

BLOCKING THE WAY TO SPACE:

EVALUATION OF A PATIENT WITH
RECURRENT SMALL BOWEL
OBSTRUCTION FOR SPACEFLIGHT

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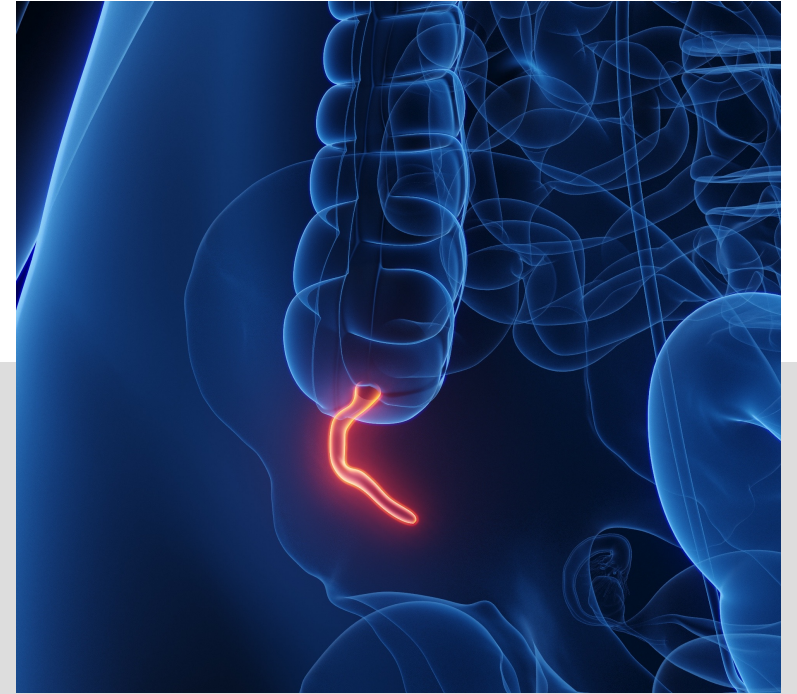
DISCLOSURE INFORMATION

94TH ANNUAL SCIENTIFIC MEETING

- The authors report the following disclosures:
 - Multiple authors are employees of the University of Texas Medical Branch at Galveston
 - None of the authors will discuss off-label use and/or investigational use in this panel presentation

CASE BACKGROUND

- 40-60 year-old astronaut
- PMHx:
 - No significant medical history
- PSHx
 - Appendicitis status post open appendectomy as a child complicated by a...
 - Small bowel obstruction (SBO) approximately 10-20 years later
 - treated with laparotomy and adhesion release
- Previously granted a waiver for long duration spaceflight – MDC 1
 - 10 years after SBO



CASE CONTINUED...

While in preparation for another mission:

- Pt developed another SBO
- Treated with laparoscopic adhesiolysis without complication
- No further adhesions found
- Excellent, rapid recovery



AFTER RECOVERY, REQUESTING RE-CERTIFICATION FOR
LONG-DURATION SPACEFLIGHT

ASSIGNED TO: BACK-UP CREW (8 MONTHS) AND PRIME CREW (14 MONTHS)



[OCHMO-STD-100.1A]
Release Date: 05/10/2021

National Aeronautics and Space Administration

OFFICE OF THE CHIEF HEALTH AND MEDICAL OFFICER

**NASA ASTRONAUT MEDICAL STANDARDS,
SELECTION AND ANNUAL RECERTIFICATION**

5.3 Medical Conditions to Consider for Selection and Annual Recertification of NASA Astronauts

Table 7, Disqualifying Medical Standards, details those medical conditions that are medically disqualifying for the selection and retention of NASA astronauts, or that may require further testing and evaluation to assess medical suitability. In general, all conditions are worded as disqualifying. The term “unless” is used when specific exceptions are listed. Annual medical recertification ensures the individual has not developed any new medical conditions that would preclude safe performance of training and/or space flight duties or participation. This section pertains to all NASA astronauts.

11. History of intestinal obstruction due to any chronic or potentially recurrent disease. Surgery to relieve childhood pyloric stenosis, intussusception, volvulus, or Meckel’s diverticulum is not disqualifying if there are no sequelae.

