Clinical Investigations

Emergency Department Thrombolysis Critical Pathway Reduces Door-to-Drug Times in Acute Myocardial Infarction

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Summary

Background: Rapid time to treatment with thrombolytic therapy is an important determinant of survival in acute myocardial infarction (AMI).

Hypothesis: We hypothesized that establishment of an AMI thrombolysis critical pathway in the Emergency Department could successfully reduce the "door-to-drug" time, the time between patient arrival and start of thrombolysis.

Methods and results: Before establishment of the AMI critical pathway, median door-to-drug time was 73 min, which was reduced to 37 min after critical pathway implementation (p < 0.05). The percentage of patients treated within 30 min rose from 0% prior to establishment of the pathway to 43% (p = 0.03). Similarly, the percentage treated in within 45 min rose from 0 to 67% (p = 0.0005). Door-to-drug times were longer for women than for men (median 105 min for women vs. 70 min for men before pathway implementation). The pathway reduced door-to-drug time for both genders, but the median door-to-drug times were higher for women than for men (Mann-Whitney p = 0.013). The difference between men and women was 35 min before establishment of the pathway to 10 min by the end of the study period.

Conclusions: Our critical pathway was successful in reducing door-to-drug times. We observed a "gender gap" in door-to-drug times, with longer mean times for women, which was reduced by the AMI critical pathway. Thus, our data provide support for the use of critical pathways to reduce door-to-drug times, as recommended by the National Heart Attack Alert Program.

Introduction

Thrombolytic therapy improves survival of patients with acute myocardial infarction (AMI) presenting with ST-segment elevation or new left bundle-branch block, but an important time dependency has been established with regard to the efficacy of this intervention.[1–3] Early reperfusion of the infarct-related artery is known to be associated with improved survival;[2, 4] thus, to maximize the benefit of thrombolytic therapy, continuing efforts should be made to reduce the time from symptom onset to treatment.[1, 3] Beginning in November of 1993, we established an AMI thrombolysis critical pathway in the Emergency Department (ED) to reduce in-hospital treatment delays, similar to the subsequent recommendation of the National Heart Attack Alert Program.[3] Although this approach has been widely adopted, few data are available on the effects of a critical pathway on door-to-drug time (i.e., between hospital arrival until initiation of thrombolysis).[5] During the first 19 months following our critical pathway implementation (November 21, 1993), we assessed the effect of the critical pathway on door-to-drug times in ST-elevation AMI compared with the 6 months prior to critical pathway implementation.

Methods

The rationale and overview of the critical pathway has been previously described.[1] For patients presenting to the ED, initial screening is carried out by the triage nurse, and if the patient's complaint suggests ischemia or suspected AMI, the patient is moved rapidly into an "acute" room and a 12-lead electrocardiogram (ECG) is obtained. The ECG is delivered immediately to the emergency medicine (EM) attending physician for interpretation. If ST elevation or left bundle-branch block is present, the physician assesses the patient for possible contraindications to thrombolysis. In parallel with this assessment, the cardiologist on call is paged, although treatment is not delayed for the cardiologist's input, unless specifically sought by the EM attending physician. If no contraindications are present, the thrombolytic agent is prepared in the ED and administered as quickly as possible. If contraindications are present, or if the patient is in cardiogenic shock, primary percutaneous transluminal coronary angioplasty (PTCA) is considered as a means of reperfusion therapy.

The goal of the critical pathway is to administer thrombolytic therapy within 30 min of arrival to the ED. Maintaining high specificity for correctly identifying patients who are truly eligible for thrombolysis is an important component in the rapid assessment and treatment of the patient. Thus, for patients with a less clear history, or with possible relative contraindication to thrombolytic therapy, additional time is allowed for clarification of the medical history, verification of prior history from the medical history, or discussion with the cardiologist. Once the decision is made to treat with thrombolysis, preparation of the drug and initiation of therapy is carried out at the bedside by the ED nurses as specified by the AMI critical pathway. The use of other important adjunctive agents, such as aspirin, heparin, beta blockers, angiotensin-converting enzyme inhibitors, or magnesium is also specified in the AMI critical pathway.

Continuous quality improvement is an important component of the AMI critical pathway. Each patient with an ST elevation AMI is discussed at the cardiology morbidity and mortality conference, with emphasis on the door-to-drug time and ways to improve time to treatment. Cases with perceived system issues or problems are also discussed at the department of emergency medicine morbidity and mortality conference. There is also regular feedback in both directions between designated physicians from both services.

