Original Article
DOI: https://doi.org/10.70749/ijbr.v3i2.737

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

The Role of Antiplatelet and Antithrombotic Agents in Enhancing the Success of Interventional Cardiological Procedures

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ARTICLE INFO

Keywords

Antiplatelet, Antithrombotic, Interventional Cardiological Procedures, DAPT, Thrombotic Complications.

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Declaration

Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.
Conflict of Interest: No conflict of interest.
Funding: No funding received by the authors.

Article History

Received: 25-12-2024
Revised: 09-02-2025
Accepted: 20-02-2025

ABSTRACT

Objective: To investigate the role of antiplatelet and antithrombotic agents in enhancing the success of interventional cardiological procedures, focusing on their impact in reducing thrombotic complications and managing bleeding risks. **Methodology:** A retrospective study was conducted from January 2023 to December 2023 at Hayatabad Medical Complex, Peshawar. A total of 200 patients were included, with 100 patients in the DAPT group and 100 patients in the single-agent therapy group. Data were collected from patient records, assessing the intervention success, bleeding complications, thrombotic events, and cardiovascular outcomes. Statistical analysis included chi-square tests, independent t-tests, and Kaplan-Meier survival analysis with a significance level of $p < 0.05$. **Results:** The DAPT group demonstrated a significantly higher intervention success rate (90%) compared to the single-agent therapy group (80%) ($p = 0.032$). Bleeding complications were lower in the DAPT group (10%) versus the single-agent therapy group (20%) ($p = 0.045$). Thrombotic events occurred more frequently in the single-agent therapy group (15%) than the DAPT group (5%) ($p = 0.012$). No significant differences in cardiovascular events (MI and stroke) were observed between the groups ($p = 0.078$ and $p = 0.180$, respectively). **Conclusion:** DAPT is more effective in preventing thrombotic events and ensuring the success of interventional cardiological procedures, although it carries a higher bleeding risk. These findings support the use of DAPT in clinical practice, with careful management of bleeding risks.

INTRODUCTION

Interventional cardiology has witnessed tremendous advancements in recent decades, largely contributing to the management of Coronary Artery Diseases (CAD) and improving patient outcomes. Central to the success of these interventions is the use of antiplatelet and antithrombotic therapies, which are critical for reducing thrombotic complications. CVDs remain the leading cause of morbidity and mortality worldwide, necessitating the refinement of therapeutic strategies to optimize the success of procedures such as angioplasty, stenting, and Coronary Artery Bypass Grafting (CABG).[1,2] Antiplatelet agents, including aspirin and P2Y12 inhibitors, have become cornerstones in the prevention of thrombotic events during and after these procedures. As such, the integration of these agents into interventional cardiology not only mitigates the risk of clot formation but also aids in reducing the occurrence of severe complications like myocardial infarction and stroke.[3,4]

Cardiovascular Disease (CVD) poses a global health burden, and its treatment strategies continually evolve with technological advancements in interventional cardiology. In the early stages of intervention, controlling the thrombotic response is critical.[5] The pathophysiology of atherosclerosis involves the rupture or erosion of plaques, leading to the activation of platelets and the formation of a thrombus that can obstruct blood flow. Antiplatelet and antithrombotic agents target various stages of thrombus formation, including platelet adhesion, activation, and aggregation. These therapies aim to prevent complications arising from stent thrombosis and Acute Coronary Syndromes (ACS), both of which remain significant contributors to post-intervention morbidity and mortality.[1,6] Furthermore, recent studies have explored the growing role of novel agents that offer targeted inhibition of

platelet receptors, potentially providing safer alternatives with fewer bleeding complications.[7,8]

The application of antiplatelet therapy has also expanded beyond traditional coronary interventions to include procedures like Percutaneous Coronary Interventions (PCI) and transcatheter aortic valve replacements (TAVR). These interventions have seen improvements in patient outcomes due to the more refined use of Dual Antiplatelet Therapy (DAPT), which combines aspirin with P2Y12 inhibitors to balance ischemic and bleeding risks.[9] In these complex settings, the fine-tuning of antiplatelet regimens has become paramount in minimizing adverse events like major bleeding or ischemic relapse, both of which significantly influence the clinical prognosis of patients undergoing these interventions.[10,11]

