OXYGEN CONTENT

$$= \text{Hg-bound } O_2 + \text{Dissolved } O_2$$
$$C_vO_2 = (Hg \times 1.34 \times S_vO_2) + (P_vO_2 \times 0.003)$$
$$C_aO_2 = (Hg \times 1.34 \times S_aO_2) + (P_aO_2 \times 0.003)$$

C_vO_2 = mixed venous oxygen content
C_aO_2 = arterial oxygen content
Hg = hemoglobin
1.34 = volume of O_2 bound to 1 gram of saturated Hg
S_vO_2 = % Hg fully saturated with O_2 in venous blood
S_aO_2 = % Hg fully saturated with O_2 in arterial blood
P_vO_2 = partial pressure of O_2 dissolved in venous blood
P_aO_2 = partial pressure of O_2 dissolved in arterial blood
0.003 = solubility coefficient of O_2 dissolved in blood

OXYGEN DELIVERY

$$DO_2 = CO \times C_aO_2$$

OXYGEN CONSUMPTION

$$VO_2 = CO \times (C_aO_2 - C_vO_2)$$

OXYGEN EXTRACTION RATIO

$$ER_{O2} = (VO_2 \div DO_2) \times 100$$

DO_2 = oxygen delivered
VO_2 = oxygen consumption
ER_{O2} = oxygen extraction ratio
CO = cardiac output
C_aO_2 = arterial oxygen content
C_vO_2 = mixed venous oxygen content

FICK EQUATION

$$S_vO_2 = S_aO_2 - [VO_2 \div (CO \times Hg \times 1.34)]$$

S_vO_2 = mixed venous O_2 saturation (normal: 65-75%)
S_aO_2 = arterial O_2 saturation
VO_2 = total body O_2 consumption
CO = cardiac output
Hg = hemoglobin

$S_vO_2 \propto S_aO_2$, CO, Hg
$S_vO_2 \propto 1/VO_2$

- ↑ DO_2 — Inotropes, IV Fluids, Transfusion, Oxygen therapy
- ↓ VO_2 — Cyanide toxicity, Sepsis (late), ↑ CO, L→R shunt, Hypothermia

→ ↑ S_vO_2

- ↓ DO_2 — Hypoxia, Anemia, Hypovolemia, Hypothermia, Carboxyhemoglobin
- ↑ VO_2 — Fever, Sepsis (early), Exercise, Pain, Shivering, Thyroid storm

→ ↓ S_vO_2

APNEIC TIME

$$= (FRC \times EtO_2) \div VO_2$$

FRC = functional residual capacity
EtO_2 = end-tidal oxygen percent
VO_2 = oxygen consumption

Pre-oxygenation (denitrogenation) can be achieved by Tidal volume breathing 100% O_2 over 3 mins OR by 8 vital capacity breaths over 1 minute

USEFUL 'ANCHOR' POINTS

SO_2	50%	75%	85%	90%	97%
PO_2 (mmHg)	27	40	50	60	100

MEAN ARTERIAL PRESSURE

$$MAP = CO \times SVR$$

SYSTEMIC VASCULAR RESISTANCE

$$SVR = 80 \times (MAP - CVP) \div CO$$

CARDIAC OUTPUT

$$CO = HR \times SV$$

STROKE VOLUME

$$SV = Preload \times Contractility \times Afterload$$

MAP = mean arterial pressure
CO = cardiac output
SVR = systemic vascular resistance
80 = conversion factor to change woods units 'mmHg/L/min' to metric units 'dynes/sec/cm^5'
CVP = central venous pressure (surrogate for right atrial pressure, RAP)
SBP = systolic blood pressure
DBP = diastolic blood pressure
HR = heart rate
SV = stroke volume

Parameter	Normal Values
Cardiac Output (CO)	5-6 L/min
Cardiac Index (CI)	2.5-4 L/min/m^2
Pulmonary Capillary Wedge Pressure (PCWP)	4-12 mmHg
Central Venous Pressure (CVP)	8-12 mmHg
Mixed Venous O_2 Saturation (S_vO_2)	75 %
Mixed Venous O_2 Partial Pressure (P_vO_2)	40 mmHg
Systemic Vascular Resistance (SVR)	700-1500 dynes/sec/cm^5
Oxygen consumption (VO_2)	250 cc/min

ALLOWABLE BLOOD LOSS

$$= EBV \times (H_i - H_f) \div H_i$$

EBV = estimated blood volume
H_i = initial (starting) hematocrit
H_f = final (lowest acceptable) hematocrit

VOLUME TO TRANSFUSE

$$= EBV \times (H_{desired} - H_{current}) \div H_{transfused}$$

EBV = estimated blood volume
$H_{desired}$ = desired hematocrit
$H_{current}$ = current hematocrit
$H_{transfused}$ = hematocrit of transfused blood

Age	Estimated Blood Volume (mL/kg)
Preemie	100
Neonate	90
< 1 year	80
< 12 years	75
Men ♂	70
Women ♀	65 (~90 in pregnancy)

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