

Mitral Stenosis



The 4 valves of the heart are normally very efficient, providing almost no resistance to forward flow when open and nearly infinite resistance to backflow when closed.

Valves that fail to open properly can create a significant impediment to forward flow. This is called stenosis.

Valves that fail to close properly provide less than infinite resistance to backflow. This backflow is called regurgitation.

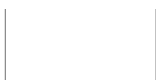
In this exercise, we'll investigate the hemodynamic consequences of stenosis of the mitral valve.

The Mitral Stenosis Protocol

Click **Restart** to reestablish initial conditions and then record control values.



Go to **Valves** and reduce the open area of the mitral valve to 0.8 mM². Record the acute hemodynamic effects of this stenosis. Advance time and record data. Look for evidence of compensation.





Cardiac Output (mL/Min)

Pulm. Artery Pressure (mmHg)

Pulm. Capillary Pressure (mmHg)

Pulm. Vein Pressure (mmHg)

Left Atrial Pressure (mmHg)



Plasma Colloid Pressure (mmHg)

Arterial pO2 (mmHg)

Blood Volume (mL)



Excess Lung H2O (mL)

Time	Control	Acute	1 Week
Cardiac Output			
Pulm. Artery Pressure			
Pulm. Caps Pressure			
Pulm. Vein Pressure			



Left Atrial Pressure			
Plasma COP			
Arterial pO2			
Blood Volume			
Excess Lung H2O			

Pulmonary Edema

Normally, the plasma colloid pressure is considerably greater than the pulmonary capillary pressure. Note the control data above. This creates a negative filtration pressure in the pulmonary capillaries and keeps the lungs dry.

Mitral stenosis increases the pulmonary capillary pressure and erodes the pressure gradient. In severe mitral stenosis, the pressure gradient can swing to a positive value (Finlayson, *et.al.*, 1961). A life threatening pulmonary edema will result.

Click **Restart** to reestablish initial conditions and then record control values.



Go to **Valves** and reduce the open area of the mitral valve to 0.6 mM². Record the acute hemodynamic effects of this stenosis. Attempt to advance time for a week, but stop and record data if QCP's condition deteriorates.

Time	Control	Acute	1 Week



Cardiac Output			
Pulm. Artery Pressure			
Pulm. Caps Pressure			
Pulm. Vein Pressure			
Left Atrial Pressure			
Plasma COP			
Arterial pO ₂			
Blood Volume			
Excess Lung H ₂ O			

Physical exertion increases the likelihood that a patient with mitral stenosis will develop pulmonary edema. Why?

References

Finlayson, J. K., M. N. Luria, C. A. Stanfield, & P. N. Yu. Hemodynamic studies in acute pulmonary edema. *Ann Int Med.* 54:244-253, 1961.

