Introductionwhy people. one of my relative’s have parkinson’s

IntroductionWhy did I choose this question? I have always been interested in the brain and stem cells, as both of these topics are complicated and have a huge impact on modern day society.

The brain is such a complicated organ and it fascinates me how who we are is just a brain in a body, which consists of electrical impulses. However, it is scary to suggest that our very being can degrade – our neurons in the brain can die – this is essentially killing who we are; that's why I think a cure for neurodegenerative diseases such as Alzheimer's is very important. Stem Cells can provide a cure for almost anything; once we have the research and the knowledge, stem cells are very powerful. However, we are still new to the area of stem cells and it could take decades for scientists to unlock their full potential. Alzheimer's is a disease that is very prominent for people of old age. Due to the advancements of medical science, humans are living longer, but this causes a sharp increase in the number of Alzheimer cases to the point where 1 in 85 old people could have Alzheimer's by 2050 (well over 100 million people, currently 35 million).

This is a very serious case and treatment for diseases such as this is vital for people of all ages, as in anyone's future, Alzheimer's is possible. Parkinson's is not as severe as Alzheimer's in most cases, but can still have a large negative effect on people's lives – once again, it is more prominent in older people. One of my relative's have parkinson's so it gives me motivation to learn more about the topic and potential cures, as I know the negative effect it has on people.

About Alzheimer’s DiseaseAlzheimer’s is a neurodegenerative disease of the brain and therefore one of the main causes for Dementia – which is a set of symptoms that is crippling to people of all ages; symptoms such as memory loss, problems with thinking/problem solving and a negative effect on speech can all be caused by Dementia. Alzheimer’s causes 50-70% of all dementia cases – cases like these have no thus far. Other forms of dementia can be cured, so this is why Alzheimer’s is different – there is no known cure, only theories on how it could be cured in the future. The cause for Alzheimer’s is due to the neurons in the brain degrading/dying, also known as a neurodegenerative disease. Brain cells in the brain die, which also contributes to the overall shrinking of the brain and a huge decrease in brain cells.

Furthermore, as a result of fewer nerve cells, there are less connections which prevents us from performing certain tasks or fetching certain memories – this stops us functioning as efficiently. The direct cause of Alzheimer’s is unknown, but there are two main theories that highlights two proteins in the brain. In the deteriorating areas of the brain, two proteins are more concentrated and focussed than the others. One of these is called Amyloid Beta. Clumps of amyloid beta form plaques in the brain – consequently, signals from neurons can be obstructed and it prevents the correct information from being sent properly.

The other protein that could be a cause of alzheimer’s is Tau. This protein is very important for cells to function normally; however, in this case the Tau protein builds up and becomes tangled which prevents the neurons getting nutrition which it needs to function correctly. This can cause neurons to

decay and die. Scientists have also observed that Alzheimer’s disease (AD) brains make less neurotrophins which are also proteins that help neurons grow and survive. Furthermore, Stem Cells don’t only have the potential for curing Alzheimer’s, they can also be used to grow neurons that have the same genetic background as people with AD; this allows the disease to be carefully monitored and valuable data can be gathered. Currently there are no known cures for Alzheimer’s, but there are a few treatments. Some treatments involve drugs such as Cholinesterase inhibitors which treat symptoms such as memory, thinking, language and judgement. The way it does this does not actually stop the disease, but it slows down the process of worsening symptoms.

However, side effects for treatments for Alzheimer’s are quite severe, often resulting in vomiting, dizziness, nausea and many more. They aren’t common, but not many alternate medication can be supplied. There are many risk factors of Alzheimer’s, many of which are uncontrollable. One example of this is age. Everyone ages and Alzheimer’s is especially common in older people. It is the largest known risk for Alzheimer’s; after age 60 the rate of dementia cases is doubled. However, it is possible to develop Alzheimer’s as early as your 30s, as it is not limited by age, only less likely to happen the younger you are.

Genetics also play a big part in the inheritance of Alzheimer’s, especially if a relative that is close to you (also known as a first degree relative), eg a parent or sibling. There are 3 genes that have an incredibly small chance of having a mutation. If this mutation takes place, anyone who inherits these genes is almost 100% guaranteed to develop the disease. However, only 5

percent of the mutations are actually responsible for the disease. The gene that holds the highest risk is called apolipoprotein e4.

