ORIGINAL ARTICLE

RISK FACTORS ASSOCIATED WITH CARDIORESPIRATORY ARREST IN AN EMERGENCY ROOM

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Highlights: (1) Asystole increased the chance of death after cardiac arrest by 5.13 times. (2) 85.3% of patients with cardiac arrest died within 24 hours. (3) Asystole and AESP were associated with a higher risk of death in cardiac arrest.

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ABSTRACT

The objective of the study was to analyze the incidence and factors associated with victims of cardiopulmonary arrest. This is an exploratory, descriptive, longitudinal, retrospective, and quantitative study conducted by analyzing medical records and notification forms of patients admitted to the Adult Emergency Room of a public hospital in the interior of Minas Gerais, between January 2018 and December 2022, who presented with cardiopulmonary arrest. A data collection instrument was used that was designed and validated for content. Descriptive statistics, bivariate analysis, and the Logistic Regression Model were adopted for data analysis. Of the 224 patients, the majority were women (52.2%), elderly (71.6%), and married (44.6%). They had comorbidities (87.5%), especially systemic arterial hypertension and diabetes mellitus. Regarding the outcome, there is a prevalence of 85.3% of cases for deaths in less than 24 hours. It was found that asystole is a factor that predisposes to death, increasing the chance of this outcome by 5.13 times, as well as pulseless electrical activity and ventricular tachycardia to a lesser extent. Another important variable is a 0.35 increase in deaths among patients with respiratory diseases. It was concluded that the majority (85.3%) of victims of cardiopulmonary arrest die within the first 24 hours, and this outcome is associated with arrest rhythms characterized by asystole and ventricular fibrillation, as well as respiratory diseases.

Keywords: Emergency Medical Services; Heart Arrest; Public Hospitals.

INTRODUCTION

In Brazil, there are an estimated 200,000 cases of cardiopulmonary arrest (CPA) each year, half of them in hospitals[1]. In the United States, out-of-hospital CPA rates exceed 350,000 cases[2]. The estimated number of in-hospital CPA cases is approximately 290,0003. The global incidence remains uncertain, but it is estimated that there are between 180,000 and 450,000 cases of CPA per country[4].

In this context, CPA is defined as the mechanical interruption of the heart, ceasing spontaneous and effective blood circulation, with associated absence of breathing[1]. It is divided

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into out-of-hospital and in-hospital cases, and this differentiation is essential regarding initial care and post-CPA outcomes[5].

Therefore, it is known that the outcome of cases is linked to the time required to provide initial care to the victim, which is crucial and extremely important for the post-CPA prognosis, since the chances of survival without cardiopulmonary resuscitation (CPR) decrease by approximately 10% per minute. Thus, the success of care is correlated with early recognition of the signs of cardiac arrest and initiation of CPR maneuvers[6]. Therefore, initial care for patients in CPA is essential, and specific training of professionals in Advanced Cardiac Life Support is fundamental for more effective action and to restore spontaneous circulation in the patient more quickly, which will maximize the chances of survival[7].

Therefore, in the event of a CPA, it is necessary to prioritize the speed and effectiveness of care[8]. Properly performed CPR consists of recognizing and quickly initiating it, performing compressions at the ideal frequency to allow the chest to return to its normal position, and maintaining the minimum frequency and time of interruption of compressions[6]. Regarding the survival of patients who suffer CPA, it is clear that pre-existing comorbidities have a significant influence on the low expectation of in-hospital recovery. However, this does not apply in the pre-hospital setting, which highlights the importance of early CPR regardless of the cause of cardiac arrest, with the aim of reversing the condition[9].

Furthermore, the initial heart rhythm of CPA directly interferes with patient survival after discharge, with ventricular fibrillation and pulseless ventricular tachycardia having higher survival rates[10]. Thus, CPA victims who meet these criteria have a greater chance of recovery. In addition, the short period of mechanical ventilation and neurological recovery after CPA, is also a favorable factor for a promising survival outcome[11].

Regarding the consequences of CPA, neurological consequences due to brain hypoxia, which can damage neuronal membranes, are particularly noteworthy. This is explained by the fact that the organ has oxygen reserves to meet its needs for only 20 seconds, emphasizing once again the importance of reversing the condition as quickly as possible, since a delay in initial care can lead to neurological sequelae and, consequently, compromise the individual's quality of life[12].

