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Cardiology

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Out-of-Hospital Cardiac Arrest Survivors Without ST-Segment Elevation had Lower Coronary Artery Stenosis in an Asian Population

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Abstract

Objectives: Guidelines recommend emergent coronary angiography (CAG) for out-of-hospital cardiac arrest (OHCA) patients with ST-segment elevation (STE) and selective angiography for those without STE. However, real-world data reporting coronary artery status in OHCA patients without STE are scarce, especially in an Asian population. This study evaluated the coronary artery status and associated outcomes in Asian OHCA patients without STE, comparing the results with those of patients with STE.

Methods: This retrospective study enrolled 345 OHCA survivors with presumed cardiogenic cause who underwent CAG. Based on electrocardiographic evidence of STE following return of spontaneous circulation, the patients were segmented into an STE group (n = 150) and a non-STE group (n = 195). The CAG findings and percutaneous intervention details for the non-STE group were compared with those of the STE group. Chi-squared tests were applied for categorical variables, whereas Mann-Whitney U tests were applied for continuous variables.

Results: Compared with the STE group, the non-STE group had a lower but still high prevalence of coronary artery stenosis (69.7% vs 91.3%, P < .001) and multivessel involvement (50.8% vs 68.0%, P = .001), especially in the left anterior descending coronary artery (56.9% vs 79.3%, P < .001). No differences in survival-to-discharge and neurological outcomes were observed.

Conclusion: In OHCA survivors with presumed acute coronary syndrome, there was a high prevalence of coronary artery stenosis and multivessel involvement in patients without STE. Moreover, patients without STE had

abstract continues

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Abstract (continued)

comparable survival-to-discharge and neurological outcomes with patients with STE.

Keywords: *coronary artery stenosis, out-of-hospital cardiac arrest, acute coronary syndrome, non-ST-segment elevation, outcome*

1 INTRODUCTION

1.1 Background

Out-of-hospital cardiac arrest (OHCA) is a major cause of mortality worldwide. Although OHCA presentations are heterogeneous and the etiology of the condition varies, acute coronary syndrome (ACS) is the principal cause of nontraumatic cardiac arrest.[1] Current guidelines recommend emergent coronary angiography (CAG) for all patients with ST-segment elevation (STE) after cardiac arrest and for patients without STE after cardiac arrest but with hemodynamic or electrical instabilities.[2–4] Although CAG provides benefits for the diagnosis and intervention for occluded culprit vessels, it may also cause intervention-related complications or delay postarrest care. Therefore, the optimum balance between the risks and benefits of emergent CAG for postarrest patients without STE remains controversial and may differ between populations.

Several observational studies have examined the relationships between CAG results and the non-STE status in OHCA survivors. In cohort studies from the United States and Europe, patients with OHCA without STE had a prevalence of occlusive coronary artery disease (CAD) of 34% to 62% after angiography.[5–7] Both the Coronary Angiography after Cardiac Arrest (COACT) and TOMAHAWK trials failed to reveal differences in survival outcomes between patients treated with emergent CAG and those treated with delayed CAG at 1-year follow-up.[8,9] However, the COACT study only revealed an incidence of culprit coronary lesions of 15%, and the TOMAHAWK study revealed an incidence of culprit lesions of 39%. The low incidence of culprit lesions in these 2 trials may be attributable to the exclusion of patients with unstable hemodynamic status, which is common in the early stage of cardiac arrest [10–12] and is not a predictor of acute coronary occlusion.[13] Moreover, only patients with initial shockable rhythm were recruited into the COACT study, but there was no robust evidence of the direct relationship between initial arrest rhythm and the etiology of cardiac arrest, especially a cardiogenic cause.[14,15]

1.2 Importance

The aforementioned studies were all conducted in the United States or Europe and included a predominantly White population. The coronary artery status of OHCA survivors without STE in the Asian population remains poorly understood. The prevalence of CAD varies across ethnicities.[16] In addition, Asian patients have a lower prevalence of non-ST-segment elevation myocardial infarction (NSTEMI) than White patients.[17]

1.3 Goals of This Investigation

Thus, the present study evaluated the coronary artery status and outcomes of OHCA patients without STE in an Asian population and compared the results with those of patients with STE.

