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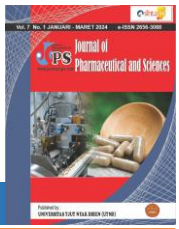

Effectiveness of Anticoagulant Therapy on Coagulation Parameters in Patients with Ischemic Stroke: A Retrospective Study at Dr. M. Djamil General Hospital, Padang

Efektivitas Terapi Antikoagulan terhadap Parameter Koagulasi pada Pasien Stroke Iskemik: Studi Retrospektif di RSUP Dr. M. Djamil Padang

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Abstract

Introduction: Ischemic stroke is a major cause of global morbidity and mortality, with anticoagulant therapy being the primary choice for secondary prevention in specific cases. However, scientific evidence regarding the effectiveness of anticoagulant therapy in the Indonesian population remains limited. **Objective:** To evaluate the effectiveness of anticoagulant therapy based on changes in coagulation parameters (PT, APTT, INR) and their association with clinical outcomes in ischemic stroke patients at Dr. M. Djamil General Hospital, Padang. **Methods:** This retrospective analytical observational study included 68 ischemic stroke patients who received anticoagulant therapy (January–December 2024). Effectiveness was assessed by comparing PT, APTT, and INR before and after treatment using the Wilcoxon and Kruskal-Wallis tests. **Results:** Anticoagulant therapy significantly increased PT, APTT, and INR values in most treatment groups ($p<0.05$), with no significant differences among anticoagulant types ($p>0.05$). Patients with mortality outcomes showed greater increases in coagulation parameters, but a significant association was observed only for changes in APTT ($p=0.033$). **Conclusion:** Anticoagulant therapy effectively affects coagulation parameters in ischemic stroke patients, and increased APTT after therapy is associated with mortality. Further prospective studies are needed to confirm these findings.

Keywords: Ischemic stroke; anticoagulants; effectiveness; mortality.

Abstrak

Pendahuluan: Stroke iskemik merupakan penyebab utama morbiditas dan mortalitas global, dengan terapi antikoagulan menjadi pilihan utama untuk pencegahan sekunder pada beberapa kasus tertentu. Namun, bukti ilmiah mengenai efektivitas terapi antikoagulan pada populasi di Indonesia masih terbatas. **Tujuan:** Mengevaluasi efektivitas terapi antikoagulan berdasarkan perubahan parameter koagulasi (PT, APTT, INR) serta hubungannya dengan luaran klinis pada pasien stroke iskemik di RSUP Dr. M. Djamil Padang. **Metode:** Studi observasional analitik retrospektif melibatkan 68 pasien stroke iskemik yang menerima antikoagulan (Januari–Desember 2024). Efektivitas dinilai dari perubahan PT, APTT, dan INR sebelum dan sesudah terapi menggunakan uji Wilcoxon dan Kruskal-Wallis. **Hasil:** Terapi antikoagulan meningkatkan PT, APTT, dan INR secara signifikan pada sebagian besar kelompok ($p<0,05$), tanpa perbedaan signifikan antartipe antikoagulan ($p>0,05$). Pasien dengan luaran meninggal menunjukkan peningkatan parameter koagulasi yang lebih tinggi, namun hubungan yang signifikan hanya ditemukan pada perubahan APTT ($p=0,033$). **Kesimpulan:** Terapi antikoagulan efektif memengaruhi parameter koagulasi pada pasien stroke iskemik, dan peningkatan APTT setelah terapi berhubungan dengan mortalitas. Penelitian prospektif lebih lanjut diperlukan untuk mengonfirmasi temuan ini.

Kata Kunci: Stroke iskemik, antikoagulan, efektivitas, dan mortalitas.

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Introduction

Stroke is defined as a sudden focal neurological disorder caused by ischemia or intracerebral hemorrhage, resulting in permanent brain tissue damage and potentially leading to death [1]. Globally, stroke remains a major public health problem. According to the Global Burden of Disease (GBD) 2021 study, stroke ranks as the second leading cause of death and the third leading cause of combined disability and mortality, accounting for more than 160 million disability-adjusted life years (DALYs) lost annually. This burden has increased substantially since 1990, with 93.8 million people living with a history of stroke and 11.9 million new cases reported in 2021 [2]. In Indonesia, the significance of this problem is highlighted by the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia/SKI), which reported a stroke prevalence of 8.3 per 1,000 population [3]. This high burden is further exacerbated by challenges in stroke management, including a shortage of specialists, limited adherence to clinical protocols among healthcare professionals, and inadequate public awareness, all of which contribute to delays in treatment [4].