Study patients were identified through the critical pathway documents, via a listing of all AMI patients by ICD-9 codes for hospital inpatients, as well as by cross-checking pharmacy lists of patients who had received thrombolytic agents during the study period. The hospital records of all patients with AMI who received thrombolytic therapy were subsequently reviewed by three separate reviewers (MC, BMS, MJS) with supervision by a faculty member (CPC). For patients who received thrombolytic therapy, the time of hospital arrival, times of initial and first diagnostic ECG, and time of initiation of thrombolytic therapy were recorded. Data for the time of

therapy decision were not available on the chart in the majority of patients, thus precluding analysis of the subcomponents of the door-to-drug time.

Results

Over the 2-year study period, 142 patients with ST elevation AMI were identified. Reperfusion therapy was used in 67% of patients. Thrombolysis was given to 62 patients (86% tissue plasminogen activator, 11% TNK-tissue plasminogen activator,[6] and 3% streptokinase) and primary PTCA was used in 33 patients. Forty-seven patients did not receive either form of reperfusion therapy: 4% presented > 12 h, contraindications were present in 19%, onset of pain 6 to 12 h was cited in another 21%, advanced age in 2%, resolution of chest pain in 2%, a "nondiagnostic" ECG (despite documented ST elevation ≥ 0.1 mV) in 2%, preference for treatment by a physician in another 8%, and no reason was documented in the remaining 30%.

Before establishment of the AMI critical pathway, median door-to-drug time was 73 min. As shown in Figure 1, median door-to-drug times were reduced to 37 min after critical pathway implementation ($p < 0.05$). The majority of improvement occurred in the first 8 months. The percentage of patients treated in the NHAAP-recommended ≤ 30 min rose from 0% prior to the use of pathway to 35% over the first 8 months ($p = 0.04$) and to 43% at the end of the study ($p = 0.03$). Similarly, the percentage treated in ≤ 45 min rose from 0 to 67% by the end of the study period ($p = 0.0005$).

We also evaluated the effect of research protocols on door-to-drug times. Over the two 6-month periods from July 1994 to June 1995, the percentage of persons participating in either Thrombolysis in Myocardial Infarction (TIMI) 9B[7] or TIMI 10A[6] rose from 38 to 62% of all thrombolytic-treated patients. In Figure 2, the door-to-drug times with the critical pathway in place are shown for nonresearch patients (A), median times of 40 and 50 min during two time periods. These
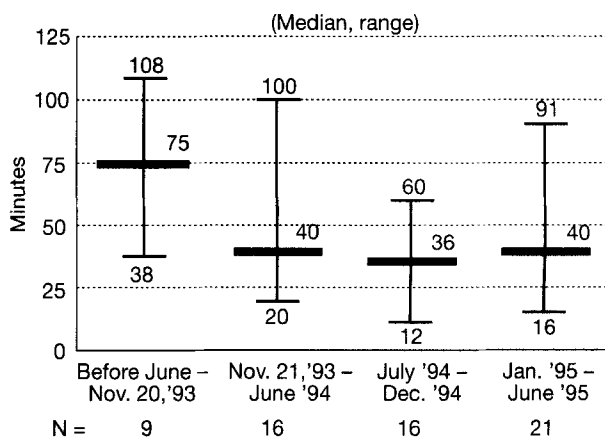

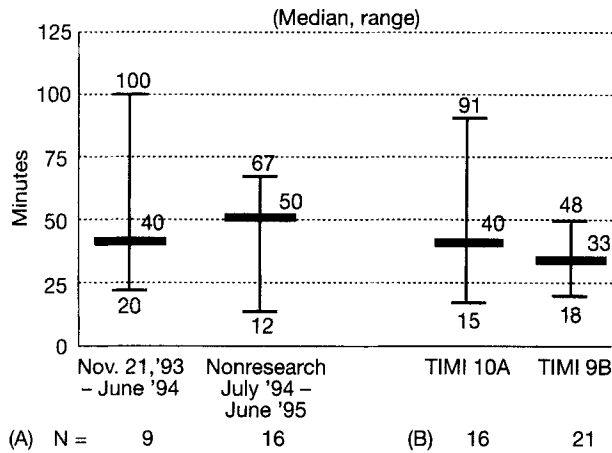FIG. 1   Effect of thrombolysis critical pathway on door-to-drug times.

FIG. 2   Effect of research protocols on door-to-drug times.

