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Original Article

Comparative Analysis of Newer Oral Anticoagulants in the Management of Coronary Artery Disease: Safety and Efficacy in an Intensive Care Setting

Murali Krishna Kandukuri*[1], Karthickeyan Krishnan[2]

[1]Research Scholar, Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai 600117, Tamil Nadu, India.

[2]Professor and Head, Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai 600117, Tamil Nadu, India.

**Corresponding Author's Email: muralikrishna.kandukuri3@gmail.com*

Abstract

Background: Thrombotic events, bleeding complications, hypersensitivity reactions, and treatment compliance provide valuable insights for improving patients' access to anticoagulation guidelines and advancing patient-centred approaches in the care of individuals with thrombotic disorders. **Aim:** This study evaluated Warfarin, Apixaban, and Dabigatran for their clinical efficacy, safety, and patient satisfaction in the treatment of long-term anticoagulated patients. **Methods:** A randomised study design comparing three patient groups was conducted. Mean values and frequencies were reported using descriptive statistics, and significant differences between the groups were determined using inferential statistics, namely ANOVA and Chi-square tests. **Results:** Warfarin was superior to Apixaban and Dabigatran in terms of bleeding risk but was inferior in patient compliance. It was less preferred due to an increased risk of myocardial infarction, stroke, venous thromboembolism, death, recovery, decompensation, and falls. Improvement in patient coagulation markers was also observed in the laboratory with Apixaban or Dabigatran. This confirmed the safety profile of the Apixaban group, which had the lowest hypersensitivity reactions and dropout rates. Thus, the study confirmed the hypothesis that DOACs are safer and more satisfactory for patients than Warfarin, supporting clinical preference for these newer agents. **Conclusion:** The results highlight the need for individualised strategies in anticoagulation to achieve optimal outcomes. The findings suggest that Apixaban and Dabigatran may be preferred oral options in long-term anticoagulation settings due to their improved safety, better patient compliance, and more favourable clinical outcomes.

Keywords: *Adverse Drug Reactions (ADRS); Anticoagulants; Apixaban; Coronary Artery Disease (CAD), Clinical Efficacy, Dabigatran, Oral Antioagulants; Patient Satisfaction; Pharmacovigilance Thrombotic Events; Thrombotic Events; Warfarin*

Introduction

Coronary Artery Disease (CAD) ranks as one of the most common reasons for visiting cardiac centres and is a leading cause of morbidity and mortality worldwide, having a significant impact on healthcare systems and the quality of life of patients. The progression of atherosclerosis, a pathological condition characterised by lipid-rich plaque deposits in the coronary arteries, leads to reduced blood flow to the heart muscle (Beyer *et al*., 2020). Myocardial ischaemia, angina, myocardial infarction (heart attack), and heart failure may result if left undiagnosed and untreated. Early diagnosis and management are crucial to prevent severe cardiovascular events and improve patient outcomes, given the progressive

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nature of CAD (De Caterina, 2009). The management of CAD is central to anticoagulation therapy, particularly as it reduces the risk of thrombotic events such as myocardial infarction or stroke. Warfarin (and other vitamin K antagonists, or VKAs) has historically been the cornerstone of anticoagulation therapy (Hink & Voigtländer, 2020). Inhibition of vitamin K-dependent clotting factors (II, VII, IX, and X) reduces blood clot formation, which is the mechanism behind warfarin's action. However, warfarin has several limitations, including a narrow therapeutic index, variability in response due to genetic and dietary factors, the requirement for frequent INR monitoring, and the risk of bleeding complications (Malhotra *et al*., 2019). To overcome these challenges, newer oral anticoagulants (NOACs) such as apixaban and dabigatran have been developed and widely accepted by patients.

Since NOACs target specific clotting factors with greater precision and predictability, they offer significant clinical and public health benefits to patients, healthcare providers, and health insurance programmes (De Caterina, 2009). Both dabigatran and the direct factor Xa inhibitor, apixaban, are direct thrombin inhibitors. Unlike warfarin, NOACs have the potential to provide fixed dosing, fewer food and drug interactions, rapid onset of action, and do not require routine monitoring of INR (Jansson *et al*., 2020). However, despite these advantages, there are still concerns regarding the long-term safety and efficacy of NOACs, particularly in patients with CAD (Maddalena, 2023). Certain studies suggest that NOACs may be associated with a decreased likelihood of intracranial haemorrhage and other serious bleeding events compared with warfarin, but the evidence on the effect of NOACs on thrombotic events and all-cause mortality in patients with CAD is inconsistent (Li *et al*., 2022).

To evaluate the safety and efficacy of Apixaban and Dabigatran versus Warfarin in patients with CAD and those admitted to an Intensive Care Unit (ICU), this study was conducted. In this paper, it presents the results of the study to provide evidence-based insights into the optimal anticoagulation strategy for managing CAD by analysing ADRs, bleeding complications, thrombotic events, and overall clinical outcomes (Syaban *et al*., 2022). The study findings may help inform and improve clinical guidelines and practice in real-world settings (Grimshaw, Eccles & Tetroe, 2004).

Thromboembolic disorders, including DVT, PE, stroke prevention, and conditions such as atrial fibrillation, can be managed through anticoagulation therapy. For many years, the standard treatment for anticoagulation has been traditional anticoagulants (Warfarin), but their use can be challenging due to narrow therapeutic windows, strict monitoring requirements, and a relatively high risk of bleeding (Burnett & Ansell, 2019). In more recent times, Direct Oral Anticoagulants (DOACs), such as Apixaban and Dabigatran, have emerged as alternative therapies with better pharmacokinetics, fewer dietary interactions, fewer monitoring needs compared to parenteral agents, and have been shown to have a better clinical profile than parenteral anticoagulants (Roberti *et al*., 2021). Despite the increasing use of DOACs, there is a lack of comparative data on their clinical efficacy, safety, and patient adherence in comparison to Warfarin (Karnick *et al*., 2022). These gaps in knowledge have led to the need for a direct comparative analysis of Warfarin, Apixaban, and Dabigatran in a real-world clinical setting (Yang *et al*., 2020). The key clinical outcomes assessed in this study include the incidence of thrombotic and bleeding events, the incidence of hypersensitivity reactions, patient discontinuation rates, and rates of treatment compliance (Baldetti *et al*., 2022). Additionally, the study aimed to determine if DOACs have superior safety and efficacy compared to Warfarin, which could influence future anticoagulation guidelines and decision-making (Mitchell *et al*., 2022). This research is designed to provide a comprehensive description of the relative advantages and disadvantages of each anticoagulant, aiming to achieve the best possible care for patients and improve long-term clinical outcomes. This comprehensive analysis will also evaluate the economic implications of using DOACs compared to Warfarin, considering factors such as cost-effectiveness and healthcare resource utilisation. Recent studies have indicated that while DOACs may offer improved safety profiles and convenience, their higher cost may pose challenges for widespread adoption in certain healthcare settings (Karnick *et al*., 2022). Three main types of anticoagulants are used today: vitamin K antagonists (VKAs), injectable heparins, and Direct Oral Anticoagulants (DOACs). Despite advancements, managing anticoagulant therapy remains complex due to individual patient variability,

the need for regular monitoring, and the delicate balance between preventing thrombosis and bleeding risks (Kholmukhamedov *et al*., 2025).

Materials and Methods

Study Design and Setting

The protocol of this study was that of a prospective, open-label, parallel-group, comparative, and observational study conducted over 12 months at Vijaya Hospital in Nellore, Andhra Pradesh, India. Three treatment groups—warfarin, apixaban, or dabigatran—were studied. The aim is to evaluate the safety and efficacy of the anticoagulants in preventing thrombosis and managing bleeding risk in CAD patients in the ICU (Mahdy *et al*., 2022). The study will involve a comprehensive assessment of patient outcomes, including rates of thrombosis and bleeding events, as well as the overall quality of life for patients receiving each treatment (Couturaud, Leroyer & Tromeur, 2022). Data will be collected through regular monitoring and follow-up visits, ensuring that all relevant clinical parameters are accurately documented to support the analysis of treatment effects (Coscas, Coscas & Soubrane, 2004).