12. Adhesive disease. Asymptomatic adhesive disease requires specialist evaluation.



EVALUATION OF RISK AFTER SMALL BOWEL OBSTRUCTION

HISTORY SMALL BOWEL OBSTRUCTION RISKS

Surgical Intervention Complications:

- Intra-abdominal infection
- Wound infection
- **Adhesions from surgical intervention**

Long Term Complications:

- **Recurrence!**
 - Short term risk: Up to 5% within 1 year¹
 - Increased risk with adhesions
 - Significantly decreased after 5 years

LAPAROSCOPIC RISKS REDUCED

- Prior data predominantly from open surgical intervention
- Reduced risk of recurrence with laparoscopic intervention of small bowel obstruction or recurrent small bowel obstruction^{2,3}
- One study with 0% recurrence and one with 2.3% recurrence at 38 to 41 months
 - Cumulative 0.5% recurrence

IMM RISK SIMULATION AND EVALUATION

- IMM = Integrated Medical Model
 - Software-based decision support tool
 - Monte-Carlo simulation
 - Evaluation of likelihood and consequence
 - Utilization of best-case and worst-case scenarios
 - Input in likelihood of events in best and worst case
- Comparative analysis performed (100K trials)
 - Crew without hx of appendectomy
 - Crew with hx of appendectomy
 - Evaluation for:
 - Evacuation
 - Loss of Crew Life
 - SBO related evacuation
 - SBO related Loss of Crew Life

IMM RISK SIMULATION AND EVALUATION*

Outcome	Prime Mission Relative Risk	Back-up Mission Relative Risk
Evacuation	1.08 (1.01, 1.14)	1.11 (1.05, 1.18)
Loss of Crew Life	1.05 (0.88, 1.20)	0.94 (0.82, 1.09)

CAN IT BE REDUCED FURTHER?



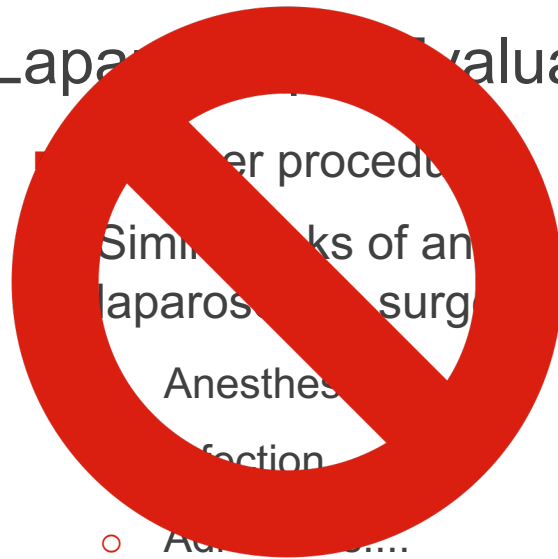
RISK STRATIFICATION OF ADHESIONS

Not



At least prior risk level
Unknown if adhesions still
present
recurrence
potentially are

Laparoscopic Evaluation



per procedure
Similar risks of an
laparoscopic surg
Anesthes
fection
Ad...

Ultrasound

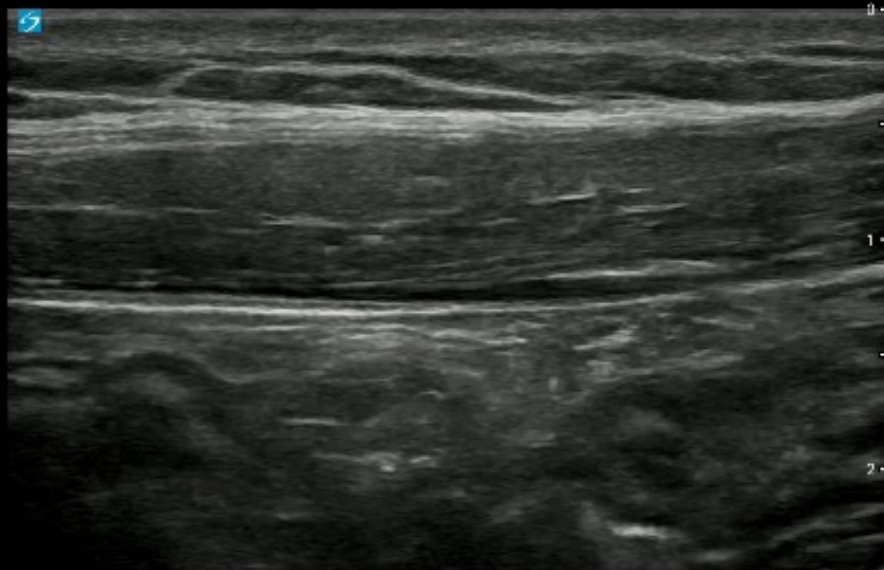
- Screening for adhesions
- Evaluation for “visceral slide”

