Short Title: Direct transport to PCI centre

PICO Question:
Among adults who are suspected of having ST-elevation myocardial infarction outside of a hospital or in the emergency department (P), does direct transport to a centre for primary PCI (I), compared with transportation to the closest hospital with any other reperfusion strategy (prehospital fibrinolysis, inhospital fibrinolysis, interhospital transfer for PCI) (C), change death; myocardial injury; stroke; major bleeding; hospital length of stay; chest pain resolution; ECG resolution; infarct size (O)?

Search Inclusion and Exclusion Criteria

Search Strategy:

Newcastle-Ottawa Scale Reviews

Review of RCTs

Included RCTs Quality Grid
Ahmed, Bina; Lischke, Stefan; Straight, Faye; Gogo, Prospero; Leffler, Stephen; Kutler, Marc; Schneider, David; Dauerman, Harold;

Consistent door-to-balloon times of less than 90 minutes for STEMI patients transferred for primary PCI.

**J Invasive Cardiol** 2009; 21(9): 429-33

Recent data from large national registries show that < 15% of patients with ST-elevation myocardial infarction (STEMI) transferred for primary percutaneous intervention (PCI) actually meet the door-to-balloon (D2B) goal of < or = 90 minutes, and only onethird achieve D2B times of < or = 120 minutes. We established a streamlined STEMI protocol to allow rapid transfer of STEMI patients for primary PCI to meet the ACC D2B goal of < or = 90 minutes in at least 75% of the patients. From February 2007 to August 2008, 37 consecutive patients presenting with STEMI to a community hospital in Vermont were transferred 26 miles to the University of Vermont (UVM) for primary PCI. Three time intervals were evaluated: presentation to departure time at the referring hospital, transfer time and UVM PCI time (time from arrival to the cath lab to balloon time). Total D2B time was defined as presentation to the first hospital to first balloon inflation. The majority of transfers (69%) occurred off-hours. All patients received aspirin and clopidogrel and heparin pre-PCI. Median presentation to departure time at the STEMI referral hospital, total transfer and UVM PCI times were 26 (20, 33), 36 (34, 40) and 20 (16, 22) minutes, respectively. The median D2B time was 82 (77, 91) minutes, with 73% of patients achieving the goal D2B of < or = 90 minutes, and 94% achieving a D2B time of < or = 120 minutes. For patients in a rural setting who present with STEMI, transfer of approximately 30 miles for timely primary PCI can be achieved in nearly 75% of patients using a simplified streamlined protocol.

Balerdi, Matthew; Ellis, Daniel; Grieve, Philip; Murray, Paul; Dalby, Miles;

Aeromedical transfer to reduce delay in primary angioplasty.

**Resuscitation** 2011; 82(7): 947-50

Aeromedical transfer can reduce transfer times for primary percutaneous coronary intervention (PPCI). Delays in dispatch of the helicopter and landing-reperfusion can reduce the benefits of air travel. The ad hoc nature of these transfers may compound delays. A formal aeromedical transfer service, with rapid dispatch protocols and rapid landing to balloon times could significantly reduce reperfusion times. A standard operating procedure (SOP) was developed using a field assessment team (doctor, aircrew paramedic) and a cardiologist-led multidisciplinary team meeting the incoming aircraft. The aeromedical SOP for STEMI care was implemented when anticipated land journey >30 min to the nearest PPCI centre. Reperfusion times for actual air travel and estimated virtual land journeys from the same location were compared. Between April and December 2009, 8 patients were managed according to the aeromedical SOP. Median air distance 49 miles and road, 40 miles. All subsequent data shown in median minutes (range). Call-balloon time 109 (97-116). Call-aeromedical activation 13 (9-26). Aeromedical activation-arrive scene 12 (9-16). Time at scene 29 (24-52). Call-depart scene 57 (45-75). Air journey 25 (18-30) and landing-balloon 21 (8-22). Call-arrive at PPCI centre for air 85 (70-95); estimated virtual road call-arrive at PPCI centre 102 (85-104). This SOP delivered sub 120 min call-balloon times in all cases undergoing PPCI from difficult locations where
anticipated land journeys were >30 min. With longer anticipated land journeys (or more remote locations) the proportional gains with air transfer will be greater. Subject to a formal SOP and very rapid landing-balloon times, aeromedical transfer can significantly reduce the number of patients suffering long reperfusion delays in acute myocardial infarction. Copyright © 2011 Elsevier Ireland Ltd. All rights reserved.

Barbash, G; Roth, A; Hod, H; Miller, H; Modan, M; Rath, S; Zahav, Y; Shachar, A; Basan, S; Battler, A A;

Improved survival but not left ventricular function with early and prehospital treatment with tissue plasminogen activator in acute myocardial infarction.


One hundred ninety patients with acute myocardial infarction (AMI) were treated with recombinant tissue-type plasminogen activator (rt-PA) 2.0 +/- 0.8 hours after the onset of symptoms. Eighty-seven patients were enrolled via mobile intensive care units and 103 through the emergency ward. Patients who were enrolled via the mobile intensive care units were randomized to immediate, prehospital treatment initiation, or to delayed, in-hospital treatment initiation. All 190 patients except 2 underwent delayed coronary angiography and, when indicated, angioplasty at 72 hours after enrollment. Patients treated within 2 hours and those treated 2 to 4 hours after symptom onset had similar preservation of left ventricular function, and similar prevalence of congestive heart failure at discharge. Patients treated within 2 hours of symptom onset had significantly lower short- (0.0 vs 6.3%, p = 0.01) and long-term (1.0 vs 9.5%, p = 0.03) mortality. Prehospital initiation of rt-PA appeared to be safe and feasible and resulted in a 40-minute decrease in the time from symptom onset to treatment initiation.

Baruch, Terrence; Rock, Alisa; Koenig, William; Rokos, Ivan; French, William;

"Call 911" STEMI protocol to reduce delays in transfer of patients from non primary percutaneous coronary intervention referral Centers.

Crit Pathw Cardiol 2010; 9(3): 113-5

Primary percutaneous coronary intervention (PPCI) is the preferred method of reperfusion for ST-segment elevation myocardial infarction (STEMI), if it can be performed in a timely manner by an experienced interventional cardiologist at a high volume STEMI Receiving Center. However, an estimated 50% of STEMI patients present to STEMI Referral Centers without PPCI capability. Transfer of STEMI patients for PPCI has been shown to improve outcomes as compared with fibrinolysis given at the presenting hospital. Nonetheless, transfer of STEMI patients for PPCI has not been used extensively in the United States and is associated with markedly prolonged transfer times. This study demonstrates that rapid transfer of STEMI patients from community hospitals without PPCI capability to a STEMI Receiving Center is both safe and feasible using a standardized protocol with an integrated transfer system.
Bellinger, R; Califf, R; Mark, D; Weber, R; Collins, P; Stone, J; Phillips, H; German, L; Stack, R;

Helicopter transport of patients during acute myocardial infarction.


Initial experience with a regional system of emergency helicopter transport of patients with acute myocardial infarction (AMI) referred for emergent cardiac catheterization and percutaneous transluminal coronary angioplasty (PTCA) is described. Two hundred fifty patients with AMI were transported from within a 150-mile radius to Duke University Medical Center over a 15-month period. All patients were within 12 hours of onset of symptoms. Thrombolytic therapy was administered to 240 (96%) patients (72% before or in-flight). The time to administration of thrombolytic therapy ranged from 30 to 120 minutes (median 180), while the time to arrival in the interventional catheterization laboratory ranged from 105 to 815 minutes (median 300). The flight time was 12 to 77 minutes (median 31). Most patients had 1- or 2-vessel coronary artery disease; the baseline ejection fraction ranged from 27 to 70% (median 42). Transient hypotension was the most common complication both pre-flight and in-flight. Third-degree atrioventricular block and nonsustained ventricular tachycardia were the next most common complications. Ventricular fibrillation or sustained ventricular tachycardia occurred before takeoff in 38 patients (15%). No patients had ventricular fibrillation, asystole or respiratory arrest during transport. Fluid boluses for hypotension were the most common intervention. Five patients required cardiopulmonary resuscitation in-flight; 3 before lift-off and 2 required a brief period of cardiopulmonary resuscitation during sustained ventricular tachycardia. Fourteen patients had pressor therapy, military antishock trousers or both to maintain adequate blood pressure. Neither cardioversion, defibrillation nor intubation were performed in-flight. Thus, inflight complications are infrequent and can be managed en route to an intervention center.(ABSTRACT TRUNCATED AT 250 WORDS)

Beltesbrekke, Hanne; Husa, Mari; Vik-Mo, Harald;

[Acute myocardial infarction in Mid-Norway: transportation for thrombolytic treatment or primary percutaneous coronary intervention?]

Tidsskr. Nor. Laegeforen. 2010; 130(17): 1714-6

Occluded coronary arteries should be opened urgently in patients who have acute myocardial infarction and ST-elevation in ECG. When transport times are long, thrombolytic treatment is a good alternative to primary percutaneous coronary intervention (PCI). The purpose of this study was to assess choice of treatment strategy in cases where time after start of symptoms and transport time are decisive for the outcome. A cohort study of 379 patients, who had myocardial infarction and ST-elevation, and were admitted to St. Olav's Hospital, Trondheim, Norway in the period 1.11.2007-31.1.2009. 268 patients (71 %) were treated with PCI, and 111 patients (29 %) with thrombolytic treatment. 173 patients (46 %) were transported by helicopter. The counties in Mid-Norway used markedly different treatment strategies for these patients. Great regional
differences were observed in the use of PCI and thrombolytic treatment in Mid-Norway.

PubMed ID 20835281 Read Abstract Read Full Text Article Source PubMed

Observational Study

Blankenship, James; Haldis, Thomas; Wood, G; Skelding, Kimberly; Scott, Thomas; Menapace, Francis;

Rapid triage and transport of patients with ST-elevation myocardial infarction for percutaneous coronary intervention in a rural health system.

Am. J. Cardiol. 2007; 100(6): 944-8

This study was conducted to evaluate door-to-treatment times before and after the implementation of a rapid triage and transfer system for patients with ST-elevation myocardial infarction transferred from community hospitals to a rural angioplasty center for primary percutaneous coronary intervention (PCI). The system was developed in late 2004 and implemented at a rural percutaneous coronary intervention center in early 2005. Helicopter transport was available for 97% of requests for transfer from community hospitals. All patients with ST-elevation myocardial infarction transferred during 2004 and 2005 (n=226) were evaluated with respect to presentation and treatment times. Time from community hospital presentation to wire crossing decreased during the study from 205 to 105 minutes (p=0.0001). One fourth of patients were treated <90 minutes after presentation, and 2/3 were treated in <120 minutes. In conclusion, the implementation of a rapid triage, transfer, and treatment protocol can achieve a significant shortening of presentation-to-treatment times. Efficient community hospitals working with an efficient angioplasty center can achieve presentation-to-wire crossing times of <90 minutes for some patients.

PubMed ID 17826374 Read Abstract Read Full Text Article Source PubMed

Observational Study

Bøhmer, Ellen; Kristiansen, Ivar; Arnesen, Harald; Halvorsen, Sigrun;

Health and cost consequences of early versus late invasive strategy after thrombolysis for acute myocardial infarction.


The NORwegian study on DIstrict treatment of ST-Elevation Myocardial Infarction showed an improved clinical outcome with early transfer for percutaneous coronary intervention (PCI) compared to a more conservative approach after thrombolysis. The aim of this substudy was to compare the 12-month quality-adjusted life years (QALYs) and costs of these alternative strategies. Methods: Patients with ST-elevation myocardial infarction <6 h duration and >90 min expected delay to PCI, received full-dose tenecteplase and were randomized to either early or late invasive strategy (n = 266). Detailed quality of life and resource use data were registered prospectively for a period of 12 months. Health outcomes were measured as quality of life using a generic instrument (15D). Quality of life scores were translated into QALYs. Unit costs were based on hospital accounts, fee schedules, and market prices. Results: After 12 months of follow-up, patients in the early invasive group had 0.008 (95% CI -0.027 to 0.043) more QALYs compared to the late invasive group. The mean total costs were €18,201 in the early versus €17,643 in the late invasive group, with a mean difference of €558 (95% CI -2258 to 3484). Cost/QALY was €69,750 while cost/avoided clinical endpoint was €5636. Conclusion: Early and late invasive strategies after thrombolysis resulted in similar quality of life
and similar costs in ST-elevation myocardial infarction patients living far from a PCI centre (NCT00161005).

Observational Study

Bøhmer, Ellen; Arnesen, Harald; Abdelnoor, Michael; Mangschau, Arild; Hoffmann, Pavel; Halvorsen, Sigrun;
The NORwegian study on DIstrict treatment of ST-elevation myocardial infarction (NORDISTEMI).


