Medical University of Graz

Enrich your microbiome: effects of positive environmental modulation on microbiota-gut-brain axis signaling

Summary

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Supervisor:	Dr. Florian Reichmann
Availability:	This position is available.
Offered by:	Medical University of Graz
Application deadline:	Applications are accepted between August 03, 2022 00:00 and September 20, 2022 23:59 (Europe/Zurich)

Description

Background:

Gut-brain axis signalling describes the dynamic, bidirectional communication between visceral organs and the brain. Signals from the brain are essential to maintain gut homeostasis and gut-derived neural, humoral, immunological and microbial signals are able to influence many brain functions and neurobiology (1). While aversive environmental factors such as chronic stress are known to have a marked impact on the microbiota-gut-brain axis, it is unknown whether beneficial environmental factors have a similar strong effect.

Hypothesis and Objectives:

This project sets out to investigate for the first time, whether and how a widely recognised positive environmental intervention influences the microbiota-gut-brain axis with a focus on gastrointestinal microbiota and microbial metabolites. We hypothesize that (i) environmental enrichment (EE), a set of refined husbandry procedures known to improve laboratory animal housing and to beneficially modulate animal behavior and neurobiology (2), is able to change the gastrointestinal microbiome and levels of microbial metabolites. We further hypothesize that (ii) microbial alterations are essential in mediating the well-known beneficial behavioural and neurobiological effects of EE and that (iii) microbial changes/metabolites altered by EE can mimic the beneficial effects of the intervention.

Methodology:

The recruited PhD student will use mice and zebrafish EE models to investigate the connections between the gastrointestinal microbiome and EE. Interventions, besides EE, include antibiotics to deplete the gastrointestinal microbiota, germ-free animal models and fecal microbiota transplantations between the treatment groups. Readouts include big data analysis such as bacterial community profiling (16S and/or shotgun metagenomics) within the gut and RNAseq of intestinal cells and neurons. Potential circulating mediators will be identified by flow cytometry, ELISAs and MS-based metabolomics. A battery of behavioural tests will be used to assess the effects of the experimental interventions on brain functions such as anxiety, cognition, social and depressive-like behaviour. These readouts will be complemented with gene/protein expression profiling of mediators known to be altered by EE and newly identified target genes/proteins of interest.

References:

1. Cryan JF, O'Riordan KJ, Cowan CSM et al. The Microbiota-Gut-Brain Axis. Physiological Reviews 2019 99:4, 1877-2013.

2. Nithianantharajah J, Hannan AJ. Enriched environments, experience-dependent plasticity and disorders of the nervous system. Nat Rev Neurosci 2006 Sep;7(9):697-709