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Racial and Ethnic Disparities in Post-Cardiac Arrest Targeted Temperature Management Outcomes

Dr. Claire S. Jacobs, MD, PhD¹, Louis Beers, BA², Suna Park, BA, MS², Dr. Benjamin Scirica, MD³, Dr. Galen V. Henderson, MD², Dr. Liangge Hsu, MD⁴, Dr. Matthew Bevers, MD, PhD², Dr. Barbara A. Dworetzky, MD², Dr. Jong Woo Lee, MD, PhD²

¹Department of Neurology, Massachusetts General Hospital

²Department of Neurology, Brigham and Women's Hospital

³Department of Medicine, Division of Cardiology, Brigham and Women's Hospital

⁴Department of Radiology, Brigham and Women's Hospital

Abstract

Objective—To evaluate racial and ethnic disparities in post-cardiac arrest outcomes in patients undergoing targeted temperature management (TTM).

Design—Retrospective study

Setting—Intensive Care Units in a single tertiary care hospital

Patients—367 patients undergoing post-cardiac arrest targeted temperature management, including continuous EEG monitoring.

Interventions—None

Measurements and Main Results—Clinical variables examined in our clinical cohort included race/ethnicity, age, time to return of spontaneous circulation (ROSC), cardiac rhythm at time of arrest, insurance status, Charlson Comorbidity Index (CCI), and time to withdrawal of life-sustaining therapy (WLST). CT on admission and continuous EEG monitoring during the first 24 hours were used as markers of early injury. Outcome was assessed as good (Cerebral Performance Category [CPC] 1–2) vs poor (CPC 3–5) at hospital discharge.

Corresponding author: Jong Woo Lee, MD, PhD, Department of Neurology, Brigham and Women's Hospital, 60 Fenwood Rd, Boston, MA 02115, 617-732-7547, 617-730-2885 (fax), jlee38@bwh.harvard.edu.

Statistical analysis completed by Claire Jacobs, MD, PhD (Department of Neurology, Massachusetts General Hospital), Suna Park BS, MS (Department of Neurology, Brigham and Women's Hospital), and Jong Woo Lee, MD, PhD (Department of Neurology, Brigham and Women's Hospital).

Claire Jacobs contributed to acquisition of data, analysis of the data, and drafting the manuscript.

Louis Beers contributed to acquisition of data.

Suna Park contributed to analysis of the data.

Benjamin Scirica contributed to acquisition of data and revising the manuscript for intellectual content.

Galen Henderson contributed to revising the manuscript for intellectual content.

Liangge Hsu contributed to acquisition of data and revising the manuscript for intellectual content.

Matthew Bevers contributed to analysis of the data and revising the manuscript for intellectual content.

Barbara Dworetzky contributed to analysis of the data and writing of the manuscript.

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White non-Hispanic (“White”) patients were more likely to have good outcomes than White Hispanic/non-white (“Non-white”) patients (34.4 vs 21.7%, $p=0.015$). In a multivariate model that included age, time to ROSC, initial rhythm, combined EEG/CT findings, CCI, and insurance status, race/ethnicity was still independently associated with poor outcome (OR 3.32, $p=0.003$). Comorbidities were lower in White patients but did not fully explain outcomes differences. Non-white patients were more likely to exhibit signs of early severe anoxic changes on CT or EEG, higher creatinine levels and receive dialysis, but had longer duration to WLST. There was no significant difference in catheterizations or MRI scans. Subgroup analysis performed with patients without early EEG or CT changes still revealed better outcome in White patients.

Conclusions—Racial/ethnic disparity in outcome persists despite a strictly protocolled TTM. Non-white patients are more likely to arrive with more severe anoxic brain injury, but this does not account for all the disparity.

