A Routine Invasive Strategy for Out-of-Hospital Cardiac Arrest Survivors
Are We There Yet?

Sripal Bangalore, MD, MHA; Judith S. Hochman, MA, MD

Out-of-hospital cardiac arrest (OHCA) is estimated to afflict approximately 236,000 to 325,000 people in the United States annually,1 with wide regional1 and interhospital3 variation in the survival to discharge rates. The prospective, multicenter registry of OHCA in 8 US and 3 Canadian emergency medical service (EMS) agencies and receiving institutions (ROC Epistry–Cardiac Arrest) serving an area of 21.4 million people reported a survival to discharge rate of a mere 1.1% to 8.1% for all EMS-assessed OHCAs, 3.0% to 16.3% for EMS-treated, and 7.7% to 39.9% for patients who presented with ventricular fibrillation.1 Of note, these reported rates are for all EMS-assessed or EMS-treated OHCA regardless of whether there was return of spontaneous circulation (ROSC) before hospital entry. In patients with ROSC at hospital entry, the survival to discharge rate ranges from 10% to 42%.2-7 With the initiation of a community-wide early defibrillation program, White et al8 reported that in patients with ventricular fibrillation and sustained ROSC after defibrillation (only in the field), the survival to discharge rate was a remarkable 87%. Thus, there is wide variation in reported rates of survival depending on the cohort reported and the regional systems of care. There are great opportunities to further improve outcomes in OHCA. In this setting, the role of urgent cardiac catheterization and percutaneous coronary intervention (PCI) is of great interest.

In patients with cardiac arrest (predominantly due to ventricular fibrillation) up to 71% have coronary artery disease and 50% have acute coronary artery occlusion.9,10 Prior studies have shown that in postcardiac arrest patients with ST elevation on ECG, PCI was associated with angiographic success rates of 78% to 95% and overall survival to discharge rates of 44% to 75%.11-13 The 2008 consensus statement on post–cardiac arrest syndrome therefore recommends immediate angiography and subsequent PCI (or thrombolytic therapy if PCI is unavailable), if indicated, in patients resuscitated from cardiac arrest who have ECG criteria for ST-segment elevation myocardial infarction.14 This recommendation is not intended for patients with ongoing cardiopulmonary resuscitation (CPR). Recently concluded randomized trials of fibrinolytic therapy in patients with ongoing CPR have not demonstrated improved outcomes compared with the usual care group.15,16 Because chest pain after cardiac arrest and absence of ST-segment elevation are poorly correlated with the presence or absence of acute coronary occlusion in post–cardiac arrest patients,9 the consensus statement states that “it is appropriate to consider immediate coronary angiography in all postcardiac arrest patients in whom acute coronary syndrome is suspected,” a recommendation that is not as strong as that for the ST-segment elevation cohort.

In this issue of the Journal, Duman et al17 make an important contribution to this literature with a report of encouraging data from the Paris PROCAT registry that suggest improved hospital survival with a routine invasive strategy, regardless of the ECG pattern, in 435 survivors with OHCA (with no obvious extracardiac cause) and ROSC in the field. Coronary angiography revealed at least 1 significant coronary artery lesion in 70% of patients: 96% in those with ST-segment elevation on ECG performed after ROSC and 58% in those without ST-segment elevation. The hospital survival rate was relatively high (40%), and successful coronary angioplasty compared with failed PCI or no PCI was independently associated with survival regardless of whether the postresuscitation ECG showed ST elevation or another pattern (no ST elevation). They recommend the use of immediate coronary angiography in survivors of OHCA with no obvious noncardiac cause of arrest regardless of the ECG pattern. Are we there yet?

For perspective, the variation in regional systems of care and the cohort studied is worth highlighting. In PROCAT, of the 714 patients with ROSC admitted to the intensive care unit, the majority, 435 (61%) patients, were considered to have no obvious extracardiac cause for the arrest and were taken for immediate angiography. In Paris, unlike the United States, the field emergency team includes at least 1 trained physician who reports to a central command center. This cohort, selected for immediate angiography, had exceptional prehospital care with time from collapse to basic life support (BLS) of <5 minutes and time from BLS to ROSC of <15 minutes in half the cohort; 68% had ventricular fibrillation. The reported rates of bystander CPR in the United States are

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

From the Brigham and Women’s Hospital (S.B.), Boston, Mass; Harvard Clinical Research Institute (S.B.), Boston, Mass; and New York University School of Medicine (J.S.H.), Cardiovascular Clinical Research Center, New York, NY.

Correspondence to Judith S. Hochman, MD, Harold Snyder Family Professor of Cardiology, New York University Langone Medical Center, Skirball 9R, 530 First Ave, New York, NY 10016. E-mail Judith.Hochman@nyumc.org

© 2010 American Heart Association, Inc.

Circ Cardiovasc Interv is available at http://circinterventions.ahajournals.org

DOI: 10.1161/CIRCINTERVENTIONS.110.957241
low (19% to 31%), with a median time from call to first EMS rhythm analysis of over 9 minutes. However, with organized regional systems of care, such as that reported by White et al, the bystander CPR rate can be as high as 41% to 50% and the call-to-shock time just over 6 minutes. The majority of patients in PROCAT received therapeutic hypothermia, which was infrequently used in the United States during a comparable period. In patients with ST-segment elevation (31% of this cohort), the study adds to the growing data on the importance of primary PCI in post–cardiac arrest patients with ROSC. The overwhelming majority (96%) with ST elevation in the PROCAT cohort had at least 1 significant coronary stenosis; PCI was attempted in 86% of patients with a significant lesion and was successful in 90% of those who underwent PCI. Thus, 74% of patients with ST elevation had a successful PCI, and this translated into a survival rate of 54%, compared with a survival rate of 31% (P<0.001) in ST-elevation patients with failed or no PCI.

