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Original Research Article

IMPROVEMENT IN LV END-DIASTOLIC PRESSURE AFTER PRIMARY PCI AND ITS IMPACT ON PATIENTS' RECOVERY

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Abstract: *Left ventricular end-diastolic pressure (LVEDP) is a crucial indicator of cardiac function, particularly in patients with acute ST-segment elevation myocardial infarction (STEMI). Primary percutaneous coronary intervention (PCI) is the standard of care for STEMI, but its impact on LVEDP and patient recovery remains to be thoroughly studied.* ***Objective:*** *This study aimed to evaluate the improvement in LVEDP following primary PCI in patients with acute STEMI and to assess its impact on recovery and clinical outcomes.* ***Methods:*** *This prospective study included 100 patients with acute STEMI treated by primary PCI. LVEDP was recorded at four-time points: before PCI, and at one week, one month, and three months post-PCI. Demographic and clinical characteristics were also collected. Statistical analysis was performed to compare LVEDP values at different time intervals using paired t-tests and repeated measures ANOVA to assess significant changes over time.* ***Results:*** *The mean LVEDP significantly decreased from 18 ± 4 mmHg before PCI to 12 ± 3 mmHg at one week, 10 ± 2 mmHg at one month, and 9 ± 2 mmHg at three months post-PCI ($p < 0.001$). This demonstrated a consistent improvement in left ventricular function and hemodynamic status, suggesting favorable patient recovery post-intervention.* ***Conclusion:*** *Primary PCI significantly reduces LVEDP in patients with acute STEMI, leading to improved cardiac function and patient recovery. Monitoring LVEDP post-PCI can serve as a valuable predictor of patient prognosis and long-term outcomes. Further studies are warranted to explore additional therapies that may further enhance recovery and improve the quality of life in STEMI patients.*

Keywords: Left ventricular end-diastolic pressure, primary percutaneous coronary intervention, ST-segment elevation myocardial infarction, cardiac recovery, hemodynamic stability, myocardial infarction, patient outcomes, adjunctive therapies

Introduction

Emergency or primary percutaneous coronary intervention, or PCI, is one of the essential therapeutic measures for patients with acute STEMI. This technique enhances patient outcomes by preserving the LV function since restitution of coronary blood flow through PCI is done early to avoid further myocar-dial necrosis. Another parameter that has been used to assess the function of LV is the left ventricular end-diastolic pressure LVEDP, which indicates the pressure of the LV chamber at the end of the diastolic period and is related to the heart's capacity to fill the stroke volume and pump blood. Clinically, raised LVEDP after STEMI has been linked to poor prognosis, including higher mortality, worsening heart failure, and renal dysfunction (2).

LVEDP is also a signification of post-MI remodeling that could be useful to evaluate patient outcomes after an MI. LV remodeling is changes in size, shape, and function of the heart submitted to an infarction, and in this process, LVEDP can be considered an important actor. Scientific work by van der Bijl et al. (3) shows that a lack of adequate management of post-infarct LV remodeling may lead to systolic dysfunction and increased mortality of the patient. It is also seen that high LVEDP brings about further adverse remodeling in the sense that new neurohormonal activation takes place following an augmentation in myocardial wall stress. This neurohormonal activation, in turn, worsens the Cardiac damage and pitches a vicious cycle of decline (6). Appreciation of this association is essential in the formulation of relevant treatment approaches to enhance the success rate in patients after MI. Consequently, it will be possible to decrease the impact of remodeling and improve the patient's outcomes by reducing LVEDP.

Since primary PCI can reverse those adverse changes with LV dysfunction, LVEDP may be reduced, and favorable remodeling results may be achieved. New studies have shown that a reduction in LVEDP after PCI is connected with more significant improvement in echocardiographic LVEF, decreased hospital mortality, and improved clinical outcomes in patients. For example, Batra et al. (1) proved that improved changes in LVEDP were associated with the preservation of the ventricular function, decreasing the failure rate. Moreover, it was established that the externalization of the ability of the changes in LVEDP to predict risks, including contrast-induced nephropathy, has also been examined (2). Other work has also been previously conducted investigating the impact of LVEDP on late LV remodeling has also been studied (4). In this regard, LVEDP may be considered helpful for assessing PCI and subsequent management outcomes. This illustrates that if LVEDP were reduced, clinicians would increase late survival and the cardiac condition of patients after myocardial infarction.

Therefore, it is essential to comprehend how primary PCI affects LVEDP and the consequent outcome of patients'

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recovery. Therefore, this study intends to examine the changes in LVEDP post-PCI, functional remodeling, and long-term consequences for patients. Since LVEDP was found to be associated with worse outcomes, optimizing LVEDP could potentially become a valuable therapeutic goal for patients after STEMI, especially those who would benefit from post-STEMI PCI (5, 7). The reduction of LVEDP is an area for improvement in the care of patients with myocardial infarction because focus on cardiac function will lead to a decrease in complications and improved quality of life. This focus could lead to a massive improvement in post-PCI care as well as patient results.

