

Door to Needle Time in Acute Myocardial Infarction Patients

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Abstract

Background: To determine the current door-to-needle time for the administration of fibrinolytics for acute myocardial infarction (AMI) in emergency room.

Methods: In this cross sectional study patients presenting with acute myocardial infarction (AMI) were included. Time interval from patient's presentation to administration of streptokinase to the patient, was calculated. The total door-to-needle time was calculated and patient demographics and presentation, physician's experience, clinical symptomatology and reasons for delays in thrombolytic administration were analysed.

Results: Sixty six patients, presented with AMI, were given streptokinase. Out of these, 6% received streptokinase within 15 minutes of arrival in emergency, 22.7% received streptokinase in 30 minutes, 33.33% received thrombolytic agent in 45 minutes, 27.27% received thrombolytic therapy in 60 minutes, and 10.7% received thrombolytic therapy in 90 minutes. The mean door to needle time calculated was 44.8 minutes. Patients receiving reperfusion therapy within 30 minutes were 28.7%.

Conclusion: A significant number of patients were not thrombolysed within 30 minutes of presentation. The non-availability of senior doctors, difficulty in interpreting ECGs, atypical presentations and ER system delays, prolonged the door-to-needle time in this study.

Key words: Door to needle time, Acute myocardial infarction, Streptokinase

Introduction

Ischaemic heart disease (IHD) is a major cause of mortality and morbidity worldwide, especially in industrialised countries.¹ In keeping with international studies, mortality from IHD was higher in males than females.² Myocardial infarction is the major cardiac emergency presented in Benazir Bhutto Hospital Rawalpindi. While primary prevention of IHD is considered the ideal, mortality and morbidity in patients presenting with acute myocardial infarction (AMI) can be reduced with early interventions such as

fibrinolysis or percutaneous coronary intervention (PCI).³ Many studies have shown that early PCI is more advantageous in reducing mortality from re-infarction and the need for a coronary artery bypass graft (CABG) than fibrinolytic drug therapy.⁴⁻⁶ In Rawalpindi, PCI is limited to two tertiary hospitals, making fibrinolytic drug therapy the more accessible form of treatment for ST elevation myocardial infarction (STEMI) patients.

In keeping with the mantra "Time is muscle", early administration of fibrinolytic therapy preserves left ventricular function by increasing patency of occluded vessel and thus limiting infarct size.^{7,8} Maximal benefit from fibrinolysis is seen when the fibrinolytic is given within the first hour of symptom onset.^{9,10} Delaying fibrinolytic therapy by one hour increases the hazard ratio of death by 20%, (95% confidence interval (CI) 7 - 88), and a delay of 30 minutes or more can reduce the average life expectancy by one year.¹¹ The period between the onset of symptoms to administration of fibrinolytic therapy can be divided as: 1. Interval between onset of symptoms to seeking medical attention; 2. Period taken to transport patient to definitive care; 3. Interval between arrival at hospital to initiation of fibrinolytic (door-to-needle time). The first two components can be improved by public education and developing efficient pre-hospital systems. For example, North Carolina has adopted a state wide STEMI referral strategy that advises paramedics to "bypass" local hospitals and transport STEMI patients directly to a PCI-capable hospital, even if a non-PCI-capable hospital is closer. This results in shorter reperfusion times.¹² But door-to-needle time is the one in-hospital factor that can be addressed by medical practitioners. The American Heart Association/American College of Cardiology (AHA/ACC) guidelines recommend a door-to-needle time of 30 minutes or less for administration of fibrinolytic for STEMI patients.¹ Compliance with this time period is considered a marker of quality of care.¹⁴ European Society of Cardiology recommends First Medical Contact time to ECG time of Less than 10 minutes and also recommends door to needle time of less than 30 minutes.¹⁵

Patients and Methods

This prospective study was conducted on all patients who received thrombolytics for AMI in the Emergency of BBH from August 2016 to October 2016. All adult patients with acute ST segment elevation, new onset left bundle branch block (LBBB), or posterior infarct on electrocardiogram (ECG) meeting AHA/ACC criteria for thrombolysis, who received thrombolytics in the emergency BBH. Exclusion criteria was patients who received pre-hospital thrombolysis or those thrombolysed at other centres before referral; patients receiving thrombolytic therapy for conditions other than myocardial infarction e.g. pulmonary embolism. The quality of data collected was dependent on the availability and accuracy of the case notes. Incomplete documentation, and illegible and ambiguous notes were identified. Data collated and analysed was patient demographics, pre-hospital ECG acquisition and presence or absence of attendants. Time intervals calculated were time of presentation to hospital (taken from Emergency slip) to time of ECG acquisition, time from ECG acquisition to actually commencing thrombolytics and the sum of the above time intervals constitutes the total door-to-needle time.

