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ORIGINAL ARTICLES

Most Significant Factors Affecting the Survival of Patients with Out-of-hospital Cardiac Arrest

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Abstract

Introduction: Cardiac arrest, the sudden loss of heart function, often strikes without warning. Immediate medical intervention is not only critical, but it is also a lifeline for these patients. Without prompt action, cardiac arrest is usually fatal. Resuscitation. This study explores key factors that influence the survival of patients experiencing cardiac arrest in prehospital settings.

The primary aim of this study is to thoroughly investigate and identify the most crucial factors influencing the survival of patients experiencing cardiac arrest in pre-hospital settings.

Material and Methods: An extensive review of global and local literature focused on studies involving patients of various age groups who underwent prehospital Resuscitation. Key factors affecting survival outcomes in prehospital cardiac arrest were tracked and analyzed.

Results: Large meta-analyses reveal that data from 37 Emergency Medical Services across Europe indicate a one-year survival rate following Cardiopulmonary Resuscitation of approximately 20.7%. From 2016 to 2023, the Emergency Medicine Center in Pristina resuscitated 576 patients, achieving an average one-year survival rate of 8.8%. Timely defibrillation of ventricular fibrillation is crucial, potentially increasing survival rates by up to 90%. However, each minute of delayed defibrillation reduces survival rates by about 10%. This highlights the crucial role of Emergency Medical Services in ensuring timely intervention. Optimal defibrillation occurs within 3 to 5 minutes after cardiac arrest. Healthcare professionals must be equipped to perform both basic and advanced cardiopulmonary resuscitation techniques to improve outcomes.

Conclusion: The success of resuscitation depends on the time elapsed between cardiac arrest and the initiation of resuscitation measures. Early intervention with basic life support techniques significantly increases the chances of survival. However, it is not solely the responsibility of professionals. The community also plays a vital role. Automated External Defibrillators (AEDs) are a safe and effective method, especially when applied promptly in cases of cardiac arrest.

Keywords: Resuscitation, cardiac arrest, prehospital, defibrillation, survival rate, Cardiopulmonary Resuscitation

Introduction

American Heart Association (AHA) "Learn and Live" Cardiopulmonary Resuscitation (CPR) is a set of technical, medical measures and procedures designed to establish spontaneous activity of the heart and lungs. [1-4]

By examining people and our literature in this field, we can conclude that emergency medical services (EMS), through their technological and therapeutic capabilities, enable patients to survive for long periods after CPR in the prehospital phase. This instills hope and optimism in the audience about the potential for long-term survival.

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However, very often, these patients remain in a permanent vegetative state. Automated external defibrillators (AEDs) are portable devices that control irregular heart rhythms. They deliver a shock to the heart to restore a normal rhythm. According to some data, 79% of patients do not regain consciousness after anoxic coma. Therefore, determining prognostic factors, in addition to medical ones, has socio-economic importance. [1]

Especially in highly developed countries, a large number of patients who undergo resuscitation remain in a persistent vegetative state, which can last several years and create a significant burden on family, medical, and social resources.

"More often, cardiac arrest occurs due to chaotic heartbeats (ventricular fibrillation - VF), which can be returned to a normal rhythm if treated as soon as possible with an electric shock (defibrillation)."[5]

Studies

A possible explanation is that the paradoxical increase in response and arrival times to the scene of cardiac arrest in cities is related to short distances but heavy traffic. In contrast, rural areas face longer distances and extended transport times to patients, as well as longer patient hospitalization durations, which contribute to this phenomenon. [10]

Becker finds that Resuscitation after cardiac arrest in the city of three million, Chicago, accounts for 100% of hospital admissions; 7% are hospitalized or hospitalized for a long time, and only 2% are discharged from the hospital. [14]

A study from the Victorian era showed that prehospital CPR is more successful in metropolitan Areas than in rural communities.

In contrast to these results, the PHASE studies show a significantly lower rate in metropolitan areas than in suburban and rural areas. [8]

Of all out-of-hospital deaths, 80% occurred at home, about 15% on the street or in public places, of which 40% occurred without witnesses.

The conclusion of research by Bedell De Ebarda, James B. Elmore, and Suljaga Pechtela, along with their collaborators, is that the location of cardiac arrest is not a significant factor in survival if the patient receives immediate CPR. [9]

Objectives

After reviewing the research of world-renowned authors, the goal is to define the most critical factors in resuscitating patients in cardiac arrest in prehospital settings. The study at EMC lasted for one calendar year (January 1 - December 31, 2023). The study was retrospective, and the EMC archive was utilized.

