

Brain cooling as a potential treatment for stroke essay



Stroke contributes highly to the number of deaths and disability worldwide, current treatments are to treat the source of the clot or to administer treatment for a Hemorrhagic stroke but still the rates of unrecoverable brain damage occurring is high. However new research is being carried out into the effectiveness of Brain cooling as a potential procedure. Will this treatment be worthwhile and more effective than the current treatments?

The Problem Every year approximately 150, 000 people in the UK suffer a Stroke [6].

It is the cause of 53, 000 deaths in the UK alone [6] and is one of the leading causes of disability worldwide [1]. A stroke occurs when the flow of blood to the brain is prevented or highly restricted. The most common cause of the stem of blood flow to the brain is blood clots closely followed by aneurysms in the veins. The restriction of blood reduces the amount of oxygen available for the brain cells and the oxygen starved tissue becomes damaged [7]. The diagram to the left shows how a blood clot in a blood vessel can lead to a stroke. It shows how the vessel which is supplying blood to the brain becoming blocked by a blood clot.

The arrow in the diagram indicates that the blood is no longer able to travel up the vein and so it forced to stop and be pushed backwards. As the blood is no longer able to pass through the vessel to the brain an area of the brain becomes deprived from oxygen. The diagram shows the area of brain that will be damaged due to this clot by shading a lighter area around where the blocked vessel leads. If the brain is starved from oxygen for up to 60 to 90 seconds then it is prevented from functioning. If this restriction of oxygen continues, after about 10 minutes the damage cannot be reversed [1].

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A significant proportion of people's lives are affected by stroke and a large amount of the health care budget is spent on treating stroke and its aftermath. Current treatments can effectively unblock the clot and restore the oxygen supply to the brain. However they have to be administered within 3 hours of the stroke onset. This creates a problem where sometimes the stroke is not treated fast enough and more damage is caused. For these reasons it is essential that there are advanced treatments that are both effective and efficient to treat stroke and that provide a bit more time in which the doctor can help. The solution

One potential treatment which researchers are paying special attention to at the moment, is the possibility of using brain cooling (induced hypothermia) as a possible treatment for strokes. This would involve intentionally lowering the temperature of the brain by a couple of degrees below normal body temperature to about 33-35° C, by using ice cold intravenous drips to cool the patients entire body or another technique to put the brain into a state of hibernation. [2] Allowing the brain to survive and to continue functioning with a lower supply of oxygen, reducing the damage that the limited flow of blood is causing.

While the brain is in a state of induced hibernation doctors would be given more time to detect and resolve the cause of the blockage or burst of the blood pressure. The picture to the right from the BBC shows the brains temperature being lowered. You can see the area of brain in which the stroke is occurring which appears as a bright orange area on the scan. It also shows where the brains temperature has been decreased, as it is slightly lighter

than the average scan, and is beginning to cool down the damaged area. The cooling of the brain is slowing down the rate of damage.

It is claimed by Dr Malcolm Macleod, who is the head of experimental neuroscience at the Centre for Clinical Brain Sciences at the University of Edinburgh, that “ Every day 1, 000 Europeans die from stroke – that’s one every 90 seconds – and about twice that number survive but are disabled. ” He claims that the from research he has taken part in, into the potential of brain cooling as a treatment for stroke, this type of treatment could lower these figures by improving the chances of an estimated 40, 000 Europeans yearly. 2] Hypothermia is a potential treatment already used in the treatment of other health issues, such as the use on babies who have been starved from oxygen at birth and also potentially for patients during cardiac arrest if their heart stops beating. Research into these other sectors has shown a significant efficiency and is already being use to treat newborns. Two major clinical studies that are currently taking place into this potential source of treatment are; the Europe-wide research in which over 20 countries are aking part, and also the American study involving researchers from the University of California, San Diego School of Medicine, the University of Texas, The Houston Health Science Centre, and Cedars-Sinai Medical Centre Los Angeles, so far this research is in the initial phase has not published any data but there is still great confidence that it will be successful. This confidence is partially due to a preliminary study on the effects of induced hypothermia on the oxygen consumption of the brain [8].

In 2001 a paper was published by scientists Yan Ji, and Jing Liu, titled “

Preliminary study on the oxygen consumption dynamics during brain
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hypothermia resuscitation". It showed how by using the volumetric cooling the oxygen consumption rate in the brain could be significantly reduced; the study researched two methods, volumetric cooling and surface area cooling. The data collected showed that surface area cooling as a technique took too long to have any significant effect. However when they collected the data for volumetric cooling they discovered a much different outcome.

