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# Spaceflight: the final frontier for airway management?

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*The conquest of space is worth the risk of life.*

*Virgil I. Grissom, 1967*

A shift towards long duration interplanetary space missions (e.g. to Mars), is expected in the near future.[1] It is clear that these missions will unavoidably be associated with an increased risk of acute medical problems.[2] During a 950-day mission to Mars, for example, with six crew members in the capsule, the risk for a medical problem potentially requiring general anaesthesia has been estimated to be 2.6%.[3] Other data show that one major medical event could occur during a 900-day mission in space.[4–7]

Since evacuation will not be possible during long-duration space exploration missions, there is a clear need for emergency medical skills by crew members.[8–10] An autonomous crew will have to handle medical emergencies alone during extreme isolation not expecting both physical and timely telemedicine assistance.[19] One of the essential skills for management of surgical cases is airway management (tracheal intubation or the use of supraglottic airways). So far, no human has ever required general anaesthesia or airway management in microgravity.

In a recently published systematic review, Warnecke and colleagues[11] identified and analysed original papers published so far on airway management in (simulated) microgravity. They only found three papers from missions during parabolic flight and underwater.[12–14] The success rate of conventional laryngoscopy under free-floating conditions was between 15% and 86%, and supraglottic airway devices had a significantly higher success rate.[11] However, use of videolaryngoscopy has not been reported, and data from spaceflight are not available. Data from the operating room indicate that the learning curve for videolaryngoscopy and the success rate are usually steeper and higher than for conventional laryngoscopy.

In this issue of the *British Journal of Anaesthesia*, Starck and colleagues[15] present an important and interesting study on difficult airway management in microgravity using direct laryngoscopy and videolaryngoscopy in a manikin during parabolic flight. The authors used time to intubate and success rate to analyse and compare performance of tracheal intubation.[16] This study is of high quality since it analyses data from an RCT during real weightlessness. It is not surprising that intubation success rates were higher and intubation times shorter when using videolaryngoscopy compared with direct laryngoscopy. However, it was surprising that novices and experts had a comparable success rate with videolaryngoscopy in microgravity. This could be the first indication that videolaryngoscopy can emerge as the first-line technique for tracheal intubation in microgravity.

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Using a videolaryngoscope as a first-line device for tracheal intubation is also recommended for airway rescue, for example, in critically ill patients.[17] In this setting, the success rate is usually higher even for trained anaesthesiologists.[18] In contrast to usual in-hospital settings for airway management, securing the airway in the out-of-hospital field is far more complicated, associated with a higher risk, and usually a lower success rate.[19]

In addition to these important new results, some limitations must be taken into account. One parabola is usually 21 s long, which is a very short time for tracheal intubation. From previous studies we know that tracheal intubation underwater (which is used as simulation of microgravity) can take significantly longer (mean 36 s).[11 13] During free-floating conditions (which were not analysed in the present study), time for tracheal intubation may be significantly longer compared with a standard situation such as in the operating room.[11] Whereas tracheal intubation is usually associated with lower success rates and longer times in the unrestrained setting, restraining may increase success rate and decrease time. Hence, data should be carefully interpreted since restraining is time consuming during spaceflight and not always possible in the International Space Station, for example. Future studies should investigate airway management in the first phase of emergencies, unrestrained and possibly longer than 21 s. However, this is currently limited to real spaceflight since parabolas are limited to short times.

With future spaceflight, especially long-duration missions, airway problems can surely be anticipated. Besides microgravity-induced fluid shifts to the upper body, including airway oedema, which is a possible rationale for using an airway manikin with a difficult airway, several other spaceflight-related airway problems require future research. Airway trauma attributable to smoke or ammonia inhalation can provoke oedema in the upper airway and complicate airway management.[20] Research activities for airway management during (real) spaceflight are very limited so far. This includes use of airway devices and specific anaesthesia drugs. A major challenge will be how to recover and manage a ventilated patient, as evacuation of intubated and ventilated astronauts is not possible so far.

Future research should cover several specific aspects ideally investigated during spaceflight and not in simulation. Protocols and concepts are of the utmost importance to care for astronaut patients. These should include airway management, conduct of anaesthesia, including regional anaesthesia techniques, and medical treatment. We clearly need scientific data to develop recommendations for future space missions.

In conclusion, the field of anaesthesiology and space medicine is quite interesting and promising for extensive future research. We clearly need more studies in both airway management and emergency medical care during spaceflight! Interplanetary spaceflight is our dream, but also our very near future, as it will likely become reality.

## Declarations of interest

JH is President of the German Society of Aerospace Medicine (DGLRM), Treasurer of the European Society of Aerospace Medicine (ESAM), and chairman of the ESAM Space Medicine Group (ESAM-SMG).

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