When is Risky to Apply Oxygen for Congenital Heart Disease?

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The primary change in circulation after birth is a shift of blood flow for gas exchange from the placenta to the lungs.

In the congenital heart disease (CHD) patient, if arterial blood and venous blood are mixing completely or if there is shunting of blood from the venous system to the arterial system, a reduced saturation is anticipated. Therefore, an understanding of the appropriate saturation target for each patient is important.

1. Hypoplastic Left Heart Syndrome (HLHS)

The HLHS is an example of complete mixing with a ductal dependent cardiac output. Blood returning from the healthy lungs mixes with venous blood. If equal volumes of blood are distributed to the lungs and to the body (Qp/Qs=1 or normal), a saturation of about 80% would be expected. As with other single ventricular defects, using high levels of oxygen could also lead to excessive pulmonary blood flow and congestive heart failure (CHF), which are already precautionary factors in HLHS.

2. Double Outlet Right Ventricle (DORV) & Double Outlet Left Ventricle (DOLV)

DORV and DOLV are congenital heart defects in which both the pulmonary artery and aorta originate from one ventricle. Pulmonary stenosis occurs in 50% of patients with this anomaly, resulting in cyanosis. Pulmonary blood flow is dependent on the degree of stenosis. Some degree of pulmonary stenosis protects the pulmonary capillary bed from being exposed to high pressures and flow. High levels of oxygen can decrease PVR, resulting in the potential for pulmonary edema.

3. Tricuspid Atresia (TA)

TA is one of the most common cyanotic heart defects in the pediatric population. Pulmonary blood flow in a patient with TA is dependent on a PDA. In these patients, PGE1 should be administered early to maintain PDA patency. PGE1 will also help prevent pulmonary edema and systemic acidosis. High levels of oxygen may promote ductal closure so care must be given when administering it.

4. Heterotaxy

The most common problem with heterotaxy is not enough blood flow to the pulmonary circulation. The treatment is a surgical intervention to create a systemic to pulmonary conduit. Administration of oxygen will decrease PVR and aid in pulmonary blood flow. Oxygen should be delivered to maintain saturations between 75% and 85% via blender to control FiO2. The use of subambient air might be required for saturation greater than 90% to inhibit pulmonary over-circulation by increasing PVR.