Hypoxic Pulmonary Vasoconstriction

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**Recommended Citation**
Shull, Miranda, "Hypoxic Pulmonary Vasoconstriction" (2016). *Nursing Student Class Projects (Formerly MSN)*. 200.
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The symptoms of HPV depend on the degree of hypoxic lung tissue. HPV is a cell reaction occurring in hypoxic areas of the lung. It may be localized due to various causes including regional anesthetics; it can also be diffuse, affecting both lungs, as seen in high-altitude pulmonary edema. HPV is triggered by absolute hypoxia, not arterial hypoxemia as one may assume. The peak effect of absolute hypoxia is seen within 15 minutes. Many elements can affect HPV including cardiac output, medications, PEEP and Pe25.

Pathophysiology
- HPV is the autoregulatory mechanism which prevents the ventilation to perfusion mismatch caused by alveolar hypoxia in order to improve gas exchange and arterial oxygenation. HPV is active in utero, reducing regional atelectasis. Studies have shown that anesthesiologists can inhibit HPV, however, none commonly used augment it (Lamb & Slinger, 2015).
- HPV is active in utero, reducing regional atelectasis. It can lead to permanent pulmonary vascular occlusion of the airway can worsen the ventilation to perfusion mismatch ratio. Excessive PEEP and perfused lung by about 50% (Lamb & Slinger, 2015). In both asthma and chronic obstructive pulmonary disease (COPD), giving 100% oxygen worsens the ventilation to perfusion (V/Q) matching ratio.
- Many of the drugs used during anesthesia have some sort of effect on HPV. Many anesthetic drugs inhibit HPV, however, none commonly used augment it (Lamb & Slinger, 2015). Any drug that is a vasodilator may inhibit HPV, and all current anesthetic agents can inhibit HPV but are dose dependent (Lamb & Slinger, 2015).
- The effects of nitrous oxide on HPV are unclear at this time.

Factors that Reduce Effectiveness of HPV
- Alkalosis
- Hypothermia
- Hypocapnia
- Hypervolemia
- Hypoxic pulmonary vasoconstriction

Anesthetic Implications
- During mechanical ventilation it is very important to match ventilation and perfusion in order to optimize gas exchange in the mechanically ventilated patient. Studies have shown that the occurrence of the arrest can very quickly lead to a reduction of blood flow to that region of the lung by about 50% (Lamb & Slinger, 2015). In both asthma and chronic obstructive pulmonary disease (COPD), giving 100% oxygen worsens the ventilation to perfusion (V/Q) matching ratio.
- Many of the drugs used during anesthesia have some sort of effect on HPV. Many anesthetic drugs inhibit HPV, however, none commonly used augment it (Lamb & Slinger, 2015).
- Any drug that is a vasodilator may inhibit HPV, and all current anesthetic agents can inhibit HPV but are dose dependent (Lamb & Slinger, 2015).
- The effects of nitrous oxide on HPV are unclear at this time.

Introduction
- Hypoxic pulmonary vasoconstriction (HPV) is characterized by a local reaction to tissue hypoxia, specifically in the pulmonary circulation. This reaction is in response to low partial pressure of oxygen (Lamb & Slinger, 2015).
- This reaction triggers by absolute hypoxia, not arterial hypoxemia. It may be triggered by acidosis, affecting both lungs, as seen in high-altitude pulmonary edema.
- HPV is triggered by absolute hypoxia, not arterial hypoxemia as one may assume.
- The peak effect of absolute hypoxia is seen within 15 minutes.
- Many elements can affect HPV including cardiac output, medications, PEEP and Pe25.

Characteristics & Symptoms
- The result of only one portion of the lung being affected, is that blood is shunted from the hypoxic region to the well ventilated portion of the lung (Artusio & Van, 2012). If the entire lung is affected by absolute hypoxia however, then there is widespread pulmonary vasoconstriction, leading to pulmonary hypertension (Artusio & Van, 2012).
- The symptoms of HPV depend on the degree of hypoxic lung tissue. HPV is a cell reaction occurring in hypoxic areas of the lung. It may be localized due to various causes including regional anesthetics; it can also be diffuse, affecting both lungs, as seen in high-altitude pulmonary edema. HPV is triggered by absolute hypoxia, not arterial hypoxemia as one may assume. The peak effect of absolute hypoxia is seen within 15 minutes. Many elements can affect HPV including cardiac output, medications, PEEP and Pe25.

Hypoxic pulmonary vasoconstriction. The left frame shows normal alveolar ventilation and perfusion. In the right frame, reduced ventilation (thus O2 tension) in the alveolus (green) leads to a reduced perfusion because of the hypoxic pulmonary vasoconstriction mechanism.

Hypoxia-induced alveolar hypoxia causes an increase in RV affected, dilation of the right heart, with an associated decrease in contractility and tisuc value incompetence.

References

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Additional Sources