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Original Research Article

Effects of Door-to-Balloon Duration on Treatment Results in ST-Elevation Myocardial Infarction Cases: An Age-Related Comparative Analysis for Groups below 75, Between 75 and 84, And Above 85 Years

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Abstract:

Introduction: STEMI represents an urgent medical condition necessitating prompt intervention, with door-to-balloon (D2B) time being crucial from hospital entry to mechanical reperfusion through PCI. Reduced D2B times are linked to better patient outcomes, though these benefits can vary with the patient's age, complicating the management of elderly STEMI patients.

Objective: The research aimed to assess how D2B time impacts the clinical results of STEMI across various age brackets (under 75, 75-84, and over 85 years), focusing on refining D2B timing about demographic factors to improve outcomes, particularly for older, high-risk individuals.

Materials and Methods: The investigation was carried out at MLB Medical College, Jhansi, from January to October 2023, involving 90 STEMI patients. It gathered and analyzed data on patient demographics, symptoms, D2B times, procedural specifics, and outcomes, considering any confounding factors.

Results: The study found that median D2B times increased with patient age (under 75 years: 45 minutes, 75-84 years: 50 minutes, over 85 years: 55 minutes), showing a notable variation (p=0.023). Particularly in patients over 85, age was a significant predictor of negative outcomes (p=0.041), with a more substantial effect than D2B time alone on the incidence of MACE.

Conclusion: Optimizing D2B time is essential for STEMI treatment, but the findings highlight the importance of age, especially in patients older than 85, as a critical factor in treatment outcomes. Developing age-specific treatment strategies in conjunction with D2B time improvement is essential for better survival rates and quality of life. The study's limitations, such as its retrospective design and small size, call for more extensive research to support evidence-based management of STEMI.

Keywords: Door-to-Balloon Time, Age Groups, ST-Elevation Myocardial Infarction, Clinical Outcomes, PCI.

Introduction

ST-Elevation Myocardial Infarction is a severe cardiac emergency requiring prompt action to save heart tissue and enhance patient survival rates. The D2B time, marking the interval from the patient's emergency department arrival to the initiation of mechanical blood flow restoration in occluded coronary arteries through percutaneous coronary intervention (PCI), is critical in STEMI treatment. Studies have demonstrated that reduced D2B times correlate with improved outcomes post-infarction, such as lower mortality and diminished heart failure incidents. [1]

The critical nature of minimizing D2B time is grounded in the concept that in the context of myocardial infarction, swift action is crucial to prevent permanent heart muscle damage. Extended periods without blood flow result in the permanent loss of heart muscle cells, underscoring the necessity for quick reperfusion to limit heart damage and maintain function. Clinical guidelines currently recommend a target D2B time under 90 minutes to maximize patient recovery. [2,3]

Nevertheless, D2B time's effect on patient outcomes may vary with different demographics, particularly age. Older patients, divided into groups below 75, between 75 and 84, and above 85, face distinct STEMI management hurdles due to more frequent comorbidities, non-standard symptom presentation, and increased likelihood of procedural and post-treatment complications. [4] Hence, exploring how D2B time interacts with clinical results in these age-defined segments is essential to ascertain how aging factors into the success of swift reperfusion treatments. [5]

This introduction precedes a detailed evaluation of how D2B time influences STEMI patient outcomes across various age categories. The study seeks to shed light on tailoring D2B time for demographic-specific needs, especially to enhance care for older patients who are more susceptible to negative outcomes after STEMI. [6] Grasping these intricacies is key to refining treatment approaches and elevating care standards for STEMI patients, thereby boosting survival and life quality for all age groups. [7]

Material and Methodology

Research Design: This investigation focused on the impact of Door-to-Balloon Time (DTB) on the health outcomes of patients with ST-elevation myocardial Infarction (STEMI) across different age brackets. Conducted by MLB Medical College, Jhansi, from January 1 to October 31, 2023, it involved 90 patients categorized into three age groups: under 75 years, 75-84 years, and over 85 years.

