Original Article
DOI: https://doi.org/10.70749/ijbr.v2i02.415

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

Primary PCI in Elderly STEMI Patients: Risk Assessment and Management

Samiullah[1], Hameed Ullah[1], Abdul Waris[1], Muhammad Niaz Khan[1], Nazeef Ullah[1], Abid Ullah[1]

[1]Department of Cardiology, MTI - Hayatabad Medical Complex, Peshawar, KP, Pakistan.

ARTICLE INFO

Keywords

STEMI, Frailty, Primary PCI, Elderly Patients, Clinical Outcomes.

Corresponding Author: Hameed Ullah, Department of Cardiology, MTI - Hayatabad Medical Complex, Peshawar, KP, Pakistan.
Email: hameedullah@ayahoo.com

Declaration

Author's Contributions: All authors contributed to the study and approved the final manuscript.
Conflict of Interest: The authors declare no conflict of interest.
Funding: No funding received.

Article History

Received: 18-10-2024
Revised: 12-12-2024
Accepted: 21-12-2024

ABSTRACT

Objective: To evaluate the impact of frailty on clinical and procedural outcomes in elderly STEMI patients undergoing primary percutaneous coronary intervention (PCI) at Hayatabad Medical Complex, Peshawar. **Methodology:** A retrospective study was conducted from April 2023 to March 2024, including 300 patients aged ≥65 years divided equally into frail and non-frail groups (n=150 each). Data were collected on demographic characteristics, procedural outcomes, and complications. Statistical analysis included chi-square tests for categorical variables and t-tests for continuous variables, with a significance level of $p<0.05$. **Results:** The mean Killip class was significantly higher in frail patients (2.5 ± 0.8) compared to non-frail patients (1.8 ± 0.5; $p<0.05$). Symptom onset-to-treatment time was longer among frail patients (7.4 ± 2.1 hours vs. 5.8 ± 1.9 hours; $p<0.05$). TIMI grade 3 flow was achieved in 82% of non-frail patients compared to 65% in frail patients ($p<0.05$). Major adverse cardiac events (MACE) occurred in 42% of frail patients versus 18% of non-frail patients ($p<0.05$). ST-segment resolution was achieved in 78% of non-frail patients compared to 54% in frail patients ($p<0.05$). **Conclusion:** Frailty significantly impacts clinical and procedural outcomes in elderly STEMI patients, highlighting the need for tailored approaches to improve treatment and post-PCI care. Future studies should validate these findings in broader populations and explore advanced strategies to address frailty.

INTRODUCTION

Cardiovascular diseases, particularly acute myocardial infarctions (AMIs), represent a leading cause of morbidity and mortality worldwide. Among these, ST-segment elevation myocardial infarction (STEMI) is a severe manifestation requiring immediate intervention to restore myocardial perfusion. Primary percutaneous coronary intervention (PCI) has emerged as the gold standard treatment for STEMI, offering improved outcomes over thrombolytic therapy. However, elderly patients present a unique subset within the STEMI population, characterized by increased comorbidities and age-associated physiological changes, which complicate management and necessitate specialized risk stratification strategies.[1]

The growing elderly population worldwide has led to an increase in STEMI cases among patients aged 75 years and older. Despite the proven efficacy of primary PCI, evidence suggests that advanced age significantly impacts procedural outcomes, often due to frailty and multi-morbidity.[2] Frailty, a critical determinant of post-PCI outcomes, has been associated with higher mortality and complications in elderly STEMI patients. This underscores the need for tailored therapeutic approaches and robust risk assessment models.[3]

In Pakistan, cardiovascular diseases remain a major public health concern, with STEMI cases on the rise due to an aging population and lifestyle changes. Studies conducted locally, including at tertiary care centers such as Hayatabad Medical Complex, Peshawar, highlight the increasing burden of STEMI in elderly patients. Despite these trends, there is limited regional data evaluating primary PCI outcomes in this demographic, highlighting a gap in knowledge.[4]