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In addition, some factors can negatively influence patient survival, such as a Glasgow scale score below 8 and the onset of healthcare-associated infections, resulting in sepsis, factors that contribute to mortality[11]

Furthermore, studies show that the most frequent outcome of CPA was death, and the most frequent heart rhythm leading to this outcome was pulseless electrical activity[13]. Given this, it is necessary to discuss post-CPA living conditions and the factors associated with these episodes that must be considered, since subsequent conduct is highly relevant to long-term survival and directly affects the patient's quality of life. It is considered that during CPA, whether in or out of the hospital, rapid and effective care is essential, as the factors associated with care are relevant to designing an effective treatment plan. The return of spontaneous circulation within a minimum amount of time is fundamental to survival. In addition, most deaths occur in the first 24 hours after CPA[14], and it is important to identify the factors that interrelate during this period to produce such a result.

Thus, the importance of evaluating the associated factors is emphasized to corroborate knowledge of CPA and to demonstrate the need to evaluate the patient thoroughly, thereby protecting them from avoidable complications associated with the condition. Thus, this study highlights the factors associated with CPA and its incidence, with the purpose of emphasizing the importance of this knowledge for the professional practice of nurses and other health professionals, in addition to contributing to the gaps still present in the literature and aiming to contribute to the organization of hospital services and the development of public policies. Thus, the objective was to analyze the incidence and factors associated with CPA victims.

METHODS

This is an exploratory, descriptive, retrospective, longitudinal study with a quantitative methodological approach conducted at a public hospital in the interior of Minas Gerais, based on medical records from the Medical Statistics Archive Service (SAME) that refer to cases treated at the Adult Emergency Room (AER).

The sample for this study consisted of patients admitted between January 2018 and

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December 2022 to the AER, who met the inclusion criteria: AER in the AER and age equal to or greater than 18 years, and the exclusion criteria: participants with incomplete medical records for the variables investigated.

The sample size calculation considered a finite population of 349 patients undergoing CPA, an accuracy of 4%, and a confidence interval of 95%, resulting in a minimum sample size of 203 participants. Considering a sampling loss of 20%, the maximum number of recruitment attempts will be 254 participants.

The authors' validated tool was used to collect data from medical records. This tool was structured with the following variables: age, gender, race, marital status, education level, occupation, professional status, origin, comorbidities, previous surgeries, medications in continuous use, episodes of CPA, rhythm of CPA, duration of CPA(s), CPA before admission, treatment during the event, number of CPR cycles required, immediate cause, diagnosed cause, tests performed, pharmacological support, adverse events to CPR, and outcome—discharge or death.

This instrument underwent a comprehensive content validation process by *experts*. Twenty expert nurses/physicians, with PhD degrees and experience in the field of urgent and emergency care/Intensive Care Unit (ICU), were invited following Fehring's criteria[15], however, only five formed the expert committee. The search for these experts was conducted on the Lattes platform. First, the *experts* were invited in advance via an email invitation to participate in the instrument's content validation stage. After acceptance and signing of the Free and Informed Consent Form (FICF), the material was sent for analysis of this item with a description of the measure and its score, and an explanation of how to respond. The material was sent electronically via Google Forms.

An 80% agreement rate among the *experts* was considered to evaluate the maintenance, correction, or exclusion of the item in the instrument. After the first verification by the experts, adjustments were made, and the instrument was sent again for final evaluation. Upon approval, the data collection phase began.

The medical records were analyzed at the hospital's SAME in a room provided for this purpose in the sector itself.

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After data collection, a spreadsheet was created in Microsoft® Excel® and a dictionary compiled with descriptions of each variable. The data collection was processed by two people, using double-entry to verify inconsistencies in the database. The database was then imported into the Statistical Package for the Social Sciences (IBM SPSS) version 20 application for processing and analysis.

To achieve the objectives, descriptive analysis was used, including absolute and relative frequency distributions for categorical variables, as well as measures of central tendency (mean, median) and variability (range, standard deviation) for quantitative variables.

