Space Adaptation Back Pain
A Retrospective Study

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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)
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

Shuttle SABP Analysis Males

- SABP: 233 (43%)
- No SABP: 315 (57%)

Shuttle SABP Analysis Females

- SABP: 40 (41%)
- No SABP: 57 (59%)

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%

Legend:
- Lumbar
- Thoracic
- Cervical
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 is present in the early phase of spaceflight, with a peak prevalence on flight day 2 and none reported after flight day 12.
Temporal Component

Time of Day SABP Present

- Night: 75%
- Day: 15%
- Both: 10%
The most effective treatments were bending the knees to the chest (91%), stretching the lumbar spine (90%) and anti-inflammatory medication (85%)
The incidence of SABP varied in relation to the space flight vehicle

Vehicle Analysis

Space Adaption Back Pain by Vehicle

- Mercury: 0%
- Gemini: 0%
- ASTP: 0%
- Skylab: 0%
- Apollo: 10%
- Mir: 31%
- ISS: 39%
- STS: 58%
History of Pre-flight Back Pain

Positive History of Preflight Back Pain Analysis

- SABP = Y: 57 (35%)
- SABP = N: 106 (65%)

Negative History of Preflight Back Analysis

- SABP = Y: 132 (48%)
- SABP = N: 142 (52%)

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

Percentage of flyers with SABP based on Number of Missions

- First Mission: 53%
- Second Mission: 46%
- Third Mission: 47%
- Fourth Mission: 46%
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
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