Lumbar Spine Fracture

From HumanResearchWiki

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Introduction

The human spine is comprised of 33 individual, interlocking bones called vertebrae. They are further subdivided into cervical, thoracic, lumbar, and sacral regions respectively, from the base of the skull to the coccyx. Within the vertebrae is an opening through which the spinal cord connects to all the body organs. The lumbar region spans the lower back and is made up of the five largest and strongest vertebrae along with cartilaginous discs positioned between each vertebral bone. The discs allow for some movement and also serve to absorb shock.

A lumbar spine fracture is a break in one or more of the lumbar vertebrae. Traumatic events account for many of these fractures; however, other risk factors exist and include disease processes such as osteoporosis, malignancy, and localized infection, all of which contribute to weakening of the bone structure. All bone fractures including vertebral fractures will cause pain (including pain caused by muscle spasms and nerve compression. Other neurological symptoms due to involvement of the spinal cord may occur and could be evident on physical exam depending upon the severity of the injury (e.g. paresis, paralysis, decreased sensation, or change in muscular reflexes).

Multiple factors are taken into consideration when determining the pathway for definitive lumbar bone and disc treatment. The goals of surgical and non-operative therapy in spinal column injuries are to relieve pain and muscle spasm, determine and treat (if necessary) nerve entrapment and dysfunction, stabilize unstable vertebral segments, and restore alignment of the vertebrae as practical.[1]

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).

<table>
<thead>
<tr>
<th>Design Reference Mission</th>
<th>Clinical Priority</th>
<th>Clinical Priority Rationale</th>
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<tbody>
<tr>
<td>Lunar sortie mission</td>
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<tr>
<td>Assumptions:</td>
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<tr>
<td>- 4 crewmembers (3 males, 1 female)</td>
<td>Not Addressed</td>
<td>Crewmembers in the reduced gravity environment of the moon, either inside a lunar habitat or outside on an EVA, will be unlikely to sustain anything more than minor musculoskeletal trauma or strain. The reduced gravity is thought to be protective in that impact forces will be minimized and the pressurized EVA suit is expected to offer some additional protection. Minor injuries are addressed under the condition of Back Injury.</td>
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<tr>
<td>- 14 days total</td>
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<td>- 4 EVAs/crewmember</td>
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<tr>
<td>- Level of Care 3</td>
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<tr>
<td>Lunar outpost mission</td>
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<td>Assumptions:</td>
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<tr>
<td>- 4 crewmembers (3 males, 1 female)</td>
<td>Not Addressed</td>
<td>Crewmembers in the reduced gravity environment of the moon, either inside a lunar habitat or outside on an EVA, will be unlikely to sustain anything more than minor musculoskeletal trauma or strain. The reduced gravity is thought to be protective in that impact forces will be minimized and the pressurized EVA suit is expected to offer some additional protection. Minor injuries are addressed under the condition of Back Injury.</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>
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<tr>
<td>Near-Earth Asteroid (NEA) mission</td>
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<td>Assumptions:</td>
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<tr>
<td>- 3 crewmembers (2 males, 1 female)</td>
<td>Not Addressed</td>
<td>Crewmembers in the microgravity environment of the exploration spacecraft and the asteroid’s surface will be unlikely to sustain anything more than minor musculoskeletal trauma or strain. The reduced gravity is thought to be protective in that impact forces will be minimized and the pressurized EVA suit is expected to offer some additional protection. Minor injuries are addressed under the condition of Back Injury.</td>
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<tr>
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<td>- 30 EVAs/crewmember</td>
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<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.

- Imaging modality [Ultrasound, X-ray, Magnetic Resonance Imaging (MRI), Computed Tomography (CT) myelography]
- Tape measure
- Reflex hammer

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.

- Spinal immobilization device and lumbar support/brace
- Pharmacy
  - Analgesics
  - Muscle relaxants
  - Antibiotics
  - Steroids (for decreased swelling)
  - Anesthesia
- Supplies including hot and cold compresses, etc.
- Orthopedic and neurosurgical operative equipment and other surgical and anesthesiology supplies
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.
4.03 – Limited capability to treat back/neck pain and injuries in the space flight environment
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.
4.06 – We do not have the capability to stabilize bone fractures and accelerate fracture healing 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
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 15:42.