EDITORIAL

Opportunities to Improve Care for Patients With ST-Segment Elevation Myocardial Infarction: Focusing on How to Deliver the Care

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For patients with ST-segment elevation myocardial infarction (STEMI), timely primary percutaneous coronary intervention (PCI) improves patient outcomes compared with fibrinolytic therapy.[1] The advantage depends importantly on the ability to open the artery quickly, preferably within 90 minutes or less from the time that the patient reaches medical attention. The faster the procedure can be done, the lower the mortality risk for the patient.[2]

Despite the importance of the timeliness of primary PCI, delays were very common. As recently as 2002, only about a third of patients in the United States were treated within 90 minutes.[3] Moreover, a third of patients were treated more than 2 hours after presenting to the hospital, with some patients waiting several hours or more for treatment. As a consequence, the benefit of therapy was attenuated or eliminated for many patients.

The delays in treatment led to the recognition that the translation of the trials showing the superiority of primary PCI into practice was incomplete. The trials showed what was possible under the ideal circumstances of the study, at centers that were primed for enrolling ideal patients and able to produce outstanding results. However, in actual practice the application of the trial results was achieving very different results. Clinicians may have known what to do based on the trials, but the health care delivery system was having trouble determining how best to do it.

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Research revealed substantial variability in the performance of hospitals in providing primary PCI. Some institutions were consistently achieving rapid door-to-balloon (D2B) times, the interval from the time the patient arrived at the hospital to the time that reperfusion was established in the culprit coronary artery. Others were lagging, with long delays occurring in most cases. This variability demonstrated the possibility that faster times could be achieved. The questions were: what are the exemplary institutions doing to achieve faster times, and could those practices be generalized? Bradley and colleagues have described the approach of learning from the best performers as research into positive deviance.[4]

Using a mixed methods approach, researchers from the United States made site visits to the best performers and conducted a national survey to validate their findings. They found that several simple, inexpensive strategies were common among the institutions that excelled.[5] These strategies included activation of the interventional team by emergency medicine physicians (circumventing the need for a cardiologist to travel to the patient and make the decision); a single call for activation (circumventing the need to make many calls to alert the team); an expectation that the team could be ready for the patient within 20-30 minutes; and that the team employed timely data feedback to assess its performance.

As a result of site visits, the team also found that successful hospitals possessed a culture that enabled them to succeed, despite the challenges of changing practice and the way that care was delivered. The best institutions had common cultures and approaches.[6] Themes emerged from these visits, including a commitment to an explicit goal to improve door-to-balloon time motivated by internal and external pressures; senior management support; innovative protocols; flexibility in refining standardized

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protocols; uncompromising individual clinical leaders; collaborative teams; and an organizational culture that fostered resilience to challenges or setbacks in improvement efforts.

The results from this research were disseminated through an international campaign, which included Spain, to improve D2B times.[7] The American College of Cardiology was the principal sponsor of the effort, and many other organizations joined. The campaign, along with an effort by the government of the United States to publicly report each hospital's D2B time, led to an intense focus on adopting the key strategies and improving performance. The campaign provided webinars, tools, and support. Regional efforts to improve times also developed. Many institutions developed innovative approaches to improve the timeliness of their care.[8,9]

The result of the effort to improve D2B times in the United States is quite gratifying. Since the time when only a third of patients were treated within 90 minutes, marked improvements have occurred. Now, almost 90% of patients in the American College of Cardiology registry, which captures almost 80% of the nation's PCI centers, who underwent primary PCI for the treatment of STEMI had reperfusion within 90 minutes of arriving at the hospital.[10]

The achievement of a system that can produce outstanding times depends on rapid decision-making when a patient is first evaluated. The decision about whether a patient is experiencing a STEMI is not always an easy one. Certainly the patient with substantial cardiovascular risk factors who presents to the emergency department with crushing substernal chest pain radiating down his or her left arm and obvious ST-segment elevations in multiple leads presents little diagnostic uncertainty. However, a young woman with slightly atypical symptoms and minimal ST-segment elevations with no prior electrocardiogram for comparison is much more difficult to diagnose. More time for evaluation of the second patient would undoubtedly assist with the diagnosis, but the case of a possible STEMI does not give the luxury of extra time. The reality is that a decision must be made despite the uncertainty.