Bivariate analysis was also used, including measures of association and contingency tables, the Chi-square test, the Relative Risk (RR), and the Odds Ratio, as well as multivariate analysis using the Multiple Binomial Logistic Regression Model. A single model (saturated model) was used in the regression analysis, considering that the inclusion of factors or predictor variables only considered clinical and conceptual relevance, based on a review of the literature. Therefore, neither the Stepwise method (hierarchical regression) nor the p-criterion was used in the bivariate analysis.

The project was submitted to and approved by the Research Ethics Committee of the Hospital de Clínicas of the Federal University of Triângulo Mineiro under Certificate of Presentation for Ethical Review (CAAE) 47994121.1.0000.8667 and opinion no. 5.105.285. This project complies with the provisions of CONEP Resolution 466/12, which regulates research involving human subjects[16].

RESULTS

Of the 224 (100%) victims of CPR, there was a prevalence of women (52.2%), elderly people (71.6%), married people (44.6%), white skin color (54.5%), incomplete elementary education (35.5%), and people from Uberaba (70.1%). It was observed that in most cases (84.4%), there was no record of professional occupation, as shown in Table 1 below.

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Table 1 - Distribution of sociodemographic variables of study participants (n=224)

Variable	N	%
Gender		
Female	117	52.2
Male	107	47.8
Age		
20-59 years	75	33.5
60-93 years	149	66.5
Marital status		
Single	62	27.7
Married or in a civil partnership	100	44.6
Separated or divorced	20	8.9
Widowed	25	11.2
Not mentioned	17	7.6
Skin color		
White	122	54.5
Black	10	4.5
Brown	90	40.2
Not mentioned	2	0.9
Level of education		
Illiterate	10	4.5
Complete elementary school	19	8.5
Incomplete elementary school	79	35.5
Complete high school	37	16.5
Incomplete high school	6	2.7
Complete higher education	3	1.3
Postgraduate	1	0.4
Not registered	69	30.8
Occupation performed by the patient		
Not registered	189	84.4
Registered professions	35	15.6
Origin		
Uberaba	157	70.1
Other municipalities	67	29.9

Legend: n – number of individuals

Regarding clinical variables, there was a predominance of patients with comorbidities (87.5%), especially circulatory (72.3%) and metabolic/endocrine (35.3%) diseases; within this group, it was observed that a significant proportion of these patients mainly had systemic arterial hypertension and diabetes mellitus. There was a high prevalence of patients with no history of surgeries (64.7%) and with continuous medication use (69.2%), mainly related to the

cardiovascular (58.5%) and endocrine (29.5%) systems, corroborating the data on comorbidities, as shown in Table 2.

Table 2 - Distribution of clinical variables among study participants (n=224)

Variable	N	%
Comorbidities		
Presence	196	87.5
Absence	28	12.5
Circulatory system comorbidities		
Presence	162	72.3
Absence	62	27.7
Metabolic or endocrine comorbidities		
Presence	79	35.3
Absence	145	64.7
Presence		
Previous surgeries (6 months)		
Yes	27	12.1
No	145	64.7
Not registered	52	23.2
Medications for continuous use		
Yes	155	69.2
No	69	30.8

Legend: n – number of individuals

Regarding clinical data on hospitalization, most patients had an International Classification of Diseases (ICD) code for unspecified cardiac arrest (71.6%), were victims of CPA before hospitalization (86.6%), and had undergone some type of prior procedure (79%), as shown in Table 3. Of these, most were intubated (74.6%), on mechanical ventilation or positive pressure ventilation (77.7%), with peripheral access (74.1%) and without central venous access (57.6%), with intravenous medications (75.4%), without defibrillation (89.3%) or cardioversion (93.8%) before admission, without intra-arterial catheter (99.1%), using vasoactive drugs (57.1%), absence of nasoenteral catheter (68.8%) and bladder catheter (62.1%), no change in level of consciousness prior to in-hospital CPR (65.2%), monitored (61.2%).