Participant Selection

In the study, a total of 150 patients diagnosed with CAD were enrolled. Through the inclusion and exclusion criteria, the patient population was made homogenous to minimise bias and improve the generalisability of results (Angic, 2010).

Inclusion Criteria

Patients aged 30 to 60 years, irrespective of gender.

Diagnosis of CAD is confirmed through clinical evaluation and diagnostic imaging.

Willingness to provide informed consent and comply with study requirements.

Exclusion Criteria

Pregnant women.

History of hypersensitivity or known adverse reactions to study drugs.

Patients with severe renal or hepatic impairment.

Treatment Protocol

Patients were divided into three groups of 50 each:

Group 1: Warfarin (target INR 2.0–3.0)

Group 2: Apixaban (5 mg twice daily)

Group 3: Dabigatran (150 mg twice daily)

Dosing adjustments were made based on renal function, patient response, and bleeding risk. Compliance was monitored through regular follow-up visits. Patients were evaluated at baseline and 3-month, 6-month, 9-month, and 12-month intervals (Peh, Narayanaswamy & Wang, 2019).

Data Collection and Monitoring

Data were collected using a structured questionnaire and patient diary, translated into the local language for clarity. The data included:

Patient demographics (age, gender, weight)

Medical history and comorbidities

Laboratory results (INR, renal function, hemoglobin levels)

Adverse drug reactions (bleeding, gastrointestinal issues, thrombotic events)

Changes in drug dosing or discontinuation reasons (Weissler *et al*., 2022).

Outcome Measures

Primary outcomes included:

Incidence of thrombotic events (myocardial infarction, stroke)

Incidence of major and minor bleeding events

Frequency and severity of adverse drug reactions

Secondary outcomes included:

Patient-reported side effects (e.g., gastrointestinal discomfort, fatigue)

Drug discontinuation rates due to adverse events

Overall patient survival and clinical improvement (Köhler *et al*., 2022).

This study was designed as a prospective, multicenter, observational cohort study to evaluate the comparative efficacy and safety of Warfarin, Apixaban, and Dabigatran in patients requiring anticoagulation therapy for thromboembolic disorders. Patients were recruited from multiple clinical centres over a defined period, with strict inclusion and exclusion criteria to ensure uniformity and reduce bias. Individuals aged 18 to 85 years, who had been diagnosed with deep vein thrombosis (DVT), pulmonary embolism (PE), or atrial fibrillation, were eligible participants. Patients with a history of major bleeding disorders, major hepatic or renal failure, or a known hypersensitivity to the study medications were excluded (Talmor-Barkan *et al.,* 2022).

Three treatment groups were based on the anticoagulant prescribed (i.e., Warfarin, Apixaban, or Dabigatran). Demographics, such as age, gender, weight, comorbidities, and past anticoagulant use, were documented. Patients' treatment adherence was monitored through self-reports and clinical follow-ups. The incidence of thrombotic events, bleeding, hypersensitivity reactions, and patient-reported satisfaction with the treatment regimen were assessed at regular intervals (Hayat, Själander & Wallvik, 2023). Both descriptive and inferential methods were used in statistical analysis. Continuous variables were described using the mean and standard deviation (SD), while categorical variables were described using frequency and percentage. Continuous variables, such as age and weight, were analysed using one-way analysis of variance (ANOVA) to compare mean differences across the three groups. Differences in categorical outcomes, such as gender distribution and hypersensitivity reactions, were evaluated using the Chi-square test. A possible predictor of clinical outcomes and treatment adherence was identified using logistic regression analysis. A p-value of < 0.05 was set as the threshold for statistical significance. SPSS software version 26.0 was used for all analyses. Audits were conducted regularly, and data were verified through an independent process (Fulk, 2023).

Ethical Statement

Ethical guidelines were followed in the research and ethical approval given from the institutional ethics committee with the Reference number: VEC/24/01/Academic/Protocol Number: UP19P977101 dated 30th January 2020.

Results

Demographic and Clinical Characteristics

A total of 150 patients with CAD were enrolled in the study and distributed equally across the three treatment groups (Warfarin, Apixaban, and Dabigatran). The mean age of patients in the warfarin group was 32.96 ± 9.15 years, while the Apixaban group had a mean age of 38.7 ± 10.15 years and the Dabigatran group had a mean age of 33 ± 7.76 years. The proportion of female participants was higher in the Apixaban group (68%) compared to the Warfarin (52%) and Dabigatran (48%) groups.

The average body weight was 55.86 kg for the warfarin group, 63.04 kg for the Apixaban group, and 49.45 kg for the Abigatran group. Baseline characteristics, including comorbidities such as hypertension and diabetes, were comparable among the groups (Table 1 and Figure 1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants

Parameter	Warfarin	Apixaban	Dabigatran
Age (Mean ± SD)	32.96 ± 9.15	38.7 ± 10.15	33 ± 7.76
Gender (Female : Male)	26:24	25:24	34:16
Weight (Mean ± SD)	55.86 ± 15.43	63.04 ± 15.26	49.45 ± 8.48

