Postcards From the Cutting Edge

New cardiac science will have us looking differently at acronyms like PCI, TPA and GIK

By S. Christopher Suprun, Jr., NREMT-P, CCEMT-P

Your patient is suffering chest pain that started 20 minutes ago. His pain, which he rates as 8 on a scale of 10, radiates from his substernal chest to his left arm. He complains of nausea and has obvious diaphoresis. You are a few miles away from your local community hospital, but 45 minutes away from an emergency facility with catheterization capability. Where do you go?

Several studies suggest that primary angioplasty is the best choice in this case,[1–3] but is it really?

In acute coronary syndromes, particularly ST-segment-elevation heart attacks, reperfusion of some sort is required, or muscle death will occur. Heart attacks happen when coronary arteries become blocked by clots that have moved into the myocardium. Our primary treatment focuses on providing oxygen to the patient; making the platelets slippery and interfering with the clotting cascade with baby aspirin; and opening the peripheral pipes with nitroglycerin and morphine.

Hospital care has focused on breaking the clot up with thrombolytics or fibrinolytics, or on percutaneous coronary interventions (PCIs) such as stent placement and angioplasty to physically open the arteries and remove atherosclerotic buildup of plaque.

Part of the issue with fibrinolytics is that they chew through clots. These clots may be in the coronary arteries, where we want them broken up—or in other places, such as the stomach (including ulcers) or other parts of the body, from recent trauma. They may also be from insignificant surgeries such as hair plugs.

Another factor in the use of fibrinolytics is time. We have typically used a time frame of six hours to administer fibrinolytics. However, some studies suggest that to be effective, they need to be used much earlier than previously thought.[4,5] In fact, optimal timing may be within 70–120 minutes.[6,7] Earlier field initiation of certain fibrinolytic drug therapies may be indicated.

In one study, patients had a 50% reduction in mortality from early fibrinolytic administration.[8] This study followed up with its subjects at five years and found that fewer had died in the out-of-hospital fibrinolytic group (25%) than in the hospital fibrinolytic group (36%).[9]

Similarly, it appears that PCIs are best used early as well, and it may be that combining both treatments is even more effective.

Fibrolytics in the Field

Some aggressive EMS systems may be treating heart attack patients with fibrinolytics in the field, even in suburban systems, in the not-too-distant future. One example of this is in a suburb north of Houston, where 21 EMS services, a local air-medical provider and Conroe Regional Medical Center, the local tertiary-care heart center, are aggressively integrating the thrombolytic TPA (tissue plasminogen activator) in the field and implementing an organized approach to incidents of myocardial infarction to provide for quicker reperfusion therapies to their patients.

The area—which runs the gamut from

near-urban settings to the countryside—has transport times ranging from 5–40 minutes. It is approximately 1,100 square miles, with a population of around 300,000, and averages a cardiac arrest a day. Local EMS uses early 12-lead acquisition and interpretation, thrombolytic checklists and Retavase—commonly used in hospitals—as its fibrinolytic of choice.

Retavase is delivered in two doses 30 minutes apart. As an added benefit for field providers, it is not weight-based.

For one patient who received both field TPA and PCI, symptoms of his massive heart attack were classic: chest pain, numbness in the arms, difficulty breathing. But from there on, his case was different from most. EMS arrived and administered oxygen and AHA-recommended acute coronary syndrome drugs (baby aspirin, nitroglycerin and morphine). They also performed a 12-lead, which showed ST segment elevation. The patient rated his pain at 9½ on a 10-point scale.

The crew called for a helicopter to quickly ferry their patient to the local heart center. A 12-minute chopper ride later, Spencer "Donny" Parish was at Conroe Regional Medical Center, where he received two stent placements. Within minutes his pain went from 9½ to 0.

It took just 90 minutes from the time Parish activated 9-1-1 until he was treated with the stents.

"It's not the drug, it's not the medics, it's not the ED—it's the system," says Jay Kovar, MD, medical director for both Conroe Regional Medical Center's Emergency Department and Montgomery County EMS.

While we talk about time being muscle, much of the heart debate seems to be based on how we treat as a unit, instead of as a system. That is not the case in this community, where three different hospitals, three different EMS systems and the local air-med operator have all bought in to treating these patients aggressively.

Patients are treated in this manner even when transport times are short.

"The cardiologists say 'If it's me and we're five minutes from the hospital, I want the lytic,'" Kovar says. In essence, the patient qualifies for such treatment based on 12-lead changes and the thrombolytic checklist, not their distance from the hospital.

