Herpes Zoster/Simplex Reactivation

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Introduction

Herpes zoster reactivation occurs when a latent Varicella-Zoster Virus (VZV) begins replication in a dorsal root ganglion of the spinal cord. Vesicular eruption (shingles) occur along the involved dermatome and there may be pain or burning which can start before the eruption of the vesicles. Treatment includes anti-viral medication, best administered within 72 hours of the onset. Additional treatment may be necessary for acute or postherpectic pain. There is an effective vaccine available to reduce the risk of occurrence. Clinically overt herpes zoster is expected to be a rare event on a space mission, but evidence has shown that space flight causes subclinical reactivation of the varicella zoster virus as evidenced by increases in IgG anti-VZV antibody titers and shedding of the virus in saliva samples taken from astronauts during and after space flight.[1]

Herpes Simplex Virus 1 (HSV1) is the cause of herpes labialis, or cold sores, affecting the lips, mouth or gums. These are thought to be a reactivation of the latent virus in the trigeminal nerve. Most ulcers are acute, single, last about seven to 10 days and heal spontaneously[2] This is a relatively common condition seen in about 15% of the general adult population. Although no increase was observed in shedding of HSV1 in astronauts' saliva, cold sores affecting the lips have been reported on orbit by U.S. astronauts.[3]

Clinical Priority and Clinical Priority Rationale by Design Reference Mission

One of the inherent properties of space flight is a limitation in available mass, power, and volume within the space craft. These limitations mandate prioritization of what medical equipment and consumables are manifested for the flight, and which medical conditions would be addressed. Therefore, clinical priorities have been assigned to describe which medical conditions will be allocated resources for diagnosis and treatment. "Shall" conditions are those for which diagnostic and treatment capability must be provided, due to a high likelihood of their occurrence and severe consequence if the condition were to occur and no treatment was available. "Should" conditions are those for which diagnostic and treatment capability should be provided if mass/power/volume limitations allow.

Conditions were designated as "Not Addressed" if no specific diagnostic and/or treatment capability are expected to be manifested, either due to a very low likelihood of occurrence or other limitations (for example, in medical training, hardware, or consumables) that would preclude treatment. Design Reference Missions (DRMs) are proposed future missions designated by a set of assumptions that encompass parameters such as destination, length of mission, number of crewmembers, number of Extravehicular Activities (EVAs), and anticipated level of care. The clinical priorities for all medical conditions on the Exploration Medical Condition List (EMCL) can be found here (https://humanresearchwiki.jsc.nasa.gov/index.php?title=Category:All_DRM). The EMCL document may be accessed here (https://humanresearchwiki.jsc.nasa.gov/images/6/62/EMCL_RevC_2013.pdf).

Design Reference Mission	Clinical Priority	Clinical Priority Rationale
Lunar sortie mission Assumptions: ▪ 4 crewmembers (3 males, 1 female) ▪ 14 days total ▪ 4 EVAs/ crewmember ▪ Level of Care 3	Shall	The immunologic and physiologic changes of space flight have been shown to increase susceptibility to reactivation of latent viruses such as Varicella Zoster and Herpes Simplex, making the likelihood of developing one of the two during a lunar sortie mission a possibility. In-flight treatment is of importance because reactivated lesions are infectious to previously uninfected crewmembers and treatment may decrease the risk to them. In addition, treatment may decrease risk of sequelae such as neuropathic pain. The newly introduced Zoster vaccine can reduce zoster incidence by about half but cannot prevent its occurrence.
Lunar outpost mission Assumptions: ▪ 4 crewmembers (3 males, 1 female) ▪ 180 days total ▪ 90 EVAs/ crewmember ▪ Level of Care 4	Shall	The immunologic and physiologic changes of space flight have been shown to increase susceptibility to reactivation of latent viruses such as Varicella Zoster and Herpes Simplex, making the likelihood of developing one of the two during a lunar sortie mission a possibility. In-flight treatment is of importance because reactivated lesions are infectious to previously uninfected crewmembers and treatment may decrease the risk to them. In addition, treatment may decrease risk of sequelae such as neuropathic pain. The newly introduced Zoster vaccine can reduce zoster incidence by about half but cannot prevent its occurrence.
Near-Earth Asteroid (NEA) mission Assumptions: ▪ 3 crewmembers (2 males, 1 female) ▪ 395 days total ▪ 30 EVAs/ crewmember ▪ Level of Care 5	Shall	The immunologic and physiologic changes of space flight have been shown to increase susceptibility to reactivation of latent viruses such as Varicella Zoster and Herpes Simplex, making the likelihood of developing one of the two during a lunar sortie mission a possibility. In-flight treatment is of importance because reactivated lesions are infectious to previously uninfected crewmembers and treatment may decrease the risk to them. In addition, treatment may decrease risk of sequelae such as neuropathic pain. The newly introduced Zoster vaccine can reduce zoster incidence by about half but cannot prevent its occurrence.

