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ORIGINAL RESEARCH

Characteristics, etiologies and outcomes of cardiac arrest in the emergency department

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Abstract

Background: Emergency department cardiac arrests (EDCA) account for approximately 10% of all in-hospital cardiac arrest (CA) events. However, data regarding EDCA remain scarce. Since EDCA has unique characteristics, etiologies, and outcomes, it should be considered distinct from out-of-hospital and in-hospital cardiac arrest. **Methods**: This study included adult patients who received cardiopulmonary resuscitation in our emergency department for EDCA between 01 January 2019, and 30 June 2023. Patients with a do-not-resuscitate order and those with trauma were excluded. On the basis of the assessment performed by emergency physicians, we divided the patients into unexpected and expected EDCA groups. **Results**: This study included 266 patients, of whom 93 had experienced an unexpected EDCA. Shockable initial rhythm was observed in 21.05% of the overall cohort. The incidence of initial shockable rhythms and the prevalence of end-stage renal disease were higher in the unexpected EDCA group (40.86% and 22.58%, respectively). The predominant etiologies of EDCA in the expected and unexpected EDCA groups were sepsis (24.86%) and shockable fatal dysrhythmia (40.86%), respectively. The overall probabilities of survival to hospitalization, survival to hospital discharge, and favorable neurological outcomes were 49.62%, 27.44%, and 12.41%, respectively. A trend toward better neurological outcomes was observed in the unexpected EDCA group. **Conclusions**: Expected and unexpected EDCA events differ in terms of characteristics, etiologies, and outcomes. To enhance care quality and prognosis, these differences should be considered when treatment is being planned for patients with EDCA.

Keywords

Cardiac arrest; Emergency department cardiac arrest; Unexpected; Neurological outcome; Resuscitation

1. Introduction

Cardiac arrests (CAs) in the emergency department (ED), which are also known as EDCA events, account for approximately 10% of all in-hospital CAs [1–3]. Although numerous studies have explored in-hospital and out-of-hospital CAs, few have specifically analyzed CAs occurring within the ED. Given its unique characteristics, etiologies, and outcomes, EDCA should be regarded as a distinct clinical entity [4–7].

In real-world ED practice, some EDCA events occur in patients who are already known to be critically ill and are under continuous monitoring, whereas others occur suddenly and in the absence of warning signs or clinical suspicion. In consideration of this, the present study categorized EDCAs into two groups: expected and unexpected. This distinction reflects variations in the levels of clinical anticipation and monitoring at the time of arrest in real-world ED settings. Furthermore, determining whether an EDCA was expected may help uncover gaps in early risk recognition, triage processes, and resource allocation. Although this topic has clinical relevance, few studies have employed this classification of EDCA.

Understanding the characteristics and reversible causes of EDCA may support timely intervention and appropriate post-cardiac arrest care and ultimately improve patient outcomes. The present study provides a comprehensive analysis of the characteristics, etiologies, and outcomes of both expected and unexpected EDCAs with the aim of identifying opportunities for earlier recognition and prevention of CA in ED settings.

2. Materials and methods

2.1 Study design and settings

This retrospective study was conducted at the ED of Chi Mei Medical Center between 01 January 2019, and 30 June 2023. CAs that occurred outside of the hospital or in units of the hospital other than the ED were excluded. Using the Utstein Resuscitation Registry Template for in-hospital CA [8], we collected data from the patients with EDCA. In addition, we calculated the National Early Warning Score (NEWS) based on two sets of vital signs: the latest recorded vital signs prior to EDCA, and the initial triage vital signs upon arrival at the emergency department. The total score was categorized as follows: low (0–4 points), medium (5–6 points), and high ($\geq$7 points). Patients who survived for more than 30 days of hospitalization were considered to have achieved survival to discharge. Cerebral Performance Category (CPC) scores of 1 or 2 were considered favorable neurological outcomes. CPC scores of 3–5 were considered poor neurological outcomes [8, 9]. Peri-intubation CA was defined as a CA occurring within 20 minutes from the initiation of an intubation attempt [10].

2.2 Resuscitation facilities

Chi Mei Medical Center is a 1267-bed, accredited medical center. The ED of the Chi Mei Medical Center receives approximately 105,000 patients per year. The ED is divided into resuscitation, acute care, pediatric, and observation (for boarding or further observation) units.

