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Clinical paper

The short- and mid-term mortality trends in out-of-hospital cardiac arrest survivors: insights from a 5-year multicenter retrospective study in Taiwan

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Abstract

Background: The survival trend and factors influencing short- and mid-term mortality in Asian out-of-hospital cardiac arrest (OHCA) survivors should be elucidated. We performed survival analyses on days 3 and 30, hypothesizing decreased survival rates within the initial 3 days post-resuscitation. Additionally, variables linked to mortality at these two timepoints were examined.

Methods: We performed a retrospective analysis on adult nontraumatic OHCA survivors admitted to the National Taiwan University Hospital and its branches between 2017 and 2021. We collected the following variables from the NTUH-Integrative Medical Database: basic characteristics, cardiopulmonary resuscitation events, inotrope administration, and post-resuscitation management. The outcomes included 3- and 30-day mortality. Subgroup analyses with the Kaplan–Meier method explored the survival probability of the OHCA survivors and assessed differences in cumulative survival among subgroups. Cox proportional hazards model was used to estimate adjusted hazard ratios with 95% confidence interval.

Results: Of the 967 survivors, 273 (28.2%) and 604 (62.5%) died within 3 and 30 days, respectively. The 30-day survival curve after OHCA showed an uneven decline, with the most significant decrease within the first 3 days of admission. Various risk factors influence mortality at 3- and 30-day intervals. Although increased age, noncardiac etiology, and prolonged low-flow time increased mortality risks, bystander CPR, targeted temperature management, and continuous renal replacement therapy were associated with reduced mortality at 3- and 30-day timeframes.

Conclusion: Survival declined in most OHCA survivors within 3 days post-resuscitation. The risk factors associated with mortality at 3- and 30-day intervals varied in this population.

Keywords: Out-of-hospital cardiac arrest, Risk factor, Survival analysis, Outcome, Mortality

Introduction

As resuscitation knowledge and techniques advance, the rate of return of spontaneous circulation (ROSC) in out-of-hospital cardiac arrest (OHCA) has increased from 17% to 45%.[1–4] However, the overall survival rate at hospital discharge for OHCA remains low, between 8% and 13%, both in the short- and long-term.[1,4,5] The survival rates among OHCA survivors tend to decline rapidly, with most deaths occurring within the first 24 to 72 h.[5–7]

The factors influencing survival are diverse. A previous study identified that the key factors of 30-day survival in OHCA were witnessed collapse, bystander cardiopulmonary resuscitation (CPR), CPR duration, and cardiac etiology. The *meta*-analysis of Sasson et al. showed higher survival rates in patients with witnessed collapse and bystander CPR.[8] Khan et al. found that cardiac-related OHCA patients had double the survival-to-discharge rate compared with noncardiac cases.[9] Longer CPR durations were associated with lower survival,[10] and inotrope use in the intensive care unit (ICU) correlated with reduced in-hospital survival.[11] The effects of targeted

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https://doi.org/10.1016/j.resplu.2024.100747

Received 17 May 2024; Received in revised form 2 August 2024; Accepted 5 August 2024

temperature management (TTM) on survival were inconsistent across studies,[12–14] although it seemed beneficial in patients on extracorporeal membrane oxygenation (ECMO) for 28-day survival.[15]

However, reports on the survival trend of OHCA survivors are inconsistent, and the factors influencing outcomes vary. This study addressed whether survival trends decline unevenly and whether OHCA survivors exhibit different key factors between short-term and mid-term mortality. To test the hypothesis of a rapid decline in survival rates within the first 3 days, survival analyses were conducted on days 3 and 30 post-resuscitation. Additionally, we investigated factors associated with mortality at these timepoints.

Method

Study design and setting

This study was conducted at National Taiwan University Hospital (NTUH), a tertiary medical center, and its two affiliated hospitals, an urban secondary hospital (Hsin-chu branch) and a rural secondary hospital (Yun-lin branch). Patients suffering from OHCA were transported to these hospitals by different regional EMS departments. The characteristics of the three hospitals and their respective EMS systems are shown in Supplementary Table 1.

The study complied with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The Institutional Review Board (IRB) of the NTUH provided ethical approval for our study (Approval No. 202302076RINB).

Data on variables and outcomes were collected from the National Taiwan University Hospital-Integrative Medical Database (NTUH-iMD). This comprehensive database includes patient demographics, diagnostic records, treatment histories, imaging and laboratory results, prescription details, nursing care notes, and administrative data. The team of specialized research staff of the NTUH-iMD ensures stringent control and regulation of access and queries regarding the database following IRB guidelines.

Study populations

We included OHCA survivors subsequently admitted to the ICUs of the three hospitals between January 2016 and December 2021. We excluded patients < 18 years, those with OHCA due to trauma, and individuals with data restrictions due to legal constraints.

