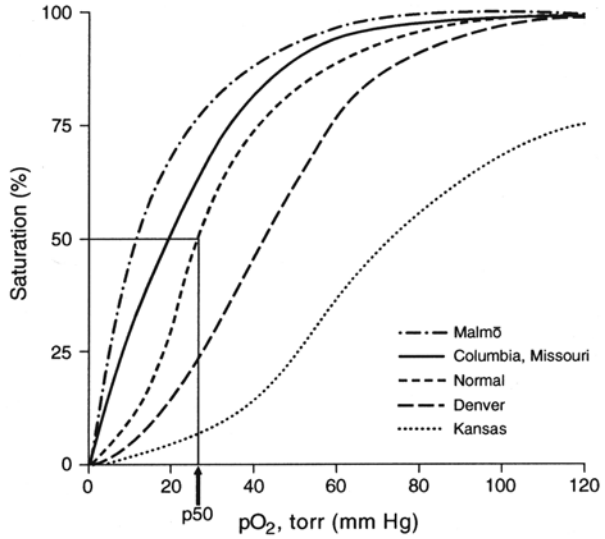
Hemoglobin-O_2 Affinity (p50) Testing (Oxygen Dissociation, p50, Erythrocytes)

Among the rare causes of polycythemia is hereditary polycythemia due to the presence of a high O_2 affinity hemoglobin. More than 100 such abnormal hemoglobins have been described. They are associated with increased erythrocyte count, increased blood hemoglobin concentration, increased hematocrit (to values as high as 60%), but normal leukocyte and platelet counts and no splenomegaly. Some of these hemoglobin variants can be detected by electrophoresis; many cannot. However, the presence of a high O_2 affinity hemoglobin variant in blood can almost always be detected by measurement of hemoglobin-O_2 affinity. Congenital cyanosis may be due to the presence of a low O_2 affinity hemoglobin, and these may also be detected by the O_2 affinity study.

The hemoglobin-O_2 affinity assay plots O_2 saturation in percent on the ordinate vs. pO_2 on the abscissa. The entire O_2 affinity curve of hemoglobin is plotted from 0% to 100% saturation, yielding a smooth curve based on hundreds of instantaneous measurements. From this, the pO_2 is determined at which O_2 saturation is 50%, and this is the p50. In addition, the curve is inspected to evaluate whether it exhibits the normal sigmoidicity, since some high O_2 affinity hemoglobin variants have nearly normal p50 but exhibit non-sigmoidal O_2 affinity curves (see illustration).



The patient's specimen must be accompanied by a fresh heparinized whole blood specimen from a normal, unrelated, non-smoker (control) drawn at the same time. No charge is made for the O_2 affinity study performed on the control specimen.

Some of the high O_2 affinity hemoglobin variants that we have examined have had p50 as low as 12 mm Hg; low O_2 affinity hemoglobin variants have had p50 as high as 42 mm Hg. The p50 of hemoglobin Kansas was reported as being much higher (see table for interpretive values). Some variants with high or low O_2 affinity that have been studied in Mayo Medical Laboratories are shown in the following chart.

Variant	p50 torr (mm Hg)	Effect
Reference Range	24-32	
Syracuse	11	Polycythemia
Bethesda	12	Polycythemia
Osler	12	Polycythemia
Wood	12	Polycythemia
Malmö	13	Polycythemia
British Columbia	14	Polycythemia
Andrew-Minneapolis	15	Polycythemia
Kempsey	15	Polycythemia
San Diego	16	Polycythemia
Johnstown	18	Polycythemia
Köln	18	Hemolytic Anemia
Chesapeake	19	Polycythemia
Columbia, MO	19	Polycythemia
Washtenaw	40	Cyanosis
Loves Park	40	Cyanosis (Mild)
Denver	42	Cyanosis
(Kansas)*	(70)*	Cyanosis

*Hb Kansas has not been seen in Mayo Medical Laboratories but is shown for comparison only, with p50 estimated from published case.