2.3 Data acquisition

All emergency physicians at Chi Mei Medical Center are required to complete a standardized post resuscitation documentation form following each EDCA event. This structured form records key information, including the resuscitation process, diagnostic findings, suspected etiology, and whether the cardiac arrest was deemed expected or unexpected. The attending physician or senior resident directly involved in the case is responsible for making this classification.

To promote consistency, our department adheres to the following operational definitions, which are reinforced through quarterly morbidity and mortality (M&M) conferences and routine departmental reviews:

- EDCAs are "expected" if they occur in patients who were assessed as critically ill—including patients with persistently unstable vital signs—and who were under continuous electrocardiographic monitoring in the resuscitation bay or observation area.
- EDCAs are "unexpected" if they occur in patients who:

1. Were not under electrocardiographic monitoring (typically because the patient was not initially determined to be at high risk or collapsed before monitoring could be initiated) or;
2. Were under electrocardiographic monitoring but did not have preceding signs of instability, such that the event was perceived as clinically surprising by the attending physician.

Data on EDCA classification in our department are incorporated into an internal EDCA registry and validated by a group of emergency physicians, who manually review each entry. These physicians also review hospital discharge diagnoses, and electronic medical records, including documentation from the ED, intensive care unit, and inpatient wards.

All cases with missing values were excluded during data preprocessing. As a result, the final analytic dataset contained no missing data.

2.4 Study cohort

This study included patients aged >18 years who had received cardiopulmonary resuscitation for EDCA between 01 January 2019, and 30 June 2023. Patients with a documented do-not-resuscitate order and those with trauma were excluded.

2.5 Statistical analysis

Data are presented as medians with interquartile ranges, or as frequencies with percentages. Between-group differences were analyzed using Pearson's chi-square test or Fisher's exact test for categorical variables and the Mann-Whitney U test for continuous variables. To reduce estimation bias of data separation, odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using logistic regression with Firth's penalized likelihood approach. These estimates were used to identify the independent predictors of favorable neurological outcomes at hospital discharge. The multivariable logistic regression model used for this purpose was adjusted for potential risk factors, such as initial rhythm (shockable *vs.* nonshockable), age, sex, comorbidities, and NEWS. We also constructed a model that included all variables presented in the demographic characteristics of patients. To examine the association between favorable neurological outcomes and each risk factor, we constructed a reduced model by eliminating variables that did not reach statistical significance in the univariate analysis. Data were analyzed using SAS (version 9.4; SAS Institute, Cary, NC, USA). A p-value of < 0.05 was considered to indicate significance.

3. Results

3.1 Patient characteristics

This study included 266 patients (median age, 68 years; men, 68.42%) (Fig. 1). The patients were divided into two groups: expected EDCA (n = 173) and unexpected EDCA (n = 93). The patient characteristics are summarized in Table 1. The two groups were similar in terms of sex composition and median age. Regarding comorbidities, the prevalence rates of diabetes mellitus, hypertension, prior myocardial infarction, heart failure, prior cerebrovascular accident, end-stage renal disease (ESRD), and malignancy were 42.86%, 62.78%, 21.80%, 13.53%, 12.78%, 13.53%, and 19.92%, respectively. Notably, the prevalence of ESRD differed significantly ($p = 0.002$) between the expected (8.67%) and unexpected (22.58%) EDCA groups.

3.2 EDCA etiologies

The etiologies of EDCA are multifactorial (Table 2). The predominant etiology in the overall cohort was a cardiac cause. In the unexpected EDCA group, the most common etiology was fatal dysrhythmia (40.86%), followed by unknown causes