Measures

The data collected for eligible OHCA survivors included basic demographic information and extensive medical histories, covering both outpatient clinic visits and hospital admissions before the OHCA event. The patients were classified into three age groups: young adults (18–44 years), middle-aged individuals (45–64 years), and seniors (≥65 years). Data on pre- and in-hospital resuscitation efforts included witnessed collapse, bystander CPR, presence of any shockable rhythm, response time, low-flow time, and cardiac rhythm post-ROSC. The response time was defined as time from emergency call to EMS arrival. If the patient was sent to the hospital by the family, the response time was defined as witnessed arrest to hospital arrival. Low-flow time was the duration from EMS arrival to ROSC/death, including both prehospital and in-hospital resuscitation.

Post-resuscitation care variables were inotrope use, TTM, ECMO, and continuous renal replacement therapy (CRRT). The criteria for initiating TTM and CRRT in the three hospitals are listed in Supplementary Tables 2 and 3. Inotrope use was specified as the intravenous administration of norepinephrine, epinephrine, vasopressin, dopamine, and dobutamine. Four independent emergency physicians initially determined the origin of an OHCA event through a thorough review of medical charts. A senior specialist resolved any discrepancies from individual assessments in a consensus meeting. This method aimed to maximize the accuracy of determining the OHCA etiology without autopsy data.

Outcomes

The primary outcome was defined as 30-day all-cause mortality, which referred to all-cause death within 30 days from the cardiac arrest. The secondary outcome was 3-day all-cause mortality from the cardiac arrest.

Statistical analysis

A statistician conducted data collection, cleaning, and statistical analysis. Particularly, we compared the characteristics, resuscitation

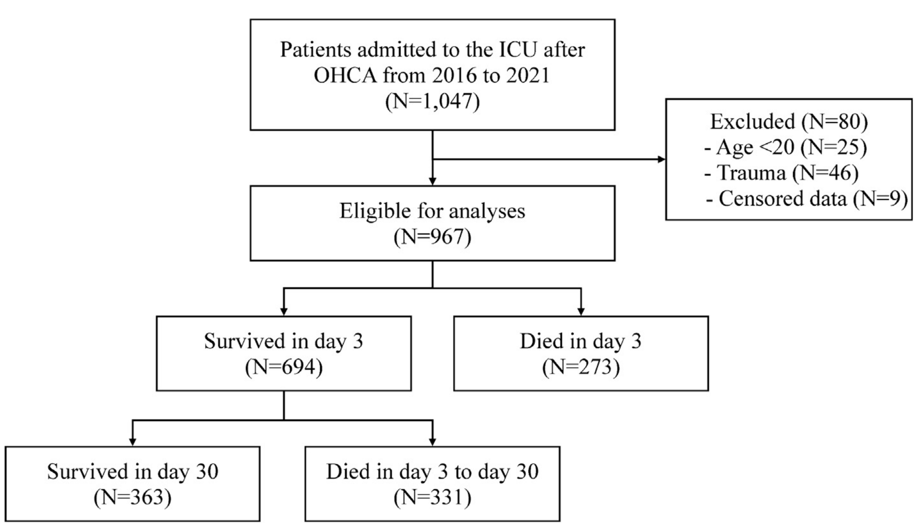

Fig. 1 – Flow chart of the eligible patient selection. ICU: intensive care unit; OHCA: out-of-hospital cardiac arrest.

Table 1 – Basic characteristics of OHCA patients in National Taiwan University Hospital and its affiliated hospitals from 2016 to 2021.

