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TCA Cycle and Mitochondrial Membrane Potential Are Necessary for Diverse Biological Functions.

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Mitochondrial metabolism is necessary for the maintenance of oxidative TCA cycle function and mitochondrial membrane potential. Previous attempts to decipher whether mitochondria are necessary for biological outcomes have been hampered by genetic and pharmacologic methods that simultaneously disrupt multiple functions linked to mitochondrial metabolism. Here, we report that inducible depletion of mitochondrial DNA ($\rho(o)$ cells) diminished respiration, oxidative TCA cycle function, and the mitochondrial membrane potential, resulting in diminished cell proliferation, hypoxic activation of HIF-1, and specific histone acetylation marks. Genetic reconstitution only of the oxidative TCA cycle function specifically in these inducible $\rho(o)$ cells restored metabolites, resulting in re-establishment of histone acetylation. In contrast, genetic reconstitution of the mitochondrial membrane potential restored ROS, which were necessary for hypoxic activation of HIF-1 and cell proliferation. These results indicate that distinct mitochondrial functions associated with respiration are necessary for cell proliferation, epigenetics, and HIF-1 activation.

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Plant mitochondrial Complex I composition and assembly: A review.

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In the mitochondrial inner membrane, oxidative phosphorylation generates ATP via the operation of several multimeric enzymes. The proton-pumping Complex I (NADH:ubiquinone oxidoreductase) is the first and most complicated enzyme required in this process. Complex I is an L-shaped enzyme consisting of more than 40 subunits, one FMN molecule and eight Fe-S clusters. In recent years, genetic and proteomic analyses of Complex I mutants in various model systems, including plants, have provided valuable insights into the assembly of this multimeric enzyme. Assisted by a number of key players, referred to as "assembly factors", the assembly of Complex I takes place in a sequential and modular manner. Although a number of factors have been identified, their precise function in mediating Complex I assembly still remains to be elucidated. This review summarizes our current knowledge of plant Complex I composition and assembly derived from studies in plant model systems such as *Arabidopsis thaliana* and *Chlamydomonas reinhardtii*. Plant Complex I is highly conserved and comprises a significant number of subunits also present in mammalian and fungal Complexes I. Plant Complex I also contains additional subunits absent from the mammalian and fungal counterpart, whose function in enzyme activity and assembly is not clearly understood. While 14 assembly factors have been identified for human Complex I, only two proteins, namely GLDH and INDH, have been established as bona fide assembly factors for plant Complex I. This article is part of a Special Issue entitled Respiratory complex I, edited by Volkerzickermann and Ulrich Brandt.

Mary

ATPase-Modulated Stress Granules Contain a Diverse Proteome and Substructure
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Stress granules are mRNA-protein granules that form when translation initiation is limited, and they are related to pathological granules in various neurodegenerative diseases. Super-resolution microscopy reveals stable substructures, referred to as cores, within stress granules that can be purified. Proteomic analysis of stress granule cores reveals a dense network of protein-protein interactions and links between stress granules and human diseases and identifies ATP-dependent helicases and protein remodelers as conserved stress granule components. ATP is required for stress granule assembly and dynamics. Moreover, multiple ATP-driven machines affect stress granules differently, with the CCT complex inhibiting stress granule assembly, while the MCM and RVB complexes promote stress granule persistence. Our observations suggest that stress granules contain a stable core structure surrounded by a dynamic shell with assembly, disassembly, and transitions between the core and shell modulated by numerous protein and RNA remodeling complexes.

Keith

High-fidelity CRISPR–Cas9 nucleases with no detectable genome-wide off-target effects

Nature 529, 490–495 (28 January 2016)

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CRISPR–Cas9 nucleases are widely used for genome editing but can induce unwanted off-target mutations. Existing strategies for reducing genome-wide off-target effects of the widely used *Streptococcus pyogenes* Cas9 (SpCas9) are imperfect, possessing only partial or unproven efficacies and other limitations that constrain their use. Here we describe SpCas9-HF1, a high-fidelity variant harbouring alterations designed to reduce non-specific DNA contacts. SpCas9-HF1 retains on-target activities comparable to wild-type SpCas9 with >85% of single-guide RNAs (sgRNAs) tested in human cells. Notably, with sgRNAs targeted to standard non-repetitive sequences, SpCas9-HF1 rendered all or nearly all off-target events undetectable by genome-wide break capture and targeted sequencing methods. Even for atypical, repetitive target sites, the vast majority of off-target mutations induced by wild-type SpCas9 were not detected with SpCas9-HF1. With its exceptional precision, SpCas9-HF1 provides an alternative to wild-type SpCas9 for research and therapeutic applications. More broadly, our results suggest a general strategy for optimizing genome-wide specificities of other CRISPR-RNA-guided nucleases.

Small Heat Shock Proteins are Novel Common Determinants of Alcohol and Nicotine Sensitivity in *Caenorhabditis elegans*.

Genetics. 2016 Jan 15. pii: genetics.115.185025.