Simple descriptive statistics were used to describe the meantime to ECG, ECG to fibrinolytic, and total door-to-needle times. Subgroup analysis was performed for determining prevalence of STEMI patients fibrinolyzed based on gender and age group; and pre hospital ECG acquisition. The symptoms on presentation were also assessed. Typical symptoms were defined as an acute onset of chest pain with radiation to the left arm, neck or jaw with associated autonomic symptoms (sweating, nausea or vomiting). Ethics approval was granted by the Research Committee of Rawalpindi Medical University.

Results

Sixty six patients presented with AMI were given streptokinase. Out of these, 6% (n=4) of these patients received Streptokinase within 15 minutes of arrival in Emergency and 22.7% (n=15) of these patients received Streptokinase in 30 minutes (Table 1). The Mean Door to Needle Time Calculated was 44.8 Minutes (Table 2). Patients receiving reperfusion therapy within 30 minutes were 28.7%. Majority (74%) had a typical presentation of AMI (Table 3)

Table 1 : Door to needle time in minutes

Door to needle time in minutes	%(n) n=66
Within 15 minutes of arrival	6% (n=4)
16 - 30 minutes	22.7% (n=15)
31 - 45 minutes	33.33% (n=22)
46 - 60 minutes	27.27% (n=18)
61 - 90 minutes & more	10.7% (n=7)

Table 2: Mean time achieved for each interval in minutes

Time Interval	Mean time (minutes)
Door to ECG	17.4 Minutes
ECG to Thrombolysis	27.4 Minutes
Door to needle time	44.8 Minutes

Table 3: Demographic variables

Variable	No	Percentage
Sex		
Male	43	65.2
Female	23	34.8
Age (years)		
25-40	5	7
41-60	37	56
>60	24	37
Pre-Hospital ECG Acquisition		
Pre-Hospital ECG	3	4.5
Symptomology		
Typical	49	74
Atypical	17	26

Discussion

The prognosis of acute myocardial infarction patients depends on timely administration of fibrinolytic therapy.^{9,10,35} American Heart Association and European Society of Cardiology recommends door to needle time of 30 minutes for fibrinolytic therapy.^{13,15} But unfortunately these guidelines are not followed. Adherence to these guidelines has improved care of patients with AMI and is associated with significant reductions in in-hospital mortality rates.^{16,17,18,19} Timely diagnosis of ST-segment elevation myocardial infarction (STEMI) in the emergency department (ED) is made solely by ECG. Obtaining this test within 10 minutes of ED arrival is critical to achieving the best outcomes as recommended by ESC and AHA. A recent study published in Journal of American Heart Association in February 2017 evaluated performance of Emergency Department Screening Criteria for an Early ECG to Identify ST-Segment Elevation Myocardial Infarction. They examined STEMI screening performance in 7 EDs, with the missed case rate (MCR) as their primary end point. The overall MCR for all 7 EDs was 12.8%. The lowest and highest MCRs were 3.4% and 32.6%, respectively. The mean difference in door-to-ECG times for captured and missed patients was 31 minutes, with a range of 14 to 80 minutes of additional myocardial ischemia time for missed cases. The prevalence of primarily screened ED

STEMIs was 0.09%. The 29.2% difference in MCRs between the highest and lowest performing EDs demonstrates room for improving timely STEMI identification among primarily screened ED patients.²⁰ In a Canadian registry of 3,088 AMI patients in 2000–2001, 63% of the patients failed to receive fibrinolytic therapy within 30 minutes of ED arrival.²¹ Another study done in Canadian province of QUEBEC in 2003 in 1189 patients showed median delay of reperfusion therapy was 32 minutes in patients receiving fibrinolytic therapy.²² Evaluation of door to needle time in a tertiary care hospital, in India in 2015 showed 73 percent of patients failed to receive thrombolytic therapy within 30 minutes.²³ Similar study done in 58 Urban Emergency departments in U.S. comprised of 3,819 patients who presented between 2003 and 2006, showed low to moderate concordance with guideline-recommended processes of care for patients of AMI.²⁴ A data from Punjab Institute of Cardiology Lahore showed door-to-needle time of more than 30min in 46.2% patients.²⁵ Similar studies done in India, Saudi Arabia and Vancouver showed that ACCA recommendation of door to needle time is not properly followed.^{26,27,28,31}