	3-day			30-day		
Variables	Mortality (n = 273)	Survival (n = 694)	*p*	Mortality (n = 604)	Survival (n = 363)	*p*
Males	186(68.6)	468(67.2)	0.677	403(66.7)	251(69.1)	0.435
Age			0.074			<0.001
<40	8(3.0)	39(5.6)		22(3.6)	25(6.9)	
40-64	102(37.6)	290(41.7)		222(36.8)	170(46.8)	
≧65	161(59.4)	367(52.7)		360(59.6)	168(46.3)	
Pre-existing comorbidities						
Hypertension	108(39.9)	314(45.1)	0.138	266(44.0)	156(43.0)	0.747
Diabetes mellites	76(28.0)	196(28.2)	0.971	183(30.3)	89(24.5)	0.053
Coronary artery disease	54(19.9)	168(24.1)	0.162	122(20.2)	100(27.5)	0.009
Congestive heart failure	16(5.9)	62(8.9)	0.123	49(8.1)	29(8.0)	0.946
Mental illness	18(6.6)	32(4.6)	0.197	36(6.0)	14(3.9)	0.153
Chronic kidney disease	45(16.6)	112(16.1)	0.846	100(16.6)	57(15.7)	0.727
Cerebrovascular accident	30(11.1)	68(9.8)	0.547	73(12.1)	25(6.9)	0.009
Cancer	36(13.3)	86(12.4)	0.696	82(13.6)	40(11.0)	0.246
COPD	14(5.2)	27(3.9)	0.372	29(4.8)	12(3.3)	0.264
Liver cirrhosis	10(3.7)	11(1.6)	0.043	17(2.8)	4(1.1)	0.077
Seizure	4(1.5)	16(2.3)	0.419	14(2.3)	6(1.7)	0.482
Witnessed collapse	148(54.6)	467(67.1)	<0.001	353(58.4)	262(72.2)	<0.001
Bystander CPR	97(35.8)	341(49.0)	<0.001	245(40.6)	193(53.2)	<0.001
Non-shockable rhythm	247(91.1)	623(89.5)	0.448	559(92.5)	311(85.7)	0.001
Non-cardiac etiology	163(60.1)	318(45.7)	<0.001	351(58.1)	130(35.8)	<0.001
Response time(min)	5 [3,7]	4 [0, 6]	0.005	5 [2,7]	4 [0, 6]	<0.001
Low-flow time(min)	32 [23, 45]	24 [14, 35]	<0.001	30 [20, 42]	21 [10,31]	<0.001
ROSC cardiac rhythm			0.884			0.775
ST-elevation	24(8.9)	56(8.0)		50(8.3)	30(8.3)	
ST-depression	7(2.6)	16(2.3)		16(2.6)	7(1.9)	
others	240(88.6)	624(89.7)		538(89.1)	326(89.8)	
TTM	21(7.7)	260(37.4)	<0.001	157(26.0)	124(34.2)	0.007
ECMO	53(19.6)	67(9.6)	<0.001	88(14.6)	32(8.8)	0.009
CRRT	84(31.0)	150(21.6)	0.002	176(29.1)	58(16.0)	<0.001
Inotropes use	252(93.0)	565(81.2)	<0.001	543(89.9)	274(75.5)	<0.001
Norepinephrine	180(66.4)	443(63.6)	0.419	409(67.7)	214(59.0)	0.006
Epinephrine	172(63.5)	191(27.4)	<0.001	286(47.4)	77(21.2)	<0.001
Vasopressin	134(49.4)	168(24.1)	<0.001	246(40.7)	56(15.4)	<0.001
Dopamine	163(60.1)	320(46.0)	<0.001	340(56.3)	143(39.4)	<0.001
Dobutamine	2(0.7)	24(3.4)	0.019	12(2.0)	14(3.9)	0.082
Inotropes ≧50% of ICU stays				445(73.7)	47(12.9)	<0.001

Dichotomous and categorical variables were reported as number (percentages), whereas continuous variables were reported as median [Q1, Q3];

COPD: chronic obstruction pulmonary disease; CPR: cardiopulmonary resuscitation; CRRT: continuous renal replacement therapy; ECMO: extracorporeal membrane oxygenation; ICU: intensive care unit; OHCA: out-of-hospital cardiac arrest; ROSC: return of spontaneous circulation; TTM: targeted temperature management.

events, and ICU treatment between the mortality and survival groups on days 3 and 30. Dichotomous and categorical variables were presented as counts and percentages, respectively. The missing values were imputed with the median values within the corresponding hospital. The chi-square test was used to examine statistical significance between the categorical variables. Survival analyses were performed with Kaplan–Meier (KM) plots on days 3 and 30 by using R (version 4.2.3) and associated packages (ggplot2, survivner, and survival). In the subgroup analysis, we selected nine key factors associated with OHCA outcomes based on the univariate analyses and assumed clinical relevance (Supplementary figure 1): age,[16] bystander CPR,[17] initial shockable rhythms,[18] presumed cardiac etiology,[19] response time, low-flow time,[20] TTM, ECMO, and inotrope use. The response time and low-flow time subgroups were categorized by the median value of the population. The log-rank test was used for statistical comparison, and a two-sided $p < 0.05$ indicated statistical significance.

Before conducting the multivariable analysis, we selected variables from the univariate analyses with a p-value < 0.1 from the 3-day and 30-day mortality, respectively. In the Cox proportional hazard regression analysis, variables were added to the model separately in a stepwise manner. The risk of mortality was calculated and presented as the adjusted hazard ratio (aHR) with 95% confidence interval (CI). To test collinearity between covariates, variance inflation factor (VIF) was calculated. To address for potential confounding factors, we illustrated a directed acyclic graph (Supplementary Figure 1). The Cox regression analyses was performed by SPSS version 26 (International Business Machines Corporation, IBM).

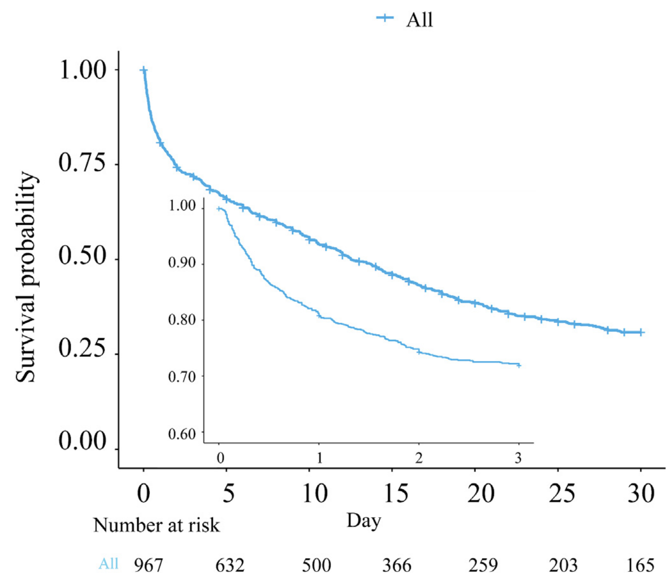

Fig. 2 – Kaplan-Meier plot of the overall OHCA survivors in 3 days and 30 days.

