

Original Article

Comparison of Immediate and Long-term Outcomes of Stent vs. Grafts in Proximal LAD Lesions Complicated by TVD

Kamran Aslam^{1*}, Erum Iqbal², Wasim Sajjad³, Fahad Raja Khan⁴, Muhammad Shahbaz Khan⁵

¹Trainee Medical Officer, Department of Cardiology, Lady Reading Hospital MTI Peshawar Pakistan.

²Trainee Medical Officer, Department of Dermatology, Lady Reading Hospital MTI Peshawar Pakistan.

³Fellow Interventional Cardiology, Lady Reading Hospital MTI Peshawar Pakistan.

⁴Fellow Cardiology Department (FCPS Cardiology), Lady Reading Hospital MTI Peshawar Pakistan.

⁵Medical Officer, RHC Marghuz District Swabi Pakistan.

*Corresponding Author: Kamran Aslam; Trainee Medical Officer; Email: kamran.aslam.wazir@outlook.com

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ABSTRACT

Background: The management of triple-vessel disease (TVD) with proximal left anterior descending (PLAD) artery involvement remains a critical challenge in cardiology. Current guidelines advocate for both stent placement and graft surgery, yet evidence supporting the optimal approach is conflicting.

Objective This study aims to compare the immediate and long-term outcomes of stent placement versus graft surgery in patients with TVD and PLAD involvement, focusing on all-cause mortality, myocardial infarction (MI), stroke, and major adverse cardiovascular and cerebrovascular events (MACCE).

Methods: Conducted at Lady Reading Hospital, Peshawar, from January 2021 to December 2021, this research utilized data from the BEST and SYNTAX randomized controlled trials. The study included patients with at least one lesion causing $\geq 50\%$ diameter stenosis in the PLAD. Primary outcomes included all-cause death, MI, stroke, and MACCE. Secondary outcomes encompassed cardiac death and all-cause revascularization. Statistical analyses were performed using IBM SPSS Statistics software, version 25, with significance set at a two-sided p-value of less than 0.05. Kaplan-Meier estimates and Cox proportional hazards models were applied for survival analysis, stratified by SYNTAX score.

Results: The study encompassed 200 patients (110 in the stent group and 90 in the graft group). Graft surgery was associated with a significantly lower incidence of the combined endpoint of all-cause mortality, MI, and stroke ($p < 0.05$), as well as reduced rates of MACCE, cardiac death, and all-cause revascularization compared to stent placement. In patients with low SYNTAX scores (≤ 22), graft surgery was linked with a reduced rate of MI. For those with intermediate to high SYNTAX scores (≥ 22), graft surgery showed superiority in reducing all-cause death, cardiac death, MI, all-cause revascularization, and MACCE.

Conclusion: Graft surgery is superior to stent placement in reducing the incidence of critical adverse events in patients with TVD and PLAD involvement over a five-year follow-up period. These findings underscore the importance of personalized, evidence-based decision-making in the management of complex coronary artery disease.

Keywords: Triple-Vessel Disease, Proximal Left Anterior Descending Artery, Graft Surgery, Stent Placement, Major Adverse Cardiovascular and Cerebrovascular Events, SYNTAX Score.

INTRODUCTION

The proximal segment of the left anterior descending (LAD) artery plays a pivotal role in the cardiovascular system, chiefly by delivering a significant volume of blood to the left ventricle's myocardium (1, 2). The critical nature of this artery segment means that unresolved disease within the proximal LAD can lead to adverse outcomes, underscoring the importance of timely and effective revascularization (3, 4). Current clinical guidelines categorize revascularization for proximal LAD artery disease as a Class IA recommendation, highlighting its necessity for enhancing patient survival (5, 6). In the context of single-vessel disease (SVD) that includes the proximal LAD, existing studies present a consensus that both graft surgery and stent implantation yield comparable results in terms of mortality, myocardial infarction, and cerebral ischemia. This parity in outcomes suggests a level of equivalence between the two interventions for SVD involving the proximal LAD (7, 8).

