Need More Chimp Flights: Medical Drama and Presidential Decision-Making in Project Mercury

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This year NASA and its partners observe the twentieth year of continuous human presence in space on the International Space Station. While certain physiological decrements have been noted in crewmembers on long-duration missions, the record shows that astronauts selected according to rigorous medical standards and conscientiously applying available on-orbit countermeasures have performed extremely well. However, before the first U.S. mission in Project Mercury nearly six decades ago, there were major concerns about whether the combined stresses of spaceflight, particularly weightlessness, would be disabling or even fatal to astronauts (see **Table I**). Great differences of opinion emerged between the operational medical support team of NASA and the Department of Defense (DOD) and the academic community and scientific advisors of the president-elect John F. Kennedy.

The success of Apollo 11 more than 50 years ago depended completely on the success of its predecessor human spaceflight programs, Mercury and Gemini. Mercury demonstrated that humans could not only survive in space (and debunked many—but not all—of the identified concerns) but could perform complex mission tasks successfully. Gemini built upon that foundation to prove that orbital change, rendezvous, docking, space walks (extravehicular activity or EVA), and missions of up to the 14 days as planned for the longest Apollo lunar missions were humanly possible. The first Mercury mission of Alan Shepard was delayed considerably for technical reasons. However, medical concerns also threatened timely progress even after multiple suborbital (technically, above 100 km in altitude) and ballistic flights by nonhuman primates Able and Baker on a Jupiter vehicle in May 1959 and Sam and Miss Sam on Little Joe Mercury flights in 1959 and 1960 demonstrated survivability in the spaceflight environment.

In addition, President Dwight D. Eisenhower was not keen on the projected cost for future spaceflight, and his final budget contained funding for Mercury but not Apollo (Gemini had not yet been proposed). Programs and funding beyond Project Mercury were left to the discretion of the incoming president, making his position on spaceflight even more critical. As part of the Kennedy administration's planning process, his incoming science advisor—and formerly a member of Eisenhower's Scientific Advisory Committee–Jerome Wiesner prepared a report on the space program that was released to the president-elect 1 week before his inauguration.[8] According to NASA Deputy Administrator Hugh Dryden, Wiesner did not have direct contact with NASA before filing his report.[6] The Wiesner report was the principal information that the incoming president had available with regard to the NASA space program. While the report covered several areas and particularly the problem with inadequate boosters, it was generally negative toward "man in space." With regard to Project Mercury, it said, "It exaggerates the value of that aspect of space activity where we are less likely to achieve success, and discounts those aspects in which we have already achieved great success and will probably reap further success in the future."

John Kennedy was inaugurated on January 20, 1961, and NASA's first contact with him as the new president was through science advisor Wiesner on January 25 regarding the upcoming Mercury Redstone (MR)-2 test flight with the chimpanzee Ham (named for Holloman Aerospace Medicine) (**Fig. 1**), which was successfully completed on January 31.[6]

Before 1961, the Space Task Group assigned by NASA Headquarters to implement Project Mercury had employed many expert panels, primarily from the DOD, to assist in the medical planning for Mercury. Yet many from academia were uncomfortable about human flights without extensive further animal studies. This led to divergent opinions between the laboratory scientists and the operations engineers. The laboratory scientist, based on long experience designing and implementing carefully controlled investigations with clear outcomes, "wished to take a conservative course and carry out extensive animal experimentation prior to exposing a human being—perhaps tragically—to manned space flight…" The operations engineer, more familiar with demonstrations of technical solutions to practical problems, "relied to a great extent upon the extension and application of existing biotechnology and biomedical experience that had supported the X-15 and other comparable programs" which convinced him that "the hazards of manned space flight were no greater that those experienced by an X-15 test pilot."[4]

Dr. Charles Berry, an Air Force physician assigned to the Space Task Group during Mercury before becoming the chief

Table I. Medical Concerns Prior to Mercury Flights.

• Motion sickness, disorientation, nausea
• Cardiac arrhythmia, tachycardia, hypertension, hypotension, reduced blood volume, reduced plasma volume, deceased G tolerance, postflight syncope, decreased exercise capacity
• Pulmonary atelectasis
• Dehydration, weight loss, anorexia, GI disturbance
• Urinary retention, diuresis
• Muscular incoordination, muscular atrophy
• Bone demineralization, renal calculi
• Sleepiness, sleeplessness
• Euphoria, hallucinations

From Houston, TX.