Results

Fig. 1 shows the patient selection flowchart. From 2016 to 2021, 1047 OHCA patients were admitted to the ICU. We excluded 25 non-adult OHCA cases, 46 OHCA incidents related to trauma, and 9 cases with censored data. Consequently, 967 patients were eligible for analysis. The survival rate was 71.8% (694 patients) 37.5% (363 patients) on days 3 and 30 post-admission, respectively.

Comparisons of baseline characteristics on days 3 and 30

Table 1 presents a comparison of baseline characteristics between the mortality and survival groups on days 3 and 30 following admission. The survival rate at the 30th day was associated with different age groups, but this association was not observed at the 3rd day. Regarding preexisting comorbidities, liver cirrhosis was significantly more prevalent among patients who died within 3 days (3.7% vs. 1.6%, p = 0.043). Conversely, coronary artery disease was less frequent in patients who died by day 30 (20.2% vs. 27.5%, p = 0.009), whereas cerebrovascular disease was more common in this group (12.1% vs. 6.9%, p = 0.009).

In terms of resuscitation events, OHCA patients who died by days 3 and 30 had lower rates of witnessed collapse (3-day: 54.6% vs. 67.1%, p < 0.001; 30-day: 58.4% vs. 72.2%, p < 0.001) and bystander CPR (3-day: 35.8% vs. 49.0%, p < 0.001; 30-day: 40.6% vs. 53.2%, p < 0.001). Additionally, those in the 30-day nonsurvivors more often presented with initial nonshockable rhythms (92.5% vs. 85.7%, p < 0.001). Both days 3- and 30-day nonsurvivors had higher proportion of noncardiac etiologies (3-day: 60.1% vs. 45.7%, p < 0.001; 30-day: 58.1% vs. 35.8%, p < 0.001), longer response time (3-day and 30-day: 5 mins vs. 4 mins, p < 0.001) and longer low-flow time (3-day: 32 mins vs. 24 mins, p < 0.001; 30-day: 30 mins vs. 21 mins, p < 0.001).

For postresuscitation care, the nonsurvivors had lower rates of undergoing TTM (3-day: 7.7% vs. 37.4%, p < 0.001; 30-day: 26.0% vs. 34.2%, p = 0.007), but higher rates of ECMO (3-day: 19.6% vs. 9.6%, p < 0.001; 30-day: 14.6% vs. 8.8%, p = 0.009), CRRT (3-day: 31.0% vs. 21.6%, p = 0.002; 30-day: 29.1% vs. 16.0%, p < 0.001), and inotrope use (3-day: 93.0% vs. 81.2%, p < 0.001; 30-day: 89.9% vs. 75.5%, p < 0.001). The most commonly used inotrope was norepinephrine, followed by epinephrine, vasopressin, and dopamine. Considering the duration of inotrope use during ICU stay, deceased OHCA patients had a higher rate of prolonged inotrope use (>50% duration of ICU stay) at 30 days (73.7% vs. 12.9%, p < 0.001).

Overall and subgroup survival analyses on days 3 and 30

Fig. 2 shows the overall 30-day survival probabilities over time. Death commonly occurs more among post-OHCA patients within the first 3 days, with a sharp decline during this initial period, which gradually decreases thereafter. The figure inset provides a more detailed view of the first 3 days post-admission.

Fig. 3 illustrates the unadjusted survival probabilities over the first 3 days post-admission, stratified by nine key factors. The observed survival probabilities (indicating lower mortality) were higher in patients who received bystander CPR, had a cardiac-related OHCA, underwent shorter response time (<5 mins), shorter low-flow time (<26 mins), received TTM, and were not subjected to ECMO or inotropes. No significant variations in survival probabilities were noted based on age or initial cardiac rhythm.

Fig. 4 shows the unadjusted survival probabilities stratified by the same nine key factors, but over the initial 30 days postadmission. The observed survival probabilities (suggesting lower mortality rates) were higher in younger patients (<65 years), who had bystander CPR, with an initial shockable rhythm, had cardiac-related OHCA, had shorter response time (<5 mins), shorter low-flow time (<26 mins), received TTM, and were free from ECMO or inotropes.

