HEMOLYTIC DISEASE OF THE FETUS AND NEWBORN (HDFN)

HDFN, also known as erythroblastosis fetalis, is a disorder of fetus or newborn in which fetal red cells are destroyed by maternal immunoglobulin G (IgG) antibodies, directed against fetal antigens, cross the placenta, sensitize fetal red cells and shorten red cell survival. This premature red cell destruction results in disease varying from mild anemia to death in utero. The transfusion service plays a critical role in the prediction, diagnosis, treatment and most important, the prevention of this potentially life-threatening disease.

Etiology of HDFN

During pregnancy, the placenta functions as the site of oxygen, nutrients and waste exchange. In addition, it serves as a barrier between maternal and fetal circulation. At the time of delivery when placenta is separated from the uterus, a significant number of fetal RBCs escape into the maternal circulation (known as fetomaternal hemorrhage, FMH). In addition to delivery, immunization can also result from fetal RBC exposure following amniocentesis, spontaneous or induced abortion, chorionic villus sampling, ectopic pregnancy or abdominal trauma. Foreign antigens on the fetal RBCs can stimulate an active immune response in the mother which results in the production of IgG antibodies.

In a subsequent pregnancy the IgG antibodies cross the placental barrier by an active transport mechanism. The antibodies bind to fetal antigens, which results in RBC destruction by macrophages in the fetal liver and spleen. Hemoglobin liberated from the damaged RBCs is metabolized to indirect bilirubin. The indirect bilirubin is transported across the placenta, conjugated by the maternal liver, and harmlessly excreted by the mother. However, as the RBC destruction continues, the fetus become increasingly anemic. Fetal liver and spleen enlarge as erythropoiesis increases in an effort to compensate for RBC destruction. Immature RBCs (erythroblasts) are released into the fetal circulation (which explains the term erythroblastosis fetalis). If the condition is left untreated, cardiac failure can occur accompanied by hydrops fetalis, or edema and fluid accumulation in the fetal peritoneal and pleural cavities. Thus, the greatest threat to the fetus is cardiac failure resulting from uncompensated anemia.

After delivery the infant faces challenges of continued RBC destruction with release of indirect bilirubin. The infant lacks glucuronyltransferase (liver enzyme needed to conjugate indirect bilirubin). As the indirect bilirubin is released, it binds to albumin and circulates in the infant harmlessly. However, when the binding capacity of albumin is exceeded, the indirect bilirubin binds to tissues which results in jaundice. In particular, it may bind with tissues of the CNS and cause permanent brain damage (kernicterus), resulting in deafness, mental retardation, or death.

Overview of HDFN

- The mother must lack the antigen and following exposure to the antigen from previous pregnancies or transfusions produce an antibody of IgG class.