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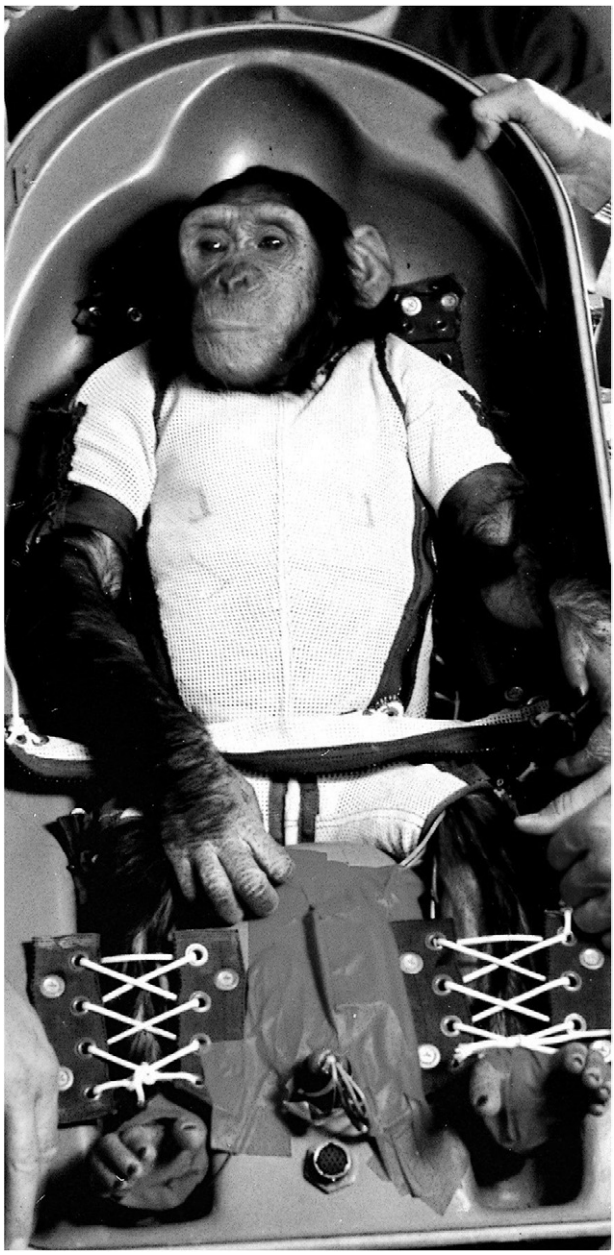

Fig. 1. Ham in the restraint couch for Mercury Redstone-2.

flight surgeon for NASA, remembered it this way. "There was a 'science community,' always from the academia, the National Academy of Science. They always had this specter out there that, 'Well, the humans weren't going to be able to do it.' Even if we got a little bit [that is, if a potential problem was demonstrated to be less significant than predicted], they'd say, 'Well, they aren't going to be able to do the next thing.'"[1]

The scientists outside of the Space Task Group were particularly alarmed that no ability to check in-flight blood pressure (BP) noninvasively in astronauts had been secured even when MR-2 had noted high pulse rates associated with low blood pressure measured invasively.[7] In the end, BP analysis during Mercury was limited to preflight and postflight analysis with in-flight measurements only on the final two missions.[2]

As part of an ongoing review of the space program by Kennedy's science team, and particularly Project Mercury, a special Presidential Science Advisory Committee (PSAC) panel chaired by Donald F. Hornig was established in February 1961 to perform an ad hoc review of Project Mercury. This panel was supportive of the Mercury program overall, but had extensive reservations about the medical aspects.[3] Even with the previous flights with primates Able, Baker, Sam, Miss Sam, and Ham, and successful animal (mostly dogs with a few rabbits) flights in the Soviet program, their report of April 12, 1961,[3] stated:

> *"It is not known whether the astronauts are likely to border on respiratory or circulatory collapse, suffer a loss of consciousness or cerebral seizures, or be disabled from inadequate respiratory or heat control. These uncertainties are awesome. Data from NASA and DOD aircraft and high-altitude balloon flight programs demonstrate a demanding constellation of stresses, yet measurements are not available which would provide assurances of physiological fitness for survivability characteristics of the pilots. Essential observations which could provide the basis for extrapolation have not been made before, during, or after these flight programs nor during ground simulation test. How great a risk is being hazarded in the forthcoming Mercury flights is at present a matter for clinical impression and not for scientific projection. The considered opinion reluctantly arrived at by the panel is that the clinical aspects of the Mercury medical programs have been inadequate. We find this opinion is also shared by several Mercury consultants, by individuals contributing to the simulation training program, and by other qualified observers."*

In their ad hoc report, the panel recommended a crash effort to obtain additional medical data through centrifuge testing and combining stresses, additional flights that compare human and nonhuman primate responses before committing an astronaut to a Mercury flight, and using university labs and the DOD. The committee had reportedly considered recommending up to 50 additional primate flights[5] before the first astronaut launch, but events intervened to dissuade them from taking that extreme step. Soviet cosmonaut Yuri Gagarin was launched on a one-orbit flight on April 12 and his survival clearly offset some of the negative thinking of those outside of NASA. Foreign sources had reported prematurely on April 10 that the Soviet Union had already launched a human into space, and perhaps coincidentally the final report of the Hornig Panel on April 12—the very day of Gagarin's flight—did not specify the number of preliminary primate flights that needed be accomplished. This may have reflected back-tracking by the panel in the face of evidence that spaceflight was, in fact, survivable. In any event, the Mercury medical team was undeterred by the Hornig Panel Report and the U.S. successfully launched Alan Shepard on a suborbital mission MR-3 on May 5, 1961, with no delay for further primate flights. Indeed, only a single additional primate flight with the chimpanzee Enos was accomplished prior to John Glenn's Friendship 7 mission on February 20, 1962.

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AEROSPACE MEDICINE HISTORY, *continued*

The next nonhuman primate to fly in space was the macaque Bonnie on NASA's Biosatellite 3 in 1969, followed by occasional ballistic, suborbital and orbital flights of primates by Argentina, the Soviet Union, the United States, and Iran over the next five decades.[9] These were all research flights; no human flight program has been threatened with delay by the need for more such flights.

From a political and national perspective, John F. Kennedy's science advisors in early 1961 were very negative toward the medical safety of human spaceflight. It is amazing that within 2 weeks of the successful 15-minute suborbital Mercury flight of Alan Shepard that John Kennedy appeared before a joint session of the U.S. Congress to announce the goal of landing a man on the Moon and returning him safely to Earth within the decade. Of equal importance, he set a clear timetable and funding targets for the program. The rest of the story is now history.

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