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Amyotrophic lateral sclerosis and Parkinson's disease around lakes in northern New England, northern Ohio, and Vancouver: Association with glacial sediments and mineral exposure

Kavitha Reddy, M.D.

Harvard Vanguard Medical Associates, Boston, Massachusetts

Email: kreddy@bu.edu

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Abstract

Scientists have observed amyotrophic lateral sclerosis (ALS) disease clusters around certain lakes in the regions of northern New England and northern Ohio. A Parkinson's disease cluster has also been observed in Vancouver. Cyanobacteria toxin exposure has been considered as a potential risk factor to explain this association. It is reported here that these regions have several commonalities in their environment, including a notable geologic history, the presence of abundant glacial sediments, and possible mineral and bentonite exposures. The possible association with and significance of these risk factors in ALS and Parkinson's disease is discussed.

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Introduction

Amyotrophic lateral sclerosis (ALS) and Parkinson's disease (PD) both belong to the group of human protein misfolding disease, and lead to progressive neurodegeneration in the affected individuals. While a percentage of ALS and PD cases are due to genetic mutation, sporadic disease appears common in both conditions and one or more as yet unknown environmental risk factors are considered likely. These conditions sometimes overlap or share a disease spectrum, leading to consideration that there may be a common environmental factor.[1]

Certain locations have shown an increased incidence of ALS and PD compared to the general population.[2] These include areas of ALS disease clusters identified around certain lakes in northern New England and northern Ohio, and a Parkinson's disease cluster suggested in or around Vancouver.[2] Cyanobacteria (blue-green algae) blooms, which are common on several lakes and produce a neurotoxin beta methyl-amino-alanine (BMAA), are being studied as a potential risk factor.[2]

Minerals, including in silts and clays present in glacial sediments, weathered volcanic rocks, or other environmental sources, may be associated with protein misfolding diseases.[3] The hypothesis is reviewed that the risk of ALS and possibly also of Parkinson's disease may be increased by exposure to minerals in lakes or other areas rich in glacial deposits, silts, or clay minerals. Such features are predominant in the above areas of reported disease clusters.

Lake Mascoma and Lake Champlain, Northern New England

Amyotrophic lateral sclerosis hotspots have been identified in several locations in northern New England.[2] A cluster has been observed in the Lake Mascoma area of Enfield, New Hampshire.[2] This area has substantial geologic history, which includes glacial activity, and is rich in glacial sediments of several major varieties, including rocks, till, silt, sand, and clay.[4] The water supply to the town comes largely from bed rock wells.[5] The water is reported as naturally filtered through the soil.[5] Bed rock wells are also called artesian or drilled wells.[6] Drilling mud (which is commonly composed of a bentonite mixture) is often used in forming this type of well.[6] The bedrock itself also contains minerals and the various rocks, till and sediment above the bedrock can affect the well water depending on the well features and construction.[6] A potential cluster of cases of ALS has also been found in the Lake Champlain area of Vermont and other areas of the state.[2] Study of this lake area also reveals a rich glacial history and a strong presence of sediments and clays.[7]

These observations raise the question of whether residents of these areas may be exposed to minerals that could influence ALS. The minerals might be on land, in the air, or dissolved in water, and reach residents either chronically or episodically in concentrations of concern. There is frequent well water and possible surface water source exposure in the affected areas of New England. This water could carry and hold minerals, such as from natural glacial till, silt, or clay in the region, or from bentonite use in wells (e.g. drilling and sealing). In addition, water

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sports such as waterskiing were associated with an increased risk of ALS in the studied areas.[8] Notably, these activities result in a lot of splashing and water surface disruption, possibly increasing exposure of the individuals to inhalation or ingestion of minerals in the water. It might be considered whether intermittent construction, projects in and around the lake area, such as for example, cable burial in the lake, use of drilling fluids in the lake bed, or storms or other events that disturb soil, sand, silt and minerals could increase the concentration of silt and clay at the lake surface waters or increase exposure of the public or the water supply to minerals at various times.

Lake Erie area, City of Conneaut, Ohio

The city of Conneaut, which borders Lake Erie in northern Ohio, has also had several cases of ALS. Interestingly, while northern Ohio may seem to be distant from northern New England, both are part of a common broader region famed for its glacial history along the Great Lakes area and in the region around the United States-Canadian border. As in northern New England, glacial effects are prominent in the region of Conneaut.[9] Tills, sediments, alluvial deposits, clays, and shale are present in Ashtabula County. Marcellus or Devonian shale of the region may contain bentonites such as montmorillonite. Lake Erie may contain sediments, sands and clays that can affect humans. Drilling mud has been used in Lake Erie as well and there have been reported spills of montmorillonite (drilling mud bentonites) during work. The water source for the town of Conneaut is surface water from Lake Erie.[10] In addition, hydraulic fracturing (fracking) and pipeline construction uses bentonite in some of its processes. As discussed for the northern New England region, one may consider whether local construction, drilling, dredging and other activities may increase the exposure of land, water or drinking water to silts and clay minerals either through bentonites used, disruption or vibration/physical movement of silts and minerals in the land, and/or increased movement into or dissolution into local waters or water supply pipes. These are thoughts to consider for further study within a wider differential of possible causes of the disease clusters in these areas.

Vancouver area, British Columbia, Canada

A cluster of Parkinson's disease has also been seen in the area of Vancouver, Canada.[11] The Vancouver area and surrounding regions had significant glacial activity in the past. Michael J. Fox, a prominent actor who has developed early-onset Parkinson's disease, worked in Vancouver along with others affected by the disease. Interestingly, some of the areas he lived in as a child also share these geologic features. For example, North Bay, Ontario, is situated near Lake Nipissing, which has a volcanic and glacial history. In addition, Burnaby, British Columbia is also rich in glacial history, silts, sands and clays, and contains the Frazier lowland that is rich in sediments.[12]

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Further Discussion

The possible association of certain mineral exposures with ALS, Parkinson's disease and other diseases of protein misfolding has been explored in further detail in a separate manuscript, including in areas away from glacial geology or lake exposure.[3] It has been discussed that mineral exposures might explain the association of Parkinson's disease with well-water use seen in many areas, including those distant from lakes.[3] In addition to the possible contamination of well water by natural ground minerals or by minerals in pesticide products, it should be noted that bentonites are also often used to seal wells, providing another potential exposure source. An increased rate of ALS has also been described in sports players.[3] A possible explanation based on the mineral hypothesis includes the application of topdressing or soil conditioning using calcined clay, a form of montmorillonite, on fields as a potential risk factor worthy of further study.

As ALS, Parkinson's disease and other disease of protein misfolding have remained some of the most mysterious and difficult diseases to understand, many potential risk factors and hypotheses are regularly explored by those interested exploring prevention and treatment of these conditions. Varied mineral exposures are in some sense ubiquitous, and therefore one must remain cautious when considering whether the association is one of coincidence or one of significance. Given the potential associations described here, further study is encouraged of the role of bentonite and mineral exposures in ALS, Parkinson's disease, and other protein misfolding diseases.

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