e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(7); 52-58

Original Research Article

Impact of Door-to-Balloon Time on Clinical Outcomes in Patients with ST-Elevation Myocardial Infarction

Panchanan Sahoo[1], Binayananda Padhee[2]

[1]Associate Professor, Department of Cardiology, KIMS, Bhubaneshwar, Odisha, India
[2]Assistant Professor, Department of Cardiology, KIMS, Bhubaneshwar, Odisha, India

Received: 10-05-2022 / Revised: 10-06-2022 / Accepted: 30-06-2022
Corresponding author: Panchanan Sahoo
Conflict of interest: Nil

Abstract

Background: Studies on the connection between the Door-to-Balloon time and ST-Elevation myocardial infarction have produced inconsistent findings. Although its effectiveness may be constrained by delivery delays, prompt percutaneous coronary intervention (PCI) for patients with ST-segment elevation myocardial infarction (STEMI) can considerably reduce mortality and morbidity. For patients with ST-segment elevation myocardial infarction (STEMI) receiving primary percutaneous coronary intervention, we wanted to ascertain the impact of door-to-balloon time on death (PCI).

Methods: For three years, we conducted a cohort analysis of 292 STEMI patients treated with PCI within six hours of presentation at our hospital. We assessed the impact of door-to-balloon time on in-hospital mortality using hierarchical models in the full cohort as well as in other patient subgroups based on symptom onset-to-door time and baseline risk status.

Results: Increased in-hospital mortality was linked to longer door-to-balloon timings (mortality rates of 3.0%, 4.2%, 5.7%, and 7.4% for door-to-balloon times of ≤ 90 min, 91 to 120 min, 121 to 150 min, and > 150 min, respectively; p-value= 0.01) Patients with a door-to-balloon time more than 120 minutes had a higher risk of dying than those with a door-to-balloon time of 90 minutes (odds ratio 1.42; 95 percent confidence interval [CI] 1.24 to 1.62). In subgroup analyses, mortality increased with longer door-to-balloon times independent of the length of time between the beginning of symptoms and the door (≤ 1 h, >1 to 2 h, >2 h), as well as the presence or absence of high-risk factors.

Conclusions: Regardless of how long it takes for symptoms to manifest and regardless of the pre-existing risk of mortality, the time from primary PCI to mortality risk is crucial. All patients should be included in efforts to reduce door-to-balloon times.

Introduction

While prompt percutaneous coronary intervention (PCI) can considerably lower mortality and morbidity in patients with ST-segment elevation myocardial infarction (STEMI), its efficacy may be constrained by delivery delays. [1–3] Door-to-balloon time describes the period of time between the STEMI patient's arrival at the emergency department (ED) and the cardiac catheterization lab's balloon angioplasty of the blocked coronary artery (CCL). Although ST-elevation myocardial infarction (STEMI) is a dangerous condition, timely primary

percutaneous coronary intervention (PCI) has been proven to reduce mortality [4]. Prompt detection is the first step in managing a STEMI patient since reperfusion treatment works best when administered soon after presentation. An electrocardiogram can be used to confirm the diagnosis of STEMI in patients who report to the emergency department (ER) with ischemic symptoms that raise suspicion of an acute coronary syndrome (ECG). The STEMI patient should get ongoing cardiac monitoring, oxygen, intravenous access, and antiplatelet medication as soon as the diagnosis of STEMI is made in the emergency room.

Studies on the association between mortality and time to reperfusion following primary percutaneous coronary intervention have produced inconsistent findings (PCI). Shorter symptom onset-to-reperfusion times have been linked to lower mortality by certain researchers, whether they looked at all patients [5] or just select subgroups like high-risk patients [6] or those who presented within two hours of symptom onset [7]. Shorter symptom onset to balloon time did not result in lower mortality in other investigations, while shorter door to balloon time did [8,9]. Finally, some studies [10,11] were unable to identify a correlation between the time from symptom beginning to balloon or the time from door to balloon and death. Numerous practical methods for a considerable DBT decrease have been demonstrated in recent studies [12–16]. The best-supported strategies include (1) using emergency physicians rather than cardiologists to activate the cardiac catheterization laboratory, (2) making good use of pre-hospital electrocardiograms, and (3) monitoring and providing feedback on performance data [12, 13, 15, 17, 18]. Improved patient care depends on the implementation of solutions to address institutional-specific delays, which are also a crucial sign of a hospital's quality of care [12]. This prospective observational study's goal was to examine how Door-to-Balloon Time affected patients with ST-Elevation Myocardial Infarction who were <75 years of age or older, 75 to 84 years of age, and ≥85 years of age or older.

