

## **PRESENTATION: AEROSPACE MEDICAL ASSOCIATION: 1994**

NASA GROUP ACHIEVEMENT AWARD PRESENTED TO  
Dr. Burton Silver of INTRACELLULAR DIAGNOSTICS, INC.

**SPACE FLIGHT EFFECTS ON INTRACELLULAR IONS IN SUBLINGUAL CELLS OF NON-HUMAN PRIMATES. S.B. ARNAUD\* R. DOTSENKO P. FUNG, M. NAVIDI, AND B. SILVER.** Life Sciences Division, NASA Ames Research Center, Moffett Field, CA 94035, Institute for Biomedical Problems, Moscow, Russia, and IntraCellular Diagnostics, Inc., Foster City, CA 94404.

**INTRODUCTION:** We have used a novel technique that quantifies minerals and electrolytes from smears of sublingual cells by x-ray microanalysis to monitor metabolic changes in best rest subjects as well as normal ambulatory subjects. Normative values when compared to test subjects indicated changes of intracellular electrolytes. Increases of intracellular calcium (Ca), phosphorus (P), and potassium (K), were characteristic of subjects whose exercise regimen was inadequate to maintain calcium metabolism.

**METHODS:** To test the effects of space flight on intracellular ions, we analyzed cells from 1-4 kg Rhesus monkeys before and after 2 weeks in space or chair restraint (CR).

**RESULTS:** There were increases in sublingual cell CA, P, and K after space flight which paralleled the clinical estimates of metabolic status of the animals and exceeded the levels during CR on R + 11. Increases after 2 weeks CR were 26% in CA, 6% in P and 29% in K.

**CONCLUSIONS:** Species similarity in responses of intracellular ions to inactivity imposed by bed rest, restraint or micro gravity suggests that this innovative noninvasive technique would be a useful in-flight monitor of exercise countermeasure directed toward maintaining calcium balance.

The National Aeronautics and Space Administration  
Presents the

## Group Achievement Award

to

### Cosmos 2229 Biosatellite Team

For dedication to international space life sciences research and for contributions to the success of the joint U.S./Russia Cosmos 2229 Biosatellite Mission.

**Burton Silver**

*IntraCellular Diagnostics, Inc.*



*Signed and sealed at Washington, D.C.  
this seventeenth day of March  
Nineteen Hundred and Ninety four*

A handwritten signature in dark ink, appearing to read "Gerald B. Griffin".

ADMINISTRATOR, NASA

**PRESENTED...Aerospace Medical Association  
Washington, D.C. April, 1989**

**EFFECTS OF SIMULATED MICROGRAVITY ON INTRACELLULAR ION CONCENTRATIONS IN SUBLINGUAL CELLS AND SKELETAL MUSCLE.** B.B. Silver, S.B. Arnaud, B.A Harris and J. Vernikos-Danellis. IntraCellular Diagnostics, Inc., San Jose, CA 95148 & NASA - Ames Research Center, Moffett Field, CA 94035.

**INTRODUCTION:**

Prior studies indicate significant intracellular ion shifts in sublingual cells during and after 30 days of head down bedrest (simulated microgravity). Skeletal muscle biopsies and oral cell smears from bedrest subjects were performed.

**METHOD:**

Sublingual cells were analyzed by electron-probe microanalysis at the beginning and end of a 30-day bedrest study. Soleus and vastus lateralis muscle biopsies, taken at the start and end of bedrest, were immediately frozen. Fluorescent x-ray analysis on the freeze-dried muscle was used to quantitate intracellular ion concentrations of Mg, Ca, P, Na, K and Cl. Scanning EM and light microscopy confirmed cell integrity.

**RESULTS:**

After bed rest, sublingual cells had INCREASES of Ca, K, and P, [p.0.001] while Soleus muscle had DECREASES of Ca, K, and P, [p>0.001] Vastus lateralis muscle also had significant post bedrest losses of K, and P. [p.0.001] Ca was unchanged. Baseline muscle P and K concentrations were 55% and 36% greater than sublingual cell levels.

**CONCLUSION:**

Sublingual cell ion shifts appear to be related to effects of micro gravity. Concurrent muscle intracellular ion loss could reflect atrophy and functional loss. Non-invasive, analysis of sublingual cell ions appears to be a sensitive biomarker for effects of micro gravity.