Keywords

anoxic brain injury; cardiac arrest; disparity; prognosis; targeted temperature management

Introduction

Cardiac arrest is a significant contributor to death and long-term disability, with up to 347,000 adults suffering out-of-hospital cardiac arrest (OHCA) annually in the United States (1). Overall rates of survival to hospital discharge for patients who suffer OHCA are 6–9.6%, though this improves to 14.6–18.0% for patients with OHCA due to ventricular tachycardia (VT) or ventricular fibrillation (VF), and up to 30.1% in cases of bystander-witnessed collapse with shockable rhythm (2, 3). By now, it is well known that Therapeutic Hypothermia (TH) and Targeted Temperature Management (TTM) improve neurological outcomes for comatose post-cardiac arrest patients with return of spontaneous circulation (ROSC) (4, 5).

Ethnicity has been shown to affect health outcomes, including cardiac arrest outcomes, but there is limited published data on the association between ethnicity/race and post-cardiac arrest TTM outcomes (6–9). As TTM is strictly protocolled, this is expected to control for many confounding factors contributing to potential disparities. This study set out to determine whether there exist racial disparities in outcomes for post-cardiac arrest TTM patients, and the etiology of such disparities.

Materials and Methods

Study Design

This was a single-center, retrospective, observational study utilizing patient data previously entered into an internal TTM database. This database includes clinical data from the medical records of patients admitted to the Brigham and Women’s Hospital (BWH) between April 2009 and October 2016 who underwent TTM for any reason.

Cardiac arrest protocol

TTM was performed according to the previously published protocol utilized at BWH (10). All eligible resuscitated cardiac arrest patients received TH at 33°C for 24 hours, using ice packs and a surface cooling device (Arctic Sun System, Medivance, Louisville, CO). Patients were intubated and sedated for 24 h with Propofol (0–83 mcg/kg/min) or midazolam (0–3 mg/h) and fentanyl (25 mcg/h). Cisatracurium was administered as needed for shivering (0.15 mg/kg IV q10min PRN, escalated to infusion at 0.5 mcg/kg/min for persistent shivering). After 24 h of cooling, patients were rewarmed by 0.25°C per hour. When clinically feasible, sedation was lightened after return to normothermia (core temperature greater than 36°C) for clinical assessments. Withdrawal of life sustaining treatment (WLST) is not protocolized at our institution, but instead is performed on a case-by-case basis through informed decision making by the patient's family or guardian in close collaboration with the attending cardiologist, usually also the consulting neurologist, and the patient's allied health team members.

Patient cohort

Patients entered into our internal TTM database were reviewed and included in the current study if they underwent TTM after cardiac arrest with ROSC. Exclusion criteria were TTM for reasons other than cardiac arrest (e.g. subarachnoid hemorrhage). Patients were excluded for the following reasons: TTM for reasons for other than cardiac arrest (2), TTM performed at an outside facility and transferred our facility for prognosis or further care (10), TTM aborted or not targeted to protocol temperature (6), incomplete/insufficient information (5).

Definition of variables

The following data points were collected for each study subject: Age, sex, rhythm at time of arrest (ventricular fibrillation/shockable rhythm vs pulseless electrical activity/asystole), estimated time to ROSC, in-house arrest, Charlson Comorbidity Index (CCI) (11), insurance status (private vs nonprivate), condition at discharge, discharge destination (home, home with services, rehabilitation facility, nursing home, or long-term care facility), and race/ethnicity. Race and ethnicity data were either self-reported, reported by family members, or obtained by other available public records. Race and ethnicity were binarized to "White" (White non-Hispanic) vs Non-white (White Hispanic, Black, and Asian) patients. Although this combines race and ethnicity, this classification is also consistent with the United States Census definition of racial/ethnic minority (Hispanic, Black, and Asians) (12). Subjects for whom race or ethnicity could not be determined were excluded. CCI at time of admission was calculated based on information in the patient record. Cerebral performance category (CPC) at discharge was determined and binarized to good (CPC 1–2) or poor (CPC 3–5) outcome (13). CT scans obtained within the first 24 hours were interpreted by a neuroradiologist and categorized as 1) normal, 2) showing evidence of anoxic injury, or 3) showing evidence of other major acute abnormalities. Continuous video EEG monitoring (Natus XLTEK system, Pleasanton, CA) according to the international 10–20 system was placed as soon as possible after starting TTM, and patients were recorded for a minimum of 24 h during TTM and a minimum of 24 h after normothermia was achieved; EEG leads were removed as soon as possible if a WLST decision was reached. EEG data was interpreted

