

The Critical Care Equation

(The Oxygen Flux Equation)

Definitions

Definitions

Tissue Hypoxia

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Tissue Hypoxia Inadequate cellular respiration

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Tissue Hypoxia Inadequate cellular respiration

Hypoxia

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Tissue Hypoxia Inadequate cellular respiration

Hypoxia Low arterial oxygenation

Definitions

Tissue Hypoxia Inadequate cellular respiration

Hypoxia Low arterial oxygenation

Shock

Definitions

Tissue Hypoxia Inadequate cellular respiration

Hypoxia Low arterial oxygenation

Shock Inadequate perfusion of the tissues

Types of Tissue Hypoxia

Types of Tissue Hypoxia

Stagnant

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Hypoxic

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Hypoxic

Low arterial oxygenation

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Hypoxic

Low arterial oxygenation

Anaemic

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Hypoxic

Low arterial oxygenation

Anaemic

Low effective haemoglobin concentration

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Hypoxic

Low arterial oxygenation

Anaemic

Low effective haemoglobin concentration

Cytotoxic

Types of Tissue Hypoxia

Stagnant

Low cardiac output

Hypoxic

Low arterial oxygenation

Anaemic

Low effective haemoglobin concentration

Cytotoxic

Mitochondrial dysfunction

Oxygen Delivery

Oxygen Delivery

$$O_2 \text{ Flux} = Q \cdot [O_2]_{\text{blood}}$$

Oxygen Delivery

$$Q = SV \cdot HR$$



$$O_2 Flux = Q \cdot [O_2]_{blood}$$

Oxygen Delivery

$$Q = SV \cdot HR$$


$$O_2 \text{ Flux} = Q \cdot [O_2]_{\text{blood}}$$

$$[O_2]_{\text{blood}} = [O_2]_{\text{Haemoglobin}} \cdot [O_2]_{\text{Plasma}}$$

Oxygen Delivery

$$Q = SV \cdot HR$$


$$O_2 \text{ Flux} = Q \cdot [O_2]_{\text{blood}}$$


$$[O_2]_{\text{blood}} = [O_2]_{\text{Haemoglobin}} \cdot [O_2]_{\text{Plasma}}$$


$$[O_2]_{\text{Haemoglobin}} = [Hb] \cdot \text{SatHb} \cdot 1.34 \text{ ml/g}$$

Oxygen Delivery

$$Q = SV \cdot HR$$


$$O_2 \text{ Flux} = Q \cdot [O_2]_{\text{blood}}$$


$$[O_2]_{\text{blood}} = [O_2]_{\text{Haemoglobin}} \cdot [O_2]_{\text{Plasma}}$$


$$[O_2]_{\text{Haemoglobin}} = [Hb] \cdot \text{SatHb} \cdot 1.34 \text{ ml/g}$$


$$[O_2]_{\text{Plasma}} = Pa O_2 \cdot 0.03 \text{ ml/L}$$

Oxygen Delivery

$$O_2 \text{ Flux} = Q \cdot ([Hb] \cdot SatHb \cdot 1.34 \text{ ml/g}) + (Pa O_2 \cdot 0.03 \text{ ml/L})$$

Oxygen Delivery

Shock



$$O_2 \text{ Flux} = Q \cdot ([Hb] \cdot SatHb \cdot 1.34 \text{ ml/g}) + (Pa O_2 \cdot 0.03 \text{ ml/L})$$

Types of Shock

Types of Shock

Types of Shock

Obstructive

Types of Shock

Obstructive

Cardiogenic

Types of Shock

Obstructive

Cardiogenic

Hypovolaemic

Types of Shock

Obstructive

Cardiogenic

Hypovolaemic

Redistributive

Types of Shock

	JVP	Perfusion
Obstructive		
Cardiogenic		
Hypovolaemic		
Redistributive		

Types of Shock

	JVP	Perfusion
Obstructive	↑↑	↓
Cardiogenic		
Hypovolaemic		
Redistributive		

Types of Shock

	JVP	Perfusion
Obstructive	↑↑	↓
Cardiogenic	↑	↓
Hypovolaemic		
Redistributive		

Types of Shock

	JVP	Perfusion
Obstructive	↑↑	↓
Cardiogenic	↑	↓
Hypovolaemic	↓	↓
Redistributive		

Types of Shock

	JVP	Perfusion
Obstructive	↑↑	↓
Cardiogenic	↑	↓
Hypovolaemic	↓	↓
Redistributive	↓	↑