Methods

Sample population

This prospective observational cohort study details the experiences of a tertiary care facility that offers STEMI patients a 24-hour interventional method. There were 138 acute myocardial infarction (AMI) admissions at both institutions for three years, during the study period.

Exclusion and inclusion criteria

Patients who were transferred to or from another acute care facility, had a first electrocardiogram (ECG) that did not show ST-segment elevation or left bundle branch block, had AMI symptoms start after the admission date and time, had a nondiagnostic first ECG (i.e., had a diagnostic ECG that did not show ST-segment elevation or left bundle branch block), or had a diagnostic ECG that was performed more than one hour before hospital presentation (prehospital). Patients treated in hospitals reporting fewer than 20 PCI patients over the three-year period were also excluded to avoid including facilities that conducted primary PCI infrequently. In the final cohort, 292 patients from hospital were represented. All patients' mortality status at the time of discharge was known.

Data Collection

Age (<75, 75 to 84, and ≥85 Years), gender, body mass index (BMI), infarct site, systolic and diastolic blood pressure (BP), heart rate, left ventricular ejection fraction (LV-EF), cardiogenic shock, laboratory values such as maximum creatine kinase (CK max) or serum glucose, co-morbidities such as diabetes, prior myocardial infarction, PCI or coronary artery bypass grafting Additionally, each patient's Thrombolysis

in Myocardial Infarction (TIMI)-risk score was determined as previously mentioned. (DBT, PBT, and hospital contact-to-balloon time for transferred patients) were gleaned from ambulance call reports, emergency department STEMI triage process, computer-generated catheterization reports, and medical records.

Statistical Analysis

Using chi-square tests to determine the relationship between categorical variables and in-hospital mortality and t-tests or F tests to determine the relationship between continuous variables and in-hospital mortality, we first looked at the bivariate relationship between patient characteristics and in-hospital mortality. Then, using door-to-balloon time as a categorical variable, we looked at the bivariate correlation between door-to-balloon time and in-hospital mortality. For the entire group, we did this and stratified by the symptom onset-to-door time (≤1 h, > 1 to 2 h, > 2 h) and the presence or absence of anterior/septal location, diabetes mellitus, heart rate > 100 beats/min, systolic blood pressure <100 mm Hg, and any of these baseline risk factors. In univariable Cox regression analysis, only variables with a probability value of 0.05 were included for multivariable regression. We employed the likelihood ratio (LR) criterion with a stepwise forward Cox regression. We offer odds ratios (OR) and hazard ratios (HR), together with the accompanying 95% confidence intervals (CI). Statistical significance was defined as a two-tailed p-value = 0.05. The software programme Statistical Package for Social Sciences was used to conduct statistical analyses (SPSS, Version 15.0, SPSS Inc., IL, USA).

Results

Table 1: The cohort was predominantly male (71%) with a mean age of 61.6 years

	Door-to-Balloon time		Mortality	
Description	(Quartile Range)	p	n (%)	p
All	292		138	
Demographics				
Age		<0.0001		<0.0001
<75 years	163		75	
75 to 84 years	78		28	
≥85 years	51		35	
Gender				
Male	208	<0.0001	91	<0.0001
Female	84		47	
Medical history				
Chronic renal insufficiency	83	<0.0001	14	<0.0001
Diabetes mellitus	27	<0.0001	27	<0.0001
Previous myocardial infarction	34	<0.0001	23	0.1565
Hypertension	18	<0.0001	13	<0.0001
Hypercholesterolemia	56	0.0124	14	<0.0001
Family history of coronary artery disease	32	0.0005	18	<0.0001
Congestive heart failure	67	<0.0001	34	<0.0001
Percutaneous coronary intervention	41	0.0032	43	0.0005
Coronary artery bypass	17	<0.0001	42	0.0001
Chronic obstructive pulmonary disease	45	<0.0001	29	<0.0001

