News
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******Space travel creates cardio-vascular abnormalities.

DALLAS--Earthbound humans, who once marveled when chimps came back alive from space travel, now seek details on how the body responds to weightlessness.

Space travel creates potentially dangerous body changes for astronauts who must pass hours with distended neck veins and puffy faces. Mild ballooning of the heart with congestion of blood vessels in the lungs seems to be one consequence.

Weightlessness initiates, among other things, a shift of body fluids--one to two quarts--from the lower to the upper half of the body.

Heart and circulation can adapt efficiently within the first few hours of flight, but signs of heart abnormality arise during the early stages of re-entry into the earth's gravity, says Dr. Gunnar Blomqvist, professor in the Cardiology Unit at The University of Texas Health Science Center at Dallas. Because of difficulties in fluid balance and nervous system control of blood pressure and flow, there is a tendency to faint in the upright position, he says.

With previous long-term research support from NASA, Blomqvist is one of a small group of scientists whose experiments will be conducted aboard a 1985 flight of the space shuttle. Blomqvist, an M.D. with expertise in physiology, hopes to find the regulatory changes involved in the body's adaptation to zero gravity and to re-entry. Once the body's controlling factors are identified, countermeasures can be designed to prevent problems.

In early space models there was a passive entry into normal gravity with the spacecraft run by computers and the astronauts lying down during descent. In the space shuttle the pilot is sitting up and actively controls the spacecraft during re-entry. While there have been no problems thus far, the possibility exists for crew members to blackout. This risk of complications will increase during work on space stations, Blomqvist says, when selection for people going into space will not be as stringent as it is now in terms of physical fitness.

The body compensates for the fluid shift of weightlessness primarily by excretion of fluids. Heart and blood vessels, expanded beyond normal size by fluid and pressure, are brought back to normal. Early loss of fluids decreases the overall blood volume and relieves congestion. "We know the decrease in blood volume is appropriate for adaptation to zero gravity since previous flight studies show that in-flight exercise capacity remains normal," says Blomqvist.

Once the cardiovascular system is well adapted to zero gravity, a sudden return to gravity produces effects similar to dehydration, he says. Crew members complain of dizziness and walking with effort on landing. "This intolerance to standing erect and decreased exercise capacity are caused by a reduction in the heart's pumping ability."

(over)

If the problem of gravity adaptation only involved fluid loss it could be easily solved, said Blomqvist. Complications come from what seems to be a change in nervous system hormones that regulate blood flow. "A tennis player loses that much fluid in a game and doesn't have the same trouble. Something happens to the control mechanisms so the body can't make the adjustments it normally makes."

Blomqvist and a UT Southwestern Medical School team, including Drs. Drew Gaffney, Samuel E. Lewis, Jere Mitchell, Robert L. Johnson Jr., as well as Dr. Loring B. Rowell of the University of Washington School of Medicine, will direct data gathering in studies before, during and after the shuttle flight. Four experiments will take 60 hours of in-flight crew time. Weight, power and space are all considerations. Minute-to-minute scenarios have been established on what crew members are to do, power to be consumed and which instruments are on or off.

Pre-flight testing will include simulated weightlessness. This is accomplished by a 24-hour period of bed rest with the head lowered at a subtle five-degree tilt. Bed rest and weightlessness are similar in their deconditioning effects on the body. These effects include a loss of blood volume with a subsequent tendency to faint, general heart deconditioning, metabolic abnormalities and disturbances of hormones effecting blood circulation and fluid balance. Prolonged bed rest and space flight also cause a loss of muscle due to disuse atrophy and loss of calcium from bone.

Calcium loss seems to be the most critical problem and is the primary biological factor limiting safe space flight, according to Blomqvist. After about six months in space, the loss of bone substance puts one in danger of irreversible skeletal damage by vertebral collapse. The loss of calcium can be reversed during bed rest by weightbearing, e.g. three hours of quiet standing each day. Calcium loss during weightlessness is more severe than during bed rest and countermeasures have not been devised.

Exercise and the redistribution of blood volume are the two avenues being explored by Blomqvist as countermeasures to cardiovascular deconditioning. Short-term body cooling using a special suit with cooling coils of water will be observed as a possible aid in redistributing blood from the skin to the heart.

In-flight and related studies call for a group of four subjects--two Payload Specialists, on board for participation in experiments, and two Mission Specialists, who are trained in scientific fields and will include an M.D. or Ph.D. Mission Specialists will fly the first 12 hours with central venous catheters inserted within their chests to precisely measure the filling pressures of the heart during the early adaptation period. Similar catheters are routinely used for monitoring patients with heart disease and patients with other conditions in which blood volume is important, e.g. trauma or burns. All other measurements will be obtained by non-invasive methods. Information will be gathered on hormonal changes, arterial pressures, cardiac output and pulmonary capillary blood volume. Left and right ventricular volumes and dynamic dimensions of all four cardiac chambers and the vena cava will be measured by sophisticated, high-quality echocardiographic equipment being designed for providing images of the heart.

Work directly applicable to the flight experiment has been carried out in Blomqvist's laboratory over the past several years. All the procedures to be used, including the protocol for 24-hour head-down tilt studies are well established.

"No satisfactory animal models are available for these studies," says Blomqvist. "The combination of a normally upright stature plus body mass and fluid distribution predominately below the heart creates unique problems in humans during weightlessness.

"Gravity plays a key role in how well our hearts function."

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