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EDITORIAL COMMENT

The Heart or the Brain?

Which Takes Priority After Cardiac Arrest and Can We Identify Patients in Whom Aggressive Cardiac Care Is Futile?*

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Out-of-hospital cardiac arrest (OHCA) affects approximately 350,000 adults in the United States each year, with the majority (70%) of these occurring at home and 50% unwitnessed, thus delaying time to resuscitation (1). The prognosis for resuscitated individuals is poor. Although the survival to discharge rate for emergency medical services-treated arrests has improved, the overall survival is still only about 10%, with survival rates as high as 30% to 40% in the subgroup of patients with arrest due to an initial shockable rhythm (ventricular tachycardia [VT] or ventricular fibrillation [VF]) and bystander witnessed (1–4). Many of the deaths are from anoxic encephalopathy (5) and many survivors are profoundly neurologically impaired. The presenting rhythm is an important determinant of outcome. A study from the Netherlands found that 41% of patients with a shockable first rhythm survived with favorable neurological outcome compared with only 3% of those with a nonshockable first rhythm (2).

Following successful resuscitation, clinicians face several management decisions. One relates to treatment of the anoxic brain injury. Targeted temperature management to 32°C to 34°C in the initial hours after arrest improves survival and neurologic outcome in comatose, resuscitated patients (6). There are really no contraindications to cooling except perhaps active bleeding, sepsis, and profound hemodynamic instability, and thus cooling should be considered in all neurologically impaired patients and initiated as soon as feasible (7,8). Another management decision relates to treatment of the heart. Given that the most common cause of OHCA (especially those with VT or VF), is ischemic heart disease, we often consider emergency coronary angiography and percutaneous coronary intervention (PCI) in resuscitated cardiac arrest patients. For patients with ST-segment elevation myocardial infarction (STEMI) on the initial, post-resuscitation electrocardiogram (ECG), our guidelines state that immediate angiography and PCI should be performed (7,8). The role of emergency coronary angiography in resuscitated patients without STEMI, and its role in those without initial VT or VF, is unclear and controversial. A few observational studies suggest emergency angiography may be beneficial in non-STEMI post-arrest patients (9–11). These studies found a "culprit" or "significant" lesion in 33% to 58% of patients without STEMI and 23% to 27% had an acute coronary occlusion. Better survival and functional outcomes were associated with emergency angiography.

However, a blanket endorsement of emergency angiography in all resuscitated comatose patients defies logic. Few would withhold emergency angiography in a comatose 45-year-old with witnessed VF, resuscitated after 10 min of bystander cardiopulmonary resuscitation (CPR) with an anterior STEMI on ECG. I also suspect most would agree that angiography is futile in an 85-year-old found unresponsive and pulseless, without bystander CPR, discovered to have asystole and regaining circulation after 30 min of resuscitative efforts without STEMI on initial ECG. The extremes are easy, but where do we draw the line? As physicians, we always want to give patients the benefit of the doubt; however, emergency angiography saps valuable resources and shifts the focus from their brain to their heart, neglecting that for

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many OHCA patients, prognosis will be defined by their neurologic insult rather than their myocardial injury. Addressing their heart first may delay therapeutic hypothermia or delay correction of acidosis, hypotension, or hypoxemia thus potentially extending their neurologic injury. Similar to a hamster spinning on an exercise wheel, the energy we expend to achieve rapid reperfusion of an occluded coronary in a patient who will almost certainly die from neurologic devastation is an exercise in futility.

Treatment algorithms recognize that emergency angiography may not be appropriate for OHCA patients with "unfavorable resuscitation features" (12). Predictors of poor neurologic outcome include: unwitnessed arrest, rhythm other than VF or VT, absence of bystander CPR, prolonged time (>30 min) to spontaneous circulation, severe lactic acidosis, low pH, presence of end-stage renal disease, advanced age (>85 years of age), and other pre-existing medical conditions such as dementia, frailty, and severe lung disease. However, simply providing a list of "unfavorable features" is not very helpful to the clinician. Clearly, we need better methods to discriminate those who benefit from those in whom aggressive cardiac treatment is futile.

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In this issue of *JACC: Cardiovascular Interventions*, the observational study by Bougouin et al. (13) is a valuable step in this direction. The authors used a registry of 1,410 cardiac arrest patients in France. All treatment decisions including whether to perform angiography and PCI were at the discretion of the treating physicians. Patients were then stratified into low, medium, and high-risk groups based on their Cardiac Arrest Hospital Prognosis (CAHP) score designed to predict risk of in-hospital death. This score is based on several variables obtained at presentation including age, setting of arrest (public vs. home), initial rhythm (shockable vs. nonshockable), time to basic life support, time from basic life support to return of spontaneous circulation, pH, and dose of epinephrine needed. This score has been shown to predict neurologic prognosis. In this study, the overall survival rate at hospital discharge was 32%. More patients subsequently characterized as low risk underwent coronary angiography (86%) compared with medium (66%) and high (47%) risk, suggesting that the presence of some of the unfavorable features that make up the CAHP score also influence the decision to perform angiography. The most important finding of this study, however, was that emergency angiography was associated with better survival only in the low-risk group.

Interestingly, a recently published study by Kiehl et al. (14) derived and validated a simple scoring system (CGRApH [Coronary artery disease, Glucose, Rhythm, Age and pH]) in survivors of OHCA. The score ranges from 0 to 5, with 1 point earned for each of the following: known coronary artery disease, glucose >200 mg/dl, rhythm other than VT or VF, >45 years of age, and pH <7.0. Favorable neurologic outcomes were seen in 70% of patients with low scores (0 or 1), but only in 19% of patients with intermediate scores (2 or 3) and in 2% for patients with high scores (4 or 5). Although this study did not look at the role of angiography, clearly those with intermediate or high scores have such poor outcomes that angiography would prove futile.

We need more data such as these to guide clinical trials and management of this challenging patient subset. A randomized trial comparing the role of emergency versus delayed angiography in non-STEMI patients with cardiac arrest (with and without VT or VF) based on their initial CGRApH or CAHP score would be helpful. Such studies would inform our decisions and advance the science of resuscitation medicine. Until then, we will continue to observe variation in care in the management of post-resuscitation patients with decisions regarding emergency angiography made on an individual and mostly uninformed basis.

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