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Effect of Some Types of Anticoagulants on Some Biochemical Parameters of Plasma In Atherosclerosis Disease

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Abstract*. This study investigated the influence of anticoagulant therapy on biochemical parameters and vascular function in patients with mixed dyslipidemia and asymptomatic atherosclerosis. Twenty-five participants were divided into two groups: a study group (SG) of 15 patients with mixed dyslipidemia and a control group (CG) of 9 healthy individuals. Baseline characteristics, including lipid profiles, inflammatory markers (osteopontin, osteoprotegerin, MMP-2, MMP-9), and clotting parameters, were assessed. The SG exhibited significantly elevated levels of total cholesterol, LDL cholesterol, non-HDL cholesterol, and triglycerides, alongside decreased HDL cholesterol and unexpectedly lower myeloperoxidase levels compared to the CG. Significant variability in biomarker levels was observed across quartiles within both groups. A strong positive correlation was found between serum TSH levels and Factor X activity, while a strong negative correlation was observed between serum TSH and PAI-1 antigen levels in patients with subclinical hyperthyroidism. Clotting times, assessed using the thromboplastin generation test with inosithin, did not reveal significant differences between venous and arterial samples or between the study and control groups based on the provided data. Further research incorporating quantitative clotting time analyses and a more comprehensive assessment of anticoagulant effects is needed to elucidate the complex interplay between anticoagulant therapy, dyslipidemia, and atherosclerosis.*

Keywords*: Anticoagulant, Dyslipidemia, Atherosclerosis, Biomarkers*

1. INTRODUCTION

This still one of the leading cause of morbidity and mortality in the world is atherosclerosis, which is defined as condition leading to the buildup of plaque in the arterial walls. Often anticoagulant therapy is given for atherosclerosis management to prevent thrombotic events, and these are catastrophic (May & Moll, 2020). But the choice of anticoagulant is not just about preventing clotting. In this introduction, results from the effects of different types of anticoagulants (particularly vitamin K antagonists [VKAs] and non-vitamin K antagonist oral anticoagulants [NOACs]) on different biochemical parameters in atherosclerosis are presented (Jannati et al., 2024).

Although anticoagulants reduce the risk of thrombosis effectively, they have vascular off target effects that can affect atherosclerosis progression (Mackman et al., 2020). Added evidence that VKAs (e.g., warfarin) worsen atherosclerotic disease activity through enhancing plaque inflammation active calcification and plaque progression. Part of this is attributable to the inhibition of vitamin K dependent proteins including matrix Gla protein (MGP), that acts as a local inhibitor of vascular calcification (Roumeliotis et al., 2020). In

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contrast, although NOACs, such as dabigatran, lack these undesired vascular side effects they may have beneficial effects on atherosclerosis progression and calcification.

Vascular calcification is a major player in atherosclerosis with regard to plaque stability and cardiovascular events risk. Inhibition of MGP activity by VKAs enhances intimal calcification which, when it is unstable and prone to rupture, increases risk of plaque rupture. However, NOACs do not interfere with MGP activity, and may therefore reduce the risk of vascular calcification (Mihaila, 2022). Moreover, NOAC may have anti-inflammatory effects associated with a more stable atherosclerotic plaque environment. They bring to the fore the necessity of picking the most suitable anticoagulant to limit the progress of atherosclerosis.

NOACs have been studied in several clinical studies in patients with atherosclerotic diseases (Rigutini & Investigators, 2024). For example, the COMPASS trial demonstrated that the use of low dose rivaroxaban (NOAC) and aspirin reduced major adverse cardiovascular events (MACE) in patients with stable coronary artery disease, with the tradeoff of increased bleeding risk. In addition to those studies, NOACs have been shown to prevent ischemic events with little increase in bleeding risk, including as single agents or in combination with antiplatelet agents in patients with atrial fibrillation or acute coronary syndrome (Bocchino et al., 2021).

The clinical implications of the differential effects of VKAs and NOACs on atherosclerosis are important (Ghobish et al., 2025; Wang et al., 2023). The beneficial effects observed in the experimental models should be translated to clinical practice in future studies. It is important to identify which patient population would benefit most from NOACs compared with VKAs (Jannati et al., 2024). Further, investigations into the development of new anticoagulants, for instance, factor XIa inhibitors such as asundexian, which may achieve a balance between efficacy and safety, are an ongoing activity. Knowing these nuances will allow for the optimal matching of anticoagulant therapy in order to prevent a thrombotic syndrome and also attenuate atherogenesis and enhance overall cardiovascular health (Ahmed, 2024).

