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FOCUS EDITORIAL

Focus on cardiac arrest

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Outcome

Cardiac arrest (CA) survival rates vary substantially, which may reflect differences in quality of the local chain of survival for both out-of-hospital and in-hospital cardiac arrest (OHCA and IHCA). A recent large, prospective, population-based registry conducted over 2 years in Paris, France, found a 7.5 % survival rate at discharge after OHCA [1] (Fig. 1), whereas a 10.8 % 30-day survival rate was reported from the Danish National Registry [2]. A recent analysis of the American Heart Association Get with the Guidelines-Resuscitation registry, including 358 hospitals between 2000 and 2009, documented a 18.8 % (IQR 14.5–22.6 %) median survival rate to hospital discharge following IHCA [3]. A similar survival rate (18.4 %) was reported by the UK National Cardiac Arrest Audit database [4]. Survival rates are widely variable in IHCA patients, depending on the location and circumstances, even for patients in intensive care units as illustrated by recent reports [5, 6]. The use of a prediction model in the emergency department could facilitate the identification of patients with a higher mortality risk [7] to guide preventive interventions.

Post-resuscitation care

The importance of post-CA management is reflected by the substantial increase in clinical studies in recent years published in critical care journals. Health authorities and ethics committees ensure that the principles of ethical conduct of research involving human subjects are fulfilled, despite the time constraints and urgency inherent to CA and resuscitation, giving adequate opportunities for research [8].

The European Resuscitation Council (ERC) collaborated for the first time with the European Society of Intensive Care Medicine (ESICM) in 2015 to produce updated European post-resuscitation care guidelines [9, 10]. Changes in guidelines included a greater emphasis on the need for targeted temperature management (TTM) [11] that still seemed to be missing in almost half of CA patients according to pragmatic registry data [1]. The use of TTM at 33 °C was seriously challenged by the results of the landmark TTM Trial [12] and subsequent substudies. In a post hoc analysis of patients with moderate shock on admission after OHCA, TTM at 33 °C compared to 36 °C did not significantly influence 180-day mortality but was associated with increased levels of lactate and need for increased vasopressor support [13]. As it is difficult to discern which patients may further benefit from one or other temperature level, the ERC–ESICM 2015 guidelines acknowledge that there is now an option to target a temperature of 36 °C instead of the previously recommended 32–34 °C. The optimal time to start TTM is also challenged. Prehospital induction of hypothermia using cold fluids did not improve survival or neurological status among patients resuscitated from OHCA. Intra-arrest induction of hypothermia did not confer any additional benefit as compared with hypothermia started at hospital arrival as judged by biological markers of inflammation or brain damage as well as clinical outcome in OHCA patients [14]. While these studies were performed irrespective of shockable or non-shockable initial cardiac rhythms, the importance of this issue remains debatable.

The ERC–ESICM 2015 guidelines also highlighted the importance of early coronary angiogram and recommended that an early coronary angiogram (CAG) be performed in patients with ECG criteria for ST segment elevation myocardial infarction (STEMI), including left bundle branch block. Among patients without STEMI criteria, the best approach regarding coronary angiogram remains unclear. A TTM Trial post hoc analysis of patients without acute ST elevation found no difference in survival or neurological outcome between patients who did or did not receive an early CAG within 6 h of arrest, even after adjustment using a propensity score analysis [15]. In contrast, in a large cohort study in which

