Contribution ID : **65** Type : **not specified**

Force-biased nuclear import sets nuclear-cytoplasmic volumetric coupling by osmosis.

We have developed an innovative approach to simultaneously measure the volume of the cell and the volume of the nucleus in live cultured cells. Through this method, we have made a surprising discovery that challenges the conventional understanding of cellular growth. While the cytoplasm grows exponentially, in line with previous findings, we have found that the nucleus grows linearly. This contradicts the widely accepted notion that the scaling of nuclear and cellular volumes follows a universal law driven by osmotic balance across the nuclear envelope. Our groundbreaking research provides the first direct simultaneous observation of nuclear and cellular volume in single live mammalian cells. These observations defy a simple explanation based on osmotic balance, which predicts a constant ratio between the volumes of the nucleus and the cytoplasm as the cell grows. Through a combination of experiments and physical modeling, we have demonstrated that our findings can be explained by two well-established elements. Firstly, the ratio of the nucleus and cytoplasm volumes depends on an osmotic balance influenced by the ratio of protein contents in these compartments, which is determined by the import/export balance. Secondly, the forces exerted on the nucleus modulate the import/export balance. Consequently, changes in these forces lead to variations in import/export processes, altering the ratio of protein contents between the nucleus and the cytoplasm, thus influencing the ratio of their volumes. This general mechanism, ultimately impacting the concentration of nuclear proteins, including transcription factors, could have significant implications for nuclear organization, control of gene expression, and overall cell homeostasis [Pennacchio et al., Nat Commun 2024 - https://doi.org/10.1038/s41467-024-45168-4].

Department

Dipartimento di Medicina Molecolare e Biotecnologie Mediche

Primary author(s) : Dr. PENNACCHIO, Fabrizio A.; Dr. POLI, Alessandro; Dr. PRAMOTTON, Francesca Michela; Dr. LAVORE, Stefania; Dr. RANCATI, Ilaria; Dr. CINQUANTA, Mario; Dr. VORSELEN, Daan; Dr. PRINA, Elisabetta; Dr. ROMANO, Orso Maria; Dr. FERRARI, Aldo; Dr. PIEL, Matthieu; Prof. COSENTINO LAGOMARSINO, Marco; Prof. MAIURI, Paolo (Department of Molecular Medicine and Medical Biotechnology, Università degli Studi di Napoli "Federico II")

Presenter(s) : Prof. MAIURI, Paolo (Department of Molecular Medicine and Medical Biotechnology, Università degli Studi di Napoli "Federico II")