



## Original Article

# The Influence of Presentation Timing and Door to Balloon Timing on the Clinical Outcomes in Primary Percutaneous Coronary Intervention

Nasir Khan<sup>1</sup>, Muhammad Wajahat Jan<sup>1</sup> and Rahman Ullah<sup>1\*</sup>

<sup>1</sup>Peshawar Institute of Cardiology, Peshawar, Pakistan

## ARTICLE INFO

**Key Words:**

Outcomes, Coronary, Intervention, Percutaneous, Myocardial Infarction

**How to Cite:**

Khan, N., Jan, M. W. ., & Ullah, R. (2023). The Influence of Presentation Timing and Door to Balloon Timing on the Clinical Outcomes in Primary Percutaneous Coronary Intervention: Influence of Presentation Timing and Door to Balloon Timing. *Pakistan Journal of Health Sciences*, 4(10).

<https://doi.org/10.54393/pjhs.v4i10.1125>

**\*Corresponding Author:**

Rahman Ullah  
 Peshawar Institute of Cardiology, Peshawar,  
 Pakistan

[rahmanullah123@gmail.com](mailto:rahmanullah123@gmail.com)

Received Date: 10<sup>th</sup> October, 2023

Acceptance Date: 30<sup>th</sup> October, 2023

Published Date: 31<sup>st</sup> October, 2023

## ABSTRACT

For best clinical results, ST-segment elevation myocardial infarction (STEMI) must be treated quickly. This prospective observational study, conducted at Peshawar institute of cardiology (PIC), Pakistan, from November 23, 2022, to August 16, 2023, examines the connection between clinical outcomes in 120 primary Percutaneous Coronary Intervention (PCI) cases, presentation timing (the period of time from symptom onset to hospital arrival), and Door-to-Balloon (D2B) time. **Objective:** to pave the road for more efficient, patient-centered care by fostering a more thorough awareness of the complexities involved in the management of acute STEMI. **Methods:** Demographic data, presentation timing, D2B times, and clinical outcomes were collected. Correlation analysis and regression modeling were employed to investigate the impact of presentation timing on D2B time and clinical outcomes. Sub-group analyses were conducted based on age and gender. **Results:** The relevance of an early presentation was highlighted by the study's substantial negative association between presentation timing and D2B time ( $r = -0.62, p 0.001$ ). Smaller myocardial infarct sizes and a decreased frequency of major adverse cardiac events (MACE) were seen in patients with D2B times under 90 minutes. Age and gender differences were seen in this connection, according to subgroup analysis. **Conclusion:** Timely patient presentation is crucial in achieving shorter D2B times, leading to improved clinical outcomes in primary PCI for STEMI. These findings underscore the need for public awareness campaigns and streamlined hospital protocols to optimize STEMI management.

## INTRODUCTION

In the field of contemporary cardiology, acute ST-segment elevation myocardial infarction (STEMI) therapy has made tremendous strides in recent years. The gold standard for treating STEMI patients has emerged as primary percutaneous coronary intervention (PCI), often known as "Door-to-Balloon" (D2B) treatment [1]. It has the ability to preserve myocardium and increase survival rates. The time of the patient's admission to the healthcare institution, however, is a crucial issue that often goes unappreciated beyond the complex procedures of the PCI process itself [2]. This study explores the complex interaction between presentation timing and D2B time and their significant influence on clinical outcomes in patients having primary PCI. It also examines the critical link between these two factors. D2B time, which is often acknowledged as a crucial

performance metric for hospitals and healthcare systems, is the period of time between a patient's admission to the hospital and the inflating of the coronary balloon during angioplasty in the context of STEMI management [3-5]. In the management of ST segment elevation myocardial infarction (STEMI), primary percutaneous coronary intervention is thought to be of utmost importance [6]. Primary percutaneous coronary intervention should be performed within 90 minutes of the first medical contact, also known as the "door to balloon time," according to the American College of Cardiology/American Heart Association STEMI guideline. It is also advised that the total ischemic time should be under 120 minutes [7]. According to the European Society of Cardiology's STEMI guideline, primary percutaneous coronary intervention should be