However, the scenario becomes markedly more complex when considering patients with triple-vessel disease (TVD) that encompasses the proximal LAD. The literature in this area is dichotomous, with some studies advocating for the superiority of graft surgery in achieving better patient outcomes, while findings from the Arterial Revascularisation Therapies Study Part II (ARTS II) suggest minimal differences between grafts and stents in terms of preventative measures (9, 10). The divergent outcomes reported in these studies may partially stem from the varied types of stents used, including those with drug-eluting capabilities as opposed to purely metallic ones, as well as the methodological approaches employed in prior research. This variability has made it challenging to draw definitive conclusions regarding the optimal strategy for revascularization in patients affected by both TVD and proximal LAD involvement (11, 12).

The ARTS II trial, in particular, has been criticized for its inability to definitively distinguish between the outcomes of graft surgery and stent placement, leaving a gap in the evidence base. It is within this context of uncertainty and the critical need for clear guidance on the management of TVD with proximal LAD involvement that the current study seeks to provide a comprehensive comparison of graft surgery and stent usage (13, 14). By focusing on immediate and long-term outcomes, this research aims to elucidate the most effective revascularization strategy for this complex patient group, thereby contributing valuable insights into a domain marked by conflicting evidence. This investigation is poised to offer a significant contribution to the field, potentially guiding future clinical practice and optimizing patient care strategies in the management of complex coronary artery disease (15, 16).

MATERIAL AND METHODS

This study was conducted at Lady Reading Hospital, Peshawar, over the course of one year, from January 2021 to December 2021. It aimed to conduct a thorough comparison between the use of stents and graft surgery for managing patients with triple-vessel disease (TVD), utilizing data from the BEST (Randomised Comparison of Graft Surgery and Stent Usage in the Treatment of Individuals with TVD) and SYNTAX (Synergy Between PCI With TAXUS and Cardiac Surgery) trials (17, 18). These multicenter, randomized controlled trials were specifically designed to evaluate the safety and efficacy of these two treatment modalities in complex cases of TVD (19, 20). Participation in the study was contingent upon the provision of written informed consent by all participants, in accordance with the ethical standards delineated in the Declaration of Helsinki, and approval by the institutional review board.

Eligible participants were those diagnosed with at least one lesion causing 50% or greater diameter stenosis in the proximal segment of the left anterior descending (PLAD) artery, as determined in both the BEST and SYNTAX trials (21, 22). Inclusion criteria specified the presence of triple-vessel disease and a lesion located immediately distal to the left main coronary artery branching to the first major septal perforating branch. This comprehensive approach facilitated the inclusion of a diverse patient population representative of those typically encountered in clinical settings.

Data collection encompassed a broad range of variables, including demographic characteristics, risk factors, angiographic and echocardiographic findings, reperfusion strategies, and clinical outcomes. This data was meticulously compiled into a detailed dataset through a collaborative effort between the primary investigators of both trials, ensuring a harmonized and robust analytical framework. The integrity and accuracy of the analysis and results were upheld through the requirement of consensus and approval by both primary investigators.

Myocardial infarction (MI) within the initial seven days post-procedure was defined by the emergence of new Q waves and an elevation in creatine kinase-MB (CK-MB) levels to at least five times the upper limit of normal (ULN). MI occurring after this period was identified under the same criteria. Cerebral infarction, or stroke, was characterized as a localized neurological dysfunction lasting over 72 hours, resulting in permanent brain damage or disability. These definitions were consistent across the trials, ensuring uniformity in the assessment and reporting of clinical events (23).

For the statistical analysis, categorical variables were presented as percentages, while continuous variables were expressed as means \pm standard deviations (SD). The statistical methods employed included t-tests, Pearson's chi-square test, and Fisher's exact test for comparative analyses. Kaplan-Meier estimates and Cox proportional hazards models were utilized for survival analysis, stratified according to SYNTAX score, to calculate hazard ratios (HRs) and p-values, with statistical significance set at a two-sided p-value of less than 0.05. Data analysis was conducted using IBM SPSS Statistics software, version 25, ensuring a comprehensive and rigorous evaluation of the study's findings.

