Open Access Emergency Medicine

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Prehospital Blood pH Testing and Survival in Non-Traumatic Out-of-Hospital Cardiac Arrest: Insights from a Thai EMS Unit

Chavin Triganjananun[1], Welawat Tienpratarn[2], Chaiyaporn Yuksen[2], Lunlita Chukaew[2], Chetsadakon Jenpanitpong[3], Suteenun Seesuklom[3]

[1]Department of Emergency Medicine, Chakri Naruebodindra Medical Institute, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Samut Prakan, Thailand; [2]Division of Emergency Medicine, Department of Emergency Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand; [3]Division of Paramedicine, Department of Emergency Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Correspondence: Welawat Tienpratarn, Division of Emergency Medicine, Department of Emergency Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, 270 Rama VI Road, Thung Phaya Thai, Ratchathewi, Bangkok, 10400, Thailand, Tel +660817022447, Email welawat.tie@mahidol.ac.th; pedz_welawat@hotmail.com

Background: Point-of-care testing (POCT) for blood gas and electrolyte analysis supports the identification of reversible causes of out-of-hospital cardiac arrest (OHCA). In 2021, the Ramathibodi Emergency Operation (RAMA EMO) unit became the first emergency medical service team in Thailand to apply POCT in its prehospital resuscitation protocol. Prior to this implementation, POCT had not been used in prehospital OHCA care in Thailand, so its clinical impact was unknown. The aim of this study was to evaluate the association between initial prehospital POCT-measured pH and return of spontaneous circulation (ROSC) at emergency department (ED) admission in a Thai EMS-managed OHCA cohort.

Methods: This single-center ambispective cohort study analyzed adult non-traumatic OHCA patients managed by the RAMA EMO unit. Prehospital POCT was used in all eligible OHCA cases after the initiation of advanced resuscitation. Multivariable analysis was employed to assess the association between blood pH and ROSC at ED admission.

Results: A total of 148 patients were included, and ROSC at ED admission occurred in 25% of the cases. Higher prehospital pH was significantly associated with ROSC at ED admission. In ROC analysis, a pH cutoff of ≥ 7.1 demonstrated the optimal discriminative performance. In multivariable logistic regression, pH ≥ 7.1 remained independently associated with ROSC at ED admission (adjusted odds ratio 3.68, 95% CI 1.37–9.89; P = 0.010). Internal bootstrap validation confirmed the robustness of this association.

Conclusion: Prehospital POCT blood gas analysis provides valuable prognostic information regarding OHCA, with a pH ≥ 7.1 serving as an independent predictor of ROSC at ED admission. Bootstrap validation supports the stability and reliability of this cutoff. The integration of POCT into EMS protocols may enhance early clinical decision-making during resuscitation. Further external validation is warranted to confirm these findings.

Keywords: out-of-hospital cardiac arrest, point-of-care testing, blood gas, pH level, prehospital care, return of spontaneous circulation

Introduction

Management of out-of-hospital cardiac arrest (OHCA) in Thailand's prehospital setting is challenging due to limitations in space, personnel, and equipment for cardiopulmonary resuscitation (CPR).[1,2] In past years, prehospital care has lacked the diagnostic tools necessary to guide definitive resuscitation and identify reversible causes of arrest, such as severe metabolic derangement. However, point-of-care testing (POCT) for blood gas and electrolyte analysis is increasingly utilized by prehospital teams and provides real-time, portable measurements of critical blood parameters, such as pH, lactate, potassium, and bicarbonate levels, in prehospital settings. This analysis is conducted primarily to help with on-site identification and correction of reversible causes of cardiac arrest, such as severe acidosis or hyperkalemia.[1–6] Previous studies have suggested that blood pCO_2 levels measured by POCT predict the return of spontaneous circulation (ROSC) in OHCA patients, whereas

https://doi.org/10.2147/OAEM.S549407
Received: 12 July 2025
Accepted: 25 January 2026
Published: 24 February 2026

other blood markers, such as lactate and pH, show mixed results.[7–12] However, blood pH has been identified as an independent predictor of survival and neurological recovery in OHCA patients, with certain thresholds, such as pH $\geq$ 6.8 during cardiopulmonary resuscitation (CPR), linked to better outcomes.[13–15] The Korean ED-PLANN score also incorporates a blood pH level of $\leq$ 7.1 to predict survival with good neurological outcomes.[16]

In 2021, the RAMA EMO unit became the first emergency medical services (EMS) unit in Thailand to incorporate POCT blood gas and electrolyte analysis into its prehospital resuscitation protocol. In a previous evaluation of POCT implementation, we reported that POCT patients received significantly more sodium bicarbonate and calcium gluconate and showed sustained ROSC in prehospital OHCA when compared to non-POCT patients.[17] The aim of the present study was to provide a more detailed analysis of initial prehospital POCT-measured pH as an independent predictor of ROSC at emergency department (ED) admission in a Thai EMS-managed OHCA cohort. We also further explored the relationship between pH and potassium levels, as well as the POCT-guided use of sodium bicarbonate and calcium gluconate in OHCA cohorts.

Methods

Study Design and Setting

This was a single-center retrospective and prospective (ambispective) cohort study. We included consecutive prehospital OHCA patients aged 18 years or older who received advanced prehospital resuscitation and for whom POCT blood gas and electrolyte analysis was utilized, with the results reported by the EMS team of the RAMA EMO unit. A retrospective review was conducted from February 2021 to February 2023, and prospective patient data were collected from March to December 2023. Ethical approval for this study, granted on February 16, 2023, was obtained from the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (IRB COA. MURA2023/124). For the prospective phase of the study, each participant provided written informed consent in accordance with the ethical principles governing research involving human subjects.