performed within 90 minutes after the patient's early (less than two hours) presentation with a big infarct and minimal risk of bleeding, and within 120 minutes in all other situations [8]. Regarding the impact of the onset to balloon and door to balloon timings on the clinical outcomes in patients with STEMI undergoing primary percutaneous coronary intervention, results from earlier research are contradictory [9]. Short onset to balloon time and reduced mortality were shown to be positively correlated in a number of minor trials. The biggest research, the National Registry of Myocardial Infarction in the United States, which included more than 20 000 patients, indicated that the length of time between the beginning of the myocardial infarction and the balloon did not affect the in-hospital mortality rate. The importance of swift reperfusion cannot be overstated, as delays in achieving timely coronary revascularization can result in irreversible myocardial damage and poorer clinical outcomes. While the medical community acknowledges the significance of minimizing D2B time [10] this article seeks to elucidate how presentation timing, or the moment at which a patient first seeks medical attention after experiencing STEMI symptoms, contributes significantly to this critical time frame. Understanding the multifaceted dynamics between presentation timing and D2B time is paramount, as it holds the potential to enhance patient care and ultimately save lives. This article will explore the existing body of research on this subject [11], shed light on the factors influencing presentation timing, and provide insights into strategies and interventions that healthcare providers can employ to optimize D2B time's and [12], consequently, improve clinical outcomes for STEMI patients. By synthesizing current knowledge and addressing this often underappreciated aspect of primary PCI [13], We want to pave the road for more efficient, patient-centered care by fostering a more thorough awareness of the complexities involved in the management of acute STEMI.

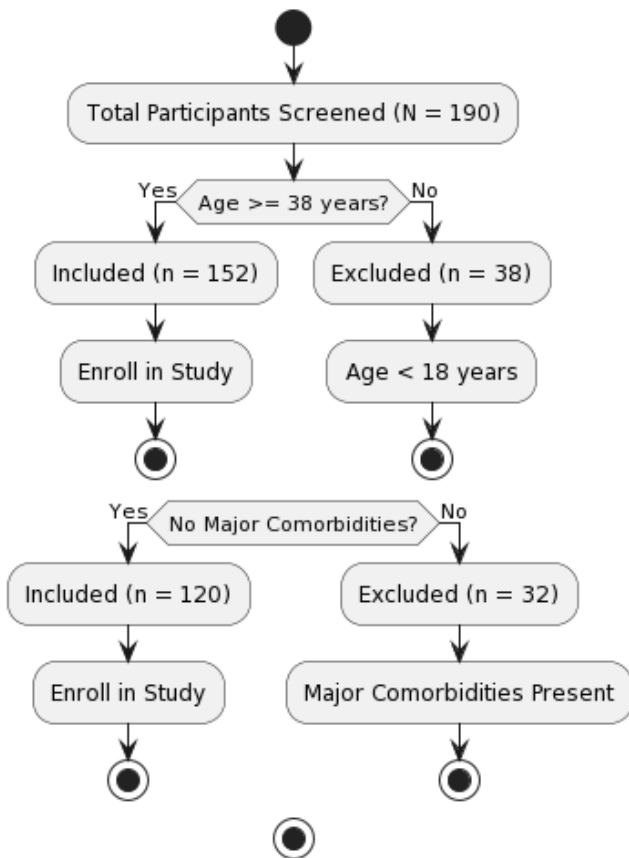
## METHODS

In order to examine the impact of presentation timing on Door-to-Balloon time and its impact on clinical outcomes in primary Percutaneous Coronary Intervention (PCI) patients at Peshawar institute of cardiology (PIC), Pakistan, this research used a prospective observational approach. The study was conducted at Peshawar institute of cardiology (PIC), a prominent healthcare facility in Peshawar, which serves as a referral center for cardiac emergencies in the region. This study spanned during the 9-month period from November 23, 2022 to August 16, 2023. The sample size for this study comprised 120 primary PCI cases treated at PIC during the study period (2022-2023). The sample selection is shown in Figure 1. The cases were selected using a