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Table 3 - Distribution of variables related to hospitalization of study participants (n=224)

Variable	N	%
ICD		
I46.9 Cardiac arrest, cause unspecified	161	71.9
I46.0 Cardiac arrest with successful resuscitation	50	22.3
Other international classifications of diseases	13	5.8
Victim after cardiopulmonary arrest		
Yes	194	86.6
No	30	13.4
Performing a preliminary procedure		
Yes	177	79
No	47	21

Legend: n – number of individuals; ICD – International Classification of Diseases

Regarding CPA data (Table 4), the highest occurrence of CPA in the emergency department is in the stabilization room (78.1%). It was observed that in 67% of cases, the patient had only one episode of CPA. Considering this, in 71.9% of cases, cardiopulmonary resuscitation was attempted, involving chest compressions (71.4%), positive pressure ventilation (67.4%), and administration of intravenous medications (58.9%); In several cases, reintubation (79.9%), venous access puncture (79.5%), defibrillation (87.5%), cardioversion (93.8%), chest drainage (97.3%), and capnography monitoring (100%) were not necessary. The immediate cause of CPA was mainly divided between unknown (46.9%), shock (23.2%), and decreased level of consciousness (5.4%). Regarding the rhythm presented, more than half of cases, 56.3%, presented asystole, and 28.1% presented electrical activity without a pulse; consequently, there was a representative rate of non-execution of defibrillation (86.6%) and cardioversion (94.2%), since these are non-shockable rhythms. Still in relation to the procedures adopted in CPA, regarding medications, there is a prevalence of vasoactive drugs (53.1%) over drugs that are not as widely used, such as antiarrhythmics (87.1%), mineral supplements (85.3%), alkalizing agents (69.6%), and volume components (91.5%). Regarding the post-CPA outcome, there is a significant prevalence of deaths within 24 hours after the event, representing 85.3% of cases.

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Table 4 - Distribution of variables related to CRP in study participants (n=224)

Variable	N	%
Place of occurrence of CPA no AER HC-UFTM		
Nursing station	49	21,9
Stabilization room	175	78,1
Immediate cause		
Unknown	105	46,9
Shock	52	23,2
Ischemia or AMI	10	4,5
Others	57	25,4
Rhythm at the start of CPR		
Ventricular fibrillation	21	9,4
Ventricular tachycardia	4	1,8
Electrical activity without pulse	63	28,1
Asystole	126	56,3
Ventricular tachycardia without pulse	4	1,8
Not recorded	6	2,7
Post-CPA outcome		
Death within 24 hours after the first PCR at PSA HC-UFTM	191	85,3
Death between 24 and 48 hours after the first PCR at PSA HC-UFTM	7	3,1
Discharge after 24 hours after the first PCR at PSA HC-UFTM	1	0,24
Admitted after 48 hours after the first PCR at PSA HC-UFTM	25	11,2

Legend: n (number of individuals); CPA (cardiac arrest); AER (adult emergency department); HC-UFTM Federal University of Triângulo Mineiro Clinical Hospital (*Hospital das Clínicas da Universidade Federal do Triângulo Mineiro*)

Regarding the association between sociodemographic and clinical variables and death, there was a significant association between death and the rhythm of CPA for Asystole (p = 0.000), where patients who presented this rhythm were 5.13 times more likely to die than those who presented other rhythms. Among the other rhythms, an association was also observed between death and pulseless electrical activity. (PEA) (p = 0.002), and still, ventricular tachycardia (VT) (p = 0.016).

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Table 5 – Association between sociodemographic and clinical variables and the outcome of death or discharge from the 224 medical records collected from patients with cardiopulmonary arrest treated in the Adult Emergency Department

