

Management of Asymptomatic Renal Stones in Astronauts

David Reyes, MD, MPH, and James Locke, MD, MPH

Introduction

Management guidelines were created to screen and manage asymptomatic renal stones in U.S. astronauts. The risks for renal stone formation in astronauts due to bone loss and hypercalcuria are unknown. Astronauts have a stone risk which is about the same as commercial aviation pilots, which is about half that of the general population. However, proper management of this condition is still crucial to mitigate health and mission risks in the spaceflight environment.

Methods

An extensive review of the literature and current aeromedical standards for the monitoring and management of renal stones was done. The NASA Flight Medicine Clinic's electronic medical record and Longitudinal Survey of Astronaut Health were also reviewed. Using this work, a screening and management algorithm was created that takes into consideration the unique operational environment of spaceflight.

Results

Renal stone screening and management guidelines for astronauts were created based on accepted standards of care, with consideration to the environment of spaceflight. In the proposed algorithm, all astronauts will receive a yearly screening ultrasound for renal calcifications, or mineralized renal material (MRM). Any areas of MRM, 3 mm or larger, are considered a positive finding. Three millimeters approaches the detection limit of standard ultrasound, and several studies have shown that any stone that is 3 mm or less has a ~95% chance of spontaneous passage. For mission-assigned astronauts, any positive ultrasound study is followed by low-dose renal computed tomography (CT) scan, and flexible ureteroscopy if CT is positive. Other specific guidelines were also created.

Discussion

The term "MRM" is used to account for small areas of calcification that may be outside the renal collecting system, and allows objectivity without otherwise constraining the diagnostic and treatment process for potentially very small calcifications of uncertain significance. However, a small asymptomatic MRM or stone within the renal collecting system may become symptomatic, and so affect launch and flight schedules, cause incapacitation during flight, and ultimately require medical evacuation. For exploration class missions, evacuation is unlikely. The new screening and management algorithm allow better management of mission risks, and will define the true incidence of renal stones in U.S. astronauts. This information will be used to refine future screening, countermeasures and treatment methods; and will also inform the needed capabilities to be flown on exploration-class missions.