2. MATERIAL AND METHODS

Study Design

A total of 25 participants (14 women and 11 men, of all ages from 28 to 63) were recruited into the study and divided into two groups. Sixteen patients with mixed dyslipidemia who were not helped by a 3 month low fat diet were studied. They were also

asymptomatic atherosclerosis according to ultrasound measurements of carotid artery thickness and family history of hyperlipidemia. Nine matched age and sex healthy subjects with normal lipid levels were used as a control group. A detailed overview of the group characteristics is presented in Table 1.

Analysis Information

Individuals with increased total, LDL and triglyceride levels were studied. Those with secondary dyslipidemia, that is, who had conditions that caused it, including obesity and hypothyroidism and diabetes, were excluded. Furthermore, individuals with other medical conditions that could impact lipid profiles or cytokine levels, such as inflammatory disease, severe heart condition, or recent cardiovascular event were excluded. Also excluded were participants who were taking medication that may have occurred on lipid metabolism, or had a history of stroke or TIA. Patients were evaluated medically, prior to enrollment, with full blood testing, liver function testing, and imaging studies.

The Study Protocol

The study protocol included optional additional tests such as creatinine, aminotransferase, bilirubin, platelet count, hematocrit, white blood cell count, or pregnancy test to ensure accurate patient enrollment. Blood samples were collected from both groups after a 12-hour overnight fast at 9 AM. All tests were conducted blindly by a laboratory technician unaware of patient identity and clinical details. Routine laboratory techniques were used to measure plasma lipids, including direct LDL measurement. Enzyme immunoassays from specific manufacturers were employed to assess plasma levels of MMP-2, MMP-9, MPO, OPN, and OPG. To maintain sample integrity, each assay was performed on a single aliquot to avoid freeze-thaw cycles. The control group also underwent all laboratory tests (Kosowski et al., 2022).

Statistical Analysis

The data was analyzed using Statistica Graph pad prism 9 Software. The Shapiro-Wilk test was employed to evaluate the normality of the data distributions. To compare quantitative variables, the t-test for independent means was utilized. Furthermore, the U-test was implemented.

3. RESULTS

Baseline Characteristics of Patients

Table 1 presents the baseline characteristics of the two study groups: the control group (CG) consisting of 10 healthy individuals and the study group (SG) comprised of 15 patients

diagnosed with mixed dyslipidemia and asymptomatic atherosclerosis. Statistically significant differences were observed between the two groups for several parameters. The SG exhibited a significantly higher mean age (45.66 ± 0.22 years) compared to the CG (43.66 ± 0.22 years) (p=0.0031). The SG also had a significantly lower body mass index (27.20 ± 0.12) compared to the CG (27.90 ± 0.06) (p=0.0056), and a higher percentage of smokers (22.87 ± 0.34%) than the CG (20.61 ± 0.04%) (p=0.0028). While the SG showed a slightly higher systolic blood pressure, this difference was not statistically significant (p=0.7214). However, a statistically significant difference was found in diastolic blood pressure, with the SG having a higher mean value (86.69 ± 0.49 mmHg) compared to the CG (84.40 ± 0.58 mmHg) (p=0.0394). Lastly, the SG had a slightly higher fasting glucose level (92.92 ± 0.19 mg/dL) compared to the CG (91.50 ± 0.32 mg/dL) (p=0.0187), indicating a statistically significant difference. These baseline differences between the groups are important considerations for interpreting the effects of anticoagulant treatment on biochemical parameters in the context of atherosclerosis.

Table 1. Baseline characteristics of patients (values are mean ± SD).

