Pulse Oximetry, An Accurate Monitor for Detection of Hypoventilation

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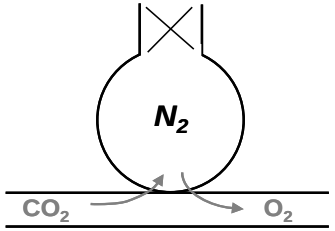
BACKGROUND

- Arterial hypoxemia is considered to be significant when SpO_2 is <90%
- Only three of six classical physiologic causes of arterial hypoxemia are clinically relevant
  - Low V_A/Q
  - Shunt
  - Hypoventilation (see AGE)
- None explain the rapid desaturation observed with acute hypoventilation and airway obstruction, the most common hypoxemic events!



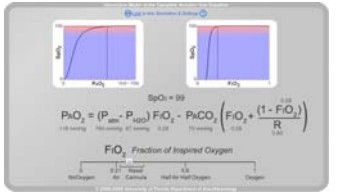
A schematic of gas exchange during airway obstruction or hypoventilation. (indicated by the X in the trachea)

HYPOTHESES

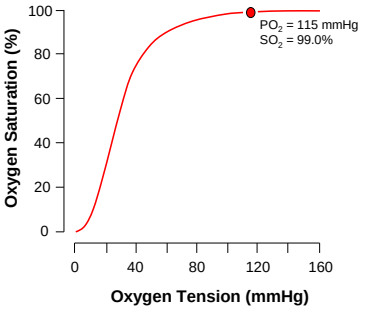
- The pulse oximeter is a sensitive monitor for acute hypoventilation
- SpO_2 <90% is tolerable (for the patient)
- Supplemental O_2 will not prevent hypoventilation induced hypoxemia
- Supplemental O_2 is minimally effective for increasing O_2 delivery at the cellular level
- The rate of O_2 desaturation, once initiated, is directly proportional to FIO_2

DISCUSSION OF FALLACIES

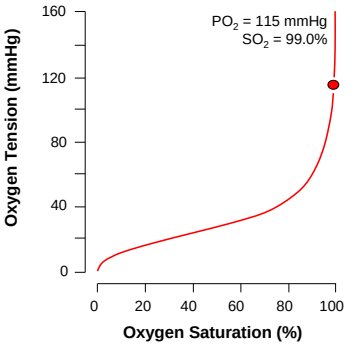
- The O_2 Hgb dissociation curve represents a "slippery slope" (It's flawed)
- Supplemental O_2 is appropriate, innocuous and protective
- Pulse oximetry prevents morbidity and mortality
- The respiratory gas exchange quotient R is a constant



A deterministic simulation of the complete alveolar gas equation available at: http://vam.anest.ufl.edu/simulations/alveolargasequation.php



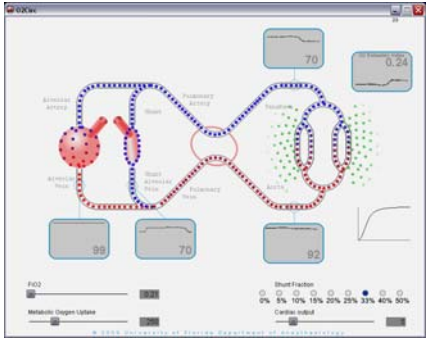
The traditional oxyhemoglobin dissociation curve



The oxyhemoglobin dissociation curve with oxygen saturation as the independent variable (on the x-axis)

SUMMARY

- Capillary and tissue PO_2 levels are **dependent** variables; saturation is the independent variable for presentation of the oxyhemoglobin dissociation curve
- Dissolved O_2 is of minimal significance in determining O_2 delivery; therefore, so is supplemental O_2
- The sensitivity of pulse oximetry as a monitor of ventilation is inversely proportional to FIO_2
- Used appropriately, pulse oximetry is a sensitive monitor for detection of acute hypoventilation and/or airway obstruction



A stochastic model of oxygen circulation with user-adjustable shunt fraction, cardiac output, FIO_2 and metabolic O_2 uptake

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