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Causes of death in the Emergency Department: a retrospective monocentric study

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Abstract

The Emergency Department (ED) serves as a critical entry point for patients with life-threatening conditions, yet mortality within this setting remains a significant clinical and epidemiological concern. This retrospective monocentric study investigates the primary causes of death in the ED of Emergency Municipal Hospital, Timişoara, Romania, over a five-year period (2019–2023). A total of 63 cases were analyzed, integrating clinical data at the time of presentation with *post-mortem* pathological findings to ensure diagnostic accuracy. Results indicate that irreversible cardiac arrest (ICA) constituted the predominant cause of mortality, with non-shockable rhythms accounting for 88.88% of cases – asystole (80.35%) and pulseless electrical activity (19.65%) – while shockable rhythms (ventricular fibrillation and pulseless ventricular tachycardia) were observed in only 11.12% of cases. Among non-cardiac etiologies, septic shock (31.74%) and respiratory failure (17.46%) were the most prevalent contributors. These findings highlight the need for improved diagnostic methodologies, optimized resuscitation strategies, and enhanced resource allocation within emergency settings. This study underscores the necessity for systematic mortality documentation, evidence-based intervention protocols, and targeted management strategies to mitigate preventable deaths in the ED. The integration of clinical and autopsy-based data offers valuable insights into pathophysiological mechanisms contributing to ED mortality and provides a foundation for future research aimed at improving emergency medical outcomes.

Keywords: critical care, cardiopulmonary resuscitation, shockable and non-shockable rhythms, defibrillation, autopsy study, hospital mortality.

Introduction

The Emergency Department (ED) of any healthcare institution is integral to the management of critically ill patients, serving as their primary point of contact with the in-hospital care system [1]. The initial management of such patients presents significant challenges, necessitating the efficient coordination of medical personnel, optimal utilization of available resources, and the capacity to effectively navigate the phenomenon of the so-called "organized chaos" [1, 2].

It is estimated that over 4.5 million patients are treated annually in EDs nationwide, a number that continues to increase as a result of demographic shifts, the reduction of alternative pre-hospital care systems, including the decline in scheduled outpatient visits, and a concerning rise in patient comorbidities [2, 3]. Consequently, the emergency medical team must maintain constant vigilance, possessing both robust theoretical knowledge and advanced practical skills, to swiftly and accurately establish a diagnosis and administer therapeutic interventions according to the severity of each individual medical case [2, 3].

However, what transpires when no further interventions can be made for critically ill patients? On a more contemplative level, this scenario can be likened to a tumultuous sequence of heroic efforts, collaborative teamwork, determination, quick thinking, ultimately yielding to a profound silence. In the ensuing stillness, a multitude of questions arise: Why? What if...?

An examination of the available data on causes of death in EDs at the national level reveals a substantial gap in both the accurate determination of scientifically substantiated causes of death and in the identification of effective prevention strategies or methods to enhance survival outcomes

in such cases. A more nuanced understanding of the etiologies of death could reveal critical aspects of the healthcare system that require management and organizational strategies in alignment with the evolving needs of modern society. Moreover, it could inform the strategic allocation of in-hospital resources to optimize patient care [4].

Aim

This study aimed to systematically evaluate the principal causes of mortality in the ED over a five-year period, with a particular focus on irreversible cardiac arrest (ICA) and its underlying pathophysiological mechanisms. By integrating clinical presentation data with *post-mortem* pathological findings, this research seeks to elucidate the epidemiological and etiological factors contributing to ED mortality, assess the distribution of cardiac and non-cardiac causes, and identify potential strategies for optimizing resuscitation protocols and emergency medical interventions.

Materials and Methods

Data collection

The scientific conclusions outlined below are based on a retrospective, monocentric study. The statistical data gathered predominantly pertains to mortality events that occurred within the ED of Emergency Municipal Hospital, Timişoara (SCMUT), Romania, over a five-year period, precisely from January 1, 2019, to December 31, 2023.

The database included a total of 63 subjects, all of whom passed away during the designated period. These individuals represented a broad spectrum of social categories, reflecting a diversity of socio-economic and demographic characteristics.

