Q6 Outline the physiological consequences of a tension pneumothorax. (60% of marks) Describe the anatomy relevant to the insertion of an intercostal catheter. (40% of marks) (Sept 2010)

Pneumothorax – accumulation of air in the pleural space secondary to a breach of the visceral, parietal or mediastinal pleura
Tension pneumothorax – accumulation of air under pressure in the pleural space – medical emergency

PHYSIOLOGICAL CONSEQUENCES

- RESPIRATORY
  - Tachypnea (sympathetic response / activation of irritant stretch receptors (Hering-Brauer reflex) / hypoxic chemoreceptor response /
  - Subjective dyspnea (increased intrapleural pressure, increased PAP sensed by intrapulmonary baroreceptors)
  - Increase in pleural pressure results in a an increase in pleural space volume and a decrease in lung volumes
  - Decrease in lung compliance due to increase in intrapleural pressure
  - Increase in airways resistance
  - Increase in pleural volume decreases the length of the insp muscles → less tension created upon contraction → reduced effectiveness of inspiratory muscles → increased work of breathing
  - Hypoxemia occurs due to reduction in V/Q ratio and increases physiological and anatomical shunting
  - Large A-a gradient due to shunt
  - PCO2 initially normal due to hyperventilation but may become hypercapnoeic

- CARDIOVASCULAR
  - Sympathetic response causes tachycardia
  - Accumulation of pressurized air in the pleural cavity compresses the ipsilateral lung
  - Compression of lung parenchyma also compresses alveolar vessels and hypoxic pulmonary vasoconstriction increases PVR (adds to work of breathing)
  - The mediastinum is displaced to the opposite side decreasing venous return and compressing the contralateral lung
  - Reduction in VR causes hypotension and shock → eventually PEA

INSERTION OF AN INTERCOSTAL CATHETER

- 'Safe triangle' the triangle bordered by the anterior border of the latissimus dorsi, the lateral border of the pectoralis major muscle, a line superior to the horizontal level of the nipple, and an apex below the axilla – clinically this is at the 4^{th}-5^{th} intercostal space in the anterior axillary or mid axillary line
- This minimizes risk to underlying structures such as the viscera and internal mammary artery and avoids damage to muscle and breast tissue resulting in scarring.
- The second intercostal space in the mid-clavicular line has been suggested as an alternate site; however, this requires dissection through the pectoralis muscle and leaves a visible scar.
- The layers of the skin traversed in order are: skin, subcutaneous tissue, intercostal muscles, parietal pleura
- Needle should 'skate' over the top of the rib to avoid damaging the neurovascular bundle which lies along the inferior surface of the rib