In contrast, interpretation of the findings in patients without ST-segment elevation is more challenging. The percentage of no ST-elevation patients with troponin <2.3 (minimal or no elevation) was 49% in this cohort. Making the diagnosis of an acute coronary event as the primary event leading to arrest when there is no ST elevation and only low-level troponin elevation in a cohort of patients who received CPR/defibrillation is very difficult in the absence of confirmation of an acute culprit. Only 58% of all no ST-elevation patients had at least 1 significant coronary stenosis, in contrast to 96% with ST elevation, and no information is provided regarding culprit lesions. PCI was attempted in only half of the no ST-elevation patients who had a significant lesion; it was successful in 85% of those in whom it was attempted. Therefore, among all patients without ST-segment elevation, only 26% had successful PCI, and this was associated with a 47% survival rate compared with 31% survival rate (P<0.001) in patients with failed or no PCI. It is unknown why the operators chose to attempt PCI on only half of these patients with significant lesions (chronic total occlusion, diffuse disease, disease in a distal branch vessel, no clear culprit, etc) but it is likely that those with disease who were not selected for PCI were poor candidates with a worse prognosis. Among the reasons for failed PCI, 52% were due to inability to cross the lesion with a guide wire or balloon, suggesting chronic lesions. Moreover, angiographic data reporting lesion characteristics were not presented, and it not known if the operators followed any algorithm to attribute a lesion as the likely cause for the cardiac arrest or merely attempted PCI on lesions with a high likelihood of success, thus introducing bias. In many studies of PCI for chronic total occlusions, higher survival rates have been shown in patients with procedural success compared with those with a failed procedure. However, this has usually been attributed more to a greater extent and severity of the atherosclerotic process and greater comorbidities in the failed group. This was illustrated in a subacute occlusion population in which the event curves were superimposable for those with successful PCI versus those assigned to no PCI, in contrast to numerically higher event rates for those with failed PCI. It is therefore unknown if the higher survival rates observed with successful PCI in patients without ST-segment elevation is a reflection of a higher-risk comparator group.

A similar study from the same region (Paris) noted that only 32% of patients with OHCA and ROSC had ST-segment elevation on hospital admission (similar to PROCAT) and only a minority (38%) overall had clinical or angiographic evidence of acute coronary syndrome. A final diagnosis of myocardial infarction was assigned to only 38% of patients (21 of 23 with ST elevation versus only 6 of 49 with no ST elevation); 33% had successful PCI. The reported overall hospital survival rates in the same regional system of care as PROCAT was high (49%), and there was no suggestion of PCI being associated with survival in this smaller study of 72 patients. In the PROCAT study, PCI was successful in 41% of patients and the overall hospital survival was 39%. It therefore leads us to wonder how much of the benefit in patients without ST-segment elevation is due to the regional systems of care (faster response time, faster arrest to BLS time, BLS to ROSC time, use of hypothermia, etc). Of note, there was only a 22% survival in those with BLS to ROSC time of >15 minutes and 29% in those with arrest to BLS time of ≳5 minutes. Whether a routine invasive strategy should be adopted for all patients or be applied to select group of patients (those with ST-segment elevation, those with short times to ROSC) remains to be determined. There is a need for more robust data and, ideally, a randomized trial.

Based on the current body of evidence, including this largest cohort of postarrest ROSC patients, it is prudent to adopt a routine invasive strategy for suitable OHCA survivors with ST-segment elevation. It is likely that a select group of patients without ST-segment elevation, such as those with acute circumflex occlusion (posterior myocardial infarction) or critical left main disease may benefit from emergent coronary angiography. Therefore, it is prudent to consider immediate coronary angiography where there is high index of suspicion of acute occlusion and emergency PCI in select patients if angiography suggests an acute culprit. Whether a routine emergent invasive strategy is beneficial in all postarrest patients with ROSC and no ST elevation on ECG is yet to be determined. More widespread use of PCI performed for postarrest patients who have not promptly regained consciousness by the time of cardiac catheterization and may have anoxic brain damage after prolonged arrest times has implications for both for the patients and publicly reported interventionalist mortality rates. Given the extremely poor prognosis in patients with longer delays to resuscitation, even with a routine invasive strategy, in most areas the greatest need is for regional systems of care to streamline the process and promote rapid initiation of bystander chest compression. “Time is survival” for cardiac arrest.

Disclosures
None.

References

Key Words: Editorials | cardiac arrest | myocardial infarction | revascularization
A Routine Invasive Strategy for Out-of-Hospital Cardiac Arrest Survivors: Are We There Yet?
Sripal Bangalore and Judith S. Hochman

*Circ Cardiovasc Interv*. 2010;3:197-199
doi: 10.1161/CIRCINTERVENTIONS.110.957241
*Circulation: Cardiovascular Interventions* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2010 American Heart Association, Inc. All rights reserved.
Print ISSN: 1941-7640. Online ISSN: 1941-7632

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circinterventions.ahajournals.org/content/3/3/197

**Permissions:** Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Circulation: Cardiovascular Interventions* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

**Reprints:** Information about reprints can be found online at:
http://www.lww.com/reprints

**Subscriptions:** Information about subscribing to *Circulation: Cardiovascular Interventions* is online at:
http://circinterventions.ahajournals.org//subscriptions/