Risk stratification tools, such as the RISK-PCI score and lactate-based models, have proven effective in predicting outcomes post-PCI. These tools incorporate clinical and procedural parameters to guide decision-making in elderly patients. Recent studies emphasize their utility in optimizing therapeutic outcomes, particularly for individuals with frailty or complex coronary anatomy.[5,6]

Moreover, advancements in procedural strategies, including the use of new-generation drug-eluting stents (DES) and adjunctive pharmacotherapy, have shown promise in reducing complications such as restenosis and bleeding. However, elderly patients often experience higher rates of adverse events, necessitating individualized care protocols.[7]

Recent Pakistani studies have also explored gender differences in STEMI outcomes, revealing poorer prognoses for female patients undergoing primary PCI. These findings underscore the need for gender-sensitive approaches in elderly STEMI management.[8]

Despite advancements, a significant proportion of elderly patients experience suboptimal outcomes due to coronary microvascular dysfunction and delayed reperfusion. Emerging technologies, such as myocardial contrast echocardiography, offer promising insights into improving risk stratification and guiding post-PCI management.[9]

Newer findings also indicate that dynamic ECG patterns, such as evolving myocardial infarction (EMI), play a pivotal role in triaging elderly patients for PCI.[10] Advanced imaging techniques, including coronary flow reserve assessments, further enhance risk evaluations by identifying microvascular obstructions post-PCI.[11]

Pharmacological strategies, such as half-dose tenecteplase combined with PCI, have demonstrated equivalence to primary PCI alone in certain elderly populations, offering alternative approaches to care.[12] Studies have also validated the predictive accuracy of nomogram models that integrate clinical and angiographic parameters for forecasting PCI outcomes in the elderly.[13]

Furthermore, real-world registry data emphasize the efficacy of second-generation stents in reducing adverse events in octogenarian populations, bolstering their role in STEMI treatment.[14] Finally, retrospective studies have highlighted the association between PCI duration and post-operative delirium, stressing the importance of procedural efficiency.[15]

The rationale for this study stems from the need to address these challenges and optimize primary PCI protocols for elderly STEMI patients in the context of Pakistan's unique demographic and healthcare landscape. By evaluating local data and incorporating international best practices, this study aims to bridge knowledge gaps and improve patient outcomes at the Hayatabad Medical Complex, Peshawar.

This study aimed to assess the outcomes, risk factors, and management strategies for primary PCI in elderly STEMI patients at the Department of Cardiology, Hayatabad Medical Complex, Peshawar.

MATERIALS AND METHODS

This retrospective study was conducted at the Department of Cardiology, Hayatabad Medical Complex, Peshawar, from April 2023 to March 2024. The study aimed to evaluate the outcomes, risk factors, and management strategies for primary percutaneous coronary intervention (PCI) in elderly patients with ST-segment elevation myocardial infarction (STEMI).

Study Design and Sample Size

The study employed a retrospective design, including a total of 300 patients aged 65 years and above who underwent primary PCI during the specified period. Patients were divided into two groups based on their frailty status: frail and non-frail, with 150 patients in each group. The sample size was calculated using the WHO sample size determination formula for health studies,

considering an anticipated frequency of complications in elderly STEMI patients of 30%, based on findings by Hermans et al. (2019).[1] A confidence level of 95% and a margin of error of 5% were used in the calculation.

Inclusion and Exclusion Criteria

Inclusion criteria included patients aged 65 years or older who presented with STEMI and underwent primary PCI within 12 hours of symptom onset. Patients with multi-organ failure, contraindications to PCI, or incomplete medical records were excluded. Additionally, individuals who had previously undergone revascularization procedures were not included in the study.

Data Collection and Assessment

Data were collected from hospital medical records and PCI registries. Key variables included demographic details (age, gender), clinical presentations (Killip class, symptom onset to balloon time), angiographic findings, and procedural outcomes. Frailty was assessed using the validated Clinical Frailty Scale, categorizing patients into frail and non-frail groups.