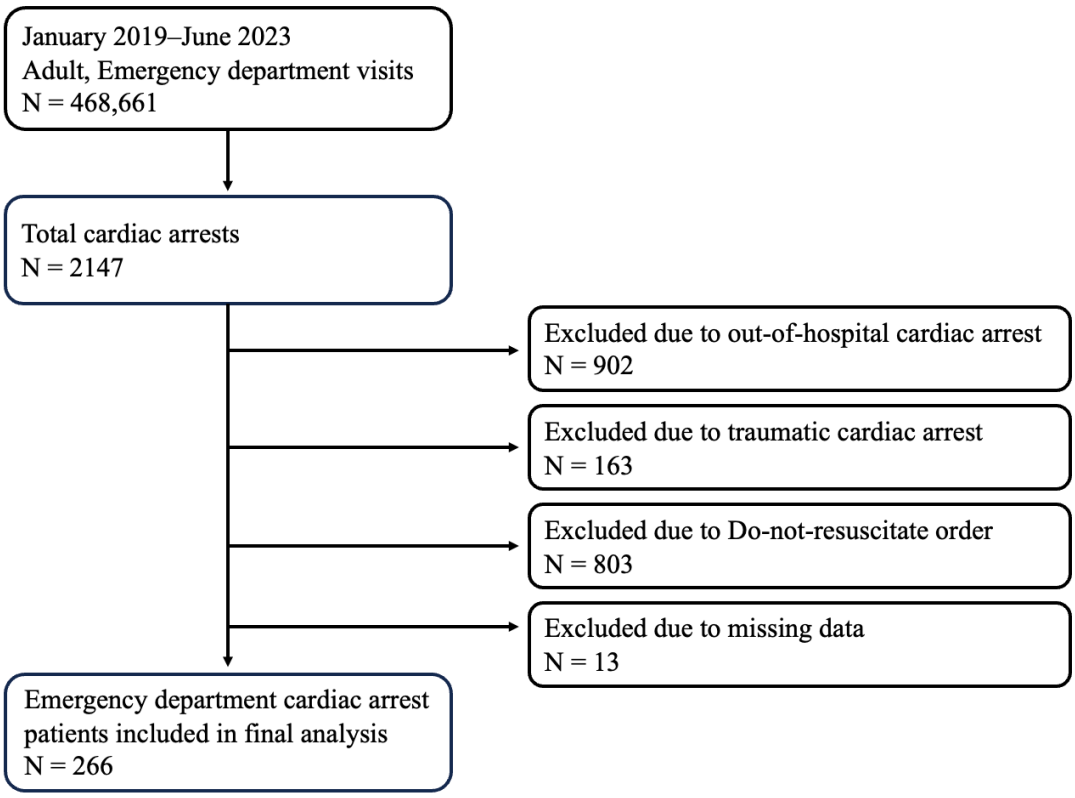

FIGURE 1. Flow diagram of patient selection.

TABLE 1. Demographic characteristics of patients with expected or unexpected EDCA.

Variable	Overall (n = 266)	Expected EDCA (n = 173)	Unexpected EDCA (n = 93)	*p*
Age, yr				
Median (Q1, Q3)	68.00 (58.00, 79.00)	69.00 (59.00, 80.00)	66.00 (58.00, 76.00)	0.337
Age group				
<65 yr	107 (40.23)	70 (40.46)	37 (39.78)	0.914
≥65 yr	159 (59.77)	103 (59.54)	56 (60.22)	
Sex, n (%)				
Female	84 (31.58)	54 (31.21)	30 (32.26)	0.861
Male	182 (68.42)	119 (68.79)	63 (67.74)	
Comorbidities, n (%)				
DM	114 (42.86)	70 (40.46)	44 (47.31)	0.282
HTN	167 (62.78)	107 (61.85)	60 (64.52)	0.668
Prior MI	58 (21.80)	34 (19.65)	24 (25.81)	0.247
Heart failure	36 (13.53)	19 (10.98)	17 (18.28)	0.097
Old CVA	34 (12.78)	23 (13.29)	11 (11.83)	0.733
ESRD	36 (13.53)	15 (8.67)	21 (22.58)	0.002
Cancer	53 (19.92)	35 (20.23)	18 (19.35)	0.865
Initial rhythm, n (%)				
Nonshockable	210 (78.95)	155 (89.60)	55 (59.14)	<0.001
Shockable	56 (21.05)	18 (10.40)	38 (40.86)	
Location, n (%)				
Observation Area	82 (30.83)	33 (19.08)	49 (52.69)	<0.001
Resuscitation area/Acute care unit	184 (69.17)	140 (80.92)	44 (47.31)	

TABLE 1. Continued.