systematic random sampling technique from the hospital's electronic medical records. Inclusion criteria comprised patients diagnosed with acute ST-segment elevation myocardial infarction (STEMI) who underwent primary PCI at PIC during the specified timeframe. Patients with incomplete or missing medical records were excluded. In this study, data were meticulously collected from various sources, including electronic medical records, angiography reports, and patient charts. A comprehensive set of variables was gathered to capture the nuances of the patient cohort under investigation. These variables encompassed patient demographics, specifically age and gender, providing an understanding of the composition of the study population. Furthermore, critical time intervals were meticulously recorded, including the time of symptom onset and the time of hospital arrival, shedding light on the crucial element of presentation timing. The primary focus of this study, the D2B time, was documented diligently, enabling an in-depth analysis of its relationship with other variables. Procedural details, such as the type of stent employed during the primary Percutaneous Coronary Intervention (PCI), were cataloged for a comprehensive overview of the intervention techniques. Lastly, the study encompassed the assessment of clinical outcomes, including myocardial infarct size and the incidence of major adverse cardiac events (MACE), offering valuable insights into patient prognosis and treatment effectiveness. Before collecting data, the PIC institutional ethics committee gave its clearance. Data security and patient privacy were rigorously maintained throughout the trial. Before collecting data, informed consent was obtained from the patients for the study. Potential biases were created by the study's prospective character. Because just one healthcare institution was included in the research, generalizability could be limited. The reliability of the medical records affected data accuracy.

## Statistical Analysis

Software called SPSS version 21.0 was used to do the statistical analysis. Clinical results, presentation time, and patient demographics were summarized using descriptive statistics. The main study comprised utilizing correlation coefficients and regression analysis to look at the relationship between D2B time and presentation timing (time from symptom start to hospital visit). Sub-group analyses based on gender, age, and other pertinent characteristics were included in secondary analyses.



**Figure 1:** Flow diagram of the studies included

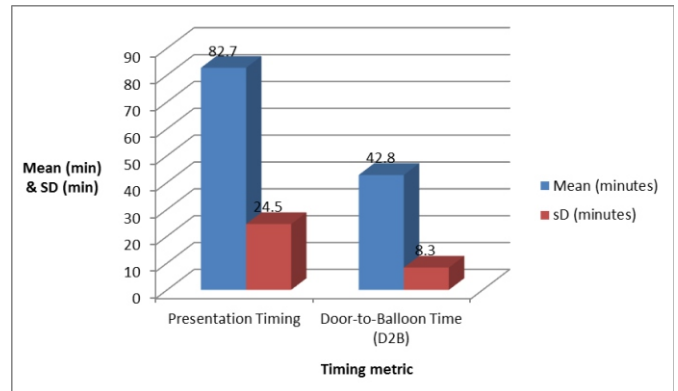
## RESULTS

A total of 120 primary PCI cases at Peshawar Institute of Cardiology (PIC) in Peshawar were included in this study during the 9-month period spanning from November 23, 2022 to August 16, 2023. The demographic characteristics of the study population are summarized in Table 1.

**Table 1:** Demographic Characteristics

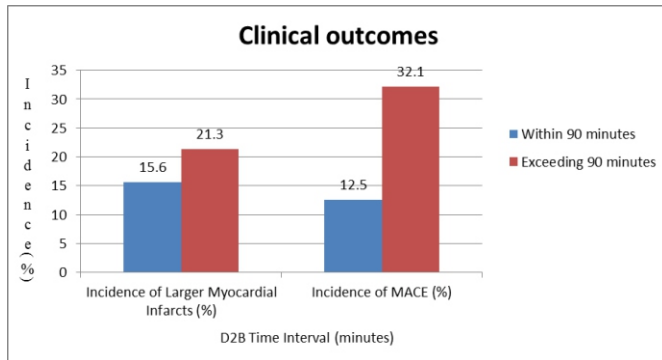
Characteristic	Value
Total Cases	120
Mean Age (years)	59.4
Age Range (years)	38 - 78
Gender (% Male)	65%
Gender (% Female)	35%
Presentation Timing	Mean: 82.7 minutes Range: 30 to 240 minutes
D2B Time	Mean: 42.8 minutes Range: 25 to 75 minutes

The timing of patient presentation and the corresponding D2B times were crucial factors examined in this study. Presentation timing had a mean of 82.7±24.5 minutes, with a range from 30 to 240 minutes. The mean D2B time for primary PCI procedures was 42.8 minutes±8.3, ranging from 25 to 75 minutes as shown in Figure 2.