2 METHODS

2.1 Design and Setting

This single-centered, retrospective, observational study was conducted in the emergency department of National Taiwan University Hospital (NTUH), a tertiary care medical center in Taipei, Taiwan, with 24/7 availability of emergent CAG. The following information was collected from medical records and a predesigned questionnaire including baseline characteristics, preexisting comorbidities, cardiac arrest events, and postarrest care. The questionnaire was designed by an expert committee composed of emergency and cardiology physicians with the variables selected according to the Utstein out-of-hospital cardiac arrest registry template. The designed questionnaire was filled out by experienced study nurses in the field of cardiac arrest with 60 hours of continuing education per year. The filled questionnaire would be confirmed afterwards by an expert physician in the study group for quality and validity checks. The study was approved by the Institutional Review Board of NTUH (201902068RIND), and the informed consent was waived.

2.2 Selection of Subjects

A total of 1194 adult OHCA patients without trauma with successful resuscitation were enrolled into the study between March 2011 and July 2021. The exclusion criteria were as follows: having suspected noncardiac etiology of cardiac arrest (n = 600) and not receiving CAG (n = 249). A total of 345 patients with presumed cardiogenic arrest who received CAG were enrolled into the study, and they were divided into an STE group of 150 patients with STE on electrocardiogram (ECG) following return of spontaneous circulation (ROSC) and a non-STE group of 195 patients without STE on post-ROSC ECG (Fig 1).

The Bottom Line

Current guidelines suggest selective coronary angiography (CAG) for out-of-hospital cardiac arrest (OHCA) patients without ST-segment elevation (STE). Real-world data reporting coronary artery status in OHCA patients without STE are scarce, especially in an Asian population. This retrospective cohort study showed a high prevalence of coronary artery stenosis and multivessel involvement in OHCA patients with non-STE acute coronary syndrome (ACS) and highlighted the importance of CAG in postarrest care for OHCA patients with non-STE ACS.

2.3 Interventions

Initial shockable rhythm was defined as pulseless ventricular tachycardia or ventricular fibrillation. Repeated cardiopulmonary resuscitation (CPR) was defined as CPR applied during additional episodes of cardiac arrest developing within 1 hour after ROSC. Recurrent fatal rhythm was defined as the recurrence of pulseless ventricular tachycardia and ventricular fibrillation within 1 hour after gaining ROSC. Presumed cardiogenic arrest was defined when ischemic heart disease, structural heart disease, heart failure, or arrhythmia without electrolyte imbalance was considered the cause of arrest.[18] At NTUH, a targeted-temperature management (TTM) protocol included cooling the patient's body temperature to the targeted temperature (33 °C) within 6 hours after ROSC, maintaining the targeted temperature for 24 hours, gradually rewarming the patient by increasing the temperature by 0.25 °C per hour up to 36 °C, and maintaining the body temperature at <36.5 °C for 24 hours after completion of rewarming. The application of extracorporeal membrane oxygenation (ECMO), intra-aortic balloon pumps (IABPs), and inotropes were defined as the use of these therapies within 7 days of ROSC. The use of dual antiplatelet therapy, beta-blockers, angiotensin-converting enzyme inhibitors (ACEis)/angiotensin receptor blockers (ARBs), and statins was recorded throughout hospitalization.[19] As guideline recommendations for the role of CAG in OHCA patients without STE vary with time,[4,20–22] emergent CAG was defined as receiving CAG within 24 hours after the ROSC.[18] The on-duty cardiologist was consulted for decisions regarding the application of emergent CAG based on guideline recommendations. After gaining ROSC, patients were transferred to the angiography room if emergent CAG was indicated or to the intensive care unit for further postarrest care. Coronary artery stenosis was considered significant when emergent CAG revealed stenosis >70%. The culprit lesion was defined as the coronary artery stenosis responsible for the cardiac arrest, as revealed by CAG findings. Culprit only revascularization was defined as the intervention for the culprit lesion alone. Complete revascularization was defined as the intervention for all coronary vessels with stenosis indicated in CAG. Glasgow-Pittsburgh Cerebral Performance Category (CPC) 1 and 2 indicated favorable neurological outcomes.