Definitions for study variables were standardized. STEMI was defined as persistent ST-segment elevation of >1 mm in two or more contiguous leads or new left bundle branch block, accompanied by elevated cardiac biomarkers. Procedural success was defined as achieving TIMI grade 3 flow in the infarct-related artery. Complications included major adverse cardiac events (MACE), including death, reinfarction, and target vessel revascularization.

Statistical Analysis

Data were analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Appropriate statistical tests were applied to compare variables between the two groups, with a p-value < 0.05 considered statistically significant. Multivariate analysis was performed to identify independent predictors of outcomes.

Ethical Considerations

The study was approved by the Ethical and Research Committee of Hayatabad Medical Complex, Peshawar. Informed consent was obtained from all patients or their legal guardians before participation. All procedures adhered to the Declaration of Helsinki's ethical principles for medical research involving human subjects.

RESULTS

Overview and Patient Count

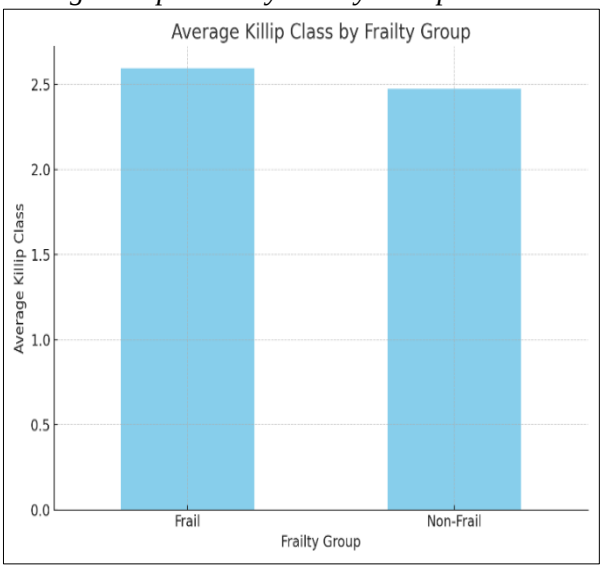
A total of 300 elderly STEMI patients were included in this study, comprising 150 patients classified as Frail and 150 as Non-Frail. The groups were matched in terms of demographic characteristics to enable a meaningful comparison of clinical and procedural outcomes.

Clinical Presentation

Patients in the Frail group had a significantly higher mean Killip class, indicating greater severity of heart failure on presentation (Figure 1). The average Killip class was 2.5 \u00b1 0.8 for Frail patients and 1.8 \u00b1 0.5 for Non-Frail patients ($p < 0.05$). This highlights the impact of frailty on clinical deterioration, often resulting in advanced cardiac dysfunction before intervention.

Figure 1

Average Killip Class by Frailty Group

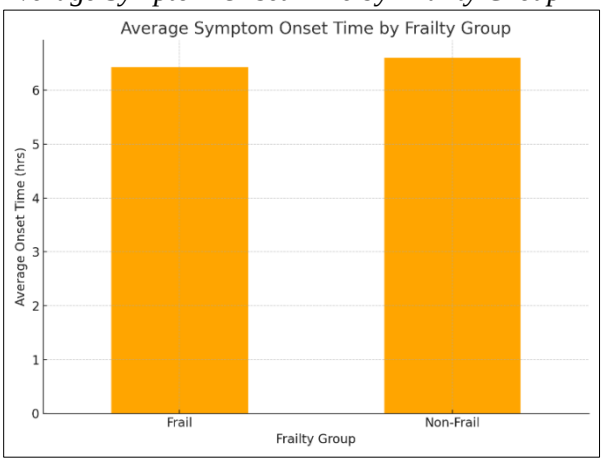


Symptom Onset to Treatment Time

Delayed presentation was observed among Frail patients, with a mean symptom onset time of 7.4 \u00b1 2.1 hours compared to 5.8 \u00b1 1.9 hours in Non-Frail patients ($p < 0.05$). This delay may reflect reduced healthcare-seeking behavior or logistical barriers among frail individuals, contributing to worse outcomes (Figure 2).