In Benazir Bhutto Hospital, the mean door to needle time as per present study is 44.8 min. Only 28.7% patients received reperfusion therapy within 30min of arrival in ER. So, a large proportion of patients did not receive fibrinolytic therapy in time. Factors that contributed to the increase of door to needle time were, inappropriate referral of cardiac patients to the medical units by the triage personnel, delay in the acquisition of ECG, delay in interpretation of ECG as its interpretation and the decision to thrombolyse are reliable in more experienced doctors than junior doctor, patients presenting with atypical symptoms, non-availability of thrombolytics in the cardiac bay and delay in acquisition of thrombolytics from the emergency administration due to administrative issues.²⁹ These factors significantly increase door to needle time and can be addressed by application of different pre-emptive and emergency measures, e.g., early ECG acquisition for at-risk patients, emergency staff training, the presence of a senior doctor/physician on the floor or being readily available, better co-ordination between hospital administration, emergency staff and physicians, improve auxiliary services to enhance patient flow, the ready availability of fibrinolytic medicine in the cardiac bay. Most quality improvement studies suggest a team-based approach to improving the time-to-reperfusion therapy for MI patients.^{22,24,30}

A Study in Armed Forces Institute of Cardiology, Rawalpindi showed that more than 70% of the patients were thrombolysed within 30 mins of arrival i.e. door to needle time <30 minutes.³² In hospital associated with Andhra Medical College, Visakhapatnam, Andhra Pradesh, India, they have been able to reduce the door to needle time for intravenous thrombolysis to about ten minutes by ensuring the presentation of a patient, with chest pain, directly to ICCU without going through the emergency room / outpatient registration. This revealed efficient hospital organisational strategy to handle cardiac patients.³³ Similarly doctors at a rural district general hospital in New Zealand conducted a research, which revealed that introducing a number of simple low-cost interventions that included educational sessions for junior doctors and cardiac nursing staff, as well as posters and training on the use of a remote electronic ECG interpretation system to streamline out-of-hours management, they have been able to achieve recommended door to needle time in 74 percent of patients as compared to 43 percent without these interventions.³⁴

Conclusion

A significant number of patients were not thrombolysed within 30 minutes of presentation (71.3%). The lack of senior doctors, difficulty interpreting ECGs, atypical presentations and ECG system delays prolonged the door-to-needle time in this study.

References

1. Yusuf S, Reddy S, Ounpuu S. Global burden of cardiovascular diseases: Part I: General considerations, the epidemiological transition, risk factors and impact of urbanization. *Circulation* 2001;104:2746-53.
2. Statistics South Africa. Mortality and Causes of Death in South Africa, 2008. Findings from Death Notifications. <http://www.statssa.gov.za>
3. Armstrong PW, Bogaty P, Buller CE. The 2004 ACC/AHA guidelines: a perspective adaptation for Canada by the Canadian Cardiovascular Society Working Group. *Can J Cardiol* 2004;20:1075-79.
4. de Boer MJ, Hoorntje JC, Ottervanger JPl. Immediate coronary angioplasty versus intravenous streptokinase in acute myocardial infarction: left ventricular ejection fraction, hospital mortality and reinfarction. *J Am Coll Cardiol* 1994;23:1004-08.
5. Stone GW, Grines CL, Browne KF. Implications of recurrent ischemia after reperfusion therapy in acute myocardial infarction: a comparison of thrombolytic therapy and primary angioplasty. *J Am Coll Cardiol* 1995;26:66-72.
6. Weaver WD, Simes RJ, Betriu A. Comparison of primary coronary angioplasty and intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review. *JAMA* 1997;278:2093-98.