The inclusion criteria for study participants necessitated the correlation of post-autopsy anatomical-pathological data with the clinical data recorded at the time of presentation to the ED. This methodology ensured that the initially established diagnosis, which may be considered "presumptive" to some extent, was substantiated by precise scientific evidence.

Data collection was conducted using the archives of medical records for all patients examined in the ED of SCMUT between 2019 and 2023. Following a meticulous selection process to identify candidates who met the initial inclusion criteria, the obtained clinical data was subsequently cross-referenced with the records from the Pathology Department of the same healthcare institution, specifically utilizing autopsy reports from the designated statistically relevant period. Participant anonymity was rigorously maintained in accordance with General Data Protection Regulation (GDPR) guidelines on personal data protection.

Statistical analysis

The statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) software for Windows, version 20 (IBM Corp., Armonk, NY, USA), and Microsoft Office 2023 (Microsoft Corp.). The dataset was constructed in Microsoft Excel, incorporating demographic data and values for each of the variables. The collected data were categorized based on their type and characteristics into quantitative, categorical, or ordinal variables.

A confidence interval (CI) of 95% (n=63) was employed for the analysis. The minimum sample size required to achieve a 95% CI was 377, and for a 99% CI, it was 643. The population size was estimated at 20 000, with a response distribution of 50%. Given the sample size of 63, the margin of error accepted in the study was 12.33%.

Descriptive statistical methods were utilized to characterize the study participants and to describe sub-groups based on the selected variables. For quantitative variables, the descriptive statistics were expressed either as the mean or median, depending on the distribution type and interval characteristics. The variability within each group was measured using the standard deviation (SD). Nominal and ordinal variables were represented as proportions and percentages.

The collected data were quantified through a query-based search. To estimate the relative frequency of each parameter, the total number of mentions for each variable was computed and subsequently divided by the total number of records.

Results

During the study period, a total of 63 subjects were identified as meeting the established inclusion criteria. Of these, 28.57% (n=18) passed away between January 1, 2019, and December 31, 2019; 11.11% (n=7) between January 1, 2020, and December 31, 2020; 28.57% (n=18) between January 1, 2021, and December 31, 2021; 26.98% (n=17) between January 1, 2022, and December 31, 2022; and 4.77% (n=3) between January 1, 2023, and December 31, 2023 (Figure 1).

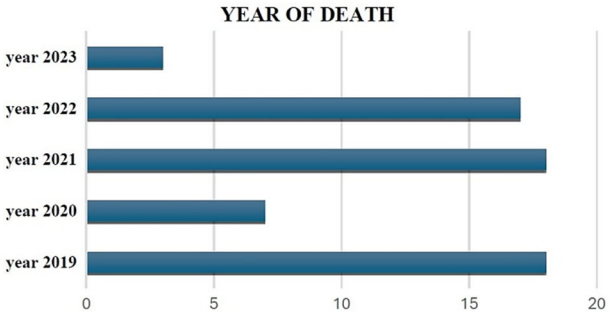

Figure 1 – ***Proportional distribution of study participants based on the year of death.***

Of the 63 subjects, 41.26% (n=26) were female, with ages spanning from 46 to 97 years (median age 71.5 years), while 58.74% (n=37) were male, with ages ranging from 42 to 88 years (median age 65 years). The participants were distributed across both rural (39.68%, n=25) and urban areas (60.32%, n=38) (Figure 2).

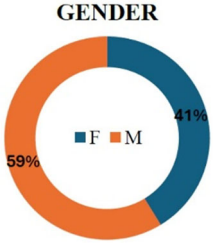

Figure 2 – ***Proportional distribution of study participants based on gender.***

Concerning the way patients presented themselves at the hospital, a mere 7.93% (*n*=5) of individuals chose to travel *via* private means, while a significant majority of 92.07% (*n*=58) utilized the transport services provided by the relevant authorities (EMS or SMURD), in accordance with established triage criteria and standardized protocols employed by the regional emergency dispatch center. These statistics underscore the high level of confidence the population has in the prompt response of emergency medical teams during unforeseen events (Figure 3) [4–6].