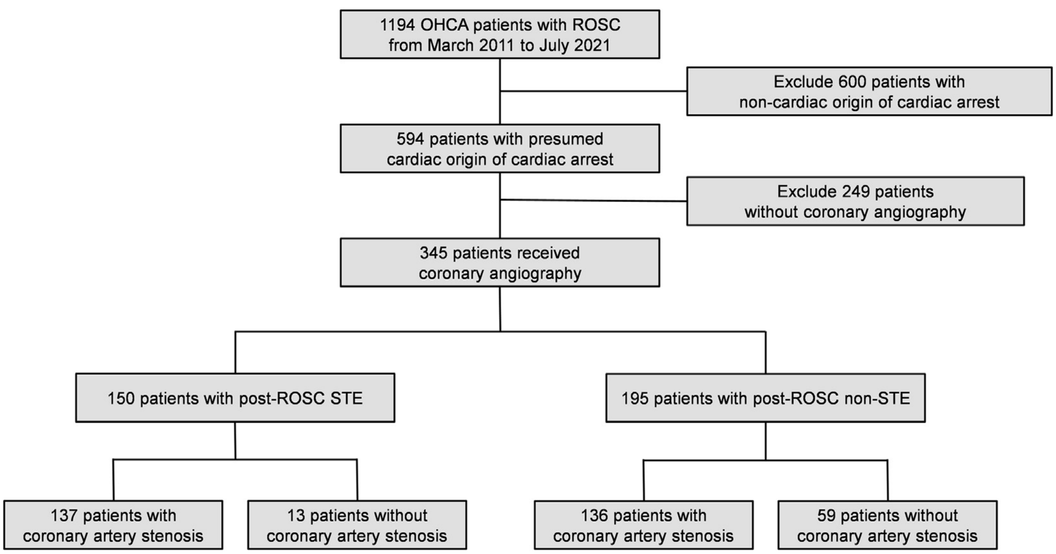

FIGURE 1. Flowchart of nontraumatic OHCA patient enrollment. OHCA, out-of-hospital cardiac arrest; ROSC, return of spontaneous circulation; STE, ST-segment elevation.

2.4 Outcomes

The primary outcome of this study was coronary artery stenosis in the non-STE group compared with the STE group. The secondary outcome was the difference in survival-to-discharge and favorable neurological outcomes at discharge between the 2 groups.

2.5 Data Analysis

Categorical variables were presented as numbers (percentages), and the Chi-squared tests or Fisher's exact tests were applied to evaluate the differences between the groups. Continuous variables were presented as median (IQR), and Mann-Whitney U tests were used to evaluate the differences between the groups. Multiple logistic regression was performed to analyze the association between selected variables in the univariate analysis (with a P cutoff value of <.01) and coronary artery stenosis. Kaplan-Meier survival analysis was applied to plot the survival curves of the groups. The comparison between the curves was performed using the log-rank test. All statistical analyses were performed using Statistical Package for Social Sciences Statistics version 16 (SPSS; International Business Machines). Statistical significance was set at $P < .05$.