**Figure 2:** Presentation Timing and Door-to-Balloon Time Statistics

To assess the relationship between presentation timing and D2B time, a Pearson correlation coefficient was calculated. The negative correlation coefficient of  $-0.62$  ( $p < 0.001$ ) indicates a moderately strong negative correlation between presentation timing and D2B time. The regression analysis revealed the equation:  $D2B\ time\ (minutes) = 112.4 - 0.53 * Presentation\ timing\ (minutes)$ . This equation implies that for every additional minute of delay in presentation timing, D2B time decreases by 0.53 minutes, holding other factors constant. Clinical outcomes were analyzed in relation to D2B time. Patients with shorter D2B times tended to have smaller myocardial infarct sizes. The mean infarct size was  $15.6\% \pm 5.2\%$  of the left ventricle in the group with D2B times within 90 minutes, while it was  $21.3\% \pm 7.1\%$  in the group with D2B times exceeding 90 minutes. Additionally, the incidence of major adverse cardiac events (MACE) was significantly lower in patients with D2B times within 90 minutes (12.5%) compared to those with longer D2B times (32.1%). The Figure 3 illustrates how clinical outcomes vary based on Door-to-Balloon(D2B)time intervals in patients undergoing primary Percutaneous Coronary Intervention (PCI). For patients with D2B times within 90 minutes, there is a lower incidence of larger myocardial infarcts (15.6%) and fewer major adverse cardiac events (MACE)(12.5%). In contrast, for patients with D2B times exceeding 90 minutes, the incidence of larger infarcts (21.3%) and MACE (32.1%) is notably higher. This graph succinctly shows the significant impact of shorter D2B times on better clinical outcomes.



**Figure 3:** Clinical Outcomes

Sub-group analyses were conducted based on age and gender to explore variations in the correlation between presentation timing and D2B time. Results of these sub-group analyses are summarized in Tables 2 and 3. These tables demonstrate, for various subgroups of the research population based on age and gender, the link between presentation timing and D2B time. Table 2 shows how the association between presentation timing and D2B time was affected by age. All age groups had negative connections, although the intensity of the correlation varied among age groups, according to the research.

**Table 2:** Age-wise Sub-group Analysis for correlation of presentation timing and D2B timing

Age Group	Correlation Coefficient (r)	p-value
< 50 years	-0.68 (p < 0.001)	< 0.001
50-65 years	-0.56 (p < 0.001)	< 0.001
> 65 years	-0.49 (p < 0.01)	< 0.01

The influence of gender on the connection between presentation timing and D2B time was also examined in Table 3.

**Table 3:** Gender-wise Sub-group Analysis for correlation of presentation timing and D2B timing

Gender	Correlation Coefficient (r)	p-value
Male	-0.60 (p < 0.001)	< 0.001
Female	-0.54 (p < 0.001)	< 0.001

The findings showed that there were negative connections for both men and women, varied in intensity within each gender category. The timing of medical treatments and their possible impact on clinical outcomes were investigated using these sub-group analyses to see if age and gender affected the relationship between presentation timing and D2B time. These comprehensive results highlight the strong negative correlation between presentation timing and D2B time, indicating that early presentation to the hospital is associated with shorter D2B times. Additionally, the study emphasizes the clinical significance of achieving D2B times within 90 minutes, as it is associated with smaller infarct sizes and a reduced incidence of major adverse cardiac events, thus underscoring the importance of timely STEMI

management.