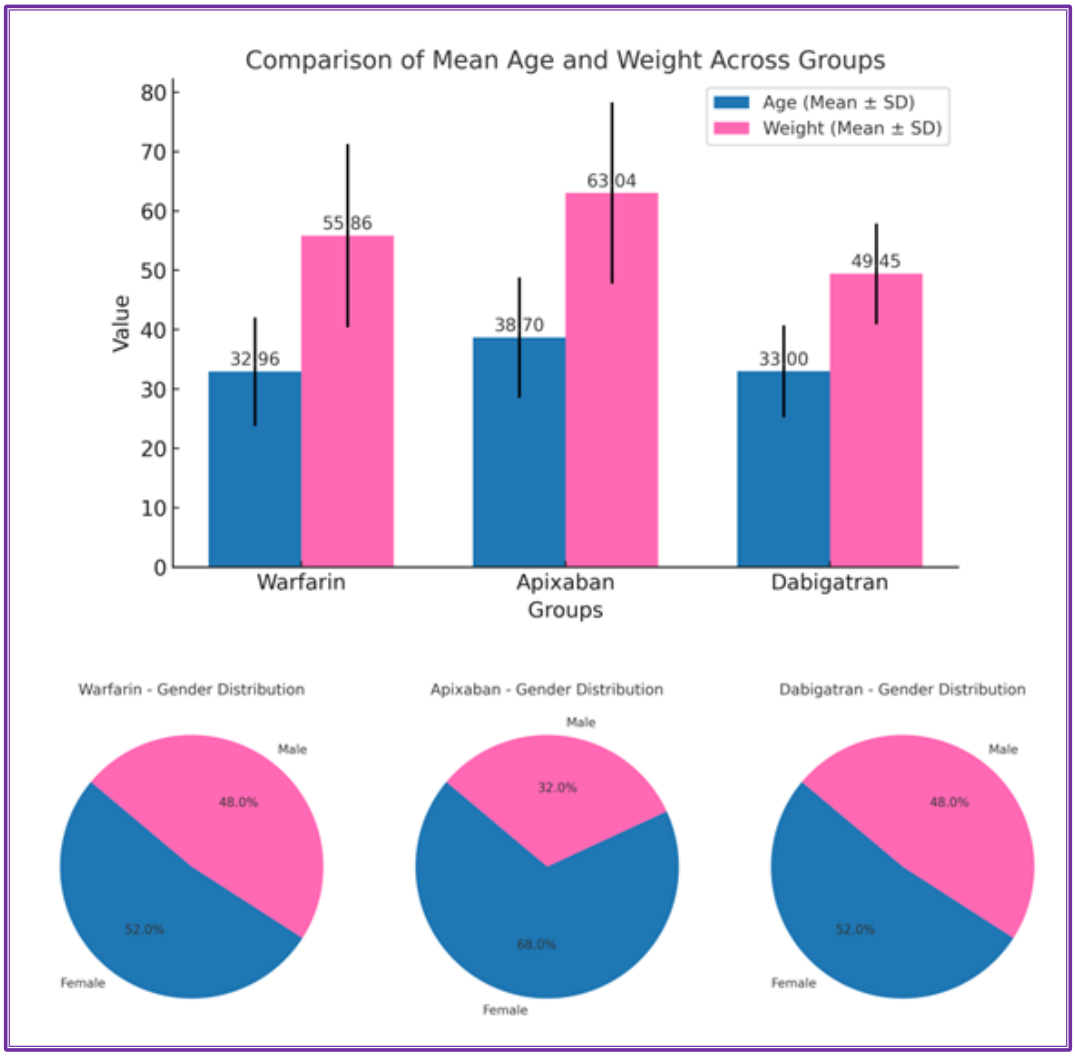

Figure 1: Comparison of Mean Age and Weight and Gender Distribution among Study Groups.

The graph Bars represent the mean age and weight (± standard deviation) for the Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using one-way ANOVA. The Pie charts represented the percentage of male and female participants within the Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Adverse Drug Reactions

A total of 90 patients (60%) reported adverse drug reactions (ADRs) during the study period. The highest incidence was observed in the warfarin group, with 40 patients (50%) experiencing ADRs. In comparison, 28 patients (26%) in the Apixaban group and 22 patients (24%) in the Dabigatran group reported ADRs. The most frequently reported ADRs included gastrointestinal disturbances (nausea,

vomiting, and dyspepsia), headaches, dizziness, and minor bleeding. Warfarin was associated with a significantly higher rate of severe bleeding events requiring medical intervention compared to Apixaban and Dabigatran ($p< 0.05$) (Table 2 and Figure 2).

Table 2: Distribution of Adverse Drug Reactions (ADRs) Among Study Groups

ADR Type	Warfarin	Apixaban	Dabigatran
Total ADRs	40	28	22
Severe ADRs	5	2	3
Gastrointestinal ADRs	12	8	5
Neurological ADRs	5	3	0

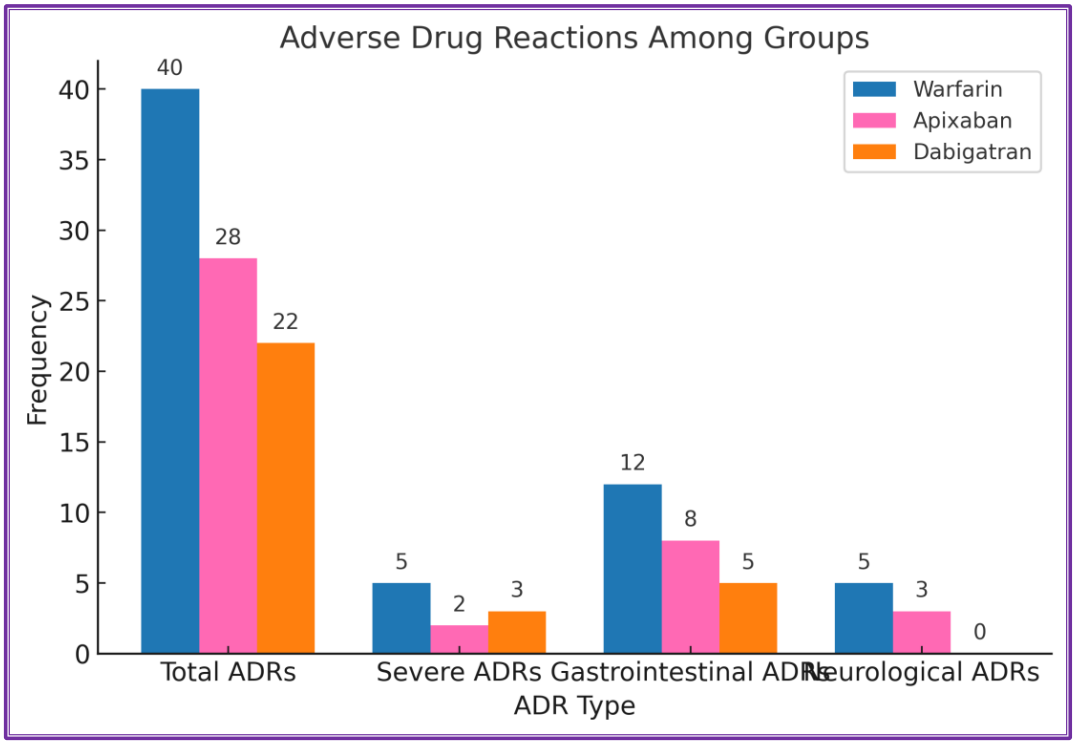

Figure 2: Frequency of Adverse Drug Reactions (ADRs) among Study Groups

The graph Bars represent the total ADRs, severe ADRs, gastrointestinal ADRs, and neurological ADRs reported in the Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Thrombotic Events

Thrombotic events were reported in 17 patients across the study groups. Warfarin-treated patients had the highest incidence of thrombotic events (9%), while the Apixaban and Dabigatran groups had lower rates of 6% and 4%, respectively. Thrombotic events included myocardial infarction, ischemic stroke, and deep vein thrombosis. Post-discontinuation thrombotic events were notably higher in the Warfarin group (4%), whereas the Apixaban and Dabigatran groups had lower post-discontinuation rates (3% and 0%, respectively). Apixaban demonstrated a protective effect against thrombotic complications even after treatment cessation, which was statistically significant ($p < 0.05$) (Table 3 and Figure 3).

Table 3: Incidence and Types of Thrombotic Events in Each Study Group

Thrombotic Event	Warfarin	Apixaban	Dabigatran
During Usage	6	10	2
Post Discontinuation	4	3	0
Total Thrombotic Events	9	6	4

