Space Adaptation Back Pain
A Retrospective Study

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Aerospace Medical Association
80th Annual Scientific Meeting
Los Angeles, CA
May 2009
Space Adaption Back Pain

- Astronauts frequently report back pain in the early phase of space flight as they adapt to microgravity.
- The epidemiology of space adaptation back pain (SABP) has not been well established.
Objectives

• Determine the exact incidence of SABP among astronauts
• Develop a case definition of SABP
• Delineate the nature and pattern of SABP
• Review available treatments and their effectiveness in relieving SABP
• Identify any operational impact of SABP
Methods

Retrospective review of all available mission medical records of astronauts in the U.S. space program, which included:

- Preflight medical exams
- Flight surgeon logs
- Postflight medical exams
- Postflight medical debriefs
- Standardized back pain questionnaire
- Private Medical Conference (PMC) Tool
Missions

- Mercury
- Gemini
- Apollo
- Apollo-Soyuz Test Project (ASTP)
- Mir (U.S. Astronauts only)
- Skylab
- International Space Station (ISS) missions (Expedition 1 through 15)
- Shuttle missions STS-1 through STS-122 (Except STS-51L Challenger and STS-107 Columbia)
Study Size

A total of 772 astronaut flights were reviewed
Case Definition of SABP

• Symptoms are not precipitated by an injury or related to prolonged recumbent sitting on the launch pad
• Symptoms develop within the first 5 days of space flight
• Multiple days of in-flight back pain were considered as one case
Results

Incidence of SABP was 52%
Gender Analysis

Comparison of Gender and Space Adaptation Back Pain

Males
- SABP: 52%
- No SABP: 48%

Females
- SABP: 58%
- No SABP: 42%

Males
- SABP: 52%

Females
- SABP: 58%
Shuttle Gender Analysis

Males
SABP 57%

Females
SABP 59%
SABP Intensity

Mild pain 86%
Moderate pain 11%
Severe pain 3%
SABP Location

Back Pain Location

- Lumbar: 86%
- Thoracic: 12%
- Cervical: 2%

Lumbar  86%
Thoracic  12%
Cervical  2%
Onset of SABP

In most SABP cases, the initial onset of symptoms was within the first 2 days of space flight. Only 12 astronauts reported an onset of symptoms after flight day 2.
SABP & Flight Days

SABP is present in the early phase of spaceflight, with a peak prevalence on flight day 2 and none reported after flight day 12.

Flight Days Associated With SABP

<table>
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<th>Flight Day</th>
<th>Crew</th>
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<tbody>
<tr>
<td>FD1</td>
<td>80</td>
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<tr>
<td>FD2</td>
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<td>FD11</td>
<td>2</td>
</tr>
<tr>
<td>FD12</td>
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</table>
Temporal Component

Time of Day SABP Present

- Night: 75%
- Day: 15%
- Both: 10%
Effectiveness of Treatments

The most effective treatments were bending the knees to the chest (91%), stretching the lumbar spine (90%) and anti-inflammatory medication (85%).

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Interventions / Results

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Tried</th>
<th>Helped</th>
</tr>
</thead>
<tbody>
<tr>
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<td>28</td>
<td>15</td>
</tr>
<tr>
<td>Exercise</td>
<td>28</td>
<td>24</td>
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<tr>
<td>Medication</td>
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<td>108</td>
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<tr>
<td>Stretching</td>
<td>114</td>
<td>103</td>
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<tr>
<td>Bent Knees</td>
<td>177</td>
<td>161</td>
</tr>
</tbody>
</table>

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Respondents

Intervention

0 50 100 150 200

Tried  Helped
Vehicle Analysis

The incidence of SABP varied in relation to the space flight vehicle.

![Space Adaption Back Pain by Vehicle](chart.png)
History of Pre-flight Back Pain

Positive History of Preflight Back Pain Analysis

- Positive History (SABP=Y): 65%
  - Number: 106
- Negative History (SABP=N): 35%
  - Number: 57

Negative History of Preflight Back Analysis

- Positive History (SABP=Y): 52%
  - Number: 142
- Negative History (SABP=N): 48%
  - Number: 132

Positive History
SABP 65%

Negative History
SABP 52%
SABP Based on Number of Missions

Among astronauts who flew more than one mission; they had a higher incidence of SABP on their first mission than on subsequent missions.
SABP Characteristics

- Symptoms are usually mild to moderate
- Symptoms are usually localized to the lumbar region
- Symptoms are described as an ache or stiffness
- Symptoms typically occur during the sleep period
- Neurological symptoms (radicular pain, numbness, tingling) are absent
- Symptoms tend to improve or resolve with the use of bending the knees to the chest, stretching of the lumbar spine, or anti-inflammatory medication
Conclusions

• The incidence of SABP has been determined to be 53% among astronauts in the U.S. space program

• Most cases of SABP are mild, self-limited, or respond to available treatments

• There are no currently accepted preventive measures for SABP

• It is difficult to predict who will develop SABP

• The precise mechanism and spinal structures responsible for SABP are uncertain

• There was no documented evidence of direct operational mission impact related to SABP

• There is potential mission impact related to uncontrolled pain, sleep disturbance, or the adverse side effects of anti-inflammatory medications
Limitations

• Retrospective study
  • Missing data
  • Misinterpretation of existing data

• Standardized back pain questionnaire only used on Shuttle missions

• Reluctance among astronauts to report in-flight back pain
Recommendations

• Promote the most effective treatments of SABP with the least potential for adverse side effects

• Sleep accommodations on all space flight vehicles should allow for crewmembers to bend their knees to the chest

• The precise mechanism, spinal structures and causative factors associated with SABP should be further investigated in order to facilitate the development of preventive measures, as well as additional effective treatments
Acknowledgements

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Questions
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