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INTRAVENOUS SALINE EXPERIMENT MAY HELP SOLVE SPACE FLIGHT BODY FLUIDS PROBLEM

DALLAS--Saline solution will be administered intravenously on a February international space-research flight to learn more about the radical shift in body fluids of astronauts as they leave and re-enter the earth's gravity. The experiment in intravenous fluid loading is being conducted by a space medicine laboratory team at The University of Texas Southwestern Medical Center at Dallas.

The dramatic changes in the body's fluid balance that occur in space make it difficult to maintain a normal blood flow and blood pressure on return to normal gravity, said Dr. Gunnar Blomqvist, director of UT Southwestern's space medicine laboratory and principal investigator on the UT Southwestern experiment.

"Called orthostatic hypotension, this fluid shift causes dizziness and a tendency to faint in the upright position," said Blomqvist, professor of internal medicine at UT Southwestern. For more than 15 years Blomqvist has been investigating the problems associated with fluid changes in the body--under actual and simulated space conditions--particularly as they affect the cardiovascular system.

UT Southwestern's fluid-balance work is one of nine National Aeronautics and Space Administration (NASA) projects on board Deutsche-2 (D-2), an international manned scientific research flight scheduled to launch Feb. 25. Deutsche-2 is the second research flight in partnership among the German Research Establishment for Aerospace

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(DLR), the research arm of the German Space Agency (DARA); the European Space Agency (ESA) and NASA. There are 90 experiments on the flight, including 20 in human physiology. Ten percent of the research projects are NASA-sponsored.

Participating in the human research studies will be two U.S. mission specialists and two German payload specialists, with two German payload specialists as alternates. All will participate in preflight research, and those who fly the mission will be studied post-flight.

Blomqvist has been researching fluid shifts since 1978, using bed rest and the head-down tilt to simulate conditions in space. The head-down tilt position, in which the subject's feet are elevated, has been found to be a good model for weightlessness in cardiovascular-system research.

"While NASA routinely prescribes oral fluid loading--a combination of salt tablets and a large volume of water--before return to earth, the treatment often fails to prevent the symptoms of dehydration, including orthostatic hypotension," Blomqvist said. "If landing is delayed, the fluid loading may actually make the dehydration worse. However, we need more information to serve as a basis for more effective countermeasures."

In the D-2 experiment intravenous saline solution will be rapidly infused into the four scientific payload crew members, who will take turns as researchers and subjects. Then their circulatory systems will be monitored closely for changes in heart size, blood pressure and cardiac output as the blood volume increases. The body's regulatory mechanism that causes excess volume to decrease also will be monitored.

"The distribution of body fluids as well as the functional characteristics of the normal circulatory system are very much a function of the presence of gravity," said Blomqvist. "This force, working in tandem with the forces generated by the heart, determines all the pressures inside the cardiovascular system. A person's normal pattern of body-fluid pressures and

volumes is defined by the combination of a predominately upright body posture and the earth's gravitational field."

Conditions change drastically on entry into space, when all gravity-induced pressure differences disappear and body fluids--both inside and outside the cardiovascular system--move from the lower to the upper half of the body, causing what astronauts call "puffy-face, bird-leg syndrome."

The upward shift of body fluids before and during liftoff causes the heart to expand, and the body interprets this expansion as a fluid overload, adjusting by decreasing both total-body and intravascular-fluid volumes, Blomqvist explained.

Detailed studies of the interplay between fluid balance and cardiovascular function in space were carried out for the first time in 1991, on Spacelab Life Sciences-1 (SLS-1). At that time Dr. Drew Gaffney, NASA payload specialist and then-UT Southwestern faculty member, was the first person to wear a central venous catheter in space to study changes in the filling, or priming, pressure of the heart following lift-off. Two payload specialists on D-2 will participate in a similar experiment conducted by a Danish team to gather further data. Gaffney will be a member of the UT Southwestern D-2 team.

Researchers in the UT Southwestern Space Lab also are preparing experiments for SLS-2, scheduled for flight later in 1993, and SLS-3, scheduled for 1996. UT Southwestern research on SLS-2 will expand studies done on SLS-1. Entirely new experiments will be designed for SLS-3, which will focus on muscular-skeletal research.

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NOTE: The University of Texas Southwestern Medical Center at Dallas comprises Southwestern Medical School, Southwestern Graduate School of Biomedical Sciences, Southwestern Allied Health Sciences School, affiliated teaching hospitals and outpatient clinics.