Overall survival and brain death frequency following out-of-hospital cardiac arrest

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ABSTRACT

Out-of-hospital cardiac arrest (OHCA) is a major cause of mortality that is responsible for over 300,000 deaths in the United States each year. Underlying cardiac etiologies remain the most common culprit. Despite medical advances in the treatment of coronary artery disease, the mortality following OHCA remains dismal. Additionally, of those who survive the initial event, many are left with debilitating and irreversible anoxic brain injuries. Therefore, improving survival as well as neurologic outcome is of primary importance in this group. Our goal was to evaluate the underlying etiologies, neurologic outcomes, and cardiac interventions being performed in patients with OHCA presenting to our large tertiary care center. We retrospectively reviewed 181 charts of patients presenting to our emergency department over a 1-year time period with a diagnosis of OHCA. Following exclusion criteria, 130 patients remained, with 17 of those surviving to hospital admission. Of the 17 initial survivors, only 9 survived to hospital discharge and only 6 of those obtained good neurologic outcomes. Additionally, there was no mortality benefit in the 4 patients who had coronary angiography or percutaneous intervention.

KEYWORDS Brain death; cardiac arrest; emergency department

Approximately 325,000 people are affected by out-of-hospital cardiac arrest (OHCA) in the United States annually.¹ Survival rates to hospital discharge in the United States vary from 3.4% to 22%.² Coronary artery disease remains the most common etiology of sudden cardiac arrest.³ However, it is not clear whether survival after OHCA improves with immediate percutaneous coronary intervention (PCI).⁴ Additionally, a critical goal for patients surviving OHCA is obtaining good neurologic outcome. Despite improvements in cardiopulmonary resuscitation (CPR) and hypothermia protocols, preventing hypoxic brain damage sustained during and after cardiac arrest remains a major challenge.^{5,6} Because obtaining coronary reperfusion will not improve the quality of life of patients who have sustained an irreversible neurologic injury, some physicians have favored awaiting signs of neurologic recovery and hemodynamic stabilization prior to obtaining coronary angiography. Our objective was to evaluate the underlying etiologies, survival, neurologic outcomes, and cardiac interventions being performed in patients presenting to our large tertiary care center with a diagnosis of OHCA. We tracked the clinical presentation, sex, age, initial presenting rhythm, electrocardiogram following return of spontaneous circulation, and trends of survival to discharge.

METHODS

Patients were identified using a search for the associated *International Classification of Diseases*, Ninth Revision, diagnosis of cardiac arrest. Retrospective chart review was performed on all patients presenting to the Baylor University Medical Center emergency department with a diagnosis of OHCA from November 2014 to November 2015. Exclusion criteria included patients <20 years of age and those who had experienced drowning or trauma. The primary outcome was evaluation of survival with good neurologic recovery and determining whether coronary interventions were performed.

RESULTS

A total of 181 patients met the criteria for OHCA between November 2014 and November 2015. Following exclusion criteria, 130 patients remained for analysis. Of the 130 patients, 85 (65%) were men. The average age of patients was 63 years. All of the patients presenting to the emergency department were initially unconscious without a pulse. The most common description of clinical presentations prior to OHCA included patients “found down” ($n = 58$, 45%), chest pain ($n = 23$, 18%), syncope ($n = 16$, 12%), and dyspnea ($n = 9$, 7%). Most presented with pulseless electrical activity or asystole as their initial rhythm ($n = 105$, 81%). Only 17 patients (13%) survived to hospital admission, and only 9

Figure 1. Patient flowsheet from emergency department to discharge.

(7%) survived to hospital discharge. Of the 9 patients who survived to discharge, 6 obtained good neurologic outcomes as determined by hospital discharge summaries showing that they were alert, oriented, and able to ambulate without any focal deficits (*Figure 1*). Three of the survivors suffered severe anoxic brain injuries following arrest and were not oriented or able to ambulate on discharge. Only one of the survivors had a history of a prior cardiac arrest.

Of the 17 initial survivors, 4 had ischemic changes on the post-return of spontaneous circulation electrocardiogram. In total, 4 patients obtained coronary angiography: one without evidence of coronary artery disease, one with stable multivessel coronary artery disease, one with an aortic root dissection, and one with a 100% thrombotic occlusion of the left anterior descending artery (LAD). Only one patient who obtained coronary angiography received percutaneous coronary intervention for an occluded LAD artery but did not survive to discharge (*Table 1*).

There was a slight difference in the age of survivors compared to those who did not survive to discharge (60 vs 64). The survivors included 8 men and one woman: 6 presented with ventricular fibrillation or ventricular tachycardia and 3 with asystole/pulseless electrical activity.

Table 1. Comparison of patient characteristics among all patients versus those surviving to discharge

Variable	All patients (n = 130)	Survivors (n = 9)
Average age (range)	63 (20–99)	60 (20–83)
Men	85	8
Shockable rhythm	25	6
ST elevation or left bundle branch block on electrocardiogram	4	1
Coronary angiography performed	4	2
Percutaneous coronary intervention performed	1	0

DISCUSSION

In our relatively small, real-world cohort of patients with a diagnosis of OHCA, survivors were more likely to be slightly younger, be male, and present with a shockable rhythm. Although there is notable variation in previously reported survival studies, our survival rate to discharge is similar to previously reported data (7% vs 7.5%).⁷ Our predominance of male patients presenting with OHCA has been seen in previous studies.^{8,9} We suspect that this is likely largely secondary to more male patients with underlying cardiac disease. Despite increased longevity seen in women, this gender difference for OHCA survival among males has also been noted previously, even after adjusting for baseline differences.¹⁰ Possible hypotheses for this include the rate of bystander CPR for men with witnessed arrests and more male patients with underlying cardiac etiology of arrest.^{11,12} Not surprisingly, younger patients were more likely to survive to discharge. Additionally, the improved outcomes with shockable compared to nonshockable rhythms has been noted for many years.¹³

Three of the 4 patients who had evidence of ST elevation or left bundle branch block were taken for emergent catheterization. Patients with evidence of ischemia were more likely to go for catheterization despite studies suggesting that postresuscitation electrocardiograms may not be reliable in determining myocardial ischemia.¹⁴ Contrary to some previously reported studies, our patients who received coronary angiography or PCI showed no improvement in survival, but very few candidates for angiography were seen in this cohort. Only one patient received PCI for a 100% thrombotic lesion to the LAD and expired after the procedure. Review of the history and presentation of the limited number of survivors suggested some obvious noncardiac etiologies of their arrest, including heroin overdose, hypoglycemia, hyperkalemia, and electrocution.

Two patients in our study were monitored for improvement in neurologic function and hemodynamic stability prior to coronary angiography. The patients were monitored for 2 days on average following OHCA. Although neither required a PCI, both survived until hospital discharge with good neurologic function, suggesting that monitoring patients prior to angiography may be a reasonable strategy.

Perhaps more important than survival is regaining neurologic function following an arrest. Both the duration of CPR

and increased time down until initiation of CPR are associated with worsened neurologic outcomes.^{15,16} Advances such as initiation of and improvements in hypothermia protocols have shown beneficial neuroprotective effects in comatose patients following cardiac arrest.¹⁷ Of note, 5 of the survivors to initial hospital admission in our study had eventual withdrawal of life-sustaining treatment after discussions with family regarding their irreversible neurologic injuries. Three of the 9 who survived to discharge also sustained severe anoxic brain injuries preventing them from ambulating or participating in meaningful conversation. These statistics illustrate how an improvement in neurologic outcome rather than solely survival of OHCA is the primary goal.

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