

# A Retrospective Analysis of Door-to-Balloon Time and Its Determinants in STEMI Patients

## ABSTRACT

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**Aims:** Door-to-balloon time directly impacts the prognosis of STEMI patients, reducing d-to-b time and early reperfusion is essential in STEMI treatment. Hence, our study aims to determine the factors that prolong door-to-balloon time.

**Study Design:** This is a retrospective study.

place and duration of study: department of Cardiology, Aster Ramesh Hospitals, Vijayawada, India.

**Methodology:** The study included patients arriving at the emergency department diagnosed with STEMI and underwent angioplasty. The study employed a pre-designed data collection form covering demographic data, past medical history, the time when the patient entered the emergency department (ed), the first ECG time, door-to-balloon time, and why the door-to-balloon time was delayed.

**Results:** a total of 170 patient's data was collected, of these, 75% were male and 25% were female. The mean door-to-balloon time (D-to-B) was 2 hours, 29 minutes. subjects were divided into group I (DTBT  $\leq 90$  min, n=90), group II (DTBT 91-120 min, n=40), group III (DTBT 121-180 min, n=22), and group IV (DTBT  $> 180$  min, n=18). among the patients whose DTB  $> 90$  min, 31% of the delays were due to difficulty in assimilating and understanding the severity of the disease, 30% wanted to take a second opinion, 29% were delayed due to financial issues, and 10% were having problems with hemodynamic abnormalities that prevent rapid management in the cath lab (e.g., an active source of sepsis).

**Conclusion:** for patients, a DTB time of 90 minutes can be attained with efficient hospital strategies. difficulty in assimilating and understanding the severity of the disease is the primary cause of the DTB time delay in this study. Socioeconomic and cultural barriers adversely affect the door to balloon time in diverse countries like India. public awareness campaigns nationwide about common medical emergencies and their solutions may favourably improve treatment in the golden hour.

*Keywords: Angioplasty, door-to-balloon time, factors affecting DBT, ST-elevation myocardial infarction.*

## 1. INTRODUCTION

The prevalence of cardiovascular disease in India has reached epidemic proportions. the probability of ischemic heart disease is four times higher in urban Indians than in Americans. India has a higher burden of CAD, especially in the younger population than the West, resulting in a decreased valuable life span. previous studies showed that 50% of males affected by ischemic heart disease are under the age of 50, and 25% occur in men under the age of 40. [1] the CREATE registry has made clear crucial aspects of ST-elevation MI (STEMI) management. STEMI is more common (60.6%) and

more deadly (8.6%) in the Indian population than in developed countries. these statistics call for stringent and effective STEMI treatment protocols. [2]

despite significant progress in medical technology in recent years, acute coronary syndrome (ACS) continues to pose a challenge for healthcare professionals. it is of two types: non-st segment elevation acute myocardial infarction (NSTEMI) and st-segment elevation myocardial infarction (STEMI). prompt reperfusion therapy can achieve and sustain normal blood perfusion in myocardial tissue, lower the risk of heart failure, and minimize the size of infarcts. [3–4] Additionally, in patients with new-onset left bundle branch block and STEMI that occurred within 12 hours of continuous ST-segment elevation, it can inhibit left-ventricular remodeling and prevent infarct expansion. [5-6]

percutaneous coronary intervention (PCI) has thus emerged as a significant and successful reperfusion treatment in STEMI patients. The door-to-balloon (d-to-b) time directly correlated with the prognosis of STEMI patients following their initial PCI. As a result, the D-to-B time reduction and the ratio of increase in early reperfusion are the most important requirements for STEMI patient treatments. [7–8] The time between a patient entering the hospital and the first balloon dilatation (angioplasty) is called door-to-balloon time. according to aha/acc treatment guidelines, DBT should be within 90 minutes in STEMI patients. [9]

the present study aims to determine the factors that prolong door-to-balloon time.

## 2. MATERIAL AND METHODS

### 2.1 Study Design:

This is a retrospective study including patients arriving at the emergency department and diagnosed with STEMI and underwent angioplasty. This study was approved by the Institutional Ethics Committee (ECRH042024).

### 2.2 Study Site and Sample Size:

The study was conducted at a tertiary cardiac hospital in a tier II town in Vijayawada, south India. A total of 170 patient's data was collected.