Cox proportional hazard regression on 3- and 30-day mortality

Fig. 5 displays the association between potential risk factors in 3-day and 30-day mortality following OHCA, with confounders adjusted in the Cox proportional hazard model. Fig. 5(a) shows that each

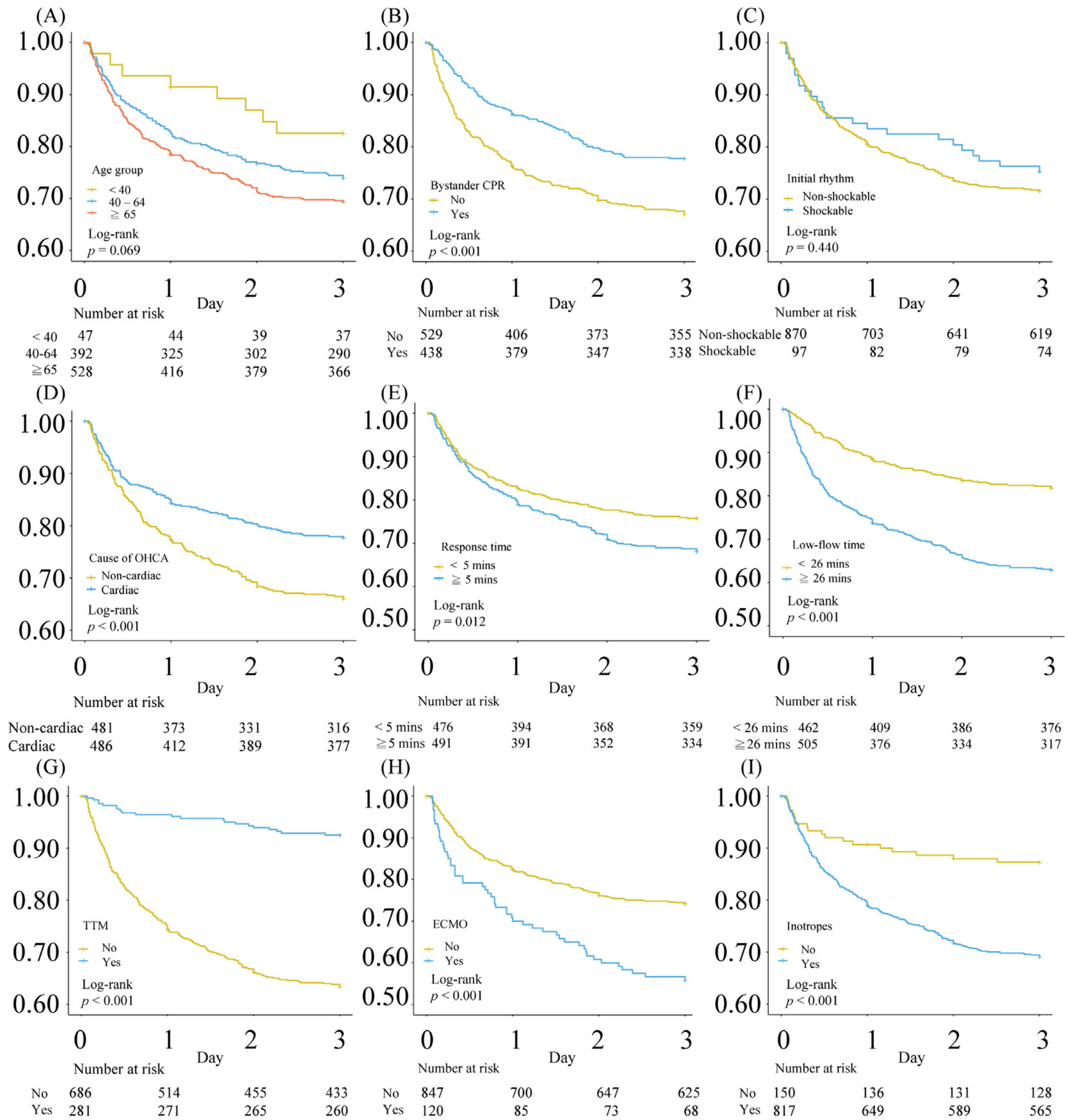

Fig. 3 – Unadjusted Kaplan-Meier survival curves for various subgroups of OHCA survivors over the first 3 days. (A) Age group. (B) Bystander CPR. (C) Initial rhythm. (D) Cause of OHCA. (E) Response time. (F) Low-flow time. (G) TTM. (H) ECMO. (I) Inotropes. CPR: cardiopulmonary resuscitation; ECMO: extracorporeal membrane oxygenation; OHCA: out-of-hospital cardiac arrest; TTM: targeted temperature management.

additional year of age increased the 3-day mortality risk by 2% (aHR, 1.02; 95% CI, 1.01–1.02, p = 0.001). Moreover, non-cardiac etiology was associated with a 1.8-fold increased risk of 3-day mortality (aHR, 1.77; 95% CI, 1.33–2.34, p = 0.001). Each additional minute in the low-flow time increased the 3-day mortality by 3% (aHR, 1.03; 95% CI, 1.02–1.03, p < 0.001). The use inotropes was correlated with 2.1-fold (aHR, 2.06; 95% CI, 1.28–3.31; p = 0.003) higher risks of 3-day mortality. Conversely, witnessed collapse (aHR, 0.67; 95% CI, 0.51–0.86, p = 0.002) and bystander CPR (aHR, 0.72; 95% CI, 0.55–0.94, p = 0.017) were associated with a 33% and 28% reduction in 3-day mortality risk, respectively. Receiving TTM was associated with an 83% reduction in mortality risk (aHR, 0.17; 95% CI, 0.11–0.27, p < 0.001).