The RAMA EMO unit provides EMS to the urban population in Bangkok. The standard OHCA protocol begins with immediate CPR by dispatched first responders. Upon EMS team arrival, roles are assigned to optimize care, with one paramedic designated to establish vascular access and conduct the POCT blood gas analysis. Cardiac rhythm assessment and interventions are initiated based on advanced cardiac life support (ACLS) guidelines that primarily follow the 2020 American Heart Association (AHA) recommendations. The advanced EMS team also utilizes a mechanical chest compression device for continuous chest compressions. Vascular access is promptly established for both adrenaline administration and blood sample collection.

A dedicated POCT protocol is implemented for blood gas analysis, ensuring that an initial blood sample is rapidly drawn immediately upon successful vascular access. The collected sample may be arterial or venous. This sample is analyzed on site using a portable blood gas analyzer to determine baseline physiological parameters, including pH, pCO_2, PO_2, lactate, and electrolytes. The results are then used to guide advanced resuscitation strategies, focusing on the identification and correction of reversible causes of cardiac arrest. All patients are intubated by the EMS team and ventilated with 100% oxygen. Continuous cardiac monitoring using electrocardiography (ECG) and a defibrillator is provided as indicated, with resuscitation efforts maintained throughout transport. All procedures and patient responses are documented and communicated during hospital handover.

The RAMA EMO unit began implementing POCT blood gas and electrolyte analyses in February 2021. The device used was the i-STAT Alinity system (Abbott Point of Care Inc., Princeton, NJ, USA). This tool is now routinely applied in all OHCA cases unless the device malfunctions, delivers unreadable results, or is unavailable. Due to variability in i-STAT cartridge availability, potassium measurements were not included in all cases, resulting in missing potassium data for a subset of the patients in our cohort. Therefore, analyses involving potassium were restricted to complete cases which actual potassium data were available and not imputed.

In the present study, the presumed cause of cardiac arrest was determined based on the on-scene physician's clinical judgment and synthesized from the patient's history, physical examination, symptoms preceding the event, and supporting POCT results. In adherence to the local EMS protocol, sodium bicarbonate ($NaHCO_3$) was not routinely administered during resuscitation. Its use was strictly reserved for OHCA patients with confirmed severe acidosis (pH < 7.2) and required explicit authorization from the on-scene physician.

The primary objective of this study was to examine the association between initial POCT-measured pH and ROSC at ED admission in a Thai EMS-managed OHCA cohort. The secondary objective was to describe the characteristics of POCT blood gas and electrolyte measurements and their association with POCT-guided treatments, with the aim of providing clinically relevant information to support POCT-guided resuscitation and improve outcomes in patients with OHCA.

Study Participants

The inclusion criteria comprised adult patients with non-traumatic out-of-hospital cardiac arrest (OHCA) managed by the emergency medical services (EMS) team of the RAMA EMO unit, who were consecutively enrolled. Exclusion criteria included refusal of resuscitation, signs of imminent death being present upon EMS arrival, pregnancy, traumatic cardiac arrest, and absence of prehospital point-of-care testing (POCT) results. Signs of imminent death were defined according to the EMS protocol and included clinical findings indicating irreversible or nonsurvivable conditions, for which resuscitative efforts were not initiated. The study flow is illustrated in Figure 1

Data Collection

The collected baseline data for the prehospital OHCA patients included the following: age, gender (male), witnessed arrest, bystander CPR, automated external defibrillator (AED) use, response time, first documented rhythm (shockable, non-shockable), defibrillation, presumed cause (cardiac cause, hypoxia, hypovolemia, metabolic, intoxication, others, unknown), time to first dose of adrenaline, total dose of adrenaline, total CPR time, POCT blood gas and electrolyte analysis parameters, time to POCT blood gas, and specific treatment (7.5% sodium bicarbonate, 10% calcium gluconate). The primary outcome of this study was ROSC at ED admission. During the retrospective phase, data were collected from the electronic medical record system of Ramathibodi Hospital, whereas the prospective phase utilized the RAMA EMO database of Ramathibodi Hospital.

Sample Size Estimation

As this study was based on all eligible cases managed during the study period, no formal sample size calculation was performed. The sample consisted of all consecutive adult non-traumatic OHCA patients who underwent prehospital POCT and met the inclusion criteria.

