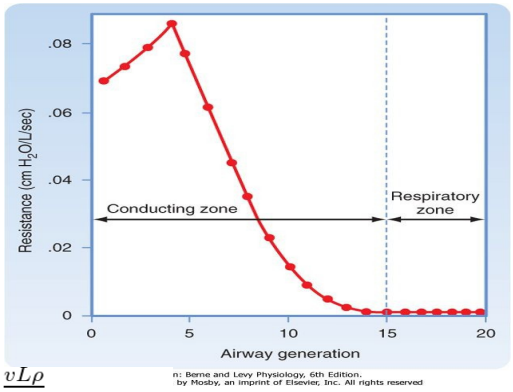
2013-2-23 What factors affect airway resistance? (80% of marks) Briefly outline how it may be measured and/or changes in flow are detected. (20% of marks) (18% pass)

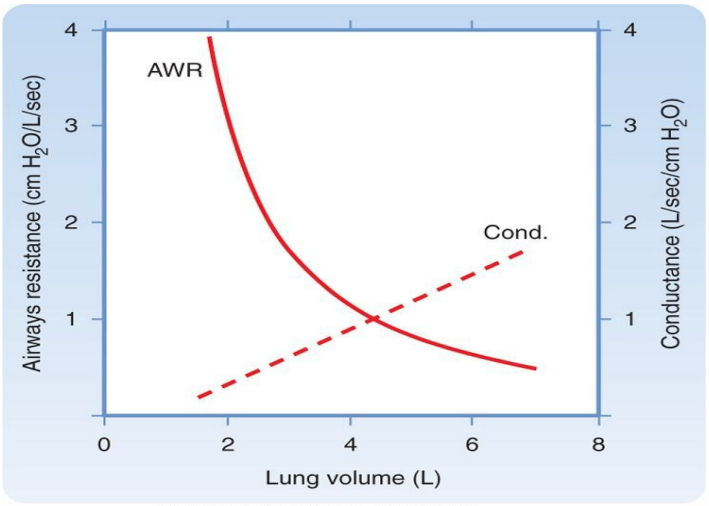
Normal Airways Resistance (AWR): ~2 cmH2O/L/s



Main Site of AWR:
- Mid-sized bronchi 7th/8th generation
- comparatively smaller cross-sectional area

Factors effecting AWR:
1. Physics factors:
   - Laminar Flow vs turbulent flow
   - Depends on Reynolds number factors
     - density more important than dynamic viscosity, velocity (flow rate) as Main Site is Turbulent.
2. Radius changes
   - ↓intramural radius:
     - oedema, ↑mucous, wall hypertrophy
   - smooth mm tone:
     - (↓r) bronchospasm, Musc antag (PSNS), LTs, PGF2-alpha
     - (↑r) β2-agonists, adrenaline neb, SNS
   - External compression:
     - tumour, haemorrhage, PTX
     - dynamic airways compression with forced expiration
3. Lung Volume
   - ↑lung vol →
     - ↑radial traction → ↓AWR
     - ↑-ve intrapleural → ↑patency of small airways

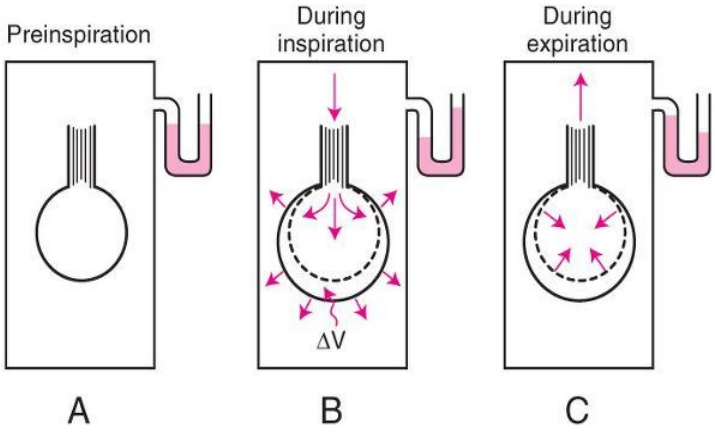
$$R_e = \frac{vL\rho}{\eta}$$
where;
$L = \text{Length}$
$\rho = \text{Gas Density}$
$\eta = \text{Gas Viscosity}$



Measurement:
1. Body Plethysmography:
   1. Q measured with flow meter
   2. Lung Volume is measured with Plethysmography
   3. ΔP via Plethysmography and Boyle's Law
      - (A) box pressure is atmospheric
      - (B) inspiration
        - ΔV allows for ΔP measurement for given Q since
        - PV = constant
   4. Then AWR can be calculated from 1
2. Interrupter Technique (direct from AWR eqn)
   1. Method
      1. Manometer distal to shutter
      2. Used to measure mouth and alveolar pressure

$$AWR = \frac{\Delta P}{Q}$$

$$V_{Lung} = \frac{P_{Atm} V_{init}}{P_{insp}}$$



    3. Flow during inspiration or expiration in interrupted for 50–100 ms repeatedly throughout the respiratory cycle.
2. Q - flow rate (measured before interruption)
3. P2 - mouth pressure (measured before interruption)
4. P1 - pressure in alveoli (measured at the end of the interruption at te level of the mouth after equilibration)
5. Apply Ohm's Law (AWR equation above).
6. Adequate for normal lungs not diseased.

Examiner Comments

This topic required a definition and understanding of airways resistance. It was expected candidates could identify that issues around the nature of flow (turbulent vs. laminar) and airway diameter were central determinants. It was expected candidates would describe the determinants of turbulent flow. The provision of formula and comments about Reynolds number helped demonstrate an understanding of this. Better answers discussed the transitional point in the airway and the paradox about size vs. total cross sectional area and its influence on total resistance. Several candidates confused pulmonary vascular resistance with airways resistance. Using graphs to help illustrate certain concepts would have been helpful. Measurement of resistance (indirectly via measurement of flow and pressure difference by a body plethysmography, spirometry) and detection of flow (spirometry, capnography) was in general poorly understood.