’s shape can provide information regarding the circulatory conditions.

References

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