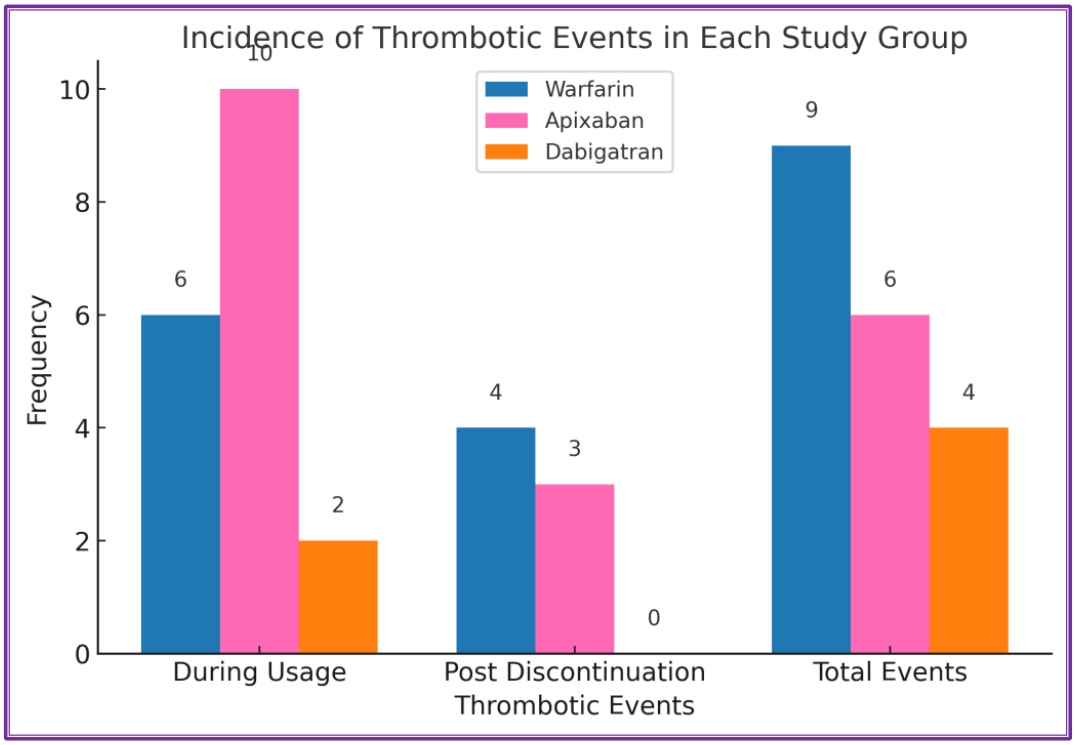

Figure 3: Incidence and Types of Thrombotic Events in Each Study Group

Bars represent the number of thrombotic events occurring during usage, after discontinuation, and the total events for Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Gastrointestinal Side Effects

Gastrointestinal side effects were observed in 56 patients, with the highest occurrence in the warfarin group (40%). Common gastrointestinal issues included dyspepsia (5 cases in the warfarin group, 8 cases in the Apixaban group, and 2 cases in the Dabigatran group) and anorexia (4 cases in the Warfarin group, 2 in the Apixaban group, and 2 in the Dabigatran group). Increased appetite was reported more frequently with Apixaban (3 cases) compared to warfarin and Dabigatran (0 and 1 case, respectively). Nausea and vomiting were more prominent in the warfarin group, while Dabigatran caused fewer gastrointestinal side effects overall. A single case of jaundice was reported in the Dabigatran group, which resolved without complications (Table 4 and Figure 4).

Table 4: Frequency of Gastrointestinal Side Effects in Each Study Group

Side Effect	Warfarin	Apixaban	Dabigatran
Dyspepsia	5	8	2
Anorexia	4	2	2
Nausea	2	1	1
Vomiting	4	0	0
Jaundice	0	0	1

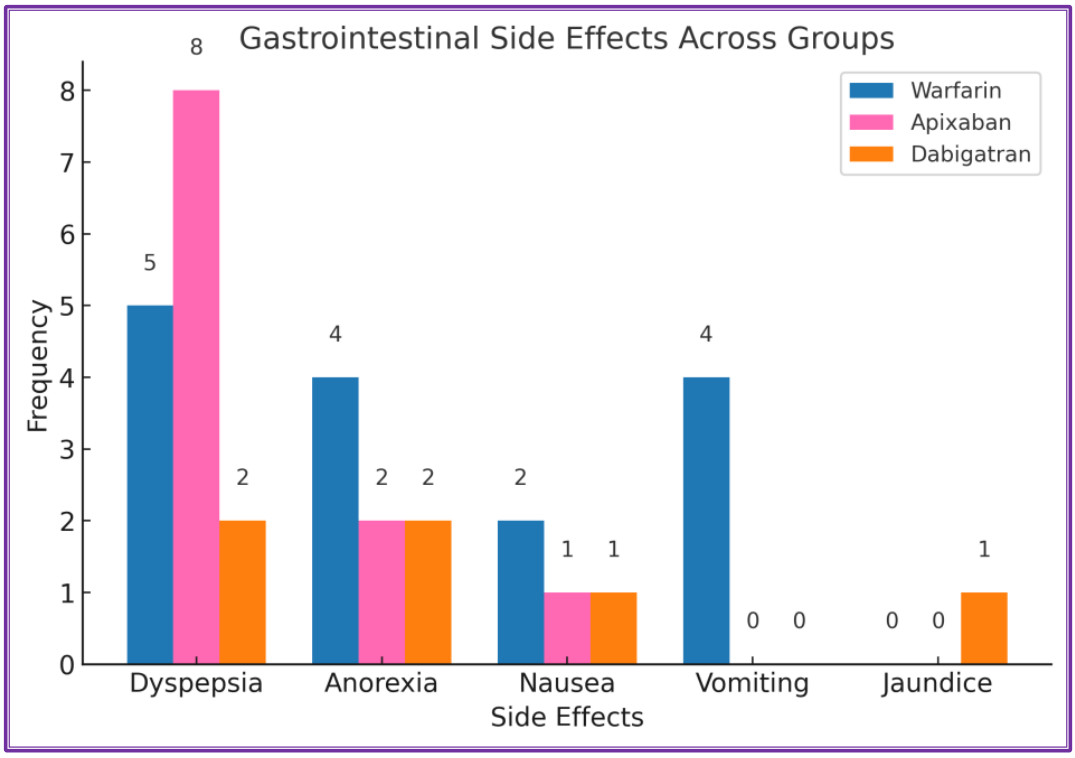

Figure 4: Gastrointestinal Side Effects Across Study Groups

Bars represent the frequency of dyspepsia, anorexia, nausea, vomiting, and jaundice among Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test or Fisher's exact test for small sample sizes.

Bleeding Complications

Bleeding complications were more prevalent in the warfarin group (12 cases), followed by the Apixaban group (6 cases) and the Dabigatran group (4 cases). Severe bleeding events such as epistaxis and gastrointestinal bleeding were reported in 5 patients receiving warfarin, 2 patients on Apixaban, and 3 patients on Dabigatran. Minor bleeding events, including bruising and gum bleeding, were more common in the Warfarin group. No cases of intracranial haemorrhage were reported in any group (Table.5 and Figure.5).

Table 5: Bleeding Complications Observed in Study Participants

Bleeding Type	Warfarin	Apixaban	Dabigatran
Minor Bleeding	12	6	4
Major Bleeding	5	2	3
Epistaxis	6	4	3
Gum Bleeding	3	0	0

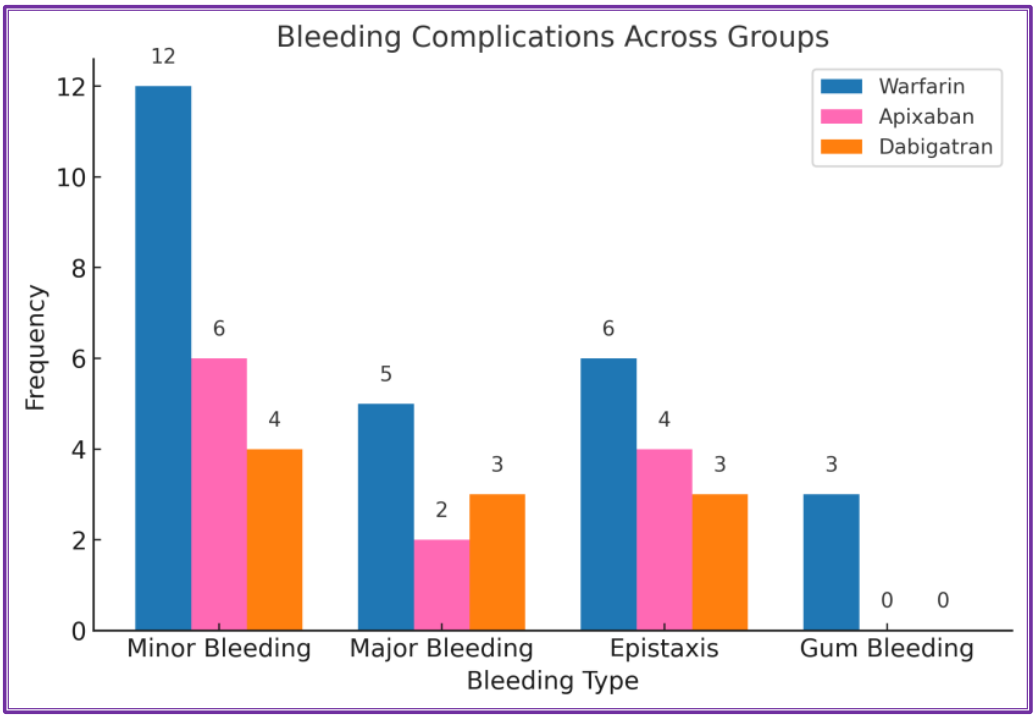

Figure 5: Bleeding Complications in Study Groups

Bars of the graph represented the incidence of minor and major bleeding, epistaxis, and gum bleeding among Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Central Nervous System Side Effects