### 2.3 Study tools:

A pre-designed data collection form was made for this research. Patient records were systematically reviewed to extract data such as demographic information including their admission details, past medical history, the time when the patient entered the Emergency Department (ED), the first ECG time, door-to-balloon time, and why the door-to-balloon time was delayed.

### 2.4 Statistical analysis:

The data collection process involved using a pre-designed data collection form and the subsequent recording of responses in spreadsheet format. A thorough error check was conducted to ensure data accuracy. The data was subject to descriptive analysis using cross-tabulation in IBM SPSS Statistics, Version 29.

## 3. RESULTS AND DISCUSSION

### RESULTS

During the study period, 170 patient data were collected. Among them, 75 % were male participants, and 25% were female participants, with a mean age of 57.4 years. Subjects were divided into group I (DTBT  $\leq$ 90 min, n=90), group II (DTBT 91-120 min, n=40), group III (DTBT 121-180 min, n=22), and group IV (DTBT >180 min, n=18). At the time of admission, 29.4% of patients had type 2 diabetes mellitus, and 23.5% of patients had hypertension. Before being admitted to the hospital, 7% of patients did not know they had high blood pressure, and 6% did not know they had diabetes (Table 1, Table 2).

**Table 1. Baseline demographic and clinical characteristics of the study group.**

Characteristic	Number (%)
Age (mean) years +SD	57.4 $\pm$ 11.6
Male	127 (75)

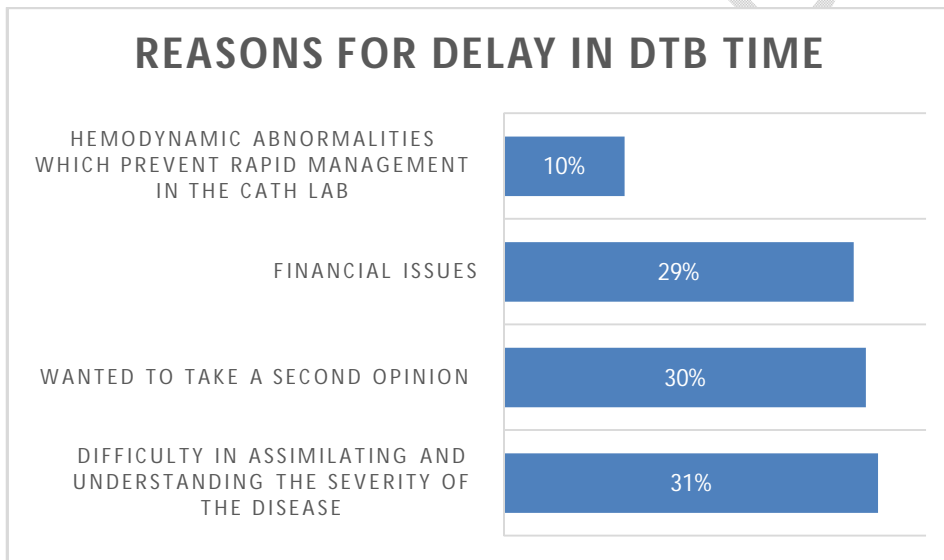
Female	43 (25)
Hypertension	52 (30.5)
Diabetes mellitus	60 (35.2)
Expired Patients	5 (2.9)

**Table 2: Door-to-balloon time in males and females**

S.NO	Parameters	Group I	Group II	Group III	Group IV
1.	Males	70	29	14	14
2.	Females	20	11	8	4

The mean time to ECG is 3 minutes and 24 seconds (SD 0.0007). The average D-to-B time was 2 hours 29 minutes. Among the D-to-B >90 min group, 31% of the delays were due to difficulty in assimilating and understanding the severity of the disease, 30% wanted to take a second opinion, and 29% delayed due to D-to-B financial issues. Ten percent had hemodynamic abnormalities, preventing rapid management in the Cath lab (e.g., an active source of sepsis) (Fig. 1).

**Figure 1. Reasons for delay in DTB time**



## DISCUSSION

Numerous studies have shown that the probability of death in acute MI decreases with less DTB time [13, 20]. To minimize DTB time as much as possible, integrated teamwork, realistic goals, and committed compliance are needed [21]. Multiple randomized clinical trials suggested thrombolysis and primary PCI as treatments for STEMI [10, 11]. Data from twenty-three randomized trial results show that those who underwent PPCI have less chance of getting nonfatal re-infarction, heart attack, and short-duration mortality than thrombolysis cases in STEMI patients [12]. Studies have shown the importance of shorter door-to-balloon (DTB) times in the management of STEMI [13, 14].

