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1. Introduction

Tourette's Syndrome (TS) is a neurological condition characterised by motor deficiencies and tics. Tics are muscle contractions that can take place in two different forms: motor tics or phonic tics (Piedmonte, Andreani, et. al, 2012). This clip, taken from the show, "A Current Affair", a program shown on the popular Channel Nine investigating current issues and news stories around the world, is titled Tourettes's Syndrome Surgery and DBS Surgery, presenting the audience with two males living with TS. Tyler experiences screaming, twitching and convulsing to the point where every day functions are difficult for him. Stuart, another male with TS, developed a snorting habit and head jerks when he was just eight years old. Both of these men can no longer partake in normal daily activities, such as driving a car and working, so they undergo Deep Brain Stimulation to try and offset these neurological symptoms. This particular clip is of interest to our group due to the neurological treatment of Tourette’s Syndrome: Deep Brain Stimulation. Deep Brain Stimulation is one major treatment for TS and we wanted to explore the advantages and disadvantages of this particular treatment and other potential treatments for TS. With this extensive procedure, two electrodes are placed into the brain with two batteries placed in the chest to maintain a continuous electrical current within the brain.

2. Context

2.1 Tourette's Syndrome

Tourette’s Syndrome, usually abbreviated as TS, is a neurodevelopment disorder associated with symptoms such as tics or other behavioural problems. Patients with TS usually experience signs of other mental-behavioural disorders such as obsessive-compulsive disorder and attention-deficit/hyperactivity disorder (Bronfeld and Bar-Gad, 2013). Figure 1 represents the overlapping neurological symptoms associated with TS and shows how TS is associated with many different disorders, rather than just a single symptom. The exact prevalence of Tourette's is unknown but estimated, by the Tourette's Association of Australia, to be
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1 in 200.

Figure 1: http://schoolworkhelper.net/tourette-syndrome-causes-symptoms-treatment/

Even though the direct cause of TS is still unknown, our study suggests that a dysfunction in the dopamine system in the brain causes tics in a patient with TS (Boone et al., 2012). Dopamine is a neurotransmitter located in the brain that is responsible for emotions, cognition, and movement. Figure 2 shows an illustration of dopamine (located at the pre-synaptic space where it will travel across the synaptic gap to reach the dopamine receptor and have a profound effect on the body. Since movement is an aspect that is controlled by dopamine, it is evident in patients with TS that an imbalance in this neurotransmitter is the cause of tics. It is apparent that dopamine levels are involved in TS because most drugs that target the symptoms of tics function with dopamine levels in the brain. These pharmacological drugs block the D2 receptors which have been shown to decrease tics in a patient (Boose et al., 2013). There are two types of tics: phonic or motor. Tics are characterized by “sudden, rapid, non-rhythmic, recurrent, and mostly involuntary behaviors” (Boose et al., 2013). Another known cause of TS is abnormalities in the prefrontal cortex, thalamus, and the basal ganglia. These particular structures are responsible for the communication between the different parts of the brain that are in charge of motor and phonomotor functions. The basal ganglia (BG) are a group of neurotransmitter nuclei associated with motor and motorized functions that have been linked with motor tics in patients with TS (Bennet and Bar-Gad, 2013).

Figure 2: http://whyfiles.org/225drug_receptors/index.php?g=4.txt

One disturbing symptom of TS is known as Non-Obscene Socially Inappropriate Symptoms (NOSIS) which can include an array of socially unacceptable behaviors such as yelling out loud or even yelling “bomb” in an airport (Siddiqui and Curran, 2013). This, including many other symptoms of TS, cause a person to experience social withdrawal and stop them from going out in public.