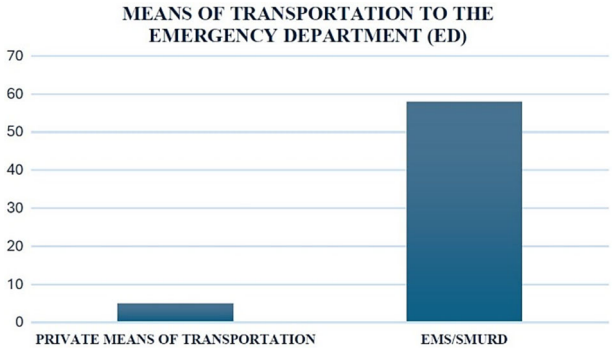

Figure 3 – ***Proportional distribution of study participants based on the mode of transportation to the hospital.***

Considering patients whose presentation to the ED resulted in cessation of life, the primary factor contributing to irreparable clinical deterioration is represented by ICA which cannot be resuscitated due to a variety of underlying physiological mechanisms [7]. Cardiac arrest (CA) is characterized by the cessation of both electrical and mechanical activity of the heart, leading to the loss of the ability to perform spontaneous ventilation. This subsequently induces cerebral hypoxia, resulting in loss of consciousness and, ultimately, death. The prognosis for survival in individuals experiencing CA is contingent upon numerous variables, some of which are dependent upon the skill and intervention of the medical personnel involved in the resuscitation process, while others are independent of medical intervention.

Cardiac arrhythmias associated with CA are categorized based on their responsiveness to defibrillation, which involves the application of an electric shock. These rhythms are classified into two primary categories: shockable rhythms, which include ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT), and non-shockable rhythms, such as asystole and pulseless electrical activity (PEA). Cardiac arrhythmias, or heart rhythm disturbances, arise when the electrical impulses responsible for coordinating myocardial contractions fail to function correctly, leading to abnormal heart rates that may be excessively rapid, abnormally slow, or irregular.

Patients presenting with a shockable rhythm on the electrocardiogram (ECG) at the onset of CA have been shown to exhibit a significantly higher survival rate when compared to individuals who experience arrhythmia classified as non-shockable [8].

Nevertheless, the occurrence of shockable arrhythmias at the onset of CA has shown a significant decrease in the context of in-hospital CAs. The primary contributing factor is believed to be the insufficient management of chronic cardiovascular conditions in the elderly population, which results in complex and potentially fatal complications that are difficult to manage in the long term [4, 9]. While the incidence of non-shockable rhythms remains higher, it is important to note that an initial non-shockable rhythm may often spontaneously revert to a shockable rhythm, thereby considerably improving the patient's survival prognosis [10, 11].

Extrapolating from the previously summarized data, a conclusion can be drawn in a similar vein. The statistical analysis reveals that out of a total of 63 subjects, 88.88% (*n*=56) experienced CA with a non-shockable rhythm, of which 80.35% (*n*=45) were asystole and 19.65% (*n*=11) were PEA. In contrast, only 11.12% (*n*=7) of the study participants presented with a shockable rhythm, of which 85.71% (*n*=6) were VF and 14.29% (*n*=1) were pulseless VT (Figure 4).

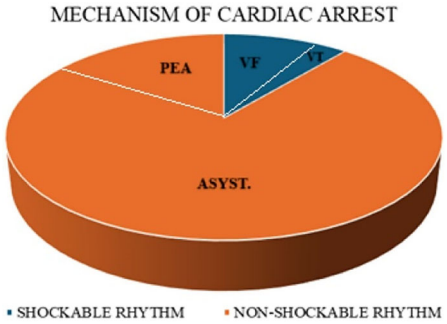

Figure 4 – ***Proportional distribution of shockable/ non-shockable rhythms based on their etiology. PEA: Pulseless electrical activity; VF: Ventricular fibrillation; VT: Ventricular tachycardia.***

Once in CA, each minute becomes crucial for the patient. However, time is not the sole determinant when seeking a favorable outcome [12, 13]. The distinction between a patient with a realistic chance of achieving return of spontaneous circulation (ROSC) and one with minimal prospects for survival lies in the understanding and management of the underlying causes of the established CA, specifically the triggering factors, and the implementation of effective interventions to mitigate them [14].