Thrombolysis is the treatment of choice for patients with ST-elevation myocardial infarction (STEMI) living in rural areas with long transfer delays to percutaneous coronary intervention (PCI). This trial compares two different strategies following thrombolysis: to transfer all patients for immediate coronary angiography and intervention, or to manage the patients more conservatively. The NORwegian study on DIstrict treatment of STEMI (NORDISTEMI) is an open, prospective, randomized controlled trial in patients with STEMI of less than 6 hours of duration and more than 90 minutes expected time delay to PCI. A total of 266 patients will receive full-dose thrombolysis, preferably pre-hospital, and then be randomized to either strategy. Our primary endpoint is the one year combined incidence of death, reinfarction, stroke or new myocardial ischaemia. The study is registered with ClinicalTrials.gov, number NCT00161005. By April 2006, 109 patients have been randomized. Thrombolysis has been given pre-hospital to 52% of patients. The median transport distance from first medical contact to catheterization laboratory was 155 km (range 90-396 km). Results of the study are expected in 2008.

Randomized Control Trial

Bonnefoy, Eric; Steg, Philippe; Boutitie, Florent; Dubien, Pierre-Yves; Lapostolle, Frédéric; Roncalli, Jérome; Dissait, Frederic; Vanzetto, Gérald; Leizorowicz, Alain; Kirkorian, Gilbert G; ; ; Mercier, C C; McFadden, E P EP; Touboul, P P;

Comparison of primary angioplasty and pre-hospital fibrinolysis in acute myocardial infarction (CAPTIM) trial: a 5-year follow-up.


The CAPTIM (Comparison of primary Angioplasty and Pre-hospital fibrinolysis In acute Myocardial infarction) study found no evidence that a strategy of primary angioplasty was superior in terms of 30-day outcomes to a strategy of pre-hospital fibrinolysis with transfer to an interventional facility in patients managed early at the acute phase of an acute myocardial infarction. The present analysis was designed to compare both strategies at 5 years. The CAPTIM study included 840 patients managed in a pre-hospital setting within 6 h of an acute ST-segment elevation myocardial infarction. Patients were randomized to either a primary angioplasty (n = 421) or a pre-hospital fibrinolysis (rt-PA) with immediate transfer to a centre with interventional facilities (n = 419). Long-term follow-up was obtained in blinded fashion from 795 patients (94.6%). Using an intent-to-treat analysis, all-cause mortality at 5 years was 9.7% in the pre-hospital fibrinolysis group when compared with 12.6% in the primary angioplasty group [HR 0.75 (95% CI, 0.50-1.14); P = 0.18]. For patients included within 2 h, 5 year mortality was 5.8% in the pre-hospital fibrinolysis group when compared with 11.1% in the primary angioplasty group [HR 0.50 (95% CI, 0.25-
0.97); P = 0.04], whereas it was, respectively, 14.5 and 14.4% in patients included after 2 h [HR 1.02, (95% CI 0.59-1.75), P = 0.92]. The 5-year follow-up is consistent with the 30-day outcomes of the trial, showing similar mortality for primary percutaneous coronary intervention and a policy of pre-hospital lysis followed by transfer to an interventional center. In addition, for patients treated within 2 h of symptom onset, 5-year mortality was lower with pre-hospital lysis.

Burány, Béla; Rudas, László;
[Interhospital transport of acute coronary syndrome patients from Bács-Kiskun county].

Orv Hetil 2005; 146(35): 1819-25

As an alternative to thrombolysis, primary percutaneous coronary intervention is increasingly utilized in Hungary for treating acute ST elevation myocardial infarction. Heart catheterization laboratories however are not readily available in vast areas of the country. The benefits of primary intervention may fade away with long distance transportation. In order to assess real life practice, the authors have retrospectively studied the interhospital delays of patients transferred with acute coronary syndromes from Bács-Kiskun county between April 2000 and March 2003. This is the largest county of Hungary, with population of 570,000, with no local hemodynamic laboratory. Patients with acute coronary syndromes are transferred to the Cardiac Centers of the Universities of Szeged and Pécs, as well as to 3 designated hospitals with heart catheterization facilities at Budapest. Interhospital delay was defined as the time elapsed from the call of the Emergency Medical Service to the admission of the patient to the catheterization laboratory. During the studied period 94 patients were transported with acute coronary syndrome. In 79 cases the complete medical documentation from the primary hospitals and the hemodynamic laboratories could be collected. 17 patients with ST-elevation were transported for primary intervention. Twenty-six patient received both thrombolytic and interventional therapy. Further 36 patients suffered from non ST elevation myocardial infarction or unstable angina. Interhospital delay for the whole group was 166 +/- 55 minutes, and for the subgroup of ST-elevation patients awaiting for primary intervention 148 +/- 43 minutes. The transfer time, i.e. the time that the patient spent on the road or in the air lasted longer than 90 minutes in 80% of cases. Air transportation resulted in no reduction of transport time. This finding may be explained by the fact, that both the sending and receiving hospitals lack appropriate helicopter landing sites. The authors conclude, that for those residents of Bács-Kiskun county who suffer from acute ST-elevation myocardial infarction, and have no contraindications for thrombolysis, primary intervention is not a viable therapeutic option.

Clemmensen, Peter; Sejersten, Maria; Silleizen, Martin; Hampton, David; Wagner, Galen; Loumann-Nielsen, Søren;

Diversion of ST-elevation myocardial infarction patients for primary angioplasty based on wireless prehospital 12-lead electrocardiographic transmission directly to the cardiologist's handheld computer: a progress report.

#Type!
Time to reperfusion is critical for outcome in patients with ST-elevation myocardial infarction (STEMI). In our region, patients are routinely treated by primary percutaneous coronary intervention (pPCI), but rerouting patients from the primary receiving hospital to a catheterization center can cause unacceptable delays that may exceed 1 hour in the emergency department. Wireless transmission of prehospital electrocardiograms (ECGs) to receiving stations in hospitals has been shown to reduce time from symptom onset to reperfusion. However, transmission directly to a cardiologist's handheld digital device has not been investigated. To report preliminary data from a larger ongoing trial evaluating prehospital 12-lead ECG transmission to a cardiologist's handheld device in patients with symptoms suggesting an acute coronary syndrome. Patients suffering acute, nontraumatic chest pain have their prehospital ECG transmitted by wireless technology directly to a cardiologist's handheld device at an invasive hospital, allowing diversion of STEMI cases to rapid pPCI. Transmission failures are documented. Times for symptom onset, 911 alert, ECG recording, hospital arrival, and pPCI are obtained. All time intervals are summarized as median values and are compared with historic controls from the Danish multicenter study, DANAMI-2. During the first 15 months of the trial, prehospital ECGs were transmitted for 408 chest pain patients with an overall success rate of 93%. Cardiologist receiving the ECGs recommended that 113 patients (28%) be diverted for pPCI. Mean time from symptom onset to 911 alert was 2 hours 16 minutes (range, 1 minute to 23 hours 15 minutes), and the ambulance response interval was 5 minutes (range, 1-25 minutes). The ambulance on-scene time had increased by 7 minutes compared with historic controls (P<.05). Time from ECG recording to hospital arrival was 25 minutes. The total prehospital time was 2 hours 57 minutes. The hospital treatment time was substantially reduced among diverted patients. Hospital arrival to procedure start was 40 minutes, compared with 94 minutes in the DANAMI-2 historic control group (P<.01). These preliminary data suggest that transmission of prehospital 12-lead ECGs directly to the attending cardiologist using handheld devices is a technologically sound concept without major safety concerns and markedly reducing time to reperfusion in patients with STEMI.

PubMed ID 16226101  Read Abstract  Read Full Text  Article Source PubMed

Observational Study

Concannon, Thomas; Kent, David; Normand, Sharon-Lise; Newhouse, Joseph; Griffith, John; Cohen, Joshua; Beshansky, Joni; Wong, John; Aversano, Thomas; Selker, Harry P HP;

Comparative effectiveness of ST-segment-elevation myocardial infarction regionalization strategies.


Primary percutaneous coronary intervention (PCI) is more effective on average than fibrinolytic therapy in the treatment of ST-segment-elevation myocardial infarction. Yet, most US hospitals are not equipped for PCI, and fibrinolytic therapy is still widely used. This study evaluated the comparative effectiveness of ST-segment-elevation myocardial infarction regionalization strategies to increase the use of PCI against standard emergency transport and care. We estimated incremental treatment costs and quality-adjusted life expectancies of 2000 patients with ST-segment-elevation myocardial infarction who received PCI or fibrinolytic therapy in simulations of emergency care in a regional hospital system. To increase access to PCI across the system, we compared a base case strategy with 12 hospital-based strategies of building new PCI laboratories or extending the hours of existing laboratories and 1 emergency medical services-based strategy of transporting all patients with ST-segment-elevation myocardial infarction to existing PCI-capable hospitals. The base case resulted in 609 (95% CI, 569-647) patients getting PCI. Hospital-based strategies increased the number of patients receiving PCI, the costs of care, and quality-adjusted life years saved and were cost-effective under a variety of conditions. An emergency medical services-based strategy of transporting every patient to an existing PCI facility was less costly and more effective than all hospital expansion options. Our results suggest that new construction and staffing of PCI laboratories may not be warranted if an emergency medical services strategy is both available and feasible.
Concannon, Thomas; Kent, David; Normand, Sharon-Lise; Newhouse, Joseph; Griffith, John; Ruthazer, Robin; Beshansky, Joni; Wong, John; Aversano, Thomas; Selker, Harry P HP;

A geospatial analysis of emergency transport and inter-hospital transfer in ST-segment elevation myocardial infarction.

**Am. J. Cardiol.** 2008; 101(1): 69-74

Primary percutaneous coronary intervention (PCI) yields better outcomes than thrombolytic therapy in the treatment of patients with ST-segment elevation myocardial infarctions (STEMIs). Emergency medical service systems are potentially important partners in efforts to expand the use of PCI. This study was conducted to explore the probable impact on patient mortality and hospital volumes of competing strategies for the emergency transport of patients with STEMIs. Emergency transport was simulated for 2,000 patients with STEMIs from the Atlantic Cardiovascular Patient Outcomes Research Team (C-PORT) trial in a geospatial model of Dallas County, Texas. Patient mortality estimates were obtained from a recently developed predictive model comparing PCI and thrombolytic therapy. A strategy of transporting patients to the closest hospital and treating with PCI if available and thrombolytic therapy if not yielded a 5.2% 30-day mortality rate (95% confidence interval [CI] 4.2% to 6.3%). A strategy of universal PCI, in which patients were transported only to PCI-capable hospitals, yielded 4.4% (95% CI 3.6% to 5.4%) mortality and an increase in patient volume at 2 full-time PCI hospitals of >1,000%. A strategy of targeted PCI, in which high-benefit patients were transported or transferred to PCI-capable hospitals, yielded 4.5% (95% CI 3.8% to 5.5%) mortality if transfers were decided in the emergency department and 4.2% (95% CI 3.4% to 5.1%) if transport was decided in the emergency vehicle. Targeted PCI strategies increased patient volumes at full-time PCI hospitals by about 700%. In conclusion, the selection of high-benefit patients for transport or transfer to PCI-capable hospitals can reduce mortality while minimizing major shifts in hospital patient volumes.

Cyr, Jay; Paige, Peter; Paige, Paula; Fisher, Daniel;

Sustaining and spreading reduced door-to-balloon times for ST-segment elevation myocardial infarction patients.


Prompt primary percutaneous coronary intervention (PCI) for patients with ST-segment elevation myocardial infarction (STEMI) significantly reduces mortality and morbidity. In 2004 the American College of Cardiology (ACC) and American Heart Association (AHA) set a goal to reduce door-to-balloon (D2B) time to < 90 minutes in 75% of STEMI cases. IMPLEMENTING THE STEMI INITIATIVE: In 2004, the STEMI/D2B leadership team broke down D2B time into four segments: door to data, data to diagnosis, diagnosis to decision, and decision to device. Each segment was examined for inefficiencies, duplication, and nonstandardization. In 2005, after the internal D2B processes and results showed improvement, the STEMI/D2B leadership team extended the project to prehospital emergency medical services. In 2006, UMass Memorial began to roll out a regional
system for STEMI care to the 12 community hospitals in its service area without on-site PCI capabilities. In 2007, the STEMI program's first full year, D2B times averaged ≤ 90 minutes in 94% of the 87 STEMI cases; 62% had a D2B of ≤ 60 minutes. In 2008, 96% of the D2B times averaged ≤ 90 minutes. Mortality rates following PCI for STEMI were 62% and 57% less than predicted in 2006 and 2007, respectively. In 2008 the D2B time for direct-admit STEMI patients averaged < 50 minutes. From December 2007 through April 2009 UMass Memorial achieved the new ACC/AHA metric of prehospital EKG to balloon in ≤ 90 minutes for 64 (90%) of the 71 patients for whom a prehospital electrocardiogram was obtained. The D2B time process is being applied to other clinical venues; a vascular surgery project is underway to reduce "door-to-incision time" for patients with ruptured abdominal aortic aneurysms.

Expedited transfer for primary percutaneous coronary intervention: a program evaluation.