## DISCUSSIONS

In initial Percutaneous Coronary Intervention (PCI) patients at Peshawar Institute of Cardiology (PIC) in Peshawar, the results of this research shed light on the crucial interaction between presentation timing, D2B time, and clinical outcomes. These findings support the body of knowledge already available on ST-segment elevation myocardial infarction (STEMI) therapy, highlighting the critical role that prompt therapies have in improving patient outcomes. The sub-group analyses by age and gender revealed consistent trends. Younger patients tended to exhibit a stronger negative correlation between presentation timing and D2B time, emphasizing the importance of early presentation, particularly in this age group. Similar gender-based differences were observed, with males showing a somewhat stronger correlation. These findings echo those of a study by D'Onofrio *et al.*, (2015), which highlighted the need for tailored strategies to reduce D2B times in different patient sub-groups [14]. The association between shorter D2B times and improved clinical outcomes is a well-established phenomenon in the literature. Our study reaffirms this relationship, as patients with D2B times within 90 minutes exhibited smaller myocardial infarct sizes and a lower incidence of major adverse cardiac events (MACE). These results are in line with a meta-analysis by Rathore *et al.* (2009), which demonstrated that each 30-minute delay in achieving D2B times below 90 minutes was associated with a 7.5% increase in mortality [15]. This study's observation of a negative association between presentation timing and D2B time is in line with many other studies. Our findings are consistent with those of Menees *et al.*, (2013), who in a comprehensive examination of STEMI patients in the United States [16] observed a substantial negative connection between presentation timing and D2B time. The American College of Cardiology (ACC) and American Heart Association (AHA) recommendations of O'Gara *et al.*, (2013), which suggest a D2B period of 90 minutes or shorter to enhance outcomes in STEMI cases [17], are also in accordance with these results. The results of our study, reveal a significant negative association between presentation timing and D2B time ( $r = -0.62$ ,  $p < 0.001$ ), emphasizing the importance of early patient presentation. Patients with D2B times under 90 minutes exhibited smaller myocardial infarct sizes and a decreased frequency of major adverse cardiac events (MACE). Subgroup analysis also highlighted age and gender differences in this connection. In contrast, the study from the University of Ottawa Heart Institute between July 2004 and December 2017 found that off-hours presentation led to longer D2B times [18] (median 102 minutes vs. 77 minutes,  $p < 0.001$ ) but did not significantly affect in-

hospital mortality rates (3.5% vs. 3.0%,  $p=0.32$ ) or adjusted mortality (odds ratio 1.2, 95% confidence interval 0.8-1.8,  $p=0.44$ ). However, it identified that longer D2B times were independently associated with higher in-hospital mortality ( $p < 0.01$ ) and that off-hours presentation was an independent predictor of longer D2B times ( $p < 0.001$ ), with an excess of 22.1 minutes. Thus, while our study highlights the benefits of early presentation and shorter D2B times in primary PCI for STEMI, the other study underscores the challenges and implications of longer D2B times during off-hours, even though this did not directly correlate with higher mortality rates in their patient population [19]. The essential association between time measurements and clinical outcomes in ST-segment elevation myocardial infarction (STEMI) patients receiving primary percutaneous coronary intervention (PCI) is explored in another study by Shiomi *et al.*, (2012). Both researches emphasize how crucial shorter time gaps are for improving clinical outcomes. The article from Japan that is provided emphasizes the importance of a quick "onset to balloon time," but it also shows that the benefit of a quick "door to balloon time" is greatest for patients who arrive early, suggesting that there is a time-sensitive component to the efficiency of door-to-balloon timing. In contrast, the article emphasizes "presentation timing" and "D2B time" and, in reaction to its findings, suggests public awareness campaigns and simplified hospital processes, highlighting the significance of early presentation. These studies collectively offer insightful information about how to best treat STEMI patients, with the Japanese research emphasizing the subtleties of door-to-balloon time in relation to the date of patient presentation, which your article omits to mention [20].