Fig. 5(b) shows that male sex was an independent risk factor for 30-day mortality (aHR, 1.23; 95% CI, 1.03–1.47; p = 0.022). The 30-day mortality rate increased by 1% for each additional year (aHR, 1.01; 95% CI, 1.01–1.02; p < 0.001), 1% and 2% for each additional minute in the response time (aHR 1.01, 95% CI, 1.00–1.03, p = 0.01) and low-flow time (aHR 1.02, 95% CI, 1.01–1.02, p < 0.001). Non-cardiac arrest etiology were associated with 44% (aHR, 1.44; 95% CI, 1.20–1.72; p < 0.001) increased risk of 30-day mortality, respectively. Receiving bystander CPR was linked to a 24% decrease in 30-day mortality (aHR, 0.76; 95% CI, 0.64–0.89; p < 0.001). Patients receiving TTM and CRRT had lower risks of 30-day mortality (aHR, 0.57; 95% CI, 0.48–0.69; p < 0.001; aHR, 0.76; 95% CI 0.63–0.91; p = 0.004, respectively). Patients administered inotropes for > 50% of their ICU stay had a > 6-fold increase in 30-day mortality risk (aHR, 6.43; 95% CI, 5.25–7.84; p < 0.001).

All VIFs for each covariate were less than 10, as shown in Supplementary Table 4, indicating no significant collinearity between covariates.

