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Altered innate and lymphocytic immunity in murine splenocytes following short-duration spaceflight

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Background: Immune dysregulation has been demonstrated following spaceflight of varying durations and limited in-flight studies indicate this phenomenon may persist during spaceflight. Causes may include microgravity, physiological stress, isolation, confinement and disrupted circadian rhythms. To further investigate the mechanisms associated with flight-associated immune changes, murine splenocytes immune parameters were assessed following 14 day space flight on Space Shuttle mission STS-135.

Methods: Splenocytes were stimulated with T-cell or monocyte specific mitogens or toll-like receptor agonists. Phenotype and cell function measurements were performed by flow cytometry. Production of adaptive (IFNg, IL2, IL-4, IL-10 and IL-17a) and innate (TNFa, IL-6) cytokines was determined by cytometric bead array. Post-flight data were compared to ground control data from age-matched mice.

Results: The $CD4^+$ population decreased postflight with no concurrent decrease in $CD8^+$ cells from shuttle mice postflight. Following T cell-specific stimulation a significant reduction in production of IL-10 was observed. Following monocyte-specific stimulation a significant increase in IL-6 was observed, and TNFa production was trending towards elevation. Splenocytes also showed significant post-flight increase in bead uptake, increased Class I expression, increased TNF-a and IL-6 production in response to TLR-2 (zymosan) and TLR-4 (LPS) agonists. Dendritic cells showed markedly decreased levels of MHC I and CD86 after stimulation with TLR agonists. Stimulation of T cells with signals that bypassed secondary activation processes increased expression of the IL-2R-alpha chain (CD25), consistent with increase in regulatory T cell function

Conclusion: These data indicate that alterations in splenocytes phenotype, function and cytokine production patterns are evident following spaceflight. The pattern suggests that some innate immune functions are possibly enhanced, whereas some adaptive immune parameters may be inhibited. Follow up human and in-flight studies will determine if a clinical risk related to immune dysregulation exists for astronauts.