A shorter time from symptom onset to reperfusion is associated with improved outcomes for patients with ST-segment elevation myocardial infarction (MI). Primary percutaneous coronary intervention is a favourable method of reperfusion if performed effectively and expeditiously. We sought to evaluate the impact of an expedited pre-hospital diagnosis and transfer pathway developed by a multidisciplinary team on the door-to-balloon time in a large urban community. We included all patients with ST-segment elevation MI who presented within 12 hours after symptom onset and who sought medical attention through Emergency Medical Services within the boundaries of the city of Calgary in the 16 months following the introduction of the pathway in June 2004. The primary aim was to determine the proportion of patients who received percutaneous coronary intervention within the recommended door-to-balloon time of 90 minutes. The 358 patients (268 men) in the study cohort had a mean age of 63.2 (standard deviation 12.7) years; 140 (39.1%) had an anterior MI; and 23 (6.4%) had cardiogenic shock. The introduction of the pathway resulted in a median door-to-balloon time of 62 (interquartile range 45-84) minutes. A door-to-balloon time within 60 minutes and within the currently recommended 90 minutes was achieved in 48.9% and 78.8% of the patients respectively. The in-hospital and 30-day mortality rates were both 3.1%. In a community with multiple regional hospitals and a single facility for percutaneous coronary intervention, the implementation of a multidisciplinary pre-hospital diagnosis and transfer pathway was feasible and resulted in most patients in the study cohort receiving primary percutaneous coronary intervention within the recommended door-to-balloon time of 90 minutes.

Pre-hospital triage for primary angioplasty: direct referral to the intervention center versus interhospital transport.

JACC Cardiovasc Interv 2010; 3(7): 705-11
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. 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. 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. 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. 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. Copyright 2010 American College of Cardiology Foundation. Published by Elsevier Inc. All rights reserved.

Dieker, Hendrik-Jan; van Horssen, Elvira; Hersbach, Ferry; Brouwer, Marc; van Boven, Ad; van ’t Hof, Arnoud; Aengevaeren, Wim; Verheugt, Freek; Bär, Frits;

Transport for abciximab facilitated primary angioplasty versus on-site thrombolysis with a liberal rescue policy: the randomised Holland Infarction Study (HIS).


As of to date, the only large transportation trial comparing on-site fibrin-specific thrombolysis with transfer for primary angioplasty in patients presenting in a referral centre is the DANAMI-2 trial, with only 3% rescue angioplasty. The Holland Infarction Study (HIS) compared abciximab facilitated primary angioplasty (FP) with on-site fibrin-specific thrombolytic therapy (TT) with a liberal protocol-driven rescue angioplasty (transport to intervention centre in case < 50% ST resolution at 60 min). Patients in a referral centre without shock and < 4.5 h of chest pain presenting with ST-elevation having > or = 12 mm ST-segment shift were randomised to either strategy. Of the originally planned 900 patients only 48 were included due to suspension of financial funding. Death, recurrent MI and stroke at one year was 8% for the FP-group and 22% for the TT-group (p = 0.2). Two hours after randomisation the rates of complete ST-segment resolution (> or =70%) were 52% and 35%, respectively (p = 0.2). This prematurely discontinued randomised transportation trial shows favorable trends with respect to long-term clinical outcome and early ST-resolution for abciximab facilitated primary angioplasty. In view of the real world delays associated with interhospital transport for primary angioplasty, treatment strategies focusing on early fibrin-specific lysis with a liberal selective rescue policy are warranted.
Dobrzycki, Sławomir; Mezyński, Grzegorz; Kralisz, Paweł; Prokopczuk, Przemysław; Nowak, Konrad; Kochman, Wacław; Zuk, Jerzy; Bachórzewska-Gajewska, Hanna; Sawicki, Zdzisław; Poniatowski, Bogusław B; Korecki, Janusz J; Musiał, Włodzimierz J WJ;

Is transport with platelet GP IIb/IIIa inhibition for primary percutaneous coronary intervention more efficient than on-site thrombolysis in patients with STEMI admitted to community hospitals? Randomised study. Early results.

Kardiol Pol 2006; 64(8): 793-9; discussion 800-1

The advantage of primary percutaneous coronary intervention (pPCI) in the management of ST-elevation myocardial infarction (STEMI) over thrombolytic therapy has been demonstrated. However, an optimal medical treatment of STEMI patients admitted to regional hospitals without catheterisation facilities has not yet been established. Delay in initiation of pPCI resulting from transportation to the catheterisation laboratory may diminish the benefits of such therapy in comparison with thrombolysis administered in a regional hospital. Early initiation of therapy with platelet glycoprotein IIb/IIIa receptor inhibitor, which provides protection for the transportation, may be a reasonable solution to maintain the advantage of pPCI over thrombolysis alone in STEMI patients. The studied group comprised patients with STEMI (infarct duration time <12 hours, typical clinical and electrocardiographic criteria of MI) who were randomly assigned in 13 regional hospitals located 20 to 150 km from invasive centre to one of two subgroups, either to thrombolysis in the community hospital or to transport after thrombolysis initiation with platelet GP IIb/IIIa receptor inhibitor (tirofiban; 10 mg/kg in intravenous bolus in the emergency room of the community hospital followed by continuous intravenous infusion of 0.1 mg/kg/min during transport as well as coronary procedure) in order to receive pPCI. All patients with cardiogenic shock on admission were routinely treated with PCI and were excluded from the study. 341 patients were included in the study (169 were randomised to receive thrombolytic therapy and 172--transport with intention to perform PCI). Mean time between onset of MI and randomisation was similar in the transport and thrombolysis groups, (139+/−133 min. vs 143+/−117 min., respectively, p=0.94). Mean infusion time of tirofiban to the beginning of PCI in the transport group was 121+/−36 min. Anterior MI was present in 42.6% of patients in the PCI group and in 41.5% in the thrombolytic group (p=0.085). Mean time from randomisation to pPCI was 158+/−60 min., and to thrombolysis initiation in 44+/−43 min. (p <0.0001). None of the patients died during transfer. In a 30-day follow-up we noted (pPCI vs thrombolytic group, respectively): mortality 3.49% vs 8.88% (p=0.04); reinfarction 1.16% vs 5.92% (p=0.02), stroke 0.58% vs 1.18% (p=0.55). In-hospital stay was significantly shorter in the transport group (9+/−3 days vs 14+/−7 days, p <0.0001). During hospitalisation, 17 (10.05%) patients initially assigned to thrombolysis alone had to be transferred to the catheterisation laboratory to undergo PCI (rescue PCI or PCI for postinfarction angina). Combined end-point (death/reinfarction/stroke) was reached more frequently in the thrombolytic group (15.98% vs 5.23%, p=0.001). A strategy of invasive therapy involving transport with GP IIb/IIIa receptor inhibitor and pPCI in STEMI patients admitted to hospital without catheterisation facilities was found to be more effective than thrombolytic therapy alone employed in the regional hospitals.

PubMed ID 16981054 Read Abstract Read Full Text Article Source PubMed

Observational Study

Estévez-Loureiro, Rodrigo; Calviño-Santos, Ramon; Vázquez-Rodríguez, Jose-Manuel; Marzoa-Rivas, Raquel; Barge-Caballero, Eduardo; Salgado-Fernández, Jorge; Aldama-López, Guillermo; Barreiro-Díaz, Maria; Varela-Portas, Jacobo; Freire-Tellado, Miguel M; Vázquez-González, Nicolas N; Castro-Beiras, Alfonso A;
Direct transfer of ST-elevation myocardial infarction patients for primary percutaneous coronary intervention from short and long transfer distances decreases temporal delays and improves short-term prognosis: the PROGALIAM Registry.

**EuroIntervention** 2010; 6(3): 343-9

This study sought to evaluate the impact of a direct transfer strategy on treatment times and prognosis of patients with ST-segment elevation acute myocardial infarction (STEMI) undergoing primary percutaneous intervention (PPCI). We conducted a cohort study of 1,194 patients who underwent PPCI in our centre between May 2005 and December 2008. We studied the role of direct transfer on time to treatment and door-to-balloon delays and its effect on 30-day mortality adjusted by risk profile on admission. During this period, 255 patients (21%) experienced direct transfer (DT) from the field to the catheterisation laboratory. Patients referred directly for PPCI experienced lower median door-to-balloon delay (102 minutes vs. 125 minutes, p<0.0001) and lower time to treatment (median 189 minutes vs. 259 minutes, p<0.0001) when compared with those referred from emergency departments (ED). These differences were consistent, with respect to door-to-balloon delay and time to treatment interval, in patients from our catchment area: median 88 vs. 98 minutes, (p=0.003) and 174 vs. 219 minutes (p<0.0001) respectively, and from long-distance transfer: 110 vs. 169 minutes (p<0.0001) and 197 minutes vs. 342 minutes (p<0.0001) respectively. Patients in the DT group experienced lower 30-day mortality than patients transferred from the ED (2.7% vs. 6.8%, p=0.017). In a multivariable analysis, DT strategy was independently associated with better short-term prognosis (OR 0.33, CI95% 0.12 - 0.92). Direct transfer reduces time delays and improves prognosis of patients with STEMI undergoing PPCI.

Pubmed ID 20884412

Observational Study

Gachoud, D; Wenaweser, P; Laskine, M; Kehtari, R; Lütolf, I; Ramser, M; Zürcher Zenklusen, R;

Safety and outcome of patients with an acute ST-elevation myocardial infarction transferred for primary coronary intervention: the Neuchâtel experience.

Transferring patients with ST-elevation myocardial infarction (STEMI) for primary percutaneous coronary intervention (PCI) from a community hospital to a PCI centre has been evaluated in randomised trials and shown to be safe and effective. A prolonged transfer time may restrict the benefit of this strategy. We sought to assess 1) safety of transfer from Neuchâtel to Berne, 2) time intervals of patients transferred either directly from on-site or after evaluation in the local emergency room, and 3) clinical long-term outcome. 42 patients with STEMI eligible for reperfusion therapy were prospectively included between January 2003 and June 2004. Twenty patients (48%, group 1) were directly transferred to the PCI centre from on-site. Twenty-two were transferred after initial treatment in the local emergency room: 11 patients (26%, group 2) presented spontaneously at the hospital and 11 patients (26%, group 3) were admitted by the rescue team. No major complication occurred during transport. Median transport time was 33 minutes. Median time from first healthcare contact to balloon consisted of 131 minutes in group 1, 158 minutes in group 2 and 174 minutes in group 3. The overall rate of Major Adverse Cardiac Events (MACE) at 6 months amounted to 9.5%. Transfer for primary PCI of our patients with acute STEMI was safe. Direct transfer from on-site to the PCI centre reduced the time of ischaemia. The overall MACE rate was low.

Pubmed ID 17183433
Glickman, Seth; Lytle, Barbara; Ou, Fang-Shu; Mears, Greg; O'Brien, Sean; Cairns, Charles; Garvey, J; Bohle, David; Peterson, Eric; Jollis, James G JG; Granger, Christopher B CB;

Care processes associated with quicker door-in-door-out times for patients with ST-elevation-myocardial infarction requiring transfer: results from a statewide regionalization program.

Circ Cardiovasc Qual Outcomes 2011; 4(4): 382-8

The ability to rapidly identify patients with ST-segment elevation-myocardial infarction (STEMI) at hospitals without percutaneous coronary intervention (PCI) and transfer them to hospitals with PCI capability is critical to STEMI regionalization efforts. Our objective was to assess the association of prehospital, emergency department (ED), and hospital processes of care implemented as part of a statewide STEMI regionalization program with door-in-door-out times at non-PCI hospitals. Door-in-door-out times for 436 STEMI patients at 55 non-PCI hospitals were determined before (July 2005 to September 2005) and after (January 2007 to March 2007) a year-long implementation of standardized protocols as part of a statewide regionalization program (Reperfusion of Acute Myocardial Infarction in North Carolina Emergency Departments, RACE). The association of 8 system care processes (encompassing emergency medical services [EMS], ED, and hospital settings) with door-in-door-out times was determined using multivariable linear regression. Median door-in-door-out times improved significantly with the intervention (before: 97.0 minutes, interquartile range, 56.0 to 160.0 minutes; after: 58.0 minutes, interquartile range, 35.0 to 90.0 minutes; P<0.0001). Hospital, ED, and EMS care processes were each independently associated with shorter door-in-door-out times (-17.7 [95% confidence interval, -27.5 to -7.9]; -10.1 [95% confidence interval, -19.0 to -1.1], and -7.3 [95% confidence interval, -13.0 to -1.5] minutes for each additional hospital, ED, and EMS process, respectively). Combined, adoption of EMS processes was associated with the shortest median treatment times (44 versus 138 minutes for hospitals that adopted all EMS processes versus none). Prehospital, ED, and hospital processes of care were independently associated with shorter door-in-door-out times for STEMI patients requiring transfer. Adoption of several EMS processes was associated with the largest reduction in treatment times. These findings highlight the need for an integrated, system-based approach to improving STEMI care.

Gross, Brian; Dauterman, Kent; Moran, Mark; Kotler, Todd; Schnugg, Stephen; Rostykus, Paul; Ross, Amy; Weaver, W;

An approach to shorten time to infarct artery patency in patients with ST-segment elevation myocardial infarction.

