NIEHS
National Institute of
Environmental Health Sciences

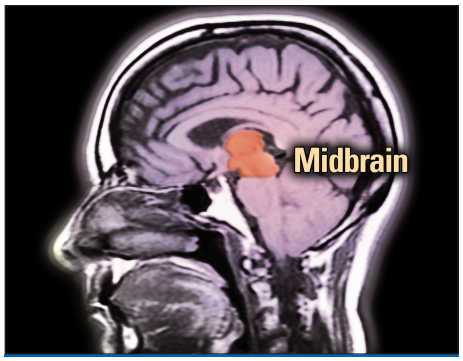
The Role of the Environment in Parkinson's Disease

Susan, a 66 year-old office worker, is experiencing problems controlling her hands and arms. She is finding it increasingly difficult to grasp or handle things such as coins and car keys from her right trouser pocket. While her hand writing is still quite clear, the required motion is harder to execute, and simple tasks like writing checks can take up to five minutes. She schedules a visit with a neurologist, who conducts a thorough evaluation of Susan's symptoms, health conditions, family history, and current level of functioning. The test results confirm Susan's suspicions — she is suffering from a debilitating neurological condition called Parkinson's disease.

Older Adults

Parkinson's disease is a chronic neurodegenerative disease, the second most prevalent such disorder after Alzheimer's disease. It is a slowly progressive disease caused by the death of small clusters of cells in the midbrain. The gradual loss of these cells results in reduction of a critical neurotransmitter called dopamine, the chemical messenger responsible for coordinated muscle movement.

Although 5 to 10 percent of patients are diagnosed before age 50, Parkinson's disease generally occurs in older adults. Incidence of the disease increases with age, affecting one of every 100 persons over the age of 60. More than 1 million people in North America suffer from Parkinson's disease, with approximately 50,000 new cases reported each year. Actor Michael J. Fox, former U.S. Attorney General Janet Reno, and Pope John Paul II are some well-known people diagnosed with Parkinson's disease.



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Causes of Parkinson's Disease

For the vast majority of cases, the causes of Parkinson's are unknown. Researchers estimate that less than 1 percent of Parkinson's cases are caused by genetics. Scientists at the Parkinson's Institute in Sunnyvale, California found that genetics played a role in early-onset Parkinson's, where symptoms begin before age 50, but found that genetics was not a contributing factor when symptoms developed later in life.[1]

In the 1980s, researchers discovered that MPTP, a contaminant found in synthetic heroin, caused severe Parkinson-like symptoms in drug addicts who injected it intravenously. As a result, Parkinson's researchers turned their attention to toxins in the environment. These studies found increased Parkinson's associated with pesticide use, consumption of well water, exposure to herbicides, and proximity to industrial plants, printing facilities, and quarries.[2]

Parkinson's Centers Look for Answers

In order to meet the growing need for research in this important area, the NIEHS funds three Centers for Parkinson's Disease Environmental Research.

NIEHS Environmental Research Centers for Parkinson's Disease

- **The Parkinson's Institute, Sunnyvale, California**
- **University of California at Los Angeles (UCLA)**
- **Emory University, Atlanta, Georgia**

Strength in Numbers: The Parkinson's Disease Registry

With support from the NIEHS and the Michael J. Fox Foundation, the Parkinson's Institute launched a statewide registry of Parkinson's disease patients. The registry will be the largest database of its kind, enrolling as many as 5,000

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U.S. Department of Health and Human Services
National Institute of Health
National Institute of Environmental Health Services

October 2005

Parkinson's patients each year. Armed with this new tool, researchers will be able to access medical history along with information about a patient's exposure to different environmental agents. Then researchers will test the idea that Parkinson's is triggered by contact with pesticides or other chemicals. For more information, please visit the Parkinson's Institute website at www.parkinsonsinstitute.org.

Research for Prevention and Treatment

Although there is no cure for Parkinson's, there are a number of highly effective medications, including Parlodel, Permax and Mirapex, that can significantly improve a patient's level of functioning.

Research conducted at the UCLA Parkinson's Disease Research Center suggests that some people may carry genetic defects that make them more susceptible to Parkinson's. Scientists want to know more about how genetic defects and environmental toxins interact to cause this degenerative condition. Also, they are conducting studies on stem cells, deep brain stimulation, and compounds called growth factors that may protect dopamine-containing cells.

Researchers at the Mayo Clinic in Rochester, Minnesota, with support from the Michael J. Fox Foundation, have identified 12 "susceptibility" genes associated with Parkinson's disease. While these genes do not cause the disease directly, subtle changes in the genes may make some people more or less likely to develop Parkinson's later in life.

At Emory University, scientists are focusing on the role of chemical pollutants in Parkinson's disease. Their studies show that dieldrin, a pesticide used to control termites, and polychlorinated biphenyls (PCBs), toxic compounds used in electrical transformers, prevent proper storage of dopamine and may even contribute to the death of dopamine-containing neurons. In other research, scientists are looking at the effects of environmental chemicals on the function of DJ-1, a gene that was linked to Parkinson's.

A team of NIEHS-funded researchers at the University of Washington is conducting studies on genetic susceptibility and environmental factors as possible causes of Parkinson's. Their results indicate that people who consume two or more cups of tea per day have a lower risk of developing Parkinson's disease than those who do not drink tea. These findings suggest that the caffeine in the tea may offer some protection against the brain cell death that is characteristic of the disease.[3]

Chemical Imitators: Compounds That Mimic Parkinson's

Animal studies with the widely-used herbicide *paraquat* produced some intriguing results. Researchers found that long-term exposure to *paraquat* results in the loss of the same dopamine-containing neurons that die in Parkinson's patients. Earlier studies suggest a possible explanation for this – it appears that exposure to the herbicide also increases production of a specific brain protein, called alpha-synuclein, which researchers believe is involved in the degenerative process that leads to Parkinson's.[4]

Occupational Exposures

An NIEHS grant to Wayne State University funded a long-term study of people who were exposed to metals such as iron, lead, copper, manganese and zinc in their workplaces. Researchers found a significantly greater incidence of Parkinson's among workers with more than 20 years of exposure to copper or manganese. Furthermore, among those with more than 20 years of exposure to lead and copper, lead and iron, and iron and copper, there was an even greater association with Parkinson's than with exposure to any of these metals alone.[5]

As yet, there is no definitive way to predict or prevent Parkinson's disease. However, research in the last decade offers new insights and moves scientists ever closer to unraveling the mysteries of this disease.

For more information on Parkinson's Disease, go to our website at:
http://www.niehs.nih.gov/

[1] *Tanner et al. (1999) Parkinson Disease in Twins: An Etiologic Study. Journal of the American Medical Assn. 281(4):341-346.*

[2] *Hubble et al. (1993) Risk Factors for Parkinson's Disease. Neurology 43(9):1693-97.*

[3] *Checkoway et al. (2002) Parkinson's Disease Risks Associated with Cigarette Smoking, Alcohol Consumption, and Caffeine Intake. American Journal of Epidemiology 155(8):732-738.*

[4] *McCormack et al. (2002) Environmental Risk Factors and Parkinson's Disease: Selective Degeneration of Nigral Dopaminergic Neurons Caused by the Herbicide Paraquat. Neurobiology of Disease 10(2):119-127.*

[5] *Gorell et al. (1999) Occupational Exposure to Manganese, Copper, Lead, Iron, Mercury and Zinc, and the risk of Parkinson's Disease. Neurotoxicology 20(2-3):239-247.*