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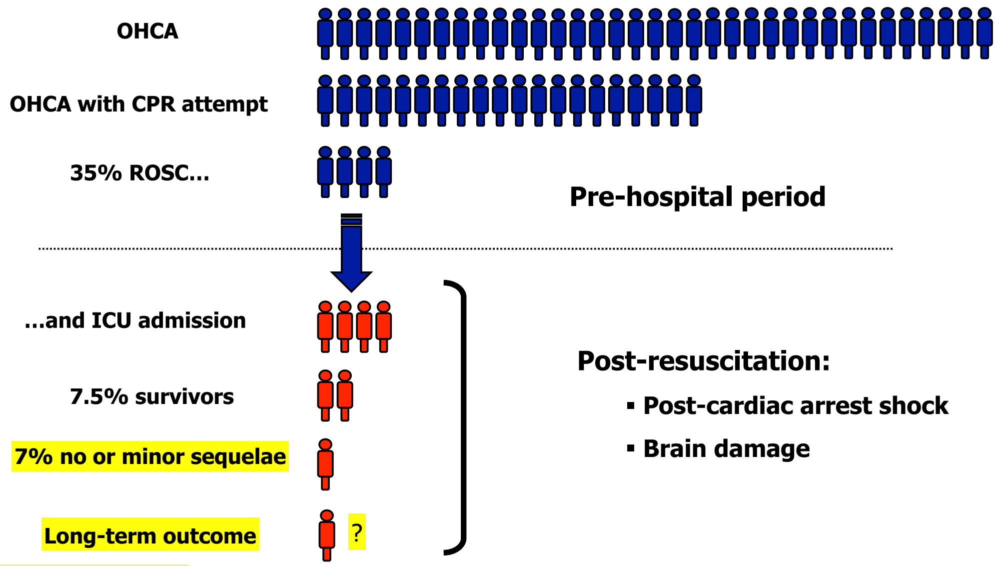

Fig. 1 Outcome after cardiac arrest. Illustration of the progressive decrease in the proportion of survivors after OHCA from collapse to discharge (adapted from Bougouin et al. [1])

a systematic and immediate CAG was performed in all non-STEMI patients, emergent percutaneous coronary intervention in nearly one-third of the population was independently associated with an improved hospital outcome [16]. Several ongoing studies are investigating the potential benefits associated with an early invasive strategy in selected population of post-CA patients (DISCO study, NCT 02309151; PEARL study, NCT 02387398).

Regarding ventilatory post-resuscitation management, the ERC–ESICM 2015 guidelines recommend to titrate the inspired oxygen concentration to maintain the arterial blood oxygen saturation in the range of 94–98 %. Severe hyperoxia (>300 mmHg) over the first 24 h was associated with decreased survival to discharge in 184 OHCA patients admitted to ICU [17], similar to previous observational studies. Metabolic derangements occurring in the first hours and days after resuscitation may also increase the risk for detrimental neurological outcome. In 381 patients resuscitated following OHCA, an increased blood glucose level over the first 48 h was an independent predictor of poor outcome (cerebral performance category 3–5) [18]. A strategy combining both control of glycemia and minimization of glycemic variations is suggested to improve post-resuscitation outcomes.

Prognostication

Early identification of patients with no chance of a good neurological recovery after CA is necessary to avoid inappropriate treatment and to inform relatives. Members of the ERC and the Trauma and Emergency Medicine Section of the ESICM have provided an advisory statement on neurological prognostication in comatose survivors of cardiac arrest [19]. Following review of 73 studies, the quality of evidence was found to be low or very low for almost all studies. The role of clinical examination was emphasized. In patients still comatose with absent or extensor motor response at 72 h post-CA, with any TTM, bilateral absence of pupillary and corneal reflexes and early status myoclonus were identified as robust predictors. A multimodal approach, including the pivotal role of electrophysiology examination, was highlighted. The loss of N20 wave of short-latency somatosensory evoked potentials was identified as the most robust predictor of unfavorable outcome, while unreactive malignant EEG patterns after rewarming were also a strong predictor. In a recent cohort study of 54 comatose CA patients, suppression-burst at any time over the first 72 h indicated a poor prognosis, with a 0 % false positive rate (FPR) (95 % confidence interval (CI) 0–10 %); all patients with suppression-burst or a low voltage (<20 μV) EEG at 24 h had a poor outcome, with an FPR of 0 % (95 % CI 0–8 %) [20]. All these modalities help to identify that the comatose CA survivor has a poor prognosis [21].

In conclusion, there is a growing body of published clinical studies to guide cardiac arrest management, post-resuscitation care, and prognostication that will undoubtedly increase further.

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