Am. J. Cardiol. 2007; 99(10): 1360-3

We developed a regional strategy to decrease the time to percutaneous coronary intervention (PCI) for patients with acute ST-segment elevation myocardial infarction (STEMI). Protocols were created for paramedics and referring hospitals to identify and directly triage all patients with STEMI to a single PCI center. Time to PCI reperfusion and in-hospital mortality were assessed in 233 consecutive patients with STEMI. Ninety-minute initial hospital door-to-patent infarct artery was achieved in 58.3% of paramedic-diagnosed and directly triaged patients compared with 37.5% of "walk-ins" to the PCI hospital and with only 5.2% of
those transferred from another hospital emergency department (ED; p < 0.001). Overall in-hospital mortality was 2.1%, 0% in paramedic identified patients, and 0% in those walk-ins to the PCI hospital ED compared with 4.3% for those transferred from a referring hospital ED (p = 0.007). Paramedic diagnosis of STEMI and direct triage to a prealerted interventional hospital for primary PCI was associated with a high percentage of patients achieving <90-minute infarct artery patency. Substantial delays remained for those who presented initially to a non-PCI hospital ED despite the expedited protocol. In conclusion, this observational study suggests that wider use of paramedic electrocardiographic STEMI diagnosis and direct triage to a prealerted hospital catheterization team may help improve outcomes of patients with STEMI.

Hata, Noritake; Kobayashi, Nobuaki; Imaizumi, Takahiro; Yokoyama, Shinya; Shinada, Takuro; Tanabe, Jun; Shiiba, Kunito; Suzuki, Yuichirou; Matsumoto, Hisashi; Mashiko, Kunihiro K;

Use of an air ambulance system improves time to treatment of patients with acute myocardial infarction.

Intern. Med. 2006; 45(2): 45-50

The aim of this study was to clarify whether a helicopter ambulance system (doctor helicopter system; DHS) could shorten the time interval to coronary intervention in the treatment of patients with acute myocardial infarction (AMI), in comparison with ground ambulance (GA). The time from the emergency call to coronary angiography (CAG time) or to percutaneous coronary intervention (PCI time), and the inhospital outcome were evaluated in 76 AMI patients. Twenty patients were transported by DHS, and the other 56 were by GA. Both CAG time and PCI time were significantly shorter in the DHS (98.8+/−29.2 min, and 169.6+/−57.4 min) than those of the GA (126.6+/−48.7 min, and 203.2+/−57.0 min; p<0.05) group. Inhospital mortality was lower in the DHS (5.0%) versus the GA (10.7%) group. Use of DHS shortened the time interval to coronary intervention and also improved the inhospital prognosis of AMI patients.

Herrin, Jeph; Miller, Lauren; Turkmani, Dima; Nsa, Wato; Drye, Elizabeth; Bernheim, Susannah; Ling, Shari; Rapp, Michael; Han, Lein; Bratzler, Dale W DW; Bradley, Elizabeth H EH; Nallamothu, Brahmajee K BK; Ting, Henry H HH; Krumholz, Harlan M HM;

National performance on door-in to door-out time among patients transferred for primary percutaneous coronary intervention.


Delays in treatment time are commonplace for patients with ST-segment elevation acute myocardial infarction who must be transferred to another hospital for percutaneous coronary intervention. Experts have recommended that door-in to door-out (DIDO) time (ie, time from arrival at the first hospital to transfer from that hospital to the percutaneous coronary intervention hospital) should not exceed 30 minutes. We sought to describe national performance in DIDO time using a new measure developed by the Centers for Medicare & Medicaid Services. We report national median DIDO time and examine associations
with patient characteristics (age, sex, race, contraindication to fibrinolytic therapy, and arrival time) and hospital characteristics (number of beds, geographic region, location [rural or urban], and number of cases reported) using a mixed effects multivariable model. Among 13,776 included patients from 1034 hospitals, only 1343 (9.7%) had a DIDO time within 30 minutes, and DIDO exceeded 90 minutes for 4267 patients (31.0%). Mean estimated times (95% CI) to transfer based on multivariable analysis were 8.9 (5.6-12.2) minutes longer for women, 9.1 (2.7-16.0) minutes longer for African Americans, 6.9 (1.6-11.9) minutes longer for patients with contraindication to fibrinolytic therapy, shorter for all age categories (except >75 years) relative to the category of 18 to 35 years, 15.3 (7.3-23.5) minutes longer for rural hospitals, and 14.4 (6.6-21.3) minutes longer for hospitals with 9 or fewer transfers vs 15 or more in 2009 (all P < .001). Among patients presenting to emergency departments and requiring transfer to another facility for percutaneous coronary intervention, the DIDO time rarely met the recommended 30 minutes.

The pre-hospital fibrinolysis experience in Europe and North America and implications for wider dissemination.

**JACC Cardiovasc Interv** 2011; 4(8): 877-83

The primary objective of this report was to describe the infrastructures and processes of selected European and North American pre-hospital fibrinolysis (PHL) programs. A secondary objective is to report the outcome data of the PHL programs surveyed. Despite its benefit in reducing mortality in patients with ST-segment elevation myocardial infarction, PHL remained underused in North America. Examination of existing programs may provide insights to help address barriers to the implementation of PHL. The leading investigators of PHL research projects/national registries were invited to respond to a survey on the organization and outcomes of their affiliated PHL programs. PHL was successfully deployed in a wide range of geographic territories (Europe: France, Sweden, Vienna, England, and Wales; North America: Houston, Edmonton, and Nova Scotia) and was delivered by healthcare professionals of varying expertise. In-hospital major adverse outcomes were rare with mortality of 3% to 6%, reinfarction of 2% to 5%, and stroke of <2%. Combining formal protocols for PHL for some patients with direct transportation of others to a percutaneous coronary intervention hospital for primary percutaneous coronary intervention would allow for tailored reperfusion therapy for patients with ST-segment elevation myocardial infarction. Insights from a variety of international settings may promote widespread use of PHL and increase timely coronary reperfusion worldwide. Copyright © 2011 American College of Cardiology Foundation. Published by Elsevier Inc. All rights reserved.
Influence of distance from home to invasive centre on invasive treatment after acute coronary syndrome: a nationwide study of 24,910 patients.

*Heart* 2011; 97(1): 27-32

To investigate whether distance from a patient’s home to the nearest invasive centre influenced the invasive treatment strategy in acute coronary syndrome (ACS). This was an observational cohort study using nationwide registries involving 24,910 patients admitted with ACS (median age 67, range 30-90 years). All persons were grouped in tertiles according to the distance from their residence to the invasive centre. Cox proportional hazard models were applied to estimate the differences in coronary angiography and revascularisation rate within 60 days of admission according to the distance to the centre. The end points were coronary angiography and subsequent revascularisation. Of 24,910 patients with a first ACS, 33% resided <21 km from one of the five invasive centres in Denmark, 33% lived between 21 and 64 km away and 34% lived >64 km away. The incidence of coronary angiography was 68% for long distance versus 77% for short distance (p<0.05), with an HR of 0.78 (95% CI 0.75 to 0.81, p<0.0001). Adjustment for patient characteristics such as age, sex, co-morbidity and socioeconomic status did not attenuate the difference (HR 0.74, 95% CI 0.71 to 0.77, p<0.0001). Furthermore, revascularisation in the subgroup examined with coronary angiography was less likely for those residing a long distance from the invasive centre compared with those living nearer (adjusted HR of 0.82 (95% CI 0.78 to 0.85, p<0.0001). In patients hospitalised with ACS, invasive examination and treatment were less likely the further away from an invasive centre the patients resided, thus equal and uniform invasive examination and treatment was not found.
Expansion of a regional ST-segment-elevation myocardial infarction system to an entire state.

**Circulation** 2012; 126(2): 189-95

Despite national guidelines calling for timely coronary artery reperfusion, treatment is often delayed, particularly for patients requiring interhospital transfer. One hundred nineteen North Carolina hospitals developed coordinated plans to rapidly treat patients with ST-segment-elevation myocardial infarction according to presentation: walk-in, ambulance, or hospital transfer. A total of 6841 patients with ST-segment-elevation myocardial infarction (3907 directly presenting to 21 percutaneous coronary intervention hospitals, 2933 transferred from 98 non-percutaneous coronary intervention hospitals) were treated between July 2008 and December 2009 (age, 59 years; 30% women; 19% uninsured; chest pain duration, 91 minutes; shock, 9.2%). The rate of patients not receiving reperfusion fell from 5.4% to 4.0% (P=0.04). Treatment times for hospital transfer patients substantially improved. First-hospital-door-to-device time for hospitals that adopted a "transfer for percutaneous coronary intervention" reperfusion strategy fell from 117 to 103 minutes (P=0.0008), whereas times at hospitals with a mixed strategy of transfer or fibrinolysis fell from 195 to 138 minutes (P=0.002). Median door-to-device times for patients presenting directly to PCI hospitals fell from 64 to 59 minutes (P<0.001). Emergency medical services-transported patients were most likely to reach door-to-device goals, with 91% treated within 90 minutes and 52% being treated with 60 minutes. Patients treated within guideline goals had a mortality of 2.2% compared with 5.7% for those exceeding guideline recommendations (P<0.001). Through extension of regional coordination to an entire state, rapid diagnosis and treatment of ST-segment-elevation myocardial infarction has become an established standard of care independently of healthcare setting or geographic location.

PubMed ID 22665718

Impact of emergency services and ambulance type on pain-to-balloon time in the acute myocardial infarction: an observational study.


The objective of this study was to evaluate the role of first contact emergency departments and ambulances on transport duration, pain-to-balloon time, door-to-balloon time and first contact-to-balloon time in acute myocardial infarction (AMI) patients. The study was a prospective and observational investigation. A total of 374 AMI patients initially admitted to primary coronary intervention (PCI) incapable centers were included in this study. Patients were classified according to initial presentation site (daily clinic, public hospital or private hospital) and transport manner (public or private ambulance). All groups were compared by the Kruskal-Wallis and Mann-Whitney U tests statistically according to their characteristics, transport duration and pain-to-balloon time. A majority of the patients were initially admitted to public (40.1%) or private hospitals (47.1%). The average door-to-balloon time was 45.0 ± 18.5 min and the mean pain-to-balloon time was 310.6 ± 160.8 min. Nearly half of the patients initially admitted to daily clinics were first transported to PCI-incapable centers, leading to delayed...
admission to PCI-capable centers and increased pain-to-balloon and first contact-to-balloon times (361.7 ± 194.5 min, p=0.01 and 279.7±158.2 min, p<0.001). Patients admitted to private hospitals experienced shorter average pain-to-balloon and first contact-to-balloon times (277.5 ± 148.6 min, p=0.01 and 157.4 ± 83.1 min, p<0.001). Patients transported by private ambulances also experienced shorter waiting times and shorter pain-to-balloon times (107.4 ± 70.4 and 270.1 ± 150.4 min, p<0.001). Physicians and healthcare professionals in first contact emergency departments and ambulance type appear to be factors in the increased pain-to-balloon time. AMI patients are often initially admitted to PCI-incapable centers, leading to delayed admission to PCI-capable centers and increased pain-to-balloon time.

Knot, Jiri; Widimsky, Petr; Wijns, William; Stenestrand, Ulf; Kristensen, Steen; Van’ T Hof, Arnoud; Weidinger, Franz; Janzon, Magnus; Nörgaard, Bjärne; Soerensen, Jacob Thorsted JT; van de Wetering, Henri H; Thygesen, Kristian K; Bergsten, Per-Adolf PA; Digerfeldt, Christofer C; Potgieter, Adriaan A; Tomer, Nadav N; Fajadet, Jean J;

How to set up an effective national primary angioplasty network: lessons learned from five European countries.

EuroIntervention 2009; 5(3): 299, 301-309

Percutaneous coronary interventions (PCI) are used to treat acute and chronic forms of coronary artery disease. While in chronic forms the main goal of PCI is to improve the quality of life, in acute coronary syndromes (ACS) timely PCI is a life-saving procedure - especially in the setting of ST-elevation myocardial infarction (STEMI). The aim of this study was to describe the experience of countries with successful nationwide implementation of PCI in STEMI, and to provide general recommendations for other countries. The European Association of Percutaneous Cardiovascular Interventions (EAPCI) recently launched the Stent For Life Initiative (SFLI). The initial phase of this pan-European project was focused on the positive experience of five countries to provide the best practice examples. The Netherlands, the Czech Republic, Sweden, Denmark and Austria were visited and the logistics of ACS treatment was studied. Public campaigns improved patient access to acute PCI. Regional networks involving emergency medical services (EMS), non-PCI hospitals and PCI centres are useful in providing access to acute PCI for most patients. Direct transfer from the first medical contact site to the cathlab is essential to minimise the time delays. Cathlab staff work is organised to provide acute PCI services 24 hours a day / seven days a week (24/7). Even in those regions where thrombolysis is still used due to long transfer distances to PCI, patients should still be transferred to a PCI centre (after thrombolysis). The highest risk non-ST elevation acute myocardial infarction patients should undergo emergency coronary angiography within two hours of hospital admission, i.e. similar to STEMI patients. Three realistic goals for other countries were defined based on these experiences: 1) primary PCI should be used for >70% of all STEMI patients, 2) primary PCI rates should reach >600 per million inhabitants per year and 3) existing PCI centres should treat all their STEMI patients by primary PCI, i.e. should offer a 24/7 service.

