Molecular Health Engineering: Virtual Reconstruction of Intracellular Biomolecular Dynamics in Clinical Samples

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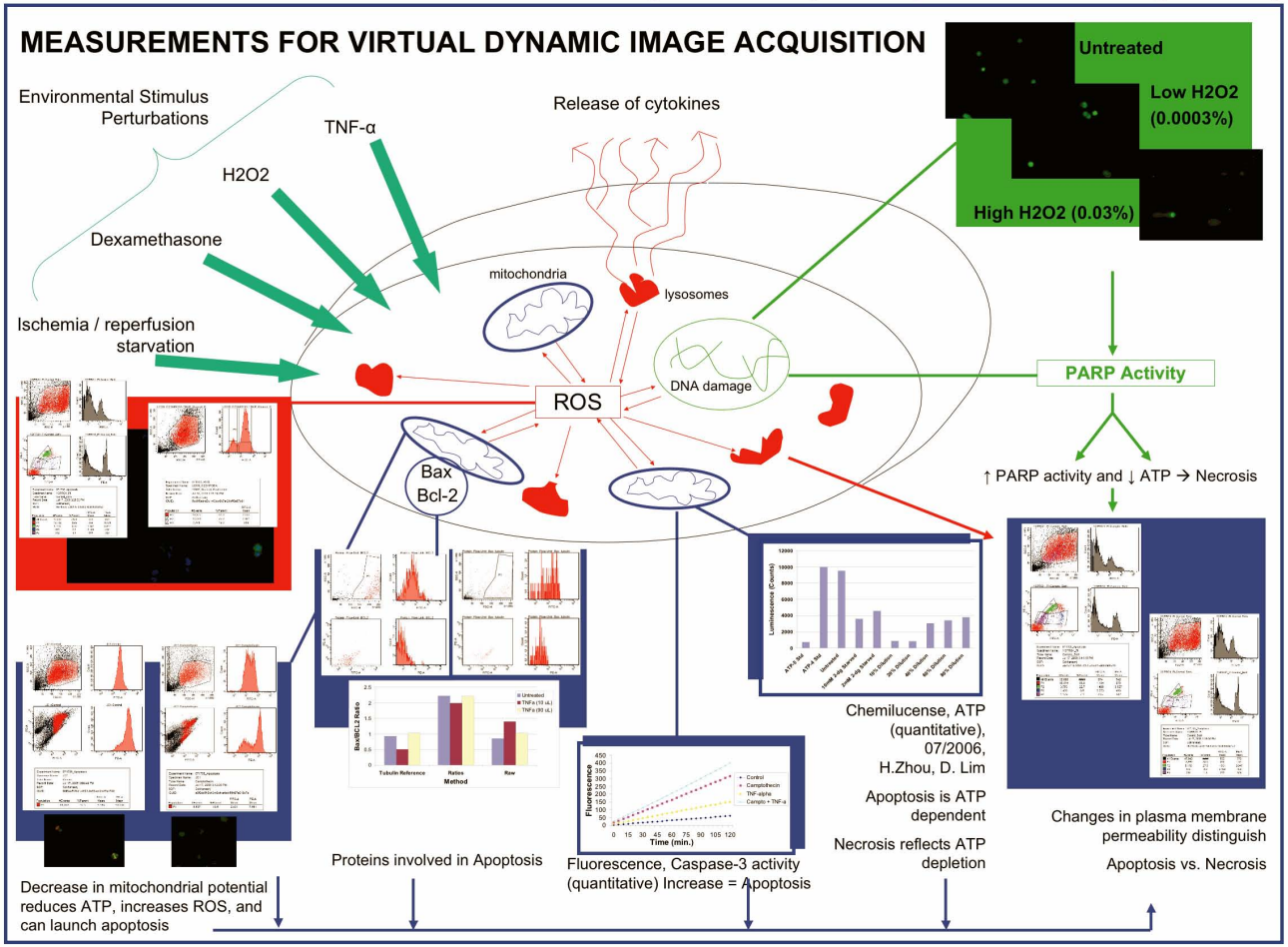
Clinical Problem: Chronic diseases i.e. diabetes, COPD, caused by chronic inflammation, fundamentally alters the health of a cell at the molecular and cellular level. This reduced capacity is seen especially when exposed to acute inflammation from infections and trauma. Can "cell health" of people be "imaged" for diagnostic and therapeutic development?

Engineering Challenge: Accurately and comprehensively visualize the dynamics of proteins and cells?

Interdisciplinary Solution: Measure key components of "cell health", associated with cellular energetics, damage, apoptosis, necrosis in samples from patients. Data obtained exposing cells to *in vitro* perturbations are applied to estimate a dynamic "cell health" model that can be used as a "virtual" system to analyze and predict cellular changes in response to acute stress.

MEASUREMENTS FOR VIRTUAL DYNAMIC IMAGE ACQUISITION



RESEARCH PLAN

1. Assay Validation

- •feasibility
- •repeatability
- •quantification and calibration

2. Model Development on Jurkat cell line

- •lymphocyte cell line
- •test perturbations: TNF-a, glucose deprivation, pro-oxidant, dexamethasone
- •evaluate model estimation methods

3. Analysis of PBMC Samples from Patients

- •IRB approved study
- •PBMC samples from patients with COPD, COPD and VAP, cystic fibrosis, asthma, and healthy controls
- •measurements with perturbation to develop preliminary disease-specific models

4. Disease concentration; obtaining external funds.

MOLECULAR HEALTH ENGINEERING LABORATORY

Team Members:

Andrew Atkins (PhD student)

He Zhao (PhD student)

Krysta Szymborski (Undergraduate Student)

Facilities:

We are currently using lab space generously offered by Dr. Mark Lechner (Biosciences)

+ other shared facilities in the Drexel Department of Biosciences & Biotechnology