Variable	Overall (n = 266)	Expected EDCA (n = 173)	Unexpected EDCA (n = 93)	*p*
Triage Priority				
1	141 (53.01)	126 (72.83)	15 (16.13)	
2	88 (33.08)	39 (22.54)	49 (52.69)	<0.001
3–5	37 (13.91)	8 (4.62)	29 (31.18)	
Time interval between arrival and EDCA				
<60 min	109 (40.98)	84 (48.55)	25 (26.88)	<0.001
≥60 min	157 (59.02)	89 (51.45)	68 (73.12)	
NEWS at ED arrival				
Median (Q1, Q3)	8.00 (3.00, 12.00)	10.00 (6.00, 13.00)	3.00 (1.00, 7.00)	<0.001
NEWS group, n (%)				
A low score (1–4)	82 (30.83)	29 (16.76)	53 (56.99)	
A medium score (5–6)	28 (10.53)	15 (8.67)	13 (13.98)	<0.001
A high score (7 or more)	156 (58.65)	129 (74.57)	27 (29.03)	
Latest NEWS before EDCA				
Median (Q1, Q3)	10.00 (5.00, 13.00)	12.00 (9.00, 14.00)	5.00 (2.00, 8.00)	<0.001
NEWS group, n (%)				
A low score (1–4)	54 (20.30)	8 (4.62)	46 (49.46)	
A medium score (5–6)	21 (7.89)	7 (4.05)	14 (15.05)	<0.001
A high score (7 or more)	191 (71.80)	158 (91.33)	33 (35.48)	

Abbreviations: EDCA, emergency department cardiac arrest; DM, diabetes mellitus; HTN, hypertension; CVA, cardiovascular accident; MI, myocardial infarction; ESRD, end-stage renal disease; ED, emergency department; NEWS, National Early Warning Score.

TABLE 2. Etiologies of expected and unexpected EDCA events.

Variable	Overall (n = 266)	Expected EDCA (n = 173)	Unexpected EDCA (n = 93)	*p*
Etiology, n (%)				
Fatal dysrhythmia (VF/pulseless VT)	49 (18.42)	11 (6.36)	38 (40.86)	<0.001
Sepsis	45 (16.92)	43 (24.86)	2 (2.15)	<0.001
Respiratory failure	37 (13.91)	25 (14.45)	12 (12.90)	0.728
Unknown	35 (13.16)	14 (8.09)	21 (22.58)	<0.001
STEMI	26 (9.77)	13 (7.51)	13 (13.98)	0.091
Acute aortic syndrome	22 (8.27)	13 (7.51)	9 (9.68)	0.541
NSTEMI	20 (7.52)	16 (9.25)	4 (4.30)	0.145
Acidosis	14 (5.26)	9 (5.20)	5 (5.38)	1.000
Peri-intubation	13 (4.89)	10 (5.78)	3 (3.23)	0.552
Heart failure, pulmonary edema	12 (4.51)	10 (5.78)	2 (2.15)	0.225
Hyperkalemia	12 (4.51)	7 (4.05)	5 (5.38)	0.758
Hypovolemia and unspecific bleeding	12 (4.51)	10 (5.78)	2 (2.15)	0.225
Gastrointestinal bleeding	11 (4.14)	11 (6.36)	0 (0.00)	0.010
Intracerebral hemorrhage and spontaneous SAH	8 (3.01)	7 (4.05)	1 (1.08)	0.268
Pulmonary embolism	7 (2.63)	5 (2.89)	2 (2.15)	1.000
Intoxication	6 (2.26)	4 (2.31)	2 (2.15)	1.000
Tension pneumothorax	3 (1.13)	2 (1.16)	1 (1.08)	1.000
Hypothermia	1 (0.38)	1 (0.58)	0 (0.00)	1.000

Abbreviations: EDCA, emergency department cardiac arrest; VF, ventricular fibrillation; VT, ventricular tachycardia; STEMI, ST-elevation myocardial infarction; NSTEMI, non-ST-elevation myocardial infarction; SAH, subarachnoid hemorrhage.

(22.58%) and ST-elevation myocardial infarction (STEMI; 13.98%). By contrast, in the expected EDCA group, the most common etiology was sepsis (24.86%), followed by respiratory failure (14.45%) and non-ST-elevation myocardial infarction (NSTEMI; 9.25%).

3.3 EDCA characteristics

Initial shockable rhythm was observed in 21.05% of the overall cohort and was significantly more prevalent in the unexpected EDCA group than in the expected EDCA group (40.86% *vs.* 10.40%; $p < 0.001$). The median latest NEWS was 10 for the overall cohort and was significantly lower in the unexpected EDCA group (median NEWS: 5) than in the expected EDCA group (median NEWS: 12; $p < 0.001$). Most EDCA events (69.17%) occurred in the resuscitation and acute care units. In the expected EDCA group, 80.92% of the EDCA events occurred in the resuscitation and acute care units. In the unexpected EDCA group, the majority of the EDCA events (52.69%) occurred in the observation unit. This between-group difference in EDCA occurrence site was significant. In the overall cohort, 40.98% of all EDCA events occurred within 60 minutes of ED arrival. In the unexpected and expected EDCA groups, these proportions were 26.88% and 48.55%, respectively.

