Deep brain stimulation and parkinson’s

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Introduction: Parkinson’s disease (PD) is a progressive degenerative disorder of the central nervous system that affects more than 1. 5 million people in the United States alone. This disease is characterized by a decrease in spontaneous movements, walking difficulty, postural unsteadiness, rigidity and tremor. “ The major symptoms of the disease were originally described in 1817 by an English physician, Dr.

James Parkinson, who called it ‘ Shaking Palsy’ (Peppe, Gasbarra, Stefani, Chiavalon, Pierantozzi, Femi, Stanzione, 2010). Men and women are equally affected by this disease and the occurrence of the disease is considerably higher in people over the age of 60, even though there is an alarming increase of cases of Parkinson’s in people of a younger age. In light of the increased life expectancy in this country and worldwide, an increasing number of people will be victims of Parkinson’s disease. The higher life expectancy is probably a major factor in the lowered age of Parkinson’s patients. There are no known immediate cures for this disease; however, there are pharmacological treatments and surgical treatments for the inhibiting symptoms in PD. Deep brain stimulation is one major surgical treatment available to all patients suffering a severe form of PD.

Deep brain stimulation (DBS) is a surgical procedure used to treat a variety of disabling neurological symptoms. On use of this procedure is used to inhibit the debilitating symptoms of PD, such as tremor, rigidity, stiffness, slowed movement, and walking problems. At present, the procedure is used only for patients whose symptoms cannot be adequately controlled with medications (Kelly, Derome, Guit, 1978). Deep brain stimulation is an amazing procedure that shows a lot of promise in the neuroscience field. The

purpose of this paper in to look into the details of Parkinson’s, mainly the symptoms and how and where the brain is affected, and also the effectiveness of deep brain stimulation in Parkinson’s patients and the variety of ways it reduces, or even cures, many symptoms of Parkinson’s disease. Causes of Parkinson’s Disease: Although there are no known immediate causes of Parkinson’s disease there are certain risk factors that may influence the onset of this disease.

The biggest risk factor know to influence parkinson’s is advancing age. This is a disease known to affect people over the age of 60. For example, people over age 60 have a two-to-four percent risk of developing Parkinson’s disease, compared with the one-to-two percent risk in the general population (“ What causes”, 2010). Genetic and environmental exposures are currently at the forefront of investigation for the main causes of PD. Studies that deal with incidence, distribution and control of PD have demonstrated that people with an affected relative, such as a parent or sibling, have a two-to-three fold increased risk of developing PD compared to someone who does not have n immediate relative with PD (Benabid, Koudsie, Bennazzouz, Fraix, Ashraf, Le Bas, Chabardes, 1999).

Scientists have identified 13 genes that are associated with PD that can influence the onset of the disease. The genes identified to date include: PARK1, DJ-1 (PARK7), Pink1 (Park6), dardarin (DRDN), Tau, lrrk2, parkin, uchl-1, park3, park9, park10, park11 (Ascone, Pazo, Macadar, Bruno, 2002). Although genetics play a role in only a small number of PD cases, they are currently the subject of intense research. The genetic risk factor is being intensely studied presently because these forms can be examined in great

detail in the laboratory, and because understanding the rare genetic forms of PD may help to understand more common forms of the disease. Along with genetic factors, environmental factors, such as a toxin or injury, have also been suggested to result in PD. There is no conclusive evidence that any environmental exposure alone can be the cause of PD, just influence other factors within the body.

To date, epidemiological research has identified rural living, well water, herbicide use and exposure to pesticides, as factors that may be linked to PD (Sringhouse, 2005). These certain environmental factors were not found to be useful in diagnosing the cause of PD in an individual person. However, they have been helpful in studying there effects on laboratory models of PD. Symptoms of Parkinson’s Disease: There are many different symptoms that appear in people with PD, although, the way that symptoms of the disease develop varies between individuals. Unfortunately, PD ultimately leads to disability.

Early onset symptoms include tremors, or trembling in the hands, arms, legs and face. People with an early onset of PD may experience a sensation of feeling shaky and may exhibit depression and irritability. Eventually the arms, legs and trunk become rigid and the person develops bradykinesia, or a slowness of movement that includes sudden freezing of muscle movement. After a number of year’s akinesia also may occur, this is when the muscle also becomes rigid or “ freezes” which leads into not being able to move at all.