2.2 Deep Brain Stimulation

Deep Brain Stimulation is a therapy that involves the surgical placement of electrodes, under anaesthetic, at specific neuroanatomical sites (placement depends on the condition being treated), which are attached to pulse generators implanted under the skin in the sub-clavicular region. Correct placement is found using an MRI and micro-electrode recordings. Once placed, the electrodes give continuous stimulation at adjustable voltages, pulse widths and frequencies. The placement is bi-lateral and reversible, either through discontinuation of the stimulation or by removal of the electrodes and generators (Cannon et al., 2012). In recent decades it has been used as a treatment for various movement and psychological disorders. These
disorders include Tourette's Syndrome, Parkinson's Disease, Anxiety Disorders and Depression. The invasive nature of the treatment has meant that it has been reserved for patients suffering from severe symptoms and for those who have not responded to pharmacological therapy or psychotherapy (Cannon et al., 2012).

Deep Brain Stimulation has had promising results in the treatment of patients that have otherwise been unresponsive to other treatments in all of the fore-mentioned disorders. It is becoming a routine treatment for Parkinson's Disease, with remarkable improvements shown in motor function and quality of life (Breit et al., 2004). It has been used successfully in 50-60% patients with highly refractory depression with minimal side-effects and long term stability (Schlaepfer et al., 2013). Improvement in mood and anxiety symptom severity has occurred within minutes of Deep Brain Stimulation being turned on in OCD patients (Koning et al., 2013).

As of 2012, 63 patients had received DBS for the treatment of Tourette's Syndrome, with 59 (93.6%) showing moderate to high reduction in their tic activity. Nine different areas of the brain have been stimulated with the most success being found in the stimulation of the Globus Pallidus Interna. This subcortical brain structure is part of the Basal Ganglia core and is found at the base of the forebrain. The stimulation of this area has shown a 78% reduction in tics. This is hypothesised to be because the stimulation modulates the basal ganglia-thalamo-cortical loop. This neuronal circuit is thought to be where the defect that causes Tourette's Syndrome lies and plays a role in controlling motor function. Results were better in the anteromedial BGT compared to the posterolateral BGT (Cannon et al., 2012).

In one study, 10 out of 11 patients (91%) with retractable Tourette's Syndrome treated with DBS in the Globus Pallidus Interna, showed reductions in the number, severity and intensity of tics within 1-3 days after surgery. They also reported an increase in their quality of life score and lessening of co-morbid OCD and depressive symptoms (the latter thought to be because of reduction in tics, not because of DBS). Only one reported worsening of symptoms and eventually discontinued treatment. In the long term, no fatigue or tolerance was reported and patients reported a reduced need for medication. Although no-one was tic free, this study provided evidence for DBS being a safe and long term effective treatment for Tourettes as well as co-morbid OCD and Depression. The authors did suggest that further larger, double-blind studies were needed and, although there were minimal negative side effects reported in this study, close supervision is needed after DBS because of known correlation with increased aggression, suicidal thoughts, increased anxiety, depression, hypomania and stroke (Cannon et al., 2012).

In another study by Ackermans et al. (2006), the Thalamus as well as the GPI was found to be a successful area of stimulation in the treatment of Tourette's. It has been hypothesised that DBS works by blocking de-
polarisation by inactivating voltage gated ion channels, reducing hyperactivity in the Subthalamic Nucleus within the Basal Ganglia and internal segment of the Globus Pallidus (the circuits involved in both Tourette's and Parkinson's Disease) (Breit et al., 2004). It is also hypothesised that DBS normalises hypercortisolism by modulating the Hypothalamic-pituitary-adrenal axis, thought to be responsible for many OCD symptoms, often found in patients with Tourette's (De Koning et al., 2013).

Studies have suggested that DBS, though expensive, is a cost-effective treatment in the long term, when compared to the cost of long term medication costs. Battery life had the biggest impact on cost, therefore increasing battery life would reduce the cost of DBS considerably (Dams et al., 2013). Although these studies have been done in relation to Parkinson's disease, we can assume the cost effectiveness would be similar for Tourette's, as they are both chronic movement disorders requiring ongoing medication.

