**Hemodialysis: the counter-current diffusion circuit**

Hemodialysis is a process by which solute removal from blood occurs by diffusion in a counter-current circuit, with a small amount of solvent removed by convection.

Why is counter-current flow better? Let us consider two dialysis chambers, one concurrent and one counter-current.

**Concurrent circuit**

- **Solute and solvent run together, in the same direction down the diffusion membrane**
- **Magnitude of the concentration gradient**
- **In the first part of the chamber, there is a large concentration gradient between the highly concentrated solute and the clean solvent; diffusion here is rapid.**
- **In the middle of the chamber, the concentration gradient is decreased and so the rate of diffusion slows**
- **At the end of the chamber, the concentration of solute on either side of the membrane has equilibrated. No further diffusion takes place.**
- **THUS: the best you can expect with this sort of circuit is to halve the concentration of the solute. In the end, your patient and the dialysate fluid will both have the same concentration of urea.**

**Counter-current circuit**

- **Solute and solvent run in opposite directions**
- **Magnitude of the concentration gradient**
- **In the first part of the chamber, the exiting dialysate fluid is already concentrated, but less so than the blood. Thus there is still a concentration gradient.**
- **In the middle of the chamber, the concentration gradient remains the same; the blood is depleted of solute at the same rate as the dialysate is enriched by it.**
- **In the end of the chamber, the concentration gradient remains the same; the solute-depleted blood is exposed to clean dialysate, and the concentration gradient remains unchanged.**
- **THUS: the end result is the two fluids exchange solutes almost completely. If your aim is to remove solute, this is a more efficient way to do it, even though the driving concentration gradient is never very high.**