JACC: CARDIOVASCULAR INTERVENTIONS VOL. 4, NO. 4, 2011

ISSN 1936-8798/$36.00

PUBLISHED BY ELSEVIER INC.

DOI: 10.1016/j.jcin.2011.02.002

EDITORIAL COMMENT

Encouraging (Not Discouraging) Optimal Care for All ST-Segment Elevation Myocardial Infarction Patients*

Karl B. Kern, MD

Tucson, Arizona

In this issue of *JACC: Cardiovascular Interventions*, Ellis et al. (1) present an enhanced ST-segment elevation myocardial infarction (STEMI) risk adjustment algorithm that better accounts for noncardiac causes of mortality after primary percutaneous intervention. The investigators note that in contemporary interventional practice, noncardiac issues are major factors affecting post–percutaneous coronary intervention (PCI) outcomes. More than 50% of post-procedural deaths result from these noncardiac comorbidities.

See page 442

The investigators persuasively argue that current risk assessment for patients undergoing PCI would be greatly enhanced by incorporating certain noncardiac comorbidities into our current algorithms. This is a crucial and much-needed step if the present systems for public disclosure of quality and outcome data are to be accurate and allow meaningful comparisons.

They specifically highlight STEMI patients resuscitated from sudden cardiac death as a subgroup whose post-PCI mortality is high and is greatly influenced by noncardiac factors, namely coincident neurological injury. Appropriate risk adjustment of expected mortality for such patients undergoing emergent primary PCI is a crucial step whose time has clearly arrived.

Patients suffering cardiac arrest with their STEMI have been systematically excluded in nearly all randomized clinical trials (2–4). Their exclusion emphasizes the recognition that such patients, even with successful reperfusion of their infarct artery, are at high risk for increased mortality when compared with STEMI patients not suffering concurrent cardiac arrest (5). Only recently have some in the interventional cardiology community begun to offer such patients standard timely reperfusion therapy (primary PCI). Unfortunately, such operators and medical centers have found themselves more often penalized than rewarded for their efforts to provide optimal cardiovascular care for such patients. That penalty is manifested in public scorecards, where their reported mortality rates may be substantially higher than for operators or centers that do not provide timely reperfusion for these very sick patients.

The important questions are:

1. Should STEMI patients resuscitated from cardiac arrest be treated aggressively with emergent reperfusion similar to STEMI patients who have not suffered cardiac arrest? Does aggressive cardiac care improve the outcome in these patients with other major noncardiac risks for mortality?
2. Should the same goals, including door-to-balloon times of <90 min, be extended to post-resuscitated STEMI patients, regardless of their acute neurological status?
3. How can appropriate risk stratification and outcome expectations for the high-risk STEMI patient be incorporated into current public reporting of clinical outcomes?

Though no randomized data exist, clinical reports involving more than 1,600 post-resuscitated STEMI patients have suggested that timely reperfusion does improve outcome. Compared with well-documented historical survival rates of only 25% to 35% for out-of-hospital cardiac arrest patients, those with concurrent STEMI treated with early reperfusion (i.e., primary PCI) have a mean survival rate of 65% (5–22). Importantly, early reperfusion combined with the induction of mild systemic hypothermia results in excellent neurological function in most such survivors (23–28).

No data are available concerning door-to-balloon times in the post-resuscitated STEMI patient, but logic suggests that reperfusion in this critically ill subgroup cannot be delayed (compared with those STEMI patients not suffering cardiac arrest), without compromising the benefit of such therapy. Hence, the previously common approach of waiting until good neurological recovery can be ensured before intervention and reperfusion of the infarct artery misses the mark. A better approach is aggressive and timely reperfusion therapy for these, the sickest, of the STEMI population. Such an approach doubles survival, with more than 80% of such survivors having excellent long-term neurological function. Nonetheless, even when survival is doubled with acute reperfusion, the mortality rate in this sick subgroup is still 30% to 40%. This is greater than 10× the expected mortality rate for reperfused STEMI patients who have not had precedent cardiac arrest. Currently accepted definitions used for interhospital mortality comparison do

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the Department of Medicine, Cardiac Catheterization Laboratories, Sarver Heart Center, University of Arizona, Tucson, Arizona. Dr. Kern is a scientific advisory board member for Zoll Medical and PhysioControl Inc.

JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 4, NO. 4, 2011
APRIL 2011:449–51

not yet risk adjust to this degree because they ignore these noncardiac comorbidities. The enhanced predictive model for post-PCI mortality proposed by Ellis et al. (1) reported in this issue of *JACC: Cardiovascular Interventions* could help this imbalance, but as these investigators note, even their model is challenged by patients at the highest decile of risk "(e.g., the 0.5% of all patients undergoing 'salvage' procedures with a 44% mortality)." They suggest that "perhaps such patients should be excluded from scorecarding altogether." White and McMullan (29) spoke out similarly when they called for "compassionate use" PCI in STEMI patients resuscitated from cardiac arrest. These recognized interventional experts suggested that outcomes from post-resuscitated STEMI patients undergoing emergency PCI for reperfusion should not be included in overall mortality statistics for hospitals or individual operators. They even argued that medical centers willing to provide primary PCI for such patients should be highlighted as "Centers of Excellence," rather than inaccurately labeled as poorly performing PCI centers because of increased mortality rates when compared with peers not providing such care to the victims of cardiac arrest.

Ellis et al. (1) highlight with their report that current public reporting of mortality data for PCI does not adequately adjust for this highest risk subgroup. Interventionalists willing to provide the best possible outcomes for those suffering cardiac arrest with their STEMI are penalized with higher than expected mortality rates, whereas their peers who avoid intervention in such high-risk patients are "rewarded" statistically for withholding potentially beneficial care. This is the exact opposite of what is needed for optimal patient care.

Unfortunately, the most recent STEMI guidelines say nothing about this increasingly important impediment to providing the best care for all STEMI patients (30). It is time for all influential cardiovascular societies—the American College of Cardiology, the American Heart Association, and the Society of Cardiovascular Angiography and Interventions—to step up and deal with this issue. Providing operators and medical centers the opportunity to do what is best for the individual STEMI patient, without fear of unfair inflation of their overall reported mortality figures, could greatly influence the outcome of the 25,000 STEMI patients per year who suffer concurrent cardiac arrest. More routine aggressive therapy should double the historical survival rate from 35% to 70%, resulting in 10,000 additional lives being saved each year! The initial experience with combining primary PCI with mild therapeutic hypothermia for those cardiac arrest STEMI victims still comatose on arrival at the hospital suggests that >80% of these survivors should have normal neurological function. Such a change cannot come too soon.

Reprint requests and correspondence: Dr. Karl B. Kern, Department of Medicine, Cardiac Catheterization Laboratories, University of Arizona, Sarver Heart Center, Tucson, Arizona 85724. E-mail: kernk@email.arizona.edu.

REFERENCES

1. Ellis SG, Shishehbor MH, Kapadia SR, et al. Enhanced prediction of mortality after percutaneous coronary intervention by consideration of general and neurological indicators. J Am Coll Cardiol Intv 2011;4:442–8.
2. Grines CL, Browne KF, Marco J, et al., for the Primary Angioplasty in Myocardial Infarction Study Group. A comparison of immediate angioplasty with thrombolytic therapy for acute myocardial infarction. N Engl J Med 1993;328:673–9.
3. Zijlstra F, De Boer MJ, Hoorntje JC, Reiffers S, Reiber JH, Suryapranata H. A comparison of immediate coronary angioplasty with intravenous streptokinase in acute myocardial infarction. N Engl J Med 1993;328:680–4.
4. Hochman JS, Sleeper LA, Webb JG, et al., for the SHOCK Investigators. Early revascularization in acute myocardial infarction complicated by cardiogenic shock. N Engl J Med 1999;341:625–34.
5. Gorjup V, Radsel P, Kocjancic ST, Erzen D, Noc M. Acute ST-elevation myocardial infarction after successful cardiopulmonary resuscitation. Resuscitation 2007;72:379–85.
6. Kahn JK, Glazier S, Swor R, Savas V, O'Neil WW. Primary coronary angioplasty for acute myocardial infarction complicated by out-of-hospital cardiac arrest. Am J Cardiol 1995;75:1069–70.
7. Spaulding CM, Joly L-M, Rosenberg A, et al. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336:1629–33.
8. Lin AC-M, Shyu K-G, Cheng J-J, Kuan P-L, Chang H. Safety and efficacy of primary percutaneous transluminal coronary angioplasty for acute myocardial infarction complicated by prolonged cardiopulmonary resuscitation. Chin Electron Periodical Serv 1998;9:145–51.
9. Bulut S, Aengevaeren WR, Luijten HJ, Verheugt FW. Successful out-of-hospital cardiopulmonary resuscitation: what is the optimal in-hospital treatment strategy? Resuscitation 2000;47:155–61.
10. Borger van der Berg AE, Bax JJ, Boersma E, et al. Impact of percutaneous coronary intervention or coronary artery bypass grafting on outcome after nonfatal cardiac arrest outside the hospital. Am J Cardiol 2003;91:785–9.
11. Keelan PC, Bunch TJ, White RD, Packer DL, Holmes DR Jr. Early direct coronary angioplasty in survivors of out-of-hospital cardiac arrest. Am J Cardiol 2003;91:1461–3.
12. Bendz B, Eritsland J, Nakstad AR, et al. Long-term prognosis after out-of-hospital cardiac arrest and primary percutaneous coronary intervention. Resuscitation 2004;63:49–53.
13. Quintero-Moran B, Moreno R, Villarreal S, et al. Percutaneous coronary intervention for cardiac arrest secondary to ST-elevation acute myocardial infarction. Influence of immediate paramedical/medical assistance on clinical outcome. J Invasive Cardiol 2006;18:269–72.
14. Garot P, Lefevre T, Eltchaninoff H, et al. Six-month outcome of emergency percutaneous coronary intervention in resuscitated patients after cardiac arrest complicating ST-elevation myocardial infarction. Circulation 2007;115:1354–62.
15. Richling N, Herkner H, Holzer M, Riedmueller E, Sterz F, Schreiber W. Thrombolytic therapy vs primary percutaneous intervention after ventricular fibrillation cardiac arrest due to acute ST-segment elevation myocardial infarction and its effect on outcome. Am J Emerg Med 2007;25:545–50.
16. Marcushon E, Roguin A, Sebbag A, et al. Primary percutaneous coronary intervention after out-of-hospital cardiac arrest: patients and outcomes. Isr Med Assoc J 2007;9:257–9.
17. Werling M, Thoren AB, Axelsson C, Herlitz J. Treatment and outcome in post-resuscitation care after out-of-hospital cardiac arrest when a modern therapeutic approach was introduced. Resuscitation 2007;73:40–5.