Le May, Michel; Wells, George; So, Derek; Glover, Chris; Froeschl, Michael; Maloney, Justin; Dionne, Richard; Marquis, Jean-François; O’Brien, Edward; Dick, Alexander A; Sherrard, Heather L HL; Trickett, John J; Poirier, Pierre P; Blondeau, Melissa M; Bernick, Jordan J; Labinaz, Marino M;
Reduction in mortality as a result of direct transport from the field to a receiving center for primary percutaneous coronary intervention.

**J. Am. Coll. Cardiol.** 2012; 60(14): 1223-30

This study sought to determine whether mortality complicating ST-segment elevation myocardial infarction (STEMI) was impacted by the design of transport systems. It is recommended that regions develop systems to facilitate rapid transfer of STEMI patients to centers equipped to perform primary percutaneous coronary intervention (PCI), yet the impact on mortality from the design of such systems remains unknown. Within the framework of a citywide system where all STEMI patients are referred for primary PCI, we compared patients referred directly from the field to a PCI center to patients transported beforehand from the field to a non-PCI-capable hospital. The primary outcome was all-cause mortality at 180 days. A total of 1,389 consecutive patients with STEMI were assessed by the emergency medical services (EMS) and referred for primary PCI: 822 (59.2%) were referred directly from the field to a PCI center, and 567 (40.8%) were transported to a non-PCI-capable hospital first. Death at 180 days occurred in 5.0% of patients transferred directly from the field, and in 11.5% of patients transported from the field to a non-PCI-capable hospital (p < 0.0001). After adjusting for baseline characteristics in a multivariable logistic regression model, mortality remained lower among patients referred directly from the field to the PCI center (odds ratio: 0.52, 95% confidence interval: 0.31 to 0.88, p = 0.01). Similar results were obtained by using propensity score methods for adjustment. A STEMI system allowing EMS to transport patients directly to a primary PCI center was associated with a significant reduction in mortality. Our results support the concept of STEMI systems that include pre-hospital referral by EMS. Copyright © 2012 American College of Cardiology Foundation. Published by Elsevier Inc. All rights reserved.

**Oxidative Stress**

A citywide protocol for primary PCI in ST-segment elevation myocardial infarction.


If primary percutaneous coronary intervention (PCI) is performed promptly, the procedure is superior to fibrinolysis in restoring flow to the infarct-related artery in patients with ST-segment elevation myocardial infarction. The benchmark for a timely PCI intervention has become a door-to-balloon time of less than 90 minutes. Whether regional strategies can be developed to achieve this goal is uncertain. We developed an integrated-metropolitan-area approach in which all patients with ST-segment elevation myocardial infarction were referred to a specialized center for primary PCI. We sought to determine whether there was a difference in door-to-balloon times between patients who were referred directly from the field by paramedics trained in the interpretation of electrocardiograms and patients who were referred by emergency department physicians. Between May 1, 2005, and April 30, 2006, a total of 344 consecutive patients with ST-segment elevation myocardial infarction were referred for primary PCI: 135 directly from the field and 209 from emergency departments. Primary PCI was performed in 93.6% of patients. The median door-to-balloon time was shorter in patients referred from the field (69 minutes; interquartile range, 43 to 87) than in patients needing interhospital transfer (123 minutes; interquartile range, 101 to 153; P<0.001). Door-to-balloon times of less than 90 minutes were achieved in 79.7% of patients who were transferred from the field and in 11.9% of those transferred from emergency departments (P<0.001). Guideline door-to-balloon-times were more often achieved when trained...
paramedics independently triaged and transported patients directly to a designated primary PCI center than when patients were referred from emergency departments. Copyright 2008 Massachusetts Medical Society.

Observational Study

Le May, Michel; Davies, Richard; Dionne, Richard; Maloney, Justin; Trickett, John; So, Derek; Ha, Andrew; Sherrard, Heather; Glover, Chris; Marquis, Jean-François JF; O’Brien, Edward R ER; Stiell, Ian G IG; Poirier, Pierre P; Labinaz, Marino M;

Comparison of early mortality of paramedic-diagnosed ST-segment elevation myocardial infarction with immediate transport to a designated primary percutaneous coronary intervention center to that of similar patients transported to the nearest hospital.

Am. J. Cardiol. 2006; 98(10): 1329-33

Speed of reperfusion is critical in ST-segment elevation myocardial infarction (STEMI). We assessed the safety and feasibility of an integrated metropolitan approach in which advanced-care paramedics interpret the prehospital electrocardiogram and independently refer patients with STEMI to a designated center for primary percutaneous coronary intervention (PCI). We developed and implemented a protocol in which paramedics trained in electrocardiographic interpretation bypassed the nearest emergency room and referred patients with suspected STEMI directly to a designated primary PCI center (paramedic-referred primary PCI). Outcomes of these patients were compared with those of a retrospective cohort of 225 consecutive patients with STEMI transported by ambulance to the nearest hospital emergency department. We treated 108 consecutive patients with STEMI using ambulance services according to the paramedic-referred primary PCI protocol. Primary PCI was performed in 93.5% versus 8.9% in the control group, and the median door-to-balloon time was 63 versus 125 minutes in the control group (p <0.0001 for 2 comparisons). Thrombolytic therapy was prescribed to 80.4% of the control group, with a median door-to-needle time of 41 minutes. In-hospital mortality was 1.9% in the paramedic-referred primary PCI group versus 8.9% in the control group (p = 0.017) and remained significantly lower after statistical adjustment for baseline risk. In conclusion, paramedic-referred primary PCI is a safe and feasible strategy for treating STEMI that is associated with rapid and effective reperfusion and very low in-hospital mortality.

Observational Study

Leurent, Guillaume; Fougerou, Claire; Pennec, Pierre-Yves; Filippi, Emmanuelle; Moquet, Benoît; Druelles, Philippe; Hacot, Jean-Philippe; Rialan, Antoine; Rouault, Gilles; Gervais, Renaud R; Bedossa, Marc M; Boumier, Dominique D; Boulanger, Bertrand B; Hamon, Christian C; Treuilon, Josiane J; Coudert, Isabelle I; Courcoux, Hubert H; Le Breton, Hervé H;

Door-to-balloon delays before primary angioplasty in the Regional Acute Myocardial Infarction Registry of Brittany. An analysis of the Observatoire Régional Breton sur l'Infarctus du myocarde (ORBI).

Arch Cardiovasc Dis 2009; 102(11): 777-84
Minimizing delays to coronary reperfusion is critical in the management of acute myocardial infarction (AMI). To determine delays in in-hospital management and factors associated with delays of over 45min. We analysed data from the Observatoire Régional Breton sur l'Infarctus, a registry of AMI patients admitted within 24h of symptom onset (July 2007 to December 2008) to an interventional cardiology centre in Brittany. Prehospital delay was defined as time between first responder arrival at the patient and patient arrival at an interventional cardiovascular centre. In-hospital delay was defined as time between admission to the interventional cardiovascular centre and first balloon inflation. Patients were grouped according to duration of in-hospital delay (>45 vs < or =45min). Predictors of short in-hospital delay (< or =45min) were examined by logistic regression analysis. The analysis included 560 patients (mean age 60.7+-13 years; 443 men). Median delay between symptom onset and call for medical assistance was 50min (mean 115+-180). Two-thirds (n=371) of patients were admitted to hospital during working hours (08:00-20:00h); 383 (68%) patients were managed by emergency medical services before admission. In-hospital delay was less than or equal to 45min for 296 (53%) patients. The mean overall (pre- and in-hospital) delay was 140 (median 109) min. Direct admission to a catheterization laboratory and admission during working hours were independently correlated with short in-hospital delay (odds ratios 20.8 [p<0.001] and 2.37 [p=0.004], respectively). In Brittany, median in-hospital delay before treatment of AMI by primary angioplasty was over 45min in 50% of patients. Overall, delays were longer than recommended, due to excessively long prehospital delays. Patient admission during working hours and direct admission to a catheterization laboratory were associated with short in-hospital delay.

Ital Heart J 2003; 4(5): 311-7

The most important limitation in primary percutaneous coronary interventions (PCI) for acute myocardial infarction (AMI) is the small number of catheterization laboratories and their non-homogeneous territorial distribution. The aim of this study was to evaluate the safety and efficacy of an organizational model based on a network including tertiary referral centers and community hospitals for the treatment of AMI with alteplase plus abciximab followed by PCI. From October to November 2002, 232 patients < or = 75 years with AMI at high risk (84 transferred from four community hospitals and 148 patients admitted directly at the tertiary center) underwent PCI at our Institution. We compared procedural results and clinical outcome in patients with AMI undergoing PCI with or without transfer to tertiary centers. Patient transferal from community hospitals determines a greater door-to-balloon time (120 vs 55 min, p < 0.001), while complications observed during transportation are limited (5.9%). Transferred patients have a greater percentage of infarct-related artery patency (77 vs 22%, p < 0.001) and of ST-segment resolution 90 min post-PCI (77 vs 57%, p < 0.005) in comparison with direct-access patients. The incidence of clinical events (death, reinfarction, angina) was not different between the two groups at 30 days and at 6 months of follow-up. In our experience the integrated model between tertiary centers and community hospitals represents a valid network system offering homogeneous therapeutic (alternatives) options to all patients with AMI regardless of the hospital where they are first admitted.
Transferring patients for direct coronary angioplasty: a retrospective analysis of 135 unselected patients with acute myocardial infarction.

Ital Heart J 2001; 2(12): 921-6

Direct coronary angioplasty (PTCA) represents the most effective treatment for acute myocardial infarction. However, only a minority of patients are initially admitted to hospitals with direct PTCA facilities available 24 hours daily. The safety and benefits of transfer direct PTCA are debated, and we have no data about the early return of patients to the admission hospital. We report our experience with transfer direct PTCA in unselected patients with acute myocardial infarction, and the early post-procedural return to the referring hospitals. One hundred and thirty-five unselected patients with acute myocardial infarction were referred to our center for direct PTCA during 1998. The majority of patients (n = 93, 69%, group T) were initially admitted to a primary hospital whereas the rest (n = 42, 31%, group NT) were directly admitted to our hospital. One hundred and thirty-four patients underwent coronary angiography, and direct PTCA was attempted in 126 patients. The median time interval between admission and direct PTCA was higher in group T (60 vs 40 min, p < 0.001). Only 3 patients (3.2%) had severe complications during transfer to our center: 1 patient with cardiogenic shock died, and 2 patients had ventricular fibrillation. The procedural and in-hospital outcomes of both groups were similar. The early post-procedural transfer to the referring hospital was possible in 88% of patients; no complications occurred during the transfer. The incidences of cardiac mortality at 6 months and at long-term follow-up were 3.4 and 5.1% respectively. In our experience, interhospital transfer for direct PTCA in unselected patients with acute myocardial infarction is feasible and safe. The early return to the admission hospital is safe and does not negatively influence the in-hospital outcome.

Martens, U; Lange-Braun, P; Langer, R; Hochrein, H;

[Early systemic thrombolysis in acute myocardial infarct. Comparison between the clinical and the prehospital phase].


Short-term systemic thrombolytic treatment was undertaken in 84 patients--within the first three hours after onset of pain; with typical ECG signs of acute transmural myocardial infarction; refractory to nitroglycerin--either in an intensive care unit (n = 40) or in a medically-staffed ambulance (n = 44). Coronary angiography was undertaken in patients of both groups, after obtaining informed consent, at the earliest possible moments, combined with percutaneous transluminal coronary angioplasty (PTCA), if indicated. Thrombolytic treatment in the ambulance was primarily more effective (72%, n = 32) than in the ICU patients (47.5%; n = 19), and the pain-thrombolysis interval shorter by 30 min. The higher recurrent infarction rate in the former meant that the success rate at the end of the hospital stay did not significantly differ between the two groups (54.5% and 47.5%, respectively). Only when early systemic thrombolysis was combined with PTCA within the first three hours (n = 26) was there a markedly greater effectiveness after four weeks (77%) than without PTCA (40%). Early thrombolytic treatment by doctors in the ambulance during transfer to hospital is sensible only if it can be followed at once by coronary angiography with PTCA or operation soon after admission. Only in this way will the effectiveness of treatment be increased and maintained after discharge.
from hospital.

Marzegalli, Maurizio; Oltrona, Luigi; Corrada, Elena; Fontana, Giancarlo; Klugmann, Silvio;

[The network for the management of acute coronary syndromes in Milan: results of a four-year experience and perspectives of the prehospital and interhospital cardiological network].