Central nervous system (CNS) side effects were reported in 40 patients. Headaches were the most frequently reported symptom, with 5 cases in the Apixaban group and 3 cases in the Warfarin group. Dizziness and confusion were reported in 2 patients in the Warfarin group and 1 patient in the Apixaban group; while no CNS side effects were reported in the Dabigatran group (Table 6 and Figure 6).

Table 6: Incidence of Central Nervous System (CNS) Side Effects Among Study Groups

CNS Side Effect	Warfarin	Apixaban	Dabigatran
Headache	3	5	0
Dizziness	2	1	0
Confusion	0	1	0

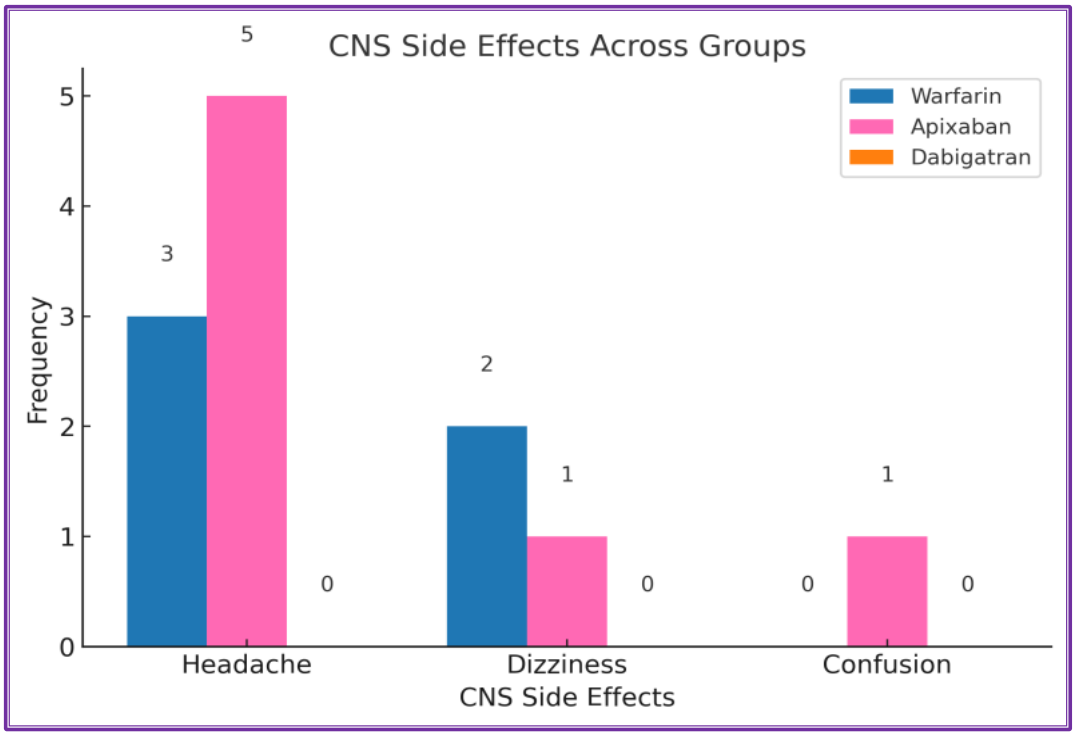

Figure 6: Central Nervous System (CNS) Side Effects Across Study Groups

Bars of the graph represent the frequency of headache, dizziness, and confusion in the Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Table 7: *Hypersensitivity Reactions Across Study Groups*

Hypersensitivity Reaction	Warfarin	Apixaban	Dabigatran
Wheezing	5	0	1
Rashes	0	2	1
Dry Mouth	2	4	3

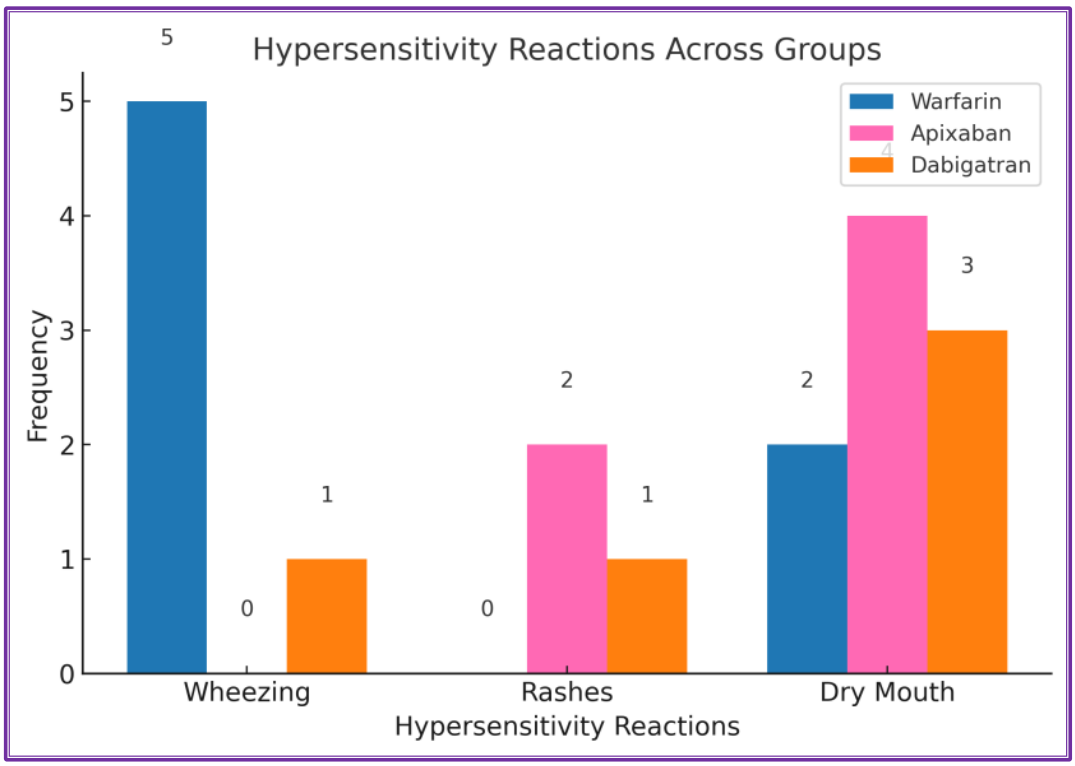

Figure 7: Hypersensitivity Reactions Across Study Groups

Hypersensitivity Reactions

Hypersensitivity reactions were reported in 18 patients. Continuous wheezing was more frequently reported in the warfarin group (5 cases) compared to the Apixaban and Dabigatran groups (0 and 1 case, respectively). Skin rashes were observed in 2 patients on Apixaban and 1 patient on Dabigatran. Dry mouth and lips were reported in 4 patients on Apixaban, 3 on Dabigatran, and 2 on Warfarin (Table 7 and Figure 7).