Though the American College of Cardiology/American Heart Association (ACC/AHA) criteria concerning managing STEMI patients suggest door-to-balloon intervals of 90 minutes or less [15], barely a minority of patients are currently treated within this time frame, and this pattern has not changed recently. There is widespread agreement that shorter First Medical Contact (FMC) and door-to-balloon times result in a better prognosis, as shown by Menees et al. Door-to-balloon time of 55 minutes is associated with higher survival, the findings provide indirect evidence of the impact of the quality

enhancement intervention on survival. In a multivariate Cox model, older age, lower TIMI flow at the end of PPCI, and an ejection fraction of 45% were also identified as predictive of death [16].

Recent research indicates that an increasing number of elderly patients, particularly women with various comorbidities, and a longer pre-hospital stay may counteract the advantages of early reperfusion. [17, 18].

A Korean patient sample with a median of 2 hours from the beginning of myocardial ischemia symptoms to the hospital door showed a significant improvement in survival at 1 year when the door-to-balloon time shortened [19]. Furthermore, even after three years, less than 90-minute D2B time was associated with a higher survival rate in anterior wall STEMI [20].

The findings suggest that, as there aren't many unavoidable scenarios, the DBT of a 90-minute goal can be achieved. In the present study, Subjects were divided into group I (DTBT  $\leq$ 90 min, n=90), group II (DTBT 91-120 min, n=40), group III (DTBT 121-180 min, n=22), and group IV (DTBT >180 min, n=18). In our study, 60% of patients achieved door-to-balloon time within the suggested time frame.

The main cause for increasing DTB time was a delay in obtaining patient consent and financial reasons reported by Suma M. Victor et al. In our study, difficulty in assimilating and understanding the severity of the disease (31%) was the primary contributor to the increased D-to-B time.

In our study among the DTB > 90-minute group, 31% of the delays were due to difficulty assimilating and understanding the severity of the disease, 30% wanted to take a second opinion, and 29% were delayed due to financial issues.

The Centres for Medicare & Medicaid Services (CMS) conducted a study from 2005 to 2010, which included patients from nine hundred hospitals this study results showed that the DBT time in America decreased from 96 to 64 minutes [22]. The average DTB time was 2 hours, and 29 minutes in the present study.

#### **4. CONCLUSION**

For Patients, a DTB time of 90 minutes can be attained with efficient hospital strategies. difficulty in assimilating and understanding the severity of the disease is the primary cause of the DTB time delay in this study. Socio-economic and cultural barriers adversely affect the door to balloon time in diverse countries like India. Public awareness campaigns nationwide about common medical emergencies and their solutions may favourably improve treatment in the golden hour.

#### **CONSENT (WHEREEVER APPLICABLE)**

Not Applicable

#### **ETHICAL APPROVAL (WHEREEVER APPLICABLE)**

This study was approved by the Institutional Ethics Committee (ECRH042024).

#### **REFERENCES**

1. Enas EA, Senthilkumar A. Coronary artery disease in Asian Indians: an update and review. *Int J Cardiol.* 2001;1(2).
2. Xavier D, Pais P, Devereaux PJ. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. *Lancet.* 2008;371(9622):1435e1442.
3. Paolasso E, Martin ES, Ravizzini G, Díaz R, Covelli G, Romero G, et al. Randomized trial of late thrombolysis in patients with suspected acute myocardial infarction. *Lancet.*