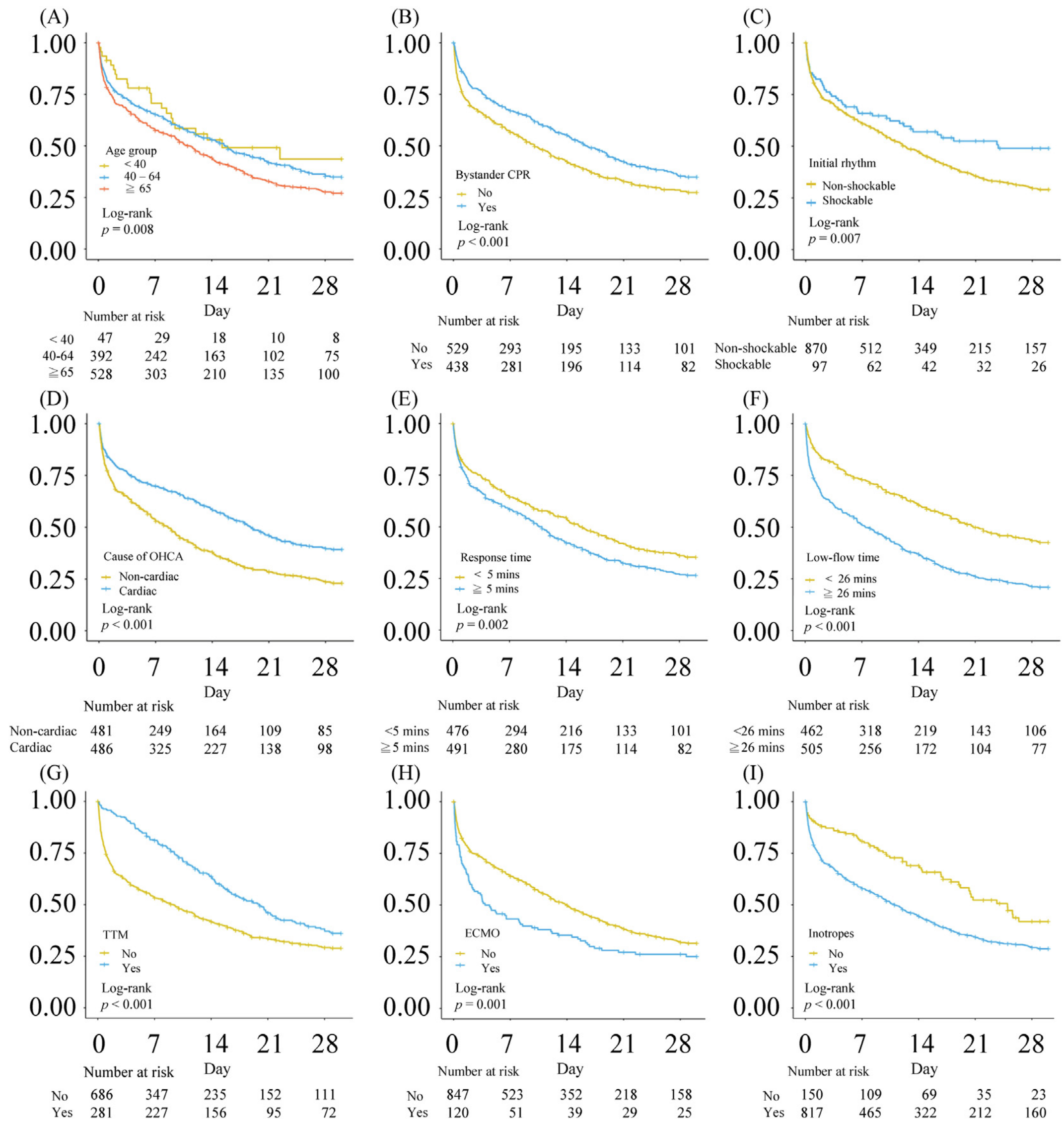

Fig. 4 – Unadjusted Kaplan-Meier survival curves for various subgroups of OHCA survivors in 30 days. (A) Age group. (B) Bystander CPR. (C) Initial rhythm. (D) Cause of OHCA. (E) Response time. (F) Low-flow time. (G) TTM. (H) ECMO. (I) Inotropes. *post-hoc analysis: age < 40 & age 40–64: p = 0.404; age 40–64 & age $\geq$ 65: p = 0.007; age < 40 & age $\geq$ 65: p = 0.054. CPR: cardiopulmonary resuscitation; ECMO: extracorporeal membrane oxygenation; OHCA: out-of-hospital cardiac arrest; TTM: targeted temperature management.

Discussion

This study analyzed short- and mid-term survival trends during ICU stay and identified key mortality factors in the Asian population. Supporting our hypothesis, the 30-day survival curve depicted an irregular decline over time, with the steepest drop occurring within the first 3 days post-admission. For 3-day mortality, increased age, noncardiac etiology, prolonged low-flow time, and inotrope use correlated with higher mortality risks. By contrast, witnessed collapse, bystander CPR, and TTM reduced mortality risk. For 30-day mortality, increased age, male sex, noncardiac etiology, prolonged response time, low-flow time, and prolonged inotrope use were linked to higher mortality risks. However, patients receiving bystander CPR, TTM, and CRRT showed lower mortality risks. These insights can guide intensivists in developing treatment strategies and discussing prognosis with OHCA survivors within the critical 30-day period.

Witnessed collapse and bystander CPR were frequently identified as predictors of survival in OHCA across various studies. The RACA (ROSC After Cardiac Arrest) score and UB-ROSC (Utstein-based ROSC) score were both considered predictors of short-term survival,[21,22] which was consistent with our findings in the 3-day mortality model. However, bystander CPR, unwitnessed collapse was the sole predictor in our model predicting 30-day mortality. The sequence of witnessed collapse followed by bystander CPR was common, but not always reciprocal. A patient may collapse with immediate bystander CPR or receive bystander CPR without a witnessed collapse. The definitive role of bystander CPR as a prognos-

Variables	aHR (95% CI)	p
(A) 3 day mortality		
Age	1.02 (1.01-1.02)	0.001
Witnessed collapse	0.67 (0.51-0.86)	0.002
Bystander CPR	0.72 (0.55-0.94)	0.017
Non-cardiac etiology	1.77 (1.33-2.34)	<0.001
Low-flow time	1.03 (1.02-1.03)	<0.001
Targeted temperature management	0.17 (0.11-0.27)	<0.001
Extracorporeal membrane oxygenation	1.43 (0.95-2.16)	0.089
Inotropes	2.06 (1.28-3.31)	0.003
(B) 30 day mortality		
Male	1.23 (1.03-1.47)	0.022
Age	1.01 (1.01-1.02)	<0.001
Coronary artery disease	0.83 (0.67-1.02)	0.074
Bystander CPR	0.76 (0.64-0.89)	0.001
Non-cardiac etiology	1.44 (1.20-1.72)	<0.001
Response time	1.01 (1.00-1.03)	0.010
Low-flow time	1.02 (1.01-1.02)	<0.001
Targeted temperature management	0.57 (0.48-0.69)	<0.001
Continuous renal replacement therapy	0.76 (0.63-0.91)	0.004
Inotropes ≥50% of ICU days	6.43 (5.25-7.84)	<0.001

