

High-Oleic Fatty Acid Foods May Help Multiple Sclerosis Patients

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The abnormal immune system response that causes multiple sclerosis (MS) by attacking and damaging the central nervous system can be triggered by the lack of oleic fatty acids in fat tissue, according to a new Yale study, published in *The Journal of Clinical Investigation*. The finding suggests that dietary change of adding high-oleic fatty acids foods might help some people with the autoimmune disease.

Fat tissue in patients diagnosed with MS lack normal levels of oleic fatty acids. The monounsaturated fatty acid is found in food this high oleic fatty acids foods such as cooking oils (olive, canola, safflower, soybean, sunflower and algal), meats (beef, chicken, and pork), cheese, nuts, sunflower seeds, eggs, pasta, milk, olives, and avocados.

This lack of oleic acids leads to a loss of the metabolic sensors that activate T cells, that mediate the immune system's response to infectious disease, the Yale team found. Without the suppressing effects of these regulatory T cells, the immune system can attack healthy central nervous system cells and cause the vision loss, pain, lack of coordination and other debilitating symptoms of MS.

When researchers introduced oleic acids into the fatty tissue of MS patients in laboratory experiments, levels of regulatory T cells increased, they found.

Tregs and Fatty Acid B-Oxidation

Numerous studies show that FOXP3⁺ regulatory T (Treg) cells are critical in maintaining immune tolerance and homeostasis of the immune system. And, the suppressive function of Tregs is critical for controlling immune responses and preventing autoimmunity. The researchers previously identified functional Treg defects in patients with autoimmune disease. Here is what is known and what the researchers found:

- FOXP3⁺ Tregs rely on fatty acid β -oxidation-driven (FAO-driven) oxidative phosphorylation (OXPHOS) for differentiation and function.

- Recent data demonstrate a role for Tregs in the maintenance of tissue homeostasis, with tissue-resident Tregs possessing tissue-specific transcriptomes. However, specific signals that establish tissue-resident Treg programs remain largely unknown.

More on Tregs and FAO

Tregs metabolically rely on fatty acid β -oxidation (FAO), and considering the lipid-rich environments of tissues, the researchers hypothesized that environmental lipids drive Treg homeostasis:

1. Using human adipose tissue to model tissue residency, researchers identified oleic acid as the most prevalent free fatty acid.
2. Mechanistically, oleic acid amplified Treg FAO-driven OXPHOS metabolism, creating a positive feedback mechanism that increased the expression of FOXP3 and phosphorylation of STAT5, which enhanced Treg-suppressive function.
3. Comparing the transcriptomic program induced by oleic acid with proinflammatory arachidonic acid, they found that Tregs sorted from peripheral blood and adipose tissue of healthy donors transcriptomically resembled the Tregs treated in vitro with oleic acid, whereas Tregs from patients with multiple sclerosis (MS) more closely resembled an arachidonic acid transcriptomic profile.
4. Finally, they found that oleic acid concentrations were reduced in patients with MS and that exposure of MS Tregs to oleic acid restored defects in their suppressive function. These data demonstrate the importance of fatty acids in regulating tissue inflammatory signals

“We’ve known for a while that both genetics and the environment play a role in the development of MS,” said senior author David Hafler, William S. and Lois Stiles Edgerly Professor of Neurology and professor of immunobiology and chair of the Department of Neurology. “This paper suggests that one of environmental factors involved is diet.”

Hafler noted that obesity triggers unhealthy levels of inflammation and is a known risk factor for MS, an observation that led him to study the role of diet in MS. He stressed, however, that more study is necessary to determine whether eating a diet high in oleic acid can help some MS patients.

Conclusion/ Researchers found that oleic acid concentrations were reduced in patients with MS. Exposure of MS Tregs to oleic acid restored defects in their suppressive function. These data demonstrate the importance of high oleic fatty acids in regulating tissue inflammatory signals. More studies are needed to establish if, how and why high oleic fatty acid foods might help some MS patients.