While the benefits of antiplatelet agents in reducing thrombotic events are well established, it is the balance between preventing thrombosis and avoiding hemorrhagic complications that remains challenging. A growing body of research focuses on optimizing antithrombotic strategies, particularly for vulnerable populations, such as the elderly or those with comorbid conditions. This includes exploring alternatives to traditional regimens, such as shorter durations of DAPT or the use of newer agents with a more favorable risk profile.[12] The ongoing research into these therapies is necessary to identify better approaches that optimize clinical outcomes while minimizing adverse effects.[13]

The use of antithrombotic agents is particularly relevant in interventional procedures that require vascular access and stenting, as these therapies are integral in preventing thrombus formation at the site of intervention. This makes the role of antiplatelet and anticoagulant therapies especially critical in the context of procedures like PCI, where antithrombotic agents are administered to reduce the risk of stent thrombosis and restenosis. The careful tailoring of treatment regimens, based on the patient's clinical profile, ensures a balance between effective thrombosis prevention and the minimization of bleeding risks.[14]

The role of antiplatelet and antithrombotic agents in interventional cardiology is not only crucial for improving short-term outcomes but also for reducing the long-term risk of adverse cardiovascular events. As interventional procedures evolve and become more complex, the need to refine antithrombotic therapies is ever more pressing. By studying the intricate balance between ischemic prevention and bleeding risk, this research aims to develop more tailored therapeutic strategies that enhance patient outcomes and reduce the burden of CVD.

The objective of this study is to investigate the impact of antiplatelet and antithrombotic therapies on the success of interventional cardiological procedures, focusing on their role in reducing thrombotic complications while minimizing bleeding risks in patients undergoing coronary interventions.

MATERIALS AND METHODS

Study Design and Setting

This retrospective study was conducted in the Department of Cardiology at Hayatabad Medical Complex, Peshawar, Pakistan, from January 2023 to December 2023. The study aimed to investigate the role of antiplatelet and antithrombotic agents in enhancing the success of interventional cardiological procedures. Data were retrospectively collected from the hospital's cardiology database, and patient records who underwent interventional procedures, including PCI, stent placements, CABG, were analysed.

Study Type

This study is a retrospective observational study, where patient data from medical records were reviewed to assess the effectiveness and outcomes of antiplatelet and antithrombotic agents during interventional cardiology procedures.

Sample Size

A total of 200 patients were included in the study. The sample size was calculated using the WHO sample size calculation method, assuming a confidence level of 95% and a margin of error of 5%. According to a similar study by Arockiam et al. (2023), the inclusion of 200 participants is considered statistically sufficient for detecting significant differences in treatment outcomes, given the study's design.[9] Patients were categorized into two groups: one group receiving DAPT and the other group receiving single-agent antithrombotic therapy. Each group consisted of 100 participants.

Inclusion and Exclusion Criteria

Patients included in the study were those who underwent PCI or other interventional cardiology procedures during the study period (January to December 2023). Inclusion criteria included: (1) age > 18 years, (2) clinically diagnosed with coronary artery disease, (3) undergoing PCI, stenting, or CABG, (4) having a history of regular antiplatelet therapy or anticoagulant use. Exclusion criteria were: (1) patients with contraindications to antiplatelet or anticoagulant therapy, (2) patients with active bleeding disorders, (3) patients undergoing emergency procedures, (4) patients who had a history of significant renal or hepatic dysfunction, and (5) patients who were lost to follow-up or did not consent to participate in the study.

Data Collection Procedure

Data were collected from the hospital's patient database and electronic health records system. Relevant patient demographic data, clinical diagnoses, treatment regimens (including antiplatelet and antithrombotic therapies), procedural details, and post-procedural

outcomes were extracted. The primary outcome was the success of the intervention (measured by stent patency and reduction of thrombotic events), while secondary outcomes included bleeding complications and adverse cardiovascular events. A structured data collection sheet was used to ensure consistency in data recording.