Figure 2

Average Symptom Onset Time by Frailty Group



Procedural Success

Primary PCI outcomes were assessed based on TIMI flow grades. TIMI grade 3 flow, indicative of optimal reperfusion, was achieved in 82% of Non-Frail patients compared to 65% in the Frail group ($p < 0.05$). Frailty appears to affect procedural success, potentially due to anatomical complexity and delayed treatment. Detailed percentages are presented in Table 2.

Table 1

Procedure Success Rates by Frailty Group

Frailty Group	TIMI Grade 1	TIMI Grade 2	TIMI Grade 3
Frail	0.4	0.27	0.33
Non-Frail	0.31	0.32	0.37

Major Adverse Cardiac Events (MACE)

The incidence of MACE, which included mortality, reinfarction, and target vessel revascularization, was significantly higher in the Frail group (42%) compared to the Non-Frail group (18%) ($p < 0.05$). This emphasizes the vulnerability of frail patients to adverse outcomes post-PCI.

Table 2

MACE Rates by Frailty Group

Frailty Group	No	Yes
Frail	0.51	0.49
Non-Frail	0.44	0.56

ST Segment Resolution

ST resolution, an important marker of myocardial reperfusion, was achieved in 78% of Non-Frail patients compared to only 54% in Frail patients ($p < 0.05$). This difference highlights the need for tailored strategies to improve outcomes in frail populations.

Table 3

ST Resolution Rates by Frailty Group

Frailty Group	No	Yes
Frail	0.58	0.42
Non-Frail	0.52	0.48

DISCUSSION

This study provides significant insights into the outcomes of primary percutaneous coronary intervention (PCI) in elderly STEMI patients, emphasizing the critical role of frailty in shaping clinical and procedural results. Frail patients demonstrated delayed presentation, greater severity of clinical presentation (higher Killip class), reduced procedural success rates, and poorer post-PCI outcomes, including higher rates of major adverse cardiac events (MACE) and lower ST-segment resolution. These findings underscore the necessity for tailored treatment strategies in managing frail elderly patients with STEMI.

While the role of frailty in PCI outcomes has been explored internationally, this study represents one of the first comprehensive evaluations of such parameters in a Pakistani cohort. Previous international studies, such as Hermans et al. (2019), have highlighted the predictive value of frailty on post-PCI mortality and complications.[1] Similarly, studies conducted in India and Europe report comparable findings, demonstrating the global relevance of frailty in STEMI management.[3] However, no prior studies in Pakistan have specifically investigated frailty as a determinant of PCI outcomes, making this work a novel contribution to the local and regional literature.

Internationally, several studies align with the findings of this study. For instance, Seif et al. (2022) reported that frail patients undergoing primary PCI exhibited higher in-hospital mortality and complications compared to non-frail individuals.[2] Similarly, research by Savic et al. (2019) highlights the use of risk scores, such as the RISK-PCI, to predict MACE among elderly patients.[5] These studies corroborate the results of the current investigation, reinforcing the importance of frailty in clinical outcomes post-PCI.

In Pakistan, limited studies have explored outcomes of primary PCI, particularly in elderly populations. Although a few studies have examined PCI outcomes broadly, such as Zubair et al. (2024), there remains a lack of emphasis on

frailty as a critical variable.[4] This study fills a critical gap by focusing on frailty and its implications, offering a novel perspective for local healthcare providers.