3 RESULTS

The median age of the enrolled patients was 59.62 (IQR, 50.39-67.65) years. A total of 291 patients were men (84.3%). Most of them (n = 342, 99.1%) had favorable prearrest neurological function, with CPC scores of 1 or 2. No significant difference in sex, age, smoking history, prearrest CPC scores, and prearrest comorbidities was observed between the groups. Regarding resuscitation events, a high percentage of patients in both groups had a witnessed collapse (92.3% vs 90.0%), received bystander CPR (67.2% vs 68.7%), and initial shockable rhythm (70.8% vs 68.0%). No difference in prehospital ROSC, CPR duration, or recurrent fatal rhythm was observed between the groups. Compared with the STE group, a lower percentage of patients in the non-STE group had repeated CPR (14.4% vs 25.3%, P = .013) and IABP use (20.5% vs 34.0%, P = .007). No significant difference in ECMO use was observed between the groups. The non-STE group had a higher TTM rate than the STE group (53.3% vs 36.7%, P = .002). A lower percentage of patients in the non-STE group used aspirin (67.2% vs 84.7%, $P < .001$), *P2Y12* inhibitors (61.0% vs 78.7%, $P < .001$), and statins (43.1% vs 61.3%, P = .001) compared with the STE group. The use of inotropes, beta-blockers, ACEis, and ARBs did not significantly differ between the groups (Table 1).

The non-STE group presented a lower prevalence of emergent CAG than the STE group (76.9% vs 96.0%, $P < .001$). Most patients in both groups received CAG through the femoral artery (87.1% vs 92.0%). A high percentage of patients had coronary artery stenosis in the non-STE group, although this percentage was significantly lower than that of the STE group (69.7% vs 91.3%, $P < .001$), particularly in the left main (LM) coronary artery, left anterior descending (LAD) coronary artery, and right coronary artery (RCA). Moreover, the non-STE group had a lower prevalence of multiple-vessel disease (50.8% vs 68.0%, P = .001). In terms of revascularization strategy, the non-STE group had a lower percentage of culprit only revascularization (28.7% vs 48.7%, $P < .001$) and thrombus aspiration (10.3% vs 37.3%, $P < .001$) compared with the STE group. However, the STE and non-STE groups did not differ significantly in the requirement of coronary artery bypass graft surgery (CABG) (Table 2).

Focusing on the subgroup of stenotic patients, no difference was observed in the location of stenosis or the involved vessel numbers between the STE and the non-STE groups. Considering revascularization strategy, the non-STE group presented a lower percentage of thrombus aspiration than the STE group (14.7% vs 40.9%, $P < .001$). However, there was no significant difference in culprit only revascularization, multivessel revascularization, or CABG between the STE and non-STE groups (Table S1).

No significant differences in survival-to-discharge (67.2% vs 60.0%, P = .176) and favorable neurological outcomes (54.9% vs 47.3%, P = .192) were observed between the non-STE and the STE groups (Table 1). The non-STE group had similar survival curves to the STE group, both for the overall population and for the subgroup of patients with stenotic lesions (Fig 2).

The demographic features, resuscitation events, and postarrest care between patients with coronary artery stenosis (n = 273) and without stenosis (n = 72) were listed in Table S2. The results of multiple logistic regression revealed that male sex, advanced age, initial shockable rhythm, diabetes mellitus, history of CAD, STE on post-ROSC ECG, and ECMO use were associated with an increased risk of coronary artery stenosis (Table 3). For patients without STE, male sex, advanced age, initial shockable rhythm, and previous CAD were associated with a higher incidence of coronary artery stenosis (Table S3).

4 LIMITATIONS

The present study has several limitations. First, as a retrospective observational study, selection bias was inevitable and confounding factors may be unidentified. The allocation of patients to groups and the quality of postarrest care may not have been balanced. Second, a 10-year patient enrollment span may influence CAG results and clinical outcomes because CAG and postarrest care techniques have improved markedly over the past 2 decades. Third, the on-duty cardiologist made the decision to apply emergent CAG for patients without STE according to the recommendation of guidelines, which also varied over time. As both the American Heart Association (AHA) and European Resuscitation Council (ERC) guidelines for resuscitation in 2010[20,21] emphasized the importance of early CAG and percutaneous intervention (PCI) despite the ECG pattern following ROSC, the role of early CAG remained controversial for postcardiac arrest patients without

TABLE 1. Baseline characteristics, CPR events, postarrest care, and outcomes between groups.