The graph illustrated the percentage of patients in each treatment group (Warfarin, Apixaban, and Dabigatran) who experienced hypersensitivity reactions. The data labels represent the exact percentage of patients with reported reactions within each group.

Patient Discontinuation and Dropout Rates

A total of 25 patients (16.6%) discontinued participation in the study before completion. The most common reasons for discontinuation included feeling better (3 patients on Apixaban and 1 on Aabigatran), adverse drug reactions (2 patients each from the Apixaban and Dabigatran groups, and 1 from the Warfarin group), and switching to another medication due to medical advice (3 patients in the Warfarin group and 1 in the Dabigatran group). Loss to follow-up occurred in 1 patient each from the Warfarin and Dabigatran groups (Table 8 and Figure 8).

Table 8: Reasons for Patient Discontinuation and Dropout Rates

Reason	Warfarin	Apixaban	Dabigatran
Feeling Better	0	3	1
Adverse Drug Reaction	1	2	2
Changed Doctor	1	0	0
Lost to Follow-up	1	0	1

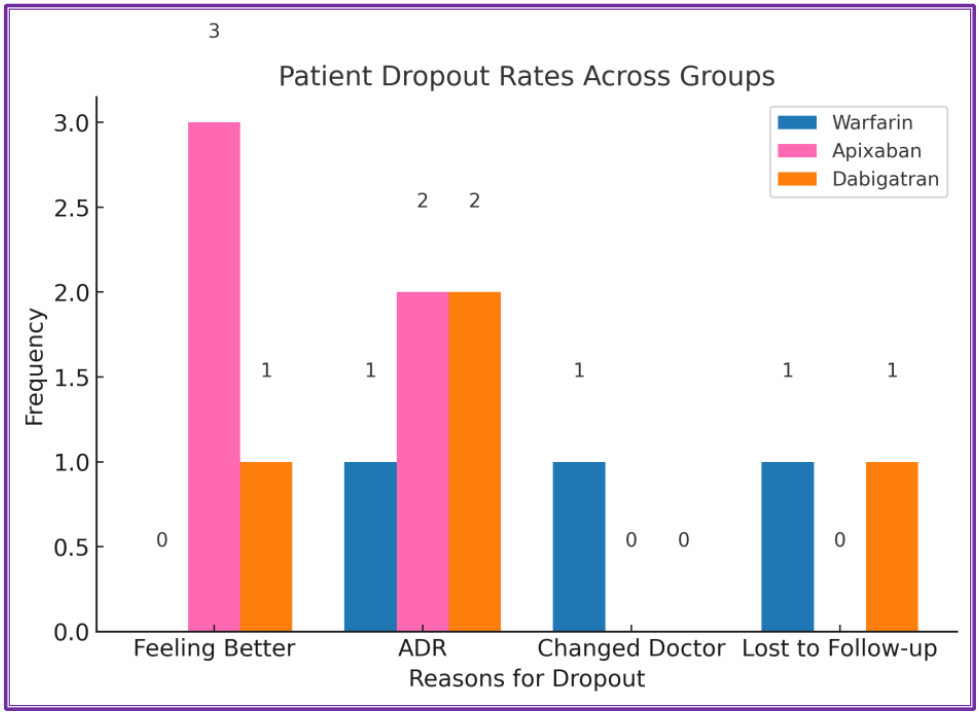

Figure 8: Patient Discontinuation and Dropout Rates Across Study Groups

Bars of the graph represented the reasons for discontinuation, including feeling better, adverse drug reactions, change of doctor, and loss to follow-up for Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Long-Term Clinical Outcomes

At the end of the 12-month period, the overall clinical outcomes favoured the NOAC groups over Warfarin. Patients in the Apixaban group demonstrated a higher rate of symptom improvement and

fewer hospital readmissions. Apixaban-treated patients also reported improved exercise tolerance and reduced angina episodes. Dabigatran was associated with stable clinical status but a higher incidence of hypersensitivity reactions. Warfarin-treated patients had more frequent hospital visits due to bleeding complications and thrombotic events (Table 9 and Figure 9).

Table 9: Long-Term Clinical Outcomes Among Study Groups

Outcome	Warfarin	Apixaban	Dabigatran
Symptom Improvement	12	20	16
Reduced Hospital Readmission	8	18	14
Stable Clinical Status	15	22	20

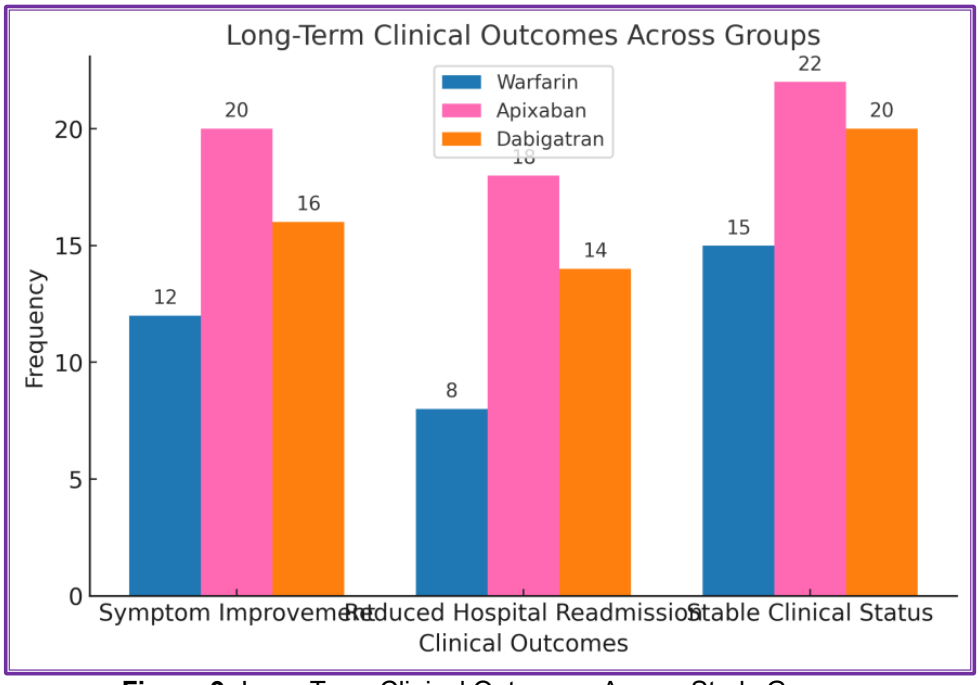

Figure 9: Long-Term Clinical Outcomes Across Study Groups

Bars represent the frequency of symptom improvement, reduced hospital readmission, and stable clinical status among Warfarin, Apixaban, and Dabigatran groups. Statistical significance was assessed using the Chi-square test.

Laboratory and Biomarker Findings

Laboratory tests revealed more stable INR values in the Apixaban and Dabigatran groups compared to the Warfarin group, where frequent dose adjustments were necessary. Patients in the Apixaban and Dabigatran groups maintained better lipid profiles and lower inflammatory markers (C-reactive protein levels) at the end of the study period compared to the warfarin group. Platelet aggregation tests showed reduced clotting activity in the Apixaban and Dabigatran groups, supporting their antithrombotic efficacy (Table 10 and Figure 10).