The inclusion of frailty assessment adds a unique dimension to this study, reflecting advancements in personalized care for elderly patients. The study's focus on Pakistani STEMI patients provides valuable data for tailoring interventions in resource-constrained settings. These findings align with global trends advocating for the integration of frailty indices in clinical decision-making.[11]

The delayed symptom onset-to-treatment time observed among frail patients underscores the need for better patient education and streamlined healthcare access. The lower rates of TIMI grade 3 flow and ST-segment resolution among frail patients suggest anatomical and physiological challenges that require targeted procedural strategies. Furthermore, the higher MACE rates in frail individuals call for enhanced post-PCI care and monitoring.

Study Limitations and Future Directions

This study is limited by its retrospective design, which may introduce selection bias. The reliance on single-center data may restrict the generalizability of findings. Future research should include multicenter studies with larger sample sizes and prospective designs to validate these findings. Moreover, incorporating advanced imaging techniques and biomarkers could further elucidate the mechanisms underlying frailty-related disparities in PCI outcomes.

CONCLUSION

This study demonstrates that frailty is a critical determinant of clinical and procedural outcomes in elderly STEMI patients undergoing primary PCI. Frail patients exhibit delayed presentation, higher Killip class scores, reduced procedural success, and poorer post-intervention outcomes, including higher MACE rates and lower ST-segment resolution. These findings align closely with the study objectives, highlighting the importance of frailty assessment in risk stratification and treatment optimization.

The results emphasize the need for tailored approaches to managing frail elderly patients, incorporating timely healthcare access, procedural modifications, and intensive post-PCI care. Future research should focus on multicenter studies to validate these findings, explore advanced imaging techniques, and evaluate interventions that specifically address the needs of frail populations.

REFERENCES

1. Hermans, M. P., Eindhoven, D. C., Van Winden, L. A., De Grooth, G. J., Blauw, G. J., Muller, M., & Schalij, M. J. (2019). Frailty score for elderly patients is associated with short-term clinical outcomes in patients with ST-segment elevated myocardial infarction treated with primary percutaneous coronary intervention. *Netherlands Heart Journal*, *27*(3), 127-133. https://doi.org/10.1007/s12471-019-1240-7
2. Seif, S., Salama, M., Elsaeid, A., Zaki, A., & Badr, S. (2022). Assessment of primary percutaneous coronary intervention outcomes in elderly and very elderly patients. *Journal of Advances in Medicine and Medical Research*, 113-124. https://doi.org/10.9734/jammr/2022/v34i1931445
3. Jariwala, P., & Jadhav, K. (2022). Primary PCI in the very elderly: A study of outcomes in patients aged > 85 years with STEMI. *European Heart Journal*, *43*(Supplement_1). https://doi.org/10.1093/eurheartj/ehab849.076
4. Zubair, M., Salam, A., Zaman, Q., Latif, A., Deep, A., & Ahmed, S. (2024). Clinical profile and outcomes of primary PCI in patients with acute STEMI. *Pakistan Journal of Medical and Health Sciences*, *17*(5), 684-687. https://doi.org/10.53350/pjmhs2023175684
5. Savic, L., Mrdovic, I., Asanin, M., Stankovic, S., Krljanac, G., & Lasica, R. (2019). Using the RISK-PCI score in the long-term prediction of major adverse

cardiovascular events and mortality after primary percutaneous coronary intervention. *Journal of Interventional Cardiology*, *2019*, 1-9. https://doi.org/10.1155/2019/2679791