	Total patients (*n* = 345)	Non-STE (*n* = 195)	STE (*n* = 150)	*P* value
Age (y)	59.62 (50.39-67.65)	58.81 (48.12-67.49)	60.88 (51.58-68.00)	.072
Sex (male)	291 (84.3%)	163 (83.6%)	128 (85.3%)	.765
Smoking (*n* = 268)[a]	98 (36.6%)	54 (35.5%)	44 (37.9%)	.703
Prearrest CPC = 1-2	342 (99.1%)	193 (99.0%)	149 (99.3%)	1.000
Precomorbidities				
Hypertension	183 (53.0%)	103 (52.8%)	80 (53.3%)	1.000
Diabetes mellitus	99 (28.7%)	50 (25.6%)	49 (32.7%)	.187
Dyslipidemia	86 (24.9%)	47 (24.1%)	39 (26.0%)	.708
Previous CAD	85 (24.6%)	48 (24.6%)	37 (24.7%)	1.000
Previous stent	60 (17.4%)	36 (18.5%)	24 (16.0%)	.570
Previous CABG	13 (3.8%)	7 (3.6%)	6 (4.0%)	1.000
CHF	40 (11.6%)	25 (12.8%)	15 (10.0%)	.498
VHD	8 (2.3%)	5 (2.6%)	3 (2.0%)	1.000
Arrhythmia	28 (8.1%)	20 (10.3%)	8 (5.3%)	.113
COPD	6 (1.7%)	3 (1.5%)	3 (2.0%)	1.000
Renal disease	33 (9.6%)	17 (8.7%)	16 (10.7%)	.582
ESRD	21 (6.1%)	13 (6.7%)	8 (5.3%)	.656
CVA	15 (4.3%)	5 (2.6%)	10 (6.7%)	.107
Malignancy	19 (5.5%)	12 (6.2%)	7 (4.7%)	.638
Resuscitation events				
Witnessed collapse	315 (91.3%)	180 (92.3%)	135 (90.0%)	.450
Bystander CPR	234 (67.8%)	131 (67.2%)	103 (68.7%)	.817
Initial shockable rhythm	240 (69.6%)	138 (70.8%)	102 (68.0%)	.637
Prehospital ROSC	107 (31.0%)	66 (33.8%)	41 (27.3%)	.199
CPR duration (min)	23.00 (12.00-41.00)	21.00 (10.00-42.00)	25.00 (13.00-40.25)	.222
Repeated CPR	66 (19.1%)	28 (14.4%)	38 (25.3%)	.013
Recurrent fatal rhythm	32 (9.3%)	16 (8.2%)	16 (10.7%)	.459
Postarrest care				
ECMO	149 (43.2%)	81 (41.5%)	68 (45.3%)	.512
IABP	91 (26.4%)	40 (20.5%)	51 (34.0%)	.007
TTM	159 (46.1%)	104 (53.3%)	55 (36.7%)	.002
Inotropes	272 (78.8%)	147 (75.4%)	125 (83.3%)	.084
Aspirin	258 (74.8%)	131 (67.2%)	127 (84.7%)	<.001
P2Y12 inhibitors	237 (68.7%)	119 (61.0%)	118 (78.7%)	<.001
Beta-blockers	206 (59.7%)	116 (59.5%)	90 (60.0%)	1.000
ACEi/ARB	161 (46.7%)	84 (43.1%)	77 (51.3%)	.130
Statin	176 (51.0%)	84 (43.1%)	92 (61.3%)	.001
Outcomes				
Survival to discharge	221 (64.1%)	131 (67.2%)	90 (60.0%)	.176
Favorable outcome	178 (51.6%)	107 (54.9%)	71 (47.3%)	.192

ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blockers; CABG, coronary artery bypass graft surgery; CAD, coronary artery disease; CHF, chronic heart failure; COPD, chronic obstructive pulmonary disease; CPC, cerebral performance category; CPR, cardiopulmonary resuscitation; CVA, cerebral vascular accident; ECMO, extracorporeal membrane oxygenation; ESRD, end-stage renal disease; IABP, intra-aortic balloon pump; ROSC, return of spontaneous circulation; STE, ST-segment elevation; TTM, targeted-temperature management; VHD, valvular heart disease.