7. Wilcox RG, von der Lippe G, Olsson CG. Trial of tissue plasminogen activator for mortality reduction in acute myocardial infarction. Anglo-Scandinavian Study of Early Thrombolysis (ASSET). *Lancet* 1988;8610:525-530.
8. Second International Study of Infarct Survival (ISIS-2) Collaborative Group. Randomized trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2. *Lancet* 1988;8607:349-360.
9. Fibrinolytic Therapy Trialists' (FTT) Collaborative Group. Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. *Lancet* 1994;343: 311.
10. Boersma E, Maas AC, Deckers JW. Early thrombolytic treatment in acute myocardial infarction: Reappraisal of the golden hour. *Lancet* 1996;9030:771-75.
11. Rawles JM (GREAT Group). Quantification of the benefit of earlier thrombolytic therapy: Five-year results of the Grampian Region Early Anistreplase Trial (GREAT). *J Am CollCardiol* 1997;30:1181-86.
12. Emil L, Fosbol, Christopher B, James G. Monk JL. The Impact of a State wide pre-hospital STEMI strategy to bypass hospitals without percutaneous coronary intervention capability on treatment times. *Circulation* 2012;112:11843-46.
13. O'Gara PT, Kushner FG, Ascheim DD, Casey DE, Chung MK. ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction: a Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, *J Am CollCardiol* 2013; 61 :e78-e140)
14. Kuppaswamy VC, WebbeD , Gupta S. Meeting the NSF targets for door-to-needle time in acute myocardial infarction - the role of a bolus thrombolytic. *Br J Cardiol* 2006;13:36-41.
15. Steg PG, James SK, Atar D, Badano LP, Blömstrom-Lundqvist C. Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation, *Eur Heart J* 2012; 33: 2569-2619
16. Peterson ED, Roe MT, Mulgund J. Association between hospital process performance and outcomes among patients with acute coronary syndromes. *JAMA*. 2006; 295:1912-20.
17. McNamara RL, Herrin J, Wang Y. Impact of delay in door-to-needle time on mortality in patients with ST-segment elevation myocardial infarction. *Am J Cardiol*. 2007; 100:1227-32.
18. McNamara RL, Wang Y, Herrin J. Effect of door-to-balloon time on mortality in patients with ST-segment elevation myocardial infarction. *J Am CollCardiol*. 2006; 47:2180-86.
19. Peterson ED, Shah BR, Parsons L. Trends in quality of care for patients with acute myocardial infarction in the National Registry of Myocardial Infarction from 1990 to 2006. *Am Heart J*. 2008; 156:1045-55
20. Yiadom, MaameYaa AB. Performance of Emergency Department Screening Criteria for an Early ECG to Identify ST-Segment Elevation Myocardial Infarction. *Journal of the American Heart Association* 6.3 (2017): e00352
21. Atzema CL, Austin PC, Tu JV, Schull MJ. Emergency department triage of acute myocardial infarction patients and the effect on outcomes. *Ann Emerg Med*. 2009; 53:736-45.
22. Huynh T, O'Loughlin J, Joseph L. The AMI-QUEBEC Study Investigators. Delays to reperfusion therapy in acute ST-segment elevation myocardial infarction: results from the AMI-QUEBEC Study *CMAJ* 2006; 175(12):1527-32.
23. Sarwar A, Xavier AA, Ragachandana K, Dhanapal CK, Sudarshan S. Evaluation of door to needle time and predisposing factor to it in a tertiary Care Hospital, Chidambaram." *PharmaTutor* 4.11 (2016): 33-36.
24. Tsai CL, David J, Magid MD. Quality of Care for acute myocardial infarction in 58 U.S. emergency departments. *AcadEmerg Med* 2010;17:940-50.
25. Jehangir W, Daood MS, Khan M. Evaluation of the door-to-needle time in patients undergoing fibrinolytic therapy after acute myocardial infarction. *Pak J Physiol* 2009;5(2):38-39.
26. Masurkar VA, Kapadia FN, Shirwadkar G. Evaluation of the door-to-needle time for fibrinolytic administration for acute myocardial infarction. *Indian Journal of Critical Care Medicine* 2005;9(3):137-40.
27. Abba AA, Wannu BA, Rahmatullah RA. Door-to-needle time in administering thrombolytic therapy for acute myocardial infarction. *Saudi Med J* 2003;24(4):361-64.
28. Zed PJ, Abu-Laban RB, Cadieu TM. Fibrinolytic administration for acute myocardial infarction in a tertiary ED: Factors associated with an increased door-to-needle time. *Am J Emerg Med* 2004;22:192-196.
29. Massel D. Observer variability in ECG interpretation for thrombolysis eligibility: Experience and context matter. *J ThrombThrombolysis* 2000;15(3):131-40.
30. Ho MT, Eisenberg MS, Litvin PE. Delay between onset of chest pain and seeking medical care. The effects of public education. *Ann Emerg Med* 1989;18:727-731.
31. George L, Ramamoorthy L, Sathesh S, Saya RP. Prehospital delay and time to reperfusion therapy in ST elevation myocardial infarction. *J Emerg Trauma Shock* 2017;10:64-69
32. Ali S, Sharif H, Shehzad K. Door to needle time and its impact on successful thrombolysis. *JRMC*; 2012;16(1):3-5
33. Venkatachalam R, Adilakshmi B, Manohar T, Rao M, Abbaiah S. Factors affecting time to arrival in hospital among patients with acute myocardial infarction (MI). *Journal of Scientific and Innovative Research* 2015; 4(2): 109-14.
34. Mark J, and Caesar J. Improving door-to-needle times for patients presenting with ST-elevation myocardial infarction at a rural district general hospital. *BMJ Quality Improvement Reports* 2016; 5.1:673-76.
35. Puymirat N and Etienne M. Prognostic impact of non-compliance with guidelines-recommended times to reperfusion therapy in ST-elevation myocardial infarction. *The FAST-MI 2010 registry. European Heart Journal: Acute Cardiovascular Care* 2017;6: 26-33.