Master/Diploma thesis in Sinner and Ebner lab collaboration

Molecular mechanisms of postoperative delirium and cognitive dysfunction

Looking for highly motivated Master's and Diploma students to join a collaborative clinical and cell biological project between Innsbruck University Hospital for Anaesthesia and Intensive Care (Director Prof. Dr. med Barbara Sinner, MBA) and the Ebner lab in the Biocenter of the Medical University of Innsbruck (Institute of Molecular Biochemistry). MSc and Diploma students will receive a contract with a salary. Start date winter semester 2026 or summer semester 2027.

Postoperative delirium (POD) and cognitive dysfunction (POCD) frequently affect elderly patients with POCD incidence reaching up to 25%. POD and POCD are caused by neuroinflammation likely incited by hyperactivated microglia cells in the CNS. However, treatment options are currently limited and two central aspects of this process are incompletely understood: First, which anaesthetics in combination with which components in the blood serum are triggering microglia inflammation and second, what are the autonomous pathways in microglia that are signaling the presence of anaesthetics and blood serum components to the inflammatory pathways, particularly to the NLRP3 inflammosome?

Aim of the project: In the advertised project the student will establish an *in vitro* microglia model for POD/POCD and systematically test commonly used anaesthetics and patient sera for their capacity to activate inflammatory pathways in microglia cells and set up genetic and compound screening platforms to discover molecular pathways that drive inflammation and compounds that can counteract activation of these pathways.

Technologies: Tissue culture, live cell fluorescence microscopy, image analysis, CRISPR Cas9 gene editing, molecular biology & biochemistry, ELISA.

Interested? Contact Barbara Sinner (barbara.sinner@i-med.ac.at) or Michael Ebner (michael.ebner@i-med.ac.at)

MEDIZINISCHE UNIVERSITÄT INNSBRUCK

Master/Diploma thesis in Ebner lab: Regulation of Lysosomal Lipid Flux

Looking for highly motivated Master's and Diploma students to join an ERC-funded cell biology project at the Biocenter, Medical University of Innsbruck (Institute of Molecular Biochemistry). MSc and Diploma students will receive a contract with a salary. Start date winter semester 2026 or summer semester 2027.

Neurodegenerative diseases are driven by defects in lysosomes, which are the central degradative organelle of all cells and function as logistic centres of cellular metabolite flux. A frequent denominator in these neuropathological conditions is the deposition of lipids and lipid metabolites in the lysosomal lumen which leads to the accumulation of dysfunctional lysosomes, inflammatory responses, and cell death. The molecular mechanisms governing lipid flux through lysosomes are poorly understood, despite their importance for human disease.

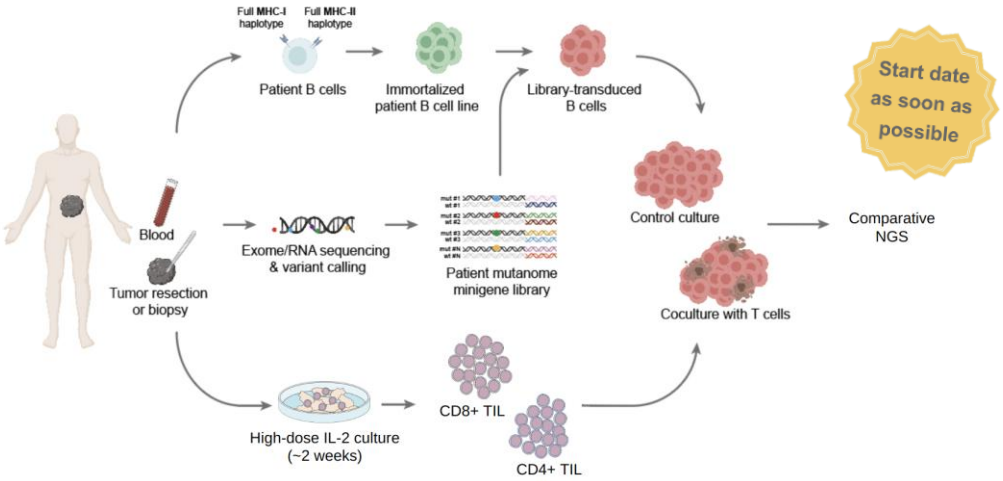
Aim of the project: In the advertised project the student will learn and refine biochemical and microscopy techniques to study novel regulatory pathways of lysosomal lipid flux and test their relevance in cellular models of rare genetic neurodegenerative diseases.

Technologies: Tissue culture, live cell fluorescence microscopy, gene knockdown, CRISPR Cas9 gene editing, molecular biology & biochemistry, lipid flux analysis.