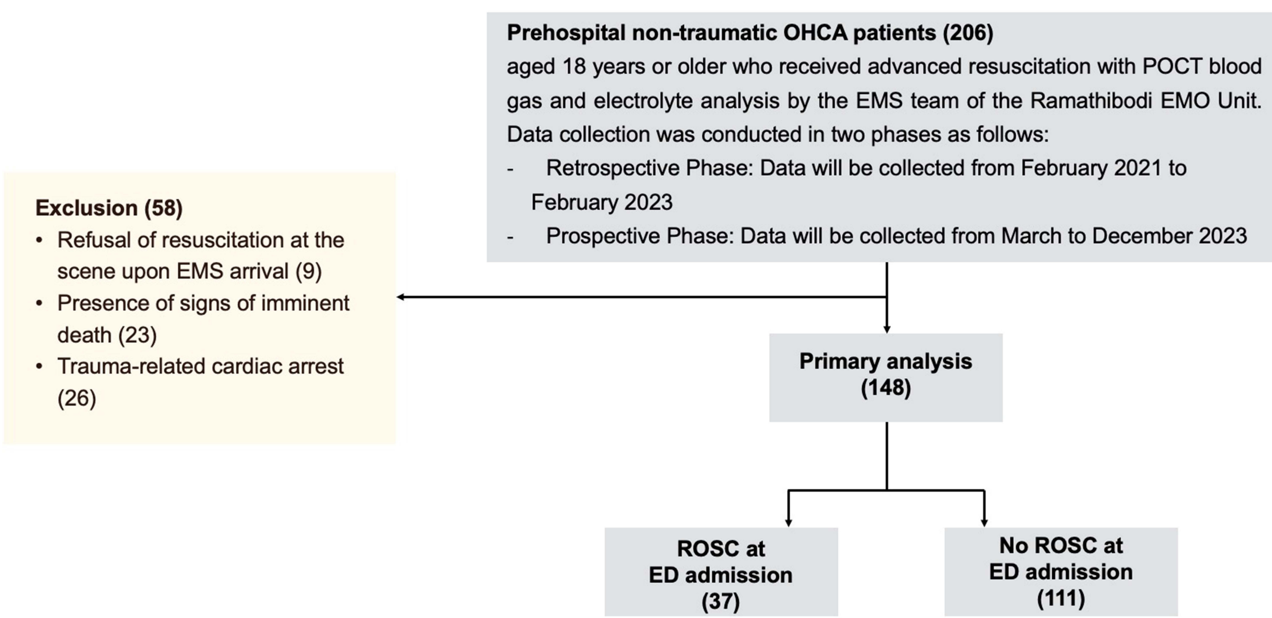

Figure 1 Prehospital non-traumatic OHCA patients study's flow.
Abbreviations: OHCA, Out-of-hospital cardiac arrest; EMO, Emergency medical operation; EMS, Emergency medical services; POCT, Point-of-care testing; ROSC, Return of spontaneous circulation; ED, Emergency department.

 https://doi.org/10.2147/OAEM.S549407

Definitions

The following definitions are based on a prior study[18]

- OHCA refers to the presence of cardiac arrest before the arrival of EMS.
- ROSC at ED admission is the sustained presence of a palpable central pulse and measurable blood pressure, documented at the point-of-care transfer to the ED.
- A witnessed arrest is a cardiac arrest that is seen or heard by another person.
- Bystander CPR/AED use is CPR performed/AED applied by a person who is on scene or alerted but not dispatched as part of an organized emergency response system. Bystanders include off-duty health care professionals and volunteer community responders.
- Presumed cause refers to the most likely primary cause of the cardiac arrest.
- Response time is the interval between an emergency call connecting to the primary public safety answering point and first responders or EMS arriving at the scene.
- The first documented rhythm refers to the first cardiac rhythm documented by a monitor or defibrillator applied after a cardiac arrest.
- Total CPR time is the cumulative duration of CPR efforts, extending from the start of bystander CPR through EMS resuscitation and in-hospital continuation of CPR, and measured until the attainment of ROSC or the formal termination of resuscitation efforts.

Statistical Analysis

Data analysis was performed using STATA version 17.0 (StataCorp LLC, College Station, TX, USA) with significance set at a two-tailed P-value of <0.05. Data distribution was assessed using histograms and plots. Categorical data are reported as counts and percentages, while continuous data are presented as mean (standard deviation) for normally distributed data and median (interquartile range) for non-normally distributed data. The data from patients with ROSC at ED admission and from those with no ROSC at ED admission were compared using T-tests or Mann–Whitney *U*-tests for continuous variables. For categorical variables, proportions and exact probability tests were employed. All analyzed variables are presented in the table.

Multivariable logistic regression analysis was conducted to adjust for confounding variables influencing ROSC at ED admission. Confounders were selected based on prior literature, clinical relevance, and stepwise selection techniques. Cases with missing data were excluded from multivariable models.

Receiver operating characteristic (ROC) curve analysis was performed to evaluate the discriminative ability of pH in predicting ROSC at ED admission. The optimal pH threshold was determined using the Youden index.

We assessed the internal validity and robustness of the association between prehospital pH and ROSC at ED admission by performing nonparametric bootstrap validation using 1000 replications. After applying the bootstrap procedure to the multivariable logistic regression model, we calculated the percentile, normal-based, and bias-corrected 95% CI for the odds ratio (OR) of the dichotomized pH variable.

Results

Data were collected from 206 adult cardiac arrest patients during the study period. Of these, 58 patients were excluded for the following reasons: 9 patients refused resuscitation, 23 showed signs of imminent death, and 26 had trauma-related cardiac arrest. Thus, 148 patients were included in the analysis (Figure 1). Thirty-seven OHCA patients (25%) had ROSC at ED admission, while 111 patients (75%) did not.

The baseline characteristics of patients who underwent POCT blood gas analysis during prehospital resuscitation for OHCA are summarized in Table 1. No significant differences were detected between the ROSC group and the non-ROSC group in age, sex, witnessed arrest, bystander CPR, or response time. Patients who achieved ROSC at ED admission received a lower total dose of adrenaline and had a shorter total CPR duration than those who did not. Hypoxia and hypovolemia were more frequently identified as presumed causes of arrest in the ROSC group.