Stroke	2	<0.0001	9	<0.0001
Angina	27	0.0288	38	0.0633
Systolic blood pressure		<0.0001		<0.0001
<100 mm Hg	136		47	
100–180 mm Hg	47		48	
>180 mm Hg	76		24	
Unknown	33		19	
Heart rate		<0.0001		<0.0001
<50 beats/min	109		33	
50–100 beats/min	102		51	
>100 beats/min	36		28	
Unknown	45		26	
First assessment of heart failure		<0.0001		<0.0001
No congestive heart failure	57		47	
Rales/jugular venous distension	35		30	
Pulmonary edema	29		8	
Cardiogenic shock	19		19	

Numerous patients had typical cardiac risk factors or a previous diagnosis of coronary artery disease. Nearly 10% of patients had a prehospital ECG, 94% reported chest pain, 11% had overt heart failure, and 2% had a left bundle branch block. Within two hours of the onset of symptoms, 62 percent of patients presented. 38 percent of the patients had an anterior/septal location, 19 percent had diabetes mellitus, 12 percent had a heart rate ≤100 beats per minute, and 10 percent had systolic blood pressure under 100 mm Hg. With longer door-to-balloon times, hospital mortality climbed considerably. Patients showed this association regardless of the period from symptom beginning to door. Both patients with high-risk ACC/AHA variables and those without them showed the correlation between shorter door-to-balloon timeframes and lower mortality. For all categories, whether by symptom onset-to-door time or presence or absence of risk factors, the odds of in-hospital mortality rose with increasing door-to-balloon time in hierarchical multivariable analysis.

Discussion

We discovered unequivocal evidence of higher mortality with longer door-to-balloon durations in this sizable observational analysis of STEMI patients receiving initial PCI. No matter how long it took for symptoms to manifest, both patients with and without high-risk characteristics showed this connection. These results give evidence that the current guideline-based guidelines for fast PCI are valid for all patients with STEMI who present within 6 hours of the onset of symptoms. Time between the onset of symptoms until reperfusion. Patients with STEMI have repeatedly demonstrated to have lower mortality when fibrinolytic therapy is administered sooner after the onset of symptoms [19-21,22,23]. However, a meta-analysis of randomised trials indicated that only patients who received PCI within two hours were affected by the length of time from the beginning of symptoms to reperfusion when receiving fibrinolytic therapy [11]. Similar findings have been seen in sizable single-center observational studies [5,7].

In contrast, research of prior patients in NRMI-1 and -2 indicated no connection between death and the interval from the onset of symptoms to ballooning [8]. After accounting for patient characteristics, our investigation of NRMI-3 and -4 did not discover better survival for patients with shorter symptom onset-to-door times. Myocardial salvage has been discovered to

be related to the time from symptom onset to fibrinolytic therapy but independent of the time from symptom onset to balloon dilation, supporting our findings [24]. Methodological problems may explain the poor relationship in addition to biological causes.

First, patient reporting error limits the precision of the symptom onset time. Patients commonly give an estimate because they are unsure of the precise moment their symptoms started. Second, because fibrinolytic therapy carries a higher risk of bleeding than PCI, individuals who are less confident of when their symptoms started may be more likely to have PCI than fibrinolytic therapy. Finally, some STEMI deaths could happen before the patient arrives at the hospital. These patients wouldn't be listed in the registry, and without them, the correlation between symptom onset and mortality would probably be less clear.

Door-to-balloon time. We looked at the door-to-balloon time as a subset of the symptom onset-to-balloon time. Door-to-balloon time can also impact estimate accuracy more easily because it is more in the hands of certain hospitals and doctors than symptom onset-to-door time [25]. Prior research examining the relationship between door-to-balloon time and mortality have yielded conflicting findings, similar to the symptom onset-to-balloon time. A close approximation of door-to-balloon time was used in the Global Use of Strategies to Open Occluded Arteries in Acute Coronary Syndromes (GUSTO) IIb study to measure the 30-day death rates [9]. Increased mortality was observed with longer door-to-balloon durations in a study of patients from an earlier cohort of NRMI [8].