ULTRASOUND EVALUATION

- Evaluation for visceral slide



ULTRASOUND: VISCERAL SLIDE



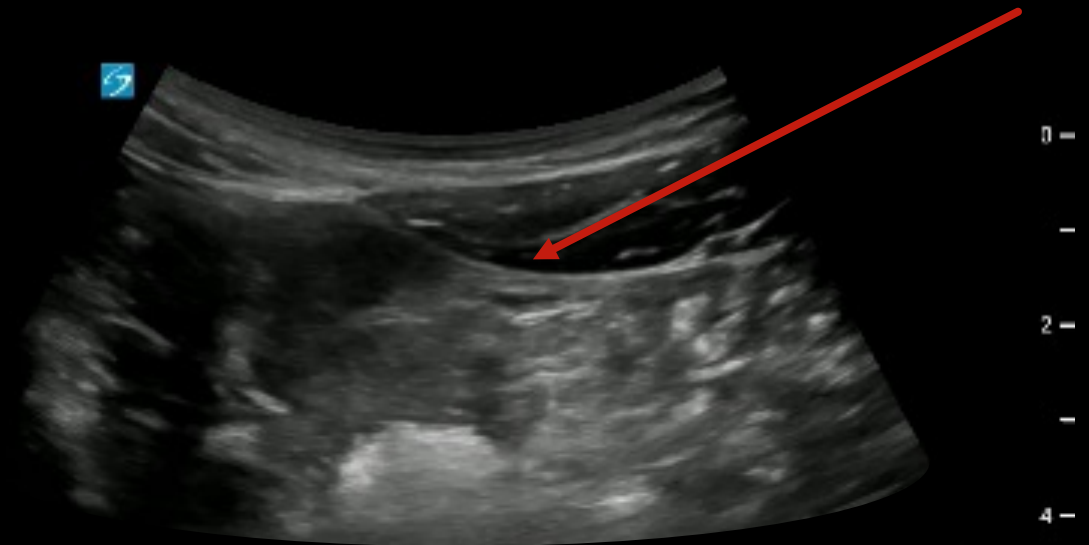
L12-3
Superficial
MI: 1.5 TIS: 0.2

2.4 cm

2D: C: 50
Res DR: 0
MB
THI

*Example image

- Evaluation for bowel movement along the fascia
 - Think like “lung sliding”
- Lack of sufficient movement concerning for adhesion