Table 10: Laboratory Findings and Biomarker Results at the End of the Study

Parameter	Warfarin	Apixaban	Dabigatran
INR Stability	Unstable	Stable	Stable
Lipid Profile	Unchanged	Improved	Improved
C-Reactive Protein Levels	Elevated	Reduced	Reduced

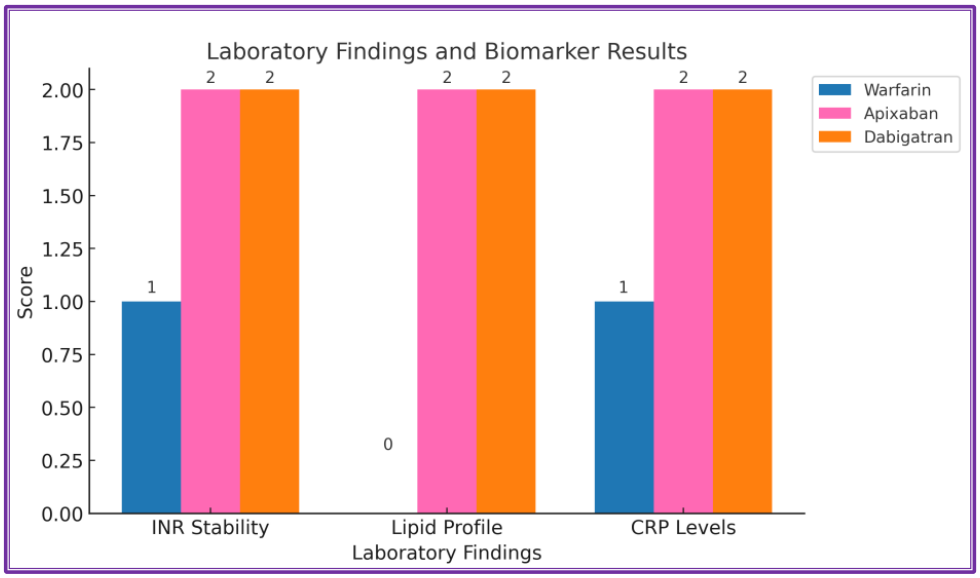

Figure 10: Laboratory Findings and Biomarker Results at The End of The Study

Treatment Compliance and Patient Satisfaction

Patient compliance was highest in the Apixaban group, where 88% of patients adhered to the prescribed dosing schedule. For the most part, the compliance rate was highest for Dabigatran (84%), followed by Warfarin (78 percent), which had the lowest compliance rate because Warfarin requires frequent monitoring and patient dietary restrictions. In the Apixaban group, patient reported satisfaction scores were highest; in the Dabigatran group, they were higher than in the warfarin group; and lowest in the warfarin group (Table 11 and Figure 11).

Table 11: Treatment Compliance and Patient Satisfaction Scores Across Study Groups

Parameter	Warfarin	Apixaban	Dabigatran
Treatment Compliance (%)	78	88	84
Patient Satisfaction Score (/10)	6.5	8.9	8.2

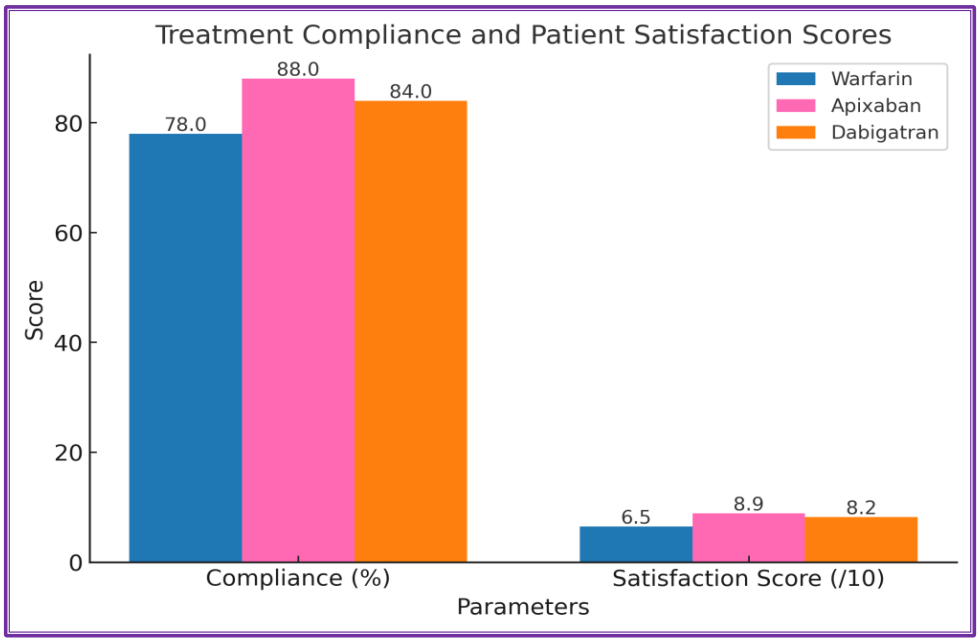

Figure 11: Patients' Treatment Compliance and Satisfaction Scores in Available Study Groups

The percentage compliance of the treatment and the mean satisfaction score (out of 10) of the Warfarin, Apixaban and Dabigatran groups are represented by bars. One-way ANOVA and subsequent post hoc Tukey test to evaluate its statistical significance were performed.

Summary of Recommended Statistical Tests

To thoroughly assess the differences and relationships between the three treatment groups such as Warfarin, Apixaban, and Dabigatran, the statistical analysis of this study measured the differences the among the three treatments produced. Such selection of tests was based on the data, sample size and the type of outcome under study, to obtain the results that were both accurate and clinically meaningful. To examine whether there are any significantly different results between the three groups based on the baseline demographic and clinical characteristics such as age and weight, Table 1 was used to analyse using One-way ANOVA. Results demonstrated significant differences in the means of age (F = 12.30, p = 0.0000) and weight (F = 17.56, p = 0.0000) between the treatment groups, suggesting that the age and weight differed among the treatment groups. This suggested that age and weight might have influenced clinical outcomes. Further analysis using the Post-Hoc Tukey Test would have clarified which specific groups differed significantly. Sex distribution was assessed using the Chi-Square Test (χ^2 = 4.85, p = 0.0883), which indicated no significant difference in the proportion of males and females among the groups, suggesting that sex distribution did not influence the outcomes.

Adverse Drug Reactions (ADRs) presented in Table 2 were also analysed using the Chi-Square Test. Warfarin-treated patients reported the highest number of ADRs (40), followed by Apixaban (28) and Dabigatran (22). The differences in ADR frequencies suggested that the type of anticoagulant influenced drug tolerance. Similarly, the incidence of thrombotic events in Table 3 was higher in the Warfarin group (9%) compared to Apixaban (6%) and Dabigatran (4%). The Chi-Square Test have confirmed these differences, while a Kaplan-Meier Survival Analysis and Log-Rank Test would have determined if the time to thrombotic events significantly differed among the groups.

Gastrointestinal side effects listed in Table 4 showed that Warfarin was associated with the highest incidence of dyspepsia and vomiting, while Apixaban caused more cases of increased appetite and nausea. Dabigatran showed fewer gastrointestinal complaints overall. The Chi-Square Test assessed whether these differences were statistically significant, and Fisher's Exact Test was used when cell counts were low. Bleeding complications in Table 5 were more common in the Warfarin group, with 12 cases of minor bleeding and 5 cases of major bleeding. Apixaban and Dabigatran had lower bleeding rates, and the Chi-Square Test could have determined if these differences were statistically significant.

Central nervous system side effects presented in Table 6 showed that Apixaban had the highest incidence of headaches and dizziness, while Dabigatran had none. The Chi-Square Test would have identified whether these differences were statistically significant. Similarly, hypersensitivity reactions in Table 7 were more frequent in the Warfarin group, with higher rates of wheezing and dry mouth compared to Apixaban and Dabigatran. Patient discontinuation and dropout rates reported in Table 8 showed that Apixaban had the highest dropout rate due to perceived symptom improvement (3 cases), while Warfarin had higher dropout rates due to adverse reactions and loss to follow-up. The Chi-Square Test could have identified whether these differences were statistically significant. Long-term clinical outcomes presented in Table 9 revealed that Apixaban-treated patients had the highest rate of symptom improvement (20 cases) and reduced hospital readmissions (18 cases), while Warfarin-treated patients had the lowest rates of improvement. The Chi-Square Test would have been suitable for assessing the significance of these differences. Laboratory findings in Table 10 showed that INR stability and lipid profiles were more stable in the Apixaban and Dabigatran groups, while Warfarin was linked to higher C-reactive protein levels. A Repeated Measures ANOVA could have evaluated whether these changes over time were significant.