FIG. 3   (A) Door-to-drug times for women versus men before and after institution of the critical pathway. ● = Women, ▭ = men. (B) Percentage of women versus men with rapid door-to-drug times. ■ = ≤45 min, ■ = ≤30 min.

are compared with research patients (B) showing a median of 33 min in TIMI 9B (which compared hirudin and heparin but used standard thrombolytic therapy)[7] and a median of 40 min in TIMI 10A (which used a different thrombolytic agent, TNK-tissue plasminogen activator).[6]

During each of the four time periods studied (both before and after the pathway implementation), door-to-drug times were longer for women than for men (see Fig. 3A). Before the pathway, the median was 105 min for women versus 70 min for men. Although time to treatment was reduced for both groups with utilization of the pathway, the median door-to-drug time was higher for women than for men (Mann-Whitney p = 0.013).(Fig. 3A) Similarly, the percentage of patients to be rapidly treated tended to be lower in women than in men (17 vs. 39% ≤ 30 min, and 39 vs. 64% ≤ 45 min, p = 0.07) (Fig. 3B).

Discussion

Our protocol was successful in reducing door-to-drug times in keeping with recommendations from the National Heart Attack Alert Program. By the end of the study, 43% of patients were treated within ≤ 30 min (p = 0.03) and 67% ≤ 45 min (p < 0.001). In the larger National Registry of Myocardial Infarction (NRMI) study, door-to-drug times were reduced over a 4-year period from 60 min to 48 min.[8] Nonetheless, there is still room for improvement, particularly in meeting the National Heart Attack Alert Program goal of thrombolytic treatment within 30 min of hospital presentation.

We also observed a gender gap in door-to-drug times, with longer mean times for women and less than half as many female patients meeting the 30 min time goal. However, the AMI critical pathway was able to reduce this gender gap from a 35 min difference between men and women to 10 min by the end of the study period. Nonetheless, efforts should continue to reduce door-to-drug times further, especially among women, a high-risk group of patients with AMI.
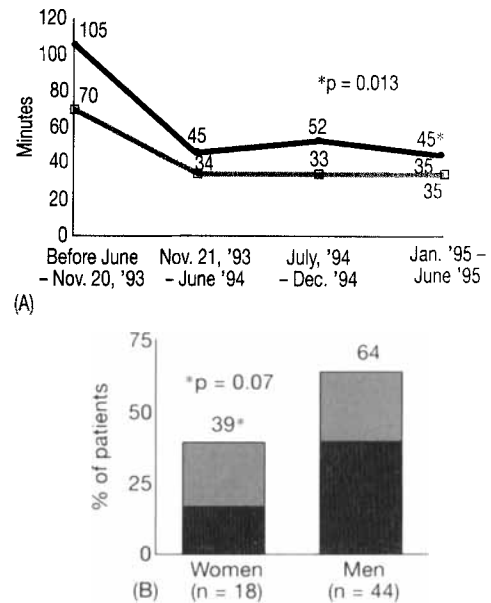
It was encouraging to note that participation in thrombolysis research protocols did not prolong door-to-drug times. Our data are consistent with other data from a participating hospital in the TIMI 5 trial.[9] Although many additional steps are needed for enrollment (assessing eligibility criteria, calling the central randomization facility for treatment assignment, preparation of the study medication), participation in a protocol also raises awareness of the need for acute treatment and involves the study team, who can rapidly enroll the patient and begin thrombolysis. Our findings are also consistent with the shorter door-to-drug time seen in the Myocardial Infarction Triage and Intervention trial compared with control patients treated the year prior to the study.[10] Thus, if the research trial is designed to facilitate rapid enrollment and the study team remains focused on rapid time to treatment, as observed in our study, research protocols do not appear to have an adverse effect on patient care.

Our experience also documents a need for increased utilization of reperfusion therapy. Of the total group of patients with ST-elevation AMI, 12% were eligible for but did not receive thrombolysis. This was also the case for 22% of the total group with contraindications or undocumented reasons for not receiving thrombolytic therapy, who could have been triaged to the catheterization laboratory for primary angioplasty. Our data suggest that although significant improvements in time to treatment have been achieved, there are still opportunities for improvement in offering reperfusion therapy to more patients with acute ST-elevation myocardial infarction.

Potential limitations of our study include lack of randomization to the critical pathway versus standard care (although this would be difficult to institute), lack of blinding of the

chart reviewers to the purpose of the study, and the modest sample size of our study.

Conclusions

Implementation of a collaboratively designed AMI critical pathway for the ED can decrease door-to-drug times (by approximately 40 min in our hospital), which should translate into improved patient outcomes. These data provide support for the use of critical pathways (in this area and potentially other aspects of acute coronary syndrome care) as means to improve clinical outcomes, and should encourage physicians to become involved in development and implementation of critical pathways. In addition, efforts should continue to reduce all aspects of time to treatment with thrombolytic therapy (or primary angioplasty) as emphasized by the new initiatives of the National Heart Attack Alert Program.

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