*Example image

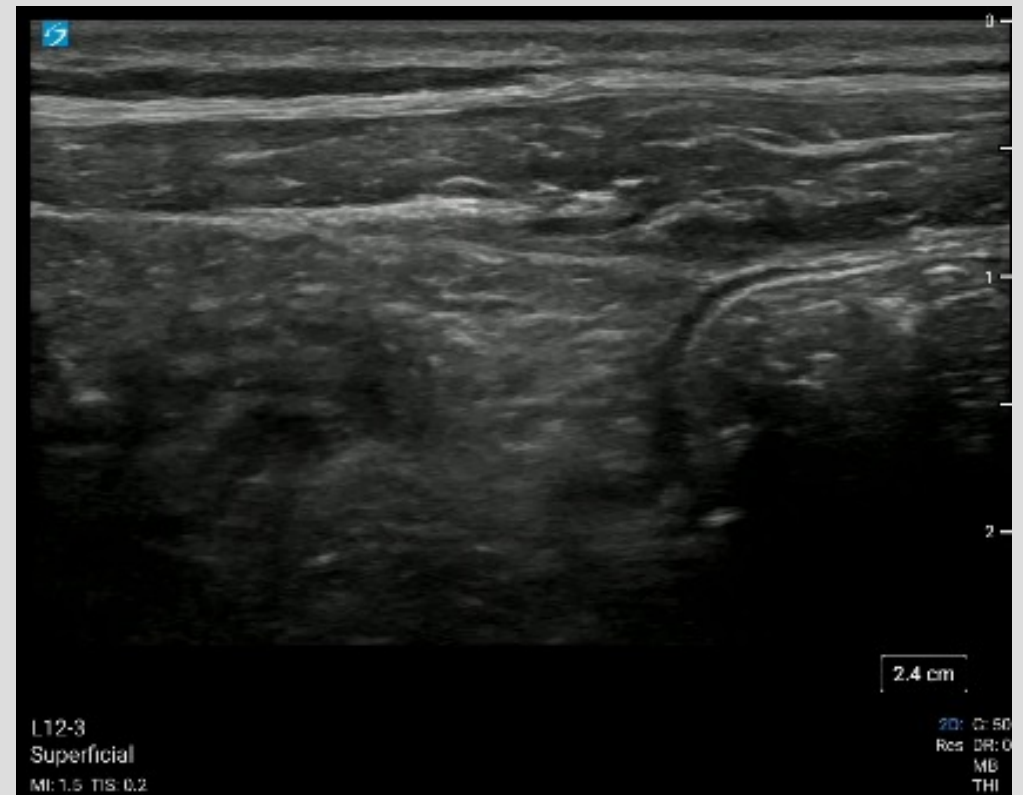
ULTRASOUND EVALUATION

- Evaluation for visceral slide
- Systematic Review: 76 to 100% accuracy⁴
 - Included literature from 1990s
 - Ultrasound improved since that time
- 2020 study of 108 patients with surgical diagnosis as Gold Standard⁵:
 - Sensitivity: 91.4 %,
 - Specificity: 100%
 - PPV: 90.7 %,
 - **NPV: 100 %**



PATIENT EVALUATION

- Patient underwent independent ultrasound evaluation for visceral slide
- Ultrasound with no evidence of adhesions

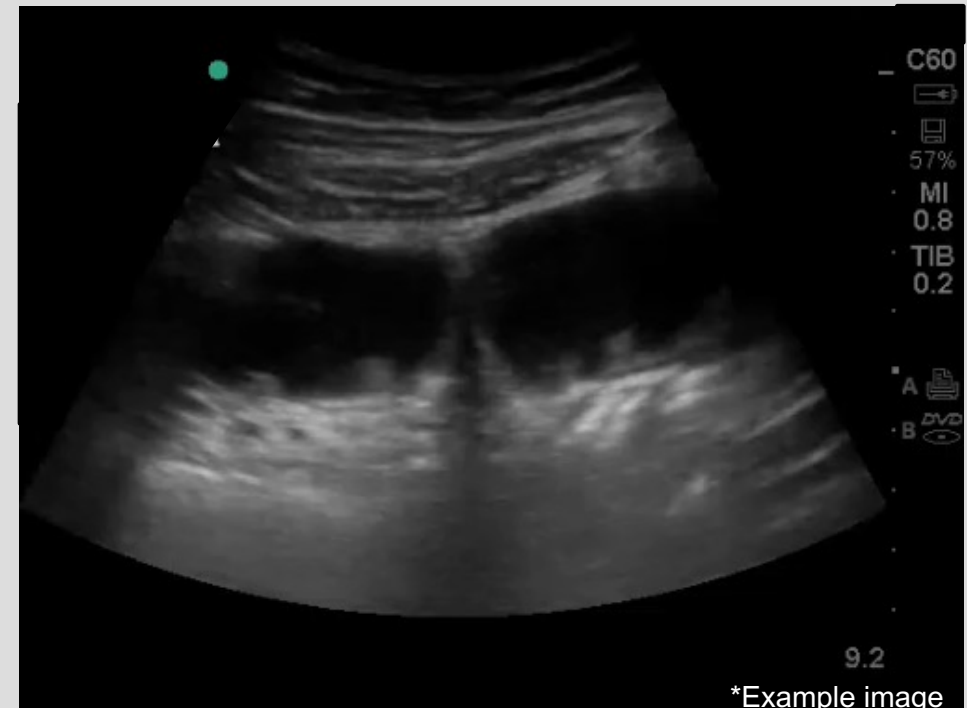


*Example image

STILL A RISK...

DIAGNOSIS AND MANAGEMENT IN LOW-EARTH ORBIT

- SBO risks: dehydration, nausea and vomiting, electrolyte imbalance, pain
- Risk stratification for adhesions pre-flight
- Ultrasound for SBO Diagnosis⁶
 - Sensitivity and specificity > 90%
- Non-surgical management⁷
 - 65 to 80% resolve spontaneously
 - IVF, nausea and pain control



CASE CONCLUSION

- Crewmember Ultrasound: negative for adhesions
- PRA analysis: relative risk slightly higher than crew without hx
- Presented to MSMB
- Medical Certification granted





THANK YOU

Sam King & Isaiah Reeves



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