3.4 EDCA outcomes

Of the 266 patients, 132 (49.62%) survived to hospitalization (Table 3). Furthermore, 73 patients (27.44%) survived to hospital discharge, and 33 patients (12.41%) had a good CPC score at hospital discharge. A trend toward favorable neurological outcomes was observed in the unexpected EDCA group. In the unexpected and expected EDCA groups, 19 (20.43%) and 14 (8.09%) patients, respectively, achieved favorable neurological outcomes (CPC score: 1 or 2) at hospital discharge. Multivariable logistic regression indicated the presence of an initial shockable rhythm (full-model OR: 3.53; 95% CI: 1.48–8.45; reduced-model OR: 3.82; 95% CI: 1.64–8.91) and an age of <65 years (full-model OR: 2.86; 95% CI: 1.27–6.67; reduced-model OR: 2.94; 95% CI: 1.33–6.67) as independent predictors of favorable neurological outcomes at hospital discharge (Table 4).

4. Discussion

Obtaining information on the reversible causes of EDCA can help with effectively treating underlying diseases and selecting appropriate post-CA interventions, such as percutaneous coronary intervention and targeted temperature management, which can improve outcomes [11, 12]. Many relevant studies have inferred presumed etiologies based on disease codes (*e.g.*, ICD-10, International Classification of Diseases, Tenth Revision) extracted from large registries [4]. However, the accuracy of diagnostic coding may be limited, thereby restricting the completeness of etiological assessment. This prompted us to manually review each case. We scrutinized data from physical examinations, post resuscitation structured forms, bedside point-of-care ultrasonography, electrocardiography, computed tomography, laboratory tests, and additional tests and final diagnoses during hospitalization.

Researchers previously used the NEWS at ED admission to predict the risk of ED mortality in older adults [13]. We found that the overall EDCA cohort had an elevated NEWS upon ED arrival and before EDCA. Furthermore, the unexpected EDCA group had a lower median NEWS than did the expected EDCA group. Thus, sole reliance on the examination of simple vital signs may leave emergency physicians unprepared for treating EDCA. Notably, the occurrence of EDCA in patients with low NEWS scores may reflect the limitations of current early warning systems in detecting certain high-risk conditions. In our study, many cases of unexpected EDCA were found to have primary cardiac etiologies, which may not be adequately captured by the NEWS. This highlights the potential need for additional clinical indicators or complementary tools to better identify patients at risk of sudden and catastrophic deterioration. Moreover, when managing patients with unexpected EDCA with low NEWS, clinicians should consider cardiac causes as a priority in the initial assessment.

It is also important to note that the NEWS was originally designed for repeated monitoring, with emphasis on trends and changes over time rather than single-point measurements [14]. In our cohort, both expected and unexpected EDCA groups showed a median increase of approximately two points in NEWS from ED arrival to the latest recorded NEWS value prior to cardiac arrest, indicating ongoing clinical deterioration. The persistence of the "unexpected" classification despite these changes may reflect challenges in the real-world application or interpretation of early warning systems in the ED setting, where workflow constraints, competing priorities, or subtle clinical changes may delay recognition and escalation. Optimizing the use of NEWS for trend monitoring, integrating it with clinical judgment, and ensuring timely interventions could enhance early recognition and prevention of EDCA.

4.1 EDCA etiologies

In most of our patients, the initial rhythm was nonshockable; this finding is consistent with those of other studies [1, 4, 5].

TABLE 3. Outcomes of expected and unexpected EDCA events.

Variable	Overall (n = 266)	Expected EDCA (n = 173)	Unexpected EDCA (n = 93)	*p*
Survival to admission, n (%)	132 (49.62)	81 (46.82)	51 (54.84)	0.212
Survival to discharge or 30-day survival, n (%)	73 (27.44)	42 (24.28)	31 (33.33)	0.114
Good CPC at discharge, n (%)	33 (12.41)	14 (8.09)	19 (20.43)	0.004

Abbreviations: EDCA, emergency department cardiac arrest; CPC, Cerebral Performance Category.

TABLE 4. Independent predictors of a good CPC score at hospital discharge.

