

USE OF THE NEUROLOGIC FUNCTION RATING SCALE FOLLOWING SPACE SHUTTLE FLIGHTS

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INTRODUCTION

The most common neurologic difficulties encountered in spaceflight are space motion sickness (SMS) and post-flight neurovestibular symptoms. Understanding neurologic difficulties of spaceflight will allow for mission objectives to be met in full, increase productivity on short duration flights, ensure that readaptation problems will not jeopardize the safe landing of pilot controlled spacecraft or the safety of astronauts during emergency egress, and maintain fitness after long duration missions. In order to assess various factors related to SMS in-flight and neurovestibular dysfunction post-flight, an extensive database was created incorporating astronaut medical debrief forms, astronaut aeromedical summary information, and the Neurological Function Rating Scale form from short duration U.S. Space Shuttle missions. The Neurological Function Rating Scale form was implemented in November of 1996 with STS-80 as a means of assessing any existing neurological dysfunction associated with spaceflight and is part of pre-flight (L-10 and L-2) astronaut physicals, landing day (R+0) physical, and post-flight (R+3) physical assessment completed by the NASA flight surgeon, as are the astronaut medical debrief forms. The Neurological Function Rating Scale assessment is conducted by the NASA flight surgeon one to four hours post landing on landing day. The Neurological Function Rating Scale form consists of a series of eleven categories of neurological symptoms and signs or performance measurements scored between 1 (no symptoms or normal performance) and 4 (persistent symptoms or severe performance decrement) as determined by the NASA flight surgeon. A total score between 11 (all 1s) and 13 is regarded as normal, 14-15 as suspect, and a score greater than 15 is considered for referral to the neurovestibular lab for posturography, gaze, and locomotion testing (see Appendix for form example). The subsets of the Neurological Function Rating Scale tests may correspond to operational skills. The first subset evaluates subjective neurological symptoms (headache, dizziness/faintness, and vertigo/spinning) which could distract crewmembers from their tasks and duties. The next subset deals with motor performance skill, which could influence vehicle control, particularly reentry and landing phases. Proper functioning of gaze and ocular movements is critical to the acquisition and interpretation of visual displays. Neurological disturbances associated with spaceflight can cause delays or incorrect interpretation in the acquisition and processing of visually acquired information. The third subset of Neurological Function Rating assesses gait and station, which are vital to emergency egress.

RESULTS

Data within the database created and analyzed in this study is solely from U.S. Space Shuttle missions launched between the dates of November 19, 1996 and February 11, 2000 (STS-80 through STS-99). The database accounts for 112 astronauts, 88 of which are male and 24 of which are female. One individual was outside the general astronaut population in terms of age and was consequently excluded from any affected analyses. Statistical analysis of database parameters included age; sex; height; crew position; mission activities; mission duration; prophylactic, in-flight, and post-flight medication use for space motion sickness or neurovestibular symptoms; episodes of vomiting in-flight; orthostatic intolerance upon landing and associated medication use; previous duration of spaceflight experience; time lapsed since last spaceflight; severity of space motion sickness and neurovestibular disturbances in previous flight; and flight surgeon rating of likelihood of successful egress.

CONCLUSIONS

The most severe neurological spaceflight deficits on the Neurological Function Rating Scale are the Gait and Station subset. Commanders and pilots may have a more stable landing day performance than other crewmember positions for total score on the Neurological Function Rating Scale tests. Gaze and ocular movement function is affected after spaceflight. The neurovestibular rating score from previous flight is a good predictor for the probability of distribution of failure index scores in this database. Previous flight experience may result in less performance deficit on post-flight Neurological Function Rating Scale test scores, particularly within the Gait and Station subset. Space motion sickness and neurovestibular symptom scores from previous flights are likely to be good predictors for space motion sickness, though both may be contributing through separate mechanisms.