FEATURED RESEARCH

MBI-IFOM partnership

A multidisciplinary approach to cancer research

By Steven J Wolf, PhD

MBI-IFOM partnership

In May 2014, a new partnership was formed between the Mechanobiology Institute, Singapore, and the FIRC Institute of Molecular Oncology (IFOM), Italy, that will see the establishment of a 'Joint Research Laboratory', to be headed by Prof. G.V Shivashankar, deputy-director of the MBI.

This partnership aims to develop a multidisciplinary approach to cancer research, where traditional biology is further enhanced by technologies and methods developed in fields such as mathematics, physics, engineering and computational biology. The Joint Research Laboratory will focus on understanding the molecular mechanisms that drive tumor formation and development.

IFOM focuses on cancer research through extensive collaboration with the international research community.

What this means for cancer research

Cancer continues to be a major cause of death in developed countries. Although lifestyle choices such as smoking or excessive exposure to the sun raise the risk of acquiring the disease, even the healthiest individuals are not immune. This is because cancer originates at a level largely beyond our reach, within individual cells, and following the gradual dysregulation of important cellular and molecular processes. When approaching cancer from the perspective of a single cell, a highly complex scene lies before the researcher. Hundreds of molecular pathways are intertwined like a spider's web of protein function and regulation. One protein can control the function of several others, culminating in measurable cellular events, such as cell motility.

At the center of this web is the cell's DNA; the molecule from which all proteins are made. Although healthy cells possess mechanisms to detect and repair damaged DNA, this is often lost in cancer cells. The production of proteins that do not function correctly, if at all, can lead to a cascade of molecular events that results in erratic cell growth, a shift in cellular metabolism or the ability of a cell to avoid death. Adding to this issue is the tendency for cancer cells to produce proteins at levels above or below that of a healthy cell.

> *"The Joint Research Lab will enable a strong multidisciplinary approach to understanding the mechanobiological basis of cancer by bringing together the Mechanobiology Institute, Singapore and FIRC institute of Molecular Oncology (IFOM) – two of the world's leading institutes"*
>
> *- Prof G.V Shivashankar*

With traditional cell biology continuing to make significant ground towards deciphering the cause and effect of perturbations in protein function and level, the integration of techniques from other fields is becoming increasingly relevant. This will be further encouraged by the Joint Research Laboratory, which will focus on establishing how mechanical forces placed on cancer cells, such as stretch or compression, determine their ability to read DNA, and produce proteins.

Recent work from the Shivashankar lab has established crucial links between cell shape, nuclear dynamics, and protein production. This work will be further explored by the Joint Research Laboratory, which will focus particularly on the relationship between mechanical and chemical signaling in protein production and cancer development. Cytokines, which are small proteins that function as chemical signals, are known to promote the production of proteins that degrade or restore the extracellular matrix; which is a component of the body that provides structural and biochemical support to many cell types. Degradation of the extracellular matrix is required for cellular invasion, and it is therefore closely linked to the onset of cancer. The primary focus of the Joint Research Laboratory will be to establish how geometric constraints within tissues, and upon individual cells, affect the cellular response to cytokines.

Through the MBI-IFOM partnership, further studies into the mechanisms that control nuclear dynamics and protein synthesis will be possible. Mathematical modelling and computer simulations will help predict the effect of mechanical stress on protein synthesis while cells will continue to be grown on surfaces designed to mimic those found in the body, such as bone, muscle or cartilage. By adopting a multidisciplinary approach to its research, the Joint Research Laboratory will be well placed to assess the effect of stretching or compressive forces on regulating cancer specific signaling pathways and protein synthesis.

For more information on how mechanical cues influence protein synthesis please visit MBInfo: http://www.mechanobio.info/topics/synthesis

Mechanobiology Institute, Singapore
National University of Singapore
T-Lab, #05-01, 5A Engineering Drive 1, S117411

MBI Science Communications Facility
W: mbi.nus.edu.sg/resources/sci-comms
E: sci-comms@mechanobio.info