HEAVY METALS AND NEUROLOGICAL DISEASES

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Introduction

Nerve cell death plays a role in a number of neurological disorders including restless leg syndrome, Alzheimer's disease, Parkinson's disease, Wilson's disease, amyotrophic lateral sclerosis (ALSO) and Huntington's disease. Because the mechanisms that control nerve cell death are complex it has been difficult to develop effective strategies for treating and preventing these diseases.

Recently the role of trace metals in regulating nerve cell death has been recognized. At present there is an ever increasing body of evidence implicating metals in the onset of these neurological conditions. One of the major roles played by metals in neurological disorders is that they appear to interact with other constituents of the cells in a manner that increases the amount of **reactive oxygen species**. This increases the **oxidative stress** on the cells which can seriously alter their structure and function. This new evidence suggests that **detecting increasing amounts of metals in the body will become an important diagnostic tool** that can lead to earlier intervention strategies to slow the progress of these conditions.

Experts project that by 2047 over 8 million people in the US will suffer from Alzheimer's disease. Parkinson's will affect over 1% of adults over 60 years of age.

Copper-mediated nerve cell death

Wilson's disease causes the body to retain copper. Eventually, the damage causes the liver to release the copper directly into the bloodstream so that excess copper is carried throughout the body. Exposure to this excess copper leads to damage in the kidneys, brain, and eyes. If not treated, Wilson's disease can cause severe brain damage, liver failure, and death.

Wilson's disease is hereditary. Symptoms usually appear between the ages of 6 and 20 years, but can begin as late as age 40. Wilson's disease is diagnosed through tests that measure the amount of copper in the blood, urine, and liver. Wilson's disease requires lifelong treatment. If the disorder is **detected early** and treated correctly, a person with Wilson's disease can enjoy completely normal health.

Iron-mediated nerve cell death

Accumulation of iron in the central nervous system has been linked to a variety of diseases including Alzheimer's disease, Huntington's disease, and Hallervorden-Spatz syndrome. A strong link has also been established between **iron and Parkinson's disease** (PD). The hypothesis that iron contributes to the development of PD and other disorders has largely been based on the participation of iron in the Fenton reaction which results in the production of **reactive oxygen species** (ROS). Indeed many of these neurological disorders are associated with the over abundance of metals and resulting changes in the oxidation chemistry of the brain. Therefore there is some suggestion that **anti-oxidants** can ameliorate the **effects of metals** in the brain. As with many other diseases, the effectiveness of any treatment strategy will be enhanced by **early detection** of metal-associated changes in brain chemistry.

Zinc-mediated nerve cell death

Zinc is a necessary component of a family of zinc-binding proteins found in the brain and, at low levels, is essential for proper brain function. **Increased levels of free zinc** in the brain have been found after-**seizures** and are associated with **stroke-induced nerve cell death**. There is also evidence that increased free zinc levels that can occur after a traumatic brain injury are a cause of injury-related nerve cell death.

An ever increasing body of evidence shows that disruption of **zinc balance** in the brain plays a major **role in the development of Alzheimer's disease** (AD). The defining feature of AD is the accumulation of amyloid plaques and neurofibrillary tangles in nerve cells. While a number of hypotheses including **oxidative stress** and increased **levels of trace elements** have been proposed to explain the formation of these abnormalities, an ever increasing body of evidence suggests that disruption of **zinc balance is an important contributing factor**. The role of zinc and other oxidation sensitive metals (like copper) in the development of AD is the subject of ongoing research to develop more effective treatments and cures for this debilitating disease.

Summary

In addition to the examples described above, the effects of lead on the human nervous system are so well known that testing of adults and children who may have been exposed to lead is commonplace. At present evidence is mounting that biological interactions of other metals is important to normal brain function and in the development of nervous system disorders. As the role of metals on human function and disease development is elucidated there will be **increased demand for accurate and rapid determination of metals** in healthy people and in persons suffering from these conditions.

Present methods for measuring metal loads require **blood, tissue or urine samples**. However, it is known that metal concentrations in saliva reflect those found in blood and other fluids. Therefore, saliva testing for metals can become a valuable strategy for meeting the increasing demand for metal testing. Saliva testing for metals is as accurate and reliable as other tests but because saliva is **much safer and easier to collect, handle and store** than other body fluids, saliva-based testing offers **significant advantages** for both the medical professional and the concerned citizen. By exploiting these advantages saliva based testing will retain the benefits associated with testing of blood or urine and be available at significantly **lower costs**. This will enhance the ability of medical professionals to monitor metal levels and may open up entirely new markets for metal testing.

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