Oxygen Delivery

Shock



$$O_2 \text{ Flux} = Q \cdot ([Hb] \cdot SatHb \cdot 1.34 \text{ ml/mg}) + (Pa O_2 \cdot 0.03 \text{ ml/L})$$

Oxygen Delivery

Shock

$$O_2 \text{ Flux} = Q \cdot ([Hb] \cdot SatHb \cdot 1.34 \text{ ml/mg}) + (Pa O_2 \cdot 0.03 \text{ ml/L})$$

Anaemia

Oxygen Delivery

Shock

$$O_2 \text{ Flux} = Q \cdot ([Hb] \cdot SatHb \cdot 1.34 \text{ ml/mg}) + (Pa O_2 \cdot 0.03 \text{ ml/L})$$

Anaemia

CO Poisoning

Oxygen Delivery

Shock

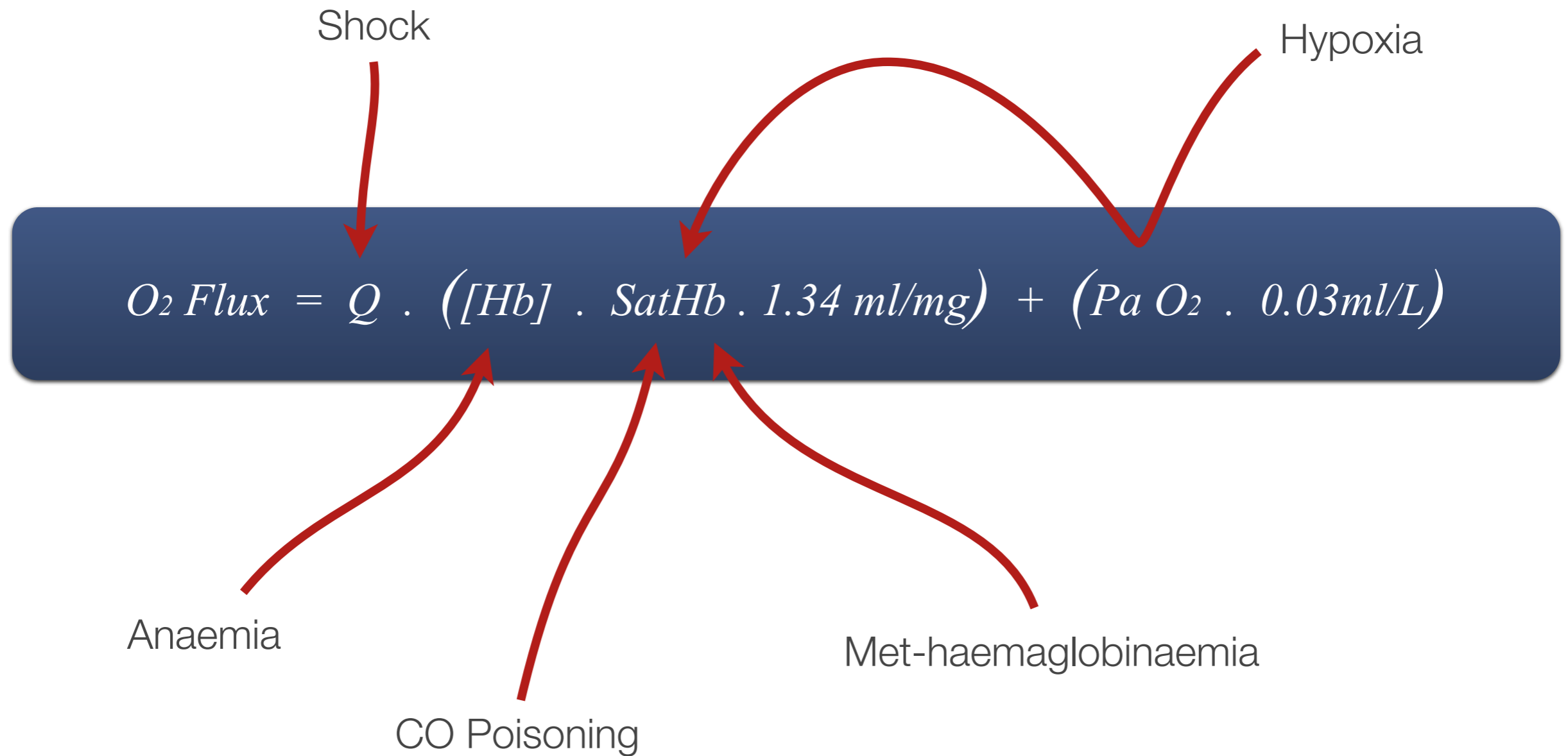
$$O_2 \text{ Flux} = Q \cdot ([Hb] \cdot SatHb \cdot 1.34 \text{ ml/mg}) + (Pa O_2 \cdot 0.03 \text{ ml/L})$$

