ABSTRACT

Intubations are a very routine procedure on Earth, but in outer space with a microgravity environment, the traditional protocol becomes inefficient and complicated. Tartan Intubation for Microgravity (TIM) is a NASA collaboration to address the lack of airway management capability in space at the patient interface. It is a system including a collapsible backboard restraint to support the patient and a modified terrestrial intubation device to accommodate for changes in the behavior of the body and liquids in microgravity.

MOTIVATION

Scope of Problem

- Level 1 criticality situation: failure to manage the airway could result in loss of the astronaut’s life
- As space exploration moves toward longer duration missions, the probability of a traumatic occurrence requiring intubation is increased
- To date, no intubations have been performed in space
- Astronauts typically are not medical doctors
  - Crew Medical Officer (CMO) has 60 hr basic medical training
  - Very limited physical working space on spacecraft
  - NASA Orion working crew area is ~316 ft²

Current Treatment

- Initial intubation experience
- Minimal medical expertise necessary to use
- Minimal trauma to patient
- Modified Continuous Positive Airway Pressure (CPAP) Facial Mask
  - Captures excess fluids that may escape from patient
  - Minimizes contamination of spacecraft air supply
  - Includes feature for possible suction devices

RESULTS

Proposed Operation Protocol

1. Transport patient to medical area of spacecraft
2. Remove TIM from medical equipment storage
3. Unfold restraint board and lock open
4. Position TIM so that patient’s head rests in curve of cushion
5. Secure patient’s head using head strap
6. Secure patient’s arms using chest strap

Intubation

1. Insert King Airway into patient’s mouth up to the 4cm marking
2. Attach 60cc syringe
3. Inflate cuffs using syringe
4. Attach manual resuscitation bag
5. Press bag to pump air into patient’s lungs

Intubation Functionality

- The time required to execute the intubation protocol was tested on simulation manikins
- Subjects for the intubation protocol had minimal to no previous intubation experience

Table 1: Average time required (in seconds) for subjects to successfully intubate and pump air into manikin’s lungs.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Traditional</th>
<th>King</th>
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</thead>
<tbody>
<tr>
<td>Normal</td>
<td>110 sec.</td>
<td>12 sec.</td>
</tr>
<tr>
<td>Tongue Edema</td>
<td>120 sec.</td>
<td>12 sec.</td>
</tr>
<tr>
<td>Decreased Cervical Motion</td>
<td>150 sec.</td>
<td>20 sec.</td>
</tr>
<tr>
<td>Pharyngeal Neck Obstruction</td>
<td>180 sec.</td>
<td>25 sec.</td>
</tr>
<tr>
<td>Trims</td>
<td>150 sec.</td>
<td>15 sec.</td>
</tr>
</tbody>
</table>

FUTURE DIRECTIONS

- Testing of the device and protocol on a zero gravity simulator
- Testing to determine if materials meet regulations for spaceflight safety
- Combining the device with other projects that utilize fluid suction

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REFERENCES