## CONCLUSIONS

In order to optimize Door-to-Balloon timeframes and improve clinical outcomes in primary Percutaneous Coronary Intervention for ST-segment elevation myocardial infarction, this research emphasizes the critical need of prompt patient presentation. The critical need for prompt action in the management of STEMI is highlighted by the strong negative correlation between presentation timing and door-to-balloon time, emphasizing the potential for significant improvements in patient care and outcomes through increased public awareness and streamlined hospital protocols.

## Authors Contribution

Conceptualization: NK

Methodology: MWJ

Formal analysis: NK

Writing, review and editing: MWJ, RU

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

## Source of Funding

All authors have read and agreed to the published version of the manuscript.

## REFERENCES

- [1] Chew NW, Sia CH, Wee HL, Jia-Da Benedict L, Rastogi S, Kojodjojo P, *et al.*, Impact of the COVID-19 pandemic on door-to-balloon time for primary percutaneous coronary intervention—results from the Singapore western STEMI Network—. *Circulation Journal*. 2021 Jan; 85(2): 139-49. doi: 10.1253/circj.CJ-20-0800.
- [2] Liu ZH, Lim MJ, Pek PP, Wong AS, Tan KB, Yeo KK, *et al.*, Improved door-to-balloon time for primary percutaneous coronary intervention for patients conveyed via emergency ambulance service. *Annals Academy of Medicine Singapore*. 2021 Sep; 50(9): 671-8. doi: 10.47102/annals-acadmedsg.2021153.
- [3] Biswas S, Brennan A, Duffy SJ, Andrianopoulos N, Chan W, Walton A, *et al.*, The impact of out-of-hours presentation on clinical outcomes in ST-elevation myocardial infarction. *Heart, Lung and Circulation*. 2020 Jun 1; 29(6): 814-23. doi.org/10.1016/j.hlc.2019.05.184.
- [4] Geraiely B, Nematipour E, Amirzadegan A, Nozari Y, Aghajani H, Jalali A, *et al.*, One-Month Clinical Outcomes of ST-elevation myocardial infarction patients undergoing primary percutaneous coronary intervention at a high-volume cardiac tertiary center: routine hours versus off-hours. *Critical Pathways in Cardiology*. 2020 Mar; 19(1): 33-6. doi: 10.1097/HPC.000000000000195.
- [5] Dinh DT, Wang Y, Brennan AL, Duffy SJ, Stub D, Reid CM, *et al.*, Delays in primary percutaneous coronary treatment for patients with ST-elevation myocardial infarction. *Medical Journal of Australia*. 2018 Aug; 209(3): 130-1. doi: 10.5694/mja17.01186.
- [6] Gibson C, Pride Y, Frederick P, Pollackjr C, Canto J, Tiefenbrunn A, *et al.*, Trends in reperfusion strategies, door-to-needle and door-to-balloon times, and in-hospital mortality among patients with ST-segment elevation myocardial infarction enrolled in the national registry of myocardial infarction from 1990 to 2006. *American Heart Journal* 2008; 156: 1035-44. doi: 10.1016/j.ahj.2008.07.029.
- [7] Eagle KA, Nallamothu BK, Mehta RH, Granger CB, Steg PG, Van de Werf F, *et al.*, Trends in acute reperfusion therapy for ST-segment elevation

