

Inhaled Anesthetics: Vapor Pressure

Important concepts to remember regarding vapor pressure.

- Although our vaporizers (and typically MAC) are marked in percentage, partial pressure is actually the determinant of effect.
- Saturated vapor pressure at 20C is 157 mmHg for sevoflurane, 238 mmHg for isoflurane, and 669 for desflurane. I don't think you need to remember these numbers, but you should know the order.
- Vapor pressure of a volatile liquid is directly correlated with temperature. For this reason, our sevoflurane and isoflurane are temperature compensated: a bimetallic strip bends with the changes in temperature allowing a changing amount of fresh gas flow to bypass the volatile to keep the amount of delivered volatile constant over a range of temperatures. Since the desflurane vaporizer is heated and pressurized to a constant temperature, there is no need for this.
- Since isoflurane has a higher vapor pressure if it were inadvertently put into a sevoflurane vaporizer, the percent volume output of the fresh gas flow would be higher than dialed in (since the sevo vaporizer is calibrated to sevo), this doesn't even take into account that you likely would have the sevo vaporizer set to a higher % to begin with. The opposite would be true if sevoflurane were put into an isoflurane vaporizer.
- The other challenge you may see is how a vaporizer will adjust to anesthesia at altitude. While we can crunch some numbers (find me for some math fun) it's easier to understand conceptually what happens. Dialing your temperature compensated variable bypass to a specific percent sends a portion of fresh gas through the chamber with volatile in it while most fresh gas bypasses that chamber. The gas following the first path "picks up" volatile and becomes completely saturated based on the vapor pressure (which is dependent on the temperature and specific agent, not the ambient pressure). At altitude (e.g. Denver) the ambient pressure is lower but the saturated vapor pressure of an agent doesn't change, this means if nothing changes but altitude...the percentage of total fresh gas flow which is volatile will be higher (and your monitor will show as much). However, the partial pressure of volatile delivered will be unchanged, and since that partial pressure determines the effect of the volatile, we don't need to change our temperature compensated variable bypass vaporizers when administering anesthesia at Denver.
- This is different for desflurane, which is a direct injection vaporizer. Since it is injected by percent volume as dialed in on the vaporizer, you must increase the percent set on the vaporizer to compensate for the lower ambient pressure when at altitude in order to maintain the same partial pressure of volatile you'd have at sea level.