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University of Liverpool

Addiction to drugs is strongly determined by multiple genetic factors. Alcohol and nicotine produce distinct pharmacological effects within the nervous system

through discrete molecular targets; yet, data from family and twin analyses support the existence of common genetic factors for addiction in general. The mechanisms underlying addiction, however, are poorly described and common genetic factors for alcohol and nicotine remain unidentified. We investigated the role that the heat shock transcription factor, HSF-1, and its downstream effectors played as common genetic modulators of sensitivity to addictive substances. Using *Caenorhabditis elegans*, an exemplary model organism with substance dose-dependent responses similar to mammals, we demonstrate that HSF-1 altered sensitivity to both alcohol and nicotine. Using a combination of targeted RNAi screen of downstream factors and transgenic approaches we identified that these effects were contingent upon the constitutive neuronal expression of HSP-16.48, a small heat shock protein (HSP) homologue of human α -crystallin. Furthermore we demonstrated that the function of HSP-16.48 in drug sensitivity surprisingly was independent of chaperone activity during the heat shock stress response. Instead we identified a distinct domain within the N-terminal region of the HSP-16.48 protein that specified its function in comparison to related small HSPs. Our findings establish and characterise a novel genetic determinant underlying sensitivity to diverse addictive substances. stress response.

REVIEW

Protein misfolding in the endoplasmic reticulum as a conduit to human disease

Nature 529, 326–335 (21 January 2016)

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In eukaryotic cells, the endoplasmic reticulum is essential for the folding and trafficking of proteins that enter the secretory pathway. Environmental insults or increased protein synthesis often lead to protein misfolding in the organelle, the accumulation of misfolded or unfolded proteins — known as endoplasmic reticulum stress — and the activation of the adaptive unfolded protein response to restore homeostasis. If protein misfolding is not resolved, cells die. Endoplasmic reticulum stress and activation of the unfolded protein response help to determine cell fate and function. Furthermore, endoplasmic reticulum stress contributes to the etiology of many human diseases.

Zebrafish as a Model for the Study of Chaperonopathies.

J Cell Physiol. 2016 Jan 27.

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There is considerable information on the clinical manifestations and mode of inheritance for many genetic chaperonopathies but little is known on the molecular mechanisms underlying the cell and tissue abnormalities that characterize them. This scarcity of knowledge is mostly due to the lack of appropriate animal models that mimic closely the human molecular, cellular, and histological characteristics. In this article we introduce zebrafish as a suitable model to study molecular and cellular mechanisms pertaining to human chaperonopathies. Genetic chaperonopathies manifest themselves from very early in life so it is necessary to examine the impact of mutant chaperone genes during development, starting with fertilization and proceeding throughout the entire ontogenetic process. Zebrafish is amenable to such developmental analysis as well as studies during adulthood. In addition, the zebrafish genome contains a wide range of genes encoding proteins similar to those that form the chaperoning system of humans. This, together with the availability of techniques for genetic manipulations and for examination of all stages of development, makes zebrafish the organism of choice for the analysis of the molecular features and pathogenic mechanisms pertaining to human chaperonopathies

Elizabeth

The Arabidopsis NRG2 protein mediates nitrate signaling and interacts with and regulates key nitrate regulators

Na Xu, Rongchen Wang, Lufei Zhao, Chengfei Zhang, Zehui Li, Zhao Lei, Fei Liu, Peizhu Guan, Zhaohui Chu, Nigel Crawford, and Yong Wang

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doi:10.1105/tpc.15.00567 **OPEN**

<http://www.plantcell.org/content/early/2016/01/07/tpc.15.00567.abstract>

Immobilized subpopulations of leaf epidermal mitochondria mediate PEN2-dependent pathogen entry control in Arabidopsis

Rene Fuchs, Michaela Kopschke, Christine Klapprodt, Gerd Hause, Andreas J. Meyer, Markus Schwarzländer, Mark David Fricker, and Volker Lipka

Plant Cell 2016 tpc.15.00887; Advance Publication December 31, 2015;

doi:10.1105/tpc.15.00887

<http://www.plantcell.org/content/early/2016/01/04/tpc.15.00887.abstract>

It's time for some "site"-seeing: novel tools to monitor the ubiquitin landscape in *Arabidopsis thaliana*

Alan Walton, Elisabeth Stes, Nicolas Cybulski, Michiel Van Bel, Sabrina Inigo, Astrid Nagels Durand, Evy Timmerman, Jefri Heyman, Laurens Pauwels, Lieven De Veylder, Alain Goossens, Ive De Smet, Frederik Coppens, Sofie Goormachtig, and Kris Gevaert
Plant Cell 2016 tpc.15.00878; Advance Publication January 7, 2016;

doi:10.1105/tpc.15.00878

<http://www.plantcell.org/content/early/2016/01/07/tpc.15.00878.abstract>

Cell

Nitric Oxide as a Switching Mechanism between Axon Degeneration and Regrowth during Developmental Remodeling Pages 170-182 Dana Rabinovich, Shiri P. Yaniv, Idan Alyagor, Oren Schuldiner

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