Anaemia

CO Poisoning

Met-haemaglobinaemia

Oxygen Delivery



Causes of Hypoxia

Causes of Hypoxia

- 1 ↓ FiO_2

Causes of Hypoxia

- 1 ↓ FiO_2
- 2 Hypoventilation

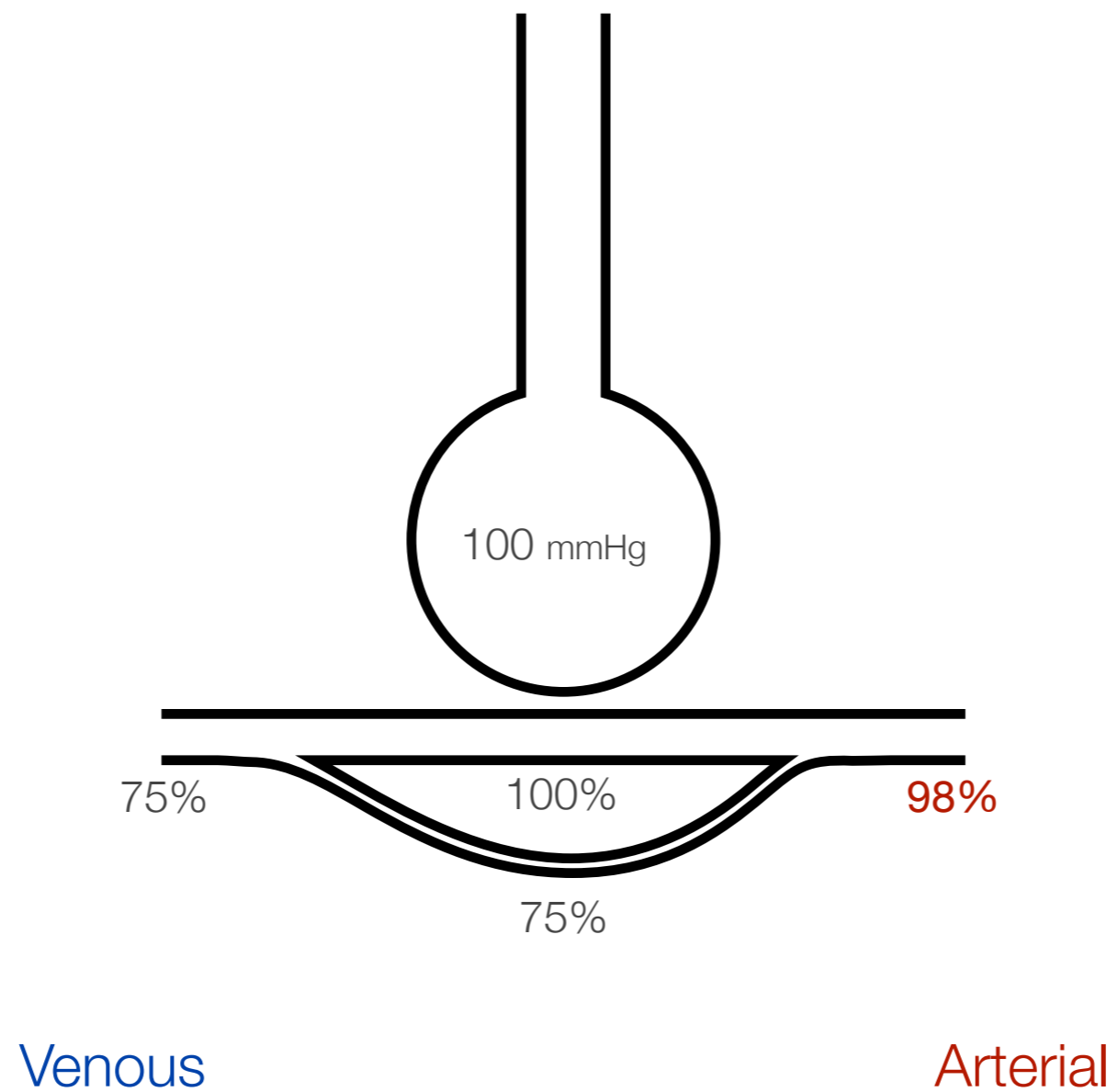
