Exploring the Gut-Brain Connection:
Microbes, Nutrition, and Parkinson's Disease

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Key Learning Points:

- What role does the gut microbiome play in the development and progression of Parkinson's disease?
- How do gut microbes differ in individuals with Parkinson's?
- Which microbes are key players?
- How does nutrition and lifestyle shape gut microbe populations, influencing progression of the disease?
- How might therapeutic probiotics and dietary interventions effect Parkinson's symptoms?

Overview of the Gut Microbiome

Trillions of bacteria living in the gastrointestinal tract
Gut microbes influence our metabolism, immune system, mood and mental function, heart health, and digestive function.
Diet is a key factor in determining gut microbiome composition.
Large intestine is most hospitable to microbes.
Gut dysfunction and microbial over-growth is associated with inflammation and chronic disease.

Gastrointestinal Symptoms in People with Parkinson's

Dysfunction of the GI tract is seen in over 80% of PD patients.
Constipation affects 80-90% of people with PD and often precedes more overt PD motor symptoms
    Delayed gastric emptying - contents of stomach move sluggishly, leading to nausea and bloating
Bacterial communities in PD patients are different from healthy individuals.
Gut microbiome imbalances are seen even in early disease stage.
Type of gut flora change is associated with specific motor phenotype.

Enteric Nervous System

Enteric nervous system is found within the GI tract and communicates with the brain via vagus nerve
Alterations to gut-brain axis may contribute to development of PD
Damage to the vagus nerve and enteric nervous system in PD:
    Slows GI motility
    Common symptoms: delayed stomach emptying and constipation
    Proper motility protects against overgrowth
Parasympathetic nervous system dysregulation
    Leads to abnormal motor complexes
    Functional bowel disorders; i.e. chronic constipation/diarrhea

Microbes can promote gut motility
    Lactobacillus acidophilus and *Bifidobacterium bifidum*
Other microbes, like *Escherichia* (genus containing *E.coli*) , inhibit motility

Microbiome Changes in Parkinson's

Lower populations of *Prevotellaceae*
Different changes dependent on predominant PD motor symptoms
    Posture-and-gait-dominant symptoms showed higher *Enterobacteriaceae* populations compared to tremor-dominant symptoms
Higher risk for dysbiosis in colon as well as small intestine
    SIBO present in up to 50% of people with PD
    Parkinson's patients with SIBO have worse motor functions than PD those without SIBO
    Eradication of SIBO results in improved motor function
    Relapse rate of SIBO is very high - 44% even at 6 months after treatment
Evidence that *H. pylori* infection is associated with increased risk for PD
H. pylori infection present in about 1/3 of PD patients. may worsen motor fluctuations, similarly to SIBO

Intestinal Permeability and Inflammation

Microbes help maintain the health of the gut lining.
When beneficial microbe populations are low, health of colon cells and mucus lining suffers.
Increased intestinal permeability or "leaky gut" occurs and causes inflammatory response.
Dysbiosis leads to inflammation:
    Dysbiosis refers to states of imbalance within the gut microbiome.
    Leaky gut is associated with a state of low-grade systemic inflammation.
    Inflammation occurs when normal commensal microbes "leak" into blood stream.
Increased intestinal permeability is correlated with markers of oxidative stress and risk for SIBO

Bacteria Work to Repair the Gut

Bacteria digest carbohydrates through the process of fermentation
This produces SHORT CHAIN FATTY ACIDS (SCFAs).
SCFAs keep the lining of the gut strong and healthy
Lower the pH of the in the large intestine, making it less hospitable for harmful bacteria
Serve as an energy source for colon cells (up to 60-70%)
Increases mucus production

Microbes and REM Sleep

Sleep disorders appear to precede PD development, previously considered a consequence of the disease
Over 80% of people with REM sleep disorder eventually develop neurodegenerative diseases.
Bacteria help induce the production of circadian-rhythm-regulating cytokines
Circadian rhythm disruption may influence PD
    Alpha-synuclein clustering around regions of the brain that regulate REM sleep.

Supplements to Heal the Gut *

Prebiotics and high-quality probiotics
Herbal Antibiotics:
- Oil of oregano
- Berberine (Goldenseal, Oregon grape)

L-Glutamine: Amino acid to improve health of colon cells and tight junctions, thus reducing leaky gut
N-acetyl glucosamine also improve tight junctions.
Herbal bitters may promote natural stomach acid production and improve digestion
Digestive enzymes to reduce GI discomfort (gas, bloating)
Slippery elm and marshmallow root - mucilaginous quality that create protective layer along gut lining

*Consult with medical professional before taking supplements. Be cautious of herb-medicine interactions.