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Editorial

Rescue collapse — A hitherto unclassified killer in accidental hypothermia



Severe accidental hypothermia (<28 °C) is a rare occurrence, it may induce cardiac arrest (CA).¹ Hypothermia induced CA is fundamentally different from primary CA.² The hypothermic heart may be unresponsive to defibrillation and resuscitative drugs.³ Extracorporeal life support (ECLS) is the recommended rewarming method for selected arrested hypothermic patients.^{3–5} Hypothermia reduces the metabolism, thereby protecting the brain in no and low blood-flow states. Outcome of arrested hypothermic compared to normothermic patients is substantially better, even if cardiopulmonary resuscitation (CPR) lasts for several hours.^{6,7} In hypothermic patients witnessed CA is called rescue collapse (RC).^{1,8} Until now, the influence of rescue collapse on survival in hypothermic arrested patients is not determined. Rescue collapse should be avoided, but if it occurs it is considered reversible with early and continuous CPR and ECLS rewarming. In this issue, Podsiadło et al. address the implications of rescue collapse on survival and the course of in-hospital therapy. Moreover, they report risk factors for rescue collapse.⁹

In a retrospective cohort study with a matched-pair analysis, they included patients from the HELP (Hypothermic Extracorporeal Life Support in Poland) registry. This Polish registry includes hypothermic patients, mostly arrested and rewarmed with ECLS.^{9,10} The control group (with hypothermia stage III) included 45 patients who did not arrest during standard non-ECLS rewarming. The RC group included 45 hypothermic patients who suffered witnessed CA who were rewarmed with ECLS. The patients of the RC group were selected from a larger cohort of 79 severely hypothermic CA patients, and matched with the patients of the control group using age, sex, core temperature and rewarming rate. The mortality rate in the matched non-arrested compared to the arrested cohort was lower (24% in the control group vs. 49% in the RC group; $p = 0.02$).

One limitation of this study is the small sample size. A second limitation is the selection of the patients. The selection criteria for the control group could have been better described: the indication for ECLS rewarming of non-arrested hypothermic patients is not well defined, and based on a lower level of evidence than ECLS rewarming in arrested hypothermic patients. The ERC 2021 guidelines propose the following criteria for ECLS rewarming in non-arrested hypothermic patients: patient deteriorates during non-ECLS rewarming, low EtCO₂ <10 mm Hg or systolic blood pressure ≤60 mm Hg.³ Many centres may reserve ECLS rewarming for hypothermic CA patients only.¹¹ In the control group, 20 patients presented with a systolic blood pressure ≤60 mm Hg, other indications for ECLS rewarming were not reported.⁹ In the control group, the mortality was 24%.⁹ Including

hypothermia stage III patients without hard indication of ECLS rewarming would certainly have reduced mortality in the control group. More information on the selection of patients for the RC group would have helped to better appreciate the 49% mortality rate.⁹ Including patients who suffered rescue collapse who were finally not selected for ECLS rewarming would have increased the mortality in the RC group. The devil's advocate may summarize the study from Podsiadło et al. as follows: patients who suffer rescue collapse are twice as likely to die than those who do not arrest. The conclusions of this study may seem to represent no more than a truism and hardly worth mentioning.

Why are the findings of Podsiadło et al. clinically important and sound? First, outcome from normothermic and hypothermic CA differs substantially, depending on whether CA was witnessed. In normothermic patients, witnessed CA is associated with good outcome.^{12–14} In hypothermic patients, witnessed CA is not an independent predictor of survival.⁶ Secondly, a normothermic CA will most often occur before the rescuers reach the patient. The situation is different in severely hypothermic patients, where CA may be amenable to preventive measures. Finally, the course of events differs between primary cardiac and hypothermic CA: a patient with witnessed primary CA likely responds to prompt defibrillation.³ In rescue collapse patients, the heart very likely will be unresponsive to timely defibrillation, or after return of spontaneous circulation (ROSC) it may quickly revert back into ventricular fibrillation (VF).³ In summary, compared to normothermia, rescue collapse is more likely to be witnessed by rescuers, more accessible to preventive measures, but less likely to result in ROSC without installing ECLS rewarming.

The study of Podsiadło et al. calls clinicians' attention to the mortality associated with rescue collapse. The findings support the 2021 ERC recommendations to transfer severely hypothermic patients in or at risk of CA (i.e., core temperature <30 °C, ventricular arrhythmia, systolic blood pressure <90 mm Hg) CA to an ECLS centre.³ Core temperature is key in defining the risk of CA in severely hypothermic patients.¹ If core temperature measurement is not available, the level of consciousness may be used to estimate the risk of hypothermia induced CA with the Revised Swiss Hypothermia Staging.¹⁵ Non-ECLS rewarming of a hypothermic CA patient is an option, which should only be considered if transport to an ECLS centre is not feasible within a reasonable time (e.g. six hours).³ Another option that has been proposed recently is to bring ECLS to the patient.¹¹ Importantly, in severely hypothermic patients, any procedure, which may trigger CA should be avoided, e.g. unnecessary mobilization, or inserting a central venous catheter close to the

heart.¹¹ Further research is required to characterize risk factors for RC in hypothermia stage III patients.

Podsiadlo et al. report a doubling of the mortality rate in hypothermic patients who suffer rescue collapse.⁹ This may only represent a lower estimate of the increase of mortality in rescue collapse patients. Rescuers are urged to prevent rescue collapse. In contrast to normothermic CA, hypothermic CA is resistant to standard ALS measures including defibrillation and drugs. Severely hypothermic patients at risk of CA should be transferred directly to an ECLS centre. In case of rescue collapse, transfer to an ECLS centre, bypassing smaller hospitals, should be arranged. ECLS is the established rewarming method in hypothermia induced CA. Even with unwitnessed CA overall survival was 27% in one systematic review (n = 221).¹⁶ Asystole was the first rhythm in 48% survivors, 79% survived with good neurologic outcome.¹⁶ Severely hypothermic patients have excellent chances of survival, they are even better if patients do not arrest.

Conflict of interest

None to declare. We, both authors, have no financial or personal relationships with other people or organisations that could have inappropriately influenced our work.

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