# Cardiogenic Shock

From HumanResearchWiki

## Contents



## Introduction

Cardiogenic shock refers to inadequate tissue perfusion secondary to cardiac dysfunction (decreased cardiac output), and is most commonly seen secondary to an acute myocardial infarction (AMI). Signs and symptoms of cardiogenic shock include hypotension, an altered mental status, cool extremities, distended jugular veins, pulmonary edema, S3 gallop, oliguria, and cyanosis.[1]

The clinical manifestations of cardiovascular shock in microgravity are unknown, but it is assumed that the presentation, cause, and initial treatment could be different without a gravity gradient. For example, pulmonary edema may present over the entire lung rather than localized initially to the basilar portions; the cause of cardiogenic shock could be due to cardiac tamponade or cardiomyopathy induced arrhythmia; and if necessary CPR would be more difficult. Other signs of central and peripheral perfusion may also be altered on orbit by the microgravity-associated cephalad fluid shift.[2]

## 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<br><br>Assumptions:<br>▪ 4 crewmembers (3 males, 1 female)<br>▪ 14 days total<br>▪ 4 EVAs/ crewmember<br>▪ Level of Care 3 | Not Addressed | The complexity of caring for a crewmember with cardiogenic shock is beyond the scope of the planned medical resources for a lunar sortie mission, and the likelihood of its occurrence is very low in the highly screened astronaut population. |
| Lunar outpost mission<br><br>Assumptions:<br>▪ 4 crewmembers (3 males, 1 female)<br>▪ 180 days total<br>▪ 90 EVAs/ crewmember<br>▪ Level of Care 4 | Not Addressed | The complexity of caring for a crewmember with cardiogenic shock is beyond the scope of the planned medical resources for a lunar outpost mission, and the likelihood of its occurrence is very low in the highly screened astronaut population. |
| Near-Earth Asteroid (NEA) mission<br><br>Assumptions:<br>▪ 3 crewmembers (2 males, 1 female)<br>▪ 395 days total<br>▪ 30 EVAs/ crewmember<br>▪ Level of Care 5 | Not Addressed | The complexity of caring for a crewmember with cardiogenic shock is beyond the scope of the planned medical resources for a NEA mission, and the likelihood of its occurrence is very low in the highly screened astronaut population. |

# 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.*

- Vital signs measurement capability (blood pressure, pulse, respiratory rate, temperature, pulse oximetry)
- Auscultation device (such as a stethoscope)
- Electrocardiogram (12-lead ECG)
- Cardiac (ECG) Monitor
- Invasive blood pressure monitor
- Echocardiogram (ultrasound)
- Blood analysis

# 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.*

- Crew medical restraint system
- Intravenous (IV) start and administration kit
- IV pump or pressure infuser
- Intravascular volume replacement (such as IV fluids)
- Central line kit
- Vasopressors (epinephrine, norepinephrine)
- Positive inotropes (dopamine)
- Medications and surgical equipment directed at the underlying medical problem causing the cardiogenic shock

- Sharps container
- Ambu bag and mask
- Intubation kit
- Ventilator
- Supplemental oxygen

# 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.
4.04 - We do not have the capability to deliver supplemental oxygen to crew members while minimizing local and cabin oxygen build-up during exploration missions.
4.05 - We do not have the capability to measure laboratory analytes in a minimally invasive manner during exploration missions.
4.09 - We do not have the capability to provide medical suction and fluid containment during exploration missions.
4.12 - We do not have the capability to generate and utilize sterile intravenous fluid from potable water 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.
4.19 - We do not have the capability to monitor physiological parameters in a minimally invasive manner during exploration missions.
4.23 - We do not have the capability to auscultate, transmit, and record body sounds 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

| | |
|---|---|
| **A** | |
| AMI | Acute Myocardial Infarction |
| | |
| **D** | |
| DRM | Design Reference Mission |
| | |
| **E** | |
| ECG | Electrocardiograph |
| EMCL | Exploration Medical Condition List |
| EVA | Extravehicular Activity |
| | |
| **H** | |
| HRP | Human Research Program |
| | |
| **I** | |
| ISS | International Space Station |
| IV | Intravenous |
| | |
| **M** | |
| MB | Megabyte |
| MI | Myocardial Infarction |
| | |
| **N** | |
| NASA | National Aeronautics and Space Administration |
| NEA | Near Earth Asteroid |
| | |
| **U** | |
| U.S. | United States |

# References

1. Lenneman A. Medscape: Cardiogenic Shock. Ooi H, editor. 2-1-2011. WebMD LLC
2. Marshburn TH. Acute Care. In: Barratt M, Pool S, editors. Principles of Clinical Medicine for Space Flight. New York: Springer; 2008. p. 101-22

# Last Update

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