Ischemic stroke, which accounts for approximately 87% of all stroke cases [2], occurs as a result of cerebral blood flow obstruction, most commonly due to thrombosis or embolism [5]. One subtype frequently associated with sudden onset and severe clinical manifestations is cardioembolic stroke, which is commonly caused by atrial fibrillation [6,7]. For this subtype, the Indonesian Neurological Association guidelines recommend anticoagulant therapy as the primary strategy for secondary prevention, given its effectiveness in reducing the risk of recurrent stroke, in contrast to antiplatelet therapy, which is primarily targeted at atherosclerotic processes [8]. Anticoagulant therapy includes vitamin K antagonists (warfarin) and direct oral anticoagulants (DOACs). Although warfarin is effective, it requires routine monitoring of the International Normalized Ratio (INR). In contrast, DOACs, such as dabigatran and rivaroxaban, offer greater convenience without the need for regular monitoring, potentially improving patient adherence [9]. The effectiveness of anticoagulant therapy is objectively assessed using coagulation parameters, including Prothrombin Time (PT) and INR to monitor the extrinsic pathway, particularly in patients receiving warfarin, and Activated Partial Thromboplastin Time (APTT) to evaluate the intrinsic pathway, especially in patients receiving heparin [10].

However, applying global evidence to the Indonesian population faces several critical challenges. First, most studies evaluating the effectiveness of anticoagulant therapy have been conducted in Western populations, which differ substantially from Indonesian patients in terms of demographic characteristics, genetic background, and disease patterns [19,20]. Evidence from Asian populations has demonstrated a higher risk of intracranial hemorrhage at standard anticoagulant doses, suggesting that direct generalization of findings from Western studies may not be appropriate [21,22]. Second, the response to anticoagulant therapy varies considerably among individuals and is influenced by factors such as age, organ function, comorbidities, and genetic variations, highlighting the need for local evidence to support safe and effective treatment strategies [11]. Unfortunately, studies addressing this issue in Indonesia remain limited and are generally descriptive, with relatively small sample sizes, thereby providing insufficient evidence to support robust clinical decision-making [12].

RSUP Dr. M. Djamil Padang has experienced a substantial increase in ischemic stroke cases, from 209 cases in 2021 to 416 cases in 2022 [13]. This trend underscores the urgent need for local scientific evidence to guide clinical practice. Therefore, this study was conducted to evaluate the effectiveness of anticoagulant therapy based on coagulation parameters (PT, APTT, and INR) among patients with ischemic stroke treated at Dr. M. Djamil General Hospital, Padang. By providing empirical evidence regarding treatment response in the Indonesian population, this study is expected to address existing knowledge gaps, support the implementation of evidence-

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based therapy tailored to local patient characteristics, and ultimately contribute to improved clinical outcomes and a reduction in the national burden of stroke.

Methods

This study was an analytical observational study with a retrospective design conducted at the Medical Record Unit and Neurology Inpatient Ward of Dr. M. Djamil General Hospital, Padang. Data were obtained from manual and electronic medical records and the Hospital Management Information System (SIMRS) for ischemic stroke patients hospitalized between January and December 2024.

The study sample was selected using a purposive sampling method based on predefined inclusion and exclusion criteria. The inclusion criteria were patients diagnosed with ischemic stroke (ICD-10 code I63), aged ≥18 years, who received anticoagulant therapy during hospitalization and had complete laboratory data, including Prothrombin Time (PT), Activated Partial Thromboplastin Time (APTT), and International Normalized Ratio (INR), measured before and after anticoagulant administration. The exclusion criteria included patients with incomplete medical records that precluded data analysis and patients who did not receive anticoagulant therapy during hospitalization. Of the 592 recorded ischemic stroke patients, 68 met the eligibility criteria and were included in the final analysis.

The variables assessed included sociodemographic characteristics (age, sex, educational level, and occupation), clinical characteristics (length of hospital stay, comorbidities, and clinical outcomes), type of anticoagulant therapy, and coagulation parameters (PT, APTT, and INR) measured before and after treatment. The effectiveness of anticoagulant therapy was evaluated by changes in coagulation parameters following treatment. In addition, analyses were performed to assess the association between changes in PT, APTT, and INR and clinical outcomes, including mortality among patients with ischemic stroke.