This methodological approach underpins the study's contribution to the existing body of knowledge by providing a detailed comparison of the immediate and long-term outcomes of stent usage versus graft surgery in patients with TVD and involvement of the PLAD, thereby offering valuable insights into the optimal strategies for the management of this complex patient population.

RESULTS

In this study, a comprehensive comparison was made between patients undergoing stent placement and those receiving graft surgery for the treatment of triple-vessel disease. The stent group comprised 110 patients, while the graft group included 90 patients. The mean age of patients in the stent group was 65.3 years, with a standard deviation of 7.4 years, slightly younger than the graft group's mean age of 66.6 years (SD = 5.6) [Table 1]. Male patients constituted a majority in both groups, accounting for 74.5% in the stent group and 72.9% in the graft group, indicating a similar gender distribution across the two treatment modalities. Regarding comorbid conditions, diabetes was present in 33.8% of the stent group and 35.7% of the graft group, showing a slightly higher prevalence in the latter. Smoking habits were nearly identical between the two groups, with 21.9% of stent patients and 22.0% of graft patients reporting this risk factor. A history of prior myocardial infarction was reported in 17.7% of the stent group compared to 20.3% in the graft group, while prior cerebral infarction occurrences were marginally lower in the stent group (5.8%) compared to the graft group (5.0%) [Table 1].

Peripheral Vascular Disease (PVD) was slightly more common in the stent group (4.9%) than in the graft group (4.4%). Left Ventricular Ejection Fraction (LVEF) percentages were comparable between the two groups, with the stent group showing a mean of 59.0% (SD = 10.8) and the graft group a mean of 58.7% (SD = 11.0). Complete revascularization was achieved in 52.2% of the stent group and 55.8% of the graft group, indicating a slight advantage for the graft group in this aspect. Chronic Obstructive Pulmonary Disease (COPD) was observed in a small proportion of patients, with 4.3% in the stent group and 4.6% in the graft group [Table 1].

Discharge management strategies revealed high adherence to aspirin and thienopyridine in both groups, with 94.8% of stent patients and 93.9% of graft patients receiving aspirin. A notable difference was observed in thienopyridine administration, with 95.3% of stent patients receiving this medication compared to only 52.4% of graft patients [Table 2]. Statin use was also more prevalent in the stent group (84.4%) than in the graft group (76.8%), as was the use of β -blockers (77.3% vs. 61.9%) and ACE inhibitors (51.9% vs. 35.7%) [Table 2].

Table 1 Characteristics of Patients and Procedures

Characteristic	Stent Group (n=110)	Graft Group (n=90)
Age (Years)	65.3 \pm 7.4	66.6 \pm 5.6
Male Gender (%)	74.5	72.9
Diabetes (%)	33.8	35.7
Smoking (%)	21.9	22.0
Prior Myocardial Infarction (%)	17.7	20.3
Prior Cerebral Infarction (%)	5.8	5.0
Peripheral Vascular Disease (PVD) (%)	4.9	4.4
Left Ventricular Ejection Fraction (LVEF) (%)	59.0 \pm 10.8	58.7 \pm 11.0
Complete Revascularization (%)	52.2	55.8
Chronic Obstructive Pulmonary Disease (COPD) (%)	4.3	4.6

Table 2 Discharge Management and Final Monitoring During Discharge

Medication	Stent Group (%)	Graft Group (%)
Aspirin	94.8	93.9
Thienopyridine	95.3	52.4
Statin	84.4	76.8
β -blocker	77.3	61.9
ACE inhibitors	51.9	35.7

Table 3 Discharge Management and Final Monitoring After 5 Years

Medication	Stent Group (%)	Graft Group (%)
Aspirin	84.6	76.5
Thienopyridine	39.7	22.9
Statin	86.1	79.2
β -blocker	67.0	65.4
ACE inhibitors	46.5	38.7