However, scientists still do not know what is the consistent cause of Alzheimer's – this gene does not guarantee Alzheimer's. About Parkinson's Disease (PD)Parkinson's is the second most common neurodegenerative disease. It is a long term degenerative disease of the central nervous system. It involves the decreased production of Dopamine in the brain. It is reported that by the time symptoms have been reported, the patient has already lost more than half of their dopaminergic neurons. This leads to a loss of control over muscles, also known as motor function: (https://stemcellres.

biomedcentral. com/articles/10. 1186/scrt37). Twitching of muscle and slowness of movement are both physical effects of PD. Current treatments of PD do not cure the disease, but merely treat the symptoms.

For surviving dopamine neurons in the brain, L-Dopa is supplied to help them convert it into Dopamine. However, this does not stop the inevitable decay of the remaining dopamine neurons (dopaminergic neurons); it only allows more dopamine to be produced so that some movement control can be regained. Eventually, supplying L-Dopa will no longer be effective, as the remaining dopaminergic neurons would have died. However, although PD is commonly affiliated with movement, many symptoms of PD is actually related to mental problems. For example, thinking and behavioral problems may be caused by PD, although it is not a given that it will. Dementia (such

as Alzheimer’s Disease) becomes quite a common condition during the later, more advanced stages of PD.

Furthermore, depression and anxiety can be a result of the disease; according to the webpage: https://en. wikipedia. org/wiki/Parkinson%27s_disease depression and anxiety occurs in more than a third of people with the disease.

Not many people really know the extent that PD affects people’s lives; it is quite a crippling disease and affects many old people to this day. In 2015, 6. 2 million people alone have been diagnosed with PD and out of that number 117, 400 people died due to the disease.

It affects a large proportion of our older generation, so treating it is as important as treating any other disease. Most of the current medical knowledge only allows doctors to treat the symptoms, rather than trying to fix the cause. It is mostly unknown why the dopaminergic start to die in the brain, but genetics and environmental causes can affect the chances of developing PD. If a family member had/has the disease, then there is a higher risk that you will develop the disease. Surprisingly, if you are a tobacco smoker, or drink more tea/coffee, there is a reduced risk of developing the disease. Unknown to some, PD doesn’t just affect movement, it can cause neuropsychiatric disturbances. Neuropsychiatric disturbances can cause problems with cognition (“ the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses” – https://en.

wikipedia. org/wiki/Cognition), mood behavior and thought. These conditions can occur before diagnosis of the disease, so these problems can worsen before you even know if you have PD.

Amyotrophic lateral sclerosis (ALS)https://www. medicalnewstoday. com/articles/281472. phphttp://www. startstemcells.

com/ALS-treatment. htmlALS is another neurodegenerative disease that has gained much publicity and support over the past few years with the “ ALS Ice Bucket Challenge” becoming viral. This disease affects the spinal cord and the brain stem, mostly during adult years. The disease targets the upper motor neurons (located in the brain) and lower motor neurons (located in the spinal cord) which causes paralysis. As for the cause of ALS, it is still unknown, but we still know where the neurons die and why this causes lack of muscular control. Motor neurons provide the connection between muscles and the brain. Many signals for muscle movement are sent along these neurons to the muscles, and from the muscles to the brain.

This can cause motor symptoms similar and worse than PD. An example of someone with ALS is Stephen Hawking. He slowly developed the symptoms over the years, losing his ability to speak, independent movement, and loss of movement with everything below his head.

Parkinson’s is only this crippling in the worst of cases, but ALS also has a higher chance of causing something as crippling as total paralysis. Usually, the patient will not survive longer than 3-5 years after being diagnosed – as there is no current cure for ALS, the main focus for researchers is to slow the progression of the disease and ease the symptoms. What are Stem Cells?

Stem cells are undifferentiated cells in the body. This means that, unlike muscles cells, fat cells etc., they have no job.

Through mitosis, they can divide and produce more stem cells. There are two main types of stem cells: Embryonic stem cells and Adult stem cells. As the name suggests, Embryonic Stem Cells are obtained from the embryo of an unborn child 4-5 days after fertilisation. At this point in time, they consist of about 50-150 cells. The cells are surrounded by the blastocyst – this is destroyed when obtaining the inner cells mass in order to gain the stem cells. This brings ethical concerns as this is essentially killing a potential child.

