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High quality chest compression: Don't be afraid of breaking ribs to gain a life!

The priority after cardiac arrest is to perform high quality chest compression (CC) to generate and maintain coronary and cerebral perfusions likely to restore spontaneous circulation (ROSC) and mitigate brain injury. Accordingly, hemodynamics produced during cardiopulmonary resuscitation (CPR) is directly related to the depth of CC.[1] Thus, achieving adequate CC depth, i.e. at least 5 cm, should be prioritized during CPR, even if potential harm from excessive depth has been reported.[2]

CC-related injuries may include skin abrasions, rib and sternal fractures, lung contusions, pneumo- and hemothorax, cardiac tamponade and rupture, liver lacerations, and others.[3] Among all the possible complications, rib fractures are the most common, occurring in up to 97% of CPRs.[4] CC skills, duration of CPR with consequent quality deterioration, patient's characteristics, i.e. age and sex, might affect rib fractures incidence. However, rescuers should be aware that such a complication is rarely associated with major life-threatening injuries, and potentially does not impact mortality during CPR.[4,5] Rescuers therefore should not be afraid of breaking ribs during CPR and/or their CC performance should not be halted, leading to shallow compression, if they feel "pop" or "crack" in the patient's chest under their hands.

This letter aims to reinforce the above call by providing a visual support. Fig. 1A shows 3D reconstructions of the rib cage from Computed Tomography scans (Brightspeed®, GE Healthcare) of a pig subjected to ventricular fibrillation and 18 min of continuous manual CC. What does the reader think looking at this rib cage? One may probably guess that the poor animal did not achieve ROSC and likely died due to extensive lung injury and/or pneumothorax and/or another CC-related lethal complication. Indeed, multiple displaced rib fractures are evident along the left ventrolateral thorax. Nevertheless, despite the extensive skeletal bone injury and chest wall deformity, lungs appear preserved and no other internal organ injuries can be

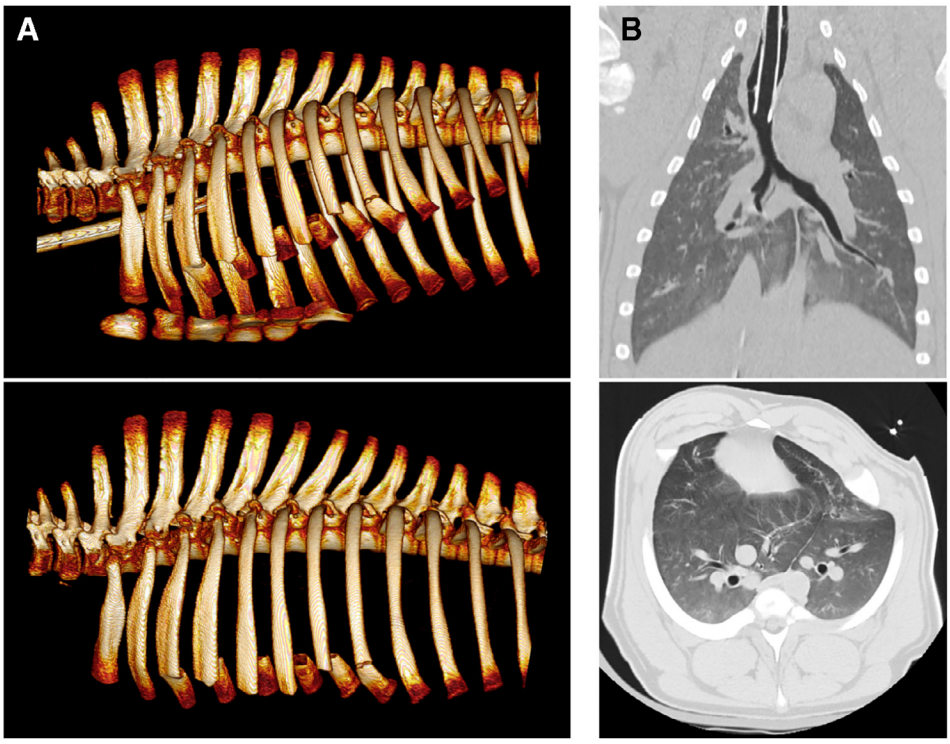

Fig. 1. A: Two different views of a rib cage 3D reconstruction from computed tomography (CT) scans in a pig resuscitated after 18 min of manual chest compression. Multiple (six) displaced rib fractures are evident along the left ventrolateral bony thorax. B: Chest CT scans (axial plane on the left and coronal plane on the right) in the same animal. Chest wall deformity is evident on the left image, but no lungs and/or other intrathoracic organ injuries are present.

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observed (Fig. 1B). Moreover, neither hemodynamics during CPR nor success of resuscitation were not affected. A mean coronary perfusion pressure of 24 mmHg and an end-tidal CO_2 of 16 mmHg were maintained by manual CC throughout the whole 18-min duration of the resuscitative efforts. The animal was successfully resuscitated after the defibrillation attempt and survived for the following planned 3 days of observation, achieving a complete neurological recovery.

CC-associated rib fractures are common and correct hands position during CPR together with an optimal CC technique may at best reduce, but not abolish, their incidence. Since rib fractures are usually not responsible for major visceral damages, they should be considered as a small price to pay during CPR, overwhelmed by the need to perform high quality CC. Moreover, as highlighted in this letter, even multiple serial rib fractures may have no impact on the maintenance of adequate circulatory support during CPR nor on ROSC/survival. On the contrary, there is evidence that delivering of shallow CC, i.e. with the aim to avoid rib injuries, does not save lives. Thus, rescuers should not be afraid of breaking ribs to gain a life!

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.hrtlng.2018.12.004.

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