Causes of Hypoxia

- 1 ↓ FiO_2
- 2 Hypoventilation
- 3 Shunt

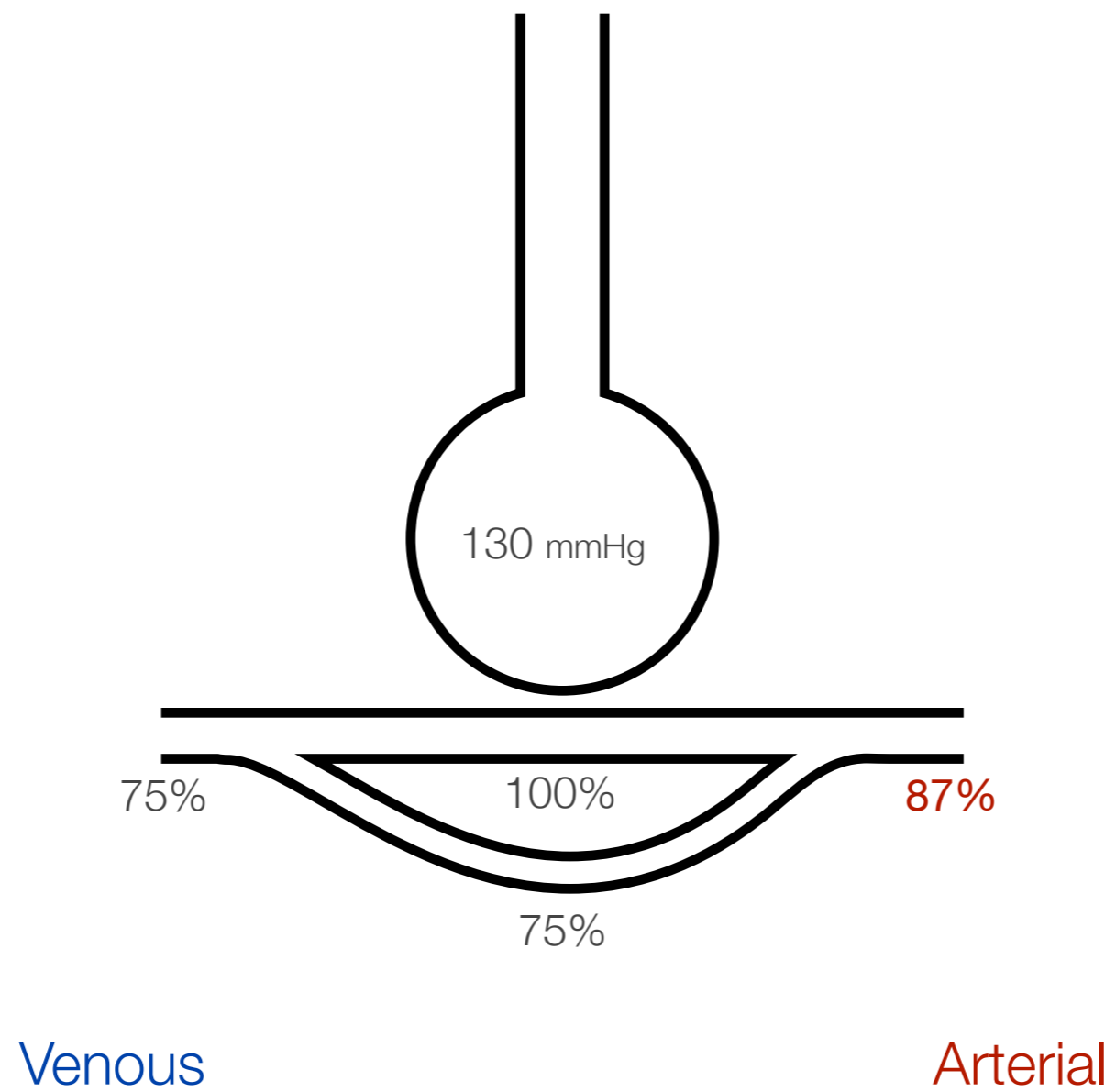
Causes of Hypoxia

- 1 ↓ FiO₂
- 2 Hypoventilation
- 3 Shunt

Normal Oxygen Exchange



Shunt



Shunt