That is why most Stem Cell research companies mostly use adult stem cells. However, these cells have more potential than any other, so unfortunately, this method of obtaining stem cells cannot be entirely dismissed. Certain rules have been put in place to make sure the retrieval of the stem cells is as ethically balanced as possible.(https://www.

medicalnewstoday. com/info/stem_cell) Stem cells have certain categories that are decided by the number of different types of cells they can differentiate into. This their potential, or potency: Totipoten (all possible cell types)Pluripotent (Almost all cell types, such as embryonic stem cells)Multipotent (closely related cells, such as adult stem cells differentiating into white and red blood cells)Oligopotent (a few different cells)Unipotent (only able to produce cells of their own type)On the other hand, Adult stem cells (somatic stem cells) can be obtained without causing the loss of a potential life – that is why they are the most available and most

used stem cells. Despite the name, adult stem cells can be obtained from both children and adults. In order to retrieve the stem cells, they have to be isolated from a tissue sample from an adult/child. They have the ability to differentiate into a multitude of cells but often have limits to certain sequences of cells in the body (called lineages).

Already, Adult stem cells have been used to treat bone/blood cancers through bone marrow transplants. Something as groundbreaking as this shows potential for the undifferentiated cells; this is why stem cells are a key area of science that holds much potential for treating diseases. How could stem cells help? OverviewTo begin with, the body uses its stem cells as its natural repairal system, so utilising these cells already given to us by nature gives us the potential to cure absolutely anything. Of course, we are nowhere near this stage yet; stem cells are relatively new to medical treatments, but if we can unlock the full knowledge of stem cells, medical science will never be the same again.

Already, we can use stem cells to speed up healing, and stem cells are being researched for cancer, but we still are new to using them. However, stem cells are hard to obtain – the best type of stem cells are found in embryo’s, yet this is seen as morally wrong by a large number of people, so it is not nearly as commonly used as adult stem cells. As mentioned above, stem cells don’t only have the potential to cure alzheimer’s, but they could also be used to grow cells in a lab that have the same genetics of someone that has already developed the disease.

This allows scientists to analyse the change as it happens, which shows them the potential causes and effects of it. Stem cells can reproduce themselves many times. This is useful to us are we are able to gain a significant amount of data rather than just one or two individual cells. From one cell, hundreds of cells can be created. Stem cells are undifferentiated cells, therefore they can differentiate into any cell needed in the body; this is why an embryo is mainly stem cells, because they need to form everything in the body. A type of cell called iPSCs are used in this method.

iPSCs (pluripotent stem cells) are taken from an ordinary cell in the body and changed back into a stem cells. These stem cells can then be manipulated to change into any cell in the body, for this example, brain cells. So by using these cells, they take the affected adults cells and convert them into a new cell type to understand the disease better and get valuable data. The good use of adult stem cells is that they have no ethical concern. The best known type and method of gaining good stem cells is taking them from an embryo.

They can differentiate into any type of cell, but many people are against the use of these cells because they are taken from what is essentially an unborn baby. Many religious people are against the use of these cells because they see it as murder; therefore only one stem cell research program is supported by the Alzheimer’s society. Furthermore, study in animals doesn’t give the same results as using human stem cells to provide research, as symptoms specific to certain people may have certain causes and these causes cannot be analysed in animals.

iPSCs are the main form of research for Alzheimer’s today. It is a big step to using stem cells in complicated medical research. Alzheimer’s DiseaseTo actually use the stem cells to aid Alzheimer’s directly, scientists could allow the stem cells to travel into the multiple areas of the brain where the damage/decay is. The damaged or lost cells could be produced by the stem cells to replace them. However, whilst actually growing the correct cells is part of our current scientific knowledge, implementing them into the brain to replace the broken connections of the complex network isn’t yet part of our capabilities.