The objective of this study is to identify cardiac arrest early, thereby reducing disability and mortality. The study emphasizes the urgency and importance of the audience's work in emergency medicine.

Methodology

After reviewing contemporary literature and comparing current data with our experience, we aimed to provide a practical perspective on efficiently managing the patient group. In compiling this article, we considered the diagnostic and treatment options available at our center.

Results

Global results and the annual incidence of out-of-hospital cardiac arrest in Europe range from 49.5 to 66 per 100,000 inhabitants. In a Maastricht study, researchers observed all cases of out-of-hospital cardiac arrest in individuals aged 20 to 75, recording an annual incidence of 1 per 1,000 inhabitants.

Survival depends on how the health system is organized. According to global statistics, survival rates ranging from 5% to 60% appear quite disappointing, varying with the nature of the arrest case.

Data compiled from 37 emergency medical services in Europe indicate that the one-year survival rate for out-of-hospital cardiac arrest is approximately 20.7%. Global data and the annual out-of-hospital incidence of CPR in Europe vary from 49.5 to 66 per 100,000 population.

In a study conducted in Maastricht, researchers observed all cases of out-of-hospital cardiac arrests in individuals aged 20 to 75 years, recording an annual incidence of one per 1,000 people. Survival rates vary based on the organization of the healthcare system.

According to global statistics, survival rates of 5-60% can seem quite disappointing, depending on the specifics of each arrest case. Data has been compiled from 37 emergency medical services. The number of cardiac arrests in the United States is alarmingly high. According to the AHA, about 350,000 cases of cardiac arrest occur each year in the United States outside of hospitals. This figure makes these cases one of the leading causes of death.

In-hospital cardiac arrest is a significant issue, with about 200,000 cases recorded each year, including patients hospitalized for heart disease treatment. Rapid response, education, and devices like Automated External Defibrillators (AEDs) are crucial for enhancing survival rates. However, statistics indicate that there is still much to be done to decrease the number of cases and improve survival rates in the overall population.

In Kosovo, the treatment of cardiac arrest is still poorly practiced, resulting in high mortality rates. The survival rate of CPR in various studies is as follows: McGrath: 38%, DeBard: 39%, Skogvoll: 34%, Cummins and Graves: 29%, Bresus: 28%, Cooper: 28%. The time interval from the onset of ventricular fibrillation (VF) to the first defibrillation shock is the primary factor determining survival time.

The Ontario Hospital Advanced Life Support has shown that reducing the standard 8-minute interval (a

functional predictor of survival) improves the one-year survival rate of patients with heart failure, consistent with the time to first defibrillation.

Time of execution for the first defibrillation and resuscitation: After 9 minutes, 4.6% are alive; after 8 minutes, 5.9% are alive; after 7 minutes, 7.5% are alive; after 6 minutes, 9.5% are alive; after 5 minutes, 12.0% are alive.

Comparing this interval with in-hospital and out-of-hospital cardiac arrest, a ratio of 2:7 is obtained.

Scientific and clinical data have been collected that establish early defibrillation as a standard of medical practice. International scientific opinion has published a guideline for using the Automated External Defibrillator (AED) by first-line rescuers.

Years	No. of Cardiac Arrests	Percentage (%)
2016	104	18.0
2017	76	13.19
2018	67	11.63
2019	69	11.98
2020	65	11.8
2021	72	12.50
2022	46	8.00
2023	77	13.40
Total	576	100

Table 1. EMC cases for the last 8 years with cardiac arrest, where CPR with heart massage, defibrillation, and transport to The Emergency Center and Invasive Cardiology were implemented

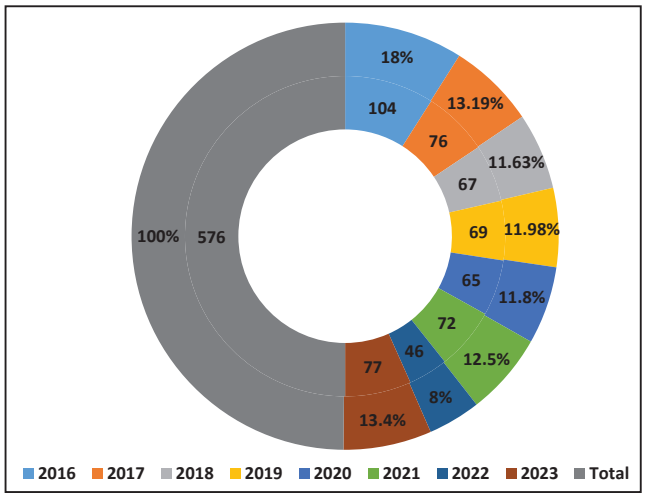

Diagram 1. The pie chart presentation expresses cases in values and percentages by year