This study received ethical approval from the Health Research Ethics Committee of RSUP Dr. M. Djamil, Padang (No. DP.04.03/D.XVI.10.1/477/2025). Data were analyzed using SPSS version 26.0. Normality was assessed using the Shapiro–Wilk test. Differences in coagulation parameters before and after treatment were analyzed using the paired t-test for normally distributed data or the Wilcoxon signed-rank test for non-normally distributed data. Comparisons between groups were performed using the Mann–Whitney or Kruskal–Wallis tests, with a statistical significance level of $p<0.05$.

Results and Discussion

A total of 68 ischemic stroke patients receiving anticoagulant therapy at RSUP Dr. M. Djamil, Padang, between January and December 2024, were retrospectively analyzed. The results are presented in three sections: patient characteristics, anticoagulant utilization profile, and the effectiveness of anticoagulant therapy based on Prothrombin Time (PT), Activated Partial Thromboplastin Time (APTT), and International Normalized Ratio (INR) parameters.

Based on Table 1, ischemic stroke patients receiving anticoagulant therapy at Dr. M. Djamil General Hospital, Padang, were predominantly older adults (52.9%). This finding is consistent with the theory that aging induces vascular changes, including reduced arterial elasticity and increased vascular stiffness, which contribute to atherosclerosis and thrombogenesis [14]. The present findings are also consistent with the study by Diansari et al., which reported that most patients with coagulation disorders were older. Aging is associated with alterations in the hemostatic system, characterized by elevated coagulation factor levels and reduced fibrinolytic activity. These changes promote thrombus formation and consequently increase the risk of thromboembolic diseases, including ischemic stroke [15].

Based on sex, male patients were more prevalent (58.8%) than female patients (41.2%). This finding is comparable to that reported by Yan et al., who observed a higher prevalence of stroke among males [16]. Hormonal differences, particularly the protective effect of estrogen on endothelial function in women, may explain this pattern, although the risk of stroke increases in women after menopause [17].

Most patients had a moderate level of education (57.4%). Educational attainment plays an important role in disease awareness and adherence to anticoagulant therapy, a regimen that requires careful monitoring [5]. Regarding employment status, the majority of patients were employed (63.2%). Employment status may theoretically influence health through physical activity and stress-related factors, whereas unemployed individuals may be at increased risk of thrombosis due to blood flow stasis [18].

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Table 1. Sociodemographic Characteristics of Ischemic Stroke Patients (n = 68)

Characteristics	Category	Number of respondents	Percentage (%)
Age	Adults (18 - 59 years)	32	47.1
	Older Adults (≥60 years)	36	52.9
Sex	Male	40	58.8
	Female	28	41.2
Highest Educational Attainment	Low (No Formal Education - Elementary School)	14	20.6
	Secondary (Junior High School - Senior High School)	39	57.4
	Higher (Academy - University)	15	22.1
Employment Status	Employed	43	63.2
	Unemployed	25	36.8
Length of Hospital Stay (Days)	1-7	39	57.4
	8-14	18	26.5
	>14	11	16.2
Comorbidities	None	4	5.9
	1-3 Comorbidities	54	79.4
	>3 Comorbidities	10	14.7
Clinical Outcomes	Improved	54	79.4
	Deceased	14	20.6

Clinically, most patients had a short hospital stay (1–7 days; 57.4%), indicating relatively stable clinical conditions and mild disease severity [18]. Comorbidities were present in the majority of patients, with 79.4% having one to three comorbid conditions, supporting the notion that stroke rarely occurs as an isolated disease [19]. This finding is consistent with previous reports indicating that 75–99% of stroke patients have comorbidities such as hypertension and diabetes mellitus, particularly among older adults [20]. Clinical outcomes improved in 79.4% of patients, and the mortality rate was 20.6%. This finding is comparable to that reported by Xian et al., who demonstrated that anticoagulant therapy, including warfarin, was associated with reduced mortality [21].