Interested? Contact Michael Ebner: michael.ebner@i-med.ac.at

Master Thesis Opportunity in Molecular Medicine: Adoptive Cell Therapy and T-Cell Epitope Recognition (computational)

Are you passionate about cutting-edge cancer research and bioinformatics? Join our research group for a **Master's Thesis in Molecular Medicine**, focusing on **Adoptive Cell Therapy**!



The Challenge:

Adoptive cell therapy involves enriching and reinfusing T-cells into cancer patients, but identifying which T-cells target specific cancer-related neoantigens remains a "black box." In research with our experimental collaborators, we sequence cancer patients' genomes to identify potential neoantigens and T-cell receptor (TCR) sequences. These neoantigens are then tested in a **co-culture system** with T-cells harboring patient-specific TCRs, allowing us to understand which neoantigens are recognized and eliminated by which T-cells.

Your Role:

We are a **bioinformatics-focused research group** using the **R programming language** to develop tools that analyze data from these co-culture experiments. The goal of this Master's thesis project is to **improve the way we quantify minigenes in DNA sequencing data** to analyze and interpret the relationships between neoantigens and TCRs, thereby advancing personalized cancer therapies.

What You'll Gain:

- Hands-on experience with **bioinformatics** and **cancer immunotherapy**
- Develop skills in **R programming** and **data analysis** for immunological applications
- Contribute to the advancement of **precision medicine** in cancer treatment

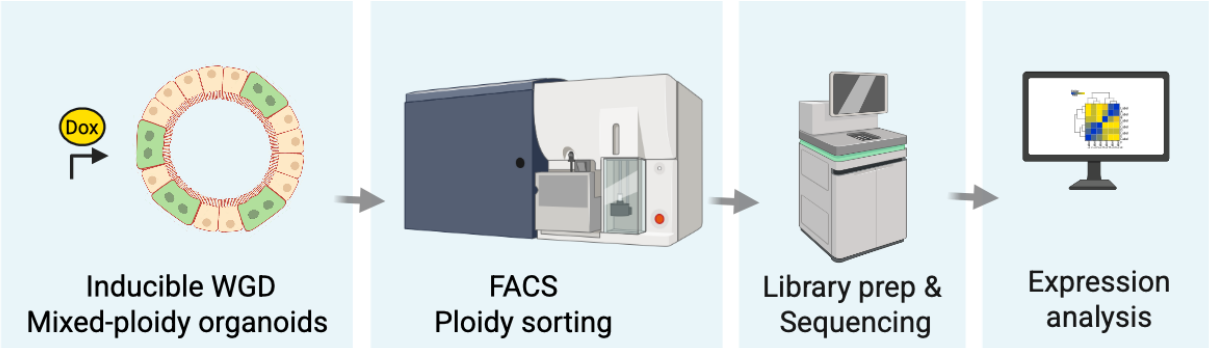
If you're excited to bridge the gap between cancer immunology and bioinformatics, please contact Asst. Prof. Michael Schubert (m.schubert@i-med.ac.at) stating your background, previous experience (if any), and when you are planning to work on your thesis project!

Master's thesis project:
Whole Genome Duplication & Gene Expression in Intestinal Organoids

We are looking for a motivated Master's student excited to get training in **advanced organoid work and gene expression analysis**.

Background

Most eukaryotic organisms and cell types are diploid, meaning they have two sets of homologous chromosomes. The term polyploidy, also known as **whole genome duplication** (WGD), defines a condition in which the entire set of chromosomes of a cell is duplicated. Whole genome duplication occurs in select mammalian tissues but its role remains poorly understood. Cells with increased genome content **differ in size, metabolism, and stress responses**. While physiological WGD is critical for certain tissues such as liver and heart, it is also a **key step in tumor evolution**, driving genomic instability and adaptation. Understanding how this state changes cell behavior is essential for studying tissue regeneration, disease, and tumorigenesis.



Project Summary
This project uses mouse **intestinal organoids** that can be experimentally driven into whole genome duplication. Organoids will be dissociated into single cells, sorted by ploidy using flow cytometry (FACS), and subjected to **bulk RNA sequencing**. Comparing transcriptional profiles across ploidy states will reveal how genome doubling affects metabolic pathways, stress responses, and senescence-associated programs.

