Head Injury

From HumanResearchWiki

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### Introduction

Head injury and traumatic brain injury (TBI) are two distinct entities that are usually related. A head injury can be defined as an injury that is clinically evident on physical examination and is recognized by the presence of ecchymosis, lacerations, deformities, and/or cerebrospinal fluid leakage. A more inclusive definition also includes any neurologic manifestation (subdural hematomas, TBI, etc.) found with neurologic imaging, Electroencephalograph (EEG), or other monitoring and brain examination.

A TBI refers specifically to an injury to the brain itself and is not always clinically evident – i.e., the brain may be damaged in the absence of any overt skull fractures. Thus, a TBI encompasses both blunt and penetrating mechanisms. Traumatic brain injuries are routinely classified using the Glasgow Coma Scale that derives point values from a patient’s motor response, verbal response, and eye opening (lowest is 3, highest is 15). Though not definitive, scores of 8 or less are considered severe injuries, 9 to 12 are moderate, and 13 to 15 are deemed as mild.

### 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 spacecraft. 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).

<table>
<thead>
<tr>
<th>Design Reference Mission</th>
<th>Clinical Priority</th>
<th>Clinical Priority Rationale</th>
</tr>
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<tbody>
<tr>
<td>Lunar sortie mission</td>
<td>Not Addressed</td>
<td>Most head injuries occurring in microgravity are expected to be minor, since the reduced gravity is thought to minimize impact forces and the extravehicular mobility unit’s (EMU) helmet is expected to offer protection while on EVAs. Minor head injuries can be managed with observation and symptomatic treatment (analgesics). In the very unlikely event that severe injury should occur, neurosurgical capability will not be feasible and the complexity of care for a severe head injury will be beyond that which can be provided in flight.</td>
</tr>
<tr>
<td>Assumptions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 crewmembers (3 males, 1 female)</td>
<td></td>
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<tr>
<td>14 days total</td>
<td></td>
<td></td>
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<tr>
<td>4 EVAs/crewmember</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of Care 3</td>
<td></td>
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<tr>
<td>Lunar outpost mission</td>
<td>Not Addressed</td>
<td>Most head injuries occurring in microgravity are expected to be minor, since the reduced gravity is thought to minimize impact forces and the EMU’s helmet is expected to offer protection while on EVAs. Minor head injuries can be managed with observation and symptomatic treatment (analgesics). In the very unlikely event that severe injury should occur, neurosurgical capability will not be feasible and the complexity of care for a severe head injury will be beyond that which can be provided in flight.</td>
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<tr>
<td>Assumptions:</td>
<td></td>
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<tr>
<td>4 crewmembers (3 males, 1 female)</td>
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<tr>
<td>180 days total</td>
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<tr>
<td>90 EVAs/crewmember</td>
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<tr>
<td>Level of Care 4</td>
<td></td>
<td></td>
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<tr>
<td>Near-Earth Asteroid (NEA) mission</td>
<td>Not Addressed</td>
<td>Most head injuries occurring in microgravity are expected to be minor, since the reduced gravity is thought to minimize impact forces and the EMU’s helmet is expected to offer protection while on EVAs. Minor head injuries can be managed with observation and symptomatic treatment (analgesics). In the very unlikely event that severe injury should occur, neurosurgical capability will not be feasible and the complexity of care for a severe head injury will be beyond that which can be provided in flight.</td>
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<tr>
<td>Assumptions:</td>
<td></td>
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<tr>
<td>3 crewmembers (2 males, 1 female)</td>
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<tr>
<td>395 days total</td>
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<tr>
<td>30 EVAs/crewmember</td>
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<tr>
<td>Level of Care 5</td>
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**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, as required per the patient’s clinical state)
- Auscultation device (such as a stethoscope)
- Otoscope
- Nasal speculum
- Ophthalmoscope
- Glasgow Coma Scale cue card
- Imaging of head and neck (such as computed tomography [CT] Scan, Magnetic Resonance Imaging [MRI], or ultrasound)
- Cardiac (Electrocardiograph [ECG]) monitor
- Electroencephalograph (EEG) monitor
- Intracranial pressure monitor

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.

- Patient immobilization capability
  - Crew medical restraint system
  - C-Collar/back board
  - Structural Aluminum Malleable (SAM®) splint
- General supplies including
  - Tape
  - Skin cleanser [such as alcohol/Benzalkonium (BZK)/iodine]
  - Sterile and non-sterile gloves
  - Skin stapler or sutures kit
  - Sterile drape
  - Medication delivery device (such as a Carpuject injector)
  - Local anesthesia for suturing
  - Sharps container
  - Cling dressing
  - All Cotton Elastic (ACE™) wrap
- Pharmacy – to include Antibiotic ointment, Analgesics (non-narcotic, narcotic, oral, injectable), Glucosteroids and drugs to decrease brain edema (mannitol, glycerin, etc.)
- Pulmonary and Airway supplies including:
  - Intubation kit (if patient is unconscious and not breathing)
  - Ambu bag and mask
  - Suction for clearing airway (if patient is unconscious and not breathing)
  - Supplemental oxygen
- Intravascular volume replacement capability
  - Intravenous (IV) fluids
  - IV start and administration kit
- Foley catheter (if patient is unconscious)
- Burr hole placement

**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/).

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.
4.07 - Limited wound care capability to improve healing following wound closure (Closed)
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)
4.27 - We do not have the capability to sterilize medical equipment during exploration missions.
5.01 - We do not have the capability to comprehensively manage medical data during exploration missions.

Other Pertinent Documents

List of Acronyms

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<thead>
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<tbody>
<tr>
<td>A</td>
<td>ACETM All Cotton Elastic</td>
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<tr>
<td>B</td>
<td>BZK Benzalkonium antiseptic</td>
</tr>
<tr>
<td>C</td>
<td>CT Computed Tomography</td>
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<tr>
<td></td>
<td>DRM Design Reference Mission</td>
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<tr>
<td>E</td>
<td>ECG Electrocardiograph</td>
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<tr>
<td></td>
<td>EEG Electroencephalograph</td>
</tr>
<tr>
<td></td>
<td>EMCL Exploration Medical Condition List</td>
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<tr>
<td></td>
<td>EMU Extravehicular Mobility Unit</td>
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<tr>
<td></td>
<td>EVA Extravehicular Activity</td>
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<tr>
<td>H</td>
<td>HRP Human Research Program</td>
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<tr>
<td>I</td>
<td>ISS International Space Station</td>
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<tr>
<td></td>
<td>IV Intravenous</td>
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<td>M</td>
<td>MB Megabyte</td>
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<td></td>
<td>MRI Magnetic Resonance Imaging</td>
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References

Last Update

This topic was last updated on 8/12/2014 (Version 2).


Category: Medical Conditions

- This page was last modified on 12 August 2014, at 15:31.