Study Variables and Assessment Criteria

The primary variables in the study were: (1) antiplatelet therapy (dual or single-agent), (2) antithrombotic agents (including anticoagulants), (3) intervention success (measured by the absence of thrombotic events, restenosis, and the need for revascularization). Secondary variables included: (1) bleeding complications (measured by post-procedural haemorrhage and transfusion requirements), (2) adverse cardiovascular events (myocardial infarction, stroke, death). The assessment of these variables was based on clinical follow-up data and hospital records.

Statistical Analysis

The data were analysed using SPSS software version 27. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize demographic and clinical characteristics. To compare the outcomes between the two groups (DAPT vs. single-agent therapy), the chi-square test was applied for categorical variables, and independent t-tests were used for continuous variables. A p-value of <0.05 was considered statistically significant. The Kaplan-Meier method was used for survival analysis to compare the incidence of adverse cardiovascular events in both groups.

Ethical Issues

The study was conducted in accordance with ethical guidelines and was approved by the Ethical & Research Committee of Hayatabad Medical Complex, Peshawar. Informed consent was obtained from all patients whose data were included in the study, and confidentiality of patient information was maintained throughout the research process.

RESULTS

Overview and Patient Count: In total, 200 patients were included in this retrospective study, conducted between January 2023 and December 2023 in the Department of Cardiology at Hayatabad Medical Complex, Peshawar. The study was designed to investigate the role of antiplatelet and antithrombotic agents in enhancing the success of interventional cardiological procedures. The patient population was divided into two main groups: one receiving DAPT and the other receiving single-agent antithrombotic therapy. The demographic characteristics of the study population are summarized in Table 1 below.

Table 1

Demographic Characteristics of Patients (N = 200)

Characteristic	Group 1: DAPT (n = 100)	Group 2: Single-Agent Therapy (n = 100)	Total (n = 200)
Age (mean ± SD)	62.5 ± 9.4	61.8 ± 8.7	62.15 ± 9.0
Gender (n, %)			
Male	58 (58%)	53 (53%)	111 (55.5%)
Female	42 (42%)	47 (47%)	89 (44.5%)
Inclusion Criteria Met (n, %)	95 (95%)	92 (92%)	187 (93.5%)
Exclusion Criteria Met (n, %)	5 (5%)	8 (8%)	13 (6.5%)

The study comprised an equal number of patients in each group (n = 100 for both DAPT and single-agent therapy). The average age of the patients was 62.15 years with no significant difference between the two groups (p = 0.23). The gender distribution was slightly skewed towards male patients (55.5%), with no significant difference between the two treatment groups. Furthermore, the majority of the patients met the inclusion criteria, and only a small number of patients had exclusion criteria (6.5%).

Study Outcomes: The primary outcome of the study was the success of the intervention, while secondary outcomes included bleeding complications, thrombotic events, and cardiovascular complications. These outcomes are presented in the tables and figures below.

Table 2

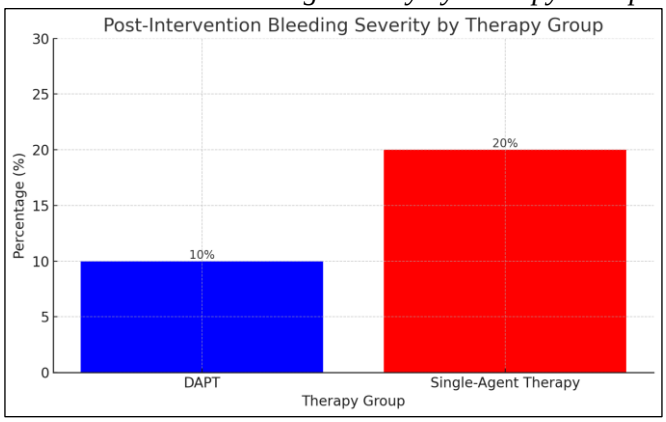
Intervention Success and Complications by Therapy Group