[a] 77 smoking data were missing in medical records.

TABLE 2. CAG findings between groups.

	Total patients (*n* = 345)	Non-STE (*n* = 195)	STE (*n* = 150)	*P* value
Emergent CAG (within 24 h)	294 (85.2%)	150 (76.9%)	144 (96.0%)	<.001
Catheterization access (*n* = 323)[a]				.205
Radial artery	35 (10.8%)	24 (12.9%)	11 (8.0%)	-
Femoral artery	288 (89.2%)	162 (87.1%)	126 (92.0%)	-
CA stenosis	273 (79.1%)	136 (69.7%)	137 (91.3%)	<.001
LM	34 (9.9%)	12 (6.2%)	22 (14.7%)	.010
LAD	230 (66.7%)	111 (56.9%)	119 (79.3%)	<.001
LCX	175 (50.7%)	92 (47.2%)	83 (55.3%)	.158
RCA	177 (51.3%)	86 (44.1%)	91 (60.7%)	.002
Involved vessel number				
Single-vessel	72 (20.9%)	37 (19.0%)	35 (23.3%)	.351
Multiple-vessel	201 (58.3%)	99 (50.8%)	102 (68.0%)	.001
Revascularization[b]	183 (53.0%)	84 (43.1%)	99 (66.0%)	<.001
Culprit only revascularization	129 (37.4%)	56 (28.7%)	73 (48.7%)	<.001
Multivessel revascularization	52 (15.1%)	27 (13.8%)	25 (16.7%)	.544
Thrombus aspiration	76 (22.0%)	20 (10.3%)	56 (37.3%)	<.001
CABG	53 (15.4%)	28 (14.4%)	25 (16.7%)	.652

CA, coronary artery; CABG, coronary artery bypass graft surgery; CAG, coronary angiography; LAD, left anterior descending coronary artery; LCX, left circumflex coronary artery; LM, left main coronary artery; RCA, right coronary artery; STE, ST-segment elevation.

[a] Twenty-two catheterization access data could not be found in medical records.

[b] Two patients in the nonstenotic group received revascularization.

STE in the following decade. The 2020 AHA guideline[22] and 2021 ERC guideline[4] eventually reached a consensus to consider emergent CAG in selective (hemodynamic or electrical unstable) postcardiac arrest patients without STE. Fourth, patients without STE who did not receive CAG were not fully investigated. The stenosis rate in this group remained unknown and the rate of emergent CAG would be much lower in the non-STE group if patients not receiving CAG were included. This may influence the results of the non-STE group and bring about potential selection bias. Finally, because this