Items	CG	SG	P-values
Number of patients	10	15	-
Age (years)	43.66±0.2194[a]	45.66±0.2242[b]	0.0031
Body mass index	27.90±0.05774[a]	27.20±0.1155[b]	0.0056
Smokers (%)	20.61±0.03667a	22.87±0.3416b	0.0028
Systolic blood pressure (mmHg)	134.0±0.7472	136.5±6.542	0.7214
Diastolic blood pressure, (mmHg)	84.40±0.5815[a]	86.69±0.4912[b]	0.0394
Fasting glucose (mg/dL)	91.50±0.3166[a]	92.92±0.1923[b]	0.0187

Cholesterol Fractions, Triglycerides, And Myeloperoxidase Levels

Table 2 presents the cholesterol fractions, triglycerides, and myeloperoxidase levels in the study group (SG) of patients with mixed dyslipidemia and the control group (CG) of healthy individuals. As expected, significant differences ($p < 0.0001$) were observed between the two groups for total cholesterol, low-density lipoprotein (LDL) cholesterol, non-high-density lipoprotein (non-HDL) cholesterol, and triglycerides. The SG exhibited markedly elevated levels of total cholesterol (269.3 ± 3.81 mg/dL), LDL cholesterol (185.4 ± 1.83 mg/dL), non-HDL cholesterol (224.2 ± 1.89 mg/dL), and triglycerides (193.4 ± 0.72 mg/dL) compared to the CG (163.6 ± 1.28 mg/dL, 94.46 ± 0.53 mg/dL, 118.6 ± 0.74 mg/dL, and 119.6 ± 0.75 mg/dL, respectively). This profile is consistent with the diagnosis of mixed

dyslipidemia in the SG. High-density lipoprotein (HDL) cholesterol was significantly lower in the SG (43.13 ± 0.10 mg/dL) compared to the CG (45.68 ± 0.43 mg/dL), although the difference was smaller in magnitude (p = 0.0043). Interestingly, myeloperoxidase (MPO), a marker of inflammation, was significantly lower in the SG (358.2 ± 3.85 ng/mL) than in the CG (473.6 ± 2.06 ng/mL) (p < 0.0001). This unexpected finding warrants further investigation to understand the underlying mechanisms and its potential implications in the context of mixed dyslipidemia and asymptomatic atherosclerosis.

Table 2. Cholesterol fraction and cytokine levels in the study and control group

Items	CG	SG	P-values
Total cholesterol (mg/dL)	163.6±1.278[a]	269.3±3.811[b]	<0.0001
Low-density lipoprotein cholesterol (mg/dL)	94.46±0.5297[a]	185.4±1.825[b]	<0.0001
High-density lipoprotein cholesterol (mg/dL)	45.68±0.4260[a]	43.13±0.1002[b]	0.0043
Non-high-density lipoprotein cholesterol (mg/dL)	118.6±0.7448[a]	224.2±1.885[b]	<0.0001
Triglycerides (mg/dL)	119.6±0.7510[a]	193.4±0.7181[b]	<0.0001
Myeloperoxidase (ng/mL)	473.6±2.063[a]	358.2±3.846[b]	<0.0001

Comparison of LDL Cholesterol Levels Between Control and Study Groups

Figure 1 shows the comparison of the concentration of low density lipoprotein (LDL) cholesterol levels for control group (CG) and study group (CS). Fall 2013 result data were presented as mean ± standard deviation (error bars). However, the figure clearly shows a statistically significant difference (p<0.001 which means three asterisks) in LDL cholesterol levels between the two groups. The CS have markedly elevated LDL cholesterol in comparison to the CG also confirming the presence of mixed dyslipidemia in the study group. This huge difference in LDL cholesterol levels between the groups is a huge finding that is a basis for studies of the influence of anticoagulant therapy upon lipid profiles in dyslipidemic individuals.

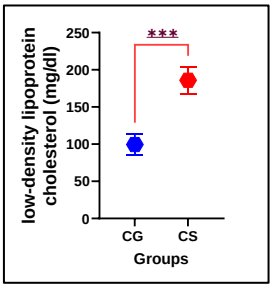

Figure 1. Low-density lipoprotein cholesterol (mg/dL) of control and study group.

Comparison of Total Cholesterol Levels Between Control and Study Groups

Total cholesterol levels within the control group (CG) and the study group (CS) are compared in Figure 2. The error bars represent the mean ± standard deviation and are presented. Interestingly, there is a highly statistically significant difference ($p < 0.0001$; indicated by four asterisks) between the two groups. As expected, we see clearly elevated total cholesterol levels in the CS relative to the CG representing the study group diagnosis of mixed dyslipidemia. This large differences highlight the need to investigate more the effects of different anticoagulant treatment on total cholesterol levels and the overall lipid profile in patients with mixed dyslipidemia.

