

Systemic properties of carcinogenesis: Lessons from studies on the Earth and in the Space.

Serhiy Souchelnyskiy, his research group and collaborators
College of Medicine, QU Health, Qatar University, Doha, Qatar; ; qu.edu.qa/medicine;
email: serhiy@qu.edu.qa; www.serhiysouchelnyskiy.expert

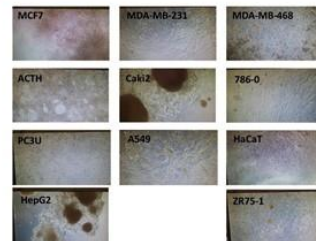
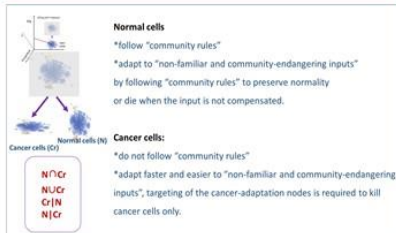
Aim

Describe systemic properties of tumorigenesis. This poster reports data on systemic properties of acquisition of invasiveness and on using the space experimentation.

Rationale

Networks are more accurate descriptions of cancer regulatory mechanisms, in comparison to lists of oncogenes and tumor suppressors. To extract essential regulators (nodes) and connections (edges), interrogations of these networks are performed, e.g. cancer cells are subjected to different treatments. Interrogation of cancer cells under variable g-forces is the treatment to which cancer cells are not normally exposed. Therefore, low (weightlessness) and high (acceleration) g-forces may trigger responses which may differ in part of followers from responses on the Earth, but still engage carcinogenesis-essential drivers nodes and edges.

Results (space contribution)



Images above show formation of microtumors by cancer cells in a 6-week simulation test of a space flight experiment. Note recovery of growing living cells and formation of microtumors/clusters.

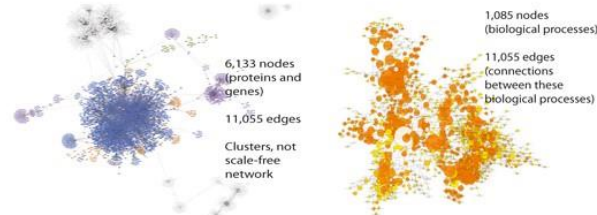
Conclusion

Regulatory network of invasiveness contains 6,113 nodes with 11,055 edges affecting 1,085 biological processes. Engagement of 6 established and 2 novel cancer hallmarks described.

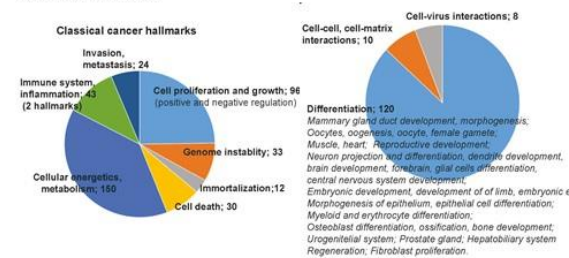
Cancer studies in the space unveil novel mechanisms of systemic responses, e.g. showing involvement of the most of the hallmarks.

Results (systemic properties of invasiveness)

Images below show the network of regulatory processes engaged in acquisition of invasiveness by human breast epithelial cells. The left image shows a network of nodes and edges. The right image shows extend and connections between engaged biological processes.



Images below show distribution of biological processes to classical (left) and novel (right) cancer hallmarks. Note differences in numbers of engaged molecular pathways. Multiplicity of pathways is essential for systemic signaling. It allows robustness and at the same time responsiveness to external stimuli.



Methods: Development of cellular models of carcinogenesis, use of cancer cells with different levels of transformation. 2D gel electrophoresis and MALDI TOF/TOF mass spectrometry are used to generate primary data. Systemic analysis was permed with SysBio SBML tools. For the space experimentation, a biomodule has been developed and is currently undergoing certification for a space flight. Systemic study of invasiveness is published as a high priority in Cancer Genomics and Proteomics, 2019.