Table 1 Baseline Characteristics of Using POCT Blood Gas During Resuscitation of Prehospital Non-Traumatic OHCA Patients Between ROSC at ED Admission Group and No ROSC at ED Admission Group

Variables	ROSC at ED Admission		P-value
	Yes (N1=37) N (25%)	No (N2=111) N (75%)	
Age (years) [Mean±SD]	62.08±15.85	59.79±19.05	0.423
Male	22 (59.46)	71 (63.96)	0.696
Witnessed arrest	22 (59.46)	59 (53.15)	0.570
Bystander CPR	34 (91.89)	103 (92.79)	1.000
AED use	9 (24.32)	42 (37.84)	0.164
Response time (minutes) [Mean±SD]	17.59±7.80	16.31±6.44	0.320
Response time within 8 minutes	2 (5.41)	6 (5.41)	1.000
First documented rhythm			
Shockable	7 (18.92)	18 (16.22)	0.800
Non-shockable	30 (81.08)	93 (83.78)	
Defibrillation	14 (37.84)	51 (45.95)	0.447
Presumed cause			
- Cardiac cause	11 (29.73)	53 (47.75)	0.059
- Hypoxia	25 (67.57)	35 (31.53)	< 0.001
- Hypovolemia	8 (21.62)	5 (4.50)	0.004
- Metabolic	24 (64.86)	59 (53.15)	0.253
- Intoxication	1 (2.70)	3 (2.70)	1.000
- Others (eg PE)	1 (2.70)	3 (2.70)	1.000
- Unknown	0 (0)	2 (1.80)	1.000
Total dose adrenaline [Median, (IQR)]	3 (2, 7)	7 (6, 8)	< 0.001
Time to first dose adrenaline (minutes) [Median, (IQR)]	4 (4, 6)	5 (4, 7)	0.210
Time to first dose adrenaline within 5 minutes	25 (67.57)	58 (52.73)	0.129
Total CPR time (minutes) [Median, (IQR)]	20 (14, 30)	32 (30, 40)	< 0.001

Abbreviations: OHCA, Out-of-hospital cardiac arrest; EMO, Emergency medical operation; EMS, Emergency medical services; POCT, Point-of-care testing; ED, Emergency department; CPR, Cardiopulmonary resuscitation; AED, Automated external defibrillator; PE, Pulmonary embolism.

The POCT blood gas and electrolyte parameters are presented in Table 2. Venous blood gas analysis was performed in the majority of cases, with POCT timing similar in both the ROSC group and the non-ROSC group. The mean pH values did not differ significantly; however, ROSC was achieved in a higher proportion of patients with pH ≥ 7.1 than in those with pH < 7.1. The pO2 levels were higher in the ROSC group than in the non-ROSC group, whereas no significant differences were observed in pCO_2, bicarbonate, or potassium levels.

Regarding the POCT-guided treatments, the patients in the ROSC group more frequently received lower doses of sodium bicarbonate, although the overall use did not differ significantly between the ROSC group and the non-ROSC group. The association between lower pH and higher sodium bicarbonate dosing was significant in the non-ROSC group but not in the ROSC group (Figure 2). Potassium levels were not significantly associated with calcium gluconate administration in either group (Figure 3).

 https://doi.org/10.2147/OAEM.S549407

Table 2 POCT Blood Gas and Electrolyte Analysis Parameters in Prehospital Non-Traumatic OHCA Patients Between ROSC at ED Admission Group and No ROSC at ED Admission Group and Their Specific Treatments

Variables	ROSC at ED Admission		P-value
	Yes (N1=37) N (25%)	No (N2=111) N (75%)	
POCT blood gas and electrolyte analysis parameters			
Arterial blood	9 (24.32)	29 (26.13)	1.000
Venous blood	28 (75.68)	82 (73.87)	
pH [Mean±SD]	6.93±0.20	6.87±0.21	0.140
- pH < 7.1	26 (70.27)	99 (89.19)	0.009
- pH ≥ 7.1	11 (29.73)	12 (10.81)	
pO_2 (mmHg) - Arterial [Median, (IQR)]	40 (37, 142)	24 (17, 52)	0.090
pO_2 (mmHg) - Venous [Median, (IQR)]	30.5 (19, 60)	20.3 (15, 29)	0.060
pCO_2 (mmHg) - Arterial [Mean±SD]	63.64±27.01	68.19±30.09	0.783
pCO_2 (mmHg) - Venous [Mean±SD]	76.48±28.02	80.53±23.74	0.622
HCO_3 (mmol/L) [Mean±SD]	16.47±5.78	15.73±6.05	0.527
K (mmol/L) [Mean±SD]	5.42±1.41	5.98±1.75	0.082
- No K result	1 (2.70)	5 (4.50)	0.658
- K < 3.5	2 (5.41)	6 (5.41)	
- K 3.5–5.5	19 (52.78)	41 (36.94)	
- K > 5.5	3 (8.33)	10 (9.01)	
- K > 6	12 (33.33)	49 (44.14)	
Lactate (mmol/L) [Median, (IQR)]	11.73 (4.09, 15.15)	12 (10, 15.16)	0.736
Time to POCT Blood gas (minutes) [Mean±SD]	12.97±5.48	13.68±5.39	0.493
Specific treatments to POCT blood gas and electrolyte analysis			
Total dose 7.5% $NaHCO_3$			
- 1 dose (50 mL)	12 (40.00)	23 (24.47)	0.097
- 2 dose (100 mL)	11 (36.67)	55 (58.51)	
- > 2 dose (> 100 mL)	7 (23.33)	16 (17.02)	
Time to first dose 7.5% $NaHCO_3$ [Mean±SD]	17.70±7.41	16.90±5.10	0.509
Total dose 10% Calcium gluconate			
- 1-2 doses (10–20 mL)	5 (26.32)	5 (8.47)	0.321
- 3 dose (30 mL)	10 (52.63)	36 (61.02)	
- > 3 dose (> 30 mL)	4 (21.05)	18 (30.51)	
Time to first dose 10% Calcium gluconate [Mean±SD]	18.95±9.27	18.48±7.21	0.817

Abbreviations: OHCA, Out-of-hospital cardiac arrest; POCT, Point-of-care testing; ED, Emergency department.

