SPACE MEDICINE BRANCH REPORT

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The following article was submitted by Michael W. Bungo, M.D., principal investigator.

During the April 1985 flight of Shuttle mission 51D, ultrasound examination of the heart was performed for the first time on a U.S. space flight. This experiment was the result of an effort by a team of NASA–Johnson Space Center investigators headed by Michael W. Bungo, M.D. A commercial echocardiograph was modified to be Shuttle-flight worthy, largely through the efforts of physician/engineer David A. Wolf, M.D. M. Rhea Seddon, M.D., a mission specialist on 51D, was responsible for collecting the inflight measurements. John B. Charles, Ph.D., a JSC co-investigator has contributed to the data reduction and interpretation.

With the uses of echocardiography in space flight, new insights into the adaptation of the human cardiovascular system to microgravity have been gained. The high spatial resolution of this technique allows direct imaging of the myocardium. This in turn permits statistical analysis on smaller sample sizes than with other non-invasive techniques. The non-invasive, benign nature of the scanning makes it ideally suited for the space flight environment. The equipment used occupied only one mid-deck Shuttle locker and weighed less than 40 pounds. Electrical power was derived directly from the orbiter and videotape images of the data were recorded and stored in the Shuttle's flight-deck recorder system. The storage arrangement allowed subsequent ground-based image analysis and also permitted downlink capabilities on standard TV interfaces.

Two-dimensional sector and "M-mode" scans of the heart were obtained from four crewmembers daily for the duration of the 7-day orbital flight. These data were compared to resting supine values acquired preflight and at selected intervals postflight. Right ventricular dimension was found to be 35% decreased through out the period of weightlessness and returned to baseline after flight. Left ventricular volume index (LVDVI) was 20% increased on the first day of flight and 15% decreased thereafter compared to preflight. Stroke volume tracked LVDVI. Mean blood pressure and heart rate were both 20% increased during weightlessness. Increases in both diastolic and systolic pressure contributed to the rise of mean pressure. After an 85% rise in cardiac index the first day, values returned to preflight levels for the duration of the mission, but were again 59% elevated during the postflight recovery period. Elevated trends in cardiovascular work and total peripheral resistance were noted throughout flight. Recovery from 7 days in space appeared to require a week of re-exposure to Earth's gravity.

The integration of the American Flight Echocardiograph into the Space Transportation System has brought commercial equipment into the operational flight program in support of cardiovascular research. Echocardiography has promise in future physiological experiments, in countermeasure evaluation, and in clinical medicine aboard a space station health maintenance facility.