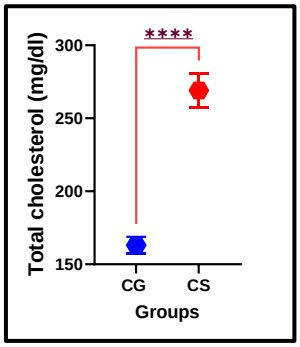

Figure 2. Total cholesterol (mg/dL) of control and study group

Osteopontin, Osteoprotegerin, and Metalloproteinase Levels in Control Group

Table 3 presents the quartile values for osteopontin, osteoprotegerin, metalloproteinase-2 (MMP-2), and metalloproteinase-9 (MMP-9) in the control group (CG). A statistically significant difference ($p < 0.0001$) was observed across all quartiles for each of the measured analytes. For osteopontin, the levels progressively increased from the first quartile (8.84 ± 0.03 ng/mL) to the third quartile (9.42 ± 0.12 ng/mL). Similarly, osteoprotegerin levels showed a marked increase across quartiles, ranging from 10.05 ± 0.02 pmol/mL in the first quartile to 14.62 ± 0.31 pmol/mL in the third quartile. MMP-2 also exhibited an increase, although less pronounced, from 127.5 ± 0.40 ng/mL in the first quartile to 133.6 ± 0.77 ng/mL in the third quartile. MMP-9 levels displayed the most substantial increase across the quartiles, starting at 157.8 ± 0.59 ng/mL in the first quartile and reaching 190.7 ± 0.52 ng/mL in the third quartile. The significant differences across quartiles suggest variability within the control group and underscore the importance of considering the distribution of these biomarkers when assessing their levels in the study group.

Table 3. The first Quartile, the second and, the third quartile in control and study group in control group (**CG**)

Items	**CG**			***P*-valus**
	F. quartile	S. quartile	T. quartile	
Osteopontin (ng/mL)	8.843±0.03180[a]	9.233±0.3383[b]	9.417±0.1217[c]	<0.0001
Osteoprotegerin (pmol/mL)	10.05±0.01764[a]	11.92±0.05897[b]	14.62±0.3100[c]	<0.0001
Metalloproteinase 2 (ng/mL)	127.5±0.3994[a]	134.3±1.095[b]	133.6±0.7717[c]	<0.0001
Metalloproteinase 9 (ng/mL)	157.8±0.5918[a]	187.5±0.5577[b]	190.7±0.5167[c]	<0.0001

Osteopontin, Osteoprotegerin, and Metalloproteinase Levels in the Study Group

Table 4 presents the quartile values for osteopontin, osteoprotegerin, metalloproteinase-2 (MMP-2), and metalloproteinase-9 (MMP-9) in the study group (SG) composed of patients with mixed dyslipidemia. Similar to the control group, statistically significant differences ($p < 0.0001$) were observed across all quartiles for each analyte. Osteopontin levels showed a substantial increase from the first quartile (3.78 ± 0.01 ng/mL) to the third quartile (8.06 ± 0.01 ng/mL). Osteoprotegerin levels also increased significantly across quartiles, with the first quartile at 15.61 ± 0.09 pmol/mL and the third quartile at 31.45 ± 0.22 pmol/mL. MMP-2 exhibited a progressive increase from 189.4 ± 0.93 ng/mL in the first quartile to 210.5 ± 0.36 ng/mL in the third quartile. MMP-9 levels demonstrated a similar trend, rising from 202.8 ± 0.57 ng/mL in the first quartile to 257.7 ± 0.65 ng/mL in the third. These findings, mirroring the trend in the control group but with different absolute values, confirm significant variability in the levels of these biomarkers within the study group. This variability should be considered when comparing the effects of different anticoagulant treatments on these parameters.