In patients with more current data as well as in a number of patient subgroups, our analysis supports this link. Door-to-balloon time did not show a similar connection with mortality in a previous study that found that symptom onsetto-balloon time was an independent predictor of mortality [5]. Only 11% of patients in this single-center trial had door-to-balloon times longer than 90 minutes, which may help to explain the disparity between these results and those of our study. [26] The majority of patients in the NRMI registry, however, had door-to-balloon timeframes that were longer than 90 minutes. Low patient numbers with times over 90 minutes may reduce the sensitivity of identifying a relationship. Time to reperfusion was found to be significant only in high-risk individuals in one research [6].

According to our research, longer door-to-balloon times are associated with higher fatality rates across the board for risk groups. The baseline risk determined how much mortality there would be, but the connection with time remained constant.

Conclusion

The adoption of a systematic, optimised STEMI technique minimises DBT considerably and aids PCI centres in complying with the recommendations. Most of the intricate procedures required to reduce DBT are successfully and reliably included into this approach. These advancements have helped to reduce mortality and morbidity, at least in part.

References

1. Berger PB, Ellis SG, Holmes DR Jr, et al. Relationship between delay in performing direct coronary angioplasty and early clinical outcome in patients with acute myocardial infarction: results from the Global Use of Strategies to Open Occluded Arteries in Acute Coronary Syndromes (GUSTOIIb) Trial. Circulation 1999 Jul 6;100(1):14–20.
2. Cannon CP, Gibson CM, Lambrew CT, et al. Relationship of symptom-onset-to-balloon time and door-to-balloon time with mortality in patients undergoing angioplasty for acute

myocardial infarction. JAMA 2000 Jun 14;283(22):2941–7.
3. Giugliano RP, Braunwald E; TIMI Study Group. Selecting the best reperfusion strategy in ST-elevation myocardial infarction: it's all a matter of time. Circulation 2003 Dec 9;108(23):2828–30.
4. McNamara, R.L., Wang, Y., Herrin, J., Curtis, J.P., Bradley, E.H., Magid, D.J., Peterson, E.D., Blaney, M., Frederick, P.D. & Krumholz, H.M. (2006) Effect of door-to-balloon time on mortality in patients with ST-segment elevation myocardial infarction. J. Am. Coll. Cardiol., 47, 2180-2186.
5. De Luca G, Suryapranata H, Zijlstra F, et al., ZWOLLE Myocardial Infarction Study Group. Symptom-onset-to-balloon time and mortality in patients with acute myocardial infarction treated by primary angioplasty. J Am Coll Cardiol 2003;42:991–7.
6. Antoniucci D, Valenti R, Migliorini A, et al. Relation of time to treatment and mortality in patients with acute myocardial infarction undergoing primary coronary angioplasty. Am J Cardiol 2002;89: 1248–52.
7. Brodie BR, Stuckey TD, Wall TC, et al. Importance of time to reperfusion for 30-day and late survival and recovery of left ventricular function after primary angioplasty for acute myocardial infarction. J Am Coll Cardiol 1998;32:1312–9.
8. Cannon CP, Gibson CM, Lambrew CT, et al. Relationship of symptom-onset-to-balloon time and door-to-balloon time with mortality in patients undergoing angioplasty for acute myocardial infarction. JAMA 2000;283:2941–7.
9. Berger PB, Ellis SG, Holmes DR Jr., et al. Relationship between delay in performing direct coronary angioplasty and early clinical outcome in patients with acute myocardial infarction: results from the Global Use of Strategies to Open Occluded Arteries in Acute Coronary Syndromes (GUSTO-IIb) trial. Circulation 1999;100:14–20.
10. Brodie BR, Stone GW, Morice MC, et al. Importance of time to reperfusion on outcomes with primary coronary angioplasty for acute myocardial infarction (results from the Stent Primary Angioplasty in Myocardial Infarction Trial). Am J Cardiol 2001;88:1085–90.
11. Zijlstra F, Patel A, Jones M, et al. Clinical characteristics and outcome of patients with early (<2 h), intermediate (2–4 h) and late (>4 h) presentation treated by primary coronary angioplasty or thrombolytic therapy for acute myocardial infarction. Eur Heart J 2002;23:550–7.
12. . Bradley EH, Curry LA, Webster TR, Mattera JA, Roumanis SA, Radford MJ, McNamara RL, Barton BA, Berg DN, Krumholz HM. Achieving rapid door-to-balloon times: how top hospitals improve complex clinical systems. Circulation 2006: 113(8): 1079–1085
13. Nestler DM, Noheria A, Haro LH, Stead LG, Decker WW, Scanlan-Hanson LN, Lennon RJ, Lim CC, Holmes DR Jr, Rihal CS, Bell MR, Ting HH. Sustaining improvement in doorto-balloon time over 4 years: The Mayo Clinic ST-Elevation Myocardial Infarction Protocol. Circ Cardiovasc Qual Outcomes. 2009: 2(2):116–122
14. Scholz H, Hilgers R, Ahlersmann D, Duwald H, Nitsche R, von Knobelsdorff G, Volger B, Mo¨ller K, Keating FK. Contactto-balloon time and door-to-balloon time after initiation of a formalized data feedback in patients with acute ST-elevation myocardial infarction. Am J Cardiol 2008:101(1):46–52
15. Sivagangabalan G, Ong AT, Narayan A, Sadick N, Hansen PS, Nelson GC, Flynn M, Ross DL, Boyages SC, Kovoor P. Effect of prehospital triage

