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

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USING LINEAR AND DIFFERENTIAL MATHEMATICAL MODELS TO DEVELOP A COUNTERMEASURE TO SPACEFLIGHT ANEMIA.

Abstract

As astronauts enter microgravity, fluid losses result in the loss of erythrocytes over time due to increased destruction and/or decreased production. As a result, when astronauts leave the microgravity environment and re-enter earth gravity (1G), fluid restoration uncovers anemia. In order to prevent spaceflight anemia it is possible to administer a dose of recombinant human erythropoietin (rhEPO) to stimulate red blood cell production. This can be done on the last leg of a spaceflight in order to prevent the onset of anemia upon arrival into 1G. We have previously developed a linear mathematical model to predict the number of erythrocytes killed as a result of spaceflight. In this study, we have modeled the dose of rhEPO required to offset the loss of erythrocytes during spaceflight. An ordinary differential equation (ODE) describes the rhEPO input (intravenous) and rhEPO output (decay over time). Using the Laplace transform method, the ODE was resolved into its moments. Our previous linear mathematical model quantified the number of erythrocytes destroyed and in turn the missing hemoglobin (Hb) that would result from spaceflight. Using Hb and erythrocyte values from the linear model, and the Hb/rhEPO relationship as developed by Mylrea et al. (J Theor Biol. 1971 Nov;33(2):279-97), we determined the necessary rhEPO administration needed in the last 5 days prior to reentering Earth (1G) that would prevent spaceflight anemia. The total rhEPO exposure was first calculated followed by the required daily dose of rhEPO over the 5 days. This model can play an important role on long-term missions to other planetary bodies as well, since upon landing, medical staff or equipment will not be available to manage anemic astronauts.