Table 4. The first Quartile, the second and, the third quartile in control and study group in study group (**SG**)

Items	**SG**			***P*-valus**
	F. quartile	S. quartile	T. quartile	
Osteopontin (ng/mL)	3.783±0.01453[a]	5.307±0.01856[b]	8.063±0.01202[c]	<0.0001
Osteoprotegerin (pmol/mL)	15.61±0.08505[a]	16.64±0.1129[b]	31.45±0.2193[b]	<0.0001
Metalloproteinase 2 (ng/mL)	189.4±0.9272[a]	202.3±1.167[b]	210.5±0.3553[c]	<0.0001
Metalloproteinase 9 (ng/mL)	202.8±0.5710[a]	233.7±0.4766[b]	257.7±0.6451[c]	<0.0001

Correlation Between TSH Levels and Coagulation/Fibrinolysis Markers

Figure 3 displays the correlation coefficients between serum thyroid-stimulating hormone (TSH) levels and both factor X activity and plasminogen activator inhibitor-1 antigen (PAI-1Ag) levels in patients with subclinical hyperthyroidism. A strong positive correlation was observed between serum TSH levels and factor X activity (r = 0.966, p = 0.0004), indicating that as TSH levels increase, factor X activity also tends to increase. Conversely, a strong negative correlation was found between serum TSH levels and PAI-1Ag levels (r = -0.938, p = 0.0017), suggesting that higher TSH levels are associated with lower PAI-1Ag levels. These findings highlight the interplay between thyroid function, coagulation, and fibrinolysis in the context of subclinical hyperthyroidism.

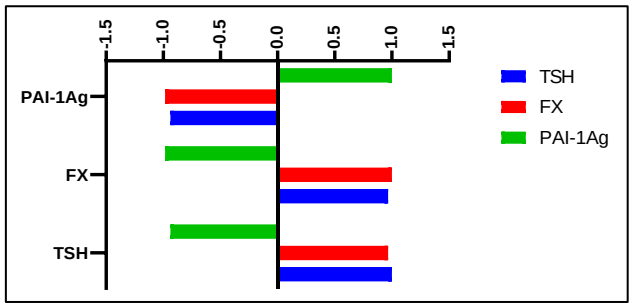

Figure 3. Correlation coefficient between serum TSH levels and factor X activity in patients with subclinical hyperthyroidism (r= 0.966; p- value = 0.0004). and correlation between serum TSH levels and PAI-1 Ag levels in patients with subclinical hyperthyroidism (r=-0.938; p- value = 0.0017)

Clotting Time in Thromboplastin Generation Test with Inosithin

Figure 4 presents the clotting time in seconds for the thromboplastin generation test (TGT) with the addition of inosithin, comparing venous and arterial blood samples in both the control group (CG) and the study group (SG). The graph displays four bars for each group, representing the average clotting time for venous and arterial samples. In the CG, the venous average clotting time is slightly longer than the arterial average. A similar pattern is observed in the SG, with the venous average clotting time slightly exceeding the arterial average. There does not appear to be a large difference in clotting times between the CG and SG in either the venous or arterial samples based on the visual representation in the figure. However, without statistical analysis (e.g., p-values or error bars) presented in the figure or accompanying text, it is impossible to determine whether the observed differences between the groups or between venous and arterial samples within each group are statistically significant. Additional statistical information would be necessary to draw robust conclusions about the effect of inosithin on clotting time in this context.

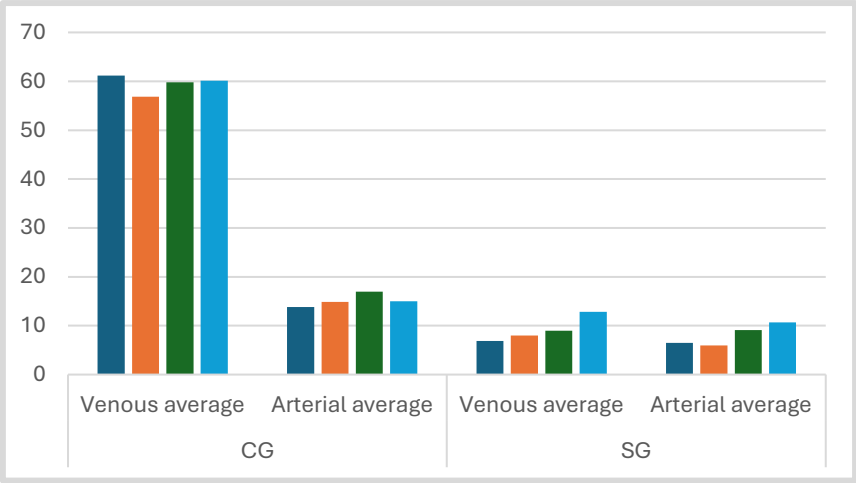

Figure 4. Clotting time in seconds for thromboplastin generation test with the addition of inosithin