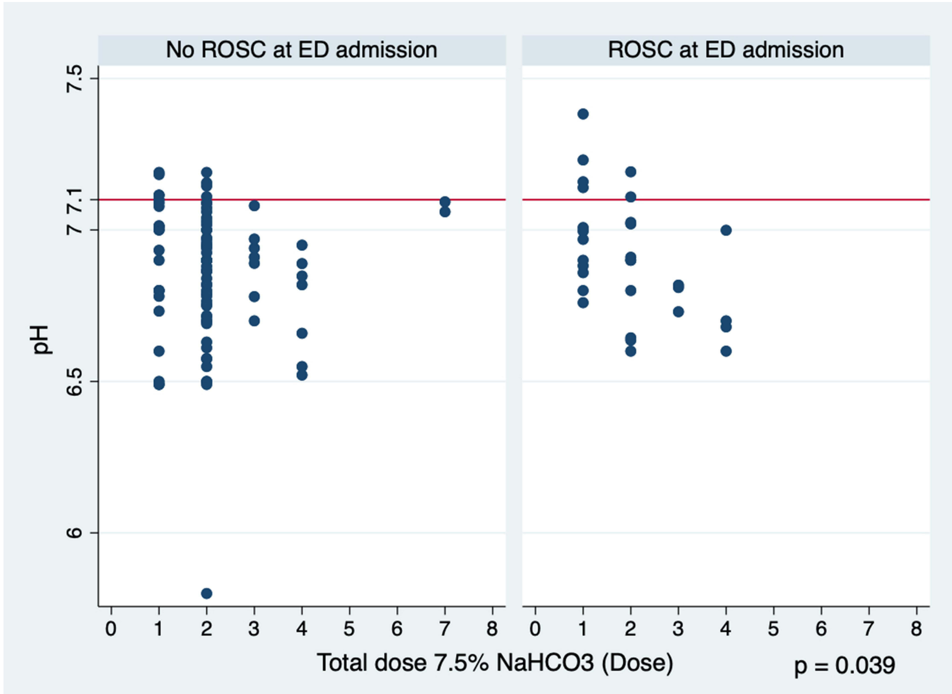

Figure 2 pH value and total dose 7.5% $NaHCO_3$ compare between ROSC at ED admission and no ROSC at ED admission in prehospital POCT Blood gas use in non-traumatic OHCA patients.

Abbreviations: OHCA, Out-of-hospital cardiac arrest; POCT, Point-of-care testing; ROSC, Return of spontaneous circulation; ED, Emergency department.

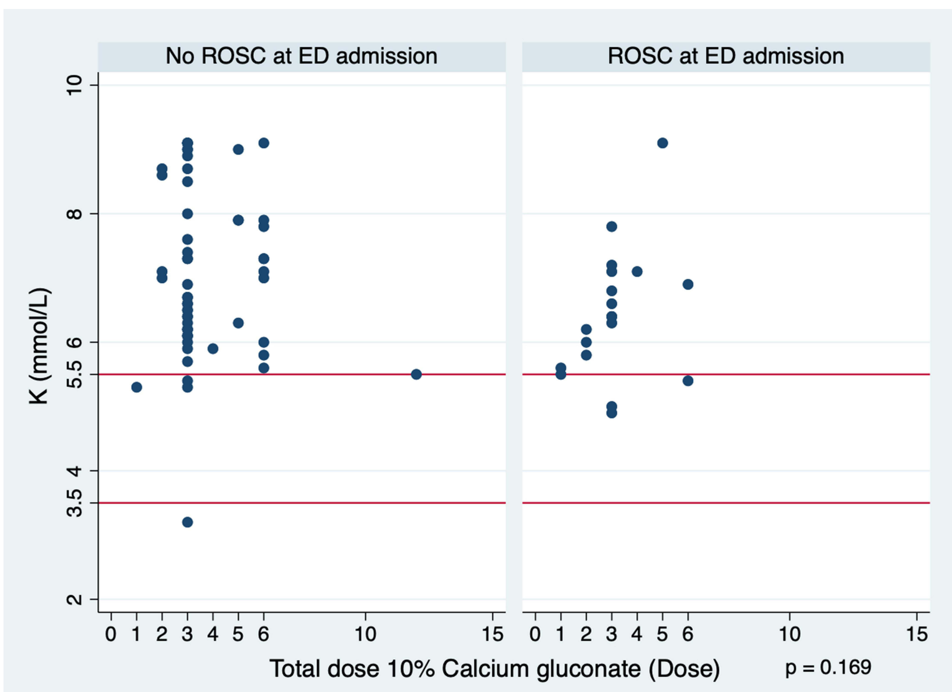

Figure 3 K level and total dose 10% Calcium gluconate compare between ROSC at ED admission and no ROSC at ED admission in prehospital POCT blood gas use in non-traumatic OHCA patients.