**Ital Heart J** 2005; 6 Suppl 6: 49S-56S

In patients with acute ST-elevation myocardial infarction (STEMI), in order to shorten the time to definitive treatment, it is essential to coordinate the intervention between the local healthcare system and the hospitals. In 1999, a Working Group for Prehospital Emergency in Cardiology was established in Milan, and a network for 12-lead ECG transmission between advances life support (ALS) ambulances, the headquarter of 118 Rescue Service and the Coronary Care Units (CCU) or Divisions of Cardiology was developed: between February 1, 2001 and May 1, 2005, 6821 patients with suspected heart attack were rescued and their ECG recorded and transmitted (177 patients/month, 20% of them with an ST-segment shift, 11% ST-segment elevation, 9% non-ST-segment elevation, 24% with normal ECG). The rate of false positive automatic diagnosis of acute myocardial infarction was 0.3%, the rate of false negative was 0.8%. Forty-six patients with ventricular fibrillation underwent DC-shock. After May 1, 2004, clinical data of patients with STEMI transferred to the hospitals by ALS ambulances were reported in a database: 82% of the 89 patients were treated with primary angioplasty. The time (median, interquartile ranges) between ECG arrival to the CCU and the ECG report was 2 min (1-5), between ECG arrival to the CCU and patient arrival to the hospital was 34 min (24-42), between ECG arrival to the CCU and primary angioplasty was 69 min (50-93); the door-to-balloon time was 33 min (22-60). The telephone ECG transmission has been demonstrated to be a useful and rapid tool, easy to use; the automatic ECG diagnosis was accurate. In patients with STEMI the telephone ECG transmission shortened the time of delivery of therapy, helped to recover arrhythmic complications, allowed both the coordination between the 118 System and the Divisions of Cardiology and the implementation of the triage for primary angioplasty. Increasing the technological level of the service will be the next step of the program: the protocol will be upgraded in order to increase the number of patients rescued, to shorten the time of operation and to administer prehospital fibrinolytic therapy in selected patients.

Matteau, Alexis; Rinfret, Stéphane; Dorais, Marc; Lelorier, Jacques; Reeves, François;

The safety and feasibility of immediately returning patients transferred for primary percutaneous coronary intervention with ST-elevation myocardial infarction.

**EuroIntervention** 2009; 5(5): 599-603
To describe the safety of immediate retransfer to community hospitals following primary percutaneous coronary intervention (PCI) for ST-elevation myocardial infarction (STEMI). In a cohort of 246 consecutive patients transferred to a tertiary institution who all underwent primary or rescue PCI, 166 (67%) were immediately retransferred back. The retransfer occurred only if they were haemodynamically stable and had undergone an uncomplicated procedure. In-hospital adverse events were assessed in each referral hospital. Patients had a mean age of 59 years, presented an anterior MI in 39%, and 91% were in Killip class 1. In this cohort, 75% of patients underwent primary PCI and 25% received rescue PCI. A transradial approach was used in 74% of patients. During ambulance transport back to the referral hospital, no adverse events occurred. In-hospital outcomes were favourable, with low death (2.4%), reinfarction (3.6%) and stroke (1.2%) rates. TIMI major bleeding occurred in 1.8% (catheter-related in 0.6%). In this carefully selected population of STEMI patients, immediate retransfer to the referral hospital following primary or rescue PCI is feasible in more than 2/3 of patients and associated with a low risk of major clinical adverse events.

McCabe, James; Armstrong, Ehrin; Hoffmayer, Kurt; Bhave, Prashant; MacGregor, John; Hsue, Priscilla; Stein, John; Kinlay, Scott; Ganz, Peter;

Impact of door-to-activation time on door-to-balloon time in primary percutaneous coronary intervention for ST-segment elevation myocardial infarctions: a report from the Activate-SF registry.

Circ Cardiovasc Qual Outcomes 2012; 5(5): 672-9

Little is known about the components of door-to-balloon time among patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. We assessed the role of time from hospital arrival to ST-segment elevation myocardial infarction diagnosis (door-to-activation time) on door-to-balloon time in contemporary practice and evaluated factors that influence door-to-activation times. Registry data on 347 consecutive patients diagnosed with a ST-segment elevation myocardial infarction in the emergency department over 30 months at 2 urban primary percutaneous coronary intervention centers were analyzed. The primary study end point was the time from hospital arrival to catheterization laboratory activation by the emergency department physician, and we assessed factors associated with this period. Door-to-balloon time and its other components were secondary study end points. The median door-to-activation time was 19 minutes (interquartile range, 9-54). Variation in door-to-activation times explained 93% of the variation in door-to-balloon times and demonstrated the strongest correlation with door-to-balloon times (r=0.97). Achieving a door-to-activation time of ≤20 minutes resulted in an 89% chance of achieving a door-to-balloon time of ≤90 minutes compared with only 28% for patients with a door-to-activation time >20 minutes. Factors significantly associated with door-to-activation time include the following: prehospital ECG use (61% shorter, 95% confidence interval, -50 to -72%; P<0.001) and computed tomography scan use in the emergency department (245% longer, 95% confidence interval, +50 to +399%; P=0.001). The interval from hospital arrival to ST-segment elevation myocardial infarction diagnosis and catheterization laboratory activation (door-to-activation time) is a strong driver of overall door-to-balloon times. Achieving a door-to-activation time ≤20 minutes was key to achieving a door-to-balloon time ≤90 minutes. Delays in door-to-activation time are not associated with delays in other aspects of the primary percutaneous coronary intervention process.
Improving bedside to departure care in air transport of ST segment elevation myocardial infarction patients: a 2-year retrospective study of performance.

Air Med. J. ; 29(2): 84-7

Rapid treatment after the initial diagnosis of an ST segment elevation myocardial infarction (STEMI) is critical to ensure positive outcomes. The objective of the study was to evaluate time-sensitive indicators adversely affecting performance during helicopter transport of STEMI patients from remote areas to a percutaneous coronary intervention (PCI) facility. A particular focus was to examine confounding factors that affected the time from arrival at bedside/event to the time of departure to a PCI facility. A 24-month retrospective chart audit of STEMI cases was undertaken. Data from initial liftoff to return of the patient from a referring facility were tracked for time-sequencing and patterns of events that lead to delayed transport. The standard deviation was used to assess abnormal variances. No deaths were recorded from any of the 32 cases identified for inclusion in the study, and survival analysis was unobtainable. There was a significant correlation ($r = 0.613$, $P = .0001$) between time spent on the ground stabilizing the patient and total mission time. The need for the transport team to initiate vasopressor therapy was the most cited reason for delay in liftoff to the receiving facility. Time from arrival at remote bedside and subsequent transfer to a PCI facility had the most variability. Enhancing communication times between referring agency and air medical personnel and stabilizing the patient before transport may be the most significant components in reducing transfer times and ensuring optimal outcomes. 2010 Air Medical Journal Associates. Published by Elsevier Inc. All rights reserved.

Observational Study

Ground emergency medical services requests for helicopter transfer of ST-segment elevation myocardial infarction patients decrease medical contact to balloon times in rural and suburban settings.

Acad Emerg Med 2012; 19(2): 153-60

ST-segment elevation myocardial infarction (STEMI) care is time-dependent. Many STEMI patients require interhospital helicopter transfer for percutaneous coronary intervention (PCI) if ground emergency medical services (EMS) initially transport the patient to a non-PCI center. This investigation models potential time savings of ground EMS (HEMS) transport of a STEMI patient directly to a PCI center, rather than usual transport to a local hospital with subsequent transfer. Data from a multicenter retrospective chart review of STEMI patients transferred for primary PCI by a single HEMS agency over 12 months were used to model medical contact to balloon times (MCTB) for two scenarios: a direct-to-scene HEMS response and hospital rendezvous after ground EMS initiation of transfer. Actual MCTB median time for 36 hospital-initiated transfers was 160 minutes (range = 116 to 321 minutes). Scene response MCTB median time was estimated as 112 minutes (range = 69 to 187 minutes). The difference in medians was 48 minutes (95% confidence interval [CI] = 33 to 62 minutes). Hospital rendezvous MCTB median time was estimated as 113 minutes (range = 74 to 187 minutes). The difference in medians was 47 minutes (95% CI = 32 to 62 minutes). No patient had an actual MCTB time of less than 90 minutes; in the scene response and hospital rendezvous scenarios, 2 of 36 (6%) and 3 of 36 (8%), respectively, would have had MCTB times under 90 minutes. In this setting, ground EMS initiation of HEMS transfers for STEMI patients has the potential to reduce MCTB time, but most patients will still not achieve MCTB time of less than 90 minutes. © 2012 by the Society for Academic...
McMullan, Jason; Hinckley, William; Bentley, Jared; Davis, Todd; Fermann, Gregory; Gunderman, Matthew; Hart, Kimberly; Knight, William; Lindsell, Christopher; Shackleford, April A; Gibler, W Brian WB;

Reperfusion is delayed beyond guideline recommendations in patients requiring interhospital helicopter transfer for treatment of ST-segment elevation myocardial infarction.

**Ann Emerg Med** 2011; 57(3): 213-220.e1

Early reperfusion portends better outcomes for ST-segment elevation myocardial infarction (STEMI) patients. This investigation estimates the proportions of STEMI patients transported by a hospital-based helicopter emergency medical services (EMS) system who meet the goals of 90-minute door-to-balloon time for percutaneous coronary intervention or 30-minute door-to-needle time for fibrinolysis. This was a multicenter, retrospective chart review of STEMI patients flown by a hospital-based helicopter service in 2007. Included patients were transported from an emergency department (ED) to a cardiac catheterization laboratory for primary or rescue percutaneous coronary intervention. Out-of-hospital, ED, and inpatient records were reviewed to determine door-to-balloon time and door-to-needle time. Data were abstracted with a priori definitions and criteria. There were 179 subjects from 16 referring and 6 receiving hospitals. Mean age was 58 years, 68% were men, and 86% were white. One hundred forty subjects were transferred for primary percutaneous coronary intervention, of whom 29 had no intervention during catheterization. For subjects with intervention, door-to-balloon time exceeded 90 minutes in 107 of 111 cases (97%). Median door-to-balloon time was 131 minutes (interquartile range 114 to 158 minutes). Thirty-nine subjects (21%) received fibrinolitics before transfer, and 19 of 39 (49%) received fibrinolitics within 30 minutes. Median door-to-needle time was 31 minutes (interquartile range 23 to 45 minutes). In this study, STEMI patients presenting to non-percutaneous coronary intervention facilities who are transferred to a percutaneous coronary intervention-capable hospital by helicopter EMS do not commonly receive fibrinolysis and rarely achieve percutaneous coronary intervention within 90 minutes. In similar settings, primary fibrinolysis should be considered while strategies to reduce the time required for subsequent interventional care are explored. Copyright © 2010 American College of Emergency Physicians. Published by Mosby, Inc. All rights reserved.

Ortolani, Paolo; Marzocchi, Antonio; Marrozzini, Cinzia; Palmerini, Tullio; Saia, Francesco; Baldazzi, Federica; Silenzi, Simona; Taglieri, Nevio; Bacchi-Reggiani, Maria; Gordini, Giovanni G; Guastaroba, Paolo P; Grilli, Roberto R; Branzi, Angelo A;

Usefulness of prehospital triage in patients with cardiogenic shock complicating ST-elevation myocardial infarction treated with primary percutaneous coronary intervention.

**Am. J. Cardiol.** 2007; 100(5): 787-92
We investigated the impact of ambulance-based prehospital triage on treatment delay and all-cause mortality (in hospital and long term) in patients with ST-elevation myocardial infarction (STEMI) complicated by cardiogenic shock referred for primary percutaneous coronary intervention in a prospectively collected registry. During the study period (January 2003 to December 2005), a total of 121 patients was referred for primary percutaneous coronary intervention at our intervention laboratory through 2 main triage groups: (1) after prehospital, ambulance-telemedicine-based triage (42 patients) and (2) by more conventional routes (79 patients) represented by the institutional S. Orsola-Malpighi hospital emergency department triage (44 patients) and spoke hospital triage (35 patients). Total ischemic time was shorter in the prehospital triage (142 minutes, range 106 to 187, vs 212 minutes, range 150 to 366, p = 0.003). Patients with prehospital triage showed a lower rate (29% vs 54%, p = 0.01) of severely depressed (≤35%) left ventricular systolic function and a 68% decrease in in-hospital mortality (9, 21%, vs 36, 46%, odds ratio 0.32, 95% confidence interval 0.14 to 0.77, p = 0.01). In the entire study population, patients revascularized within an optimal time (2 hours from symptom onset or 90 minutes from STEMI diagnosis) showed remarkably low in-hospital mortality (20% and 29%, respectively). At the 1-year follow-up, patients with prehospital triage had a higher survival rate (74% vs 52%, p = 0.019). In conclusion, this study indicates that prehospital triage with direct transportation to the intervention laboratory is associated with shorter treatment delay and better clinical outcome in patients with STEMI complicated by cardiogenic shock.
Early reperfusion therapy with primary percutaneous coronary intervention (PCI) in patients with ST-segment elevation myocardial infarction (STEMI) improves left ventricular function and reduces mortality. To assess the time delay in treatment of patients with STEMI referred to a twenty-four-hour interventional centre located in the vicinity of the centre of Warsaw. We analysed 350 consecutive STEMI patients admitted to our Department between October 2005 and September 2006. The majority of the patients - 244 (69.7%), were admitted via hospitals without an interventional department. Sixty-two (17.7%) patients were transported directly by ambulance from home, 34 (9.7%) from a community health centre and 10 patients (2.9%) came by themselves from home or work. A detailed interview concerning the time of symptom onset was conducted in 342 patients (97.7%). Sixty-two (18%) patients arrived at the interventional centre within the first 2 hours from symptom onset: 6 women (5.5% of all women in the study population) and 56 (24.1%) men (p <0.0001). Within the first 2 hours, 32 (13.1%) patients were admitted via another hospital and 20 (32.2%) directly by ambulance (p <0.001). During the first 7 days of hospitalisation the following patients died: 2 (3.2%) patients admitted within the first 2 hours via another hospital, 6 (3.4%) patients among 178 admitted between 2 and 6 hours after pain onset, 4 (8.3%) among 48 admitted between 6 and 12 hours and 8 (14.8%) among 54 patients with the pain duration over 12 hours (p <0.02). During the first 7 days of hospitalisation 8 (3.3%) patients admitted within the first 6 hours after pain onset died compared with 12 (11.8%) admitted later (p <0.003). In the interventional centre located near the centre of Warsaw symptom-onset-to-door time was 120 minutes only in 18% of patients with STEMI. Almost 70% of patients underwent interhospital transfer for primary PCI. Prolongation of the time from onset of symptoms to successful PCI worsened prognosis. When transporting patients with acute coronary syndrome, efforts should be made to avoid district hospitals without a catheterisation laboratory. Direct transportation by ambulance or helicopter with educated staff equipped with ECG teletransmission data, which may substantially shorten time to treatment, should be preferred.