using the American Clinical Neurophysiology Society (ACNS) critical care EEG terminology (14) and classified into 3 categories (highly malignant, malignant, benign) per Westhall *et al.* (2016) (15). Routine EEGs were obtained prior to continuous EEG monitoring becoming part of the hospital TTM protocol. A discontinuous background with no other malignant features was not deemed malignant, as this phenomenon is frequently seen on EEG in the initial period after cardiac arrest and in sedated patients, even in patients with an eventual favorable outcome. The presence of anoxic injury on CT or malignant EEG were combined into single variables (highly malignant or malignant, depending on whether EEG revealed highly malignant changes vs any malignant changes) as markers for early anoxic injury. In cases where a WLST decision was reached, the patient's chart was reviewed and the interval time between cardiac arrest and WLST was calculated to determine whether a difference in early WLST contributed to differences in outcome between groups.

The following data were also collected to examine for differences in care during hospitalization: number of patients who underwent cardiac catheterization, extracorporeal membrane oxygenation (ECMO), intra-aortic balloon pump, left ventricular assist devices, and dialysis. Laboratory values during the first 72 hours were also obtained: lowest pH, highest lactate, highest bilirubin, highest creatinine, lowest platelet count, and lowest PaO₂.

Anonymized data will be shared on request.

Standard Protocol Approvals

The Institutional Review Board approved this study and waived the need for informed consent for subjects included in this study.

Statistical Analysis

Comparative statistics (Student's t-test, Fisher's exact, Wilcoxon) were used as appropriate. Significant univariate results were evaluated by a multivariate logistic regression model with dichotomized CPC outcome as dependent variable. To control for effect of anoxic brain injury at presentation, a subgroup analysis was performed in patients who presented without EEG/CT changes. Calculations were performed using R 3.3.2 (www.R-project.org).

Results

Over the period of this study (April 2009 – October 2016), TTM was administered to 391 patients at the Brigham and Women's Hospital. Of these, 367 patients were included as study subjects (Table 1).

The underlying racial/ethnic distribution of the study population (Table 1) differed significantly from the underlying racial/ethnic distribution of patients presenting to the emergency department of our institution, which is approximately 78% White non-Hispanic, 16% Black, 2% White Hispanic, and 3% Asian ($\chi^2 = 24.1$, $p < 0.0001$). Post-hoc analysis revealed that the increased number of the Hispanic population was the sole significant contributor to this change in distribution ($p < 0.0001$).

White patients had a higher chance of a good outcome than Non-white patients (34.4% vs 21.7%, $p=0.015$, Table 2). Review of individual CPC scores reveal that there was a significantly greater proportion of patients with CPC 1 and 2, and significantly fewer patients with CPC 4, in the cohort of White patients. There was a non-significant trend towards fewer patients with CPC 3 and 5. White patients had a higher chance of good outcome as compared to every other group, but this reached statistical significance only compared to Hispanic patients ($p=0.04$, Table 3). Non-white patients were more likely to have early severe EEG/CT anoxic changes (25.0% vs 15.8%, $p=0.03$), and a trend towards any early EEG/CT anoxic changes. Non-white patients were also less likely to have private insurance (34.2% vs 53.6%, $p<0.0001$), and showed a trend towards higher CCI. There were no differences in ROSC time or rhythm. Early EEG and CT availability were similar in the two groups (White vs Non-white EEG: 61.9% vs 56.7%; CT: 81.8% vs 80.8%; combined CT/EEG: 89.9% vs 89.2%).