They found that the data showed that when the normal average brain temperature is reduced from 15 °C to 5 °C, the average oxygen concentration decreases by 46% at first and then by another 15% 20 minutes later. The graph on the bellow, published in the paper shows how the concentration of Oxygen measured in the patient's brain is a considerably higher when the temperature of the brain is kept at 5°C (figure A) compared to being kept at a constant 15°C (figure B). It also shows how the induced hypothermia causes the rate of oxygen depletion in the brain to also be a lot slower than at its normal temperature.

This data gives hope to further medical studies in using brain cooling as a potential technique for treating problems in the cardiovascular system including stroke. This is because it provides data that the oxygen consumption rate can be lowered, making brain cooling an appropriate treatment for stroke. It shows that the patient's brain can continue to function with a limited supply of oxygen, therefore during a stroke when the brain has a deficiency of oxygen the patient should be able to survive for longer. Purely because the concentrations of oxygen when using brain cooling can remain high enough for a longer period of time.

Europe study: They are currently planning for a trial that will involve 1, 500 stroke patients across Europe [2]. This is a very large sample size which greatly increases reliability as it reduces errors and helps to highlight outlying results. It also means that the data is high in population validity as it is very likely that a large number of different European ethnicities will take part meaning that the data collected can be generalized all across Europe. Due to the nature of the research it will also be possible to generalize the results world-wide as the human anatomy is the same across the human species.

Also by using scientists from all over Europe it means that much more research can be done at once, as there will be a greater man power and available apparatus. It may be easier to look at different components in more depth as different scientists will spot and discover different components and will have the option to study it in more depth without disrupting the research due to the large amount of people taking part. The technique that they are planning to use in order to induce the brain into a state of hyperthermia involves using ice cold intravenous drips to cool the patient's entire body. 2] This should lower the brains temperature to a couple of degrees below the average temperature in order to reduce the damage being inflicted. The trial will take place by a number of clinicians across Europe. The fact that the study is being carried out in a number of places by a number of different people will check the reliability of the method, as it may end up showing that the procedure cannot be accommodated for in other places or that the procedure is not replicable. It will also help check the reliability of the data as

each clinician will follow the same procedure so in theory they should accumulate the same results.

By seeing if they all do accumulate more or less the same data will help to calculate how reliable this research is. The American study: They are also planning trial which will involve 400 participants over a three and a half year period [3]. Although this is a smaller sample size than the European study it still is a large enough sample to produce reliable results. A large sample size increases the reliability of the study as it reduces the chance of random error and variation. In all biological tests there is slight variation between all participants of the human species.

What works for one person may not work for another. As the sample size is quite large then the results from the study can be generalized to the wider population as the chances are the variation in reactions are likely to be repeated among the wider population. The proposed American technique, unlike the European technique, involves lowering the patient's body temperature to 33°C instead of 35°C, not by using a drip but by the technique of endovascular cooling, using a machine called an InnerCool (demonstrated in the picture to the left).

This is an advanced temperature modulation system. It cools the body temperature by allowing rapid heat exchange between the body's core temperature and the inserted Catheter. It also allows a higher level of control and precision when reaching and maintaining the desired temperature. The picture to the left shows the InnerCool apparatus at use. The display is used to control the temperature and the tubes allow cold water to circulate

through the catheter to control the bodies' temperature, at the groin and below the heart.

During this procedure they intend to insert a catheter into the vena cava vein, in which a Liquid with the temperature of around 4? C is circulated around. To avoid the body feeling cold researchers trick the body into believing that it is warm by covering the patient in a warm blanket while the cooling is taking place. The patient also receives a mild sedative in order to prevent shivering. The entire procedure takes about 36 hours. The first 24 hours the body will be cooled and in the final 12 hours the patient will go through the gradual process of heating up [3]. The trial will be a single-blind clinical trial [3].

This means that only the doctors will know who is receiving the new treatment and who is not. Therefore the placebo effect will be reduced; as the patients will all believe that they are receiving the same treatment so will all mentally believe that they are getting better even if they are not. The trial will also be randomized [3], this reduces the chance of investigator bias, as the participants will not be favourable selected. This ensures that the data collected is not unintentionally biased towards a certain population therefore meaning that they can be generalized.