In this issue of *Revista Española de Cardiología*, Barge-Caballero and colleagues address the topic of patients who are identified for possibly primary PCI but ultimately have another diagnosis or no significant epicardial coronary artery disease.[11] These "false alarms" are a bane to the interventional team, which often is called in to the hospital at odd hours only to discover that the effort was unnecessary. Barge-Caballero and colleagues evaluate their experience from 2003 to 2008 at the Interventional Cardiology Unit at A Coruña University Hospital Complex (CHUAC). They provide primary PCI daily and at all hours for a population of nearly 1 million distributed across northern Galicia.

The investigators from Galicia describe a well organized system. The interventional team is activated by a single call from the diagnosing doctor. The team may also be activated by physicians in the mobile life support ambulances. D2B times are not reported, but the median time from initial medical contact to coronary arteriography is about 90 minutes. The time is comparable to that of many hospitals in the United States, although the most outstanding institutions in the United States are seeking even better performance. Since the focus of the Barge-Caballero article was not the D2B times achieved, the exact performance and reasons for delay are not clearly described. In this system, they report that 7.2% of their patients for primary PCI had no culprit coronary lesion identified and 6.3% had a diagnosis other than STEMI. They further note that most false alarms are explained by baseline electrocardiographic abnormalities or by signs and symptoms suggestive of STEMI in patients with other explanations for ST-segment elevation.

The result from the Spanish group is lower than that contained in a recent report from the United States. Using a prospective registry from a regional health system in Minnesota, Larson and colleagues evaluated false positive activations. Of 1335 patients evaluated, 187 (14%) had no culprit coronary artery and 127 (9.5%) had no significant coronary artery disease. Cardiac biomarkers were negative in about 11% of the group.

The question for any system is not whether it is possible to avoid all false alarms, but how false alarms can be minimized without compromising the care to those with STEMI who need rapid triage and treatment. This is an issue of the sensitivity and specificity of the initial assessment. Most delivery systems would be willing to sacrifice some specificity for sensitivity. By having a high sensitivity in the initial assessment, the system will not miss any individuals with a STEMI. Trading some specificity for sensitivity almost ensures that there will be some false positive activation.

From the patient perspective, these false alarm procedures are unlikely to do much harm. The procedure will assist in resolving any diagnostic uncertainty for the patient and can redirect attention to areas that are more relevant to the patient's clinical issues. Many of these patients would have undergone further testing in any case, and the coronary arteriogram could avoid future tests. The major issue is the expense to the system, with the

expenditure of resources—particularly time and supplies.

Surgeons have long confronted this issue, most commonly in debates about who requires an emergency appendectomy. The question is whether there ought to be some normal appendices removed in order to be sure that no one with a perforated appendix is overlooked. Advanced imaging techniques may have shifted the entire curve such that sensitivity can be high without reducing the specificity.

For the treatment of patients with a suspected STEMI, it is difficult to know which rapidly applied interventions could maintain a high sensitivity and a high specificity. It is problematic that the predictive model presented by the authors does not discriminate well between those with and without STEMI. Any intervention to save false activations must look closely at the cost of patients with STEMI who may have been overlooked. Having false alarms may, given current tools, be an aspect of the system that interventional teams must accept. The benchmark for false alarms has yet to be established.

There remain some important points to consider. First, false activations are not a sign of failure. They should be reviewed by emergency medicine and interventional cardiology teams, but in the spirit of learning and discussion, not blame. The discussion should acknowledge that these decisions appear different in retrospect than they did in the heat of the moment. Many false alarms are truly unavoidable. Although the goal is not zero percent, there should nevertheless be a search for opportunities to improve the system to account for the instances that are likely preventable. Second, teams of institutions should systematically gather data, standardize definitions, and share lessons about how to optimize specificity without reducing sensitivity. The same approach that was employed to identify strategies that would speed treatment may be employed to find best strategies to improve the initial assessments. Third, concerns about false activations should not distract efforts from the important mission of ensuring that patients with STEMI receive rapid treatment; the goal should be for at least 75% of the patients to have a D2B time of 90 minutes or less. Clinicians throughout the region should receive reports of performance on these times, making the performance clear to all.

Research directed toward the best way to deliver care is an important frontier. Work surrounding the topic of how best to provide primary PCI for patients with STEMI is setting a standard for how we might address health care delivery in other areas. The goal is to generate new knowledge, employing strong clinical and health system science, which will be applied to elevate our performance and benefit our patients.

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