Many scientists believe that the patients will not directly be helped by stem cells but benefitted in a different way before our knowledge of stem cells has reached that of stem cell transplants. A possible cure for AD would be to use stem cells to grow neural stem cells. These could be used to produce and implement neurotrophins into the brain, which as mentioned before, is in low production in the brain of damaged brains; maybe by using stem cells to produce these neurotrophins we could keep the current neurons alive and well. An example of this working is injecting the neural stem cells into mice which have the same key symptoms of memory loss and dementia. These mice showed improvements in memory but it is too early to start human trials, so more research is needed. Additionally, a study conducted in July of 2014 (https://www. medicalnewstoday.

com/releases/279554. php) showed that the use of mesenchymal stem cells (which are multipotent stem cells, see descriptions above) can stimulate neurogenesis in the brain of a rat or mouse. Neurogenesis (https://en.

wikipedia. org/wiki/Neurogenesis) is a process by which the CNS (central nervous system) cells are produced by the neural stem cells. This would be good for someone with a neurodegenerative disease, as the overall cells are dying, not being produced. This increased production of cells would improve tissue and function in the brain. Parkinson’s DiseaseParkinson’s however, shows more promising results from the use of stem cells and is the first probable neurodegenerative disease to be treated with stem cells.

https://hsci. harvard. edu/parkinsons-disease-0 – Scientists have been able to generate brain cells with stem cells to produce dopamine. These stem cells were collected from the patient’s skin cells, so it is ethically sound, because no life was lost, unlike using embryonic stem cells. In order to do this, the scientists biologically re-programmed the skin cells into the induced pluripotent stem cells (iPSC’s) – using these cells, they were then able to guide them to become dopaminergic neurons.

Creating this allows for a study of disease outside of the body, rather than studying it from the outside. This allowed the scientists from Isacson’s lab to start finding out compounds that could treat the disease symptoms in the cells from people who have Parkinson’s. Furthermore, the HSCI scientists are researching how to replace the neurons in the PD affected brain and have found out that one of the abnormalities within a PD affected cell is caused by the incorrect folding of proteins in the cell. It was found out that the abnormalities could be reverted with genome editing (gene therapy, by changing the genes of the patient). Another study from 5 September 2017 last year: (https://www.

medicalnewstoday. com/releases/319279. php), reports that Monkeys with Parkinson’s disease showed positive reactions following treatment with human stem cells. Whilst this is not on the level of human trials, this is a huge step for the use of stem cells for the treatment of PD.

This is one of the last trials used before using humans to test a drug/cure. This shows that if successful, stem cells could change people’s lives. Over a time period of 2 years, monkey’s transplanted with neurons from human iPSC’s, showed a noticeable improvement. Many studies have been conducted where the conclusive result showed that stem cells from fetal tissues can control the disease, yet once again it is ethically questionable, so scientists have been striving to use adult stem cells to gain a similar, if not identical result. Here, it was found that by using adult dopaminergic neurons (DA) it would gain the same substantial result as one from fetal tissues. Furthermore, the same group used another study to figure out a way to improve the survival of the transplanted cells. This is almost as important as finding working cells; the cells must get to the affected area without dying. For this to happen, antigens called human leukocytes (HLA) must match in the patient’s body and the implanted cell to prevent the tissue from being rejected.

This means less of the immunosuppressant drugs need to be used in coordination with correct HLA antigens. In the test performed, the monkey equivalent of HLA was tested to provide evidence for this hypothesis. Amyotrophic lateral sclerosis (ALS)A website known as http://www. startstemcells.

com/ALS-treatment. html claims that by using stem cells for ALS, many qualities of life can be improved and muscular functions can be aided. By using the patient’s own stem cells, the release of neurotrophic substances are increased. These substances help protect the neurons in the brain.

In this case, the motor neurons (movement neurons) are protected against damage, therefore slowing the progression of the disease, whilst making the neuromuscular connection stronger and more responsive. Following this treatment, the patient’s life is extended and symptoms of the disease are decreased. This includes limb movement increase, increased swallowing control, more controlled pronunciation and muscle tension decrease. In the procedure of the “ Swiss Medica Clinic”, they administer 200-300 million cells into the body.

Unlike many operations and drugs, this is painless and quick, therefore the need of general anesthesia is not needed. Improvements are seen within the next 2-4 months (A quick recovery). Furthermore, they claim that the cells don’t only improve the symptoms, but they reverse them as well. https://edition.

cnn. com/2016/06/29/health/als-stem-cell-research/index. htmlHowever, in a news article linked above, a case study showed that whilst the stem cells can improve the conditions of many people, it can also have no effect, or even a negative effect.

This is why the search for a cure is so hard – certain treatments work for certain people; whereas the same treatment may even worsen the conditions of another. http://www. jpost. com/HEALTH-SCIENCE/Israeli-

developed-ALS-treatment-reversing-motor-decline-breakthrough-507678Conclusion