A Medical Simulation Based Curriculum to Address Medical Contingencies Aboard the International Space Station

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Objectives

• Understand the role of international partner flight surgeons (IP-FS) and biomedical engineer flight controllers (BME) during medical contingencies aboard the ISS
• Sample the curriculum
• Work through an interesting case
Why do we do simulations?
Background

- What are the responsibilities of an IP-FS?
- What are the responsibilities of a BME?
International Partner Flight Surgeons (IP-FS)

• Flight surgeons from ISS partner agencies
• When do they get involved?
• Responsibilities
  – Daily medical responsibilities
  – Liaison with partner agency mission control
  – Coordinate medical activities with crew surgeon
Curriculum for IP-FS

• Life-threatening events that require immediate medical attention
• Scenarios involving collaborative decision making with other team members
• A cultural scenario to elucidate differences in medical practice
Biomedical Engineer Flight Controllers (BME)

- Position on console
- On-call duties
- Knowledgeable about:
  - Hardware and systems on board
  - Procedures commonly used
  - BME log
  - Contingency operations and troubleshooting
- Restrictions
Curriculum for BME

• Information gathering
• How to contact medical support
• How to prepare and troubleshoot the necessary hardware and procedures required by the medical team
Case of A.S.M. Clerk

- Scenario:
  - You are the BME sitting on console today
  - It is 0400 hrs GMT on a Saturday
  - 37 year old previously healthy female RSA cosmonaut on the International Space Station starts to complain of gradual onset of right lower-quadrant pain

Question: What would you like to do now?
BME Considerations

• Contact the Russian IP-FS or Crew surgeon (Lead U.S. Flight Surgeon)
• Arrange for a PMC via space-to-ground voice loop
• What information would be relevant now?
  – PMHx and FHx of the cosmonaut
  – What has been done by the CMO so far?
  – What support does the CMO need now?
  – What is the situation with the mission now?
  – What is the window for a contingency return?
  – What equipment might the IP-FS request?
  – Are translation resources necessary?
Situation Onboard

• The crew is in the second month of a six-month mission aboard the ISS
• Next shuttle resupply is in three weeks
• Next window for a nominal landing in Kazakhstan via the Soyuz is in 8 hours
To Further Complicate Matters…

The sick cosmonaut is the Soyuz commander

But Luckily…
There is a healthy CMO on board as well as a third ISS crewmember with Soyuz landing training
IP-FS Considerations

- What is the medical concern?
- Will this sickness impact other crewmembers?
- Will this sickness impact the mission?
- What investigations and treatments should be administered now?
- When should this be discussed with the crew surgeon and flight director?
Medical Situation On Board (continued)

• Cosmonaut is previously healthy woman, G3 T2 P1 A1 L2, on multivitamins and calcium supplements
• FHx of diabetes, heart disease, kidney stones
• Has been drinking less than 2L/d of water
• Has colicky RLQ abdominal pain
• Mild irritative urinary symptoms
Physical Exam

- Cosmonaut looks pale, diaphoretic, anxious, in distress, writhing in pain
- Vital signs: 140/85, 120, 26, 100% non-rebreather, 37.9 °C
- Could not assess bowel sounds because stethoscope misplaced, mild RLQ tenderness, +CVAT RHS, no rebound/guarding/rigidity/peritoneal signs
- Rest of physical exam is normal

Question: As the IP-FS, what would you do now?
IP-FS Considerations Continued

- Possible mission impacting event
- Need to notify the crew surgeon, deputy crew surgeon, and flight director
- In conjunction with the BME, activate the Health Research Facility ISS ultrasound and the on-call radiologist and make sure the appropriate medications are available to keep the cosmonaut comfortable
Developments

• Crew Surgeon has arrived on scene and notified the flight director of the events
• Crew Surgeon) asks you what has been done thus far and asks what you think should be done at this point
• Flight director needs to make a decision regarding Soyuz return in 3 hours
Urine analysis:
(+) or positive for leukocytes and nitrites
Imaging Results

- Dilated right renal calyx, echogenic mass in proximal right ureter, absence of ureteral jets with doppler
- No obvious vascular, gastrointestinal and ovarian abnormalities

As an IP-FS working with the crew surgeon, what are the different options now?
Activation of Medical Supports

BME gathers information
-ensures medical equipment is ready
-troubleshoots hardware malfunction
-gets hardware ready for use

Medical Event

Notifies flight surgeon
-gets PMC STAT
-history and physical exam with CMO
-institute necessary treatment
-investigations
-notifies crew surgeon and flight director

Course of Action
Summary

• Contingencies aboard the ISS have the potential to get very complicated
• Many medical team members work together to come to a medical decision
• Simulation exercises attempt to strengthen these decision-making processes by mimicking high-pressure situations that might occur on board
Future Directions

• Present the curriculum proposal to partner agencies for feedback
• Validate the curriculum
References

- International Partner Flight Surgeons Training Manual
- Biomedical Engineer Certification Guide
- International Space Station Crew Training and Certification Plan
- International Space Station Medical Checklist
- International Space Station Crew Medical Officer Certification Training
Any Questions?

Courtesty of the Canadian Space Agency