Methods & Supervision
Wet lab *(with Valentina Sladky, Institute of Developmental Immunology):*
- Intestinal organoid culture and manipulation techniques
- Advanced microscopy
- Flow cytometry–based single-cell sorting
- RNA extraction and QC for sequencing

Computational (with Michael Schubert, Institute of Bioinformatics):
- RNA-seq processing (alignment, quantification, QC)
- Differential expression and pathway analysis
- Data visualization and interpretation

Contacts:
valentina.sladky@i-med.ac.at, https://dev-immuno.i-med.ac.at
m.schubert@i-med.ac.at, https://icbi.i-med.ac.at

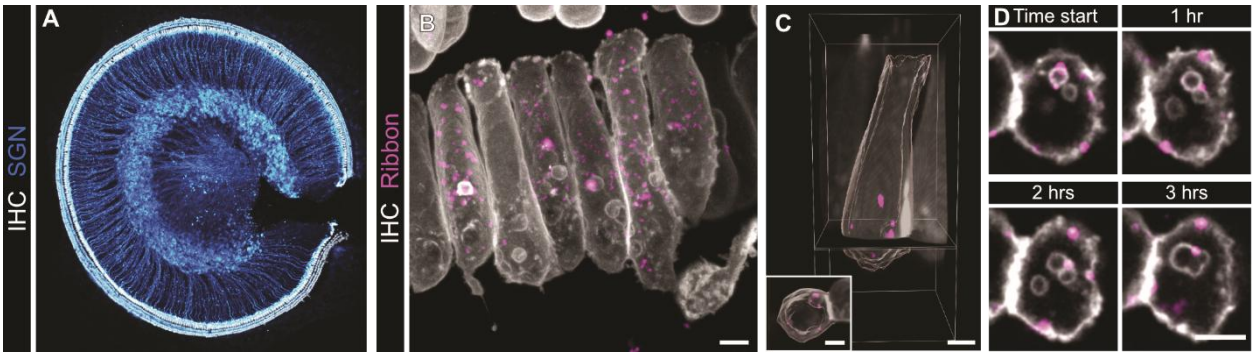
Unraveling the role of synaptic autophagy in inner ear development

Sound perception in mammals takes place in the cochlea. Here, auditory inner hair cells (IHCs) convert acoustic stimuli into a chemical signal to activate spiral ganglion neurons (SGNs). The IHCs connect to the afferent SGN via specialized synapses, so called “ribbon synapses”, which are optimized for the temporally precise and tonic release of glutamate. This continuous signal transduction is facilitated by an extremely high metabolism at the IHC synapse and poses a challenge to the maintenance of presynaptic homeostasis. At conventional synapses, this balance is maintained by presynaptic autophagy: a tightly regulated process by which excess or dysfunctional proteins and organelles are cleared from the axonal terminal. It is likely that a similar involvement of autophagy is present at the presynapse of IHCs, especially since disruptions in autophagy-associated proteins have been linked to specific types of hearing loss.

In this project, we aim to investigate the correlation between synapse maturation, synaptic activity and autophagic degradation in developing IHCs. We will use novel live-cell imaging techniques that have been developed by our lab specifically for the *in situ* tracking of IHC synapses within the three-dimensional structure of the organ of Corti. We aim to create a spatio-temporal map of the presynaptic autophagic flux in IHCs, in combination with the tracing of autophagosome dynamics in real time. You will get hands-on experience with all steps of the experimental pipeline:

Primary tissue culture (organotypic culturing of the sensory epithelium of mice) • 3D multi-color live-cell imaging • Immunohistochemistry

- Super-resolution microscopy
- Data analysis: confocal and time-lapse image processing, particle tracking, colocalization



We are looking for enthusiastic, naturally curious, and motivated MSc students to join our Auditory Neuroscience lab. Do you have an eye for microscopy and does a deep dive into the development of the inner ear sound good to you? Come and help us out on this exciting new project!

Project: Master internship + thesis
Start date: March/April 2025 Duration: ± 6 months
Official title: Unraveling the role of presynaptic autophagy in cochlear inner hair cell ribbon synapse development
Lab website: https://cavx.at/group-vogl/
Contact: roos.voorn@i-med.ac.at or christian.vogl@i-med.ac.at

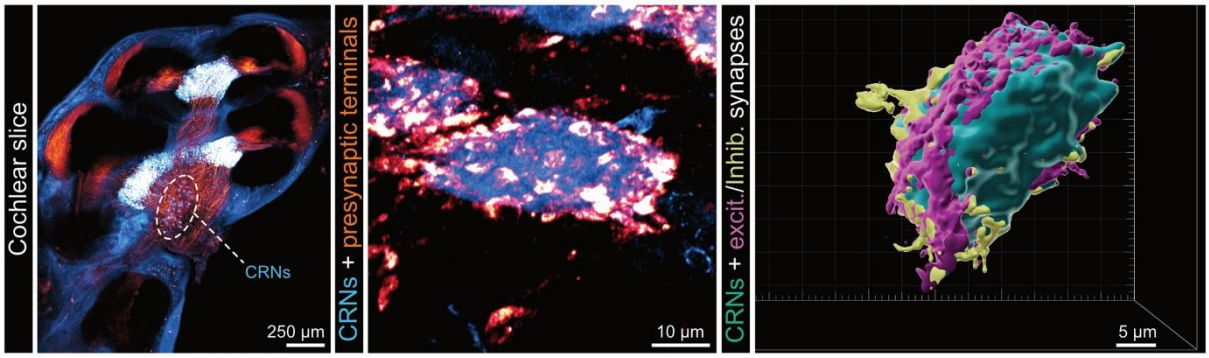
Auditory startle reflex: a cross-species analysis of cochlear root neurons in the peripheral auditory pathway