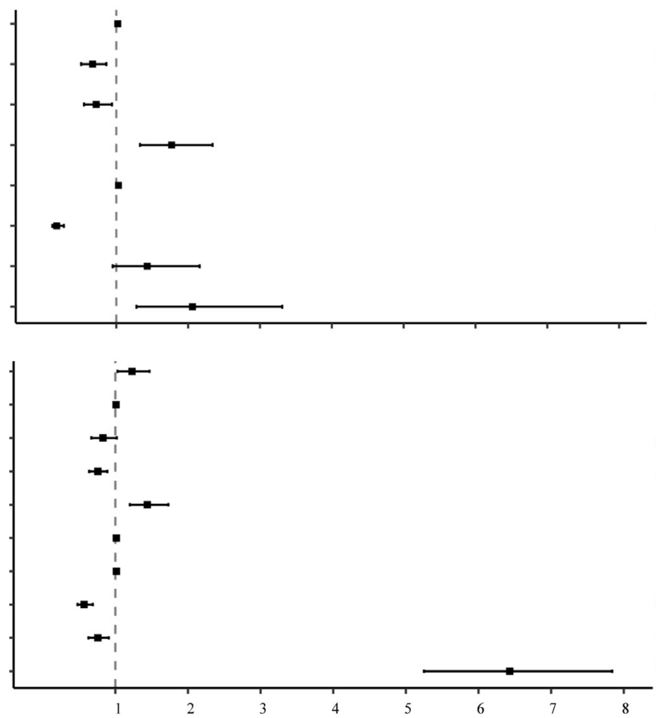

Fig. 5 – The cox proportional regression models. (A) 3-day mortality. (B) 30-day mortality. aHR: adjusted hazard ratio; CPR: cardiopulmonary resuscitation; ICU: intensive care unit.

tic factor irrespective of witnessed collapse remains unclear and should be investigated further.

Although initial cardiac rhythm has been established as a significant prognostic factor in many studies,[23–25] our results indicated no association with either 3- or 30-day mortality post-OHCA. This may be due to the potential collinearity between initial rhythm and OHCA etiology because shockable rhythms are often linked to cardiac causes, such as coronary artery disease.[26] Furthermore, CPR duration is a strong risk factor for mortality at both 3- and 30-day intervals, consistent with the findings by Jaeger et al., where increased CPR duration, particularly in cases of nonshockable rhythm, significantly lowered survival rates.[10]

TTM is a postcardiac arrest care strategies potentially beneficial for OHCA survivors. In our study, more OHCA survivors who did not receive TTM died within 3 and 30 days, which was not consistent with the findings by Tay et al. who found no association of TTM with 30-day survival.[14] The effectiveness of TTM in reducing mortality across all OHCA survivors remains debatable and may vary based on TTM protocols. Regarding ECMO, we found that OHCA survivors who underwent ECMO following ROSC had a higher 3-day mortality rate, however it was not significant after adjusted. This was consistent with the findings by Mørk et al. who reported that OHCA patients treated with ECMO had higher mortality, but their survival trend eventually matched those who did not receive ECMO. They noted that patients who underwent ECMO had longer CPR durations in the emergency room than those who did not undergo ECMO.[27] A similar confounding effect was observed in the ARREST trial, which showed a favorable outcome for extracorporeal CPR, with a time from hospital arrival to ECMO initiation of 7 min. In contrast, the INCEPTION trial, which had inconclusive results, reported a longer duration of 16 min.[28,29] The ideal timing for ECMO initiation following EMS activation remains uncertain.

CRRT is commonly used to manage acute kidney injury or refractory lactic acidosis in the post-ROSC phase of OHCA patients. However, its impact on OHCA outcomes is debatable. A retrospective study from Denmark indicated a link between CRRT usage and increased 30-day mortality among all OHCA survivors.[30] Conversely, Ghoshal et al. observed no significant relationship between CRRT and survival outcomes.[31] In our study, CRRT was identified as a protective factor against 30-day mortality, offering a contrasting perspective to the existing literature and indicating the potential benefits of CRRT in improving mid-term outcomes for OHCA patients.

This study has several limitations. Firstly, the retrospective design and the use of stepwise regression may obscure other unidentified confounding associations, despite the use of a multivariable model. Second, the study's multicenter approach involved only hospitals within the NTUH healthcare system in Taiwan. This raises questions regarding the applicability of our findings to populations from different countries or ethnic backgrounds, as the generalizability of the study beyond this specific healthcare setting was not evaluated. Third, some variables that could be crucial in understanding patient outcomes were not incorporated in our study, including intra-arrest medication and laboratory data during post cardiac arrest care. Finally, a selection bias could not be excluded. OHCA survivors who received TTM were in better condition compared to those who did not receive TTM. This positive effect of TTM on survival may originate from a selection bias, as the initiation of TTM partly depended on the patient's condition after ROSC. To address these limitations and gain a more comprehensive understanding of OHCA outcomes, a well-designed prospective study including all relevant factors is recommended for future research.

Conclusion

Most OHCA survivors died within the first 3 days post-admission to the ICU. The overall probability of survival declined unevenly over time. Additionally, the risk factors contributing to mortality at 3- and 30-day intervals varied. To strengthen our findings, further validation of these key factors in a prospective cohort study across various hospitals is essential.

Funding

This work was funded by the National Science and Technology Council (grant number: 112-2314-B-002-324).

CRediT authorship contribution statement

Cheng-Yi Fan: Writing – original draft, Formal analysis. **Edward Pei-Chuan Huang:** Validation, Methodology, Data curation. **Yi-Chien Kuo:** Visualization, Formal analysis. **Yun-Chang Chen:** Data curation. **Wen Chu Chiang:** Validation, Methodology, Investigation, Data curation. **Chien-Hua Huang:** Writing – review & editing, Supervision. **Chih-Wei Sung:** Writing – review & editing, Conceptualization. **Wei-Tien Chang:** Writing – review & editing, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resplu.2024.100747.

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