The fundamental components of treatment during CA encompass chest compressions, ventilation, early defibrillation when indicated, and prompt identification and management of potentially reversible secondary causes. These causes are classified into the 4 Hs (hypoxia, hypovolemia, hypothermia/ hyperthermia, hypo-/hyperkalemia; recent guidelines also include other metabolic disturbances, such as hypo-/hyperglycemia, within this category) and the 4 Ts (cardiac and pulmonary thrombosis, cardiac tamponade, pneumothorax, and toxins). Targeted intervention aimed at addressing these factors can substantially influence patient outcomes [9, 14].

For example, oral contraceptives, while widely utilized for pregnancy prevention, are associated with an increased risk of thromboembolic events, including pulmonary embolism (PE), which is classified as one of the 4 Ts in the context of CA. This risk is particularly pronounced in women with additional predisposing factors, such as smoking or obesity. PE, if not promptly identified and managed, can lead to CA, emphasizing the critical need for early recognition and intervention to mitigate medication-induced risks. In parallel, oral contraceptives have also been implicated in the induction of hepatotoxicity, another significant adverse effect that can further complicate patient health. The recognition of these potential side effects

underscores the importance of vigilant monitoring and management of medication-related risks across therapeutic contexts. In this regard, compounds such as alpha-tocopherol (AT) have demonstrated promise in alleviating liver toxicity induced by medications like Ethinylestradiol, a principal active ingredient in many oral contraceptives [15]. By addressing both thromboembolic risk and hepatotoxicity through targeted, evidence-based interventions, healthcare providers can optimize the management of oral contraceptive side effects and improve patient outcomes.

The etiologies of CA are typically dichotomized into cardiac and non-cardiac origins. However, CAs without an identifiable cause are generally classified as cardiac in nature, despite the existence of discrepancies between clinical diagnoses and *post-mortem* conclusions derived from subsequent pathological examinations. Consequently, the underlying causes of CA are often indeterminate [16].

A detailed analysis of the cohort of 63 subjects selected as study participants reveals that the secondary causes contributing to the onset of CA in these patients can be systematically classified into cardiac and non-cardiac etiologies.

Among the cardiac-related etiologies (Figure 5), cardiogenic shock accounts for 11.11% (n=7) of the ED deaths, acute pulmonary edema (APE) of cardiac origin for 4.76% (n=3), and acute coronary syndrome (ACS) for 3.17% (n=2).

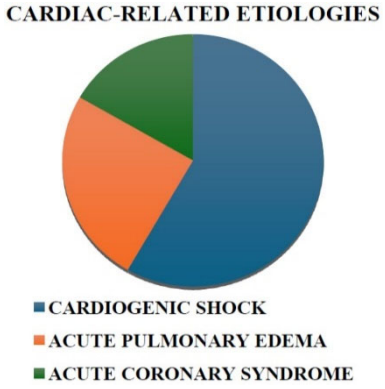

Figure 5 – ***Cardiac causes of cardiac arrest among study participants.***

In terms of non-cardiac etiologies (Figure 6), those with the highest prevalence in the analyzed cohort include septic shock, accounting for 31.74% (n=20), respiratory failure at 17.46% (n=11), and pre-existing oncological pathologies of various etiologies at 11.11% (n=7). Among the less common causes of mortality within the selected patient group, mesenteric infarction (3.17%, n=2) and acute dehydration syndrome (ADS) (1.58%, n=1) were also identified.

Discussions

The findings of this study provide a comprehensive analysis of mortality within the ED, emphasizing the predominant role of ICA as the leading cause of death. The high prevalence of non-shockable rhythms, particularly asystole and PEA, underscores the significant challenges associated with resuscitation efforts. These results align with existing literature, which indicates that non-shockable rhythms are associated with lower survival rates compared to shockable rhythms such as VF and pulseless VT. The relatively low incidence of shockable rhythms further highlights the necessity for early identification and intervention in patients at risk of cardiac deterioration [2–4].