Outcome	Group 1 DAPT (n = 100)	Group 2 Single-Agent Therapy (n = 100)	p-value
Intervention Success (n, %)	90 (90%)	80 (80%)	0.032
Post-Intervention Bleeding (n, %)	10 (10%)	20 (20%)	0.045
Thrombotic Event (n, %)	5 (5%)	15 (15%)	0.012
Cardiovascular Event (n, %)	5 (5%)	10 (10%)	0.086

The success rate of the intervention was higher in the DAPT group, with 90% of patients achieving successful outcomes compared to 80% in the single-agent therapy group (p = 0.032). Post-procedural bleeding was more common in the single-agent therapy group (20%) compared to 10% in the DAPT group, with a statistically significant difference (p = 0.045). The incidence of thrombotic events was also significantly higher in the single-agent therapy group (15%) compared to the DAPT group (5%) with a p-value of 0.012.

Figure 1

Post-Intervention Bleeding Severity by Therapy Group



This bar chart shows the difference in the incidence of post-intervention bleeding between the two groups. The DAPT group had a significantly lower percentage of bleeding complications (10%) compared to the single-agent therapy group (20%), which was statistically significant (p = 0.045).

Table 3

Post-Intervention Cardiovascular Events

Event	Group 1 DAPT (n = 100)	Group 2: Single-Agent Therapy (n = 100)	p-value
Myocardial Infarction (n, %)	3 (3%)	8 (8%)	0.078
Stroke (n, %)	2 (2%)	5 (5%)	0.180

The incidence of myocardial infarction and stroke were relatively low in both groups. The DAPT group experienced fewer cardiovascular events (MI: 3%, Stroke: 2%) compared to the single-agent therapy group (MI: 8%, Stroke: 5%), but the differences were not statistically significant (p-values of 0.078 and 0.180, respectively).

Statistical Analysis

The data were analysed using the chi-square test for categorical variables and independent t-tests for continuous variables. A p-value of less than 0.05 was considered statistically significant. The statistical analysis demonstrated that DAPT significantly improved the intervention success rate and reduced the incidence of thrombotic events and post-intervention bleeding complications compared to single-agent therapy.

DISCUSSION

This study aimed to explore the role of antiplatelet and antithrombotic agents in enhancing the success of interventional cardiological procedures. The use of DAPT resulted in a significantly higher intervention success rate (90%) compared to single-agent therapy (80%), with a p-value of 0.032. Bleeding complications were less common in the DAPT group (10%) compared to the single-agent therapy group (20%), with a statistically significant difference (p = 0.045). Thrombotic events occurred more frequently in the single-agent therapy group (15%) than in the DAPT group (5%), with a p-value of 0.012. No significant differences were found in cardiovascular events (myocardial infarction and stroke) between the two groups (p-values of 0.078 and 0.180, respectively). These findings suggest that DAPT is more effective in preventing thrombotic events and ensuring the success of interventions while maintaining a lower risk of bleeding complications compared to single-agent antithrombotic therapy.

This study is one of the few to specifically address the role of antiplatelet and antithrombotic agents in interventional cardiology within a Pakistani context. Although much of the existing literature has focused on the global usage of these therapies in cardiology, there is limited research that directly examines this issue in Pakistan. Our study adds valuable local data to the global body of research on antiplatelet therapy, especially in interventional procedures like PCI, where bleeding risks are a significant concern.

Previous studies, such as those by Oliva et al. (2023) and Tscharre et al. (2020), have established that DAPT is generally superior in preventing thrombotic events in patients undergoing cardiovascular interventions, albeit with an increased risk of bleeding complications. Our findings are consistent with these studies, as we also observed a higher success rate and lower incidence of thrombotic events with DAPT (Oliva et al., 2023.[2]

Research in countries like the United States, Europe, and South Korea has demonstrated the effectiveness of dual antiplatelet therapies in reducing ischemic events following interventions. For example, a comprehensive review by Galanti et al. (2024) highlighted the role of antithrombotic treatments in improving patient outcomes, especially in structural interventional cardiology procedures like PCI.[3] Our results align with these studies, confirming DAPT's effectiveness in preventing thrombotic events.

