P50 of hemoglobin: factors influencing

The oxyhemoglobin dissociation curve shows the relationship between the hemoglobin saturation (SO2) at different oxygen tensions (PO2).

The P50 is the oxygen tension at which hemoglobin is 50% saturated. That is, ½ of the hemoglobin binding sites contain oxygen molecules. As the p50 decreases, oxygen affinity increases, and vice versa. **The normal P50 is 26.7 mm Hg**.

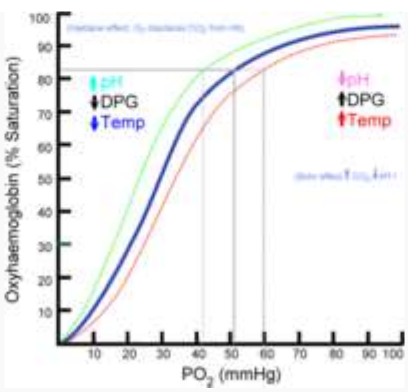
Shifting the curve to the left or right has little effect on the SO2 in the normal range where the curve is fairly horizontal; a much greater effect is seen for values on the steeper part of the curve.

Shifting of the oxyhemoglobin dissociation curve

• A rightward shift increases P50 and lowers hemoglobin's affinity for oxygen, thus displacing oxygen from hemoglobin and releasing it to the tissues.

• A leftward shift decreases P50 and increases hemoglobin's affinity for oxygen, thus reducing its availability to the tissues.

Factors affecting the oxyhemoglobin dissociation curve



Hemoglobin Dissociation Curve

The Value of p50 therefore becomes a measure of change imposed on hemoglobin affinity by the individual or multiple factors that affect it:

• A decrease in pH shifts the standard curve to the right, while an increase shifts it to the left. This is known as the Bohr effect.

• Carbon dioxide affects the curve in two ways: first, it influences intracellular pH, known as the **Bohr Effect** (see also the Haldane effect, which is physiologically much more important), and second, CO_2 accumulation causes carbamino compounds to be generated through chemical interactions. Increasing CO_2 has the effect of shifting the curve to the right and decreasing shifts the curve to the left.

• 2,3-diphosphoglycerate is created in erythrocytes during glycolysis. The production of 2,3-DPG is likely an important adaptive mechanism, because the production increases for several conditions in the presence of diminished peripheral tissue O_2 availability, such as hypoxemia, chronic lung disease, anemia, and congestive heart failure, among others. High levels of 2,3-DPG shift the curve to the right, while low levels of 2,3-DPG cause a leftward shift, seen in states such as septic shock and hypophosphatemia.

• Temperature does not have so dramatic effect as the previous factors, but hyperthermia causes a rightward shift, while hypothermia causes a leftward shift.

• Hemoglobin binds with carbon monoxide 240 times more readily than with oxygen, and therefore the presence of carbon monoxide can interfere with the hemoglobin's acquisition of oxygen. In addition to lowering the potential for hemoglobin to bind to oxygen, carbon monoxide also has the effect of shifting the curve to the left. With an increased level of carbon monoxide, a person can suffer from severe hypoxia while maintaining a normal PO_2.

• Methemoglobinemia causes a leftward shift in the curve.

• Fetal hemoglobin (HbF) is structurally different from normal hemoglobin (Hb). The fetal dissociation curve is shifted to the left relative to the curve for the normal adult. Typically, fetal arterial oxygen pressures are low, and hence the leftward shift enhances the placental uptake of oxygen.