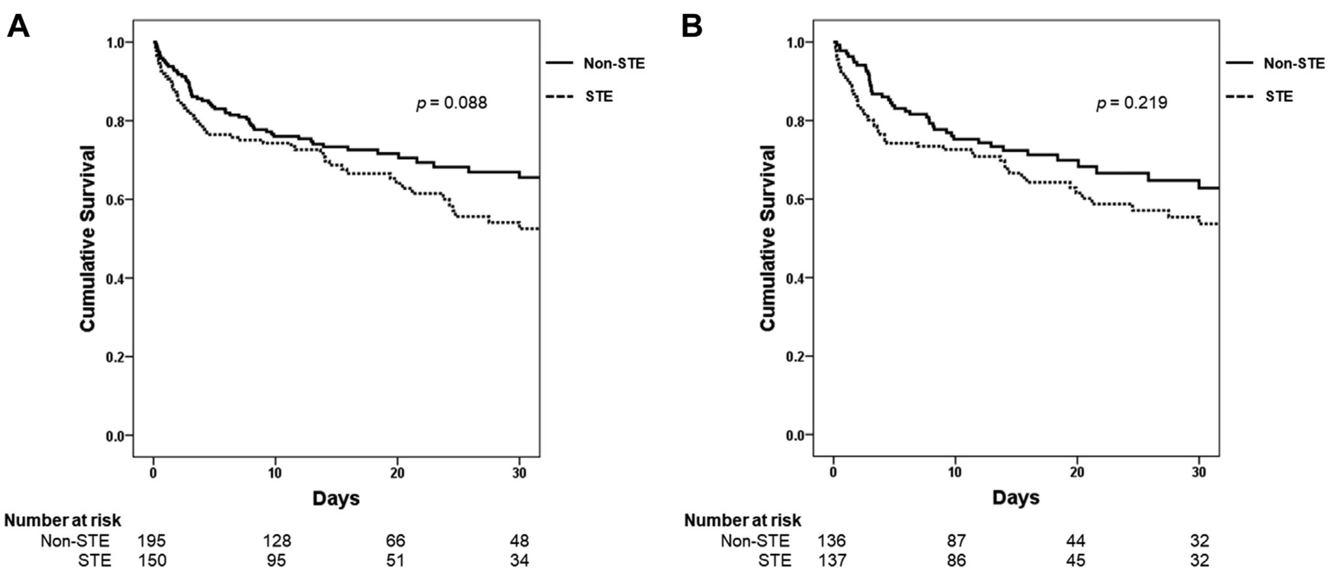

FIGURE 2. Survival curves for patients with and without STE. A, All patients. B, Patients with coronary artery stenosis. STE, ST-segment elevation.

TABLE 3. Factors related to coronary artery stenosis.

	Odds ratio	95% confidence interval	*P* value
Male sex	4.351	2.068-9.156	<.001
Age > 65 y	2.258	1.095-4.656	.027
Initial shockable rhythm	2.614	1.330-5.136	.005
HTN	1.255	0.658-2.394	.491
DM	2.908	1.209-6.994	.017
Previous CAD	3.008	1.216-7.443	.017
Post-ROSC STE	5.706	2.780-11.713	<.001
ECMO	2.377	1.232-4.588	.010

CAD, coronary artery disease; DM, diabetes mellitus; ECMO, extracorporeal membrane oxygenation; HTN, hypertension; ROSC, return of spontaneous circulation; STE, ST-segment elevation.

study recruited patients from a single center, the results may not be generalizable to other areas owing to differences in ethnicity, lifestyle, or health care systems.

5 DISCUSSION

This single-center, retrospective, observational study revealed a high prevalence of coronary artery stenosis and multivessel involvement in non-STE OHCA survivors with presumed ACS. Additionally, post-ROSC patients without STE had comparable survival-to-discharge and neurological outcomes to patients with STE. The present study reported the coronary artery status in OHCA survivors without STE with a broader inclusion criterion compared with previous randomized controlled trials, which is closer to everyday practice at an emergency department setting. The results of the current study can serve as a foundation for future prospective researches about PCI strategies in cardiac arrest patients with non-STE ACS.

Previous observational studies revealed similar CAG findings for STE and non-STE groups, although the actual prevalence varied due to the difficulty of enrolling cardiac arrest patients. A Parisian cohort studied by Dumas et al[23] included 435 OHCA survivors with no obvious extracardiac etiology for the cardiac arrest, demonstrating a prevalence of coronary artery stenosis of 96% in the STE group versus 58% in the non-STE group. No survival difference was observed between the groups, although PCI was associated with survival benefits regardless of ECG findings. However, the enrolled patients presented with a high prevalence of ventricular tachycardia or ventricular fibrillation as the initial rhythm, which indicated a highly selected cohort with possible selection bias. Another cohort study conducted in Norway recruited 210 OHCA survivors without clear extracardiac causes for cardiac arrest, revealing a prevalence of 87% for coronary artery stenosis in the STE group versus 65% in the non-STE group.[24] For comparison, the TOMAHAWK and COACT trials reported coronary artery stenosis in 72.6% and 71.6% of cardiac arrest survivors without STE, respectively. The current study reported a prevalence of coronary artery stenosis of 91.3% in the STE group versus 69.7% in the non-STE group. Although a previous study demonstrated that Asian patients had a lower prevalence of NSTEMI than the White patients, that study did not indicate differences in the coronary artery status between specific ethnic groups.[17] The present study revealed a similar prevalence of coronary artery stenosis in cardiac arrest survivors without STE to those in the TOMAHAWK and the COACT trials.