Variable	Crude OR (95% CI)	*p*	Full model OR (95% CI)	*p*	Reduced-model OR (95% CI)	*p*
Unexpected EDCA patient	2.88 (1.38, 6.01)	0.005	1.24 (0.43, 3.60)	0.696	1.09 (0.39, 3.02)	0.873
Expected EDCA patient	Ref.		Ref.		Ref.	
Age, yr						
<65	Ref.		Ref.		Ref.	
≥65	0.39 (0.19, 0.82)	0.013	0.35 (0.15, 0.79)	0.012	0.34 (0.15, 0.75)	0.007
Sex						
Female	Ref.		Ref.			
Male	1.05 (0.48, 2.29)	0.911	0.77 (0.32, 1.84)	0.557		
Comorbidities						
DM	0.47 (0.21, 1.05)	0.065	0.46 (0.18, 1.14)	0.094		
HTN	1.03 (0.49, 2.17)	0.944	1.61 (0.67, 3.83)	0.286		
Prior MI	1.00 (0.42, 2.40)	0.995	1.24 (0.42, 3.60)	0.698		
Heart failure	0.69 (0.21, 2.23)	0.532	0.67 (0.20, 2.29)	0.521		
Old CVA	0.74 (0.23, 2.41)	0.614	1.13 (0.32, 4.00)	0.845		
ESRD	0.69 (0.21, 2.23)	0.532	0.46 (0.12, 1.79)	0.263		
Cancer	0.42 (0.13, 1.33)	0.139	0.45 (0.14, 1.47)	0.186		
Initial rhythm						
Not shockable	Ref.		Ref.		Ref.	
Shockable	5.22 (2.45, 11.16)	<0.001	3.53 (1.48, 8.45)	0.004	3.82 (1.64, 8.91)	0.001
Latest NEWS before EDCA						
A low score	4.88 (2.24, 10.66)	<0.001	2.96 (0.87, 10.08)	0.082	3.08 (0.93, 10.26)	0.066
A medium score	1.46 (0.34, 6.19)	0.608	0.76 (0.14, 4.15)	0.749	0.71 (0.13, 3.75)	0.684
A high score	Ref.		Ref.		Ref.	
NEWS at arrival to ED						
A low score	2.44 (1.11, 5.37)	0.027	1.08 (0.38, 3.08)	0.892	1.07 (0.38, 3.04)	0.898
A medium score	2.49 (0.83, 7.46)	0.104	2.16 (0.61, 7.65)	0.233	1.79 (0.52, 6.19)	0.361
A high score	Ref.		Ref.		Ref.	

Abbreviations: CPC, Cerebral Performance Category; OR, odds ratio; CI, confidence interval; DM, diabetes mellitus; HTN, hypertension; CVA, cardiovascular accident; MI, myocardial infarction; ESRD, end-stage renal disease; EDCA, emergency department cardiac arrest; ED, emergency department; NEWS, National Early Warning Score; Ref.: Reference.

Evidence suggests that among patients experiencing a CA, those experiencing a CA in the ED (30.3%) are more likely to have an initial shockable rhythm than are those experiencing a CA in other hospital units [7]. However, in our study the overall incidence of initial shockable rhythm was 21.05%, and this incidence was significantly higher in the unexpected EDCA group than in the expected EDCA group. In the unexpected EDCA group, the predominant etiology was shockable fatal dysrhythmia. This finding highlights the need for immediate identification of initial rhythm and timely initiation of defibrillation in the ED when managing unexpected EDCA.

Our study suggests that the primary causes of EDCA are predominantly associated with cardiac factors. Notably, the most common and second most common (STEMI) etiologies in the unexpected EDCA had cardiac origins, necessitating timely primary percutaneous coronary intervention. By contrast, the predominant etiology in the expected EDCA group was sepsis. Thus, early diagnosis and management of sepsis are essential for the early initiation of appropriate interventions, which might include fluid resuscitation, vasopressors, and antibiotics [15].

In our overall cohort, 4.89% of EDCA events occurred during the peri-intubation period. Emergency intubation is primarily performed to improve survival outcomes. However, peri-intubation CA can occur, and it poses major clinical challenges and potentially leads to complications. Evidence suggests that patients with a pre-intubation shock or hypoxemia have an elevated risk of peri-intubation CA [10, 16, 17]. This emphasizes the need to be vigilant in recognizing physiologically difficult airways and risk factors for peri-intubation CA [17–19]. Resuscitation before intubation, selecting appropriate sedative agents, and administering adequate dosages are always prudent practices in the ED.

