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Science, Technology, and Space Subcommittee
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Witness: Timothy Hammond
Co-Director, Tulane Environmental Astrobiology Center
Staff Physician, New Orleans VA Medical Center
Associate Professor, Nephrology Section SL-45
Tulane University Medical Center
1430 Tulane Avenue
New Orleans LA 70112
Telephone (504)-988-6628 direct
(504)-588-5346 renal office for message
FAX (504)-584-1909
Email thammond@mailhost.tcs.tulane.edu

Emerging technologies developed/utilized:

Cells from specialized tissues such as brain, kidney or liver lose all the special features when grown in the laboratory (1). This greatly impedes the study of tissues for drug development and testing. Our lab studies special cell culture techniques, known as **suspension culture**, to give cells back their characteristic features in culture. A form of suspension culture optimized for the mechanical culture conditions by NASA engineers is known as the **rotating wall vesse**l (2). We are especially interested in developing protective agents for kidney toxins ranging from antibiotics, to cancer proteins using the rotating wall vessel.

Toxicity is assayed using high throughput high resolution techniques which assay expression of thousands of genes simultaneously (**gene microarray techniques**)(3). By allowing the assay of all currently cloned genes simultaneously, gene microarrays have caused a paradigm shift in cell biology. Rather than selecting targets of toxicity *a priori* based on the limits of current knowledge, gene array allows assay of all possible targets. This facilitates pattern recognition linking new drug candidates to known patterns of therapeutic benefit and toxicity, as well as unequivocally identifying previously unknown patterns.

As an example we studied the effects of mechanical culture conditions on the pattern of gene expression by growing human kidney cells in a centrifuge, in the rotating wall vessel, and in microgravity on NASA mission STS-90 "*Neurolab*". The patterns of gene expression were dramatically different and taught us a lot about how suspension culture works (3).

Federal Technology Transfer involvement:

Federal funding supported and facilitated every level of this endeavor:

Veterans Affairs
- Career development award
- Capital Equipment award

National Institutes of Health
- RO1 And R21 grants

NASA

NASA Research Announcements

Benefits and Roadblocks to current procedures in Federal technology transfer :

Strengths:

• Combination of complimentary federal programs is a unique resource to bring new commercial products to the market place by leveraging a marriage of complimentary techniques. This is exemplified by the collaboration between the VA and NASA to make our program possible.

• The multidisciplinary approach to NASA's programs in Biotechnology (Johnson Space Center, Houston TX) and Life Sciences and Astrobiology (Ames Research Center, Moffett Field, CA), by combining engineering expertise with molecular and cell biology is uniquely placed to bring new products to market. A proposed augmentation for Molecular and Cell Biology at NASA has a high probability of success.

Roadblocks:

• In our program we had to address patent application or waiver with the U.S. government serially via NIH, VA and then NASA. It would be far more time efficient, and hence market competitive to centralize the Federal process.

• NIH claims no rights to our technology, VA waived and NASA entered into a joint patent agreement with Tulane University Medical Center. NASA only desired U.S. protection, which in the global market offers very limited protection and makes licensing difficult: U.S. Government agencies should consider international rights when seeking patent protection.

• NASA should be commended for ongoing refurbishing of its procurement process. Several month delays in release of grant funds, and midyear deobligations are devastating.

References.

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2. Kaysen, J.H., W.C. Campbell, R.R. Majewski, F.O. Goda, G.L. Navar, F.C.Lewis, T.J. Goodwin, and T.G. Hammond. 1999. Select de novo Gene and Protein Expression During Renal Epithelial Cell Culture in Rotating Wall Vessels is Shear Stress Dependent. *Journal of Membrane Biology* 158:77-89, 1999.

3. Hammond T.G., , F.C.Lewis, T.J. Goodwin, RM Linnehan, D.A. Wolf, K.P. Hire, W.C. Campbell, E. Benes, K.C. O'Reilly, R.K. Globus and J.H. Kaysen. Gene expression in space. *Nature Medicine* April 1 6(4):359, 1999.