

A SPECIALIZED ULTRASOUND PROTOCOL FOR NASA'S RENAL STONE SURVEILLANCE AND CLINICAL PRACTICE

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INTRODUCTION

Ample evidence exists on the effectiveness of ultrasound in the diagnosis of kidney stones. However, terrestrial practice is mostly concerned with diagnosis of clinically significant urolithiasis. Adapting this non-irradiating, low-cost imaging modality for the asymptomatic astronaut population offers high-sensitivity screening and limits their career radiation dose.

METHODS

NASA developed a novel ultrasound-based detection and surveillance protocol to identify, categorize, and monitor mineralized renal material (MRM) in astronauts. The term MRM was developed to denote abnormal, presumably calcified, focal material of unknown clinical significance in the kidneys.

Sonographic criteria for MRMs include measurable echogenic foci, their detectability in multiple, designated imaging plains, posterior shadowing, and "twinkle" pattern visualized in Color Doppler and/or demonstrated in Spectral Doppler modes. The mere discovery of an MRM does not trigger further imaging or intervention, unless the affected crewmember is mission-assigned, or the MRM meets actionable criteria based on size, location, and sonographic characteristics. If the threshold is met, the crew surgeon is notified, and additional diagnostic imaging and urology consultation are considered.

RESULTS

In total, 73 individuals have been scanned using our specialized methods, 60 have had more than one study done. As of April 2023, 282 total studies have been performed. So far, over 30 pairs of pre- and postflight studies have been obtained, and the findings are presented elsewhere in this panel.

DISCUSSION

A surveillance program was initiated nine years ago to screen asymptomatic members of the astronaut corps for renal calcifications, from their initial hiring, through their mission timeframes, and throughout their career. The goal is to reduce the probability that an astronaut will fly with a renal stone that may become symptomatic. This also gives NASA the information it needs to improve screening criteria for future long-duration crewed missions.