Can Sickle Cell Anemia be stopped?

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I.

 How can the life of a sickle cell be increased long enough for new red blood cells to be produced? This is a question not though of by most researchers, but when you think about it; the answer to this question could solve many symptoms of sickle cell anemia, and maybe even cure the disease itself.

 Sickle cell anemia is a hereditary blood disorder in which a person inherits an abnormal hemoglobin S inside the red blood cells which then leads to the sickling of the cell. Once the cell has take a sickle shape, it makes it harder for the blood cells to move through the blood stream, often getting caught and causing chronic pain, in what is called a sickle cell crisis. The blocked arteries can cause oxygen to be deprived to major organs which could lead to permanent damage. Normal red blood cells last about 120 days, as sickle cells only last about 60-80 days. Because of this much shorter life span, cells are dying faster than they can be produced in bone marrow, which leads to oxygen deprivation and may cause many victims to have to be put on an oxygen tank. These symptoms, plus more such as anemia, and jaundice can lead to a difficult life if not treated properly.

 When looking at the affects of sickle cell anemia, one can see how the question presented at the beginning would be not only a great discovery, but it would change the lives of people living with sickle cell. If the life of a sickle cell was somehow prolonged to allow more red blood cells to produce, it would decrease the amount of oxygen deprivation and the need for an oxygen tank. Also, the lack of a low red blood count would decrease the cases of anemia seen in patients, which would give one less symptom to worry about. Then, further research could be made to increase the amount of treatments for sickle cell and/or possibly find a cure.

 Debated by experts have included uses of treatments, and new developed ways for treatment that have not been used on humans; or has barley been used on humans. Practices such as gene therapy and bone marrow transplants have had long debated because for one, the use of gene therapy is expensive and therefore has not been practiced on very many patients. Two, it is hard to find a donor for bone marrow transplants. Patients are usually limited to siblings and intermediate family which severely limits the availability of donors.

 This research question goes down to the science of chemistry and biology, and hematology. Many researchers in these fields and possibly more fields have conducted various amounts of research, which helps support this question and to hopefully draw together possible ways to find an answer to this now unanswerable question.

II.

 At the time, research has been conducted on topics from the shape of red blood cells and sickle cells, to finding ways to unsickle a sickle cell. Before I could go about anything, the basic structure of the research had to be started with the shape of a sickle cell vs the shape of a sickle cell. Understanding these formations could spark possible ideas on how to go about unsickling the blood cells and/or expanding the life span. I have found two sources that would help with this understanding. These article explain the process down to the biology of it and describes how the life inside the cell functions. After researching these topics, I decided to research on the disease in general to see if it would spark up some questions or ideas to put in the paper. When researching about sickle cell anemia, I found that it is a hereditary disorder in which the person inherits an abnormal hemoglobin S inside the red blood cell instead of normal hemoglobin A. The hemoglobin S then sends out strands in the red blood cell that causes it to sickle (Breaking Sickle Cell’s Hold on Red Blood Cells). If scientist could find out how to stop or alter the strand that is sent out of hemoglobin S, then sickling could possibly be stopped. I then to a turn a looked at a related article on malaria and sickle cell disease. Those who have sickle cell disease are resistant to malaria, so I figured by looking at this article I could see the relationship between the two and see if there was some kind of resistance in malaria itself that could be used in a way to cure and/or treat sickle cell. On the page, it said that, “Other investigations suggest that malaria parasites could be damaged or killed directly in sickle trait red cells” (Malaria and the Red Cell). If malaria parasite could be damaged or killed by sickle cell trait, than in the actual disease, the parasites should have a small chance of surviving. This kind of natural immunization could try to be used to its advantage by using it to create other immunization for other infections which may reduce the susceptibility to infection for sickle cell disease patients. Switching to a different route yet again, I found another article that suggested that Peroxiredoxin II is responsible for prolonging the life span of red blood cells in mice (Tae-Hoon Lee). The article mainly described an experiment in which the protein peroxiredoxin was used on mice to see if they would have an effect on the life of a red blood cell. In the article, it states, “These proteins were characterized to have a number of cellular functions, including cell proliferation and differentiation and protection of specific proteins from oxidative damage” (Tae-Hoon Lee). Oxidative damage is a major setback when trying to preserve cells because it may alter the cells or age them in a way that destroys the cells (Acker, Jason) but if these proteins stop oxidative damage it could be another possible advancement in the discovery of how to increase the life span of the sickle cells. The scholarly articles in the own ways support my question which pushes me a little bit further with each article I read. However, the more I read, the more questions that branch out of my topic which could be progression which could also push me further in my successes of research.

III.

