Induced Mechanical Power

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Reference Article

The formulas below are derived from:
Gattinoni L. et al. (2022). *Simple, accurate calculation of mechanical power in pressure controlled ventilation (PCV).* Intensive Care Medicine Experimental, 10(1).

Mechanical Power Formulas

1. Linear Model (LM)

$$MP_{LM} = 0.098 \cdot RR \cdot \left\{ V_T \cdot (P_{PEEP} + \Delta P_{insp}) - 0.15 \cdot \Delta P_{insp}^2 \cdot \frac{t_{slope}}{R} \right\} \tag{1}$$

2. Becher Comprehensive Model (CB)

$$MP_{CB} = 0.098 \cdot RR \cdot \left\{ V_T \cdot (P_{PEEP} + \Delta P_{insp}) - \Delta P_{insp}^2 \cdot C \cdot \left[0.5 - \frac{R \cdot C}{t_{slope}} + \left(\frac{R \cdot C}{t_{slope}} \right)^2 \cdot (1 - e^{-t_{slope}/(R \cdot C)}) \right] \right\} \tag{2}$$

3. Van der Meijen Model (vdM)

$$MP_{vdM} = 0.098 \cdot RR \cdot V_T \cdot \left\{ P_{PEEP} + \Delta P_{insp} \cdot (1 - e^{-t_{insp}/(R \cdot C)}) \right\} \tag{3}$$

4. Becher Simplified Model (SB)

$$MP_{SB} = 0.098 \cdot RR \cdot \{ V_T \cdot (P_{PEEP} + \Delta P_{insp}) \} \tag{4}$$

5. Pressure-Volume Loop Integration (Reference)

$$MP_{ref} = 0.098 \cdot RR \cdot \int_0^{V_T} P_{aw}\, dV \tag{5}$$

Parameter Definitions

Symbol	Definition
MP	Mechanical Power [$\mathrm{J\,min^{-1}}$]
RR	Respiratory Rate [$\mathrm{min^{-1}}$]
V_T	Tidal Volume [L]
P_{PEEP}	Positive End-Expiratory Pressure [cm]
ΔP_{insp}	Inspiratory Pressure Change [cm]
t_{slope}	Slope Time [s]
t_{insp}	Inspiratory Time [s]
R	Airway Resistance [$\mathrm{cm\,s\,L^{-1}}$]
C	Respiratory Compliance [$\mathrm{L\,cm^{-1}}$]

Table 1: Parameters used in mechanical power calculations.

Notes

- The factor 0.098 converts units from cm · L to J.
- MP_{ref} (P-V loop integration) is considered the gold standard for validation.
- The Becher Comprehensive Model (CB) accounts for nonlinear respiratory mechanics.