UC Irvine scientists uncovering link between gut E. coli and Parkinson’s disease

The interdisciplinary team identifies potential gut microbiome origins of disorder.
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Elizabeth Bess of the Department of Chemistry works to understand the human microbiome and the role it plays in our health.

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Steve Zylius / UC Irvine

Irvine, Calif., Oct. 24, 2024 — A research team led by University of California, Irvine scientists is a step closer to uncovering the mysterious origins of Parkinson's disease, finding that the incurable disorder appears to take root in the human gut.

"Parkinson's happens when proteins build up in regions of the brain that control body function," said Elizabeth Bess, professor in the Department of Chemistry and the lead researcher behind the work. "When those proteins build up in that part of the brain, it causes the neurons to die, and then people can't move their body in the way they'd like to."

Parkinson's disease causes patients to lose voluntary control of their bodily movements. It afflicts about a million people in the U.S.

Bess' lab specializes in studying the human microbiome – the community of trillions of microbes that live in your gut that are not genetically related to you. What Bess' interdisciplinary team found is that the protein chunks that aggregate in the brain and lead to Parkinson's appeared to form in the intestine as a result of the well-known *E. coli* bacteria, which resides in our gut.

The team found that waste produced by *E. coli* causes protein chunks – called alpha-synucleinaggregates – to form. The team published their work in *ACS Chemical Neuroscience*and in *ACS Chemical Biology*.

"There's evidence that these disease-causing protein clumps can travel from the gut to the brain along the vagus nerve that connects these organs," Bess said. "So, if you can stop the aggregates from forming in the gut, there's a chance that the proteins won't reach the brain and cause Parkinson's. And now that we know a way that these protein aggregates form, we can find ways to prevent their formation."

Bess' team, working with Penn State professor of electrical engineering Aida Ebrahimi, recently found that a component of coffee can prevent the protein aggregates from forming in intestinal cells. "Other studies have shown that drinking coffee decreases the risk of developing Parkinson's disease, and our findings shed light on how this could work," said Bess, whose team's findings are laying the groundwork for new treatments that target the proteins before they ever make it to the brain.

Now that the intestinal origins of the protein chunks are becoming clear, Bess and her team are planning to reveal the protein chunks' journey in greater detail. In collaboration with UC Irvine professor of chemistry Jennifer Prescher, Bess' team is tagging the proteins with bioluminescent molecules that emit light and are traceable as they move throughout the body.

"We can track the protein from intestinal cells and see if it goes into neurons, which is the proposed mechanism for getting from gut to brain," said Bess. "Clumps of alpha-synuclein are found in the gut many years before disease symptoms manifest, and so there's a real window of opportunity for stopping these pathogen proteins from forming before they become more of a problem."

The notion that a treatment for a disease like Parkinson's that afflicts the brain may begin in the gut is a new one.

"The idea that Parkinson's disease can start in the gut is a bit weird in terms of the typical dogma for thinking about Parkinson's disease," said Bess. "But our research is charting a map for how this is possible. We hope our work will open new avenues for better treatments to help people with this disease."

Funding sources include the NIH's National Institute of Neurological Disease and Stroke, and Scialog Grants sponsored jointly by Research Corporation for Science Advancement, the Frederick Gardner Cottrell Foundation and the Paul G. Allen Frontiers Group.

UC Irvine's Brilliant Future campaign: Publicly launched on Oct. 4, 2019, the Brilliant Future campaign aims to raise awareness and support for the university. By engaging 75,000 alumni and garnering $2 billion in philanthropic investment, UC Irvine seeks to reach new heights of excellence in student success, health and wellness, research and more. The School of Physical Sciences plays a vital role in the success of the campaign. Learn more at https://brilliantfuture.uci.edu/uci-school-of-physical-sciences/.

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