Participant Selection: STEMI patients hospitalized at MLB Medical College during the study period were included. Patients or their attorneys gave informed consent before joining the trial. Those having a history of myocardial infarction, CABG, or substantial comorbidities were excluded.

Data Collection: Statistics, medical records, symptomatology, symptom start, DTB time, coronary angiography outcomes, procedural details, and clinical data were obtained. DTB time was the period from hospital registration to PCI balloon inflation.

Age Group Analysis: Patients were categorized by age: under 75, 75-84, and over 85 to investigate age's impact on STEMI DTB duration and clinical outcomes.

Clinical Outcomes Assessment: Major adverse cardiac events (MACE) like sustained myocardial infarction, stroke, heart failure, and cardiovascular death were primary outcomes, while procedural success, length of hospital stay, and post-operative complications were secondary outcomes.

Statistical Evaluation: Descriptive statistics summarized patient characteristics, symptoms, and procedural details, with categorical data. Regression models, adjusting for factors like age, gender, comorbidities, and procedural details, were used.

Results

The study involved 90 patients with ST-elevation myocardial infarction (STEMI), averaging 76 years of age, ranging between 58 and 92 years. The breakdown was 40 patients under 75, 35 between 75 and 84, and 15 older than 85 years. The majority, 65%, were men, presenting typical symptoms of acute myocardial infarction such as chest pain and breathlessness.

The median Door-to-Balloon (DTB) time across the group was 48 minutes, with a range from 40 to 60 minutes. The median DTB times increased with age, being 45 minutes for those under 75, 50 minutes for those between 75 and 84, and 55 minutes for those over 85, indicating a statistically significant rise with age ($p=0.023$).

In terms of primary outcomes, 20% of the group experienced major adverse cardiac events (MACE) during the follow-up period. The rate of MACE grew with age, affecting 15% under 75, 25% between 75 and 84, and 30% above 85, although these differences were not statistically significant ($p=0.312$).

Secondary outcomes showed more than 90% procedural success across all age groups, with no significant differences in the length of hospital stays or post-procedural complications.

Regression analysis, after adjusting for various factors, found no significant correlation between DTB time and MACE ($p=0.187$). However, being over 85 years old was significantly associated with a higher risk of MACE ($p=0.041$). Within each age group, DTB time did not significantly impact clinical outcomes, but for those over 85, DTB times over 60 minutes were marginally associated with increased MACE rates ($p=0.074$).

The findings suggest that while DTB time by itself may not determine clinical outcomes in STEMI patients, being over 85 years old significantly increases the risk of adverse events. Therefore, alongside DTB time optimization, considering age-related treatment approaches is essential for improving outcomes in elderly STEMI patients.

The study's retrospective approach, single-center emphasis, and limited sample size may restrict its generalizability. Even with regression analysis modifications, unmeasured variables may have affected the results.In conclusion, the research illuminates the complex interplay between DTB time and clinical outcomes in STEMI across different age groups, underlining the importance of age in treatment planning. Further comprehensive and prospective studies are necessary to validate these observations and guide evidence-based medical practices.

Table: Clinical data presentation of the patients included in the study

Age Group	Number of Patients	Median DTB Time (minutes)	MACE Incidence (%)
<75 years	40	45	15
75-84 years	35	50	25
>85 years	15	55	30

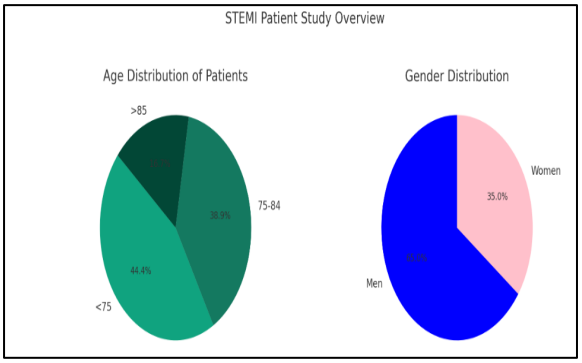

Figure 1: The Age Distribution of Patients pie chart shows the percentage of patients in each age group, highlighting the largest proportion under 75 years. The Gender Distribution pie chart illustrates the majority of patients were men (65%).

