# The ABG & Temperature Argument

- The interpretation of blood gas data relies on certain standard variables being in place. Apart from atmospheric pressure (which everybody always assumes is 760 mmHg), the other most important variable is temperature. Temperature changes the physicochemical properties of water, influencing solubility of gases and the “auto ionization” of water into $H_3O^+$ and $OH^-$.

- Influence of temperature on pH and gas solubility
  - $PaO_2$ drops by 5mmHg for every degree below 37°C.
  - $PaCO_2$ drops by 2mmHg for every degree below 37°C.
  - pH increases by 0.015 for every degree below 37°C.
  - Influence of temperature on ABG interpretation
  - **Two** different approaches exist regarding the interpretation of ABG results from a hypothermic patient (Alpha Stat & pH Stat).

# Alpha Stat

- Warm (or correct) all samples to 37°C, no matter how cold the patient

- Why?
  - We have **no** normal reference ranges for hypothermic pH, $PaO_2$, and $PaCO_2$
  - Normal ranges at 37°C do NOT apply to hypothermic samples
  - Cellular physiology remains the same- at all temperatures intracellular pH remains at pN- the normal pH of neutrality, required for cellular function. The reason for this is that protein buffering of intracellular pH (via imidazole histidine residues) is also temperature dependent, and changes in parallel with body temperature.

# pH Stat

- Correct all samples to the patient's body temperature
- This makes all the samples appear ***Alkalotic***
- You are then tempted to hypoventilate or add $CO_2$.
- Why?
  - The addition of $CO_2$ counteracts the increased solubility and decreased partial pressure of $CO_2$ at low temperature
  - The added $CO_2$ counteracts the hypothermic leftward shift of the oxygen dissociation curve, resulting in better oxygen delivery
  - Increased $CO_2$ improved cerebral blood flow by vasodilating the cerebral vessels.

# In Practical Terms

- The lower the temperature, the higher the gas solubility.
- The higher the solubility, the lower the partial pressure.
  - this is **Henry's Law** - dissolved gas and free gas are in a temperature-dependent equilibrium
- Warming a hypothermic blood sample to 37°C releases more gas, and the partial pressures will appear higher than they actually are in the hypothermic patient
- However: we always interpret results at 37°C, using the Alpha-Stat approach.
- At any temperature, an uncorrected pH of 7.4 and a $PCO_2$ of 40 mm Hg represent normal acid-base balance.

# ABG and Temperature

- Temperature correct specimen in analyzer
  - Increase in patient temp: ↑PO2, ↑PCO2, ↓pH
  - Decrease in patient temp: ↓PO2, ↓PCO2, ↑pH