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Cell mechanics and human disease states

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This presentation will provide summary of our very recent studies exploring the effects of biochemical factors, influenced by foreign organisms or *in vivo* processes, on intracellular structural reorganization, single-cell mechanical response and motility of a population of cells in the context of two human diseases: malaria induced by *Plasmodium falciparum* merozoites that invade red blood cells, and gastrointestinal cancer metastasis involving epithelial cells. In both cases, particular attention will be devoted to systematic changes induced in specific molecular species in response to controlled alterations in disease state. The role of critical proteins in influencing the mechanical response of human red bloods during the intra-erythrocytic development of *P. falciparum* merozoites has also been assessed quantitatively using specific protein knock-out experiments by recourse to gene inactivation methods. Single-cell mechanical response characterization entails such tools as optical tweezers and mechanical plate stretchers whereas cell motility assays and cell-population biorheology characterization involves microfluidic channels. The experimental studies are accompanied by three-dimensional computational simulations at the continuum and mesoscopic scales of cell deformation. An outcome of such combined experimental and computational biophysical studies is the realization of how chemical factors influence single-cell mechanical response, cytoadherence, the biorheology of a large population of cells through microchannels representative of *in vivo* conditions, and the onset and progression of disease states.