White and Non-white patients underwent a nearly identical proportion of cardiac catheterizations, left ventricular assist devices, or MRI scans. There was a nonsignificant trend towards greater proportion of White patients who underwent insertion of an intra-aortic balloon pump (White: 15.4% vs Non-white: 9.2%). A significantly greater proportion of Non-white patients received dialysis (White: 6.9% vs Non-white 15.8%, $p=0.005$).

White patients had significantly lower peak creatinine levels within the first 72 hours as compared to Non-white patients (1.40 vs 1.81 mg/dL, $p=0.01$). They also had lower peak lactate levels (5.25 vs 5.70 mmol/L), though this did not meet statistical significance. There was no difference between peak bilirubin or nadir pH/platelet levels between the two groups.

Patients with good outcome were more likely to be younger, with shorter median ROSC times (Table 3). Age ($p<0.001$), EEG/CT ($p<0.0001$), rhythm ($p<0.0001$), ROSC time ($p<0.0001$), race/ethnicity ($p=0.015$), CCI ($p=0.0001$), and private insurance ($p=0.009$) were significant in univariate models. In a multivariate model, age, EEG/CT findings, rhythm, ROSC time, and race remained significant independent predictors of good outcome, while CCI and insurance status no longer met statistical significance.

Subgroup analysis of the 282 patients with neither CT nor early EEG findings of anoxic brain injury found that race, age, rhythm, ROSC time, CCI, and private insurance remained independent univariate predictors of good outcome (Table 4). In multivariate analysis, race, age, pulse, and ROSC time remained significant independent predictors of good outcome, while CCI and insurance status again were no longer significant.

All deaths during hospitalization were due to WLST. In these patients, time from hospitalization to WLST was significantly lower in White (mean 5.4 ± 4.9 days) as compared to Non-white patients (mean 8.1 ± 8.4 days, $p=0.0098$, Table 2). Mean time to WLST was shorter in White patients as compared to every other racial/ethnic group (Asian: 14.3 days, Hispanic: 8.3 days, Black: 7.0 days). Differences in mean time to WLST persisted with or without private insurance (private insurance: White 5.2 ± 5.1 days, Non-white 8.5 ± 8.7 days; non-private insurance: White 5.6 ± 4.6 days, Non-white 7.9 ± 8.3 days).

Discussion

Racial/ethnic disparities in health and outcomes exist across a range of conditions in the United States. In this study, White patients were more likely to have a better outcome than Non-white patients after undergoing post-cardiac arrest TTM. Our data is in agreement with other recent work showing that long-term one-year survival and neurological recovery at one year is worse for black and Hispanic patients than for White patients (16, 17). In addition, a large longitudinal study found that older black survivors of in-hospital cardiac arrest had lower long-term survival compared with White patients (7).

We examined several possibilities that could account for this disparity: 1) White patients may be brought to medical attention more quickly than Non-white patients; 2) treatment response is influenced by patient-specific differences between White and Non-white patients; or 3) there are differences in treatment between White and Non-white patients.

Our data suggest that White patients may, indeed, be brought to medical attention more quickly, thereby sustaining less severe anoxic brain injury by the time ROSC is achieved and TTM is initiated. This is demonstrated by our findings of Non-white patients having evidence of anoxic brain injury on early CT scans or highly malignant EEG during the first 24 hours, and higher peak 72-hour lactate levels. Peak creatinine levels were significantly higher in Non-white patients, though this may also be due to pre-existing medical comorbidities. Non-white patients also had slightly higher peak 72-hour lactate levels, though this did not reach statistical significance. Even after adjusting for the presence of evidence for anoxic injury, however, White patients still had more favorable outcomes.

