Dr. William Carpentier—Apollo 11 Flight Surgeon

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This is a short history of a NASA flight surgeon during the Gemini and Apollo Programs, Dr. William Carpentier. He finished medical school at the University of British Columbia in Canada and then completed an Aerospace Medicine Residency at Ohio State University in 1965. Dr. Carpentier was a NASA flight surgeon from 1965 to 1971 and participated in many Gemini and Apollo missions. He then did a Fellowship in Nuclear Medicine at Baylor College of Medicine in Houston and had a 30-yr career in the field of Nuclear Medicine where he became the Division Director of Nuclear Medicine at the Scott and White Clinic in Temple, TX. He served as a consultant in Nuclear Medicine and Aerospace Medicine at the Johnson Space Center from 2003 to 2013.

Dr. Carpentier spent the first two Gemini missions (Gemini 3 and Gemini 4) in medical operations training in Mission Control. Following the final Mercury flight (MA-9), there was a significant postflight decrease in orthostatic tolerance which was also noted during tilt testing following the first two Gemini flights. The next two flights were going to be progressively longer and it was recommended that a flight surgeon be trained to jump from the rescue helicopter with the Underwater Demolition Team swimmers should medical assistance be required on landing. Dr. Carpentier had experience in both competitive swimming and scuba diving and volunteered to train for this job. He then was deployed as the helicopter recovery physician on Gemini 5, 6, 7, and 9 (Gemini 8 did not land at the primary recovery zone) (**Fig. 1**).

On the Gemini 5 postflight tilt table tests, heart rates were significantly increased and systolic blood pressures were significantly decreased after 8 d compared to the Gemini 4 flight of 4 d. Along with the data from Gemini 3 and Gemini 6 flights, these results, when extrapolated out to 14 d for the Gemini 7 flight, indicated a possible upright heart rate of greater than 180 bpm. There was also a continued linear decrease in systolic blood pressure (**Fig. 2**). In addition, plasma volume and red cell mass had been shown to have decreased postflight. This was further complicated by the fact that the Gemini spacecraft landed with astronauts in the upright sitting position and not supine.[5] There was concern that the crew could become syncopal inside the spacecraft and multiple practice simulations were performed to determine the fastest way to get the crew out of the spacecraft and onto the life raft.[2,6]

Dr. Carpentier also talked to the crew preflight and requested that they keep moving their legs in order to help pump blood upward. As it turned out, although there was still evidence of orthostatic intolerance (one of the crewmembers experienced syncope on the postlanding tilt testing), it appeared that the magnitude of the effect of spaceflight did not continue linearly with mission duration. None of the Gemini crewmembers required medical assistance during recovery despite being hoisted into the helicopter in an upright position, which could be expected to increase lower extremity blood pooling.

Fig. 1. Dr. Carpentier jumping from the helicopter during the Gemini 7 recovery.

Dr. Carpentier was involved in the pre- and postflight cardiovascular examinations for orthostatic tolerance and exercise capacity testing on the remaining Gemini missions. Exercise capacity was also found to be decreased. Weight loss was documented in all Gemini astronauts and plasma volume was decreased in 4 of the 6 astronauts in which it was measured. The rate of plasma volume decrease appeared to follow the rate of weight loss and the calculated fluid loss. By the end of the program, preliminary analysis suggested that all these findings were

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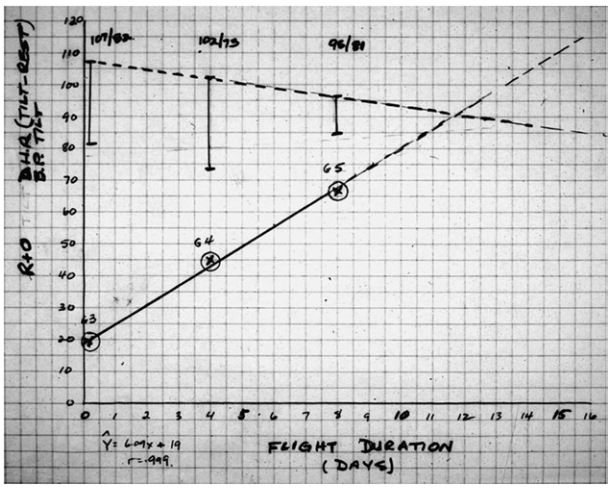

Fig. 2. Heart rate was shown to be increasing linearly and systolic blood pressure was decreasing linearly with flight duration for the first three Gemini flights.

interrelated. Also, the considerable variability among crewmembers suggested that factors other than duration in weightlessness needed to be considered. These would include caloric intake vs. energy expended and fluid and electrolyte intake vs. fluid and electrolyte output.

As the Gemini program was drawing to a close, Dr. Carpentier was transferred to Apollo medical operations and planning and was assigned to be the Crew Flight Surgeon for Apollo 7. He believed that there was still much to learn and that further comprehensive, quantitative biomedical measurements should be made on Apollo to gain a better understanding of the effects of spaceflight on human physiology prior to landing on the moon. Along with other flight surgeons and research physiologists, a comprehensive preflight and postflight operational medical plan was developed. However, following the tragedy of the Apollo 1 fire, there was tremendous time pressure on the program managers and on the crews to recover the time lost in the lunar landing schedule. Consequently, there was significant resistance to adding further medical evaluations.

After considerable discussion and negotiation with the Apollo 7 crew, an acceptable plan was worked out with the crew that could be fitted into their training schedule. Included were microbiology evaluations, orthostatic tolerance and exercise response testing, blood volume and fluid volume evaluation, clinical biochemistry and hematology, nutritional studies, and skeletal response.

During the flight, the crew developed head colds, became somewhat irritable, and proved recalcitrant on several occasions. They began to worry about wearing their suit helmets during reentry, which would prevent them from blowing their noses and clearing their ears. Mission control tried to persuade them to wear the helmets anyway, but the commander was adamant about leaving them off. Prior to re-entry, Dr. Carpentier was informed of the conflict and was told that the crew was uncooperative and that they were unlikely to participate in the postflight medical examinations. To his relief, he found that the crew was very cooperative. In the end he was successful in being able to obtain the postflight data and the crew set a pattern for medical testing on the rest of the Apollo flights.

As the Crew Flight Surgeon for Apollo 11, he was again on the recovery helicopter and followed the astronauts into the Mobile Quarantine Facility on the USS *Hornet*. Again, there was some resistance to extensive postflight medical testing during the quarantine. Despite this, he lobbied hard for data collection as a part of the mission. Comprehensive medical testing was performed by him postlanding. (He also functioned as a bartender following the postflight ceremonies.) He spent 3 wk in quarantine with the astronauts and continued the postflight data collection. He then had the honor of being the flight surgeon to accompany the Apollo 11 crew on their good-will world tour.

During Apollo 13, Dr. Carpentier was a part of the medical support team in Mission Control Center that addressed the many medical issues regarding the successful return of the crew following the Service Module explosion. He was also assigned to be the Crew Flight Surgeon for the last quarantine flight of Apollo 14 and was able to repeat all of the medical evaluations that had been developed for Apollo 11. The added results obtained from the Apollo program reinforced the results from the Gemini program and indicated that the postflight changes observed in the cardiovascular system were to a great extent predictable and, to at least some extent, preventable.[1,3,4] Dr. Carpentier is now in the process of building a complete medical data base of the first two decades of manned spaceflight and has begun organizing, integrating, and further analyzing the data collected during the Mercury, Gemini, and Apollo programs.

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