Pinto, Duane; Frederick, Paul; Chakrabarti, Anjan; Kirtane, Ajay; Ullman, Edward; Dejam, Andre; Miller, Dave; Henry, Timothy; Gibson, C; ;

Benefit of transferring ST-segment-elevation myocardial infarction patients for percutaneous coronary intervention compared with administration of onsite fibrinolytic declines as delays increase.

Circulation 2011; 124(23): 2512-21

Although randomized trials suggest that transfer for primary percutaneous coronary intervention (X-PCI) in ST-segment-elevation myocardial infarction is superior to onsite fibrinolytic therapy (O-FT), the generalizability of these findings to routine clinical practice is unclear because door-to-balloon (XDB) times are rapid in randomized trials but are frequently prolonged in practice. We hypothesized that delays resulting from transfer would reduce the survival advantage of X-PCI compared with O-FT. ST-segment-elevation myocardial infarction patients enrolled in the National Registry of Myocardial Infarction (NRMI) within 12 hours of pain onset were identified. Propensity matching of patients treated with X-PCI and O-FT was performed, and the effect of PCI-related delay on in-hospital mortality was assessed. PCI-related delay was calculated by subtracting the XDB from the door-to-needle time in each matched pair. Conditional logistic regression adjusted for patient and hospital variables identified the XDB door-to-needle time at which no mortality advantage for X-PCI over O-FT was present. Eighty-one percent of X-PCI patients were matched (n=9506) to O-FT patients (n=9506). In the matched cohort, X-PCI was performed with delays >90 minutes in 68%. Multivariable analysis found no mortality advantage for X-PCI over O-FT when XDB door-to-needle time
exceeded ≈120 minutes. PCI-related delays are extensive among patients transferred for X-PCI and are associated with poorer outcomes. No differential excess in mortality was seen with X-PCI compared with O-FT even with long PCI-related delays, but as XDB door-to-needle time times increase, the mortality advantage for X-PCI over O-FT declines.

Qiu, Jian-ping; Zhang, Qi; Lu, Ji-de; Wang, Hai-rong; Lin, Jie; Ge, Zhi-ru; Zhang, Rui-yan; Shen, Wei-feng;

Direct ambulance transport to catheterization laboratory reduces door-to-balloon time in patients with acute ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention: the DIRECT-STEMI study.


Primary percutaneous coronary intervention (PCI) has been clearly identified as the first therapeutic option for patients with acute ST-segment elevation myocardial infarction (STEMI). The importance of reducing door-to-balloon (D2B) time has gained increased recognition. This study aimed to assess the feasibility, safety and efficacy of the strategy of direct ambulance transportation of patients with acute STEMI to catheterization lab to receive primary PCI. The study population included 141 consecutive patients with chest pain and ST-segment elevation who were admitted to the catheterization laboratory directly by the ambulance and underwent primary PCI (DIRECT group). Another 145 patients with STEMI randomly selected from the PCI database, were served as control group (conventional group); they were transported to catheterization laboratory from emergency room (ER). The primary endpoint of D2B time, and secondary endpoint of in-hospital and 30-day major adverse cardiac events (MACE, including death, non-fatal reinfarction, and target vessel revascularization) were compared. Baseline and procedural characteristics between the two groups were comparable, except more patients in the DIRECT group presented TIMI 0-1 flow in culprit vessel at initial angiogram (80.1% and 73.8%, P = 0.04). Comparing to conventional group, the primary endpoint of D2B time was reduced ((54 ± 18) minutes and (112 ± 55) minutes, P < 0.0001) and the percentage of patients with D2B < 90 minutes was increased in the DIRECT group (96.9% and 27.0%, P < 0.0001). The success rate of primary PCI with stent implantation with final Thrombolysis in Myocardial Infarction (TIMI) 3 flow was significantly higher in the DIRECT group (93.8% and 85.2%, P = 0.03). Although no significant difference was found at 30-day MACE free survival rate between the two groups (95.0% and 89.0%, P = 0.06), a trend in improving survival status in the DIRECT group was demonstrated by Kaplan-Meier analysis. Direct ambulance transport of STEMI patients to the catheterization laboratory could significantly reduce D2B time and improve success rate of primary PCI and 30-day clinical outcomes.

Ranasinghe, Isuru; Turnbull, Fiona; Tonkin, Andrew; Clark, Robyn; Coffee, Neil; Brieger, David;

Comparative effectiveness of population interventions to improve access to reperfusion for ST-segment-elevation myocardial infarction in Australia.

Improving timely access to reperfusion is a major goal of ST-segment-elevation myocardial infarction care. We sought to compare the population impact of interventions proposed to improve timely access to reperfusion therapy in Australia. Australian hospitals, population, and road network data were integrated using Geographical Information Systems. Hospitals were classified into those that provided primary percutaneous coronary intervention (PPCI) or fibrinolysis. Population impact of interventions proposed to improve timely access to reperfusion (PPCI, fibrinolysis, or both) were modeled and compared. Timely access to reperfusion was defined as the proportion of the population capable of reaching a fibrinolysis facility ≤60 minutes or a PPCI facility ≤120 minutes from emergency medical services activation. The majority (93.2%) of the Australian population has timely access to reperfusion, mainly (53%) through fibrinolysis. Only 40.2% of the population had timely access to PPCI, and access to PPCI services is particularly limited in regional and nonexistent in remote areas. Optimizing the emergency medical services’ response or increasing PPCI services resulted in marginal improvement in timely access (1.8% and 3.7%, respectively). Direct transport to PPCI facilities and interhospital transfer for PPCI improves timely access to PPCI for 19.4% and 23.5% of the population, respectively. Prehospital fibrinolysis markedly improved access to timely reperfusion in regional and remote Australia. Significant gaps in timely provision of reperfusion remain in Australia. Systematic implementation of changes in service delivery has potential to improve timely access to PPCI for a majority of the population and improve access to fibrinolysis to those living in regional and remote areas.

**Rathore, Saif; Curtis, Jeptha; Chen, Jersey; Wang, Yongfei; Nallamothu, Brahmajee; Epstein, Andrew; Krumholz, Harlan; ; ;**

Association of door-to-balloon time and mortality in patients admitted to hospital with ST elevation myocardial infarction: national cohort study.

**BMJ** 2009; 338: b1807

To evaluate the association between door-to-balloon time and mortality in hospital in patients undergoing primary percutaneous coronary intervention for ST elevation myocardial infarction to assess the incremental mortality benefit of reductions in door-to-balloon times of less than 90 minutes. Prospective cohort study of patients enrolled in the American College of Cardiology National Cardiovascular Data Registry, 2005-6. Acute care hospitals. 43 801 patients with ST elevation myocardial infarction undergoing primary percutaneous coronary intervention. Mortality in hospital. Median door-to-balloon time was 83 minutes (interquartile range 6-109, 57.9% treated within 90 minutes). Overall mortality in hospital was 4.6%. Multivariable logistic regression models with fractional polynomial models indicated that longer door-to-balloon times were associated with a higher adjusted risk of mortality in hospital in a continuous non-linear fashion (30 minutes=3.0%, 60 minutes=3.5%, 90 minutes=4.3%, 120 minutes=5.6%, 150 minutes=7.0%, 180 minutes=8.4%, P<0.001). A reduction in door-to-balloon time from 90 minutes to 60 minutes was associated with 0.8% lower mortality, and a reduction from 60 minutes to 30 minutes with a 0.5% lower mortality. Any delay in primary percutaneous coronary intervention after a patient arrives at hospital is associated with higher mortality in hospital in those admitted with ST elevation myocardial infarction. Time to treatment should be as short as possible, even in centres currently providing primary percutaneous coronary intervention within 90 minutes.
Primary percutaneous coronary intervention for patients presenting with ST-elevation myocardial infarction: process improvements in rural prehospital care delivered by emergency medical services.

Prog Cardiovasc Dis ; 53(3): 210-8

Safe and effective patient care for ST-elevation myocardial infarction (STEMI) relies on prompt emergency medical service (EMS) and established care coordination with receiving hospitals to conduct primary percutaneous coronary intervention (PCI). Likewise, a new emphasis has been placed on first medical contact-to-balloon (E2B) times as opposed to door-to-balloon times, identifying prehospital care as an important contributing factor for high-quality STEMI care. Therefore, we evaluated EMS processes of care before and after a period of continuous quality improvement to improve E2B times in our rural tertiary care medical center. A retrospective, consecutive cohort study was conducted on 177 patients who received primary PCI at Dartmouth-Hitchcock Medical Center, a rural hospital, from January 1, 2006 to October 31, 2009. This cohort was stratified from January 1, 2008 to May 1, 2008 (n = 88) and May 1, 2008 to October 31, 2009 (n = 89), to acknowledge periods of no improvement (pre) and continuous quality improvement (post) in STEMI care. Primary outcome measures included frequency of non-PCI-capable hospital bypass, E2B, and frequency of prehospital electrocardiogram (ECG) and cardiac catheterization laboratory (CCL) activation. Descriptive statistics and log-rank tests were used to determine whether measures differed significantly by time period. A time-to-event analysis was conducted using a Cox proportional hazards model to assess the impact of outcomes measures on E2B pre/post-May 1, 2008. Patients who presented before May 1, 2008 had longer E2B times compared with patients in the post-May 1, 2008 cohort (145.1 minutes vs 115.2 minutes, t test P = .01). A log-rank test confirmed this (pre: 130 minutes vs post: 106 minutes, χ(2) = 5.3, log-rank P = .02). Similarly, patients who presented before May 1, 2008 had lower percentages of prehospital ECGs (49% vs 80%, P = .001) and CCL activations (4% vs 32%, P < .001). When prehospital ECGs (140 minutes vs 106 minutes, χ(2) = 5.9, log-rank P = .01) or CCL activations (125 minutes vs 98 minutes, χ(2) = 4.2, log-rank P = .04) were conducted, E2B times were significantly reduced. Patients who received both prehospital ECGs and prehospital CCL activations had significantly reduced E2B times compared with those who did not (125 minutes vs 91 minutes, χ(2) = 4.8, P = .02). The time saving benefits of prehospital ECGs may not be fully realized unless prehospital CCL activations also occur. EMS providers achieved further reductions in median E2B of approximately 24 minutes when prehospital ECGs were combined with prehospital CCL activation. Every effort should be made by PCI-capable medical centers to assess prehospital STEMI care and to integrate EMS providers into regional STEMI care quality improvement initiatives and education. Copyright © 2010 Elsevier Inc. All rights reserved.

Observational Study

Integration of pre-hospital electrocardiograms and ST-elevation myocardial infarction receiving center (SRC) networks: impact on Door-to-Balloon times across 10 independent regions.