We also found patient-specific differences between White and Non-white patients, specifically in the rates of medical comorbidities as assessed by the CCI, which has been validated in previous TTM studies (18). White patients had lower CCI scores than Non-white patients, though this did not reach statistical significance. Nonetheless, observed disparities persisted after accounting for CCI, suggesting the observed disparities in outcome are not solely explained by medical comorbidities pre-dating the cardiac arrest.

Differences in treatment between White and Non-white patients, including unmeasured subconscious provider bias, present a potential factor in differences in outcome. This is minimized in this population in several respects. The hospital TTM protocol ensures minimization of differences in treatment between patients. We carefully considered whether differences around WLST may have contributed to outcomes, particularly since WLST decisions are made on a case-by-case basis at our institution. This is unlikely to be the case for two reasons. Amongst patients with poor outcome, our data revealed a greater proportion of CPC 4 (coma or vegetative state) in Non-white patients as compared to White patients. In our cohort, there was a significantly shorter time to WLST in White patients compared to Non-white patients; this difference in WLST may have increased the proportion of CPC 5 outcomes in White patients and resulting in an under-estimation of the difference in outcomes. Previous studies have demonstrated WLST is less likely in Non-white patients than in White patients due to factors such as lack of advanced directives, cultural differences regarding WLST, and differences in trust in medical staff in Non-white patients (19, 20).

Taken together, we conclude that early WLST is not the etiology of ethnic/racial outcome differences.

As some studies have found that Non-white patients receive fewer medical interventions (21, 22), we considered whether there was a difference in the number of procedures performed on Non-white versus White patients in our study. We found no statistically differences in cardiac procedures performed, though there was a non-statistically significant increase in intra-aortic balloon pumps deployed in White patients compared to the Non-white cohort. There was a statistically significant increase in the rate of dialysis performed in Non-white patients. The small difference in intra-aortic balloon pumps likely represents a difference in number potentially eligible patients, although further study is needed to ensure that no systematic biases are present. The difference in the number of patients undergoing dialysis likely reflects greater incidence of renal insufficiency in Non-white patients, as evidenced by the greater peak creatinine levels in this group.

It is possible that other unmeasured treatment differences or post-TTM protocol care differed between groups. As such, our data suggests multiple reasons for poorer outcomes in Non-white patients, including presentation with early severe anoxic injury, greater number of comorbidities, and potentially other yet-unidentified risk factors. There is no evidence in the literature regarding any intrinsic difference in response to TTM between racial/ethnic groups, but this should be considered given these results.

There are several strengths to this study. The hospital TTM procedure is protocolized, which results in little deviation in treatment and uniform delivery of care to all patient groups and decreases risk of provider bias. We have identified patients presenting with early severe anoxic injury patients using early EEG and CT scans, allowing for the evaluation of outcome after this critical variable is controlled for.

There are several limitations to this study. This was a single center retrospective study, and the small number of patients in some race cohorts limited our ability to detect additional potential outcome differences. In most instances, race and ethnicity were self-reported and lacked objective verification. It is important to note that our classification of Non-white includes White Hispanic patients. Race and ethnicity were combined into a single parameter, particularly with respect to Hispanic patients, as Hispanic patients had outcomes similar to Non-white patients in this study, and because previous studies had observed similar poorer outcome in Hispanic patients (16); similarly, an analysis of White Non-hispanic+Hispanic vs all other groups result in only a non-significant trend towards better outcome in White patients in our cohort. Non-white patients also currently constitute the racial/ethnic minority as per United States Census Bureau (12), further justifying this classification, though we chose not to utilize the non-biological categories of “Majority” and “Minority”. We recognize this approach may not provide be optimal to understanding the racial and ethnic composition of our study population. For example, these categories do not capture more granular components of race, such as individuals with multi-racial or multi-ethnic background, particularly with respect to Hispanic patients. Although race and ethnicity categorizations follow the United States federal guidelines, these categorizations will not necessarily represent valid categorizations outside the United States. Even with a mechanism

to measure such complexities in our patient cohort, however, our study is not powered sufficiently to measure outcome differences between groups.