Along with bradykinesia and akinesia, balance and coordination become impaired which increases the risk of falls. Other symptoms include a slowing of the digestive system, leading to constipation, fatigue and weakness. Hypotension, also known as low blood pressure, can occur, leading to fainting spells. Eventually people with Parkinson’s disease develop a characteristic shuffling walk, stooped posture and blank stare.

Symptoms of PD eventually progress to become severely disabling. PD is a devastating and complex disease that interferes with movement more and more as time goes on. It also produces a wide range of other problems for patients. Symptoms of the disease vary somewhat, but they may include problems with swallowing and chewing, speech impairments, urinary problems or constipation, excessive sweating and other skin problems, depression and other emotional changes, and difficulties with sleep.

No one can predict which of these symptoms will affect a particular patient, and the intensity of the symptoms varies from person to person. None of these secondary symptoms is fatal, although swallowing problems can cause choking. The progression of symptoms in PD may take 20 years or more. In some people, however, the disease progresses much more quickly.

Brain Areas Involved in Parkinson’s Disease: The basal ganglia, a part of the brain is affected by the disease, plays a vital role in movement control. The primary area of the basal ganglia that is affected by PD is the substantia nigra. The substantia nigra contains a particular set of neurons that send signals through dopamine carrying neurotransmitters. These signals travel to

the striatum through long fibers called axons and the activity of this pathway controls normal movements of the body.

In PD the neurons in the substantia nigra degenerate and results in the loss of dopamine. This degeneration then causes the nerve cells of the striatum to fire excessively. This makes it impossible for people with PD to control their movements. Many Parkinson’s patients eventually lose 80 percent or more of their dopamine-producing cells.

Another cellular characteristic of PD is the presence of Lewy neuritis, swollen nerve fibers containing alpha-synuclein and other proteins (Krack, Bennazzouz, Pollak, Limousin, Piallat, Hoffman, Xie, Benabid, 1998). The buildup of alpha-synuclein in these nerve fibers may interfere with the transmission of nerve signals and other important neuronal functions. Treatment Options for Parkinson’s Disease: The main treatment option for Parkinson’s at the present time in pharmacological drugs. There are many different types of drug therapies including, dopaminergic drugs, decarboxylase inhibitors, dopamine agonists and anticholinergics.

Dopaminergic drugs are a class of drugs with dopamine-like action used to treat symptoms of Parkinson’s disease. The drug levodopa is a dopaminergic drug that has been the standard treatment for this disease. Once it reaches the brain, levodopa is converted to dopamine which replaces the same substance that is depleted in sufficient amounts in Parkinson’s patients. Treatment with levodopa does not, however, prevent the progressive changes of the brain typical of Parkinson’s disease. The drug may also produce side effects in some people, due to its change to dopamine before

reaching the brain. Dopamine agonists are a class of drugs that bind to dopamine receptors and imitate the action of dopamine.

Anticholinergics are a class of drugs that relax smooth muscle and are used primarily to treat tremors in Parkinson’s disease. Some new drugs have recently been approved offering a wider choice of medications for the patient, while others are under investigation in this country and overseas in an effort to obtain better therapeutic results with fewer side effects (“ Deep brain”, 2003). Although medications for Parkinson’s disease can be used to improve motor function, they may lose their effectiveness over time and/or cause major side effects. Also, as the disease progresses, the medication levels required for motor function control increase which may cause intolerable side effects in the patient. Along with drug therapies, there are also surgical treatments including lesioning, or pallidotomy, and deep brain stimulation. A pallidotomy is the destruction of a region of the brain involved with the control of movement, mostly areas of the basal ganglia.

Since pallidotomy is a procedure that destroys the brain there are adverse affects which may include hemorrhage, weakness, visual and speech deficits and confusion. DBS is a relatively newer treatment option for Parkinson’s disease symptoms. DBS involves the surgical implantation of an electrode deep into the brain, where it sends continuous electrical signals to the part of the brain that controls movement and blocks abnormal signals that cause tremors and rigidity (“ Deep brain”, 2003) DBS has many advantages over drug therapy and lesion surgery, or pallidotomy. First, it does not purposefully destruct any part of the brain.