4.2 EDCA outcomes

Studies have reported inconsistent findings pertaining to the rate of survival after EDCA. Mir *et al.* [4] reported that the rate of survival after EDCA is lower than the rate of survival after in-hospital CA (10% and 31.6%, respectively). However, most other studies have reported that the rate of survival after EDCA ranges between 15% and 35% [1, 5, 7, 20–22]. In our study, 27.44% of the patients who experienced an EDCA achieved survival to discharge or reached 30-day survival, which aligns with this range. The rate of survival did not vary significantly between the expected and unexpected EDCA groups.

In our study, 12.41% of the patients achieved favorable neurological outcomes (CPC score: 1 or 2) at hospital discharge; this proportion aligns with those reported in other studies (range, 8%–26%) [1, 5, 21, 22]. While the unexpected EDCA group had a higher proportion of favorable neurological outcomes at hospital discharge (20.43% *vs.* 8.09%), this observation represents a numerical trend rather than a statistically significant difference. It should be interpreted with caution due to wide confidence intervals and potential confounding variables and may initially appear counterintuitive. A possible explanation is that a higher proportion of unexpected EDCA cases had primary cardiac etiologies, such as acute coronary syndromes and fatal dysrhythmia, which are known to be associated with more favorable neurological recovery if promptly treated [21, 22]. These observations highlight the importance of improving early detection tools for patients at risk of sudden deterioration, particularly those who may initially present with deceptively low-acuity profiles.

The presence of an initial shockable rhythm is indicative of survival benefits after EDCA [5, 21, 22] and in other hospital units [2, 23, 24]. We identified the presence of an initial shockable rhythm and an age of <65 years to be independent predictors of favorable neurological outcomes at hospital discharge.

4.3 Limitations

Our study has several limitations that should be acknowledged.

First, the retrospective design, single-center setting, and relatively small sample size may have introduced selection bias, thereby limiting the generalizability of our findings to other populations or institutions.

Second, the classification of EDCA events as expected or unexpected in this study inherently involved subjective clinical judgment, despite the fact that the physicians making the classifications were doing so in accordance with our institution's operational definitions. This subjectivity may lead to classifications varying with the attending physician's experience and the specific context of the resuscitation environment.

Third, regarding classification of EDCA etiologies, the cause of arrest remained undetermined in 13.16% of cases. Although this proportion is notably lower than those reported in other studies, which have reported proportions ranging from 17% to 67% [1, 4, 6], further research is warranted to improve the accuracy and completeness of etiological identification.

Fourth, previous studies [25–27] have demonstrated that prolonged stays in the ED are associated with longer hospitalization and increased in-hospital mortality. This indicates that although the length of stay in the ED was not a primary variable in our study, it may influence both mortality risk, particularly in crowded or resource-limited settings. Future investigations should explore whether prolonged stays in the ED contribute to delayed recognition or management of clinical deterioration or otherwise increase the risk of EDCA.

Finally, our study did not consider intra-arrest biochemical data, such as lactate level, which was reported to hold prognostic significance in cardiac arrest scenarios [28]. The inclusion of such biomarkers may provide valuable insights in future studies aimed at better understanding EDCA prognosis.

5. Conclusions

EDCA generally occurs during resuscitation efforts. In this study, the predominant etiology of unexpected EDCA was fatal dysrhythmia with an initial shockable rhythm, and this indicates the importance of immediately identifying the initial rhythm and of immediate defibrillation. In contrast, the predominant etiology of expected EDCA was sepsis. Although survival rates were similar between unexpected and expected EDCA cases, neurological outcomes in the unexpected group were numerically more favorable but not statistically robust. Understanding these differences is crucial for optimizing patient care and improving clinical outcomes.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available upon reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

HCC and CCT—conceived and designed the study and contributed to conceptualization and visualization. CCT—providing methodology and supervision. YChiC—conducted data curation and investigation. YJL, YChC and CHH—performed the formal analysis. HCC, YChiC, YJL, YChC and CCT—prepared the original draft of the manuscript. PJC and YL—contributed to validation. PJC, CHH, CWW, CCH, YL, YHL and HML—contributed to reviewing and editing the manuscript. CCH—additionally providing important resources. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This retrospective study was approved by the Institutional Review Board of Chi Mei Medical Center (IRB No. 11301-018), which waived the requirement for written informed consent.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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