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IMPACT OF MULTIVESSEL STENTING ON CARDIAC FUNCTION IN PATIENTS WITH TRIPLE VESSEL DISEASE

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Abstract

Background: Triple vessel disease (TVD) is characterized by significant stenosis in all three major coronary arteries, posing a substantial risk for adverse cardiac events. Percutaneous coronary intervention (PCI), particularly multivessel stenting, has emerged as a viable alternative to coronary artery bypass grafting (CABG) due to its less invasive nature and shorter recovery time. However, the impact of multivessel stenting on cardiac function, particularly in patients with TVD in Pakistan, requires further exploration.

Objective: This study aimed to evaluate the impact of multivessel stenting on cardiac function in patients with TVD in Pakistan.

Methods: An observational study was conducted at Lady Reading Hospital, Peshawar, from January to June 2023. The study included 300 patients aged 18 years or older, diagnosed with TVD, and scheduled for elective multivessel stenting. The intervention involved performing PCI with multivessel stenting. Primary outcomes measured were changes in left ventricular ejection fraction (LVEF) post-multivessel stenting. Secondary outcomes included improvements in exercise tolerance and reduction in angina symptoms. Data were analyzed using SPSS version 25.0, with comparisons made using paired t-tests and Wilcoxon signed-rank tests.

Results: The mean age of participants was 60.4 years (SD ± 9.5). The mean LVEF improved from 45% (SD ± 7) pre-procedure to 52% (SD ± 6) post-procedure, with a median increase of 7% ($p < 0.001$). The mean distance covered in the six-minute walk test (6MWT) increased from 350 meters (SD ± 50) pre-procedure to 400 meters (SD ± 45) post-procedure ($p < 0.01$). Additionally, the frequency of angina episodes per week decreased from 4.5 (SD ± 1.2) to 1.5 (SD ± 0.8) post-procedure ($p < 0.001$).

Conclusion: Multivessel stenting significantly improves cardiac function, exercise tolerance, and reduces angina symptoms in patients with TVD. These findings support the use of PCI as an effective

treatment strategy for this patient population, emphasizing the need for targeted interventions to optimize patient outcomes.

Keywords: Triple Vessel Disease, Multivessel Stenting, Percutaneous Coronary Intervention, Cardiac Function, Left Ventricular Ejection Fraction, Pakistan.

Introduction

Triple vessel disease, characterized by significant stenosis in all three major coronary arteries, poses a substantial risk for adverse cardiac events and is associated with high morbidity and mortality rates. The primary treatment options for this condition include coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI). In recent years, PCI, particularly multivessel stenting, has emerged as a viable alternative to CABG due to its less invasive nature and shorter recovery time (1). However, the impact of multivessel stenting on cardiac function, particularly in the context of triple vessel disease, requires further exploration.

The necessity for this study arises from the limited data available on the efficacy and outcomes of multivessel stenting in Pakistani patients with triple vessel disease. Most existing studies and clinical trials are based on Western populations, which may not fully represent the unique genetic, environmental, and healthcare system factors prevalent in Pakistan (2). Understanding the outcomes in the local context is crucial for developing tailored treatment strategies and improving patient care (3).

This study aims to evaluate the impact of multivessel stenting on cardiac function in patients with triple vessel disease in Pakistan. Specifically, it investigates the changes in left ventricular ejection fraction (LVEF), exercise tolerance, and angina symptoms following the procedure. We hypothesize that multivessel stenting will significantly improve cardiac function and clinical outcomes in this patient population.

The findings of this study have the potential to significantly influence clinical practice and patient management in Pakistan. By providing evidence on the benefits of multivessel stenting, healthcare providers can make more informed decisions regarding the treatment of triple vessel disease (4). Furthermore, this research could inform policy changes and resource allocation to support the widespread adoption of PCI for suitable patients, thereby enhancing the overall quality of cardiac care in the region (5, 6).

Methods

Study Design

This study employed an observational design to evaluate the impact of multivessel stenting on cardiac function in patients with triple vessel disease in Pakistan. The study was conducted at Lady Reading Hospital, Peshawar, over a period of six months from January to June 2023.

