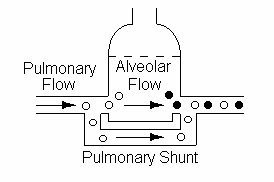
## Pulmonary Shunt

Proper oxygenation of blood in the lungs depends on having almost all of the pulmonary blood flow come in contact with well-ventilated alveoli. If blood shunts from pulmonary artery to pulmonary vein without contacting working alveoli, the blood in the peripheral circulation will subsequently not be fully oxygenated.



Pulmonary shunting, also called venous admixture, can be significant in some cardiovascular and respiratory diseases.

### The Pulmonary Shunt Protocol

Click Restart to reestablish initial conditions and then record control data. Go to . Scroll down to the hemodynamics box and slide the basic shunt flow up to 2000. Advance the solution 10 minutes

Acutely, focus on the ability of shunt to alter arterial pO2 and oxygen content.

|  |  |
| --- | --- |
|  | Arterial pO2 (mmHg)  Arterial [O2] (mL/mL)  Venous pO2 (mmHg)  Venous [O2] (mL/mL) |
|  | Arterial Pressure (mmHg) |
|  |  |
|  | Cardiac Output (mL/Min)  Heart Rate (/Min)  Stroke Volume (mL)  Fistula Flow (mL/Min) |
|  |  |
|  | Sympathetic Nerve Activity |
|  |  |
|  | Plasma Renin Activity |
|  |  |
|  | Na+ Excretion (mEq/Min) |
|  |  |
|  | Erythropoietin |
|  |  |
|  | Blood Volume (mL)  Red Cell Volume (mL)  Plasma Volume (mL)  Hematocrit (%) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time | 0  Min | 10  Min | 1  Day | 1  Month |
| Arterial pO2 | 93 | 49 | 40 |  |
| Arterial [O2] | 0.192 | 0.174 | 0.183 |  |
| Venous pO2 | 42 | 32 | 29 |  |
| Venous [O2] | 0.150 | 0.132 | 0.150 |  |
| Blood Pressure | 120/97/79 | 119/95/78 | 105/83/66 |  |
| Cardiac Output | 5468 | 5614 | 5266 |  |
| Heart Rate | 72 | 72 | 72 |  |
| Stroke Volume | 76 | 77 | 73 |  |
| Symp. Nerves | 1.50 | 1.52 | 1.57 |  |
| Plasma Renin | 2.2 | 2.2 | 1.1 |  |
| Na+ Excretion | 0.123 | 0.118 | 0.974 |  |
| Erythropoietin | 18.6 | 263.7 | 493.5 |  |
| Blood Volume | 5421 | 5424 | 5257 |  |
| Red Cell Volume | 2340 | 2340 | 2349 |  |
| Plasma Volume | 3081 | 3084 | 2908 |  |
| Hematocrit | 43 | 43 | 45 |  |

\*\*\*HumMod crashes long before the month due to a math error that involves dividing by zero

Use an exercise stress test to characterize cardiac function.

|  |  |
| --- | --- |
|  | Treadmill Speed (MPH)  Treadmill Grade (%) |
|  |  |
|  | Heart Rate (/Min) |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time | 0’ | 1’ | 2’ | 3’ | 4’ | 5’ |
| Speed | 0 | 6 | 6 | 6 | 6 | 6 |
| Grade | 0% | 0% | 2% | 4% | 6% | 8% |
| Heart Rate |  |  |  |  |  |  |

Record the elapsed time and distance when this subject finally gives up.

|  |  |
| --- | --- |
| Elapsed Time (Min) |  |
| Distance Traveled (Ft) |  |

\*\*\*No reset used between the first chart and exercise and heart rate at 0 taken with patient standing. Patient didn’t give up

### Pulmonary Shunt And Arterial pO2

### In this exercise, we’ll observe the effect of pulmonary shunt on arterial pO2 and [O2].

|  |  |
| --- | --- |
|  | Pulmonary Shunt (mL/Min) |
|  |  |
|  | Arterial pO2 (mmHg)  Arterial [O2] (mL/mL) |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Shunt (mL/Min) | 500 | 1000 | 1500 | 2000 | 2500 | 3000 |
| Shunt (%CO) |  |  |  |  |  |  |
| Arterial [O2] |  |  |  |  |  |  |
| Arterial pO2 |  |  |  |  |  |  |
| Art. pO2 (% Norm) |  |  |  |  |  |  |

Plot arterial pO2 as a function of pulmonary shunt. Use percent of normal as units for pO2. Use percent of cardiac output as units for shunt.

Ran simulation for 10 minutes before recording these values



Can arterial pO2 be used to predict the magnitude of pulmonary shunt?

### Question For Discussion

To distinguish between pulmonary shunting and diffusion block, a patient is given pure (100%) O2. What is the rationale for this test? Try it.