GETTING TO THE HEART OF CARDIOVASCULAR RISK ASSESSMENT IN ASTRONAUTS FOR EXPLORATION CLASS MISSIONS

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INTRODUCTION

Since the beginning of manned spaceflight, NASA has recognized the potential risk of cardiovascular decrements due to stressors in the space environment. Of particular concern is the effect of space radiation on cardiovascular disease since astronauts will be exposed to higher levels of galactic cosmic rays outside the Earth's protective magnetosphere. To date, only a few studies have examined the effects of heavy ion radiation on cardiovascular disease, and at lower, space-relevant doses, the association between radiation exposure and cardiovascular pathology is more varied and unclear. Furthermore, other spaceflight conditions such as microgravity, circadian shifts, and confinement stress pose unique challenges in estimating the health risks that can be attributed to exposure to ionizing radiations. In this work, we review age, cause of mortality, and radiation exposure amongst early NASA astronauts in selection groups and discuss the limitations of assessing such a cohort when attempting to characterize the risk of space flight, including stressors such as space radiation and microgravity exposure, on cardiovascular health.

METHODS

NASA astronauts in selection groups 1-7 were chosen and the comparison population was white men of the same birth cohort as drawn from data from the CDC Wonder Database and CDC National Center for Health Statistics Life Tables. Cause of death information was obtained from the Lifetime Surveillance of Astronaut Health program and deceased astronauts were classified based on ICD-10 codes: ischemic heart disease (IHD), stroke, cancer, acute occupational events, non-NASA accidents, and other/unknown. Expected years of life left and expected age at death were calculated for the cohort.

RESULTS AND CONCLUSIONS

There were 32 deaths in this early astronaut population, 12 of which were due to accidents or acute occupational events that impacted lifespan considerably. The average age at death from these causes is 30 years lower than the average expected ~70 years of age in the general population. Remarkably, all 41 living early astronauts outlived our calculated expected age at death for members of their birth cohort; furthermore, 13 of the 20 deceased astronauts who did not die in NASA/non-NASA accidents exceeded this age. There was no difference in IHD between the astronaut cohort and the comparison population; therefore, it is not possible to associate IHD mortality with radiation in that astronaut cohort.

As NASA looks toward future exploration-class missions, early astronaut cohorts provide a convenient option for assessing these risks and for developing mitigation strategies. However, many challenges still exist when assessing such limited evidence, including small cohort size, health and lifestyle confounders (such as smoking and drinking), the high accident mortality rate, and the fact that many of these astronauts are still alive, outliving many of their birth-cohort peers. Future analysis should include a longitudinal study, monitoring cases as they occur in the cohort. As this cohort is currently followed-up over time, and as more IHD cases are anticipated in a population of this age, this type of study is not as resource-intensive as would normally be the case.