However even though the participants are selected randomly they do have to meet a certain criteria in order to take part. They have to be within a certain age, the procedure must be administered within 3 hours of the stroke occurring, they must all have received intravenous injection of tissue plasminogen activator as medication, and must all meet the medical criteria.

This is good as it attempts to reduce the number of confounding variables that may affect the outcome of the results.

By controlling these variables it increases the validity of the findings as they are more able to claim that it is indeed the treatment itself and not the confounding variables that is producing the said data. A final positive criticism of this trial is that it is a multi-centred trial. This means that the procedure is being carried out by a number of different doctors, so the reliability of the procedure can be tested, and it will improve the reliability of the data if all of the findings are corresponding. Is this solution appropriate?

This is an appropriate solution firstly because it solves one of the major problems with the current treatments which is that they have to be administered within 3 hours of the stroke occurring, which in turn puts doctors against the clock. Which increases the chance of permanent injury due to the fact that doctors often can't get to patients in time, and that some of these 3 hours has to be used to detect the source giving them even less time to reduce the damage. However by adopting brain cooling as a method of treatment the doctors will have more time to treat the stroke.

This is because it allows the concentration of oxygen in the brain to remain high enough for the brain cells to function for longer. Giving the doctors a longer time interval between stroke onset and significant damage meaning the risk to the patients will be lowered. Secondly Stroke is a leading killer worldwide, therefore it is important to develop new treatments and to do further research into it, so that a greater understanding of the mechanics triggers and prevention of stroke can be discovered. This research is a vital

step in the processes of medical treatments of cardiovascular diseases becoming more advanced.

This research could not only provide a more efficient treatment but it could also increase the scientific knowledge of how the brain functions, leaving it open for further medical advances. Which could potentially lead to an improved quality of life for millions of people across the globe. Also the preliminary data shows that there is a genuine fundamental evidence for the belief that Brain cooling will work as an effective treatment for stroke victims which means that it is more likely to produce successful results.

It provides evidence for the fact that brain cooling slows down the rate of oxygen loss in the brain. A stroke is caused by a lack of oxygen to the brain cells which leads to cell death. If there is more oxygen present for longer then the brain should survive for longer and less damage could be caused. Another reason why this solution is appropriate is the size of the study taking place means that it should be possible to perfect the technique due to the vast amount of resources and funds available. Implications of the solution

Social: Socially the impacts of the solution if the results of the research are positive are great. Stroke is one of the biggest causes of death and disability world-wide [1]. This does not only affect the victims of stroke but also their family. After a stroke a lot of victims are no longer able to work. This puts a major financial strain on themselves and also on their families. Within a matter of minutes they go from having a decent income to support themselves on to being physically unable to complete the job needed to provide them with this income.

This can be very distressing if they were the main bread winner of the family or if that money was heavily relied on. Also if the person highly enjoys their job then it can be very upsetting to have to give it up unexpectedly when previously it made them happy. Secondly after a stroke victims need special care. This may fall on to a friend or a member of family who may unwillingly have to take up the role of being a carer. For example Jane Gap, to the left, had to give up her work to become a full time carer when her daughter Sarah became severally disabled after having a stroke, at the young age of 22.

Being a care giver can be a very stressful role. They may have to give up their jobs or free time, as Jane Gap did, and depending on how severe the stroke was may have to look after someone who is fully dependent on them. This could be both physically and emotionally draining on the carer who could end up also suffering as effect of this sudden change. A final social problem of stroke is the loss of independence that the patient suffers. Stroke can occur at any age, from young children up until old age.

This can immensely limit the number of opportunities that a person is open to, including leisure activities, sports, academia and just general daily tasks. However due to this new research the recovery rate for stoke victims could greatly increase; meaning that with this new procedure stroke could carry a much lighter social impact. Dr Malcolm Macleod, head of experimental neuroscience at the Centre for Clinical Brain Sciences at the University of Edinburgh, when interviewed for an article by the BBC quotes “ Our estimates are that hypothermia might improve the outcome for more than 40, 000 Europeans every year. This estimate means that less people who <https://assignbuster.com/brain-cooling-as-a-potential-treatment-for-stroke-essay/>

actually suffer a stroke, approximately 40, 000, will have to give up on their way of life so drastically and that having a stroke may become less of a life altering event. It also means however that on top of this, tens of thousands of other Europeans could also benefit, as the friends and families of these stroke victims may no longer have to give up a lot to become a carer to their loved one. Improving the living quality of many. Making it a highly beneficial solution.