Outcome was determined at hospital discharge, rather than long term. While some studies have found that hospital discharge outcome does not necessarily translate into similar long-term outcome (16), other studies have demonstrated that hospital discharge CPC correlates closely with long-term outcome and survival (17, 23). We have chosen hospital outcome to avoid confounding race/ethnicity differences in post-hospital care that may critically affect long-term outcome.

Early CT and EEG changes were used as objective proxy measures of the severity of the anoxic brain injury at time of admission. CT scans changes are specific but not particularly sensitive to early anoxic brain injury (24, 25). For this study, only the first 24-hours of EEG was utilized as a marker of early injury. The rating scale used for early EEG, particularly the omission of a suppressed background as a sign of early injury, may miss more subtle findings of early anoxic injury, thus underestimating the effect of increased early anoxic brain injury in Non-white patients. Including the final EEG reading, however, would not have provided a reasonable proxy for early injury as there is potentially ongoing injury during and after TTM initiation (26). The limitations in evaluating early EEGs likely explains the presence of a single patient with good outcome with a malignant EEG, even though previous studies have shown near perfect specificity for poor outcome (15). Despite this potential limitation, the combination of either an early CT or EEG finding likely is more sensitive than either modality by itself in identifying early severe anoxic brain injury. We did not grade CT scans in this study. Although there are studies grading the severity of CT scans, it has been found to be specific only with severe changes (24).

Our findings suggest that improving rapid access to medical attention after cardiac arrest and optimizing baseline outpatient medical comorbidities may decrease the observed outcome disparities, but other, yet unmeasured factors likely contribute as well. Further investigation is required to determine the remaining factors contributing to racial/ethnic disparities in post-cardiac arrest TTM outcomes.

Conclusions

Non-white (Black, Hispanic, Asian) patients have poorer outcome at hospital discharge as compared to White non-Hispanic patients. This is, in part, due to the greater proportion of patients in these groups presenting with early anoxic brain injury and higher pre-admission burden of medical comorbidities. Racial/ethnic disparities remain even after accounting for these differences, and are not associated with earlier WLST.

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Table 1:

Characteristics of study population (total 367 patients)

Variable	Number (%)
Female gender	131 (36%)
Discharge destination	
Home	30 (8.2%)
Home with services	21 (5.7%)
Rehabilitation Facility	70 (19.1%)
Hospital/inpatient facility/LTAC	10 (2.7%)
Dead	236 (64.4%)
Ethnicity	
White non-Hispanic	247 (67%)
White Hispanic	39 (11%)
Black	70 (19%)
Asian	11 (3%)
Initial CT head score	
Normal	245 (67%)
Evidence of Anoxic Injury	44 (12%)
Other	10 (3%)
No CT head	68 (19%)
Initial EEG feature	
Malignant Features	31 (8%)
No malignant features	196 (53%)
No early EEG	140 (38%)

Table 2:

Race/Ethnicity and main outcome predictors

Variable	White (n=247)	Non-white (n=120)	Statistical test (p-value)
Outcome			Fisher's exact (p=0.015)
Good (CPC 1–2)	85 (34.4%)	26 (21.7%)	
Poor (CPC 3–5)	162 (65.6%)	94 (78.3%)	
CPC			χ^2 (p=0.00078)
CPC=1	51 (20.6%)	15 (12.5%)	p=0.017
CPC=2	34 (13.8%)	11 (9.2%)	p=0.036
CPC=3	6 (2.4%)	7 (5.6%)	p=NS
CPC=4	1 (0.4%)	6 (5.0%)	p=0.037
CPC=5	155 (62.8%)	81 (67.5%)	p=NS
Age: mean yrs (stdev)	56.6 (17.7)	58.9 (17.1)	t-test (p=0.23)
ROSC: median min (IQR)	25 (15, 35)	20 (15, 32)	Wilcoxon (p=0.11)
CCI: mean (stdev)	2.0 (2.2)	2.4 (2.4)	t-test (p=0.14)
Insurance status (%)			Fischer's exact (p<0.0001)
Private	157 (63.6%)	41 (34.2%)	
Public/none	90 (36.4%)	79 (65.8%)	
Rhythm type (%) *			Fischer's exact (p=0.31)
VT/VS/Shockable	108 (43.7%)	46 (38.3%)	
PEA/Asystole	136 (55.1%)	74 (61.7%)	
EEG/CT malignant (%) *			Fisher's exact (p=0.23)
Highly malignant **	39 (15.8%)	30 (25.0%)	Fisher's exact (p=0.03)
Any malignant **	53 (21.5%)	32 (26.7%)	Fisher's exact (p=0.23)
Nonmalignant	169 (68.4%)	74 (61.7%)	
Unavailable	25 (10.1%)	14 (11.7%)	
In-house arrest (%)	14 (5.7%)	4 (3.3%)	Fisher's exact (p=0.44)
Procedures (%)			
Catheterization	98 (39.7%)	41 (34.2%)	Fischer's exact (p=0.30)
ECMO	4 (1.6%)	6 (5.0%)	Fischer's exact (p=0.086)
Intra-aortic balloon pump	38 (15.4%)	11 (9.2%)	Fischer's exact (p=0.14)
Left ventricular assist device	4 (1.6%)	1 (0.8%)	Fischer's exact (p=1.00)
Dialysis	17 (6.9%)	19 (15.8%)	Fischer's exact (p=0.005)
MRI	78 (31.6%)	34 (28.3%)	Fischer's exact (p=0.55)
Labs			
pH: median (IQR)	7.23 (7.12, 7.29)	7.22 (7.11, 7.29)	Wilcoxon (p=0.78)
PaO ₂ : median mm Hg (IQR)	66.00 (49.00, 80.00)	62 (46.25, 78.75)	Wilcoxon (p=0.40)
Lactate: median mmol/L (IQR)	5.25 (2.70, 8.90)	5.70 (3.20, 9.00)	Wilcoxon (p=0.52)
Bilirubin: median mg/dL (IQR)	0.70 (0.50, 1.20)	0.70 (0.40, 1.10)	Wilcoxon (p=0.77)

Variable	White (n=247)	Non-white (n=120)	Statistical test (p-value)
Creatinine: median mg/dL (IQR)	1.40 (1.12,2.28)	1.81 (1.29, 3.01)	Wilcoxon (p=0.01)
Platelet: $\times 10^3/\text{mL}$ median (IQR)	153 (103, 194)	141 (90, 177)	Wilcoxon (p=0.09)
WLST: mean days (stdev)	5.4 (4.9)	8.1 (8.4)	t-test (p=0.0098)

Cerebral Performance Category (CPC), Charlson Comorbidity Index (CCI). Withdrawal of life sustaining therapy (WLST).

* Pulseless rhythm unavailable in 3 White patients. CT/EEG not available in 25 White and 13 Non-white patients.

** "Highly malignant: CT with anoxic changes or highly malignant EEG; Any malignant: CT with anoxic changes or any malignant features on EEG. Note that "Highly malignant" is a subset of "Any malignant"

Table 3:

