

Choking-Obstructed Airway CLIFF Peer Review

1. *Strength of evidence presented in CLIFF in modeling the characteristics and mission impact of this medical condition within the spaceflight environment?*

Score: 2

Grading Scale:

4 - Confident

3 - Somewhat confident

2 – Neutral

1 – Somewhat unconfident

0 – Not confident

2. How confident are you that these data accurately represent the spaceflight environment?	Tables 1, 2 Composite Incidence and Level of Confidence	Table 3, 4 BC/WC Loss of Crew and probability	Table 4 - Clinical Phase 1, 2 durations Table 5 – CP 2 Loss of Crew	Table 4 – RTDC % Table 6 – RTDC Loss of Crew	Table 4 – Loss of Crew Life % Table 7 – Loss of Crew Life, Loss of Crew	Table 8 – TI
Score	3	3	2	2	2	2

Comments and limitations:

1. General comments. This CLIFF characterizes choking or airway obstruction resulting from the aspiration of a foreign body that could occur during spaceflight. The constellation of symptoms that can be evoked from an inhaled object range from mild irritation and cough to total obstruction of the airway and death. Despite circulation of the atmosphere by cabin fans, in microgravity particles tend to float in the air rather than settling. This increases the risk for aspiration of objects such as food, dust, or even small pieces of metal such as loose screws, particularly during exercise. There have been several reports of foreign body inhalation during spaceflight but all have been mild or self-limited. The best case is considered to be choking or cough that resolves spontaneously, or obstructed airway that responds to the Heimlich maneuver. The worst case is considered to be choking and obstructed airway that require instrument extraction or advanced life support.

2. Incidence. There have been 3 reports of choking during spaceflight, all of them very mild with spontaneous resolution of symptoms. No analog studies were available. Terrestrial incidence data includes many cases at the extremes of ages and excludes mild cases that resolve without seeking medical care. Thus, the spaceflight data was used to calculate incidence; unfortunately, no updates

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are available since the IMM CLIFF was written, so the incidence is the same. Given the young, healthy astronaut population, it is expected that airway obstruction will be extremely unlikely. The best case/worst case probabilities are calculated from spaceflight data and from terrestrial studies documenting the percentage of cases presenting to emergency providers that required instrumented removal of foreign objects. A range of values for worst case from 0% (spaceflight data) to 5.6% (terrestrial data) was used to account for the inclusion of an unscreened population in the terrestrial studies. The clinical phase durations, RTDC and Loss of crew life probabilities are supported by terrestrial evidence and by the condition definitions. Best case scenario RTDC and Loss of crew life were assumed to be zero because the BC definition includes resolution of symptoms. The worst case probabilities used data from Japanese studies that studied subjects who are primarily elderly which may overestimate the risks in astronauts. The RTDC probabilities for the worst cases were based on the likelihood of onboard flexible bronchoscopy relieving the obstruction while the worst case Loss of crew life probabilities were based on progression to cardiac arrest. The probability density curve that was derived appears to be a reasonable representation of the data presented.

3. Clinical phase data. I am in agreement with the clinical phase durations entered in this CLIFF. This data was compiled by a team of expert clinicians, and I was involved in the discussions leading to the calculation of the clinical phase durations.

4. Task impairment. The analysis was performed and reviewed by a separate team of expert clinicians. I am aware of the methods that were used but did not directly participate in the discussions.

5. Dependence on mission phase or duration of mission. This medical condition should not be dependent on mission phase. However, partial g operations (lunar or Martian) may decrease the incidence of ingestion of foreign bodies floating in the air in comparison with operations in microgravity.

6. Limitations

- The worst case probabilities for Loss of crew life used data from Japanese studies that studied subjects who are primarily elderly which may overestimate the risks in astronauts.
- This medical condition should not be dependent on mission phase. However, partial g operations (lunar or Martian) may decrease the incidence of ingestion of foreign bodies floating in the air in comparison with operations in microgravity.
- The worst case probabilities assumed that flexible bronchoscopy is available onboard the spacecraft and that a trained operator is performing the procedure. If either of these are not true, the probabilities may need to be refined.
- The best-case and worst-case scenarios for the condition do not fit perfectly with available literature. They were created because the current best-case scenario is reflective of all prior episodes of choking/obstructed airway in spaceflight. The literature, however, naturally breaks choking into complete vs. partial airway obstruction (both of which are accounted for in both the best and worst-case scenarios). Duration, RTDC, and Loss of crew life values are affected by this inconsistency between our definitions and the literature.
- In partial airway obstructions in the bronchial tree that can await definitive removal (such as seen in the 10-year duration of the untreated worst-case scenario), patients often present with concomitant issues like pneumonia, granulomas, etc. In future iterations of IMPACT, this capability of one condition leading to another will need to be implemented for this condition.

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Reviewed by:

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