Andrew Hershey SRNA

October 12, 2019

Everything in this review occurs at sea level

Inhaled Anesthetic Mechanism of Action Review (Basic)

Inhalational anesthesia significantly differs from IV anesthesia. Most notably:

The effective dose of inhaled anesthetic is based on and measured in PRESSURE, NOT CONCENTRATION. This is the most important difference between IV and Inhaled.

1. Partial Pressure: the pressure of your substance in whatever medium it is currently in.
	1. Your substance: Oxygen, N2O, Desflurane, Halothane, Chloroform, etc.
	2. Medium: Air, blood, a muscle, your brain, your foot, alveoli, a strand of your hair, etc.
	3. Partial Pressure is INDEPENDENT of the absolute number of molecules across different mediums. This is where the concept of solubility comes in.
	4. THIS IS IMPORTANT TO UNDERSTAND. FIND A WAY TO UNDERSTAND THIS.
2. The effective dose for IV drugs is measured in **mg**, which turns into a concentration in the blood, which turns into a concentration in the target tissue.
3. This gets confusing because we don’t dial in a “partial pressure” on our vaporizers, we dial in a percentage (a.k.a. concentration)
	1. In reality, that 2% Sevo we dialed in is really 15.2mmHg of Sevo
	2. Gas equilibrates across membranes according to THE PRESSURE on each side of the membrane
		1. At equilibrium, Pressure(Alveoli) = Pressure(Blood) = Pressure(brain) = Pressure(everything else)
		2. The partition coefficients (Brain:Blood, Blood:Gas, Oil:Gas, etc.) are there to help us determine what the ratio of ACTUAL MOLECULES are in each compartment when the PRESSURES ARE EQUAL.
		3. Sevo’s Blood:Gas coefficient (0.70) can be looked at as: for every 0.7 molecules of Sevo there are in the Blood, there exists 1 molecule of Sevo in the Alveoli. The coefficient can be written as (0.70 : 1), as the “1” is implied.
	3. Since it is REALLY expensive to measure the partial pressure of Sevo inside the brain, the best measurement we have is the amount of Sevo the pt is exhaling. If they are exhaling close to the same pressure they are inhaling, we can assume the pressure of Sevo has reached equilibrium in the blood and all the well-perfused organs. This is the concept of Fraction of Alveolar (FA)/ Fraction of Inspired (FI) comes in. The FA/FI Ratio.

Movement of Anesthetic Agent: Swimming Pool Complex

Imagine the body is a series of swimming pools in the summer. This pool complex hasn’t yet hired a lifeguard, so the only employee runs the entrance building.

The alveoli are the entrance building; complete with bathrooms, locker rooms, and concession stand. There is an entrance/exit gate that the operator has complete control over.

The Blood Pool is the first pool you have to jump in. It’s not too big, it glistens in the sunlight, it’s lipophobic, and it has a few floaty toys around to play on. The Blood Pool is the “Gateway” to get into or out of the entrance building.

1. Soluble molecules can swim VERY well. They’re practically fish. They hang out in the blood, splash around and laugh with their soluble friends, swim laps for hours, and generally just have a great time. They love the water.
2. Insoluble molecules can’t swim for shit. They hate the water, and when they try to swim, they end up flailing around and making other people upset. They can’t wait to leave, and most of them do end up getting out pretty quickly. Some stay in and stick it out, though, as they enjoy having all that extra space to themselves and have found a nice floaty toy to lounge on.
3. Eventually, the Blood Pool gets too crowded, and people start getting out and going on to the next set of smaller pools, the Well-Perfused Organ Pools.

The Well-Perfused Organ Pools (We-POPs) are right next to the Blood Pool, so its pretty easy for people to jump from one to the other. One We-POP is liver shaped, two look like kidneys, one looks like the brain with a spinal cord attached to it, there’s a couple lung shapes, and a teeny tiny heart pool is there, too. These We-POPs are small and have a couple more floaty toys around, so it’s easier for the people who can’t swim very well to hang around. But alas, as more and more people come in the entrance building for their summertime swim, the pools get more and more crowded, and more people start heading down the hill to the Muscle Pools.

The Muscle Pools are decently close, but still a bit of a hike away. There are A LOT of muscle pools. In the average sized pool complex, the Muscle Pools make up 50% of the total pool water! A few people made their way there before the rush hit, but as the people just keep coming in the entrance, and the Blood and We-POPs hit max capacity, the Muscles seems to be the next best option. Even more floaty toys have fallen down the hill into the Muscle Pools, so it’s even easier to swim in. People like this pool and tend to want to spend all afternoon in here once they have set up their spot. It generally never gets too crowded.

Even further away than the Muscle Pools is the Fat Pool. The size of this pool is pretty variable between pool complexes; some people barely even have a Fat Puddle and some people have a Fat Lake. A veritable TON of floaty toys have collected in this pool/puddle/lake, so people love swimming and lounging around all day here. Also, because it’s so far away, some people take their camping supplies and spend the night (or even the weekend) down here. The hike back to the entrance is REALLY far, so there isn’t a great incentive to leave anytime soon. Unless, of course, there’s only a puddle.

From Swimming Pools to Anesthesia: What is the Connection?

|  |  |
| --- | --- |
| **Analogy Term** | **Anesthesia Reference** |
| Pool Complex | One human patient |
| Swimmer at the pool | One molecule of Gaseous anesthetic |
| Entrance worker | Anesthesiologist (Nurse, MD, or Assistant) |
| Entrance Building | Alveoli |
| Floaty Toys | Lipophilic attachments |
| Blood Pool | Blood |
| We-POPs | Well-Perfused Organs |
| Lifeguard | The ability to specifically signal anesthetic molecules to come out of solution and back into the alveoli. This does not yet exist. |

Takeaways: (written in format: Analogy. **Anesthesia**)

The number of people willing to stay in a crowded pool is equal to the number of people who are piling into the entranceway to come into the pool area. **The amount of partial pressure within the blood and organs will equal the amount of partial pressure coming into the lungs.**

A pool that is a further distance from the entranceway **is equal to an organ system with less perfusion (i.e. muscles and fat)**.

I haven’t found a great way to say **the partial pressure of the brain is what determines anesthetic action**, yet. Best I have is: The pool complex is shooting a commercial at the Brain/Spinal Cord Pool and wants the perfect amount of people in it. The perfect amount of people is **a little over** **1 MAC.**

I’m really confused about how **increased Cardiac Output leads to a slower onset of anesthesia in the Brain**, therefore the people at the pool complex are really confused, too. They start walking all around the pool complex in a random order and no one stays in the Brain Pool long enough to shoot the commercial.

Less floaties in the Blood Pool is equivalent to **decreased Hgb (anemia) in the blood. When Hct is decreased, anesthesia onset is faster.** **Many lipid binding sites in the blood are on Hgb.** You can add more floaties to the Blood Pool by eating **many cheeseburgers (triglycerides, fatty acids) before surgery**.

Pool Complex Visualization Aid