	Male		Female		Total	
Age group	**No.**	**%**	**No.**	**%**	**No.**	**%**
20-30 years old	4	7.54	1	2.12	5	5
31-40 y.	3	5.66	5	10.63	8	8.0
41-50	5	9.43	3	6.38	8	8.0
51-60	11	20.75	5	10.63	16	10.0
61-70	9	16.98	11	23.40	20	20.0
71-80	14	26.41	12	25.53	26	26.0
>81	7	13.20	10	21.27	17	17.0
Total	53	53	47	77	100	100

Table 2. Number of cardiac arrest patients treated by QMU teams by gender and age group

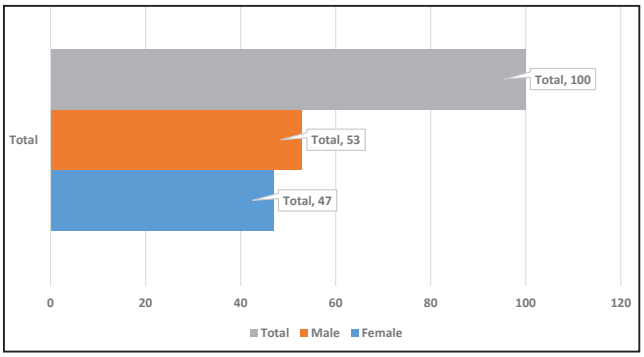

Diagram 2. The bar chart presentation expresses cases in percentages, divided by gender

The number of cardiac arrest patients treated by teams by age group and gender. Out of 100 cases, the age group 71-80 dominated with 26 cases or 26%. Of the 100 patients, 53 were male and 47 were female.

A sample of 100 cases of cardiac arrest treated during 2023/24 was analyzed. Of these, 64 patients were transported to the UCCK - Emergency Center in the Resuscitation Room, while 36 patients were treated at the location (in apartments, houses, workplaces, streets, etc.).

Measures implemented during Resuscitation:

- Determination of vital signs
- Defibrillation with a manual defibrillator by placing electrodes to monitor the cardiac rhythm
- Respirator
- Endotracheal intubation alternative: laryngeal mask
- Provision of 2 peripheral venous lines
- Parenteral I.V. Therapy according to the protocol: Adrenaline→ Amiodarone→ Adenosine …

Time of intervention	Time spent in the location	Transportation time
5.19 minutes	13.34 min	4.04 min

Table 3. Time of intervention, time spent in the location, and Transport time

Discussion

Achieving optimal survival after out-of-hospital cardiac arrest in any community is a challenge today and in the future. This challenge is faced with difficulties in providing care in both rural areas and metropolitan areas, making it challenging to find optimal solutions for organizing the EMS. [14]

A new generation of automated external defibrillators (AEDs) facilitates training for lay or non-professional resuscitation practitioners, who can apply defibrillation after completing the Basic Life Support (BLS) - AED course. [2-4]

These devices have an integrated system for identifying and analyzing the heart rhythm.

During use, automatic defibrillators clearly instruct the rescuer on the need to deliver an electric shock, including the healthcare organization's protocol in prehospital conditions and the number of teams available.

The time course of critical events and the variation in success in treating acute cardiac arrest are closely tied to the timing of these events. [7]

Changes occur from reversible to irreversible damage, from functionality to disability, and from life to death. Traditional thinking views time as a therapeutic ally, but it can become a "deadly" enemy for successful treatment. [11]

Cardiologists have had a saying for years: "Time is muscle," referring to the rescue of the myocardium during cardiac arrest. Thus, in prehospital emergency medicine, the maxim is imposed: "Recognizing the healthy heart that can die and the sick heart that can survive." [3]

Safari's vision, dating back to the 1970s, has now been surpassed in many countries: Resuscitation should begin within the first 5 minutes (the golden time frame). The EMS medical team continues to care for the patient for 15-30 minutes until he is admitted to the emergency hospital within 30-60 minutes.

Understanding the ideal time interval of the so-called "golden minute" following acute cardiac arrest is essential to understanding how the myocardium is relatively more resistant to anoxia and hypoxia compared to the cerebral cortex.