4. Hampton J, Wilcox R, Armstrong P, Aylward P, Bett N, Charbonnier, B et al. Late Assessment of Thrombolytic Efficacy (LATE) study with alteplase 6-24 hours after onset of acute myocardial infarction. *Lancet*. 1993; 342: 759-66.
5. Yang KC, Yamada KA, Patel AY, Topkara VK, George I, Cheema FH, et al. Deep RNA sequencing reveals dynamic regulation of myocardial noncoding RNAs in failing human heart and remodeling with mechanical circulatory support. *Circulation*. 2014; 129: 1009-21.
6. Kitabata H, Kubo T, Ishibashi K, Komukai K, Tanimoto T, Ino Y, et al. Prognostic value of microvascular resistance index immediately after primary percutaneous coronary intervention on left ventricular remodeling in patients with reperfused anterior acute ST-segment elevation myocardial infarction. *JACC Cardiovasc Interv*. 2013; 6: 1046-54
7. Bradley EH, Herrin J, Wang Y, Barton BA, Webster TR, et al. Strategies for reducing the door-to-balloon time in acute myocardial infarction. *N Engl J Med*. 2006; 355: 2308-2
8. Andersen HR, Nielsen TT, Rasmussen K, Thuesen L, Kelbaek H, Thayssen P, et al. A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. *N Engl J Med*. 2003; 349: 733-42.
9. Kushner FG, Hand M, Smith SC Jr, King SB 3rd, Anderson JL, Antman EM, et al. 2009 Focused Updates: ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction (updating the 2004 Guideline and 2007 Focused Update) and ACC/AHA/SCAI Guidelines on Percutaneous Coronary Intervention (updating the 2005 Guideline and 2007 Focused Update): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2009; 120: 2271-306.
10. Antman EM, Hand M, Armstrong PW. 2007 Focused update of the ACC/AHA 2004 guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2008;51:210e247.
11. Silber S, Albertsson P, Fernandez-Aviles. Guidelines for percutaneous coronary interventions. The task force for percutaneous coronary interventions of the European Society of Cardiology. *Eur Heart J*. 2005;26:804e847.
12. Mullasari Ajit. Strategy of in-ambulance thrombolysis followed by routine PCI in acute myocardial infarction. *Indian Heart J*. 2009;61:448e453.
13. Rathore SS, Curtis JP, Chen. 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.
14. McNamara RL, Wang Y, Herrin J. Effect of door-to-balloon time on mortality in patients with ST-segment elevation myocardial infarction. *J Am Coll Cardiol*. 2006;47:2180e2186.
15. Ryan TJ, Antman EM, Brooks NH, Califf RM, Hillis LD, Hiratzka LF, et al. 1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction: executive summary and recommendations: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *Circulation*. 1999 Aug 31;100(9):1016-30.
16. Menees DS, Peterson ED, Wang Y, Curtis JP, Messenger JC, Rumsfeld JS et al. . Door-to-balloon time and mortality among patients undergoing primary PCI . *N Engl J Med* 2013; 369: 901–909.
17. Sutton NR, Gurm HS. Door to balloon time: is there a point that is too short? *Prog Cardiovasc Dis* 2015;58:230–240
18. Basheer Karkabi, Gal Meir, Barak Zafirir, Ronen Jaffe, Salim Adawi, Idit Lavi, et al. *European Heart Journal - Quality of Care and Clinical Outcomes*. 2021;7(4):422–26
19. Juliard JM, Golmard JL, Himbert D, Feldman LJ, Delorme L, Ducrocq G, et al. Comparison of hospital mortality during ST-segment elevation myocardial infarction in the era of reperfusion therapy in women versus men and in older versus younger patients. *Am J Cardiol* 2013;111:1708–1713.

20. Murphy AC, Yudi MB, Farouque O, Dinh D, Duffy SJ, Brennan A, et al. Melbourne Interventional Group. Impact of gender and door-to-balloon times on long-term mortality in patients presenting with ST-elevation myocardial infarction. *Am J Cardiol* 2019;124:833–84.
21. Suma M. Victor, Door-to-balloon: Where do we lose time? Single-center experience in India.
22. Delays at Hospitals Referring STEMI Patients to PCI Centers Take Spotlight [Heart Wire]. 2011.

## **DEFINITIONS, ACRONYMS, ABBREVIATIONS**

### **LIMITATIONS:**

The limitation of the present study is the small sample size, we are planning to conduct a larger study based on this study and launch a public campaign to increase awareness in seeking timely reperfusion therapy in acute coronary syndrome.

### **ABBREVIATIONS:**

D-to-B: Door to balloon Time

ECG- Electrocardiogram

AMI- (Acute Myocardial Infarction)

NSTEMI: non-ST segment elevation acute myocardial infarction (NSTEMI)

STEMI: ST-segment elevation myocardial infarction (STEMI)

PCI: Percutaneous Coronary Intervention

ACC/AHA: American College of Cardiology and American Heart Association

CAD- (coronary artery disease)

MI-Myocardial Infarction

PPCI (Primary Percutaneous Coronary Intervention)

TIMI: Thrombolysis in Myocardial Infarction

CCU: coronary care unit

FMC: First Medical Contact