ABSTRACT FORM

Division of Medicine Research Retreat, Thursday 30th June 2022

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Position:	Research Fellow		
Department:	Renal Medicine		
Presentation Title:	Can your kidneys make it to Mars and back? – Impacts of microgravity and galactic cosmic radiation on renal health		
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Presentation preference:	Oral ☒	Poster ☐	

ABSTRACT: (please keep your abstract within this page maximum 300 words)

The impact of galactic cosmic radiation (GCR) and microgravity (MG) on deep space travellers has mainly focused on cancer risk, cardiovascular and neurological health. However, the kidney has long been recognized as very radiation sensitive organ and MG exposed astronauts have an unusually high rate of kidney stone formation which poses a mission critical risk. In fact, the kidney is the dose limiting organ in abdominal radiotherapy and total body irradiation. Chronic kidney dysfunction can occur with radiation doses as low as <0.5Gy, and when put in context, an astronaut on a 21-month Mars exploration mission has an estimated absorbed dose of 0.47Gy.

Therefore, we hypothesised that MG and GCR induce tubular remodelling of the calcium handling portions of the nephron and that the GCR doses one might be exposed to on long-term deep space missions may even induce renal failure due to sustained proximal tubular damage, as these critical tubules are dependent on mitochondrial respiration, which was recently shown to be sensitive to GCR. To investigate this, we studied kidneys and biofluids from mice either aboard the Rodent Research-10 (RR-10) Mission that launched with SpaceX-21 to the International Space Station and spent ~30 days in MG or that had been exposed to an acute 0.5Gy dose of simulated GCR at NASA 's Space Radiation Laboratory at Brookhaven National Laboratory. These were compared to sham/ground controls (n=10 per all groups) and underwent spatial transcriptomics and miRNA analysis, quantitative proteomics/phosphoproteomics, urine/plasma electrolyte analysis and 3D imaging of immunostained optically cleared tissues for histomorphometry.

Thus far, our preliminary analysis of the data supports our hypotheses and show evidence of mitochondrial damage, extracellular matrix dysfunction and decreased glomerular filtration rate. However, there are also some surprising findings relating to lipid metabolism, SLC membrane transporter protein abundance and phosphorylation status.

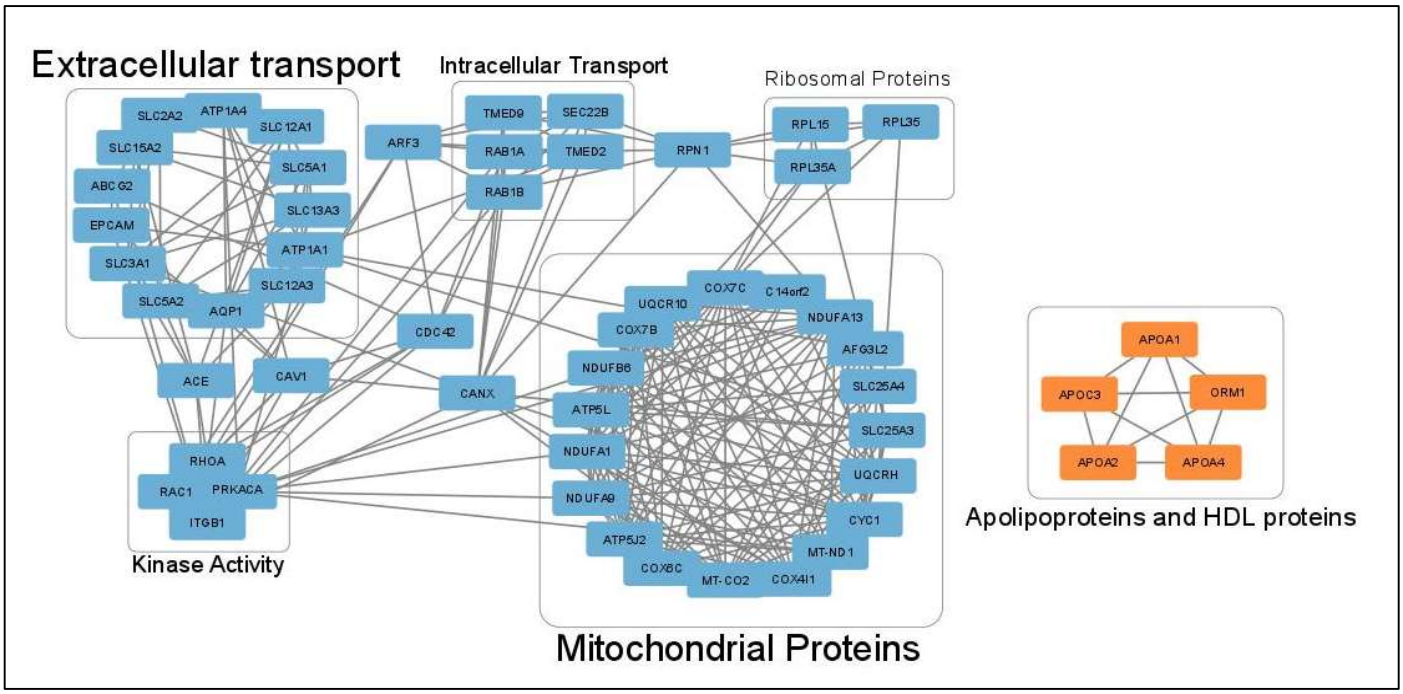

Figure Legend: Network analysis of proteome of homogenised renal tissue for animals exposed to GCR compared to animals exposed to sham. Blue nodes represent proteins with decreased expression (>-10% decrease) after GCR, orange nodes represent proteins with increased expression (>10% increase) after GCR. Only highly connected (>10 1st degree neighbours) nodes are shown.