Mammalian Phys. F08

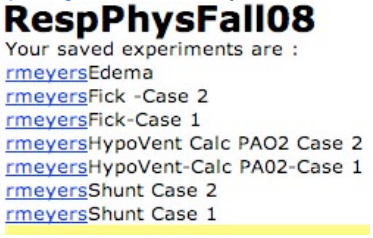
Shunt Calculations

As per the texts, the fraction of blood shunted past the lungs (physiological shunt) out of the total lung flow (Qs/Qt) can be calculated as follows:

$$\frac{\dot{Q}_S}{\dot{Q}_T} = \frac{Cc'_{O_2} - Ca_{O_2}}{Cc'_{O_2} - C\bar{v}_{O_2}}$$

where C_{aO2} & C_{vbarO2} are the measured arterial and mixed venous PO2 and Cc'_{O2} is the estimated capillary P02.

Case data retrieval (see figure below)
Case data is retrieved from experiments stored in the HUMAN data base. Log in for personalized features, select 'Get a saved experiment' and locate the folder RespPhysFall08 , open it and then, as/if directed to, open the indicated file.



Procedure
1) Run #1 – Determine by calculation (shunt equation) the size of the right to left shunt in HUMAN *at rest*.

2) Run #2 –Run the model "Shunt Case 1" to open your initial conditions & settings. Now
Run it for 5 min. with 1 min. between printouts.
Determine by calculation (shunt equation) the size of the right to left shunt in HUMAN.

3) Run #3 – Retrieve Shunt Case 2
Run it for 5 min. with 1 min. between printouts.
Determine by calculation (shunt equation) the size of the right to left shunt in HUMAN.

Present each experimental run, your calculations and any other relevant aspects of the case to the class.

Hypoventilation – PA02 calculations
Hypoventilation results in both abnormal PCO2 and PO2 values. As per the texts, the fall in PO2 resulting from lung hypoventilation may be calculated via the alveolar gas equation:

$$P_{A_{O_2}} = P_{I_{O_2}} - \frac{P_{A_{CO_2}}}{R} + F$$

where P_{IO2} is the inspired PO2, P_{AO2} is the measured alveolar PO2, P_{ACO2} is the alveolar PCO2, R is the respiratory quotient & F is a negligible correction factor under most circumstances.

Case data retrieval

Case data is retrieved from experiments stored in the HUMAN data base. Log in for personalized features, select 'Get a saved experiment' and locate the folder RespPhysFall08 , open it and then, as/if directed to, open the indicated file.

Procedure

1) Run #1 – Determine by calculation (alveolar gas equation) the value of the alveolar gas partial pressures in HUMAN *at rest*.

2) Run #2 – Run the model "HypoVent Calc PA02 Case 1"

-hit <Go> to enter these respirator settings.

-turn on the respirator (ARTRES=1) and run for 5 hours with 15 min. between printouts.

- determine by calculation (P_{AO2} -alveolar gas equation) and readout (P_{ACO2}) the value of the alveolar gas partial pressures at 5 hours.

3) Run #3 – Retrieve "HypoVent Calc PA02 Case "

-hit <Go> to enter these respirator settings.

-turn on the respirator (ARTRES=1) and run for 5 hours with 15 min. between printouts.

- determine by calculation (alveolar gas equation) the value of the alveolar gas partial pressures at 5 hours.

Present each experimental run, your calculations and any other relevant aspects of the case to the class.

Fick cardiac output calculations

Measurements of O2 consumption (VdotO2) and mixed pulmonary arterial (CvbarO2) and venous (CaO2) values yield the ability to calculate lung flow (Qdot) and cardiac output.

$$\dot{V}_{O_2} = \dot{Q}\,(Ca_{O_2} - C\bar{v}_{O_2})$$

$$\dot{Q} = \frac{\dot{V}_{O_2}}{Ca_{O_2} - C\bar{v}_{O_2}}$$

Case data retrieval

Case data is retrieved from experiments stored in the HUMAN data base. Log in for personalized features, select 'Get a saved experiment' and locate the folder RespPhysFall08 , open it and then, as/if directed to, open the indicated file.

Procedure

1) Run #1 – Determine by calculation (Fick equation) the value of the cardiac output in HUMAN at *rest*.

2) Run #2 –Run the model Fick- Case 1
- run the model as set up
- calculate the cardiac output at 20 min.

3) Run #3 - Retrieve Fick- Case 1
- run the model as set up
- calculate the cardiac output at 20 min.

Present each experimental run, your calculations and any other relevant aspects of the case to the class.

Edema – balance of forces calculation

Normal capillary fluid balance (lung and peripheral circulation) is due to a close equality between inward & outward osmotic (Π) and hydrostatic (P) forces. i.e.

$$\text{net fluid out} = K[(P_c - P_i) - \sigma(\pi_c - \pi_i)]$$

Case data retrieval

Case data is retrieved from experiments stored in the HUMAN data base. Log in for personalized features, select 'Get a saved experiment' and locate the folder RespPhysFall08 , open it and then, as/if directed to, open the indicated file.

Procedure

Retrieve the Edema case.
- run it.

Explain why the subject has "Feet" swelling given the balance of inward and outward Starling forces.

Present each experimental run, your calculations and any other relevant aspects of the case to the class.