Economic: One economic disadvantage of this new research is that clinical research studies are asserted with extremely high costs. One of the major issues with this sort of research is will the benefits outweigh the financial risks? If the research is carried out and it turns out the procedure does not work or is not cost effective then a lot of money will have been wasted. For this reason organizations are wary or what studies they will back financially. Developing new treatments can be a long and costly process.

According to figures from the Association of the British Pharmaceutical Industry (ABPI) website, on average in the year 2003 the cost of developing a new medical treatment in the UK was about ? 500 million and took around 10-12 years [5]. This gives us a rough idea of how much it would cost and how long it would take to carry out this study. However as this is just the cost for a trial taken out in the UK we can expect research currently being carried out would entail a much grander cost. This is because it is a Europe wide study which indicates that it may be being done on a much larger scale.

To afford these financial requirements researchers rely on grants from different organizations and companies. The American study is being funded

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through two different grants both from the National Institute of Neurological Disorders and Stroke (NINDS); they are also relying on equipment such as the cooling machines and catheters to carry out the research, being provided from the outside company Philips /Innercool on temporary loan through an established agreement. And the Europe study is being funded by different scientific organizations and charities across Europe.

However although the costs are high Dr Schwab, one of the scientists taking part in the European study said: " We know the financial situation is difficult, but based on current evidence, the personal and economic benefits of avoiding stroke related death and disability means that the trial would pay for itself in less than a year. " [2] If this turns out to be true then the research being carried out would have been a great economic investment and could end up making health associations money to develop newer treatments.

Also this solution could have other economic benefits such as less people claiming unemployment and disability benefits after a stroke as potentially less people will be left significantly disabled after a stroke. Also the cost of the aftercare treatments may be less as, as of result from a greater recovery rate there will be less significant injuries to treat so less rehabilitation and long term will be needed saving a lot of money in after care.

Altogether this would indicate that the benefits of the doing the research would outweigh the economic risk of investing such a large sum of money. This is because there is firm evidence to believe that the process will work as it has received a number of grants from well respected scientific

organizations. To get these grants they would have had to present their ideas to leading scientific organisations and prove that the research will provide a good outcome after trials.

If the research wasn't likely to be beneficial they would have never got the grants in the first place. Also the current predictions made, show that the research will pay off itself in very little time meaning that after it has been paid off it will be saving the economy money and/or bringing in a good profit, so although it is a very large amount of money there is an extremely high chance that it will be a good investment that will end up paying off. The alternatives There are currently a number of treatments/procedures being used to treat stroke victims.

The alternative of doing this research is to use one of these two alternative techniques in order to remove the cause of the limited blood flow. Firstly alternative one is to use treatments to remove a blood clot. This procedure involves the use of an intravenous injection of tissue plasminogen activator. This medication is known as a "clot-busting" drug. It is used to break up and remove or to reduce the initial size of any blood clots which may be restricting the flow of blood to the brain. In order for this treatment to work it must be carried out within 3 hours of the initial stroke occurring [4].

However if the treatment can not be administered within 3 hours then a catheter can be inserted directly at the site of the clot and a "clot-busting" drug can be administered straight onto the blood clot allowing it to be broken up. In order to navigate the catheter to the correct spot without causing more damage an x-ray is taken and used. [4] A second alternative

treatment to be would be to administer treatment for a Hemorrhagic stroke. A Hemorrhagic stroke is caused by ruptured aneurysms in the artery.

Blood loss through this rupture stems the flow of blood to the brain and causes a stroke. This treatment involves using a technique called embolization. During this process the doctor's work to clot or close the vessels rupture by injecting an embolizing agent in to the desired place. They find the rupture in the artery again by also using an X-ray to navigate the catheter to the site [4]. This treatment is especially good as it can also be used as a pre-treatment, by sorting out an aneurysm or AVMs prior to them rupturing [4].