Abbreviations: OHCA, Out-of-hospital cardiac arrest; POCT, Point-of-care testing; ROSC, Return of spontaneous circulation; ED, Emergency department.

 https://doi.org/10.2147/OAEM.S549407

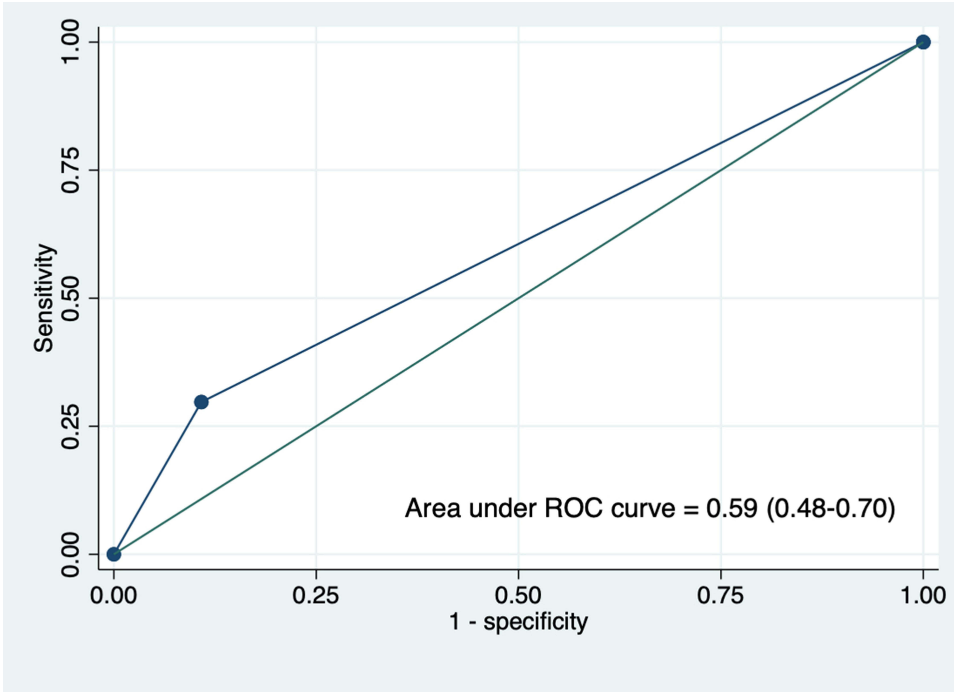

Figure 4 ROC curve demonstrating the predictive performance of prehospital blood pH (cutoff pH ≥ 7.1) for ROSC at ED admission.
Abbreviations: ROC, Receiving operation characteristic; ROSC, Return of spontaneous circulation; ED, Emergency department.

ROC analysis demonstrated a modest discriminative performance for prehospital POCT-measured blood pH in predicting ROSC at ED admission, with an area under the curve of 0.59 (95% CI: 0.48–0.70) (Figure 4). Using the Youden Index, the optimal pH cutoff value was determined to be pH ≥ 7.1, which yielded a sensitivity of 29.73% and a specificity of 89.19%.

In the multivariable logistic regression analysis in Table 3, after adjusting for relevant prognostic factors, a pH value ≥ 7.1 remained independently associated with ROSC at ED admission (adjusted OR, 3.68; 95% CI, 1.37–9.89; P = 0.010). Internal validation using 1000 bootstrap replications demonstrated consistent results, supporting the robustness of the model.

Table 3 Univariable and Multivariable Logistic Regression Analysis of 7.1 of pH Value in POCT Blood Gas and Electrolyte Analysis to Predict ROSC at ED Admission

Variables	Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
pH ≥ 7.1	3.49 (1.38–8.80)	0.008	3.68 (1.37–9.89)	0.010

Notes: The multivariable logistic regression analysis was adjusted for the following prognostic variables: age (years), male gender, bystander CPR, response time within 8 minutes, first arresting shockable rhythm, cardiac cause, time to the first dose of adrenaline within 5 minutes, and time to POCT blood gas (minutes).
Abbreviations: POCT, Point-of-care testing; ED, Emergency department; CPR, Cardiopulmonary resuscitation; AED, Automated external defibrillator; OR, Odds ratio; CI, Confidence interval.

Discussion

The study results presented here confirm our earlier findings that POCT blood pH readings, which are simple and routinely obtained prehospital data, can serve as prognostic indicators of ROSC at ED admission. The finding of a relationship between blood pH and ROSC likely reflects the extent of global ischemia and the resuscitation duration, as cardiac arrest induces acidosis through combined respiratory and metabolic mechanisms.[19–21] Despite the low sensitivity, the high specificity of the ≥ pH 7.1 cutoff suggests its potential usefulness in supporting early prehospital decision-making. The differences between our findings and those of previous studies may be explained by variations in study settings, timing of blood gas measurement, and EMS system characteristics.

Our results align with those of previous studies that identified blood pH as a significant predictor of survival outcomes in OHCA patients. Previous research has shown that pH levels correlate with both sustained ROSC and long-term survival, particularly when extracorporeal cardiopulmonary resuscitation (ECPR) is considered as an intervention.[15] In a study from Korea, a pH value ≤ 7.1 was incorporated into a validated scoring system (ED-PLANN score) for predicting favorable neurological outcomes following OHCA.[16] Although the POCT pH strongly predicted survival in our analysis, the blood lactate levels at ED admission did not differ significantly between the ROSC group and the non-ROSC group. This result is consistent with the findings of other studies reporting no association between blood lactate levels and ED survival in OHCA patients.[1,7,22]

Several studies have suggested that pCO_2 and potassium levels may also serve as predictors for sustaining ROSC in OHCA patients.[7,8,11] Although hyperkalemia is a treatable cause of cardiac arrest,[23] our findings suggest that potassium levels may not be reliable predictors of ROSC outcomes. The lack of statistically significant differences in pCO_2 between our ROSC and non-ROSC groups may reflect a lack of data on airway management, which could have influenced pCO_2 levels.