Some may think this aggressiveness unsafe, but Conroe officials report positive results. After serving 200 patients since July 2000, their safety record is better than what is reported in multiple studies, Kovar says.

GIK: A New Solution?

Another area that probably won't be directly addressed with the new ACLS standards is the use of GIK—a special glucose-insulin-KCl (potassium chloride) solution being proposed for infusion in acute coronary artery syndrome (ACS) events. GIK is just one of several potentially lifesaving treatments that will be formally examined in prehospital clinical trials funded by the National Institutes of Health (NIH) over the next several years. Separately, a host of other treatments for cardiac arrest and trauma will also be studied by the NIH's new Resuscitation Outcome Consortium (ROC), a research network that includes the EMS systems from seven major U.S. metropolitan areas, one state EMS system and several in Canada.

While the NIH has funded multicenter trials involving many other illnesses, this new initiative is essentially the first time it is specifically setting up a network to study resuscitation interventions for severe trauma and cardiac events. Using the 10-center ROC system, the NIH is hoping to prove the effectiveness of various interventions and collect epidemiological data about these major killers.

Considering that there are approximately 1.1 million heart attacks every year in the United States, it is clearly a worthwhile venture. Cardiovascular disease accounts for two of every five deaths in the U.S., and traumatic injury is the No. 1 cause of death for children and young adults. Even if a new intervention increases survival chances by only a few percentage points, the total number of lives saved could be dramatic.

As previously suggested, one promising study concept is to determine if a better "feeding" of the heart during ACS events will reduce mortality rates. GIK is one potential intervention that may do so. Therefore, one of the new trials the NIH is planning to conduct, the IMMEDIATE (for Immediate Myocardial Metabolic Enhancement During Initial Assessment and Treatment in Emergency Care) Trial, will examine whether feeding the body with GIK will provide improved "nourishment" to the myocardium in ACS events, and thus reduce mortality.

How GIK Feeds the Heart

The body generally requires both oxygen and glucose to efficiently produce energy. But, as noted in my article, *Cardiac Arrest Care: Out With the Old CPR, In With the New,* in the October issue of EMS, the heart generally consumes between 6–8 milliliters of oxygen per minute per hundred grams—an extraordinary amount of oxygen. Body tissues, including the heart, uptake oxygen much more effectively when burning pure glucose fuels than when they utilize combined cellular fuel mixtures such as those containing free fatty acids (FFAs). FFAs and other non-glucose bloodstream fuels require much more oxygen to produce energy than does glucose. Cellular uptake of those oxygen-demanding fuels can be limited through supplemental circulating insulin and glucose, thus decreasing oxygen uptake demands on the heart.

The specific GIK cocktail to be studied is designed to rapidly transport glucose into the cell. The additional glucose, and its quick uptake facilitated by additional insulin, will both restore and enhance myocardial sugar. It is believed that this may lead to an improvement in cardiac contractility in the low-flow state of coronary artery obstruction by allowing the heart to contract with less oxygen. Considering that relative hypokalemia may be a side effect of supplemental glucose and insulin administration, potassium will also be administered as part of the cocktail.

Actually, the concept of GIK infusion is not new. GIK has been used for several decades in some intensive-care settings. However, past studies have had varying amounts of GIK administered, different time intervals to start the therapy, and generally small sample sizes, making their results somewhat inconclusive. Because

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the IMMEDIATE Trial is a multicenter trial conducted simultaneously in EMS systems from several large cities, it should provide more-definitive evidence of GIK's value. Not only will GIK be used early, but researchers also expect to enroll 15,000 patients over the next few years, strengthening the study's statistical power.

One theoretical concern about this therapy is that the use of extra glucose may have a deleterious effect, especially in diabetics and other patients who may not handle the cocktail components well. Overall, though, the concentrations in the intravenous mixture are equal to only about one typical packet of sugar you'd get from a restaurant table, and the insulin is only around two units. Likewise, the potassium infusions are equal to amounts found in about half a banana. None of these levels should be harmful to the patient population to whom the GIK would be administered.

"The good news is that this appears to be a relatively innocuous therapy, so there is little downside," says study co-investigator Paul Pepe, MD, medical director for the Dallas-area BioTel EMS system and chair of the Division of Emergency Medicine at University of Texas Southwestern Medical Center. "But if it does make a significant difference even in just a small percentage of patients, it could save many lives and improve the quality of life for many patients, especially when considering the extremely high volume of acute coronary syndrome calls we face each day nationwide."

With these new directions in acute coronary syndrome treatment, EMS may continue to see changes both big and small in how we move patients from their living rooms to the cath table. Hopefully we will see them move back from the cath table to their living rooms much quicker as well.

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