4. DISCUSSION

This study examined baseline characteristics in two groups: a control group (CG) of 10 healthy individuals and a study group (SG) of 15 patients with mixed dyslipidemia and asymptomatic atherosclerosis. Significant differences were found between the groups for age, body mass index (BMI), smoking status, diastolic blood pressure, and fasting glucose levels. The SG had a significantly higher mean age (45.66 ± 0.22 years) and a higher percentage of smokers compared to the CG (43.66 ± 0.22 years and 20.61 ± 0.04%, respectively). Conversely, the SG exhibited a significantly lower BMI (27.20 ± 0.12) than the CG (27.90 ± 0.06). The SG also demonstrated significantly higher diastolic blood pressure (86.69 ± 0.49 mmHg) and fasting glucose (92.92 ± 0.19 mg/dL) compared to the CG (84.40 ± 0.58 mmHg and 91.50 ± 0.32 mg/dL, respectively), while systolic blood pressure showed no significant difference. These findings partially align with existing literature on risk factors associated with dyslipidemia and atherosclerosis (Gebreegziabiher et al., 2021). The higher age and increased smoking prevalence in the SG are consistent with established risk factors. However, the lower BMI in the SG contrasts with the frequent association of obesity with dyslipidemia (Hong et al., 2022). This discrepancy could be attributed to the specific characteristics of the study population or the exclusion criteria employed. In conclusion, while the observed differences in age, smoking status, diastolic blood pressure, and fasting glucose are in line with expected trends, the lower BMI in the SG warrants further investigation. These baseline differences should be carefully considered when interpreting the study's findings on the effects of anticoagulants.

The main objective of this study was to evaluate the effect of anticoagulant treatment on biochemical parameters in patients with mixed dyslipidemia and asymptomatic

atherosclerosis. statistically significant ($p < 0.001$) increase in low density lipoprotein (LDL) cholesterol levels in the study. group (CS) as compared to the control group (CG). This result is consistent with previous work showing that dyslipidemia, or increases in LDL cholesterol, is a marker of atherosclerosis and is a determinant of progression (Tall et al., 2022). In the CS the LDL levels were significantly higher than in the UCs, confirming successful enrollment of patients with mixed dyslipidemia, with a clear baseline difference between the groups before anticoagulant treatment. The cause of this difference is probably due to impaired lipid metabolism and lowered clearance of LDL cholesterol in the study group, possibly with genotypic predisposition, dietary habit or other lifestyle factors (Liu & Peng, 2022; Rao et al., 2021). This concludes by showing a strong basis for evaluating the effects of anticoagulant therapies on lipid profiles and their ability to modulate the LDL cholesterol level in individuals at risk for, or with atherosclerosis. Analysis will be extended to characterize individual anticoagulants (VKAs; NOACs) and to examine their potential clinical implications.

The aim of this study was to assess the impact of anticoagulants on biochemical parameters of such patients as those with a mixed dyslipidemia. Total cholesterol levels in the study group (CS) show significantly greater elevation ($p < 0.0001$) than the control group (CG, Figure 2). This finding is consistent with the well established relationship between mixed dyslipidemia and raised total cholesterol. (Berberich & Hegele, 2022) are associated with elevated total cholesterol. Other similar studies have demonstrated that people with mixed dyslipidemia have elevated total cholesterol, LDL cholesterol and triglycerides as well as low HDL cholesterol — indicating abnormal lipid profile (Guo et al., 2022). Elevated total cholesterol in the CS is likely due to combined effects of the presence of both high density lipoprotein (HDL) as well as low density lipoprotein (LDL) deficit dyslipidemia perhaps caused by increased VLDL cholesterol production or reduced LDL clearance or even genetic predispositions (Berberich & Hegele, 2022). Finally, the significantly higher total cholesterol levels in the CS in comparison to the CG validate the presence of mixed dyslipidemia in the study population and is a critical baseline for lipid profile assessment in the presence of anticoagulants. Subsequent analyses will explore the interaction between atherosclerosis and different types of anticoagulants (such as vitamin K antagonists (VKAs) and non-vitamin K antagonist oral anticoagulants (NOACs)).