Objective: To evaluate the improvement in left ventricular end-diastolic pressure (LVEDP) after primary percutaneous coronary intervention (PCI) in patients with STEMI and its correlation with recovery outcomes.

Methodology

Prospective cohort study National Institute of Cardiovascular Diseases Karachi Karachi, Pakistan The study duration was 6 months (From December 2023 to June 2024) Adults aged 18+ with STEMI scheduled for PCI. Contraindications to PCI, recent MI, significant renal impairment, or concurrent systemic illness. This prospective cohort study was conducted at NICVD Karachi, Pakistan in patients with STEMI undergoing primary PCI. Information will be obtained from patient files and during subsequent physician's visits one week, one month, and three months after the procedure. The use of echocardiography for measures of LVEDP will be done before and after the procedure [PCI]. Evaluations of the clinical effects of the intervention, including changes in left ventricular function, as well as cardiac and renal adverse events, including heart failure and contrast-induced nephropathy, will be measured according to prespecified criteria. Therefore, descriptive statistics and correlation analyses will be used to analyze the effects of changes in LVEDP on the recovery characteristics of patients. This paper will follow ethical considerations; consent will be sought from all the participants entering the study. Also, this research paper will be submitted to the relevant institutional review board for approval.

Results

The study involved one hundred Patients admitted to the light with confirmed acute STEMI and candidates for primary PCI. These participants were sourced from a tertiary care cardiac center, and all participants had a clinical examination done on them. The details of the demographic and clinical characteristics of the patients in the study are presented in Table 1 below. The mean age of the patients was 58 ± 10 years old, see Figure 2 with the majority of the male sex, 68 % of the patient population. Overall comorbidities were common among the participants, with hypertension at 54%, diabetes at 32%, and hyperlipidemia at 45%. This demographical data helps to establish a background in terms of potential effects exerted by comorbid states on rehabilitation outcomes following PCI.

Data collected from these patients indicated that in the primary PCI, an astonishing 80% of patients demonstrated enhanced left ventricular functions, approximated by an increase in ejection fraction at three months. The overall mean EF increased significantly from 45% before PCI to 60% after PCI, both values being highly significant ($t = 3.747$; $p < 0.001$). This substantial improvement in cardiac work indicates the ability of PCI in the rehabilitation of ventricular function after acute STEMI. In addition, there were few complications; heart failure, for example, was reported in only 5% of the patients, so the majority of patients had positive outcomes. However, 3 percent of patients developed contrast-induced nephropathy, and therefore, monitoring of renal function during the post-PCI recovery phase is crucial. The obtained findings show that PCI has a positive effect on subsequent patient survival and ventricular function.

Table 1: Demographic and Clinical Characteristics of Participants

Characteristic	Value
Total Patients	100
Mean Age (years)	58 ± 10
Gender (Male/Female)	68/32
Hypertension	54%
Diabetes	32%
Hyperlipidemia	45%

Table 2: Changes in Left Ventricular End-Diastolic Pressure (LVEDP)

Time Point	LVEDP (mmHg)	p-value
Baseline	18 ± 4	-
One Week	12 ± 3	<0.001
One Month	10 ± 2	<0.001
Three Months	9 ± 2	<0.001

Table 3: Clinical Outcomes at Three Months Post-PCI

Outcome	Value
Improved Ejection Fraction	80%
Mean Ejection Fraction	60% ± 5%
Heart Failure	5%
Contrast-Induced Nephropathy	3%

Discussion

These results imply that LVEDP is a valuable predictor of cardiac outcomes in the subgroups of patients with acute STEMI who are managed with primary PCI. Furthermore, our results revealed a highly significant reduction of exact LVEDP from baseline mean of (18 ± 4mmHg) to three months after PCI of (9 ± 2) mmHg, confirming a large amount of improvement carried out by the procedure regarding the reducing the left ventricular diastolic filling pressure burden and enhancing the recovery of the left ventricle. The decrease in LVEDP can not only reflect the

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repair of cardiac damage but also indicates the improvement of patients' prognosis, the reduction of heart failure rate, and the promotion of quality of life. The continuous tracking of LVEDP might offer significant utility concerning estimating long-term recovery trends and the subsequent post-interaction courses of action.

The decrease in LVEDP over time indicates enhanced left ventricular filling pressures that are important for the well-functioning heart. These results are concurrent with literature advocating for a link between decreased LVEDP and improvements in left ventricular function following PCI (8). The results are further improved if ischemia is appropriately managed during the initial CK-EB period and during any subsequent medical or surgical management that is subsequently undertaken. Additionally, the distribution of patients in the study is quite broad and is the real-world population after PCI: mainly male (68%) and with significant comorbidities. Most of the candidates had multiple cardiovascular risk factors – hypertension 54%, diabetes 32 %, and hyperlipidemia 45 %. Thus, the significant increase observed in LVEDP indicates the potential for optimizing post-PCI management to address these underlying conditions and thereby promote improved clinical outcomes.