Table 2. Most Common Comorbidities Among Ischemic Stroke Patients (n = 68)

No.	Comorbidity Diagnosis	Number of Patients	Percentage of Total Patients (%)
1	Type 2 Diabetes Mellitus	31	45.6
2	Hypertensive Heart Disease	28	41.2
3	Dyslipidemia	11	16.2
4	Atrial Fibrillation	10	14.7
5	Chronic Kidney Disease	9	13.2
6	Community-Acquired Pneumonia	6	8.8
7	Hyperuricemia	4	5.9
8	Congestive Heart Failure	4	5.9
9	Tricuspid Regurgitation	4	5.9
10	Vasculitis	3	4.4

Type 2 diabetes mellitus and hypertensive heart disease were the most frequently observed comorbidities among patients with ischemic stroke in this study. This finding is consistent with the study by Nisila et al. (2025), which reported that metabolic and cardiovascular disorders play important roles in the development of ischemic stroke [12]. However, atrial fibrillation, one of the primary indications for anticoagulant therapy in patients with ischemic stroke, was identified in only 14.7% of patients. This study did not evaluate in detail the specific indications for anticoagulant therapy in all patients; therefore, the appropriateness of anticoagulant use according to clinical indications could not be comprehensively assessed.

The profile of anticoagulant use by route of administration is presented in Table 3. Anticoagulant therapy was predominantly administered subcutaneously (enoxaparin) in 37 patients (54.4%), followed by orally (warfarin) in 22 patients (32.4%) and intravenously (heparin) in 7 patients (10.3%). Rivaroxaban and a combination of rivaroxaban and edoxaban were each prescribed in 1 patient (1.5%).

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The predominance of enoxaparin use during the acute phase of ischemic stroke is consistent with the findings of Sherman et al., who reported that low-molecular-weight heparin (LMWH) is more frequently used because it is more effective than unfractionated heparin in preventing venous thromboembolic events in patients with acute ischemic stroke, without significantly increasing the risk of bleeding. In addition, its once-daily administration makes it more practical for routine clinical use [22].

Table 3. Profile of Anticoagulant Use Based on Route of Administration

Anticoagulant	Route of Administration	Number of Patients	Percentage (%)
Heparin	Intravenous	7	10.3
Enoxaparin	Subcutaneous	37	54.4
Warfarin	Oral	22	32.4
Rivaroxaban	Oral	1	1.5
Rivaroxaban + Edoxaban	Oral	1	1.5
Total		68	100

Warfarin, the second most frequently prescribed anticoagulant in this study, is consistent with the findings of Mende et al., who reported that warfarin remains a commonly used oral anticoagulant in clinical practice, particularly for long-term therapy in patients at risk of thromboembolic events. The effectiveness of warfarin in preventing recurrent stroke has been well established, especially among patients with atrial fibrillation. Nevertheless, warfarin therapy requires close monitoring of INR values to optimize therapeutic effectiveness while minimizing the risk of bleeding [23].

Effectiveness of Anticoagulant Therapy

The effectiveness of anticoagulant therapy was evaluated based on changes in coagulation parameters, namely Prothrombin Time (PT), Activated Partial Thromboplastin Time (APTT), and International Normalized Ratio (INR), before and after treatment. Data analysis began with a normality assessment using the Shapiro–Wilk test to determine the distribution of each variable. The results of the normality test were subsequently used to guide the selection of appropriate bivariate statistical tests. For normally distributed data, a paired t-test was applied to assess differences in mean values before and after treatment. In contrast, the Wilcoxon signed-rank test was used for non-normally distributed data. Statistical significance was determined using the p-value, with a significance level of $\alpha < 0.05$.

Table 4. Effect of Anticoagulant Use on Changes in PT, APTT, and INR Values and Comparison of Effectiveness Among Therapies

Parameter Anticoagulant	Before (Mean ± SD)	After (Mean ± SD)	p-value	Mean Difference ± SD	p-value*
PT					
Heparin	12,07 ± 3,52	13,19 ± 3,97	0,018[a]	1,11 ± 1,34	0,053
Enoxaparin	11,04 ± 1,18	12,14 ± 4,72	0,002[a]	1,10 ± 4,78	
Warfarin	11,45 ± 1,67	15,17 ± 9,24	0,000[a]	3,71 ± 8,75	
APTT					
Heparin	27,89 ± 4,93	29,81 ± 3,09	0,213[b]	1,93 ± 3,66	0,981
Enoxaparin	26,97 ± 5,18	30,80 ± 12,61	0,010[a]	3,83 ± 11,88	
Warfarin	26,65 ± 3,08	29,05 ± 5,41	0,003[a]	2,40 ± 3,95	
INR					
Heparin	1,05 ± 0,29	1,16 ± 0,35	0,017[a]	0,11 ± 0,16	0,069
Enoxaparin	0,96 ± 0,13	1,06 ± 0,44	0,023[a]	0,10 ± 0,44	
Warfarin	1,03 ± 0,16	1,40 ± 1,01	0,001[a]	0,37 ± 0,95	

Note: *Kruskal–Wallis test; [a] Wilcoxon signed-rank test; [b] Paired t-test.