Predictors of outcome

Variable	CPC 1–2	CPC 3–5	Univariate (p-value)	Multivariate OR (p value)
Full cohort	111	256		
Age: mean yrs (stdev)	51.4 (16.6)	59.9 (17.3)	(p<0.001) ^a	0.96 (p=0.0001)
ROSC: median (IQR)	17.5 (10.3,25.8)	25.5 (15.0,40.8)	(p<0.001) ^b	0.96 (p=0.0006)
CCI: mean (stdev)	1.5 (1.8)	2.4 (2.4)	(p=0.0001) ^a	0.92 (p=0.39)
Insurance status (%)			(p=0.003) ^c	1.04 (p=0.9)
Private	73 (65.8%)	125 (48.8%)		
Public	38 (34.2%)	131 (51.2%)		
Rhythm type (%) *			(p<0.0001) ^c	10.49 (p<0.0001)
VT/VS/Shockable	84 (75.7%)	70 (27.3%)		
PEA/Asystole	27 (24.3%)	183 (71.5%)		
EEG/CT (%)			(p<0.0001) ^c	52.85 (p=0.0002)
Malignant	1 (0.9%)	84 (32.8%)		
Nonmalignant	99 (89.2%)	144 (56.3%)		
Unavailable	11 (9.9%)	28 (10.9%)		
Race/Ethnicity (%)				
White Non-hispanic	85 (76.6%)	162 (63.3%)	(p=0.015) ^c	3.32 (p=0.003)
Others	26 (23.4%)	94 (36.7%)		
Black	18 (16.2%)	52 (20.3%)		
Hispanic	7 (6.3%)	32 (12.5%)	p=0.04 ^c	
Asian	1 (0.9%)	10 (3.9%)		
In-house arrest (%)	2 (1.8%)	12 (4.7%)	p=0.24 ^c	
Labs				
pH: median (IQR)	7.26 (7.19, 7.31)	7.21 (7.08, 7.27)	(p<0.0001) ^b	
PaO ₂ : median mm Hg (IQR)	67.0 (51.5, 80.0)	64.0 (48.0, 79.0)	p=0.44 ^b	
Lactate: median mmol/L (IQR)	3.95 (2.28, 6.40)	6.60 (3.40, 9.70)	(p<0.0001) ^b	
Bilirubin: median mg/dL (IQR)	0.70 (0.50, 1.10)	0.70 (0.50, 1.20)	p=0.77 ^b	
Creatinine: median mg/dL (IQR)	1.16 (0.90, 1.70)	1.82 (1.31, 2.87)	(p<0.0001) ^b	
Platelet: ×10 ³ /mL median (IQR)	155 (110, 197)	143.0 (94, 180)	p=0.11 ^b	

Cerebral Performance Category (CPC), Charlson Comorbidity Index (CCI)

^a = t-test^b = Wilcoxon^c = Fisher's exact.

* Pulseless rhythm unavailable in 3 patients

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Table 4:

Predictors of outcome in patients without early EEG/CT findings

Variable	CPC 1–2	CPC 3–5	Univariate (p-value)	Multivariate OR (p value)
Cohort	110	172		
Age: mean (stdev)	51.5 (16.7)	62.3 (16.9)	(p<0.001) ^a	0.96 (p=0.0001)
ROSC: median (IQR)	17.0 (10.0, 25.0)	25.0 (15.0, 37.8)	(p<0.0001) ^b	0.96 (p=0.0009)
CCI (stdev)	1.5 (1.8)	2.6 (2.4)	(p<0.0001) ^a	0.92 (p=0.40)
Insurance status ^d			(p=0.02) ^c	1.15 (p=0.70)
Private	73 (66.4%)	89 (51.7%)		
Public	37 (33.6%)	83 (48.3%)		
Rhythm type ^e			(p=0.0001) ^c	9.93 (p<0.0001)
VT/VS/Shockable	83 (75.5%)	51 (29.0%)		
PEA/Asystole	27 (24.5%)	118 (69.4%)		
Race/Ethnicity				
White Non-Hispanic	84 (76.3%)	110 (64.0%)	(p=0.035) ^c	3.10 (p=0.005)
Others	25 (22.7%)	63 (33.9%)		
Black	18 (16.4%)	34 (18.3%)		
Hispanic	6 (5.5%)	23 (12.4%)		
Asian	1 (0.9%)	6 (3.2%)		

Cerebral Performance Category (CPC), Charlson Comorbidity Index (CCI)

^a = t-test^b = Wilcoxon^c = Fisher's exact^d = insurance status indeterminate in 14 patients^e = rhythm indeterminate in 3 patients