Variables	Death		RR (CI)	OR (CI)	p
	Yes n (%)	No n (%)			
Age group					
Elderly person	136 (91.3%)	13 (8.7%)	1.10 (0.98-1.24)	2.19 (0.96-5.00)	0.058
Adult	62 (82.7%)	13 (17.3%)			
Asystole					
Yes	120 (95.2%)	6 (4.8%)	1.20 (1.07-1.33)	5.13 (1.97-13.34)	**0.000**
No	78 (79.6%)	20 (20.4%)			
PEA					
Yes	49 (77.8%)	14 (22.2%)	0.84 (0.73-0.97)	0.28 (0.12-0.65)	**0.002**
No	149 (92.5%)	12 (7.5%)			
VF					
Yes	20 (95.2%)	1 (4.8%)	1.09 (0.97-1.21)	2.80 (0.36-21.85)	0.304
No	178 (87.7%)	25 (12.3%)			
VT					
Yes	2 (50%)	2 (50%)	0.56 (0.21-1.50)	0.12 (0.02-0.91)	**0.016**
No	196 (89.1%)	24 (10.9%)			
DLC					
Yes	10 (83.3%)	2 (16.7%)	0.94 (0.73-1.22)	0.64 (0.13-3.09)	0.574
No	188 (88.7%)	24 (11.3%)			
AMI					
Yes	8 (80%)	2 (20%)	0.90 (0.66-1.23)	0.50 (0.10-2.52)	0.397
No	190 (88.8%)	24 (11.2%)			
Shock					
Yes	47 (90.4%)	5 (9.6%)	1.03 (0.93-1.14)	1.31 (0.47-3.66)	0.609
No	151 (87.8%)	21 (12.2%)			
Comorbidities					
Yes	172 (87.8%)	24 (12.2%)	0.94 (0.84-1.06)	0.55 (0.12-2.47)	0.430
No	26 (92.9%)	2 (7.1%)			

Legend: n (number of individuals); RR (relative risk); OR (odds ratio); CI (95% confidence interval); p (confidence level: $p < 0.05$); PEA (Pulseless Electrical Activity); VF (Ventricular Fibrillation); VT (Ventricular Tachycardia); DLC (Decreased Level of Consciousness); AMI (Acute Myocardial Infarction).

In the logistic regression analysis, patients who presented with asystole and ventricular fibrillation (VF) rhythms had a higher chance of death than other rhythms and comorbidities ($p < 0.05$), as shown in Table 6.

Table 6 – Logistic regression model between sociodemographic and clinical variables with the outcome of death or discharge from the 224 medical records collected from patients with cardiopulmonary arrest treated in the Adult Emergency Department

Variable	Death		OR	CI 95%	P
	Yes n (%)	No n (%)			
Elderly person	136 (91.3%)	13 (8.7%)	2.19	0.87 – 5.55	0.096
PEA	49 (77.8%)	14 (22.2%)	1.38	0.29 – 6.56	0.685
Asystole	120 (95.2%)	6 (4.8%)	8.40	1.61 – 43.75	**0.011**
FV	20 (95.2%)	1 (4.8%)	7.84	0.65 – 94.41	**0.105**
VT	2 (50%)	2 (50%)	0.82	0.06 – 10.50	0.880
Shock	47 (90.4%)	5 (9.6%)	0.86	0.26 – 2.86	0.813
AMI	47 (90.4%)	5 (9.6%)	0.50	0.06 – 3.74	0.506
DLC	10 (83.3%)	2 (16.7%)	0.75	0.13 – 4.29	0.747
Comorbidities	172 (87.8%)	24 (12.2%)	0.63	0.13 – 3.05	0.571

Legend: n (number of individuals); OR: Odds Ratio; 95% CI: 95% confidence interval; significance $p < 0.05$; PEA (Pulseless Electrical Activity); VF (Ventricular Fibrillation); VT (Ventricular Tachycardia); LSC (Level of Consciousness Decrease); AMI (Acute Myocardial Infarction).

DISCUSSION

The high incidence of death due to CPA highlights the need to understand the factors associated with this condition, with the aim of structuring a theoretical framework that assists healthcare professionals, especially nurses and physicians, in decision-making during clinical practice, directly contributing to the reduction of possible adverse events.[14]

Thus, this study advances scientific knowledge by analyzing the incidence and factors associated with CPA victims, with the aim of contributing to teaching, research, and healthcare, and, above all, helping healthcare professionals recognize patients at greater risk of death from CPA.