 My research design will include a lengthy process of research to answer the question: How can the life of a sickle cell be increased long enough for new red blood cells to be produced. Key concepts include the life cycle of a red blood cell as well as the formation of a normal and sickle red blood cell. By understanding these processes, it can lead to further research on how to stop the sickling or find out how to extend one of the processes in the life to make the blood cell last longer whether it be a sickle cell or a normal cell. The major variable in this research project will be the sickle cell vs the normal red blood cell. In comparing the two while looking at the key concepts, scientist may be able to analyze how to alter the parts of a sickle cell to help change it. This research can and has produced new research questions out of the larger topic. Questions such as: Is it possible to preserve some cells; how would bone marrow transplants help the advancement of new red blood cell being produced in the body; are among some of the research questions that branch out from the major topic, and in all has supported both my question and research. My hypothesis for my question is that, through research one could find out how to preserve cells as well as use other medicines to possibly unsickle a sickle cell (Breaking Sickle Cell’s Hold on Red Blood Cells). When researching, I used a method in which I researched questions and topics around my question. I researched topics such as the life of a sickle/normal red blood cell; as well as the formation of a sickle/normal red blood cell. When researching these topics it was difficult to find a good article so I started looking at related articles that would help me. The related articles led to new ideas and branched off different questions for my topic; which I then began to research. My biggest limitation in this project is the fact that many scientists have started to use treatments for the disease but it hasn’t become common use due to money, or the fact that it’s still in its experimental stages. By trying to answer this question, I am trying to answer a question that scientist themselves at the moment might not be able to answer considering I am only a high school student with no professional and/or in depth education on hematology, chemistry, and biology. Other limitations are center in research in which many of the documents I come across that may be suitable for my research only give the abstract and require me to pay for the rest of the article. I do not have the funds to pay for every single article that suits my research but requires payment to view beyond the abstract. Despite limitations however, I can make a difference whether it be small or large in the breakthrough in science this research question poses.

IV.

 For the action portion of my senior project, I plan to have a fundraiser for sickle cell research. I will have an event where I can educate others while raising money for the cause. I will have the Red Cross available for giving blood, and all proceedings will go to the sickle cell foundation. It relates to my senior project in that fact that I will be educating people on my research question and the potential breakthrough it could make on finding treatment and/or a cure. Because research isn’t always free, the fundraiser portion will help in funding research. It could also go directly towards the sickle cell patient for medicine or whatever needs the fundraiser can take care of. The action will benefit me for personal reasons, plus the fact that I would have a great satisfaction for educating my community on sickle cell and finding ways I can help. It will prepare me for the future when I decide to create an event for other topics. I will have some experience in the planning process, and therefore, I will be able to use this experience to my advantage. The action will be beneficial to the community in which I will have the opportunity to make people aware who don’t even know about the disease, or the precautions of the disease. It gives the community a chance to act out and support a cause, bringing the community more close together. If they spend time devoted to a cause, the success will be greater in terms of both awareness and funding and could be supportive in leading to further research.

V.

1. Abbondanzo, Susan, MD. Cline, David, MAJ,MC. Lonergan, Gael, Lt.Col, USAF,MC. “Sickle Cell Anemia.” AFIP Archives. Vol. 21. No. 4. July-August 2001. RadioGraphics.Oct.2011. <radiographics.rsna.org/content/21/4/971.full.pfd+html>

2. Acker, Jason. Kanias, Tamir. “Biopreservation of red blood cells---the struggle with hemoglobin oxidation.” The FEBS Journal. Vol.227 Issue 2. Pg.343-356.Jan 2010. Wiley Online Library. Oct. 2011. <Onlinelibrary.wiley.com/doi/10.1111/j.1742- 4658.2009.07472.x/full>

3. “Breaking Sickle Cell’s Hold on Red Blood Cells.” Columbia University Medical Center. Vol.2 No.19. 24 Nov. 2003. Cumc.columbia.edu. Oct. 2011. Cumc.columbia.edu/publications/in- vivo/Vol2\_Iss19\_nov24\_03/index.html

4. Christoph, Garrott W. James, Hofrichter. Eaton, William A. “Understanding the Shape of Sickled Cells.” Biophysical Journal 88.2 (2005): 1371,1371-6. Proquest.Web. 30 Oct. 2011

5. Fischer, Thomas M.(2004) “Shape Memory of Human Red Blood Cells.” Biophysical journal 86.5 (2004): 3304-13. Proquest. Web. 30 Oct. 2011.

6. Hattangadi, Shilpa. Lodish, Harvey. “Regulation of erythrocyte lifespan: Do reactive Oxygen Species set the clock?” Journal of Clinical Investigation. Vol. 117 Issue 8. 1 August 2007. Jci.org. Oct. 2011. Jci.org/articles/view/32559

7. “Malaria and the Red Cell.” Harvard.edu. 2 Apr 2002. Sickle.bwh.harvard.edu/malaria\_sickle.html. Oct 2011

8. Mehanna, A.S. “Sickle Cell Anemia and Antisickling Agents and the Now.” Current medicinal chemistry 8.2 (2001) : 79, 79-88. Proquest Science Journals. Web. 30 Oct 2011

9. Mehta, Satyen. Afenyi-Annan, Arba. Byrns, Patricia. Lottenberg, Richard. “Oppourtunities to Improve outcomes in Sickle Cell Disease.” American Family Physician. 15 July 2006. [www.aafp.org](http://www.aafp.org). Oct. 2011. Aafp.org/lafp/2006/0715/p3003.html

10. Tae-Hoon Lee. Sun-Uk Kim. Seong-Lan Yu. Sue Hee Kim. Do Sim Park. Hyung- Bae Moon. So Hee Dho. Ki-Sun Kwon. Hyuh Jeong Kwon. Ying- Hao Han. Sangkyun Jeong. Sang Won Kang. Hee-Sup Shin. Kyung-Kwang Lee. Sue Goo Rhee. Dae-Yeul Yu. “Peroxiredoxin II is essential for sustaining life span of erythrocytes in mice.: Blood Journal. Vol 101 No 12.pp.5033-5038. 15 June 2011. Blood journal.hematologylibrary.orgOct. 2011. Bloodjournal.hematologylibrary.org/content/101/12/5033.full.html