Hypoxic brain damage begins in the fourth minute of heart failure, while irreversible damage occurs within 12 minutes if therapy is not applied. [6]

The most critical factor in successful CPR is the time and period that elapses from the cessation of cardiac activity to the moment of initiation.

After an acute cardiac arrest, the first link in the survival chain is activated—the early approach, which encompasses events from the initial response to the arrival of the EMS team. [13] Identifying early warning signs, such as chest pain or shortness of breath, is essential to attracting the attention of witnesses and activating the EMS system before acute cardiac arrest.

The question is constantly asked: Which link in the chain of survival is most important?

However, the "observer" who recognizes the emergency initiates the chain of survival actions.

The first responder treats the patient's cardiac arrest until the arrival of medical teams. [8]

The time it takes for the EMS team to arrive is critical. After receiving the call, the team must come as quickly as possible to the reported address of the cardiac arrest.

The speed of the EMS's arrival depends on the patient's Resuscitation. Unfortunately, rapid arrival is not always possible.

The team spends most of this time on the road. Many communities are attempting to reduce travel time by increasing the number of ambulances and strategically placing them at key locations. [1]

Introducing helicopter teams, telemedicine, improving road and traffic conditions, and special ambulance lanes are essential.

The total time, consisting of the interval during which the team is traveling and the time from stopping the vehicle to approaching the patient, should not exceed 4 minutes. This is necessary to ensure that the first defibrillation is applied within 5 minutes of the onset of cardiac arrest. [10]

More time is lost when no teams are available; the call is not reasonable or justified; the team is too far away; traffic is blocked; obstacles or other drivers do not give way to the EMS team despite using alarms and flashing lights. [9]

Many studies confirm the value of basic life support performed by laypeople or non-professionals. If CPR is started within 3 minutes, there is about a 75% chance of Resuscitation; if it is started within 4 minutes, the chances of success decrease to about 50%. After 5 minutes, the success rate decreases drastically. [12]

The timing of the first defibrillation is also critical. Defibrillation is the definitive treatment for ventricular VF.

In their research on the importance of defibrillation, Wei and Tang point out that in the case of VF, the order of actions in Cardiopulmonary Resuscitation (CPR) changes: first is D (defibrillation), then C (circulation), A (airway patency), and finally B (Breathing). [13]

It is accepted as a general principle that the time to electrical defibrillation in the resuscitation chain is one of the most critical factors in increasing the chances of Resuscitation. [7]

Conclusion

The time elapsed between cardiac arrest and the application or implementation of basic Resuscitation measures limits the success of resuscitation.

Cardiopulmonary Resuscitation initiated within the golden interval (4 minutes after acute cardiac arrest) has a higher survival rate than when CPR is initiated after 5-10 minutes (late) after arrest.

A good organization of the EMS can significantly increase survival and strengthen the chain of survival links.

A coordinated and efficient approach to emergency treatment is essential for improving patient outcomes.

Each community or community in particular should research to identify the "trigger" locations for the occurrence of out-of-hospital cardiac arrest and, in those areas, to place an AED or DAJ.

AED - Program of mass use of automated external defibrillators as an essential way to save the lives of patients in arrests that occur in prehospital settings.

Ventricular fibrillation is the leading cause of sudden cardiac arrest and is responsible for about 70%-80% of cases. This information highlights the importance of rapid interventions such as cardiopulmonary Resuscitation (CPR) and defibrillation with an AED, which can save lives in the event of sudden cardiac arrest.

Precisely, early defibrillation is a vital link in the chain of out-of-hospital care, especially in cases of cardiac arrest.

Recommendations

If defibrillation is not performed quickly, the chances of survival are significantly reduced.
Here are some key points in this regard:

Time is of the essence: The sooner defibrillation is applied, the greater the chances of survival. Every minute lost after cardiac arrest reduces the chances of survival.

Training: As many people as possible should be trained to use automated external defibrillators (AEDs), which enable a rapid response to emergencies.

Development of emergency services: Emergency service systems should be equipped and trained to provide early defibrillation as part of their response.

Awareness*:* Raising community awareness of the importance of early defibrillation can help save lives. These measures can improve the out-of-hospital chain of care and increase the chances of survival for individuals who experience cardiac arrest.

Abbreviations

EMS - Emergency Medical Services; CPR - Cardiopulmonary Resuscitation; EMC - Emergency; Medicine Center; AEDs - Automated External Defibrillators; AHA - American Heart Association; VF - Ventricular Fibrillation; UCCK - University Clinical Center of Kosovo; BLSD - Basic Life Support & AED;

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