In summary, DBS is a reversible therapy reserved for intractable cases of several movement and psychiatric disorders, including Tourette's Syndrome. It has had promising results in the reduction in number and severity of tics in Tourette sufferers, particularly when electrodes are placed in the Globus Pallidus Interna. This is thought to be because it modulates the Basal Ganglia-thalamo-cortical loop, the circuit thought to contain the defect responsible for Tourette's. Although an invasive therapy, it is proving to be a safe, long-term therapy for Tourette's as well as other co-morbid illnesses, such as Depression and OCD, reducing the need for medication and improving quality of life.

2.3 Other Treatments

Not all patients that suffer from TS have to deal with tics that prevent them from living a normal life and, therefore, treatments are undertaken only when a significant impairment is observed. It is important to state that no part of the treatment results in a complete elimination of the tics, but rather reduces them to a bearable degree. In general, the treatment of TS can be classified into three types: Behaviour Therapy, Pharmacological Treatment and Deep Brain Stimulation, whereas the latter one is only done when the first two were unsuccessful (Srour, Lespérance, Richer, & Chouinard, 2008). An important part of behaviour therapy is Habit Reversal Training (HRT) (Fig. 4) which is made up of awareness training as well as competing response training. Many patients feel a local, unpleasant sensation that occurs right before a tic and lessened as soon as the tic is performed. Thus, a negative reinforcement cycle develops and the patient's answer to the urge becomes impulsive. The awareness training focuses on the sharpening of the patient's senses to the premonitory sensation that helps them to detect the tics at an early stage. The following competing response training aims to teach how to innervate an antagonistic muscle in order to execute a competing response that is incompatible with the tic and less obvious (Hwang, Tillberg, & Scahill, 2012). Another method of behaviour therapy is specialised on the suppression of tics. In the Response Prevention Training, patients learn how to hold back their tics. This method is based on the assumption that repetitive suppression of the tics finally leads to their reduction in frequency (Srour et al., 2008).

Two different types of drugs are currently available to treat TS. The most important and effective drugs
are neuroleptic antipsychotics that function as dopamine-blockers, such as haloperidol, primozide and risperidone (Srour et al., 2008). As dopamine is a common neurotransmitter in frontal-subcortical neural circuits, which are affected in TS, it is likely that the disease is caused by an imbalance in the dopaminergic system. Dopamine is an agonist to metabotropic G protein coupled receptors and among those type-D2 receptors are of inhibitory nature. The pharmacological treatment is based on blocking postsynaptic D2-receptors, as well as preventing the accumulation of presynaptic, dopamine-containing vesicles, and on blocking dopamine synthesis (Buse, Schoenefeld, Münchau, & Roessner, 2012). Unfortunately, patients have to bear side effects, such as sedation, weight gain and anxiety, in order to find relief of their tics (Srour et al., 2008).

A second type of drug, alpha-2-adrenergic agonists, show a better side effect profile (Srour et al., 2008) but are not as efficient as neuroleptics. The patients still have to suffer from sedation, dizziness, dry mouth, headache and irritability (Shprecher & Kurlan, 2009).

In summary, it is important to recap that not all TS patients need treatments as long as their tics do not interfere with their everyday life. There is no treatment available which suppress the tics completely. In mild cases, behaviour therapy is the most preferable option. Drug administration cause side effects and a cost-benefit-analysis has to be done before patients are exposed to unpleasant adverse effects. If there is no improvement with these therapies, Deep Brain Stimulation, due to its invasive and controversial nature, is the last trial to enable patients with severe cases of TS to live a normal life.

3. Analysis

Target group

The Tourette's syndrome video is presented by 'A Current Affair'. This is a TV show airing on the Channel 9 network, presenting current issues and stories around the world. Channel Nine is one of the highest rating channels on television in Australia. Therefore, we know that this video is not necessarily being aimed at people with a medical background or people who may be affected by the illness. Instead, it is being shown to a range of audiences around Australia, of different ages and circumstances, who will watch this TV show.

Furthermore, the majority of this audience has only limited knowledge of this neurological disorder. The purpose of the video is both to inform the audience about current events, as well as to keep them interested and entertained. As most of the audience may not be personally affected by Tourette's syndrome, an effort is undergone to keep them watching and capture their interest.