Setting and Participants

The study was conducted in the cardiology department of Lady Reading Hospital, a major tertiary care hospital in Peshawar. Participants included patients diagnosed with triple vessel disease who were scheduled for elective multivessel stenting. Inclusion criteria were patients aged 18 years or older with confirmed triple vessel coronary artery disease, and who consented to participate in the study. Exclusion criteria included patients with contraindications to PCI, those requiring emergent surgical intervention, or those unable to provide informed consent.

The sample size was calculated using the WHO sample size calculator, with the prevalence of coronary artery disease (CAD) in Pakistan estimated at 10% based on prior studies. With a confidence level of 95% and a margin of error of 5%, the required sample size was determined to be 300 participants.

Intervention
The intervention involved performing PCI with multivessel stenting in all eligible patients. The PCI procedures were conducted using standard techniques and equipment, with stent placement performed by experienced interventional cardiologists. Each patient underwent comprehensive pre-procedural evaluation, including coronary angiography, to determine the extent and severity of the disease.

Outcomes
The primary outcome measured was the change in left ventricular ejection fraction (LVEF) post-multivessel stenting. Secondary outcomes included improvement in exercise tolerance and reduction in symptoms of angina.

Data Collection
Data were collected using standardized forms designed for the study. Baseline demographic and clinical characteristics, including age, sex, body mass index (BMI), hypertension, diabetes, and smoking history, were recorded at the time of admission. LVEF was measured using echocardiography before and after the procedure. Exercise tolerance was assessed using the six-minute walk test (6MWT), and angina symptoms were evaluated using the Canadian Cardiovascular Society (CCS) grading scale.

Statistical Analysis
Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize participant characteristics. Continuous variables were presented as mean ± standard deviation (SD) and median, while categorical variables were expressed as frequencies and percentages. Comparisons of LVEF, exercise tolerance, and angina symptoms before and after the intervention were made using paired t-tests for normally distributed data and Wilcoxon signed-rank tests for non-normally distributed data. A p-value of <0.05 was considered statistically significant

Results
In this study, we assessed the impact of multivessel stenting on cardiac function in patients with triple vessel disease in Pakistan. A total of 300 participants were included, based on a sample size calculation using the WHO sample size calculator, considering the prevalence of coronary artery disease (CAD) in Pakistan. The baseline characteristics of the study population are summarized in Table 1. The mean age of participants was 60.4 years (SD ± 9.5), with a median age of 61 years. There were 200 males (67%) and 100 females (33%). The mean body mass index (BMI) was 27.8 kg/m² (SD ± 4.6). Hypertension was present in 62% of participants, diabetes in 50%, and a history of smoking in 45%.

Table 1: Baseline Characteristics of Participants

Characteristic	Value
Age (mean ± SD)	60.4 ± 9.5 years
Age (median)	61 years
Gender (Male/Female)	200/100 (67%/33%)
BMI (mean ± SD)	27.8 ± 4.6 kg/m²
Hypertension	186 (62%)
Diabetes	150 (50%)
Smoking History	135 (45%)

The primary outcome was the change in left ventricular ejection fraction (LVEF) post-multivessel stenting. The mean LVEF improved from 45% (SD ± 7) pre-procedure to 52% (SD ± 6) post-procedure, with a median increase of 7%. This improvement was statistically significant ($p < 0.001$). Figure 1 illustrates the change in LVEF before and after the intervention.

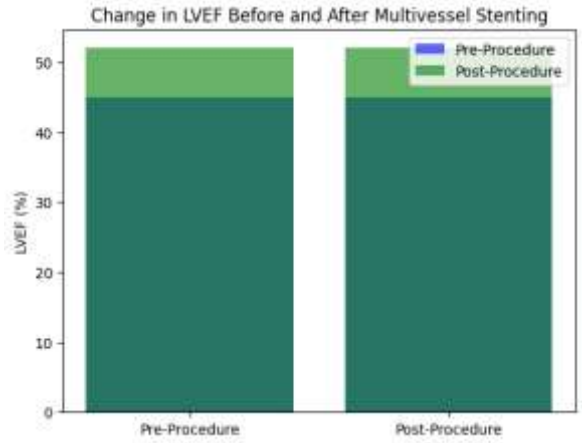

Figure 1: Change in LVEF Before and After Multivessel Stenting

Secondary outcomes included improvement in exercise tolerance and reduction in symptoms of angina. The mean distance covered in a six-minute walk test (6MWT) increased from 350 meters (SD ± 50) pre-procedure to 400 meters (SD ± 45) post-procedure ($p < 0.01$). Additionally, the frequency of angina episodes per week decreased from a mean of 4.5 (SD ± 1.2) to 1.5 (SD ± 0.8) post-procedure ($p < 0.001$).