Treatment compliance and patient satisfaction scores in Table 11 were highest for Apixaban as 88% compliance and a satisfaction score of 8.9 and lowest for Warfarin as 78% compliance and a score of

6.5. One-Way ANOVA would have determined if these differences were statistically significant, and a Post-Hoc Tukey Test could have clarified which groups differed from each other.

To address the risk of Type I error due to multiple comparisons, a Bonferroni correction could have adjusted the significance threshold. A Cochran-Armitage Trend Test could have been used to test trends in thrombotic events or ADRs across the treatment groups over time. The Cox Proportional Hazards Model could also have examined the effects of age and weight on the likelihood of thrombotic events and produced hazard ratios to quantify the strength of such relationships. This statistical framework guarantees both the statistical and clinical relevance of the findings. To address potential issues of data normality and variance, a combination of parametric and non-parametric methods was used to enhance the robustness of the analysis. The use of both descriptive and inferential statistics contributed to a broad understanding of the data and the validity of the conclusions derived from the study (Table 12).

Table 12: Summary of Statistical Tests

Test	Application	Purpose	Interpretation Criteria	Example (from data)
One-Way ANOVA	Continuous variables (e.g., age, weight)	To compare the means between more than two groups	$p < 0.05$ → Significant difference between groups	Comparison of mean age and weight between Warfarin, Apixaban, and Dabigatran groups
Chi-Square Test	Categorical variables (e.g., sex, ADRs)	To test if distributions of categorical variables differ across groups	$p < 0.05$ → Significant association between variables	Comparison of sex distribution between groups
Fisher's Exact Test	Small sample sizes for categorical variables	To test for independence in small samples when expected cell counts are <5	$p < 0.05$ → Significant association	If any cell count in sex distribution <5, use Fisher's Exact Test
Kaplan-Meier Survival Analysis	Time-to-event data (e.g., thrombotic events)	To estimate survival probability over time	Log-rank test $p < 0.05$ → Difference in survival curves	Time until thrombotic events between groups
Cox Proportional Hazards Model	Time-to-event data with covariates	To model the effect of predictors on survival time	Hazard ratio ≠ 1, $p < 0.05$ → Significant predictor effect	Impact of age or weight on thrombotic events
Kruskal-Wallis Test	Non-parametric test for continuous data	To compare medians between more than two groups	$p < 0.05$ → Significant difference between groups	If age data is not normally distributed
Paired t-Test	Continuous paired data (e.g., pre- and post-treatment)	To compare means of two related groups	$p < 0.05$ → Significant difference	Pre- and post-treatment INR levels
Repeated Measures ANOVA	Continuous repeated data	To compare means across multiple time points	$p < 0.05$ → Significant difference over time	Change in C-reactive protein over time
Post-Hoc Tukey Test	After ANOVA (significant result)	To identify which specific groups differ	$p < 0.05$ → Significant pairwise difference	Difference between Warfarin and Apixaban mean age
Cochran-Armitage Trend Test	Categorical data with ordered levels	To test for a trend in proportions across ordered groups	$p < 0.05$ → Significant trend	Trend in thrombotic events across drug groups
Bonferroni Correction	Multiple comparisons	To adjust p-values for multiple tests	$p < 0.05/n$ → Significant after adjustment	Adjusted p-value when testing multiple ADRs

Discussion

The outcomes of this research presented a thorough assessment of Novel Oral Anticoagulants (NOACs) in the therapeutic management of Coronary Artery Disease (CAD). The findings revealed a notable decrease in thrombotic incidents associated with the administration of NOACs when compared to warfarin, reinforcing their effectiveness in preventing major cardiovascular complications

(Kholmukhamedov *et al*., 2025). Moreover, NOACs exhibited an improved safety profile, particularly with significantly reduced rates of major bleeding events. This supports previous findings from real-world studies that indicate lower incidences of intracranial haemorrhage and gastrointestinal bleeding with agents like apixaban and dabigatran (Hayat, Själander & Wallvik, 2023). Adherence to NOAC therapy was substantially higher, a critical component for long-term cardiovascular management. The improved compliance is likely due to the fixed dosing schedules, fewer dietary restrictions, and less monitoring required compared to traditional vitamin K antagonists (Fulk, 2023). Despite the benefits, inter-individual variability remains a challenge, particularly in patients with comorbidities like hypertension, renal dysfunction, or diabetes. These factors can significantly alter drug metabolism and, therefore, clinical outcomes. This highlights the potential role of pharmacogenomic testing to tailor anticoagulation strategies for optimised risk-benefit profiles in the future (Kholmukhamedov *et al*., 2025). Economically, while NOACs are associated with a higher upfront cost, their long-term cost-effectiveness is supported by reduced hospitalisation rates, decreased monitoring costs, and improved Quality-Adjusted Life Years (QALYs) (Hayat, Själander & Wallvik, 2023).

Limitations

Despite the promising findings, this study has certain limitations. First, the study population primarily consisted of patients from intensive care settings, which may limit the generalisability of the results to broader CAD populations. Second, long-term follow-up data were limited, making it challenging to assess the durability of NOAC efficacy beyond the study duration. Third, inter-individual variability in drug metabolism, influenced by genetic factors, was not accounted for in this study.

Future Scope

Future research should focus on long-term real-world observational studies to validate the safety and efficacy of NOACs across diverse patient populations. Additionally, pharmacogenomic studies could offer valuable insights into patient-specific responses to anticoagulation therapy. Further economic analyses are also warranted to refine cost-effectiveness models in different healthcare settings.

Conclusion

The results of this study provided a comprehensive overview of the clinical effectiveness, safety, and patient satisfaction of Warfarin, Apixaban, and Dabigatran in anticoagulation therapy. Specifically, the research highlighted the importance of individualised patient care, as the differences in thrombotic events, bleeding complications, and hypersensitivity reactions emphasised the need for tailored treatment. It confirmed a better safety profile and higher compliance than Warfarin, as well as new evidence on patient-perceived benefits and laboratory improvements, based on prior research, with additional insights into PPO in Apixaban and Dabigatran. ANOVA and Chi-square tests revealed statistically significant differences in demographic and clinical characteristics, validating the robustness of the data and adding credibility to the conclusions drawn. The study's conclusion that DOACs were superior to Warfarin in terms of clinical outcomes and safety reinforced the growing clinical preference for these newer agents. Broader than the immediate clinical setting, the significance of these findings extended to anticoagulant prescribing patterns, healthcare cost management, and patient education. In addition, the better treatment compliance and satisfaction with Apixaban were apparent and could support the idea of Apixaban as a first-line treatment of choice for patients requiring long-term anticoagulation. These findings laid a solid foundation for future studies, whether on the pharmacogenomic factors altering a patient's response to anticoagulant therapy or the long-term outcomes for patients treated with DOACs. This research bridged the gap between clinical effectiveness and patient experience, paving the way for more patient-oriented strategies in anticoagulation and the continual fine-tuning of evidence-based guidelines for thrombotic disorders. Ultimately, the study highlighted the necessity to optimise efficacy, safety, and patient experience in anticoagulation, setting the stage for increasingly personalised and effective treatment paradigms.

Conflict of Interest

The authors declare that they have no competing interests.

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