Capturing the audience's interest is achieved by presenting the topic of Tourette's Syndrome in a very dramatic way. Already, the introductory sentence, “A young husband's bold gamble to save not just his
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marriage, but his life”, is very dramatic and captures the audience's interest immediately. Phrases such as "a young husband", used to begin the sentence, show that Tyler is just like any one of the audience members, demonstrating that any one of them could be in Tyler's situation. This allows for the audience to empathise with Tyler.

The following video of Tyler, who suffers a very severe case of Tourette's Syndrome, serves to create the audience's awareness of the need for treatments. Tyler's everyday life is highly affected by this neurological disorder. This stresses the fact that Deep-Brain Stimulation is not a routine treatment used on every Tourette's patient. Only those patients severely affected by the disorder can be treated this way.

General audience members would like to see issues be resolved, a sort of "happy ever after" ending to a story. The two success stories of Deep Brain Stimulation, that are presented at the end of the video, are packed with emotions, demonstrating the way the patients fought to save their lives and made it possible to live with their illness as best they can. The video suggests that both patients managed to save their love-life and improve their way of leading their everyday-life through this surgery.

Presentation of the neurological context
The video briefly informs the audience about the neurological disorder, Tourette's Syndrome, and its treatment, Deep Brain Stimulation. The neurological context in the video is highly simplified. This is necessary as it is assumed that the audience has little prior knowledge on this topic and the short video leaves very little time for scientific explanations. Simplifying the neurological context allows for the audience to understand and follow Tyler's journey. If the information was given in scientific terms, this would be aiming the video at audience members with a neuroscience, or medical, background. The presenters would rather not confuse the audience, and instead want the audience members to understand what is being conveyed. The information in the video needs to be simplified in order to convey the same message to a range of people. Making the context too difficult to comprehend provides confusion, making it less likely for them to continue watching and to empathise with the subjects.

The neurological basis of Tourette Syndrome is only addressed in one sentence: “Revolting neurons cause the Tourette.” Deep-Brain Stimulation is briefly explained by showing an interview with a neurosurgeon, videos of the actual surgery and an animation of the procedure. Neurological explanations in the video are kept very basic and no technical terms are used. No further information is given about which specific brain regions are stimulated or how the misbehaving brain cells are reset.

Criticism
The video creates the impression that each kind of Tourette Syndrome has a clearly identifiable cause. It seems like the 'revolting neurons' that are presented as the cause of Tourette's Syndrome are easily identified. In fact, the direct cause of Tourette Syndrome is still unknown (Buse et al., 2012). The clip shows the success stories of the patients suffering from Tourette's, which is something the audience wants to see. However, not all Tourette's Syndrome sufferers are successfully treated and this is not conveyed in the video. Therefore, a false sense of a "happy ever after" in treating the illness is demonstrated to the general audience. This has a factor of bias to it. "A Current Affair" does not tend to investigate cases in which the treatment does not work and the end result is not a positive one. It only aims to show that they are reliable and have solutions to the issues presented.
4. Appendix

4.1 Search Strategy

After forming our group, we decided that everybody should have a look at possible topics that could be interesting and informative for our wiki project. We wanted to present a topic, preferably a disease, that would not be covered in the lectures. Our search began at YouTube, as we agreed that a video clip would be the preferable media type. We typed diseases we had heard about before in the search box and looked to see if we could find interesting video clips about it. We were lucky and soon found the perfect topic for us. An "A Current Affair" clip from 2010 was discussing Tourette's Syndrome and Deep Brain Stimulation. This disease seemed quite interesting for us all and we were especially fascinated in Deep Brain Stimulation, as this is one of the newly introduced and still controversial treatments for neurological disorders. We chose this clip as we were eager to analyse how accurate that disease is presented in this famous, Australian T.V. show. We were also interested in analysing the presenter's (Tracey Grimshaw) last statement, that the patients had no other choice than to undergo Deep Brain Stimulation in order to live a better life.