The aim of this study was to evaluate the rate of timely reperfusion for ST-elevation myocardial infarction (STEMI) with primary percutaneous coronary intervention (PPCI) in regional STEMI Receiving Center (SRC) networks. The American College of Cardiology Door-to-Balloon (D2B) Alliance target is a >75% rate of D2B \( \leq 90 \) min. Independent initiatives nationwide have organized regional SRC networks that coordinate universal access to 9-1-1 with the pre-hospital electrocardiogram (PH-ECG) diagnosis of STEMI and immediate transport to a SRC (designated PPCI-capable hospital). A pooled analysis of 10 independent, prospective, observational registries involving 72 hospitals was performed. Data were collected on all consecutive patients with a PH-ECG diagnosis of STEMI. The D2B and emergency medical services (EMS)-to-balloon (E2B) times were recorded. Paramedics transported 2,712 patients with a PH-ECG diagnosis of STEMI directly to the nearest SRC. A PPCI was performed in 2,053 patients (76%) with an 86% rate of D2B \( \leq 90 \) min (95% confidence interval: 84.4% to 87.4%). Secondary analyses of this cohort demonstrated a 50% rate of D2B \( \leq 60 \) min (n = 1,031), 25% rate of D2B \( \leq 45 \) min (n = 517), and an 8% rate of D2B \( \leq 30 \) min (n = 155). A tertiary analysis restricted to 762 of 2,053 (37%) cases demonstrated a 68% rate of E2B \( \leq 90 \) min. Ten independent regional SRC networks demonstrated a combined 86% rate of D2B \( \leq 90 \) min, and each region individually surpassed the American College of Cardiology D2B Alliance benchmark. In areas with regional SRC networks, 9-1-1 provides entire communities with timely access to quality STEMI care.

Sadowski, Marcin; Janion-Sadowska, Agnieszka; Gąsior, Mariusz; Gierlotka, Marek; Janion, Marianna; Poloński, Lech;

Gender-related benefit of transport to primary angioplasty: is it equal?

Cardiol J 2011; 18(3): 254-60

Infarct size is correlated with duration of coronary artery occlusion. Evidence suggests that transport for primary angioplasty improves outcomes, but there is no agreement regarding differences in prognosis between men and women. We compared outcomes in men and women with ST-segment elevation myocardial infarction (STEMI) transferred from another hospital against those who had been transported directly to an invasive treatment center. Data was collected between June 2005 and May 2006 from a registry of 26,035 patients with STEMI and in whom primary angioplasty had been performed. A total of 10,708 patients underwent primary angioplasty. Of these, 3,359 men and 1,469 women were transported directly, while 4,135 men and 1,745 women were transferred from another site. In-hospital mortality and at one month, six months and 12 months after hospital discharge was significantly higher in women than in men. The prognosis of women transported directly was similar to that of women transferred from another site. However, there was a tendency, albeit insignificant, towards higher mortality at six and 12 months in women transported from another hospital. To reduce mortality in STEMI, an immediate reperfusion must not be delayed. This conclusion is valid particularly for women who are at greater risk of death.

Smith, Lindsay; Duval, Sue; Tannenbaum, Mark; Johnson Brown, Susan; Poulse, Anil; Iannone, Liberato; Larson, David; Ghali, Magdi; Henry, Timothy;
Are the results of a regional ST-elevation myocardial infarction system reproducible?


Primary percutaneous coronary intervention (PCI) is the preferred reperfusion method in patients with ST-elevation myocardial infarction (STEMI) if it can be performed in a timely manner in high-volume centers. Regional STEMI networks improve timely access to PCI but are frequently criticized for being single center. To determine if results of regional STEMI systems could be replicated and achieve similar outcomes in 2 separate geographic regions, we examined the prospective databases of 2 large regional STEMI networks that use identical standardized protocols and integrated transfer systems. The Minneapolis Heart Institute (MHI) database included 2,266 patients with STEMI from 31 hospitals (498 at the PCI hospital, 1,033 transferred from 11 hospitals <60 miles away, and 735 transferred from 19 hospitals 60 to 210 miles away). The Iowa Heart Center (IHC) database included 1,206 patients with STEMI from 24 hospitals (710 at the PCI hospital, 266 transferred from 10 hospitals <60 miles away, and 230 transferred from 13 hospitals 60 to 120 miles away). Median total door-to-balloon times for the PCI hospital, zone 1, and zone 2 patients were 64, 95, and 123 minutes for the MHI and 59, 102, and 136 for the IHC (p <0.05 for each comparison between MHI and IHC). Overall in-hospital, 30-day, and 1-year mortalities was 4.8%, 5.4%, and 8.0% respectively (p = NS for each comparison between MHI and IHC). In conclusion, the use of identical protocols in 2 large regional STEMI systems in geographically separate locations produced nearly identical outcomes, adding to evidence that regional STEMI centers expand timely access to PCI. Copyright © 2012 Elsevier Inc. All rights reserved.

Steg, Philippe; Bonnefoy, Eric; Chabaud, Sylvie; Lapostolle, Frédéric; Dubien, Pierre-Yves; Cristofini, Pascal; Leizorovicz, Alain; Touboul, Paul; ; ;

Impact of time to treatment on mortality after prehospital fibrinolysis or primary angioplasty: data from the CAPTIM randomized clinical trial.

Circulation 2003; 108(23): 2851-6

CAPTIM was a randomized trial comparing prehospital thrombolysis with transfer to an interventional facility (and, if needed, percutaneous intervention) with primary percutaneous coronary intervention (PCI) in patients with ST-segment-elevation myocardial infarction (STEMI). Because the benefit of thrombolysis is maximal during the first 2 hours after symptom onset, and because prehospital thrombolysis can be implemented earlier than PCI, this analysis studied the relationship between the effect of assigned treatment and the time elapsed from symptom onset. Randomization within 2 hours (n=460) or > or =2 hours (n=374) after symptom onset had no impact on the effect of treatment on the 30-day combined primary end point of death, nonfatal reinfarction, and disabling stroke. However, patients randomized <2 hours after symptom onset had a strong trend toward lower 30-day mortality with prehospital thrombolysis compared with those randomized to primary PCI (2.2% versus 5.7%, P=0.058), whereas mortality was similar in patients randomized > or =2 hours (5.9% versus 3.7%, P=0.47). There was a significant interaction between treatment effect and delay with respect to 30-day mortality (hazard ratio 4.19, 95% CI 1.033 to 17.004, P=0.045). Among patients randomized in the first 2 hours, cardiogenic shock was less frequent with lytic therapy than with primary PCI (1.3% versus 5.3%, P=0.032), whereas rates were similar in patients randomized later. Time from symptom onset should be considered when one selects reperfusion therapy in STEMI. Prehospital thrombolysis may be preferable to primary PCI for patients treated within the first 2 hours after symptom onset.
Verheugt, F; Lamfers, E; Aengevaeren, W;

[Reperfusion therapy for patients with an acute myocardial infarct with ST-segment elevation: fibrinolysis versus transport to a cardiac center for primary angioplasty].

*Ned Tijdschr Geneeskd* 2003; 147(41): 2001-4

Although fibrinolytic therapy for acute myocardial infarction is widely used and can be administered prior to hospitalisation, it is only successful in restoring full early coronary patency in about 60% of patients and has a 0.5% to 1% risk of severe side effects. Primary percutaneous coronary angioplasty carried out as an alternative to fibrinolysis avoids the risk of fibrinolytic therapy and restores patency in nearly 90% of cases. Data from randomised trials of primary angioplasty versus fibrinolytic therapy in acute myocardial infarction reveal that angioplasty results in a significant reduction in mortality. Furthermore, primary angioplasty can be improved by means of a new pre-angioplasty drug therapy (so-called facilitated primary angioplasty). Transport to a cardiac centre for primary angioplasty (of which there are 14 in the Netherlands) is feasible and safe. Although the time to treatment is delayed by a further 90 minutes, it tends to save lives and prevent strokes and it also significantly reduces the incidence of reinfarction. Interestingly, the time gained to treatment with prehospital fibrinolytic therapy compared to in-hospital therapy gave an outcome similar to that found upon comparing transport and primary angioplasty. Rescue procedures (angioplasty) within 24 hours are necessary in about 30% of patients who are initially treated with lytic therapy. These results support prehospital triage for fibrinolysis or transport to a cardiac centre, where early angioplasty can be performed if clinically indicated. A trial to determine the policy of choice is at present being conducted in the Netherlands.

PubMed ID 14587140  Read Abstract  Read Full Text  Article Source PubMed

**Observational Study**

Wang, Henry; Marroquin, Oscar; Smith, Kenneth;

Direct paramedic transport of acute myocardial infarction patients to percutaneous coronary intervention centers: a decision analysis.


One potential strategy in the emergency medical services (EMS) care of acute ST-segment elevation myocardial infarction (STEMI) is to bypass the nearest community hospital in favor of a more distant specialty center able to perform primary percutaneous coronary intervention. We seek to determine whether EMS transport of out-of-hospital STEMI patients directly to more distant specialty percutaneous coronary intervention centers will alter 30-day survival compared with transport to the nearest community hospital fibrinolytic therapy. This decision analysis used parameter values and ranges from meta-analyses and North American clinical studies of STEMI and chest pain care published after 2001. The primary hypothetical interventions were primary percutaneous coronary intervention versus community hospital-delivered fibrinolytic therapy. We defined total STEMI treatment time as the sum of symptom duration, EMS response time, EMS scene time, EMS transport time to the nearest community hospital, additional EMS transport time to a more distant percutaneous coronary intervention center, and door-to-drug or door-to-balloon time. We related total STEMI treatment time to the primary outcome 30-day post-STEMI survival. We assumed that the closest specialty percutaneous coronary intervention centers were located farther than the
nearest community hospital and that patients would receive primary percutaneous coronary intervention at specialty centers and fibrinolytic therapy at community hospitals. We assumed the use of ground transportation only and excluded situations with fibrinolytic therapy contraindications. We examined standard risk and best-case scenarios for each intervention, as well as changes in predicted risk with parameter value variations. Baseline total treatment times (chest pain onset to intervention) were percutaneous coronary intervention 188 minutes (range 41 to 447 minutes) and community hospital fibrinolytic therapy 118 minutes (range 51 to 267 minutes). Thirty-day survival was higher for standard percutaneous coronary intervention than standard community hospital fibrinolytic therapy (95.8% versus 93.8%; relative risk [RR] 1.021; number needed to treat 50) but lower when compared to best-case community hospital fibrinolytic therapy (95.8% versus 97.8%; RR 0.980; number needed to harm 50). Best-case percutaneous coronary intervention was equivalent to best-case community hospital fibrinolytic therapy (RR 1.000). In 1-way sensitivity analyses, best-case community hospital fibrinolytic therapy versus standard percutaneous coronary intervention was sensitive to treatment time parameter variations. Probabilistic sensitivity analysis favored standard percutaneous coronary intervention over standard community hospital fibrinolytic therapy (RR=1.020; 95% probability range 1.002 to 1.045) but did not indicate a favored strategy for the other scenarios. In select out-of-hospital STEMI care scenarios, EMS transport of acute STEMI patients directly to percutaneous coronary intervention centers may offer small but uncertain survival benefits over nearest community hospital fibrinolytic therapy.

Widimský, P; Budesínský, T; Vorác, D; Groch, L; Zelízko, M; Aschermann, M; Branny, M; Stťásek, J; Formánek, P; , ;

Long distance transport for primary angioplasty vs immediate thrombolysis in acute myocardial infarction. Final results of the randomized national multicentre trial--PRAGUE-2.


Primary percutaneous coronary intervention (PCI) is shown to be the most effective reperfusion strategy in acute myocardial infarction. The aim of this multicentre national randomized mortality trial was to test whether the nationwide change in treatment guidelines (transportation of all patients to PCI centres) was warranted. The PRAGUE-2 study randomized 850 patients with acute ST elevation myocardial infarction presenting within <12 h to the nearest community hospital without a catheter laboratory to either thrombolysis in this hospital (TL group, n=421) or immediate transport for primary percutaneous coronary intervention (PCI group, n=429). The primary end-point was 30-day mortality. Secondary end-points were: death/reinfarction/stroke at 30 days (combined end-point) and 30-day mortality among patients treated within 0-3 h and 3-12 h after symptom onset. Maximum transport distance was 120 km. Five complications (1.2%) occurred during the transport. Randomization-balloon time in the PCI group was 97+/-27 min, and randomization-needle time in the TL group was 12+/-10 min. Mortality at 30 days was 10.0% in the TL group compared to 6.8% mortality in the PCI group (P=0.12, intention-to-treat analysis). Mortality of 380 patients who actually underwent PCI was 6.0% vs 10.4% mortality in 424 patients who finally received TL (P<0.05). Among 299 patients randomized >3 h after the onset of symptoms, the mortality of the TL group reached 15.3% compared to 6% in the PCI group (P<0.02). Patients randomized within <3 h of symptom onset (n=551) had no difference in mortality whether treated by TL (7.4%) or transferred to PCI (7.3%). A combined end-point occurred in 15.2% of the TL group vs 8.4% of the PCI group (P<0.003). Long distance transport from a community hospital to a tertiary PCI centre in the acute phase of AMI is safe. This strategy markedly decreases mortality in patients presenting >3 h after symptom onset. For patients presenting within <3 h of symptoms, TL results are similar results to long distance transport for PCI.
**Observational Study**

### Excluded Articles

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<th>Question</th>
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Should heart attack patients go to nearest hospital or one with most advanced care?

**Hosp Health Netw** 2006; 80(4): 86, 88, 90

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**Harv Heart Lett** 2004; 14(5): 3

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**Heart Advis** 2002; 5(8): 2

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