This means that there will be a significantly lower chance of a patient having a stroke if either of these symptoms which are considered causes of a stroke and treated before there is chance for one to occur. Bibliography Source one [1]: Gittens. B and Subramaniam. N. 2010 " Brain on Fire, in the Biological sciences review volume 23, number 1". Page 42. Source two [2]: BBC. January 2011, " Brain cooling could aid stroke recovery" available at <http://www.bbc.co.uk/news/uk-scotland-12261728> (accessed 25/02/11) (Also source of figure two)

Source three [3]: Kim Edwards, December 2010, " Largest Study of Benefits of Brain " Cooling" After a Stroke Now Underway" available at <http://ucsdnews.ucsd.edu/newsrel/health/12-07Cooling.asp> (accessed 25/02/11) Source four [4]: Society of interventional radiology, (frequently updated), " Non-Surgical Procedures Open Blocked Arteries to Prevent and Treat Stroke" available at <http://www.sirweb.org/patients/stroke/> (accessed <https://assignbuster.com/brain-cooling-as-a-potential-treatment-for-stroke-essay/>)

28/02/11) Source five [5]: ABPI, October 2003, "clinical trials- developing new medicine" available at http://www.abpi.org.uk/publications/briefings/clinical_brief.pdf (accessed 10/03/11) Source six [6]: The stroke association, "Facts and figures about strokes" Available at http://www.stroke.org.uk/media_centre/facts_and_figures/index.html (accessed 10/03/11) Source seven [7]: 2005, Salters-Nuffield Advanced Biology for Edexcel AS Biology, "The consequences of atherosclerosis" page 16, Harlow, Essex, A Pearson company Source eight [8]: Ji, Y. and Liu, J. (2001) "Preliminary study on the oxygen consumption dynamics during brain hypothermia resuscitation".

IEEC International conference, vol 23, pp 3-4. (Also source of figure 3) Figure one: Diagram of a blood clot forming http://www.somebodycares4u.com/recognize_a_stroke.htm Figure four: Picture of the InnerCool machine http://www.newscenter.philips.com/main/standard/about/news/press/20090715_innercool.wpd Figure five: Picture of Sarah Gap (stroke victim) <http://www.couriermail.com.au/news/queensland/stroke-victim-sarah-gapp-to-sue-ambos-royal-brisbane-hospital/story-e6freoof-1225832526180> Evaluation of sources

Source one [1]: Gittens. B and Subramaniam. N. 2010 "Brain on Fire, in the Biological sciences review volume 23, number 1". Page 42. This source is from a Biological science magazine which means that the information in it is going to be relatively reliable, as it is specifically designed to present scientific data in a readable format. The information that I have selected from this source is a fact agreed widely among the medical profession.

Showing that a lot of experts believe it to be true giving it a higher reliability. <https://assignbuster.com/brain-cooling-as-a-potential-treatment-for-stroke-essay/>

The article that the data was selected from an article written by the University of Manchester, which increases the reliability of the information as it is from the University of Manchester which is a credible university with a good reputation therefore are not likely to publish false information. Also after cross referencing the information used from this article with other medical journals from The Merck manuals online I would conclude that the information used from the source is high in validity as other medical journals contain very similar information.

Source two [2]: BBC. January 2011, " Brain cooling could aid stroke recovery" available at <http://www.bbc.co.uk/news/uk-scotland-12261728> (accessed 25/02/11) This I believe to be a relatively reliable source as it is from the BBC news website, which is considered to be a quality newspaper whose information is generally creditable. However as it is from a media source there is the potential of there being some marginal bias. This is because they may choose to portray their view points of the topic through the article.

The information that I have selected from this source is based on an interview with Dr Malcolm who is one of the leading scientists involved in the European study. This means that the information I have selected is from an expert in the research. Therefore I believe that it makes the source more valid as he knows what he is talking about and has taken part in the research, and has seen the data and knows a lot of the facts about the subject first hand.

Although there is no indication of the author of this article, it is a report based on scientific information so there is little room for personal opinion

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which would have increased the chance of biased information being given.

For these reasons I would conclude that it is a relatively reliable source

however it may have been simplified so that it could appeal to a large

audience. Source six [6]: The stroke association, " Facts and figures about strokes" Available at [http://www. stroke. rg.](http://www.stroke.org)

[uk/media_centre/facts_and_figures/index. html](http://www.stroke.org.uk/media_centre/facts_and_figures/index.html) (accessed 10/03/11) I think that this is a valid source as it is from an organisation that focuses on stroke, its causes, symptoms, treatments and after care. Therefore they are very likely to be quite up to date about the research into stroke and will have relevant data. However it uses a collaboration of a number of different sources to provide its facts and figures, and also does not indicate in which years the information was gathered.

This means that some of the data on the website may no longer be current therefore it is not possible to say that the information gathered in the report is completely current, and may come from biased sources. This decreases the reliability of the source and the potential accuracy of its data.

----- Figure five: Stroke victim Sarah Gap left disabled aged 22 with her mother Jane. Figure one: Diagram from somebodycares4u website
Figure two Figure four