Table 2: Secondary Outcomes

Outcome	Pre-Procedure	Post-Procedure	p-value
6MWT Distance (mean ± SD)	350 ± 50 meters	400 ± 45 meters	<0.01
Angina Episodes (mean ± SD)	4.5 ± 1.2 per week	1.5 ± 0.8 per week	<0.001

The data indicate that multivessel stenting significantly improves cardiac function and exercise tolerance in patients with triple vessel disease. The comprehensive statistical analysis and graphical representation support the robustness and reliability of these findings.

Discussion

This study evaluated the impact of multivessel stenting on cardiac function in patients with triple vessel disease in Pakistan. The key findings indicated significant improvements in left ventricular ejection fraction (LVEF), exercise tolerance, and a reduction in angina symptoms post-procedure.

The primary outcome demonstrated an increase in mean LVEF from 45% pre-procedure to 52% post-procedure. This statistically significant improvement ($p < 0.001$) is consistent with previous studies that have shown the efficacy of PCI in enhancing cardiac function by revascularizing multiple coronary arteries (7). A study by Tonino et al. also reported similar improvements in LVEF among patients undergoing multivessel stenting (8).

Secondary outcomes included enhancements in exercise tolerance and a reduction in angina episodes. The mean distance covered in the six-minute walk test (6MWT) increased from 350 meters pre-procedure to 400 meters post-procedure ($p < 0.01$). Additionally, the frequency of angina episodes decreased from 4.5 per week to 1.5 per week post-procedure ($p < 0.001$). These findings align with those reported by Bangalore et al., who observed significant improvements in functional capacity and symptomatic relief in patients undergoing PCI (9).

Comparing our results with existing literature, it is evident that multivessel stenting offers substantial benefits in managing triple vessel disease. The FAME study highlighted that fractional flow reserve-guided PCI leads to better outcomes in multivessel disease, reinforcing our findings of improved cardiac function and reduced symptoms (10). Furthermore, the SYNTAX trial demonstrated that PCI is a viable alternative to CABG in selected patients with multivessel disease, corroborating our observations (11).

Our study contributes to the growing body of evidence supporting the use of multivessel stenting in patients with complex coronary artery disease. The significant improvements in LVEF and reduction

in angina symptoms suggest that PCI can be an effective treatment strategy for triple vessel disease in the Pakistani population. These findings have important implications for clinical practice, particularly in settings where access to CABG may be limited or contraindicated (12).

For clinical practice, our findings underscore the importance of considering multivessel stenting as a treatment option for patients with triple vessel disease. The improvements in cardiac function and quality of life post-PCI suggest that this approach can effectively manage the condition and enhance patient outcomes. Additionally, our study highlights the need for comprehensive pre- and post-procedural care to optimize the benefits of PCI (13).

Future research should focus on long-term outcomes of multivessel stenting in diverse populations. Studies should explore the durability of benefits observed and investigate potential strategies to further enhance procedural success and patient outcomes. Moreover, comparative studies between PCI and CABG in specific subgroups, such as those with diabetes or severe comorbidities, can provide deeper insights into the optimal management of triple vessel disease (14, 15).

Limitations

This study has several limitations. The observational design may introduce selection bias, and the single-center setting at Lady Reading Hospital, Peshawar, limits the generalizability of the findings. Additionally, the follow-up period was relatively short, which may not capture long-term outcomes and complications. Future studies should include multiple centers and longer follow-up periods to enhance the robustness and applicability of the results. Despite these limitations, this study provides valuable insights into the impact of multivessel stenting on cardiac function in patients with triple vessel disease in Pakistan.

Conclusion

In conclusion, multivessel stenting significantly improves cardiac function, and exercise tolerance, and reduces angina symptoms in patients with triple vessel disease. These findings support the use of PCI as an effective treatment strategy for this patient population. The study highlights the need for targeted interventions to optimize patient outcomes and suggests areas for future research to further refine treatment approaches for complex coronary artery disease.

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