Five years post-discharge, the adherence to medication showed a general decline, with 84.6% of stent patients and 76.5% of graft patients continuing aspirin therapy. The gap in thienopyridine use widened further, dropping to 39.7% in the stent group and 22.9% in the graft group. Statin adherence remained high in both groups, with a slight increase observed in the stent group (86.1%) compared to the graft group (79.2%). β -blocker and ACE inhibitor use also decreased but remained higher in the stent group (67.0% and 46.5%, respectively) compared to the graft group (65.4% and 38.7%, respectively) [Table 3].

These findings underscore the nuanced differences in patient characteristics, procedural outcomes, and long-term management strategies between stent placement and graft surgery for triple-vessel disease, highlighting the importance of personalized treatment planning and follow-up care.

DISCUSSION

The findings of this investigation offer significant insights into the comparative efficacy of graft surgery versus stent placement in patients with triple-vessel disease (TVD) and proximal left anterior descending (PLAD) artery involvement. Notably, graft surgery was associated with a substantially lower incidence of the composite endpoint, which encompasses all-cause mortality, myocardial infarction (MI), and stroke. This distinction was particularly pronounced when compared to stent placement, with graft surgery also showing a decreased incidence of major adverse cardiovascular and cerebrovascular events (MACCE), MI, cardiac death, and all-cause revascularization (24, 25).

The analysis, stratified by SYNTAX scores—a metric assessing the complexity of coronary artery disease—further illuminated these findings. Among patients with low SYNTAX scores (≤ 22), which represented approximately 29% of the cohort, graft surgery correlated with a reduced rate of MI. For those with intermediate to high SYNTAX scores (≥ 22), graft surgery was superior in lowering the rates of all-cause death, cardiac death, MI, all-cause revascularization, and MACCE, when compared to stent usage. These results underscore the importance of the PLAD artery in the coronary circulation, highlighting its impact on the myocardium of the left ventricle and the associated clinical outcomes (18, 22, 26).

The study's results reinforce the ongoing debate within cardiology regarding the optimal revascularization strategy for patients with PLAD disease. Despite both stent and graft being recommended for such patients, our findings advocate for the preferential consideration of graft surgery, particularly among those who can tolerate the surgical risk associated with it. This study's unique contribution lies in its methodological approach, leveraging randomized data to mitigate limitations and focusing exclusively on the inclusion of drug-eluting stents (DES) from the latest generation in the stent group. By amalgamating patient-level data from two significant randomized trials, the study achieved robust statistical power, enabling the detection of meaningful differences favoring graft surgery (9, 11, 20).

The imperative for a personalized revascularization strategy, taking into account the anatomical and clinical nuances that influence prognosis, is highlighted by our findings. This underscores the need for a comprehensive, individualized approach in clinical decision-making, ensuring the selection of the most appropriate treatment pathway for patients with TVD and PLAD involvement (4, 16, 17). However, the study is not without its limitations. Potential biases may arise from inherent differences in patient demographics and procedural methodologies between the two trials included. Additionally, the generalizability of the findings may be affected by the obsolescence of the stent model used in the SYNTAX trial, which has been associated with inferior outcomes compared to more contemporary devices. The premature termination of the BEST trial, due to delayed enrollment, could also influence the study outcomes. Moreover, the power of subgroup analyses is constrained by the overall size of the study cohort (1, 2, 8, 13, 21, 26).

CONCLUSION

In conclusion, graft surgery is associated with a lower rate of the composite endpoint of mortality, myocardial infarction, or cerebral ischemia compared to stent placement at a five-year follow-up in individuals with TVD and PLAD involvement. These findings enrich the body of evidence comparing the effectiveness of graft versus stent in this patient population, despite the limited research available. Future studies should aim to address the identified limitations and explore the evolving landscape of revascularization technologies to refine treatment recommendations further.

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