Potential Connections Between Sickle Cell Disease and Iron Deficiency Anemia

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Abstract

Sickle Cell Disease (SCD) is a genetically inherited red blood cell (RBC) disorder. A protein, Hemoglobin, is affected by a Glu-->Val polymorphism causing it to become abnormal. This causes the RBC to lose its normal morphology and forms a C-shape, resembling a sickle, also causing the RBC to become hard and sticky. Anemia is another common red blood cell disorder that results from the lack and/or dysfunction of the RBCs in the body. Iron Deficiency usually means the lack of iron but in some cases can be also caused by SCA due to the lack of Hemoglobin which helps with the transportation of iron within the RBC. Iron deficiency anemia (IDA) is when the hemoglobin that contains iron is decreased within the blood. We hypothesize that there may be a connection between SCA and Iron Deficiency Anemia. Data shows that due to the loss of Hemoglobin within SCA, Iron deficiency may cause sickling. In conclusion, data suggests a link between SCA and Iron Deficiency Anemia as reported in the literature.

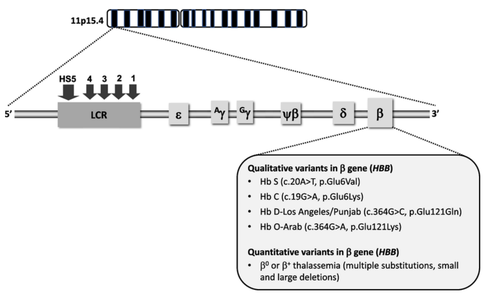
Objectives

- Explain SCD
- What is anemia?
- Explain Sickle cell Trait
- Explain Iron deficiency anemia
- Determine if there is a link between SCD and anemia

Literature Review Criteria

The literature was chosen with specific criteria through previous analysis of information collected on SCD, IDA, and anemia.

Genetics of SCD



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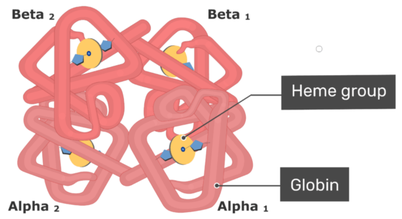
Hemoglobin Protein



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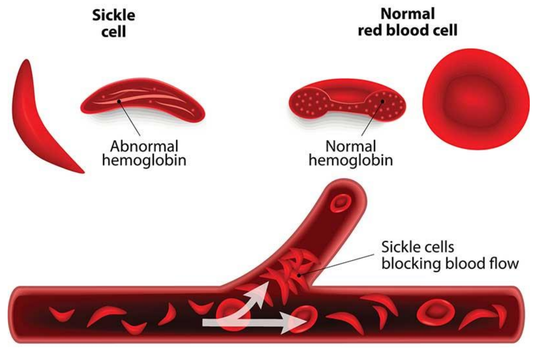
Effect of Hemoglobin Mutation on RBCs



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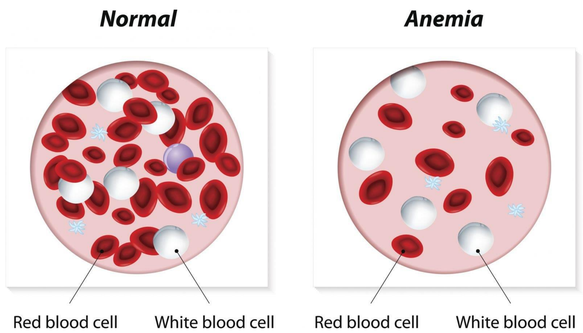
Anemia RBC



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Results

Sickle Cell Disease (SCD) is a common genetically inherited red blood cell (RBC) disorder. SCD affects a protein, Hemoglobin, causing it to become abnormal. Hemoglobin proteins are within Red Blood Cells (RBC) which travel throughout the body.

The circulatory system is designed to help deliver oxygen and nutrients to our cells and dispose of waste, which is carried out, in part, by RBCs. SCD affects the Hemoglobin S (HbS) protein by mutations of the β globin gene that can be located within chromosome 11. HbS results from the replacement of glutamic acid by valine in the sixth position of the β-globin chain of hemoglobin. (Brandow, A.M &Leim, R.I., 2022). This causes the RBC to lose its normal morphology and forms a C-shape, resembling a sickle, also causing the RBC to become hard and sticky. This effect may cause acute and chronic pain and could also be dangerous as it may get stuck and occlude blood flow. Although the pain can be ongoing, even chronic, acute pains may be more localized in areas such as; legs, arms, and back, due to the clogging within the tissues. Chronic pain lasts for over several days, sometimes months, and is usually impulses received from the central and/or peripheral nervous system. Chronic pain may also be located within a single area or multiple areas, as well. Ultimately, SCD can lead to major health problems such as infection, acute chest syndrome, stroke, and other end-organ damage.

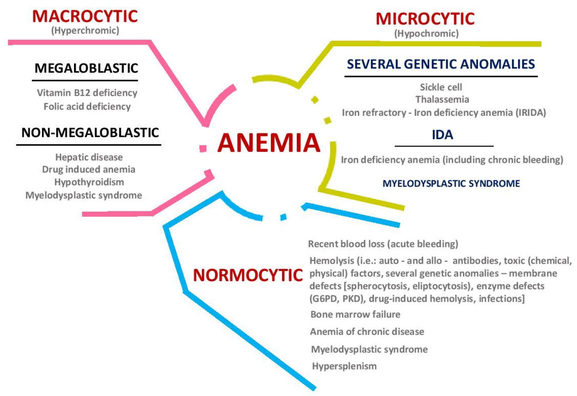
Many people carry the gene responsible for causing Sickle Cell Disease (SCD). According to the Centers for Disease Control and Prevention (CDC), about 1 in 365 African Americans are born with SCD and 1 in 13 African Americans are born with the Sickle Cell Trait (SCT). SCT is when a child inherits two different copies of alleles, a mutated hemoglobin "S" gene from one parent and a normal gene from the other. Usually, no physical signs are detected, but in some cases, in individuals with SCT, health problems may develop. Two people with SCT are likely to transfer this trait to their children.

Sickled cells have been known to only have a life span of 10 to 20 days (about 3 weeks) out of the 120 days (about 4 months) of a regular RBC. This leads to Sickle Cell Anemia due to not having enough healthy red blood cells. Anemia is another common red blood cell disorder that results from the lack and/or dysfunction of the RBCs in the body. One specific anemia disorder results in a low amount of Hemoglobin, found in RBCs, which can lead to reduced oxygen flow to some of the body's organs. There are more than 400 types of Anemia that exist, and over 30% of the world's population is affected by this. Similarly, this gene could be passed down to offspring.

Iron Deficiency, which is a lack of iron, but in some cases may also be also caused by SCA due to the lack of Hemoglobin which helps with the transportation of iron within the RBC. Iron deficiency anemia (IDA) is when the hemoglobin containing iron decreases in the blood. More than 2 billion individuals worldwide suffer from IDA, and it is still the leading cause of anemia. (Alzahrani et al. BMC). Iron Deficiency Anemia can also be developed through blood loss, genetic, and/or heavy menstrual periods.

Conclusion

In conclusion, of the 400 types of anemia within the world's population. The only potential linkage between SCD and Iron deficiency anemia is that due to the loss of Hemoglobin within SCA, Iron deficiency may cause sickling.



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