2018-2-16 Describe the forces that result in fluid exchange across capillary membranes.

General:

Capillaries contain semipermeable membranes to allow the movement of fluid and solutes.

- it is normally impermeable to large protein
- Plasma ultrafiltrate is filtered by bulk flow through the capillary wall by the action of opposing hydrostatic and oncotic pressures

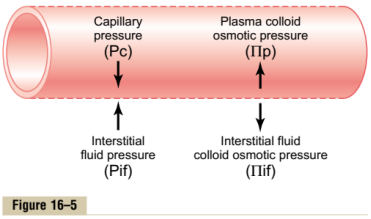

Figure 16–5

Fluid pressure and colloid osmotic pressure forces operate at the capillary membrane, tending to move fluid either outward or inward through the membrane pores.

- 4 Starling forces exist between capillary and interstitium:

Hydrostatic pressure: Pressure moving fluid	**Oncotic pressure:** pressure exerted by proteins which draw water into and keep it within a compartment
Pc ~35→15mmHg (Arterial → venous) Capillary hydrostatic pressure Pressure moving fluid out of capillary	**πc ~20mmHg** Plasma oncotic pressure Pressure keeping fluid within capillary
Pi = 5mmHg Interstitial hydrostatic pressure Pressure moving fluid into capillary	**πi ~0mmHg** Interstitial fluid oncotic pressure Pressure keeping fluid out of capillary

- **Starling Equation:** Forces are kept in balance such that Net fluid flux = kf[(Pc – Pi) – σ(πi – πc)],
  - where kf is capillary filtration constant (SA x hydraulic permeability);
  - σ is reflection coefficient (leakiness of membrane to protein 0-1)
- In general, at the arterial end of capillary NFP is positive (filtration) **+10mmHg**
- At the venous end NFP is negative (absorption) **-10mmHg**
- Approx. 24L fluid filtered / day
  - 85% reabsorbed into capillaries
  - Rest reabsorbed via lymphatics (~3.5L/day) = Net fluid loss from filtration
  -

Role of plasma oncotic pressure

- largely fixed as capillary is impermeable to oncoproteins (1° albumin)
  - If ↓πc, ↑net movement of fluid into interstitium
  - Once this exceeds the drainage capacity of lymphatics → oedema occurs
    - Especially dangerous in areas where minimal interstitial distance is required b/n capillary and cell to continue normal functioning (eg lung)

Examiner Comments:

57% of candidates passed this question.

The expected answer included a clear explanation of Starling's forces, including an understanding of the importance of the relative difference along the length of the capillary, with approximate values and examples of factors that influence them. Some explanation of what contributed to the hydrostatic or osmotic pressure gained more marks than merely stating there was a pressure. Several candidates digressed to Fick's law of diffusion or intracellular flow of ions which was not directly relevant to capillary flow.