The results of our study correlate with other papers, including Liu et al. (9), highlighting the significance of pharmacological treatments in remodeling the ventricular end function after a myocardial infarction. These investigations illustrate how particular drugs can affect the remodeling processes directly in the cardiac tissue and, consequentially, the heart's function, especially as the study identifies targeted pharmacological agents that aim at reducing adverse remodeling that could further boost the benefits of lowered LVEDP. Because these treatments appear to mitigate the pathophysiologic processes identified in the study, given appropriately optimized pharmacologic and interventional goals, they might assist patients with improved recovery postprimary PCI. Therefore, including such agents in conventional post-acute myocardial infarction treatment regimens may afford significant improvements in early and late clinical outcomes, which would improve patient survival and quality of life.

Furthermore, the other significant findings that reveal the improvements in left ventricular function, such as LVEDP reduction, were correlated with the upgraded quality of life and the decreased frequency of complications, including heart failure, in the studied patients. These findings are in concordance with findings made by Ren et al. (10) who observed that myocardial work indexed increased significantly in the group that received primary PCI. This implies that not only does a patient have increased cardiac output efficiency, but also has general functional capacity improvement. The enhancements can include increased physical activity, better moods, and an ultimate decrease in healthcare expenses due to fewer trips to the hospital and less number of treatments. Therefore, the measurement and subsequent lowering of LVEDP after PCI may serve a crucial function in not only cardiologic well-being but also quality of life in patients with myocardial infarction. This multidimensional advantage speaks volumes about post-PCI care procedures.

The inclusion of other therapeutic strategies like angiotensin receptor-neprilysin inhibitors, as suggested by Dong et al. (11), may further enhance the established LVEDP lowerings after primary PCI. Nanoparticle drug delivery systems are developed based on the comparison of two cube root models for the targeted treatment of cardiac remodeling and optimized hemodynamic performance in patients with heart failure and other diseases. Further research potential should focus on identifying the specifics of the adjunctive therapies' application to augment the cardiac recovery post-PCI to achieve the best outcome. The roles of timing, dosage, and indication, as well as the effect of these therapies on functional recovery, quality of life, and survival, need to be established by future studies. Such investigations are imperative in the formulation of multidimensional treatment intercessions to optimize PCI while facilitating long-term cardiovascular health in patients after myocardial infarction.

Notably, our investigation also points to the significance of diligent tracking of left ventricular end-diastolic pressure (LVEDP) as a robust marker of survival in patients who are primary PCI candidates. Previous studies have definitively shown that ST-segment elevation is linked with higher LVEDP and that this parameter independently predicts higher morbidity and mortality in patients with Ischaemic cardiomyopathy, suggesting that increasing LVEDP is a surrogate marker for increased risk of adverse cardiovascular events. Consequently, stratification of patients with LVEDP measurements at least periodically after PCI is likely to help identify patients who may be at higher risk of adverse outcomes. Hence, by taking LVEDP recordings from time to time, medical practitioners can be able to note changes in the patient's hemodynamic status and take necessary measures to prevent adverse outcomes. Such a preventive model could greatly advance the efficiency of patient treatment, as well as increase the overall prognosis and survival level. It also could facilitate clinical considerations about the applicable pharmacological and non-pharmacological interventions based on the specific needs of individual patients post-infarction.

Finally, as our study mainly relied on LVEDP, the inclusion of other markers like GLS of the myocardial serve as valuable additions to the evaluation of the recovery process. , as underlined by Khaled and Shalaby (12), these imaging procedures may enable the clinical assessment of the functional reserve of the heart to more precisely.

Conclusion

This study also explains how the percentage of left ventricular end-diastolic pressure (LVEDP) decreases after primary percutaneous coronary intervention (PCI) in patients with acute ST-segment elevation myocardial infarction (STEMI). LVEDP falls significantly from its

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baseline level to three months post-PCI, which is indicative of better left ventricular status and general cardiac improvement. These results stress that timely PCI is crucial and contributes to the reduction in hemodynamic stress on the heart. Prolonged assessment of LVEDP can be especially helpful as a predictor for patients' outcomes. Moreover, the inclusion of adjunctive pharmacological therapies could enhance recovery processes as well as enhance overall STEMI patient's future health. There is a need for further studies on broad-based approaches that can aid in further boosting survival.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-CARDIP-253/22)
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Coordination of collaborative efforts.
Study Design, Review of Literature.
MUHAMMAD ATTIQ UR REHMAN SAQI *(Fellow Interventional Cardiologist)*
Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.
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