Locally, a few studies, such as those from the Pakistan Heart Journal, have explored the general use of antithrombotic agents, though there is little direct investigation into their impact specifically on interventional procedures. Our study fills this gap by providing data that directly addresses antithrombotic therapy's role in PCI and similar interventions in Pakistan. This can guide local practices and further inform the management of cardiovascular patients in our region.

The existing body of literature in Pakistan mostly focuses on the general use of aspirin or basic antiplatelet therapy. This study is unique as it evaluates not just the efficacy but also the safety profile of newer and dual antiplatelet regimens, addressing the clinical challenges

faced in interventional cardiology procedures in Pakistan. This makes our findings especially valuable in the local context.

This study is significant in the Pakistani context as it is one of the few to look at the effectiveness of combination therapy (DAPT) specifically in interventional cardiology, as opposed to general anticoagulant or antiplatelet therapy. There is a clear need for more studies addressing these nuances in Pakistan, which could be instrumental in shaping clinical guidelines for antithrombotic therapy in cardiovascular interventions.

The results of this study underscore the critical role of antiplatelet and antithrombotic therapies in enhancing the outcomes of interventional cardiology procedures. Specifically, DAPT has proven more beneficial in preventing thrombotic complications, such as stent thrombosis and acute myocardial infarction, which are major concerns following PCI. This supports the findings of Tscharre et al. (2020), who highlighted the efficacy of DAPT in reducing ischemic events.[2] However, the study also addresses the concern of bleeding risks associated with these therapies, a finding that aligns with the literature suggesting a trade-off between ischemic protection and bleeding risk.[10],[12]

The increasing use of novel antithrombotic agents, as discussed by Li et al. (2020), further complements our findings, as new therapies with improved safety profiles may help mitigate the bleeding risk associated with current antiplatelet agents.[15] While our study primarily focuses on established therapies like aspirin and P2Y12 inhibitors, the future incorporation of novel agents could enhance therapeutic outcomes by improving efficacy and safety.

Study Limitations and Future Directions:

Despite its strengths, this study has several limitations. The retrospective nature of the study means that it is dependent on pre-existing patient data, which may introduce bias or inaccuracies. The study was also limited by the inability to control for certain confounding variables, such as the timing of intervention and other comorbidities, which could impact the outcomes.

Future studies should aim to conduct prospective randomized controlled trials to validate these findings and to explore the long-term effects of DAPT in diverse patient populations. Additionally, more research is needed to explore the role of newer antiplatelet agents, such as CN-218, which may offer potent antithrombotic effects with fewer bleeding complications.[15] Studies incorporating a wider variety of interventional cardiological procedures and patient demographics, including high-risk groups like the elderly, would also be beneficial in providing a more comprehensive understanding of antithrombotic therapy's impact on clinical outcomes.

CONCLUSION

This study evaluated the role of antiplatelet and antithrombotic agents in enhancing the success of interventional cardiological procedures. The results indicate that DAPT significantly improves intervention success rates and reduces thrombotic complications compared to single-agent therapy. However, DAPT also carries a higher risk of bleeding, although this can be effectively managed in clinical practice. These findings align with the study's objective of investigating the impact of antithrombotic therapies on procedural outcomes in patients undergoing coronary interventions. The study supports the conclusion that DAPT should be the preferred regimen in interventional cardiology, particularly for reducing thrombotic events, while highlighting the importance of carefully managing bleeding risks. These findings provide a valuable contribution to the understanding of antithrombotic therapy in the local context and reinforce international clinical guidelines.

Future Recommendations

Future studies should focus on prospective randomized controlled trials to further validate these findings and explore the long-term benefits and risks of dual versus single-agent therapies. Additionally, research on newer antithrombotic agents with improved safety profiles could provide valuable insights into optimizing therapy for patients undergoing interventional cardiology procedures.

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