Based on Table 4, all anticoagulant groups showed increased PT values after therapy. The increase was statistically significant in the heparin (p = 0.018), enoxaparin (p = 0.002), and warfarin (p = 0.000) groups. In terms of the magnitude of change, the highest mean difference was observed in the warfarin group (3.71 ± 8.75). In contrast, the heparin and enoxaparin groups showed relatively similar changes, with mean differences of 1.11 ± 1.34 and 1.10 ± 4.78, respectively. These findings suggest that warfarin exerted a greater effect on prolonging prothrombin time than the other anticoagulants.

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Prothrombin Time (PT) is a coagulation parameter used to assess the function of the extrinsic and common pathways of the coagulation cascade. PT measures the time required for plasma to form a clot after the addition of tissue thromboplastin and calcium ions. The normal PT value in adults generally ranges from 10 to 13 seconds [24]. In patients with ischemic stroke, PT plays an important role, particularly among those receiving anticoagulant therapy. Anticoagulants, especially warfarin, inhibit the vitamin K cycle, thereby reducing the synthesis of coagulation factors II, VII, IX, and X. This mechanism results in a more pronounced prolongation of PT compared with other anticoagulants, making PT a commonly used parameter for monitoring warfarin therapy [25].

Although the warfarin group demonstrated a greater increase in PT than the heparin and enoxaparin groups, the Kruskal–Wallis test indicated that the difference was not statistically significant ($p = 0.053$). This finding suggests that the three anticoagulants had relatively similar effectiveness in influencing PT values in the study population. The different mechanisms of action of each anticoagulant may explain this. Warfarin is generally more sensitive to PT/INR measurements, whereas the effects of heparin and enoxaparin on PT are usually smaller and not always detected as statistically significant [25]. For Activated Partial Thromboplastin Time (APTT), all anticoagulant groups demonstrated a tendency toward increased values after therapy. However, statistically significant increases were observed only in the enoxaparin ($p = 0.010$) and warfarin ($p = 0.003$) groups, whereas the increase in the heparin group did not reach statistical significance ($p = 0.213$). Based on the magnitude of change, the enoxaparin group showed the highest mean APTT difference (3.83 ± 11.88), followed by the warfarin group (2.40 ± 3.95) and the heparin group (1.93 ± 3.66). These findings indicate that enoxaparin and warfarin were associated with more consistent changes in APTT than heparin in the study population.

Physiologically, APTT is used to evaluate the activity of the intrinsic and common coagulation pathways. Increased APTT values following anticoagulant administration reflect inhibition of fibrin formation through suppression of various coagulation factors. Enoxaparin, a low-molecular-weight heparin (LMWH), enhances antithrombin III activity, thereby inhibiting factor Xa and, to a lesser extent, factor IIa (thrombin). In contrast, warfarin inhibits the synthesis of vitamin K-dependent coagulation factors and may therefore indirectly affect coagulation parameters, including APTT [26].

The absence of a significant increase in APTT in the heparin group should be interpreted with caution. This finding does not necessarily indicate that heparin was less effective than the other anticoagulants but may be attributable to the relatively small sample size in the heparin group ($n = 7$) compared with the enoxaparin ($n = 37$) and warfarin ($n = 22$) groups. A limited sample size may reduce statistical power, thereby decreasing the ability of statistical tests to detect true differences. In addition, variations in patient characteristics and individual responses to anticoagulant therapy may have contributed to the wide variability in APTT values observed in this study.

The Kruskal–Wallis test showed no significant differences among anticoagulant groups in changes in APTT values ($p = 0.981$). This finding indicates that although mean changes varied among groups, they were statistically comparable. The lack of significant differences may have been influenced by substantial interindividual variability and differences in APTT sensitivity across anticoagulant classes.

Regarding the International Normalized Ratio (INR), all anticoagulant groups exhibited increased values after therapy. The increase was statistically significant in the heparin ($p = 0.017$), enoxaparin ($p = 0.023$), and warfarin ($p = 0.001$) groups. The greatest increase in INR was observed in the warfarin group (0.37 ± 0.95), whereas smaller changes were found in the heparin (0.11 ± 0.16) and enoxaparin (0.10 ± 0.44) groups. These findings suggest that warfarin exerted a more pronounced effect on increasing INR values than the other anticoagulants.

