The Alpha-Globin Gene and Alpha-Thalassemia

Part 1

Structure of Hemoglobin

Alpha-thalassemia is caused by problems in the production of the alpha-globin protein in hemoglobin.

Hemoglobin is normally made up of two alpha-globin protein chains and two beta-globin protein chains. Different genes code for the alpha- and beta-protein chains.

Figure 1. Schematic of hemoglobin protein complex.
**Alpha-Globin Gene**

The alpha-globin gene, on chromosome 16 in humans, codes for the alpha-globin protein. Humans normally have four copies of the alpha-globin gene.

*Figure 2.* Schematic showing two copies of chromosome 16 and four copies of the alpha-globin gene. All the alleles of the alpha-globin gene are functional in this individual.

Individuals with alpha-thalassemia have a problem with one or more of their alpha-globin alleles.

*Figure 3.* Schematic showing two copies of chromosome 16 and four copies of the alpha-globin gene. One allele of the alpha-globin gene in this individual is nonfunctional.

Individuals with alpha-thalassemia do not make as much alpha-globin protein as normal individuals do. The amount of protein they make depends on how many working alleles of the alpha-globin gene a person has.
## Part 2

### Table 1. Alpha-globin Gene Functional and Nonfunctional Alleles and Related Diseases

<table>
<thead>
<tr>
<th>Number of functional alleles of the alpha-globin gene</th>
<th>Number of nonfunctional alleles of the alpha-globin gene</th>
<th>Name of disease</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>Normal condition (healthy individual)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
| 3                                                   | 1                                                       | Alpha-thalassemia silent carrier | • Usually no symptoms and no anemia  
• Blood tests usually normal  
• Hemoglobin normal  
• Slight changes in size of red blood cells (smaller than normal—microcytic)  
• Slightly lighter color of red blood cells (hypochromic) |
| 2                                                   | 2                                                       | Alpha-thalassemia trait | • Mild anemia  
• Small red blood cells (microcytic)  
• Light, pale color of red blood cells (hypochromic)  
• Blood tests usually normal  
• Hemoglobin normal |
| 1                                                   | 3                                                       | Hemoglobin H (HbH) disease | • Moderate to severe anemia  
• Small red blood cells (microcytic)  
• Light, pale color of red blood cells (hypochromic)  
• Fatigue  
• Mild jaundice  
• Enlarged spleen  
• Bone deformities (in some cases) |
| 0                                                   | 4                                                       | Alpha-thalassemia major or hemoglobin Barts hydrops fetalis (Hb Barts) syndrome | • Usually fatal before or shortly after birth |