18. Pleskot M, Babu A, Hazukova R, et al. Out-of-hospital cardiac arrests in patients with acute ST elevation myocardial infarctions in the East Bohemian region over the period 2002–2004. Cardiology 2008;109: 41–51.
19. Hosmane VR, Mustafa NG, Reddy VK, et al. Survival and neurologic recovery in patients with ST-segment elevation myocardial infarction resuscitated from cardiac arrest. J Am Coll Cardiol 2009;53:409–15.
20. Anyfantakis ZA, Baron G, Aubry P, et al. Acute coronary angiographic findings in survivors of out-of-hospital cardiac arrest. Am Heart J 2009;157:312–8.
21. Reynolds JC, Callaway CW, El Khoudary SR, Moore CG, Alvarez RJ, Rittenberger JC. Coronary angiography predicts improved outcome following cardiac arrest: Propensity-adjusted analysis. J Intensive Care Med 2009;24:179–86.
22. Dumas F, Cariou A, Manzo-Silberman S, et al. Immediate percutaneous coronary intervention is associated with better survival after out-of-hospital cardiac arrest: insights from the PROCAT (Parisian Region Out of Hospital Cardiac Arrest) registry. Circ Cardiovasc Interv 2010;3:200–7.
23. Hovdenes J, Laake JH, Aaberge L, Haugaa H, Bugge JF. Therapeutic hypothermia after out-of-hospital cardiac arrest: experiences with patients treated with percutaneous coronary intervention and cardiogenic shock. Acta Anaesthesiol Scand 2007;51:137–42.
24. Knafelj R, Radsel P, Ploj T, Noc M. Primary percutaneous coronary intervention and mild induced hypothermia in comatose survivors of ventricular fibrillation with ST-elevation acute myocardial infarction. Resuscitation 2007;74:227–34.
25. Wolfrum S, Pierau C, Radke PW, Schunkert H, Kurowski V. Mild therapeutic hypothermia in patients after out-of-hospital cardiac arrest due to acute ST-segment elevation myocardial infarction undergoing immediate percutaneous coronary intervention. Crit Care Med 2008;36:1780–6.
26. Peels HO, Jessurun GA, van der Horst IC, Arnold AE, Piers LH, Zijlstra F. Outcome in transferred and nontransferred patients after primary percutaneous coronary intervention for ischemic out-of-hospital cardiac arrest. Catheter Cardiovasc Interv 2008;71:147–51.
27. Schefold JC, Storm C, Joerres A, Hasper D. Mild therapeutic hypothermia after cardiac arrest and the risk of bleeding in patients with acute myocardial infarction. Int J Cardiol 2009;132:387–91.
28. Batista LM, Lima FO, Januzzi JL Jr., Donahue V, Snydeman C, Greer DM. Feasibility and safety of combined percutaneous coronary intervention and therapeutic hypothermia following cardiac arrest. Resuscitation 2010;81:398–403.
29. McMullan PW, White CJ. Doing what's right for the resuscitated. Catheter Cardiovasc Interv 2010;76:161–3.
30. Kushner FG, Hand M, Smith SC, et al. 2009 focused updates: ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction (updating the 2004 guideline and 2007 focused update) and the ACC/AHA/SCAI guidelines on percutaneous coronary intervention (updating the 2005 guideline and 2007 focused update): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2009;54:2205–41.

Key Words: Aldrete score ■ cardiac arrest ■ percutaneous coronary intervention ■ risk adjustment ■ ST-segment elevation MI.