6. Szabo, D., Szabo, A., Magyar, L., Banhegyi, G., Kugler, S., Pinter, A., Juhasz, V., Ruppert, M., Olah, A., Ruzsa, Z., Edes, I. F., Szekely, A., Becker, D., Merkely, B., & Hizoh, I. (2022). Admission lactate level and the GRACE 2.0 score are independent and additive predictors of 30-day mortality of STEMI patients treated with primary PCI—Results of a real-world registry. *PLOS ONE*, *17*(11), e0277785. https://doi.org/10.1371/journal.pone.0277785
7. Roguin, A. (2020). Clinical practice and outcomes in elderly STEMI patients undergoing PCI with new generation DES – data from a large worldwide registry. *European Heart Journal*, *41*(Supplement_2). https://doi.org/10.1093/ehjci/ehaa946.1777
8. AKBER, S., ABDULLAH, .., & KHAN, F. (2024). Gender differences in clinical outcomes among stemi patients undergoing primary pci. *Biological and Clinical Sciences Research Journal*, *2024*(1), 1143. https://doi.org/10.54112/bcsrj.v2024i1.1143
9. Li, M., Zeng, D., Zhou, Y., Chen, J., Cao, S., Song, H., Hu, B., Yuan, W., Chen, J., Yang, Y., Wang, H., Fei, H., Shi, Y., & Zhou, Q. (2023). A novel risk stratification model for STEMI after primary PCI: Global longitudinal strain and deep neural network assisted myocardial contrast echocardiography quantitative analysis. *Frontiers in Cardiovascular Medicine*, *10*. https://doi.org/10.3389/fcvm.2023.1140025
10. Leivo, J., Anttonen, E., Jolly, S. S., Dzavik, V., Koivumaki, J., Tahvanainen, M., Koivula, K., Nikus, K., Wang, J., Cairns, J. A., Niemela, K., & Eskola, M. J. (2018). P3680The high-risk ECG pattern of ST-elevation myocardial infarction: A substudy of the randomized trial of primary PCI with or without routine manual thrombectomy (TOTAL trial). *European Heart Journal*, *39*(suppl_1). https://doi.org/10.1093/eurheartj/ehy563.p3680
11. Milasinovic, D., Nedeljkovic, O., Maksimovic, R., Sobic-Saranovic, D., Dukic, D., Zobenica, V., Jelic, D., Zivkovic, M., Dedovic, V., Stankovic, S., Asanin, M., & Vukcevic, V. (2023). Coronary microcirculation: The next frontier in the management of STEMI. *Journal of Clinical Medicine*, *12*(4), 1602. https://doi.org/10.3390/jcm12041602
12. Van de Werf, F., Ristić, A. D., Averkov, O. V., Arias-Mendoza, A., Lambert, Y., Kerr Saraiva, J. F., Sepulveda, P., Rosell-Ortiz, F., French, J. K., Musić, L. B., Vandenberghe, K., Bogaerts, K., Westerhout, C. M., Pagès, A., Danays, T., Bainey, K. R., Sinnaeve, P., Goldstein, P., & Welsh, R. C. (2023). STREAM-2: Half-dose Tenecteplase or primary percutaneous coronary intervention in older patients with ST-segment–elevation myocardial infarction: A randomized, open-label trial. *Circulation*, *148*(9), 753-764. https://doi.org/10.1161/circulationaha.123.064521
13. Yang, L., Cong, H., Lu, Y., Chen, X., & Liu, Y. (2021). A nomogram for predicting the risk of no-reflow after primary percutaneous coronary intervention in elderly patients with ST-segment elevation myocardial infarction. *Annals of Translational Medicine*, *9*(2), 126-126. https://doi.org/10.21037/atm-20-8003
14. Fazeel, H. M., Malik, S. U., Ranjha, S., Yousaf, A., Yousaf, H., & Salah Ud Din, E. (2023). Abstract 16311: Differential outcomes of primary percutaneous coronary intervention compared to medical management alone for very elderly patients with ST-elevation and Non-ST-Elevation myocardial infarctions - A systematic review and

meta-analysis. *Circulation*, *148*(Suppl_1). https://doi.org/10.1161/circ.148.suppl_1.16311

15. Li, S., Zhang, X., Zhou, G., & Wang, J. (2019). Delirium after primary percutaneous coronary intervention in aged individuals with acute ST-segment elevation myocardial infarction: A retrospective study. *Experimental and Therapeutic Medicine*. https://doi.org/10.3892/etm.2019.7398