Initial Treatment Steps During Space Flight

A link is provided to a prior version of the International Space Station (ISS) Medical Checklist, which outlines the initial diagnostic and treatment steps recommended during space flight for various conditions which may be encountered onboard the ISS. Further diagnostic and treatment procedures beyond the initial steps outlined in the Medical Checklist are then recommended by the ground-based Flight Surgeon, depending on the clinical scenario. Please note that this version does not represent current diagnostic or treatment capabilities available on the ISS. While more recent versions of this document are not accessible to the general public, the provided version of the checklist can still provide a general sense of how medical conditions are handled in the space flight environment. Medical Checklists will be developed for exploration missions at a later point in time.

Please note this file is over 20 megabytes (MB) in size, and may take a few minutes to fully download.

ISS Medical Checklist (http://www.nasa.gov/centers/johnson/pdf/163533main_ISS_Med_CL.pdf)

Capabilities Needed for Diagnosis

The following is a hypothetical list of capabilities that would be helpful in diagnosis. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.

- Imaging capability (such as a camera)
- Laboratory - Polymerase Chain Reaction (PCR) methodology and/or staining technique

Capabilities Needed for Treatment

The following is a hypothetical list of capabilities that would be helpful in treatment. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.

- Anti-virals (such as Valtrex)
- Analgesics (non narcotic, oral)
- Antibiotics for superimposed infection
- Postherpetic pain – amitriptyline, anticonvulsant, capsaicin

Associated Gap Reports

The NASA Human Research Program (HRP) identifies gaps in knowledge about the health risks associated with human space travel and the ability to mitigate such risks. The overall objective is to identify gaps critical to human space missions and close them through research and development. The gap reports that are applicable to this medical condition are listed below. A link to all of the HRP gaps can be found here (http://humanresearchroadmap.nasa.gov/Gaps/).

1.01 - We do not know which emerging technologies are suitable for preflight medical screening for exploration missions.
2.01 - We do not know the quantified health and mission outcomes due to medical events during exploration missions.
2.02 - We do not know how the inclusion of a physician crew medical officer quantitatively impacts clinical outcomes during exploration missions.
3.01 - We do not know the optimal training methods for in-flight medical conditions identified on the Exploration Medical Condition List taking into account the crew medical officer's clinical background. (Closed)
3.03 - We do not know which emerging technologies are suitable for in-flight screening, diagnosis, and treatment during exploration missions.
4.01 - We do not have the capability to provide a guided medical procedure system that integrates with the medical system during exploration missions.
4.02 - We do not have the capability to provide non-invasive medical imaging during exploration missions.
4.14 - We do not have the capability to track medical inventory in a manner that integrates securely with the medical system during exploration missions.
4.15 - Lack of medication usage tracking system that includes automatic time stamping and crew identification
4.17 - We do not have the capability to package medications to preserve stability and shelf-life during exploration missions.
4.24 - Lack of knowledge regarding the treatment of conditions on the Space Medicine Exploration Medical Condition List in remote, resource poor environments (Closed)
5.01 - We do not have the capability to comprehensively manage medical data during exploration missions.

Other Pertinent Documents

List of Acronyms

D	
DRM	Design Reference Mission
E	
EMCL	Exploration Medical Condition List
EVA	Extravehicular Activity
H	
HRP	Human Research Program
HSV1	Herpes Simplex Virus 1
HZ	Herpes Zoster
I	
ISS	International Space Station
M	

MB	Megabyte
N	
NASA	National Aeronautics and Space Administration
NEA	Near Earth Asteroid
P	
PCR	Polymerase Chain Reaction
U	
U.S.	United States
V	
VZV	Varicella-Zoster Virus

References

1. Sams C, Pierson DL. Immunologic concerns. In: Barratt MR, Pool SL (eds.), Principles of Clinical Medicine for Space Flight. New York: Springer; 2008.
2. Scully C, Felix DH. Oral medicine Update for the dental practitioner. Aphthous and other common ulcers. Br Dent J 2005 Sep 10;199(5):259-64.
3. In-flight Compilation Lockdown revised. In-flight medical events revised. 2010. Houston, Texas, NASA, Johnson Space Center (Internal NASA document – Not publicly available).

Last Update

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