Our first step was to get a broad overview over Tourette's Syndrome and Deep Brain Stimulation. For this we used Google and looked at random pages to get an idea about the disease and what may be important to include in our wiki. At our first meeting, we discussed what would be interesting to cover and who feels especially attracted to a certain topic. The most important and useful database for finding good, reliable and scientific resources was PubMed NCBI. One important criteria for us was to build up our research on the latest research outcomes. Therefore, we based our research mostly on articles not older than 5 years. If we used older articles, we doubled-checked whether they included recent information. As a lot of research is done in this field, we did not have any problems in finding recent articles. We think it helped a lot that we discussed the content of our wiki page right at the beginning so that we knew what to search for in the databases. Otherwise, we would probably be overwhelmed by the huge amount of information provided for this research area.

4.2 Feedback responses

Overall, we received quite good reviews and are happy that our work fits the requirement of the assignment. We enjoyed researching Tourette's Syndrome and Deep Brain Stimulation as we haven't heard much about it before. It is nice to hear that we chose the right topic and that others also want to learn more about it. According to the reviews, we managed to find good and supporting research evidence and pictures, and were able to present our knowledge in a comprehensive and interesting way. Besides hearing about the strong points, reading the weak points of our wiki-page was even more important to us, as we were grateful for the feedback and suggestions on how to improve our wiki. Some reviewers detected grammatical, spelling and word choice errors. Our pictures should also be labelled differently to incorporate it more into our text. Sometimes, our text was broken awkwardly around the pictures that was confusing for the readers. The format for the headings was inconsistent. A few reviews also recommended that we put more details in the Appendix. Others thought that we should discuss our findings more, by providing more arguments and comparing the different treatment options and evaluating them. One reviewer argued that we had an extensive amount of information in the DBS section, and that we should also provide arguments against its use in Tourette's. Another review suggested to put more detail
in the Analysis.
First, we corrected the grammatical, spelling and word choice errors and capitalised where necessary, as suggested. Second, we labeled our pictures differently to incorporate it more into our text and changed the format of our headings and text so that it flowed more smoothly. Thirdly, we added some more information in the Appendix. Additionally, we compared the different treatment options and evaluated them. We also included the location of the Globus Pallidus Interna, added information regarding the cost-effectiveness of DBS, reduced the repetitiveness of the Target Group section and incorporated the estimated prevalence of Tourette’s, as suggested. Finally, we decided to disregard the critique we received regarding not enough "con" arguments against DBS. As mentioned, the largest study done so far, by Cannon et al, showed very positive results with only one participant showing any negative side-effects, and we already mentioned possible negative side-effects, such as depression and suicidal tendencies. These side-effects were absent from the study, perhaps because of the particular region of the brain that is stimulated for the treatment of Tourette's.

4.3 Jobs

- Caroline - Introduction and a third of the Neuroscientific context: Description & Causes
- Carolyn - A third of the Neuroscientific context: Deep Brain Stimulation
- Natasha - Half of the Analysis and proof reading and editing.
- Sophia - Half of the Analysis, and Graphics for Wiki page.
- Rebecca - Appendix and a third of the Neuroscientific context: Other Treatments

4.4 Deadlines

1. **August 12 at 10 am** --> group formation, topic submission, workplan
2. August 19 --> research topic
3. August 26 --> write about the allocated topic
4. September 2 --> design wiki page and fill it with content
5. September 6 --> finish wiki page (incl. appendix and references)
6. **September 9 at 10 am** --> project draft submission
7. **September 16 at 10 am** --> review comments
8. **September 23 at 10 am** --> final project submission

4.5 Meetings

08/08/13
13/08/13
Met from 4-5 in the library- study booth 323: Divided up tasks and decided when our next meeting would be

20/08/13
Met from 12-1- Study room 213: update on current research, discussed word limit, etc.

03/09/13
Met from 12-2- Study room 213: updated our wiki-page, set up new deadlines, put in pictures

References


**Comments**

*Great - I like it. An interesting topic, and Australian content. Everyone likes to bag out ACA - will be interesting to see your appraisal of their presentation of the science.*

*Approved!*