It is a phenomenon known to all of us: An intense unexpected sound elicits a reflective movement away from its source, coined as the *auditory startle reflex*. This reflex is a widespread occurrence amongst mammals. While the behavioral output is already in use to investigate cognitive, sensory and mental disorders in human and animals (Fawcett et al., 2023) a systematic anatomical, morphological and functional description of its neural basis, the so-called *cochlear root neurons* (CRNs), between species is lacking to date.

In this project, we therefore opt to characterize CRNs across multiple mammalian species regarding their anatomical localization within the peripheral auditory pathway, their cellular architecture, molecular make-up as the basis for excitability, as well as their afferent and efferent connectome. This study will be conducted using a mixture of whole-tissue chemical clearing protocols, fluorescence-based labelling techniques, high-resolution light microscopy based large volume imaging and 3D reconstructions for analysis.

You will acquire the following core techniques:

- Acute dissection of the peripheral auditory pathway (mouse, rat, gerbil, potentially human)
- Neuronal tracing using injection of lipophilic fluorescent dyes
- Immunohistochemical labeling techniques
- Whole-tissue chemical clearing approaches (iDisco, CUBIC)
- Confocal microscopy
- Large volume light-sheet fluorescence microscopy
- 3D volume reconstructions



If you are interested in basic neuroscience research and would like to obtain expertise in state-of-the-art imaging as well as analysis techniques, contact us!

Project: Master internship + thesis
Start date: March/April 2025
Duration: ± 6 months
Official title: Unraveling the role of presynaptic autophagy in cochlear inner hair cell ribbon synapse development
Lab website: https://cavx.at/group-vogl/
Contact: jan-frederik.ahrend@i-med.ac.at or christian.vogl@i-med.ac.at

Open PhD position (f/m/d) at the Department of Pediatrics III (Pediatric Cardiology, Pulmonology, and Cystic Fibrosis), Medical University of Innsbruck, Austria.

The job

The offered PhD position is part of a FWF-funded Principal Investigator project bound to the Tenure Track position for Pediatric Cardiology (metabolic cardiodiagnostics) (KLIF1036, NCT04764305). The project focuses on regulatory processes on the molecular level in patients with complex congenital heart disease before, and after Fontan operation, esp. on translational multi-omics regulatory analyses with network establishment aiming at risk stratification for the development of Fontan-associated comorbidities: Understanding Fontan through molecular and cellular approaches - Fontanology (https://fontanology.org/) (doi: 10.3390/ijms25105416, doi: 10.1038/s41598-020-65852-x).

Based on the outlined research, an expansion of the currently binational to a multinational multicenter study with the aim of implementing a European registry on omics research in these patients will be part of the PhD task, as will be the implementation of an interventional study-arm on the use of middle chain triglycerides in those patients (doi: 10.3390/metabo13080932).

The applicant ideally will be enthusiastic about working with large-scale datasets, and motivated in conducting statistical analyses using sophisticated methods. He/she will be an integral part of our multidisciplinary team. Good communication skills (English, German), independence, and a sense of proactivity and responsibility are required.

Your profile

- Master's degree in a relevant subject such as molecular medicine, biology, biochemistry,
- biostatistics, bioinformatics, or equivalent
- Interested in research on cardiometabolic disease
- Motivated to learn new tasks and being able to work independently
- Skilled in programming statistical software
- Experience in programming in high-performance computing environments is a plus
- Strong team player with excellent interpersonal and clear communication skills
- Keen to be engaged in a multi-disciplinary team
- Evidence of scientific rigor as documented by first author peer-reviewed publications
- Fluent in English both oral and written
- Proactivity and responsibility are mandatory

We offer

- Immediately available 75% PhD position for 4 years
- An interesting research project using cutting-edge statistical methods
- Integration into a supportive and interdisciplinary research environment
- International collaborations
- For a 75% post, annually gross salary about € 33.432

Venue

Innsbruck is a both historic and modern university town of 130.000 inhabitants, in the heart of the alps, combining urban comfort and country idyll. It is an excellent base for numerous outdoor activities such as skiing, hiking or biking.

Contact

To apply: Please e-mail your CV, a letter of motivation, and names and contact information for 2-3 references to: Ass.-Prof. PD Dr. Miriam Michel, e-mail: miriam.michel@i-med.ac.at