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CLINICAL RESEARCH

Pre-Hospital Triage for Primary Angioplasty

Direct Referral to the Intervention Center Versus Interhospital Transport

Hendrik-Jan Dieker, MD, Stephan S. B. Liem, MD, Hamza El Aidi, MD, Pierre van Grunsven, MD, Wim R. M. Aengevaeren, MD, PhD, Marc A. Brouwer, MD, PhD, Freek W. A. Verheugt, MD, PhD

Nijmegen, the Netherlands

Objectives We sought to study the impact of direct referral to an intervention center after pre-hospital diagnosis of ST-segment elevation myocardial infarction (STEMI) on treatment intervals and outcome.

Background Primary angioplasty has become the preferred reperfusion strategy in STEMI. Ambulance diagnosis and direct referral to an intervention center is an attractive treatment option that has not been studied extensively.

Methods Consecutive pre-hospital patients with STEMI, who were referred to our intervention center for primary angioplasty between 2005 and 2007, were studied. After pre-hospital diagnosis, patients were either directly transported to our center or referred through a nonintervention center. The catheterization laboratory was activated before transport to the intervention center.

Results Of the 581 patients referred, 454 (78%) came with direct transport and 127 (22%) through a nonintervention center. Direct transport was associated with a higher proportion of patients treated within the 90-min time window of the STEMI guidelines: 82% versus 23% ($p < 0.01$). Patients directly transported had a significantly shorter median symptom-to-balloon time of 149 min (Interquartile range: 118 to 197 min) versus 219 min (interquartile range: 178 to 315 min), $p < 0.01$, a higher post-procedural Thrombolysis In Myocardial Infarction (TIMI) flow grade 3 rate (92% vs. 84%; $p = 0.03$), and a lower 1-year mortality rate (7% vs. 13%; $p = 0.03$). Direct transport to the intervention center was independently associated with the symptom-to-balloon time, which in turn was an independent predictor of post-procedural TIMI flow grade 3, a strong prognosticator of outcome.

Conclusions After ambulance-based diagnosis of STEMI, direct transport to an intervention center with pre-hospital notification of the catheterization laboratory more than triples the proportion of patients treated within the time window of the guidelines. Time to balloon was an independent predictor of post-procedural TIMI flow grade 3, which underscores the need to reduce treatment delays. (J Am Coll Cardiol Intv 2010;3:705–11) © 2010 by the American College of Cardiology Foundation

From the Department of Cardiology, Heart Lung Center, Radboud University Medical Center, Nijmegen, the Netherlands.
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Primary angioplasty is the preferred reperfusion therapy in ST-segment elevation myocardial infarction (STEMI) if performed within 90 min of first medical contact by an experienced team of personnel in a high-volume center (1). In real-world practice, only ~10% of patients in the U.S. meet the current time goal in case of referral for primary angioplasty (2). Strategies to reduce treatment delays in primary angioplasty are a subject of interest. It was shown that early activation of the catheterization laboratory is associated with a reduced door-to-balloon time (3). Pre-hospital diagnosis, notification, and direct referral to an

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intervention center is a promising strategy associated with a significant reduction in treatment delays (4,5). This strategy was associated with better left ventricular function and a lower risk of death or myocardial infarction (6) as compared to a strategy of referral from a nonintervention center. Although most studies using pre-hospital triage were performed in Europe, data from the U.S. confirm the feasibility and impact of the pre-hospital electrocardiogram in managing patients with STEMI (7–9). In the Netherlands, where distances between hospitals are much smaller and patients with suspected STEMI usually bypass the emergency physician and are immediately triaged by a cardiologist, a higher proportion of patients is treated within the time goal of the guideline. In the Nijmegen area (the Netherlands), a system of pre-hospital triage of STEMI has been used for over 15 years; it was initially designed to triage for pre-hospital fibrinolysis (10). This same system now serves for the triage for primary coronary intervention. In contrast to previous studies in which pre-hospital triage was compared with in-hospital triage, the current study focuses on pre-hospital triage and compares direct transport to an intervention center to referral through a nonintervention center. The aim of our study is to further elucidate the impact of direct transport to the intervention center on treatment intervals and procedural and clinical outcomes.

Abbreviations and Acronyms

ECG = electrocardiogram

STEMI = ST-segment elevation myocardial infarction

TIMI = Thrombolysis In Myocardial Infarction

Methods

Patients. Consecutive patients with a pre-hospital diagnosis of STEMI referred for primary angioplasty to the catheterization laboratory of the Radboud University Medical Center in Nijmegen, the Netherlands, were included in a registry from January 2005 until December 2007.

From the beginning of 2005, in agreement with the referral sites (ambulance services and local hospitals), all pre-hospital patients with large infarctions (>15 mm cumulative ST-segment deviation) were referred for primary angioplasty. Pre-hospital patients with smaller infarctions (≤15 mm ST-segment deviation) were treated with either pre-hospital fibrinolysis or primary angioplasty depending on local agreements. Regular evaluation of the protocol demonstrated the feasibility and success of this primary angioplasty strategy, and pre-hospital fibrinolysis for smaller infarcts gradually decreased. Over time, primary angioplasty became the reperfusion strategy of choice for all patients. All patients who were presented to our intervention center were accepted for primary angioplasty. In case of an eligible patient, the resident of the intervention center was contacted either directly from the ambulance by paramedics or by the physician on call in the referral center. After acceptance, the catheterization laboratory personnel were directly activated to prepare the catheterization laboratory. If possible, the emergency room of the intervention center was bypassed and the patient was directly transported to the catheterization laboratory.

Intervention center. The Radboud University Medical Center is a university hospital and tertiary referral center. It is a high-volume center performing >1,000 angioplasty procedures/year, with 3 catheterization laboratories, surgical backup, and a team of experienced personnel with around-the-clock service. All operators perform >150 procedures/year. Before 2005, primary angioplasty was only performed in a selected group of patients (late myocardial infarction, shock, and in case of a contraindication for fibrinolysis) due to a successful pre-hospital fibrinolysis program with two-thirds of patients receiving fibrinolysis within 3 h of symptoms (10,11). Rescue angioplasty was performed in more than 100 patients/year.

Referral region. The referral region is located in the east of the Netherlands and covers parts of the provinces of Gelderland and Brabant. It has a radius of about 48 miles with about 1,000,000 inhabitants. Five referral hospitals and 4 regional ambulance services are located in the referral region. Patients presenting with STEMI in a nonintervention center were treated with primary angioplasty, but were excluded from the current analysis of pre-hospital patients.

Ambulance protocol. All ambulances in the region were equipped with the Lifepak 12 system (Physio Control, Redmond, Washington). Specially trained paramedics made a 12-lead electrocardiogram (ECG) in all patients with chest pain for <12 h of duration that did not resolve after sublingual nitroglycerin. This 12-lead pre-hospital ECG was interpreted by the paramedics with the help of a computer algorithm. In case of a clear-cut case of a patient with a large STEMI (>15 mm), paramedics contacted the cardiology resident of the intervention center to notify the catheterization laboratory before transportation. In other cases, pre-hospital fibrinolysis or primary percutaneous coronary intervention was chosen, often after initial contact