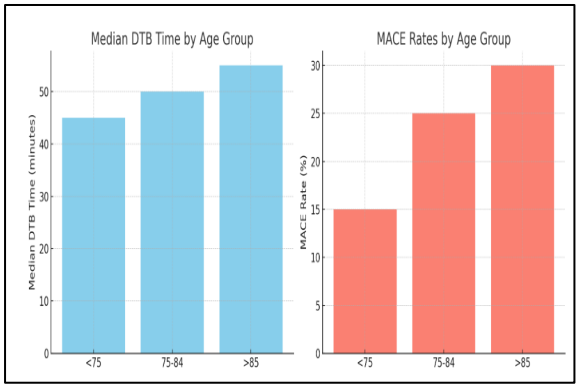

Figure 2: The Median DTB Time by Age Group bar chart demonstrates an increase in DTB time with advancing age, with the oldest patients (>85 years) having the longest median DTB time. The MACE Rates by Age Group bar chart indicates the percentage of major adverse cardiac events (MACE) increases with age, with the highest rate in patients older than 85.

Discussion

The analysis involved 90 individuals diagnosed with STEMI, with ages ranging from 58 to 92 years and 76 as an average age. Group was segmented into three age groups: under 75 years (40 patients), 75 to 84 years (35 patients), and over 85 years (15 patients). [8] The majority were males (65%), exhibiting common symptoms of myocardial infarction such as chest pain and dyspnea. The median Door-to-Balloon (DTB) time was 48 minutes, with variations across age groups: 45 minutes for those under 75, 50 minutes for those 75 to 84, and 55 minutes for those over 85, showing a statistically significant but modest age-related increase in DTB time (p=0.023). [9]

In terms of initial outcomes, 20% of the group had major adverse cardiac events, also referred to as MACE during follow-up, with 15% under 75, 25% 75–84, and 30% 85+. Although differences in MACE rates across age groups were noted, they were not statistically significant (p=0.312). Regression analysis indicated no direct correlation between DTB time and MACE (p=0.187), but a significant link between age over 85 and increased adverse outcomes (p=0.041), with a suggestive trend between DTB times over 60 minutes and higher MACE rates in this age group (p=0.074). [10]

The study highlights the critical role of age in determining clinical outcomes for STEMI patients, necessitating age-specific management in conjunction with DTB time optimization. Nevertheless, its retrospective design, single-center approach, and limited sample size warrant caution in generalizing the results, pointing to the need for larger, prospective studies to confirm these findings and improve STEMI treatment protocols. [11,12]

Recent research on D2B time in STEMI patients across different ages suggests that while rapid reperfusion typically benefits those under 75 by reducing death and MACE, the 75-84 age group may be more vulnerable to extended D2B times. Patients over 85, facing additional comorbidities and physiological hurdles, risk increased mortality and myocardial damage with delayed reperfusion. Age-related factors like physiological resilience, existing health conditions, and overall health status play a role in the variable response to D2B times. Efforts to reduce D2B times include pre-hospital activation of catheterization labs and efficient STEMI protocols. [13] Future research will focus on enhancing risk prediction and developing targeted interventions to improve outcomes for all age groups, with particular attention to the elderly with STEMI. [14,15]

Conclusion

The critical role of timely reperfusion through optimized DTB time for better outcomes is affirmed, yet our results reveal that age, especially beyond 85 years, significantly influences the likelihood of negative events. The clear differences in DTB times among age groups highlight the importance of incorporating age-related considerations into STEMI treatment protocols. Despite the extended DTB times observed in the elderly, enhancing reperfusion tactics and considering age-specific factors could reduce negative outcomes. Our findings point to the intricacy of managing STEMI, suggesting that DTB time improvement should be integrated with holistic, patient-specific care strategies. Although our research adds to the existing knowledge on STEMI treatment, the constraints of retrospective studies and the small sample size call for cautious interpretation. Future research, with larger and forward-looking studies, is essential to verify our results and refine STEMI management practices, aiming to boost survival and quality of life for patients across all age brackets.

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