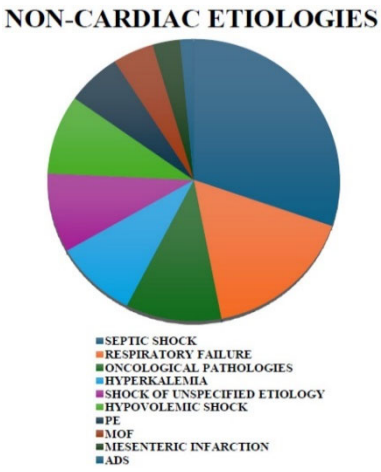

Figure 6 – ***Non-cardiac causes of cardiac arrest among study participants. ADS: Acute dehydration syndrome; MOF: Multiple organ failure; PE: Pulmonary embolism.***

Among the non-cardiac causes of mortality, septic shock and respiratory failure emerged as the most frequent contributors. These findings are consistent with global trends, which indicate that sepsis and respiratory complications represent significant determinants of mortality in critical care settings. The high prevalence of sepsis-related deaths in the ED underscores the necessity for rapid recognition and aggressive management, including early antibiotic administration, fluid resuscitation, and vasopressor support when indicated. Similarly, respiratory failure, often a consequence of chronic pulmonary conditions, acute infections, or neurological impairment, requires prompt intervention through airway management, oxygen therapy, and mechanical ventilation in severe cases [7–12].

The study also identified notable demographic trends, with a higher proportion of male patients compared to female patients. This disparity may reflect underlying gender-based differences in cardiovascular risk factors, healthcare-seeking behaviors, and comorbidities. Additionally, the age distribution of deceased patients suggests that older individuals are at an increased risk of ED mortality, reinforcing the importance of tailored geriatric emergency care protocols [2, 3].

The means of transportation to the ED further revealed critical observations, as the majority of patients arrived *via* emergency medical services (EMS/SMURD). This finding highlights the essential role of pre-hospital care in triaging and stabilizing critically ill patients before hospital admission. However, despite pre-hospital interventions, the high mortality rate among these patients suggests that many present in an already deteriorated state, necessitating earlier recognition of deteriorating conditions in outpatient or primary care settings [2–6].

The study findings emphasize the urgent need for targeted improvements in emergency care, particularly in the management of ICA and its underlying causes. Strategies such as optimizing pre-hospital triage, enhancing sepsis protocols, improving early detection of respiratory failure, and refining resuscitation techniques for non-shockable rhythms could contribute to reducing ED mortality rates. Furthermore, the integration of autopsy findings into clinical assessments provides valuable insights into the

pathophysiological mechanisms underlying ED deaths, facilitating more accurate diagnostics and prevention strategies [2, 7].

While this study provides significant insights, its limitations must be acknowledged. The retrospective, single-center nature of the study may restrict the generalizability of findings to other institutions or healthcare settings. Additionally, the relatively small sample size may not fully capture the spectrum of causes of ED mortality. Future research should focus on multi-center analyses with larger cohorts to validate these findings and develop standardized protocols aimed at improving survival outcomes in ED.

Conclusions

Despite the growing national prevalence of CA within ED, statistical documentation and scientifically supported evidence remain insufficient. Consequently, adopting a multidisciplinary approach involving emergency physicians, critical care specialists, and pre-hospital care teams is essential for improving patient survival. Strengthening training programs for resuscitation techniques, adopting advanced diagnostic tools, and developing standardized protocols for high-risk cases may further enhance outcomes. Addressing these challenges requires not only institutional commitment but also policy-level interventions to ensure adequate resource allocation and infrastructure support within emergency medical services. Ultimately, bridging the gap between clinical practice and *post-mortem* analysis will provide a more comprehensive understanding of ED mortality and pave the way for effective preventive measures.

Conflict of interests

The authors declare no conflict of interests in relation to this study.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Emergency Municipal Hospital, Timişoara, Romania (Approval No. E-1319/21.03.2025).

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