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Types of Thalassemia

Thalassemia is a broad term that refers to a group of hereditary diseases that cause faulty hemoglobin synthesis and fewer RBCs in the body than normal. In alpha thalassemia, production of the alpha chain is affected, while in beta thalassemia, the beta chain is involved. Strictly speaking, sickle cell anemia is a type of beta thalassemia because it involves a mutation to the beta chain. There are a variety of possible mutations in both chains that create a spectrum of conditions that range from mild to severe anemia. The anemia arises because the abnormal hemoglobin causes abnormal red blood cells that are broken down more quickly.

Alpha Thalassemia

Alpha thalassemia is more common in the Asian population and occurs because of the deletion or mutation of one or more genes that participate in alpha chain synthesis. This generally results in the decrease of alpha globin production and an excess of beta chains (more than two) being incorporated into the hemoglobin. Beta chain tetramers (called hemoglobin H or HbH) of four beta chains often occur and are unstable. These tetramers have abnormal oxygen dissociation curves and they can form aggregates (called **Heinz bodies**) that interact with the cell membrane in harmful ways. Damage to the red blood cell membrane causes the red blood cells to be removed by macrophages in the spleen, leading to anemic symptoms as RBC numbers decrease.

Beta Thalassemia

Beta thalassemia is more common in people of the Mediterranean populations, especially southern Italy and Greece. It is caused by a deletion or a mutation in the beta-globin gene and leads to abnormal and decreased synthesis of beta-globin. Alpha-globin chains do not form tetramers but instead degenerate and precipitate. The aggregation of alpha chains and products of their degradation can also produce inclusion bodies in the cell (Heinz bodies) and damage the RBC enough that it will be removed from circulation by splenic macrophages.

Effects and Treatment for Thalassemia

Anemia from thalassemia occurs because of several factors. First, there is decreased RBC production in the bone marrow because abnormal hemoglobin makes it impossible to generate and organize healthy hemoglobin protein. Second, the abnormal hemoglobin is less effective at delivering adequate oxygen loads. Third, abnormal hemoglobin production leads to aggregates in the cytoplasm that damage the red blood cell and lead to its destruction in the spleen. Anemia and decreased oxygen delivery leads to chronic high levels of erythropoietin, bone marrow expansion, and possible bone deformities. Excess iron from increased RBC turnover and repeated transfusions can cause iron rich deposits in the myocardium, liver, and endocrine glands.

There are three main treatments for thalassemia. The first is regular blood transfusions to improve growth and development. The second treatment is iron chelation therapy to decrease the excess iron. The third treatment is bone stem cell transplantation.