Arabi et al [25] reported a higher overall survival in cardiac arrest survivors with STE than those without STE from 2006 to 2010. However, in the study by Staer-Jensen et al,[24] no difference was observed between the STE and non-STE groups in terms of survival or favorable neurological outcomes at a 6-month follow-up from 2010 to 2013. In the present study, no significant difference was observed in either survival or neurological outcomes between the STE and non-STE groups. For comparison, the TOMAHAWK trial reported a 30-day survival rate of 50.0%, and the COACT trial reported a survival-to-discharge rate of 65.2% for non-STE patients. Additionally, 43.0% of patients in the TOMAHAWK trial exhibited favorable neurological outcomes at the 30-day follow-up, whereas 63.4% of patients in the COACT trial exhibited favorable neurological outcomes at the 90-day follow-up. Both trials excluded patients with postarrest hemodynamic instability, limiting the generalizability of their results. The present study delineated a more general picture that corresponds with clinical practice and demonstrated that 67.2% OHCA survivors without STE survived to discharge, and 54.9% discharged with favorable neurological outcomes.

The present study revealed a high prevalence of emergent CAG application in patients without STE. For comparison, 60.6% of patients received immediate CAG in the COACT trial, whereas 60.5% received immediate CAG in the TOMAHAWK trial. This discrepancy between these trials and the results of the present study may be due to differing definitions of immediate or emergent CAG between the studies. Both the COACT and TOMAHAWK trials defined immediate CAG as CAG administered as soon as possible after hospital admission. CAG after neurological recovery and CAG at least 24 hours after admission were considered delayed in CAG in the COACT and TOMAHAWK trials, respectively. By contrast, emergent CAG in the present study was defined as CAG administered within 24 hours after ROSC. Moreover, the present study did not exclude non-STE cardiac arrest survivors with hemodynamic instability, who were candidates for immediate CAG according to current guidelines.[2,4] However, similar to the study by Staer-Jensen et al,[24] most patients in our study had LAD stenosis, followed by RCA stenosis, left circumflex coronary artery stenosis, and LM stenosis. Furthermore, the present study revealed 50.8% of multivessel involvement for coronary artery stenosis in OHCA survivors without STE; by contrast, the TOMAHAWK trial reported an incidence of multivessel disease of 40.4%, whereas the COACT trial reported an incidence of 30.3%. The influence of ethnicity on the prevalence of multivessel disease requires further investigation. Moreover, the present study population had a high prevalence of PCI (43.1%) compared with 30.8% in the TOMAHAWK trial and 28.6% in the COACT trial. Differences in health care and insurance policies may explain some of these differences. Tertulien et al[26] reported that a lower income level was associated with a lower likelihood of receiving CAG and PCI, but not with differences in NSTEMI management between Asian and White patients in the United States. In Taiwan, >99% of the population is covered by the National Health Insurance program, which heavily subsidizes expenses from outpatient clinics, hospitalization, and intensive care.[18] These differences in financial burden may eventually interfere the patient's decision of management.

In conclusion, in OHCA survivors with presumed ACS, there was a high prevalence of coronary artery stenosis and multivessel involvement in patients without STE. Moreover, patients without STE had comparable survival-to-discharge and neurological outcomes with patients with STE.

AUTHOR CONTRIBUTIONS

Y-RH: conceptualization, methodology, investigation, formal analysis, writing—original draft, writing—review & editing; C-HH: methodology; H-LY: investigation; Y-WW: investigation; W-TC: data curation; W-JC: supervision; W-TC: data curation; M-ST: conceptualization, methodology, investigation, writing—review & editing.

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CONFLICT OF INTEREST

All authors have affirmed they have no conflicts of interest to declare.

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SUPPLEMENTARY MATERIALS

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