The findings of this study have important implications for prehospital non-traumatic OHCA patient care in Thailand. The ability to rapidly assess metabolic derangements, such as severe acidosis, in the field can play a crucial role in early prognostic evaluation and aid EMS providers in their resuscitation decision-making, particularly regarding advanced interventions such as early ED transport decisions or sodium bicarbonate administration. The ability to obtain prehospital pH measurements via POCT from either arterial or venous blood further highlights its practical and feasible use in the ambulance setting.

Limitations

This study has several limitations. First, its single-center design and lack of external validation limit its generalizability, particularly regarding the predictive value of the pH ≥ 7.1 cutoff, despite our internal bootstrap validation. Second, the missing potassium data due to POCT cartridge variability, coupled with the lack of detailed ventilation-related data, may have limited our interpretation of the findings related to pCO_2, pO_2, and potassium. Third, severe acidosis and hyperkalemia may reflect prolonged cardiac arrest rather than primary etiologies. Fourth, the retrospective component may have introduced selection bias. Fifth, the response times in our study were longer than the standard times,[24] likely due to the urban complexity and heavy traffic in Bangkok. The prolonged response times in our setting likely contributed to worse physiological status at ED arrival and may have influenced patient outcomes.[25] Finally, bystander CPR was broadly defined to include early CPR by dispatched basic life support teams or first responders, which may have overestimated true layperson-initiated bystander CPR rates.

Conclusion

Prehospital POCT blood gas analysis provides easily retrieved prognostic information for OHCA. In this study, a pH ≥ 7.1—measured by POCT—served as an independent predictor of ROSC at ED admission. Internal validation using bootstrapping supported the robustness of this association. These findings underscore the potential role of POCT in guiding early prehospital decision-making and support its integration into EMS resuscitation protocols. Further research is needed for the external validation of these results; however, the indication that POCT data can have direct prognostic value may have important implications for the assessment of a broad range of EMS situations other than OHCA.

https://doi.org/10.2147/OAEM.S549407

Use of Artificial Intelligence Chatbots

During the preparation of this work, the author(s) used Chat GPT 4.0 and Grammarly to check and correct grammatical errors during the manuscript writing process. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content publication.

Abbreviations

OHCA, Out-of-hospital cardiac arrest; EMO, Emergency medical operation; EMS, Emergency medical services; POCT, Point-of-care testing; ED, Emergency department; CPR, Cardiopulmonary resuscitation; AED, Automated external defibrillator; PE, Pulmonary embolism; SD, Standard deviation; OR, Odds ratio; CI, Confidence interval; ROC, Receiver operating characteristic; ROSC, Return of spontaneous circulation.

Data Sharing Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval and Consent to Participate

Ethical approval for this study was obtained from the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (IRB COA. MURA2023/124, granted on February 16, 2023). The Institutional Review Boards at Mahidol University operate in full compliance with the International Guidelines for Human Research Protection, including the Declaration of Helsinki, The Belmont Report, CIOMS Guidelines, and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP). All personal identifiers were removed and replaced with study identification numbers (IDs). For all participants enrolled in the prospective phase, written informed consent was secured. Given the time-critical nature of the OHCA setting, a deferred consent approach was utilized, in which written consent was obtained from the patient or their legally authorized representative only after the completion of resuscitation efforts and initial stabilization. Each participant provided written informed consent, aligning with the ethical principles governing research involving human subjects. This consent process was executed by the attending EMS team, who initially managed the patient, ensuring continuity and clarity regarding the use of data collected during the acute phase.

Author Contributions

Each author made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas. Each author took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; has agreed on the journal to which the article has been submitted; and agrees to be accountable for all aspects of the work.

Funding

No funding was obtained for this study.

Disclosure

The authors declare no competing interests in this work.

References

1. Prause G, Ratzenhofer-Comenda B, Smolle-Jüttner F, et al. Comparison of lactate or BE during out-of-hospital cardiac arrest to determine metabolic acidosis. *Resuscitation*. 2001;51(3):297–300. doi:10.1016/s0300-9572(01)00424-5
2. Takasu A, Sakamoto T, Okada Y. Arterial base excess after CPR: the relationship to CPR duration and the characteristics related to outcome. *Resuscitation*. 2007;73(3):394–399. doi:10.1016/j.resuscitation.2006.10.014
3. Ahn S, Kim WY, Sohn CH, Seo DW, Kim W, Lim KS. Potassium values in cardiac arrest patients measured with a point-of-care blood gas analyzer. *Resuscitation*. 2011;82(12):e25–6. doi:10.1016/j.resuscitation.2011.08.010

