Paper ID: 46467
student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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TREATMENT OF STROKE IN DEEP SPACE MISSIONS BY THE USE OF A NEUROPROTECTANT AUTO-INJECTOR.

Abstract

Background: Stroke constitutes a time critical medical emergency due to a sudden loss of blood supply to the brain, which leads to death or disability. If this occurs during spaceflight it would seriously compromise the astronaut's ability to perform mission tasks or even compromise safety in the spacecraft environment. Astronauts that travel outside of the low earth's orbit protective magnetosphere for a longer period of time may have a higher risk of developing cardiovascular disease and therefore cerebrovascular incident. A novel neuroprotectant, "NA1", has promising results in the treatment of stroke in preclinical and clinical studies. Despite promising results of NA1 administered as an intravenous infusion (IV), it wouldn't be a feasible route of administration for use in space. Due to limited supplies and personnel on the spacecraft and the microgravity environment any intravenous procedure would be challenging if required. Therefore, there is an unmet need for this agent to be administered safely, rapidly and easily in space without solution reconstitution or significant medical training.

Hypothesis: We expect that an alternative form of delivery of NA1 could achieve effective therapeutic pharamacokinetic parameters and enable easy administration for non-health care professionals in microgravity conditions.

Methods: NA1 was administered via six different extravascular routes and pharmacokinetic analysis was performed to determine the plasma concentration of NA1 using Reverse phase high performance liquid chromatography (RP-HPLC) and ELISA-based assays on rat plasma samples. NA1 effectiveness was evaluated in a permanent pial vessel occlusion (PVO) stroke model in rats. Animals were treated with a single injection of NA1 (Intramuscular (IM) or IV) and placebo at 1 hour after stroke onset. Infarct volumes were assessed in a blinded manner at 24 hours.

Results: An IM dose administration routine was identified that shows comparable Cmax to IV injection, higher area under the curve and longer half-life as measured by HPLC in rat plasma samples. No gross adverse clinical signs were noted with this route of administration. NA1 intramuscular administration 1 hour after stroke onset reduces infarct volume in animals exposed to PVO compared to placebo ($p=0.03$).

Conclusion: These results demonstrate that the intramuscular route is the most feasible alternative route out of the 6 extravascular routes evaluated. The intramuscular injection of NA1 provides the best alternative delivery method for an easier and safer use as an emergency medication for stroke to significantly reduce disability during deep space missions.