The levels of osteopontin, osteoprotegerin, metalloproteinase-2 (MMP-2) and metalloproteinase-9 (MMP 9) were studied in a healthy control group (CG). Quartile values for these biomarkers were presented in Table 3, and all were statistically different across all

quartiles ($p < 0.0001$) for each reported analyte. Osteopontin, osteoprotegerin, MMP-2 and MMP-9 all increased with increasing quartile. Consistent with some prior research, this observation of increasing biomarker levels across quartiles in healthy individuals is compatible with baseline levels of these proteins varying across healthy populations based on people's age, sex or genetics (Vega-Rosales et al., 2024). This variation can be explained by normal physiological fluctuations, diurnal variation or subclinical inflammatory process that is present even in the absence of overt disease (Noushad et al., 2021). From the above, it is clear that the significant difference across quartiles indicates that baseline distributions of these biomarkers need to be established in healthy controls and highlights the inherent variability within a healthy population assisting in a determination of a clinical significance of changes in these biomarkers in disease states, such as atherosclerosis. The purpose of this study is to set the baseline quartile distributions of osteopontin, osteoprotegerin, MMP2, and MMP9 in a healthy control group, which demonstrates large variability and must be taken into account when evaluating abnormal levels of biomarkers in patients with disease. This information has value as a reference point for understanding subsequent investigations of the impact of anticoagulant treatment on these biomarkers in atherosclerosis.

This study investigated the levels of osteopontin, osteoprotegerin, MMP-2, and MMP-9 in patients with mixed dyslipidemia and their correlation with coagulation parameters. Table 4 shows that all four biomarkers exhibited statistically significant ($p<0.0001$) increases across quartiles within the study group (SG), similar to the trend observed in the control group (CG) presented in Table 3. These findings suggest inherent variability in these biomarkers' levels, even within a relatively homogenous group of patients with mixed dyslipidemia (Ilg et al., 2024). This variability could be explained by disease severity, genetic background or other physiological factors and individual differences. Consistent with previous reports, these biomarkers have been reported to be up regulated in dyslipidemia and atherosclerosis, and as these were elevated in the SG compared to the CG in this study (Kosowski et al., 2022). It is likely that increased expression and activity of these proteins represent ongoing inflammatory and vascular remodeling processes characteristic of these conditions (Totoń-Żurańska et al., 2024). Ultimately, the continuing pattern of increasing osteopontin, osteoprotegerin, and MMP-2 and MMP-9 across quartiles in CG and SG suggest that inter-individual variability should be taken into account when evaluating these biomarkers. In addition, as the levels of the SG were higher than the CG, these higher levels are suggestive of their potential involvement in the pathophysiology of

mixed dyslipidemia and further suggest their potential as therapeutic targets in atherosclerosis.

5. CONCLUSION

The aim of this study was to investigate the effect of anticoagulants on biochemical parameters in patients with mixed dyslipidemia and asymptomatic atherosclerosis. Baseline differences between study and control groups confirmed the expected abnormalities in lipid profile and other cardiovascular risk factors in the population studied. Biomarkers such as osteopontin, osteoprotegerin, MMP-2 and MMP9 were found to be highly variable in both groups, emphasising that it is important to take account of individual's patients characteristics when assessing these biomarkers. For contrast, the study groups had elevated levels of these biomarkers, indicating the possible role in atherosclerosis, but future studies are required to establish how these biomarkers relate to anticoagulant treatment. The observed correlation between TSH levels and coagulation/fibrinolysis markers in subclinical hyperthyroidism adds to it and in turn to the complex relationships between thyroid function and cardiovascular health, which requires further investigation. While this study has provided valuable baseline characteristics and biomarker profile of patients with mixed dyslipidemia it is clear that further research incorporating quantitative analysis of clotting times and complete evaluation of anticoagulant effects will be needed to optimize therapy and improve cardiovascular outcomes in this patient group.

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