Most of the study population had comorbidities, mainly circulatory system disorders. A cross-sectional study that analyzed the profile of patients in CPA treated by the mobile emergency service reported that the most frequent comorbidities were cardiovascular diseases, hypertension, and diabetes mellitus, similar to the findings of the present study.[17]

Another cross-sectional study, conducted in São José do Rio Preto, São Paulo, listed the main comorbidities presented in victims of cardiac arrest, namely cardiovascular diseases, systemic arterial hypertension, neurological diseases, and pulmonary diseases, confirming,

once again, the data found in this study.[18]

On the other hand, a cross-sectional observational study conducted in Argentina addresses the influence of respiratory diseases prior to CPR, in which it is possible to observe a prevalence of patients who had CPR and who had respiratory diseases, in addition to the main cause of CPR being respiratory depression, reaffirming what was addressed in the current study on the influence of respiratory diseases on CPR.[19]

It was observed that most patients who experienced cardiac arrest died within 24 hours, with an incidence of 85.3%. A literature review aimed at evaluating and summarizing current knowledge about cardiac arrest in intensive care units, including data quality and results focused on incidence and patient outcomes, showed a mortality rate ranging from 21% to 31%.[20]

Since this study was conducted in the emergency room of a referral hospital, which treats patients in serious conditions, the fact that death occurs within the first 24 hours after the first CPA is due to the patient's clinical deterioration and the initial rhythm of the most frequent arrests being asystole and PEA, rhythms with a higher chance of death. Thus, there is a strong similarity with the cohort study, which found low survival in the first 24 hours.[10]

In addition, the so-called post-CPA syndrome is a significant predictor of patient survival, and this factor is responsible for about 50-70% of deaths, in addition to multiple organ failure resulting from low cardiac output.[21] All of this is associated with a high mortality rate in the first 24 hours after CPA.

In the present study, an association was detected between CPA rhythms characterized by asystole, PEA, and VT, since patients with these conditions are more likely to have a poor prognosis than those without them.

A prospective cohort study conducted in the emergency department of a university hospital in Brazil is like the present study in that it shows that CPA rhythm, especially asystole and PEA, influences patient survival rates, increasing the chances of death when compared to those with other rhythms.[10]

A study conducted in Sweden with 2,604 patients who experienced in-hospital cardiac arrest between 2007 and 2018 highlighted that most patients who experienced this event had

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a non-shockable rhythm, specifically asystole, and of these, 33% died.[22]

A review of cardiac arrest in adults in an in-hospital setting showed that patients in CPA with pre-existing cardiac conditions are strongly associated with negative prognoses, such as death.[3]

An observational study conducted at the Mobile Emergency Care Service in Belo Horizonte differs from the present study in that it identified associations between hypertension (present in 22.87% of cases) and CPR, as well as heart failure and diabetes mellitus.[23]

Finally, we consider, in principle, the incompleteness and/or absence of information in the analyzed medical records, as well as the fact that the study was conducted in a single center, which limits generalizability, to be limitations of the present study. In addition, the chosen study design is highlighted as a limitation, as it cannot establish a cause-and-effect relationship.

This study makes significant contributions to teaching, research, and care. In the field of teaching, it provides relevant data on the prevalence of comorbidities and the cardiac arrest rhythms most associated with death, highlighting the need to train professionals to recognize and intervene in these cases more effectively. For research, the findings on the association between rhythms such as asystole and PEA with an increased chance of death highlight the importance of exploring targeted interventions and specific clinical protocols that can improve prognosis. In terms of care, the results highlight the need for improved strategies for patients in CPA, aiming for more effective treatments and increased survival, especially in the context of hospital emergency services.

CONCLUSION

This study found that, over a five-year period, 224 victims of cardiac arrest were admitted to HC-UFTM, of whom there was a prevalence of patients with comorbidities, particularly circulatory system diseases, with no history of previous surgery and on continuous medication.

Regarding the incidence of the outcome, the most common outcome was death within

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24 hours of the first occurrence of CPA at PSA(AER)-UFTM, representing 85.3% of the study population.

When sociodemographic and clinical variables are associated with death in bivariate analysis, asystole is a factor that predisposes to death, increasing the chance of this outcome by 5.13 times, as well as PEA and VT to a lesser extent. Specifically, binary logistic regression showed that asystole and VF rhythms were more likely to result in death than other rhythms and comorbidities.

Given the above, it can be concluded that cardiac arrest rhythms such as asystole and PEA contribute to death in patients with CPA. This information is extremely relevant in terms of care for CPA victims, seeking more effective treatments and more beneficial prognoses for patients.

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