**Name of Disorder:** Parkinson’s Disease  
**Essay Title:** An Introduction to Parkinson’s Disease  
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**Introduction**

Parkinson’s disease (PD) is a progressive condition marked by a loss of nerve cells (neurons) in the brain (known as neurodegeneration). The exact cause of neuronal loss in PD is unknown. However, many of the symptoms of PD can be explained by the loss of cells that contain the neurotransmitter ‘dopamine’. Dopamine, like all neurotransmitters, is a chemical released by nerve cells to communicate with other nerve cells. It has a variety of key functions in the brain, including important roles in behaviour, cognition, voluntary movement, motivation, punishment and reward, sleep, mood, attention, working memory, and learning. In the case of PD, the dopamine–producing neurons of the ‘substantia nigra’, a hub of nerve cells in the brainstem, slowly die. This reduction in dopamine levels causes an imbalance with other neurotransmitters resulting in an array of both motor (movement) and non-motor symptoms that become worse over time (Sethi 2002).

What triggers this fairly selective death of neurons is a point of debate, but several different theories have been proposed. The most common theories are: environmental toxins (exposure to a range of metals and chemicals); oxidative stress (cellular processes that are a natural part of aging); genetic predisposition; and a combination of these factors.

PD is the second most common neurodegenerative condition after Alzheimer’s disease (de Lau and Breteler 2006). More than 64,000 Australians have PD (Deloitte 2011) and as the major risk factor is age, this number is expected to grow with the ageing population (Lees, Hardy et al. 2009).

**Symptoms**

Although considered to be a movement disorder, people with PD may experience a variety of motor and non-motor symptoms. There is a great diversity in presentation of Parkinson symptoms.

**Motor Symptoms**

Motor symptoms include a "shuffling" gait, tremor of the arms and legs, muscle stiffness, slowed movement and stooped posture. These can impact on many activities of daily living, for example, eating, drinking and writing. Generally, these symptoms present on one side of the body (unilateral), then over time move to both sides of the body (bilateral) (Klockgether 2004).

*Slowness, reduction and absence of movement (Bradykinesia/Hypokinesia/Akinesia)*

Changes in movements are one of the key characteristics of PD which implicates the ability to perform involuntary movements (e.g. blinking and swallowing) as well as voluntary tasks (e.g. dressing). The ability to communicate is also affected by soft monotonous vocal tone, reduced gestures, and a less expressive face (Klockgether 2004).

Particularly in later stages of the disease, people may experience the sudden inability to walk, typically lasting less than a minute, which patients have described as the sensation that their feet are “glued to the ground”. This is called gait freezing and may lead to dangerous falls (Thevathasan and Aziz 2010) and in some cases wheelchair dependency (Giladi, McDermott et. al. 2001).
Postural instability
Postural instability reflects an impairment of the reflexes to maintain an upright stance. This is frequently disabling, creating difficulty maintaining balance during everyday tasks such as walking, turning and standing up from sitting. Similar to gait freezing, this is a major cause of falls and tends to occur later in the disease (Giladi, McDermott et al. 2001, Kerr, Worthingham, et. al. 2010).

Muscle stiffness
Muscle stiffness (or rigidity) refers to the resistance felt in muscles when they are moved, for example through massage or medical intervention, without purposefully activating muscles to perform the movement. Muscle stiffness partially accounts for the sensory symptoms of neck and shoulder pain sometimes experienced during early stages of PD.

Tremor
Tremor in PD is typically noticeable when the limb is at rest and may affect different limbs with a variable severity. This “resting tremor” is found in over 70% of patients at disease onset and remains the most characteristic feature of PD (Sethi 2004). Stress may cause a worsening of tremor possibly due to increases in adrenaline (leading to further neurotransmitter imbalance).

Non-Motor Symptoms
Cognition
Cognitive problems (thinking, judgment, and memory) may also be present, particularly in the late stages of the disease, with greater than 80% prevalence after 15 years (Hely, Reid et al. 2008). Sleep disturbance is common and narcolepsy-like symptoms (excessive sleepiness and sleep attacks at an inappropriate time) may also be experienced during later stages (Schenck, Bundlie et al. 1996).

Psychiatric
Depression, which may be triggered by the diagnosis of the disease or related to a chemical imbalance within the brain, and anxiety, which can aggravate motor symptoms, are both commonly experienced (Aarsland, Bronnick et al. 2007). Visual hallucinations and psychosis are also common, particularly at later disease stages.

Autonomic System
The autonomic nervous system acts as a control system for involuntary functions such as heart rate, digestion, respiratory rate, salivation, perspiration, pupillary dilation, urination and sexual arousal. Autonomic dysfunction, including impotence, postural hypotension and constipation tend to occur later in the disease course (Chaudhuri, Healy et al. 2006).

Diagnosis
The diagnosis of PD is usually made on clinical grounds by observing symptoms of impaired movement, muscle stiffness, tremor and postural instability (Hughes, Daniel et al. 1992). In general, changes in movement and other key symptoms are considered enough for a positive diagnosis (Klogether 2004). A specialised brain scan (not available in Australia) can be used to distinguish non-Parkinsonian mimics such as tremulous dystonia, essential tremor and drug-induced Parkinsonism (Scherfler, Schwarz et al. 2007).
Treatment
Treatments at present only address the symptoms, and not the underlying neurodegenerative cause.

Drug Therapies
Dopamine replacement therapy (dopaminergic therapy) is the mainstay of treatment (Birkmayer an Hornykiewicz 1961; Cotzias, Van Woert et al. 1967). The most common dopaminergic therapy is levodopa, a pre-cursor, that unlike dopamine, is able to cross the protective blood–brain barrier. It is most effective on motor symptoms although gait freezing and postural instability respond poorly (Bloem 1992). Over time, levodopa can cause involuntary movements called ‘dyskinesias’. To spare levodopa doses and limit this effect, another class of medications are often used called ‘dopamine agonists’. However dopamine agonists are not quite as effective as levodopa and can cause a group of symptoms called impulse control disorders including obsessions and compulsions regarding hobbies, objects, sex, eating, gambling, and even with medication (Weintraub 2008). Thus, treatment must be carefully monitored to optimise the reduction in motor symptoms whilst avoiding neuropsychiatric complications.

Deep Brain Stimulation (DBS)
DBS uses a surgically implanted, battery-operated device to deliver electrical stimulation to targeted areas in the brain that control movement, blocking the abnormal nerve signals that cause tremor and other symptoms (Thevathasan and Gregory 2010).

Surgery
Lesioning (careful destruction of brain tissue) is still performed in many medical centres in specific circumstances such as in elderly patients with a predominantly unilateral tremor (Thevathasan and Gregory 2010). Since the potential of irreversible damage is high, this technique is usually the last resort.

Other Therapies
Many therapies not currently available as clinical treatments are under investigation, including dietary modification with ketone esters to enhance the function of mitochondria (subunits within nerve cells) as well as stem cell treatments (Kashiwaya, Takeshima et al. 2000). Scientific research into PD is as varied as the disease itself. Researchers continue to improve our understanding of the disease and help to provide better treatments for the underlying causes of this highly debilitating condition.

Conclusion
Parkinson’s disease results from a gradual loss of neurons that produce dopamine. This causes an imbalance in the brain leading to symptoms of tremor, gait problems and cognitive decline. Diagnosis is made on clinical grounds and treatment is typically through oral medication intended to replace dopamine. As disease severity worsens and side-effects of medication become exceedingly worse, more radical therapies such as deep brain stimulation and surgical lesioning are explored. Continued scientific research into Parkinson’s disease may reveal important clues to help find more effective treatments in the near future.
References


