

Ventilator Pocket Guide

Foundational Equations

Ohm's Law	$\Delta P = FR = P_{aw} - P_{alv} = P_{pl} - PEEP_{total}$
Equation of Motion	$P_{aw} = FR + \frac{V_t}{C} + PEEP_{total}$
Compliance	$C = \frac{\Delta V}{\Delta P}$
Natural Decay Equation	$V_i(t) = V_o e^{\frac{-t}{RC}} = V_o e^{\frac{-t}{\tau}}$
Calculating τ, General Case	$\tau = \frac{V_t F}{\ln(\frac{P_{pl} - P_{total}}{P_{pl}})}$
Alveolar Gas Equation	$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{aCO_2}}{RQ} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{VO_2}{V_a} k$
Patient Mode	TV Rate Ppeak Pplat PEEPauto \wedge PEEPset

- Vent Waveforms

Alveolar Gas Equation

$$PAO_2 = FiO_2(P_{atm} - P_{H_2O}) - \frac{PaCO_2}{RQ}$$

substituting back in to RQ equation: $RQ = \frac{P_{aCO_2}}{\frac{V_{AP_ACO_2}}{kVO_2} + \frac{VO_2}{V_a} k}$

$V_T = V_A + V_D$, where $V_A = 350$ and $V_D = 150$

Dead Space Fraction

$$\frac{V_D}{V_T} = \frac{P_{ACO_2} - P_{ECO_2}}{P_{ACO_2}}$$

Formal measurement of P_{ECO_2} requires volumetric capnography, which requires a capable ventilator or a dedicated measurement device.

Thankfully, $P_{ECO_2} \approx ETCO_2$, so an approximation would $\frac{V_D}{V_T} = \frac{P_{ACO_2} - ETCO_2}{P_{ACO_2}}$

Alveolar ventilation

$$P_{A}O_2 = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{AO_2}}{RQ}$$

$$\dot{V}_A = k \frac{\dot{V}CO_2}{P_{ACO_2}} \text{ implies } \dot{V}CO_2 = \frac{\dot{V}AP_{ACO_2}}{k}$$

To convert F_{ACO_2} into P_{ACO_2} , we have $F_{ACO_2}(P_{atm} - PH_2O) = P_{ACO_2}$. Similarly, using F_{ECO_2} , we can show $P_{ECO_2} = F_{ECO_2}(P_{atm} - P_{H_2O})$

$$Volume_{expiredCO2} = Volume_{producedAlvCO2}$$

$$V_{TF_ECO_2} = V_{AF_ACO_2}$$

$V_{TF_ECO_2} = (V_T - V_D)F_{ACO_2}$, and we can convert F_{ACO_2} into P_{ACO_2}

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