on revascularization times, left ventricular function and survival in patients with ST-elevation myocardial infarction. Am J Cardiol 2009:103(7):907–912
16. Van de Loo A, Saurbier B, Kalbhenn J, Koberne F, Zehender M. Primary percutaneous coronary intervention in acute myocardial infarction: direct transportation to catheterization laboratory by emergency teams reduces door-to-balloon time. Clin Cardiol 2006:29(3):112–116
17. Bradley EH, Nallamothu BK, Curtis JP, Webster TR, Magid DJ, Granger CB, Moscucci M, Krumholz HM. Summary of evidence regarding hospital strategies to reduce door-to-balloon times for patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. Crit Pathw Cardiol 2007:6(3):91–97
18. Manari A, Ortolani P, Guastraroba P, Casella G, Vignali L, Varani E, Piovaccari G, Guiducci V, Percoco G, Tondi S, Passerini F, Santarelli A, Marzocchi A. Clinical impact of an interhospital transfer strategy in patients with ST-elevation myocardial infarction undergoing primary angioplasty: the Emilia-Romagna ST-segment elevation acute myocardial infarction network. Eur Heart J 2008:29(15):1834–1842.
19. 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;343:311–22.
20. Newby LK, Rutsch WR, Califf RM, et al. Time from symptom onset to treatment and outcomes after thrombolytic therapy. GUSTO-1 Investigators. J Am Coll Cardiol 1996;27:1646–55.
21. Goldberg RJ, Mooradd M, Gurwitz JH, et al. Impact of time to treatment with tissue plasminogen activator on morbidity and mortality following acute myocardial infarction (the Second National Registry of Myocardial Infarction). Am J Cardiol 1998;82:259–64.
22. Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto Miocardico. GISSI-2: a factorial randomised trial of alteplase versus streptokinase and heparin versus no heparin among 12,490 patients with acute myocardial infarction. Lancet 1990;336:65–71.
23. The European Myocardial Infarction Project Group. Prehospital thrombolytic therapy in patients with suspected acute myocardial infarction. N Engl J Med 1993;329:383–9.
24. Schomig A, Ndrepepa G, Mehilli J, et al. Therapy-dependent influence of time-to-treatment interval on myocardial salvage in patients with acute myocardial infarction treated with coronary acute stenting or thrombolysis. Circulation 2003; 108: 1084–8.
25. Gallouo, M., Tsikambu, A. C. D., Alafifi, M., Alafifi, R., Boucbhareb, E. M., Benghanem, M., Moataz, A., Dakir, M., Debbagh, A., & Aboutaieb, R. Anuria: Causes and Mangement in Casablanca. Journal of Medical Research and Health Sciences, 2022:5(5), 1986–1993.
26. Luepker RV, Raczynski JM, Osganian S, et al. Effect of a community intervention on patient delay and emergency medical service use in acute coronary heart disease: the Rapid Early Action for Coronary Treatment (REACT) trial. JAMA 2000;284:60–7