Cell deformability in microchannels

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Our research focuses on the molecular mechanisms controlling migration and invasion of normal and tumoral cells. Our projects are centered on the control of cell polarity, the impact of cell-ECM and cell-cell interaction and the role of the cytoskeleton (actin, microtubules and intermediate filaments) and cytoskeletal crosstalk in cell mechanics and mechanotransduction during cell invasion through complex, mechanically challenging environment. We essentially work with normal glial cells and glioblastoma cells in *in vitro* and i*n vivo* models.

Project description

Glioblastoma multiforme (GBM), also known as astrocytoma grade IV, is the most common type of primary brain tumors with a very poor prognosis for patients. The invasive character of GBM is one of the main contributors to the poor prognosis as cells migrate away from the tumor core, evade therapy and initiate recurrence. Tumor invasion is also what ultimately causes the death of patients by altering essential brain tissues. Current diagnostic methods cannot identify the invasive cells and do not accurately predict tumor spreading. Hence, there is an urgent need for a molecular signature of GBM cell invasive properties. This requires fundamental knowledge on the biology of GBM and their mechanisms of invasion through the healthy brain parenchyma. One general goal of the lab projects is to identify molecular alterations characteristic of invading GBM cells.

In vivo invasion is an extremely complex process. It depends on the cell interactions with other cells also migrating or not, and with the ECM the composition and mechanical properties of which can change both in time and space. From a mechanical point of view, cell invasion relies on the ability of cells to deform while sustaining the mechanical constraints imposed by their microenvironment and to generate the appropriate forces required for their movement in a given environment. Here we propose to study cell and nuclear deformability by looking a cell migrating in microchannels of given size and also microchannels with constrictions of various size and shape. If time allows, it will then be possible to investigate the role of cytoskeletal elements in cell and nuclear deformability. This project will allow us to identify critical parameters controlling tumor cell invasion.

The candidate will

- generate PDMS microchannels without or with constriction
- will eventually design new microfabricated structures to investigate the behavior of glioblastoma cells in complex challenging environment
- use cells expressing cytoplasmic and nuclear markers. Using fast acquisition high resolution microscopy he/she will analyze cell and nuclear size and shape during cell migration through these confined environment
- analyze and quantify cell deformations as cells enter channels and constrictions