4. Gräsner JT, Wnent J, Herlitz J, et al. Survival after out-of-hospital cardiac arrest in Europe - results of the EuReCa TWO study. *Resuscitation*. 2020;148:218–226. doi:10.1016/j.resuscitation.2019.12.042
5. Gruebl T, Ploeger B, Wranze-Bielefeld E, et al. Point-of-care testing in out-of-hospital cardiac arrest: a retrospective analysis of relevance and consequences. *Scand J Trauma Resusc Emerg Med*. 2021;29(1):128. doi:10.1186/s13049-021-00943-w
6. Velissaris D, Karamouzos V, Pierrakos C, Koniari I, Apostolopoulou C, Karanikolas M. Use of sodium bicarbonate in cardiac arrest: current guidelines and literature review. *J Clin Med Res*. 2016;8(4):277–283. doi:10.14740/jocmr2456w
7. Kim Y-J, Lee YJ, Ryoo SM, et al. Role of blood gas analysis during cardiopulmonary resuscitation in out-of-hospital cardiac arrest patients. *Medicine*. 2016;95(25):e3960. doi:10.1097/md.0000000000003960
8. Grmec S, Krizmaric M, Mally S, Kozelj A, Spindler M, Lesnik B. Utstein style analysis of out-of-hospital cardiac arrest--bystander CPR and end expired carbon dioxide. *Resuscitation*. 2007;72(3):404–414. doi:10.1016/j.resuscitation.2006.07.012
9. Sasson C, Rogers MA, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes*. 2010;3(1):63–81. doi:10.1161/circoutcomes.109.889576
10. Shinozaki K, Oda S, Sadahiro T, et al. Blood ammonia and lactate levels on hospital arrival as a predictive biomarker in patients with out-of-hospital cardiac arrest. *Resuscitation*. 2011;82(4):404–409. doi:10.1016/j.resuscitation.2010.10.026
11. Bender PR, Debehnke DJ, Swart GL, Hall KN. Serum potassium concentration as a predictor of resuscitation outcome in hypothermic cardiac arrest. *Wilderness Environ Med*. 1995;6(3):273–282. doi:10.1580/1080-6032(1995)006[0273:SPCAAP]2.3.CO;2
12. Levine RL, Wayne MA, Miller CC. End-tidal carbon dioxide and outcome of out-of-hospital cardiac arrest. *N Engl J Med*. 1997;337(5):301–306. doi:10.1056/nejm199707313370503
13. Shin J, Lim YS, Kim K, et al. Initial blood pH during cardiopulmonary resuscitation in out-of-hospital cardiac arrest patients: a multicenter observational registry-based study. *Crit Care*. 2017;21(1):322. doi:10.1186/s13054-017-1893-9
14. Lin CH, Yu SH, Chen CY, Huang FW, Chen WK, Shih HM. Early blood pH as an independent predictor of neurological outcome in patients with out-of-hospital cardiac arrest: a retrospective observational study. *Medicine*. 2021;100(17):e25724. doi:10.1097/md.0000000000025724
15. Okada Y, Kiguchi T, Irisawa T, et al. Association between low pH and unfavorable neurological outcome among out-of-hospital cardiac arrest patients treated by extracorporeal CPR: a prospective observational cohort study in Japan. *J Intensive Care*. 2020;8(1):34. doi:10.1186/s40560-020-00451-6
16. Lim HJ, Ro YS, Kim KH, et al. The ED-PLANN score: a simple risk stratification tool for out-of-hospital cardiac arrests derived from emergency departments in korea. *J Clin Med*. 2021;11(1):174. doi:10.3390/jcm11010174
17. Tienpratarn W, Yuksen C, Chukaew L, Jenpanitpong C, Triganjananun C, Seesuklom S. Point-of-Care Testing (POCT) for blood gas and electrolyte analysis in out-of-hospital cardiac arrests' management; a cross-sectional study. *Arch Acad Emerg Med*. 2025;13(1):e32. doi:10.22037/aaemj.v13i1.2590
18. Bray JE, Grasner JT, Nolan JP, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: 2024 update of the utstein out-of-hospital cardiac arrest registry template. *Circulation*. 2024;150(9):e203–e23. doi:10.1161/cir.0000000000001243
19. Jamme M, Ben hadj salem O, Guillemet L, et al. Severe metabolic acidosis after out-of-hospital cardiac arrest: risk factors and association with outcome. *Ann Intensive Care*. 2018;8(1):62. doi:10.1186/s13613-018-0409-3
20. Momiyama Y, Yamada W, Miyata K, et al. Prognostic values of blood pH and lactate levels in patients resuscitated from out-of-hospital cardiac arrest. *Acute Med Surg*. 2017;4(1):25–30. doi:10.1002/ams2.217
21. von Auenmueller KI, Christ M, Sasko BM, Trappe H-J, von Auenmueller HJ. The value of arterial blood gas parameters for prediction of mortality in survivors of out-of-hospital cardiac arrest. *J Emerg Trauma Shock*. 2017;10(3):134–139. doi:10.4103/jets.Jets_146_16
22. Williams TA, Martin R, Celenza A, et al. Use of serum lactate levels to predict survival for patients with out-of-hospital cardiac arrest: a cohort study. *Emerg Med Australas*. 2016;28(2):171–178. doi:10.1111/1742-6723.12560
23. Neumar RW, Otto CW, Link MS, et al. Part 8: adult advanced cardiovascular life support: 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2010;122(18 Suppl 3):S729–67. doi:10.1161/circulationaha.110.970988
24. Eisenberg MS, Psaty BM. Defining and improving survival rates from cardiac arrest in US communities. *JAMA*. 2009;301(8):860–862. doi:10.1001/jama.2009.193
25. Damdin S, Trakulsrichai S, Yuksen C, et al. Effects of emergency medical service response time on survival rate of out-of-hospital cardiac arrest patients: a 5-year retrospective study. *Arch Acad Emerg Med*. 2025;13(1):e36. doi:10.22037/aaemj.v13i1.2596