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Sudden death in ICU: the Finnish experience

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In-hospital cardiac arrest (IHCA) is a frequent complication, which results in a significant mortality/morbidity and workload in most acute hospitals across the world. Its incidence is in the range of 1–5 per 1,000 hospital admissions, depending on data collection [1]. In a recent report from the National Cardiac Arrest Audit (NCAA) Steering Group, the overall incidence of adult IHCA, attended by a hospital-based resuscitation team, was 1.6 per 1,000 hospital admissions in participating UK hospitals [2]. This relatively low incidence is probably due to the fact that many IHCA occurring in monitored areas and in particular in the emergency department, intensive care units (ICU) or operating rooms are managed without either a call to the resuscitation team or are not reported in the NCAA-UK Registry. In the British registry, the proportion of cardiac arrest occurring in intensive or other

high acuity care is 17.6 % of all cardiac arrests. This is in marked contrast with two recent analysis of the American Heart Association (AHA) National Registry of Cardiopulmonary Resuscitation (NRCPR), which included all IHCA, whatever the hospital location. First, Tian showed that 37 % of IHCA occurs in the ICU [3]. Second, using a similar dataset, the “Get with the Guidelines (GWTG)” Resuscitation registry, that included 533 US hospitals between 2000 and 2009, documented a median incidence of 4.02 IHCA per 1,000 hospital admissions [4]. One of the most important findings of the US Registry was that a large proportion of cardiac arrests occurred in the ICU (ICU-CA), illustrating that critically ill patients are more susceptible to IHCA, probably because of their increased disease severity. The incidence of ICU-CA is highly variable, ranging from 7 to 78 cardiac arrests per 1,000 ICU admissions [5]. Surprisingly, in-depth data focusing on ICU-CA are currently sparse, with few information regarding incidence and mortality trends over time [5, 6].

Created in 1994 in order to improve the quality of intensive care in Finland, the Finnish Intensive Care Consortium (FICC) database is a high quality multicenter database collecting data from the majority of Finnish ICUs. Efendijev and coworkers used these data to explore incidence and hospital mortality of ICU-CA using a large nationwide ICU database [7]. They determined crude incidence and risk-adjusted hospital mortality (based on a customized severity of illness model) for all ICU-CA patients, and for predefined admission diagnosis subgroups. Their results established a crude incidence rate of 29 per 1,000 with the highest incidence (118 per 1,000) in the non-operative cardiovascular subgroup. They also provide evidence that ICU-CA incidence has declined during the observed period in the Finnish ICUs. This result may be explained in different ways, the most common being an improvement in the quality and effectiveness of care provided in these ICUs. As discussed by the authors, this might also result from the active implementation of treatment

limitations and DNAR (“do not attempt resuscitation”) policies, as supported by the proportion of ICU patients with treatment limitation that increased from 7 to 10 % over time during the study period.

In addition to its higher incidence, the prognosis of ICU-CA is also known to be different from IHCA occurring in other parts of the hospital since this is a very different situation. On the one hand, ICU patients are extensively monitored, which allows early recognition and immediate resuscitation performed by trained professionals. Time to CPR initiation below 30 s has been routinely reported in ICU-CA series [8, 9]. On the other hand, the event can occur in a very seriously ill patient with very limited physiological reserve. Although the success rate of resuscitation is high in ICU-CA patients due to early detection and an immediate response by the ICU staff, the survival rate upon hospital discharge is usually low. In the NRCPR, the survival to hospital discharge after IHCA was 15.2 %, while, in the GWTG Resuscitation Registry, the median survival rate to hospital discharge was 18.8 % for all cases, but the specific survival rate of ICU-CA patients was not reported [4]. Here, in the FICC Registry, the overall hospital mortality rate was 55.5 %, ranging from 32.9 % for post-cardiac surgery ICU-CA patients to 56.3 % for neurological/neurosurgical ICU-CA patients. The FICC study is of importance, since this is the first large one that reports the changes in outcome, providing evidence that ICU-CA mortality has declined from 2003 to 2013 in the Finnish ICUs. The study does not provide explanations for this improvement in survival over time, but several factors may be accountable, such as prevention, earlier recognition and improved training and organization. Other factors, such as improvement of CPR quality and post-resuscitation care (e.g., therapeutic hypothermia and early cardiac catheterization), might also be crucial. Future studies are required to better understand which specific factors are responsible for improvements in survival after ICU-CA so that survival gains can be consolidated and expanded to other places.

The ICU-CA patient populations studied in the various cohorts are very different: they range from neonatal to cardiac, trauma or obstetrical ICU-CA patients. It is difficult to compare and collate all these patient populations

in terms of cardiac arrest causes, incidence and outcome. Cardiac arrest after cardiac surgery, for example, is a very specific problem, and specific guidelines have been proposed [10]. The mortality (ROSC failure rate) of cardiac arrest after cardiac surgery has been published at 60 % [11], ranging from 50 to 80 % depending on the hospital’s performance. Interestingly, the immediate survival, after adjusting for patient factor, had an odds ratio of 2.28 from the best to the least performing hospital. Trauma, obstetrical and other specific populations have specific causes of cardiac arrest that should be analyzed specifically. For the last 25 years, data collection after cardiac arrest has been standardized for out-of-hospital cardiac arrest (OHCA) in adults and to some extent for in-hospital cardiac arrest [12]. However, cardiac arrest occurring in the ICU addresses specific patient populations with specific physiology and highly performing resuscitation teams. There is room for improvement and standardization in the data collection regarding cardiac arrests in the ICU, both for the pre-arrest data and the resuscitation performance. Up-to-date ICU technologies such as electronic health records, advanced monitoring systems and recording defibrillators should assist in consistent, non-operator-dependant, data collection. Better data and analysis of these data in a quality-improvement objective are associated with improvements in cardiac arrest survival in pediatric ICU [13].

A potential weakness of the FICC study is the lack of data regarding long-term outcome, so that authors had to use hospital mortality as the primary endpoint and were unable to assess patient neurological outcome. A longer time point after event should be considered in future studies, since both mortality and neurological function may fluctuate over time in the first months after the event. As for OHCA, longer-term endpoints such as 6 months coupled with neurocognitive and quality-of-life assessments (Cerebral Performance Categories or modified Rankin Scale) should be considered, as should the additional costs of this approach [14]. Nevertheless, authors have to be commended for this work, which provides a comprehensive description of this severe condition.

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