Objectives

• Address significant lack of data regarding immune status *during* flight.
• Replace several recent immune studies with one comprehensive study that will include in-flight sampling.
• Determine the in-flight status of immunity, physiological stress, viral immunity/reactivation.
• Determine the clinical risk related to immune dysregulation for exploration class spaceflight.
• Determine the appropriate monitoring strategy for spaceflight-associated immune dysfunction, that could be used for the evaluation of countermeasures.
ASSAYS FOR INTEGRATED IMMUNE

**JSC Immunology Laboratory**
- Leukocyte subsets
- T cell function
- Intracellular/secreted cytokine profiles

**Mercer University**
- Plasma cytokine balance
- Leukocyte cytokine RNA

**Microgen Laboratories**
- Virus specific T cell number
- Virus specific T cell function
- Plasma stress hormones

**JSC Microbiology Laboratory**
- Latent herpesvirus reactivation (saliva/urine)
- Saliva/urine stress hormones
- Circadian rhythm analysis
SUBJECTS

Completed to date:

10 Short duration
5 Long duration

Total ‘n’:

17 Short duration
17 Long duration
A. Immunophenotype, T cell function, intracellular/secreted cytokine profiles.
• No in-flight changes in bulk leukocyte subsets
• Post-flight granulocytosis
• Late in-flight/postflight elevated B cells, reduced NK cells
• In-flight, post-flight trend towards elevated CD4:CD8 ratio, elevated memory T cell subsets
• Elevated effector memory, central memory in-flight
• No change in peripheral constitutively activated T cells
CD8+ T CELL FUNCTION: A+B 24 hours

ISS

SEA+SEB 24hr

- CD4/CD69
- CD4/CD69/CD25
- CD8/CD69
- CD8/CD69/CD25

CD8+ T CELL FUNCTION: A+B 24 hours

CD69+

CD25+
CD8+ T cell – Intracellular IFNg

Secreted Cytokine Profiles (CD3/CD28 48hr)
B. Leukocyte cytokine mRNA
Gene Expression of Markers of Innate (A) and Adaptive (B) Immune Responses (short-duration flights).

A. Intervals of sample collection

B. Gene Expression of Markers of Innate (A) and Adaptive (B) Immune Responses (short-duration flights).
Gene Expression of Markers of Innate (A) and Adaptive (B) Immune Responses (long-duration flights).

A.
- TNF-α
- IL-1
- IL-6

B.
- IFN-γ (Th1 clones)
- IL-4 (Th2 clones)
- IL-10 (Treg clones)

Intervals of sample collection
C. Virus specific T cell number, function, plasma stress hormone levels.
Plasma cortisol levels - ISS

- Collection Time
  - L-180
  - L-45
  - 14d
  - 2-4m
  - 6m
  - R+0
  - R+30

- Plasma cortisol levels
  - L-180: 4 ug/dL
  - L-45: 6 ug/dL
  - 14d: 8 ug/dL
  - 2-4m: 10 ug/dL
  - 6m: 12 ug/dL
  - R+0: 14 ug/dL
  - R+30: 16 ug/dL

- Cortisol on ISS

- Graph showing cortisol levels over time with error bars.
EBV T cell function - ISS

% CD8 T-cells

Collection Time

L-180, L-45, 14d, 2-4m, 6m, R+0, R+30
D. Latent herpesvirus reactivation (saliva/urine), saliva/urine stress hormones, circadian rhythm analysis.
Urine CMV Assessment

ISS

CMV copies/ml

L-180 L-10 R+0 R+14

sub 7
sub 15
sub 12
sub 9
sub 8
sub 14
sub H
Saliva VZV Assessment

SHUTTLE

Saliva VZV Assessment

VZV copies/ml

-200 -180 -160 -10 0 10 4 14 24

-200 -180 -160 -10 0 10 16 24

-200 -180 -160 -10 0 10 16 24

Pre flight During flight Post flight

Sub 7 Sub 15 Sub 12 Sub 9 Sub 8 Sub 14 Sub H

VZV copies/ml
Saliva VZV Assessment

VZV copies/ml

Pre flight During flight Post flight

Sub 3
Sub 5
Sub 2
Sub 11
Sub 13

ISS
Questions?