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Letter to the Editor re: Microgravity Cardiopulmonary Resuscitation: Updates from Terrestrial Literature

Dear Editor:

We read with great interest the article by Sriharan et al.[7] in which they investigated the quality of external chest compressions in hypogravity simulation and would like to comment on 2020 European Society of Aerospace Medicine Space Medicine Group (ESAM-SMG) microgravity cardiopulmonary resuscitation (CPR) guidelines[3] in the light of recent medical advances. In line with the literature, manual chest compression, performed by Evett-Russomano (ER), handstand (HS), or reverse bear hug method (RBH) should not provide efficient long lasting circulatory support. In contrast, automatic chest compression devices (ACCD) could provide standardized external chest compression (ECC) depth, rate, and duty cycle. To our knowledge, ACCD has not been assessed in microgravity so far, but translation of the concept only raises ergonomic but no physiological concerns for its application. With respect to spaceflight hostile surroundings and untrained crewmembers, we postulate that ACCD could greatly simplify and standardize CPR procedures in order to improve survival rate. The need for the development of simple and efficient cardiopulmonary resuscitation maneuvers have been emphasized by recent studies demonstrating an important failure rate of assisted maneuvers attempted by untrained people. For example, Starck et al. reported the usefulness of videolaryngoscopy, but the failure rate remained up to 20% when novices performed tracheal intubation.[8] Airway management is a cornerstone of CPR, but recent studies suggest that it could be delayed without survival impairment.[1,9] Conventional supra glottic airway devices should be used for ventilation during CPR but should not delay chest compression and Automatic External Defibrillation (AED). Drug administration is also a crucial point of CPR and requires venous access. The intraosseous (IO) tibial route represents the simplest way to intravenous (IV) access and is efficient for drug administration during CPR;[2] thus, this route should be used by people untrained to standard IV access when drugs have to be delivered. Recent evidence suggests neither epinephrine[6] nor amiodarone[4] improve any benefit for survival without important neurological disabilities. Despite this conflicting recent literature, the latest ESICM guidelines published in 2021 still recommend epinephrine and amiodarone during CPR.[5] No standardized procedure has been proposed in the latest CPR guidelines in microgravity. Here we suggest a simplified sequential protocol updated with recent publications. Early standard ER CPR should be initiated. The patient should be transported in the dedicated medical room to be restrained and patched with AED. Subsequent Stop And Go CPR should be performed according to AED instructions. Switching to ACCD could help to manage chest compressions. The supra glottic device should be correctly positioned and connected to a standard AMBU for 100% oxygen supply with an insufflation rate of 15/min. If the rescuer isn't trained to standard IV access, the IO tibial route would be preferred for drug administration. Amiodarone 300 mg should be injected when shockable rhythm is identified by AED and epinephrine should be delivered every 3–5 min up to return of spontaneous circulation.

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In Response:

We read with great interest the proposal by Lescroart et al. in their Letter to the Editor, in particular the systematic algorithm which can be used for advanced life support (ALS) and CPR in microgravity. It is pertinent to mention that our team specifically investigated CPR in hypogravity, which differs from CPR in microgravity. The remaining gravity pull in hypogravity conditions can assist in CPR performance and thus alters what CPR method is most effective.[7]

The use of automatic chest compression devices (ACCDs) is a prominent potential idea for future space travel. A recent Cochrane review noted that ACCD CPR showed no superiority with regards to survival outcomes over manual CPR; however, it stated that it may be useful in situations where prolonged CPR is required or when limited persons are available.[8] Our findings have shown that ECC depth declines over time as fatigue accumulates in hypogravity conditions.[7] Considering those findings, the microgravity- and hypogravity-induced muscular deconditioning of potential rescuers,[1] and the limited crewmembers available in a space setting, ACCDs could play an essential role for achieving optimal CPR quality.

Excess vibrations in space shuttles and the cost and weight of these devices are issues to consider. But the key issue is the time taken for the machine to be deployed on the patient, which can be over 20 s and would require a few crewmembers.[3] This increases interruptions to vital ECCs (a key criterion for quality CPR). Potential future studies could use parabolic flights or even suborbital spaceflights to assess the adequacy of using an ACCD and the time taken for deployment of it in hypogravity/microgravity conditions. ACCDs do remain a potential way of providing ongoing, uninterrupted CPR whilst allowing crewmembers to be freed up.

With regards to CPR experience being a factor in CPR quality, the literature is variable. Peberdy et al.[5] found no major difference between BLS-trained individuals and laypersons practicing CPR with regards to ECC depth.[5] Yet Lund-Kordahl et al.[4] found that CPR quality improved as CPR experience increased. This was mainly due to a reduction in CPR interruptions and thus an improved chest compression fraction. Overall, it seems pertinent that crewmembers are trained in CPR effectively, but the level of training necessary is unclear.

The advanced life support (ALS) flowchart created by Lescroart et al. illustrates a clear structured algorithm, similar to the terrestrial algorithm, to follow for ALS in microgravity. However, as stated by Hinkelbein et al.,[2] CPR in microgravity should relatively mirror that of terrestrial AHA/ERC guidelines. In accordance with this, and the most recent 2021 ERC guidelines,[6] ventilation should be kept at 10 breaths/min and amiodarone should only be given after the third shock if a shockable rhythm is present.

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