In addition, the electrical stimulation is adjustable and programmable by external factors and can be changed as the person’s disease changes. Destructive surgery, such as pallidotomy, may reduce the person’s potential to benefit from future therapies. For example, future brain cell transplantation may be of great help to people with Parkinson’s disease. There is concern that a pallidotomy may prevent patients from benefiting from brain cell transplantation. This would not be the case with deep brain stimulation, as the stimulator could be turned off and taken out if needed without any damage to the brain. The stimulator can also be turned off at any time if deep brain stimulation is causing excessive side effects.

DBS is a relatively safe procedure and can treat all the major symptoms of Parkinson’s disease and daily living tasks and quality of life are also dramatically improved. Research Supporting DBS: For many years, the only surgical treatments for PD were pallidotomy, a procedure in which surgeons selectively destroy small portions of the brain in order to relieve tremor and rigidity (“ Treatment options”, 2010). The tissue destruction in these procedures is irreversible and they often led to troubling side effects. These destructive procedures caused surgery to be replaced with drug therapy once levodopa became available for PD in the 1960s.

In the 1980s, researchers in France discovered that chronic stimulation of the thalamus could block tremors in patients with essential tremor (Springhouse, 2005). This discovery opened the door to a new era of surgical treatments involving brain stimulation. Studies in a monkey model for PD also revealed which brain circuits that are altered in this disease nd pointed to the subthalamic nucleus as a key target for stimulation (Bennazzouz,

Gross, Feger, Boraud, Biolac, 1993). Investigators then examined the effects of stimulating the subthalamic nucleus in patients with PD and found that the stimulation had profound effects on tremors, slowness, and stiffness. In DBS, electrodes are implanted into the brain and connected to a small electrical device called a pulse generator that can be externally controlled. DBS reduces the need for levodopa, which in turn decreases the involuntary movements that is a common side effect of levodopa.

It also helps to alleviate fluctuations of symptoms and to reduce tremors, slowness of movements, and gait problems. Unlike pallidotomy, DBS is reversible. With deep brain stimulation, the vast majority of people, over 70%, experience a significant improvement of all their symptoms related to Parkinson’s disease (Bennazzouz et al, 1998). After partaking in the DBS procedure most people are able to significantly reduce their medications. In an article found in the New England Journal of Medicine, there was an experiment preformed using DBS in patients with advanced Parkinson’s disease. The experimenters implanted electrodes in the subthalamic nucleus in 96 patients and had them undergo bilateral deep brain stimulation.

Three months after the procedures were performed, evaluations demonstrated that stimulation of the subthalamic nucleus showed improvement in the motor score (P ; lt; 0). Between the preoperative and six-month visits, the percentage of time during the day that patients had good mobility without involuntary movements increased from 27 percent to 74 percent (P ; lt; 0. 001) with subthalamic stimulation. This experiment found that bilateral stimulation of the subthalamic nucleus showed significant improvement in motor function in patients with Parkinson’s disease whose

condition cannot be further improved with medical therapy (“ DBS of the”, 2001).

Conclusion: While Parkinson’s is a complex disease, research that is trying to find a cure has progressed a great deal in recent years. Halting the progression of PD, restoring lost function, and even preventing the disease are now considered realistic goals when just recently many thought that was impossible. Researchers have identified many susceptibility genes and potential environmental risk factors for PD, and these studies are contributing to a much-improved understanding of how PD develops. A number of promising therapies have been developed, such as DBS, which is now being tested, and perfected, in the laboratory setting.

Continuing studies to improve understanding of the underlying nature of the disease will lead to better ways of relieving the symptoms of Parkinson’s patients and ultimately preventing or halting the disease. DBS has now been approved by the U. S. Food and Drug Administration, and it is widely used as a treatment for PD. It also is used to treat dystonia and essential tremor, and it is being tested for disorders such as Tourettes syndrome, epilepsy, and depression. Researchers are continuing to study DBS and to develop ways of improving it.

They are conducting clinical studies to determine the best part of the brain to receive stimulation and to determine the long-term effects of this therapy. They also are working to improve the technology available for DBS. DBS is now becoming a necessary tool in relieving symptoms of PD in patients that cannot be cured by medication. Soon this procedure will be used in many PD

patients all over the world. I believe that with the research that supports DBS, this treatment will open new opportunities for people suffering from PD. This treatment will help clinical neuroscientist finally point out what parts of the brain are affected and what parts, when stimulated, lessen the symptoms of PD.

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