Seminar/Talk

Quantitative modeling of bile secretion and transport in the liver

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Host: Carl-Philipp Heisenberg

Transport processes are essential for proper function of secretoryorgans or glands, including liver, pancreas, and salivary glands.Aberrant transport is associated with diseases, like primary sclerosingcholangitis (PSC) in the liver, that have been a matter of clinical andtranslational studies for a long time. Bodily fluid secretion is aresult of an intricate combination of active transport by the epithelialcells and passive transport along a chemical potential gradient. Theformer involves vesicular trafficking that relies on small intracellularcompartments, called vesicles, and trans-membrane transporter proteinsas their cargo, and active pumping of osmolites by respectivetransporter protein. For the latter, osmosis drives the water fluxdirected against the chemical potential gradient induced by osmoliteexcess in the duct and, thereby, sets the secreted fluid in motion.Previous studies offer some qualitative insight into the secretoryprocess, but a detailed quantification has not yet been possible. Due tothe highly intricate geometry of the respective organs and non-linearityof the underlying biophysical theory, currently, neither experimentalnor theoretical studies have arrived at a detailed quantitativeunderstanding of the processes underlying secretion.During my PhD, I developed a biophysical model to describe transportprocesses in the mammalian secretory organs and glands. First, I deriveda model for osmosis-driven fluid outflow from a channel with porouswalls and then used analytic tools to study it. Then I used my model tostudy and predict bile secretion and transport in the murine liver basedon data from intravital microscopy revealing a (minor) contribution ofperistalsis to bile flow. Finally, I applied my model to a long-standingissue in the field of hepatology concerning administration ofursodeoxycholic acid (UDCA) in patients with PSC.

Monday, June 25, 2018 11:00am - 12:15pm
Meeting room 2nd floor / Bertalanffy Bldg. (I04.2OG - LAB)

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