The International Normalized Ratio (INR) is an internationally standardized parameter used to evaluate the effects of anticoagulant therapy, particularly warfarin. INR is derived from PT values adjusted for thromboplastin reagent sensitivity using the International Sensitivity Index (ISI), enabling more consistent comparisons across laboratories. In this study, the increase in INR observed in the warfarin group is consistent with the mechanism of warfarin, which inhibits the synthesis of vitamin K-dependent coagulation factors II, VII, IX, and X. Reduced activity of these coagulation factors prolongs PT, which is subsequently reflected by an increase in INR values [27].

Although the warfarin group demonstrated a greater mean increase in INR than the heparin and enoxaparin groups, the Kruskal–Wallis test indicated that the difference was not statistically significant ($p = 0.069$). This finding suggests that the three anticoagulants exerted relatively similar effects on INR values in the study population. The absence of significant differences may have been influenced by unequal sample

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sizes across groups, particularly the smaller number of patients in the heparin group compared with the enoxaparin and warfarin groups, thereby reducing the statistical power to detect true differences. Furthermore, variations in patient characteristics and individual responses to anticoagulant therapy may have contributed to the observed results. These findings are consistent with those reported by Yusuf et al., who demonstrated that warfarin significantly increased INR values after therapy but did not always produce significant differences when compared with other anticoagulants, such as rivaroxaban. Therefore, although warfarin descriptively showed a greater tendency to increase INR values, its effectiveness in influencing INR in this study was not significantly different from that of other anticoagulants [28].

Association of Coagulation Parameters with Clinical Outcomes and Mortality

To evaluate the association between changes in coagulation parameters and clinical outcomes, a comparative analysis of PT, APTT, and INR values before and after therapy was performed between patients who showed clinical improvement and those who died. The results of this analysis are presented in Table 5.

Table 5. Comparison of Changes (Δ) in PT, APTT, and INR Values According to Clinical Outcomes in Patients with Ischemic Stroke (n = 68)

Anticoagulant Parameter	Clinical Outcome		p-value*
	Improved (n = 62) Mean ± SD	Deceased (n = 6) Mean ± SD	
ΔPT	1,66 ± 5,82	2,91 ± 7,52	0,274
ΔAPTT	1,45 ± 4,06	9,35 ± 17,48	0,033
ΔINR	0,16 ± 0,63	0,28 ± 0,67	0,331

Note: Δ = change in parameter value before and after therapy, *Mann-Whitney test

Analysis of the association between coagulation parameters and clinical outcomes showed that the mean changes (Δ) in PT, APTT, and INR were higher in patients who died than in those who improved. However, only ΔAPTT demonstrated a significant association with mortality (p = 0.033). This finding suggests that prolonged APTT following anticoagulant therapy is associated with an increased risk of death in patients with ischemic stroke. Physiologically, APTT reflects the function of the intrinsic and common coagulation pathways; therefore, its prolongation may indicate more severe hemostatic disturbances and potentially increase the risk of bleeding [26].

The absence of significant associations for PT and INR may be attributable to the relatively small number of patients who died (n = 6) compared with those who improved (n = 62), thereby reducing the statistical power to detect true differences. In addition, mortality in ischemic stroke is influenced by multiple factors, including age, stroke severity, infarct size, comorbidities, and complications during hospitalization [29]. Therefore, coagulation parameters should not be considered as the sole predictors of clinical prognosis in patients with ischemic stroke.

This study has several limitations. First, the relatively small number of mortality events precluded multivariate analysis to identify independent predictors of mortality. Second, data on bleeding events were unavailable, preventing a comprehensive evaluation of the safety aspects of anticoagulant therapy. Therefore, prospective studies with larger sample sizes are required to confirm the findings of this study.

Conclusions

Anticoagulant therapy in patients with ischemic stroke was associated with increased PT, APTT, and INR values following treatment. Although no significant differences in effectiveness were observed among anticoagulant agents based on changes in coagulation parameters, patients who died tended to have greater increases in ΔPT, ΔAPTT, and ΔINR than those who improved, with a significant association observed only for ΔAPTT. These findings suggest that APTT may be a useful parameter for monitoring therapeutic response and clinical outcomes in patients with ischemic stroke receiving anticoagulant therapy. Further prospective studies with larger sample sizes are needed to confirm these findings.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to the research, manuscript preparation, or publication of this study. All research activities were conducted independently without any intervention from external parties that could have influenced the representation or interpretation of the reported findings.

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