Methemoglobinemia, beta-globin type

Methemoglobinemia, beta-globin type is a condition that affects the function of red blood cells. Specifically, it alters a molecule called hemoglobin within these cells. Hemoglobin within red blood cells attaches (binds) to oxygen molecules in the lungs, which it carries through the bloodstream, then releases in tissues throughout the body. Instead of normal hemoglobin, people with methemoglobinemia, beta-globin type have an abnormal form called methemoglobin, which is unable to efficiently deliver oxygen to the body's tissues. In methemoglobinemia, beta-globin type, the abnormal hemoglobin gives the blood a brown color. It also causes a bluish appearance of the skin, lips, and nails (cyanosis), which usually first appears around the age of 6 months. The signs and symptoms of methemoglobinemia, beta-globin type are generally limited to cyanosis, which does not cause any health problems. However, in rare cases, severe methemoglobinemia, beta-globin type can cause headaches, weakness, and fatigue.

Frequency

The incidence of methemoglobinemia, beta-globin type is unknown.

Causes

Methemoglobinemia, beta-globin type is caused by mutations in the \( HBB \) gene. This gene provides instructions for making a protein called beta-globin. Beta-globin is one of four components (subunits) that make up hemoglobin. In adults, hemoglobin normally contains two subunits of beta-globin and two subunits of another protein called alpha-globin. Each of these protein subunits is bound to an iron-containing molecule called heme; each heme contains an iron molecule in its center that can bind to one oxygen molecule. For hemoglobin to bind to oxygen, the iron within the heme molecule needs to be in a form called ferrous iron \( (\text{Fe}^{2+}) \). The iron within the heme can change to another form of iron called ferric iron \( (\text{Fe}^{3+}) \), which cannot bind oxygen. Hemoglobin that contains ferric iron is known as methemoglobin.

\( HBB \) gene mutations that cause methemoglobinemia, beta-globin type change the structure of beta-globin and promote the heme iron to change from ferrous to ferric. The ferric iron cannot bind oxygen and causes cyanosis and the brown appearance of blood.

Inheritance Pattern

This condition is inherited in an autosomal dominant pattern, which means one copy of the altered gene in each cell is sufficient to cause the disorder.
Other Names for This Condition
- blue baby syndrome
- congenital methemoglobinemia
- hemoglobin M disease

Diagnosis & Management

Genetic Testing Information
- What is genetic testing?
  /primer/testing/genetictesting
- Genetic Testing Registry: Methemoglobinemia, beta-globin type

Research Studies from ClinicalTrials.gov
- ClinicalTrials.gov
  https://clinicaltrials.gov/ct2/results?cond=%22methemoglobinemia%2C+beta-globin+type%22+OR+%22hemoglobin+M+disease%22

Other Diagnosis and Management Resources
- KidsHealth from Nemours: Blood Test: Hemoglobin
- MedlinePlus Encyclopedia: Hemoglobin
  https://medlineplus.gov/ency/article/003645.htm
- MedlinePlus Encyclopedia: Methemoglobinemia
  https://medlineplus.gov/ency/article/000562.htm
- MedlinePlus Encyclopedia: Skin Discoloration--Bluish
  https://medlineplus.gov/ency/article/003215.htm

Additional Information & Resources

Health Information from MedlinePlus
- Encyclopedia: Hemoglobin
  https://medlineplus.gov/ency/article/003645.htm
- Encyclopedia: Methemoglobinemia
  https://medlineplus.gov/ency/article/000562.htm
- Encyclopedia: Skin Discoloration--Bluish
  https://medlineplus.gov/ency/article/003215.htm
- Health Topic: Blood Disorders
  https://medlineplus.gov/blooddisorders.html
Genetic and Rare Diseases Information Center

- Methemoglobinemia, beta-globin type
  https://rarediseases.info.nih.gov/diseases/13007/methemoglobinemia-beta-globin-type

Educational Resources

- American Society of Hematology: Blood Basics
  https://www.hematology.org/education/patients/blood-basics

- Brigham and Women's Hospital: Hemoglobin Overview
  http://sickle.bwh.harvard.edu/hemoglobin.html

- Cincinnati Children's Hospital: Cyanosis in Infants and Children
  https://www.cincinnatichildrens.org/health/c/cyanosis

- Merck Manual Consumer Version: Cyanosis

- Orphanet: Hemoglobin M disease
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=330041

- Orphanet: Hereditary methemoglobinemia
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=621

- The Hospital for Sick Children (Canada): Cyanosis
  https://www.aboutkidshealth.ca/Article?contentid=1584&language=English

Patient Support and Advocacy Resources

- Resource List from the University of Kansas Medical Center: Hemoglobinopathies
  http://www.kumc.edu/gec/support/hemoglob.html

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28congenital+methemoglobinemia%5BTIAB%5D%29+OR+%28hemoglobin+m+disease%5BTIAB%5D%29+29%29+AND+%28congenital+methemoglobinemia%5BTIAB%5D%29+OR+%28hemoglobin+m+disease%5BTIAB%5D%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D

Catalog of Genes and Diseases from OMIM

- HEMOGLOBIN--BETA LOCUS
  http://omim.org/entry/141900
Sources for This Summary

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/18245076

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15603910

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/11527852 
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1071541/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/22024786

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23388674 
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  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19082413

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