

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	$V_i(t) = \frac{V_o}{e^{\frac{t}{RC}}} = \frac{V_o}{e^{\frac{t}{\tau}}}$
Calculating τ, General Case	$\tau = \frac{V_t}{F} \cdot \text{Bigg}(\frac{PIP - P_{plt}}{P_{plt} - PEEP_{total}}\text{Bigg)}$
Alveolar Gas Equation	$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{aCO_2}}{RQ}$
Patient Mode TV Rate Ppeak Pplat PEEPauto ^ PEEPset	

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Alveolar Gas Equation

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

substituting back in to RQ equation: $RQ = \frac{P_{ACO_2}}{\frac{V_{AP_{ACO_2}}}{V_{O_2}} \cdot V_a} \cdot k$

$$V_T = V_A + V_D, \text{ where } V_A = 350 \text{ and } V_D = 150$$

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.

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

Alveolar ventilation

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

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

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

$$Volume_{expiredCO_2} = Volume_{producedAlvCO_2}$$

$$V_{TF_{ECO_2}} = V_{AF_{ACO_2}}$$

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

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