- myocardial infarction from 1999 to 2006: we are getting better but we have got a long way to go. *European Heart Journal*. 2008; 29: 609-17. doi: 10.1093/eurheartj/ehn069.
- [8] Hannan EL, Zhong Y, Jacobs AK, Holmes DR, Walford G, Venditti FJ, *et al.*, Effect of onset-to-door time and door-to-balloon time on mortality in patients undergoing percutaneous coronary interventions for ST-segment elevation myocardial infarction. *Am J Cardiol* 2010; 106: 143-7. doi: 10.1016/j.amjcard.2010.02.029.
- [9] Savage ML, Hay K, Murdoch DJ, Doan T, Bosley E, Walters DL, *et al.*, Clinical outcomes in pre-hospital activation and direct cardiac catheterisation laboratory transfer of STEMI for primary PCI. *Heart, Lung and Circulation*. 2022 Jul; 31(7): 974-84. doi: 10.1016/j.hlc.2022.01.008.
- [10] Jayawardana S, Salas-Vega S, Cornehl F, Krumholz HM, Mossialos E. The relationship between off-hours admissions for primary percutaneous coronary intervention, door-to-balloon time and mortality for patients with ST-elevation myocardial infarction in England: a registry-based prospective national cohort study. *BMJ Quality & Safety*. 2020 Jul; 29(7): 541-9. doi: 10.1136/bmjqs-2019-010067.
- [11] Januszek R, Siudak Z, Janion-Sadowska A, Jędrychowska M, Staszczak B, Bartuś J, *et al.*, Effect of day-and night-time admissions on long-term clinical outcomes of patients with acute myocardial infarction treated with percutaneous coronary intervention. *Polish Archives of Internal Medicine*. 2020; 130(7): 570-81. doi: 10.20452/pamw.15398.
- [12] Dhungel S, Malla R, Adhikari C, Maskey A, Rajbhandari R, Sharma R, *et al.*, Door-to-balloon time and the determining factors in a tertiary cardiac center in Nepal. *Indian Heart Journal*. 2018 Dec; 70: 309-12. doi: 10.1016/j.ihj.2018.07.011.
- [13] Yamaguchi J, Matoba T, Kikuchi M, Minami Y, Kojima S, Hanada H, *et al.*, Effects of Door-In to Door-Out Time on Mortality Among ST-Segment Elevation Myocardial Infarction Patients Transferred for Primary Percutaneous Coronary Intervention—Systematic Review and Meta-Analysis—. *Circulation Reports*. 2022 Mar; 4(3): 109-15. doi: 10.1253/circrep.CR-21-0160.
- [14] D'Onofrio G, Safdar B, Lichtman JH, Strait KM, Dreyer RP, Geda M, *et al.*, Sex differences in reperfusion in young patients with ST-segment-elevation myocardial infarction: results from the VIRGO study. *Circulation*. 2015 Apr; 131(15): 1324-32. doi: 10.1161/CIRCULATIONAHA.114.012293.
- [15] Rathore SS, Curtis JP, Chen J, Wang Y, Nallamothu BK, Epstein AJ, *et al.*, Association of door-to-balloon time and mortality in patients admitted to hospital with ST elevation myocardial infarction: national cohort study. *BMJ*. 2009 May; 338. doi: 10.1136/bmj.b1807.
- [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. *New England Journal of Medicine*. 2013 Sep; 369(10): 901-9. doi: 10.1056/NEJMoal208200.
- [17] Rashid MK, Wells G, So DY, Chong AY, Dick A, Froeschl M, *et al.*, Off-Hours Presentation, Door-to-Balloon Time, and Clinical Outcomes in Patients Referred for Primary Percutaneous Coronary Intervention. *Journal of Invasive Cardiology*. 2023 Apr; 35(4): 185-93.
- [18] O'gara PT, Kushner FG, Ascheim DD, Casey DE, Chung MK, De Lemos JA, *et al.*, 2013 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. *Journal of the American college of cardiology*. 2013 Jan; 61(4): 78-140. doi: 10.1161/CIR.0b013e3182742c84.
- [19] Nallamothu BK, Bates ER, Herrin J, Wang Y, Bradley EH, Krumholz HM. Times to treatment in transfer patients undergoing primary percutaneous coronary intervention in the United States: National Registry of Myocardial Infarction (NRM1)-3/4 analysis. *Circulation*. 2005 Feb; 111(6): 761-7. doi: 10.1161/01.CIR.0000155258.44268.F8.
- [20] Shiomi H, Nakagawa Y, Morimoto T, Furukawa Y, Nakano A, Shirai S, *et al.*, Association of onset to balloon and door to balloon time with long term clinical outcome in patients with ST elevation acute myocardial infarction having primary percutaneous coronary intervention: observational study. *BMJ*. 2012 May; 344. doi: 10.1136/bmj.e3257.