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RESEARCH AREA

One of the most important tasks of the cells that build up our organs is to maintain our internal homeostasis, as disruption of this can trigger stress. Cellular stress can subsequently force the cell to choose between autophagy-dependent self-digestion for survival or cell death (e.g. apoptosis or necrosis). As these stress processes are induced in some of the most common human diseases (e.g. diabetes, inflammatory bowel disease, neurodegenerative diseases), studying the functioning of the regulatory network that governs the cellular stress response is crucial.

The main aim of our research is to:

1. reveal the essential regulatory motifs and cross-links of the life-and-death decision to understand the dynamic behaviour of the system;

2. test novel agents that can enhance cell viability in an autophagy-dependent manner under different cellular stresses and thus may later be of therapeutic relevance.

While the molecular biology tools we use can be used to identify unknown elements and connections in the network, mathematical models are used to perform computational simulations to provide a qualitative characterisation.

TECHNIQUES AVAILABLE IN THE LAB

To answer our scientific questions, we use a systems biology approach, involving the coordinated use of both molecular experimental and theoretical biological tools.

1. classical molecular biology methods: DNA and RNA isolation, qPCR, immunoblotting, transfection, various cell culture and genotyping methods;
2. theoretical biology methods: creation/analysis of bioinformatics databases, execution of computer simulations using various theoretical biology tools.

SELECTED PUBLICATIONS

Kapuy, O. (2024) Mechanism of Decision Making between Autophagy and Apoptosis Induction upon Endoplasmic Reticulum Stress. **Int J Mol Sci 25(8):** 4368.

Hajdú, B., Csabai, L., Márton, M., Holczer, M., Korcsmáros, T., **Kapuy, O.** (2023) Oscillation of Autophagy Induction under Cellular Stress and What Lies behind It, a Systems Biology Study. **Int J Mol Sci 24(8):** 7671.

Kapuy, O., Holczer, M., Márton, M., Korcsmáros, T. (2021) Autophagy-dependent survival is controlled with a unique regulatory network upon various cellular stress events. **Cell Death Dis 12(4):** 309.

Holczer, M., Hajdú, B., Lőrincz, T., Szarka, A., Bánhegyi, G., **Kapuy, O.** (2020) Fine-tuning of AMPK–ULK1–mTORC1 regulatory triangle is crucial for autophagy oscillation. **Sci Rep 10(1):** 17803.

Kosztelnik, M., Kurucz, A., Papp, D., Jones, E., Sigmond, T., Barna, J., Traka, MH., Lorincz, T., Szarka, A., Banhegyi, G., Vellai, T., Korcsmaros, T., **Kapuy, O.** (2019) Suppression of AMPK/aak-2 by NRF2/SKN-1 down-regulates autophagy during prolonged oxidative stress. **FASEB J 33(2):** 2372-2387.