

## **HYPERGRAVITY- INDUCED CHANGES IN URINE PROPERTIES OF TAIWANESE FIGHTER PILOTS: A PROSPECTIVE STUDY**

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**BACKGROUND** Hypergravity condition (+G<sub>z</sub>) affects the normal human body in many ways, which range from visual system impact (gray-out, black-out) to cardiovascular disturbances (arrhythmia, valvular malfunction). Little is known about the hypergravity effect on the renal system. Gross effects of hypergravity on the renal system are hypothesized as the following: decreased glomerular filtration rate, hormonal effects, and mechanical G<sub>z</sub> force on the kidney. We performed a urine analysis to study the changes of urine properties of pilots after hypergravity environment exposure.

**METHODS** Seventy-one fighter pilots who came to the Aviation Physiology Laboratory, ROCAF for 1-day high G training program were involved in this study. Six kinds of G-profile programs were designed for the trainees. Mid-stream voided urine of each pilot was obtained before (within 20 minutes) and after (within 10 minutes) centrifuge riding. Urine samples were analyzed for specific gravity, protein, urobilinogen, pH and crystal precipitation.

**RESULTS** Results showed that: 1. specific gravity of urine was higher in post-riding samples ( $1.027 \pm 0.002$ ) than in pre-riding samples ( $1.0175 \pm 0.005$ ), 2. the acidity of post-riding urine ( $6.5 \pm 0.7$ ) was significantly higher than that of pre-riding urine ( $7.41 \pm 0.68$ ) ( $p < 0.05$ ), 3. proteinuria was significantly noted in post-riding urine samples ( $0.87 \pm 0.59$ ) compared with pre-riding samples ( $0.05 \pm 0.01$ ) ( $p < 0.05$ ), 4. urobilinogen level in pre-riding samples ( $0.35 \pm 0.32$ ) was higher than that of post-riding samples ( $0.26 \pm 0.21$ ), and 5. crystal precipitate was found in only one sample before centrifuge riding (1/71); however, the number of samples with crystal precipitate, after centrifuge riding, increased to 14 (14/71).

**DISCUSSION/CONCLUSIONS:** Hypergravity condition appears to have marked effects on the renal system. The urine specific gravity, urine acidity, protein concentration and appearance of crystal precipitate were found to be changed significantly. The most interesting finding is that hypergravity seemed to increase the crystal appearance in urine. Does gravity force interfere with the process of urolithiasis formation? This topic deserves further studies to explore the mystery and the use of hypergravity in medical treatment, such as the management and prevention of renal stones.

**Key words:** hypergravity, urine properties, fighter pilots, urolithiasis