Clinical Application - Case Study #1

A 12-year-old female was a victim of a "drive-by shooting". She was standing in line outside a movie theater with some friends when a car passed by and someone began shooting at three boys standing nearby. Two of the boys died immediately, and she was shot in the upper anterior chest. Although she was breathing spontaneously through a non-rebreathing oxygen mask when she was brought into the ER, twenty five minutes later, she was unconscious.

Upon entering the emergency room, the patient's skin, lips and nail beds were blue. Her skin was cool and clammy. A small bullet hole could be seen over her left anterior chest between the second and third rib at the mid-clavicular line. No exit bullet hole could be seen. Her blood pressure was 55/35, HR 120/min, f 22/min. Auscultation of her chest revealed normal breath sounds. A pulmonary artery catheter and A-line were started immediately. ABG results were pH 7.47, $PaCO_2$ 31 mm Hg, HCO_3^- 23 mEq/L, PaO_2 503 mm Hg, SaO_2 98%.

Oxygen Transport Study

DO_2	$\dot{V}O_2$	$C(a-\bar{v})O_2$	**O_2ER**	$S\bar{v}O_2$	$\dot{Q}_s/\dot{Q}_t$
282 mL/min	214 mL/min	7.13 vol%	76%	32%	3%

What other lab/hemodynamic information would be helpful to evaluate the patient? **Hemoglobin, PvO_2**

What is the CaO_2? **9.38 vol%** $CaO_2 = \frac{C(a-v)O_2}{O_2del} = \frac{7.13}{.76} = 9.38$

How was the DO_2 calculated? **CaO_2 x CO x 10**

How was the O_2ER calculated? $O_2ER = \frac{C(a-\bar{v})O_2}{CaO_2}$

Would you suspect a high or low $\dot{V}/\dot{Q}$ ratio and why? **High V/Q due to the reduced cardiac output**

What is causing the low venous saturation? **Elevated extraction due to reduced cardiac output.**

Was the patient in shock? **Most likely this patient is in shock (low SvO_2 implies low PvO_2)**

What it the appropriate treatment? **Improve oxygen delivery by increasing cardiac output.**

Do you think the patients PaO_2 and SaO_2 were misleading in assessing this patient's condition? **Yes; the PaO_2 and SaO_2.**

Clinical Application - Case Study #2

An 18-year-old female presented in the emergency room at 0630 in severe respiratory distress. She was well known to the respiratory care team. She had suffered from asthma all of her life. Over the years, she had been admitted to the hospital on numerous occasions, averaging about three admissions per year. Five separate asthma episodes had required mechanical ventilation within 48 hours.

Upon admission, the patient appeared fatigued, cyanotic, and lethargic and is using her accessory muscles of inspiration. She was in obvious respiratory distress. Her BP was 177/110, HR 160/min, f 32/min and shallow. Her BS was diminished and wheezing could be heard bilaterally. An x-ray showed her lungs hyperinflated with areas of atelectasis presumably from extensive mucous plugging. Her ABG results on a 4 L/min oxygen by nasal cannula were: pH 7.20, $PaCO_2$ 71 mm Hg, HCO_3^- 27 mEq/L, PaO_2 27 mm Hg, SaO_2 42%. She was transferred to ICU, intubated and placed on mechanical ventilation. An IV infusion was started with prednisone and terbutaline. A-line and pulmonary artery catheters were inserted.

Oxygen Transport Studies

DO_2	$\dot{V}O_2$	$C(a-\bar{v})O_2$	**O_2ER**	$S\bar{v}O_2$	$\dot{Q}_s/\dot{Q}_t$
481 mL/min	314 mL/min	4.83 vol%	65%	24%	47%

What other lab/hemodynamic information would you want to know? **Raw, graphics to evaluate for airtrapping, Auto-PEEP measurement**

What was her CaO_2 at the time the oxygen studies were performed? **7.43 vol%**

How was the DO_2 calculated? **CaO_2 x CO x 10**

$$CaO_2 = \frac{C(a-v)O_2}{O_2del} = \frac{4.83}{.65} = 7.43$$

How was the O_2ER ratio calculated? $O_2ER = \frac{C(a-\bar{v})O_2}{CaO_2}$

Which way was the oxygen dissociation curve shifted? **Right, lower saturation than expected for the PaO_2**

How did the shift of the curve affect her oxygenation? **Improved release at the tissues.**

Would you expect a higher or lower $\dot{V}/\dot{Q}$ ratio? **Low V/Q due to reduced ventilation.**

What is causing the low venous saturation? **Reduced oxygen delivery secondary to the reduced oxygen content, low PaO_2 and low SaO_2.**

What signs/symptoms would lead you to suspect tissue hypoxia? **Drastically reduced SvO_2.**

Why do you think her oxygen consumption was increased? **Attempt by body to maximize oxygen available (note near normal extraction).**

Using Poiseuille's Law describe the clinical course of the patient's asthma attack. **The reduction in airway caliber secondary to the combination of bronchospasm, mucosal edema, and secretion accumulation led to a four-fold increase in the pressure needed to accomplish ventilation. Diaphragmatic insufficiency ensued with the development of hypercarbia and respiratory acidosis.**

What is the appropriate treatment? **Continue current course of therapy with systemic corticosteroids, inhaled beta agonists, and consideration of heliox therapy to reduce the viscosity of the inhaled gas.**