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NATURAL ANTICOAGULANT DEFICIENCIES IN PATIENTS WITH NEPHROTIC SYNDROME: COMPARATIVE EVALUATION OF ANTITHROMBIN III, PROTEIN C AND PROTEIN S AND THEIR ASSOCIATION WITH HYPERCOAGULABILITY MARKERS

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Abstract. Nephrotic syndrome (NS) is associated with a significantly increased risk of thromboembolic complications resulting from profound disturbances of the hemostatic system. One of the central mechanisms underlying this hypercoagulable state is the imbalance between procoagulant and anticoagulant factors, particularly the depletion of natural anticoagulants such as antithrombin III (AT-III), protein C, and protein S. These proteins play a crucial physiological role in regulating coagulation and preventing excessive thrombin generation. A deficiency in these factors can promote the emergence of a hypercoagulable (prothrombotic) state that is frequently seen in patients with NS.

This study was designed to evaluate the concentrations of physiological anticoagulants in patients with NS and to investigate their association with laboratory markers of hypercoagulability and disease severity. The cross-sectional study included 76 patients with primary glomerulonephritis (GN) accompanied by NS who were treated between 2022 and 2024, as well as a control group of 40 apparently healthy individuals. Hemostatic parameters were assessed using chromogenic and clot-based functional assays, and statistical analysis included correlation and multivariable regression models.

The results demonstrated clear evidence of coagulation system activation in patients with NS. Levels of D-dimer and fibrinogen were significantly higher compared with the control group, reflecting increased thrombin generation and fibrin turnover. At the same time, significant reductions in the activity of natural anticoagulants were observed. AT-III levels were markedly decreased in patients with NS, and similar reductions were detected for protein C and free protein S.

Correlation analysis revealed that AT-III showed the strongest associations with markers of NS activity and hypercoagulability. AT-III levels demonstrated a positive correlation with serum albumin and negative correlations with proteinuria, D-dimer, and fibrinogen. These findings suggest that both the severity of NS and the activation of coagulation pathways contribute to depletion of endogenous anticoagulant mechanisms.

Multivariable regression analysis identified serum albumin and D-dimer levels as independent predictors of reduced AT-III activity. Hypoalbuminemia, reflecting urinary protein loss and disease severity, was strongly associated with decreased AT-III levels, while elevated D-dimer indicated ongoing activation of the coagulation cascade.

Overall, the study demonstrates that nephrotic syndrome is characterized by a pronounced prothrombotic hemostatic profile involving both activation of coagulation and depletion of natural anticoagulants. Among the studied parameters, AT-III deficiency appears to represent the most prominent disturbance and may play a key role in the development of hypercoagulability in patients with NS.

These findings highlight the potential clinical importance of assessing natural anticoagulant levels as biomarkers of thrombotic risk and may contribute to improved risk stratification and individualized prophylactic anticoagulation strategies in patients with NS.

Keywords: nephrotic syndrome, antithrombin III, protein C, protein S, hypercoagulability, thromboembolic risk.

Introduction. Nephrotic syndrome (NS) remains one of the most common clinical manifestations of glomerular diseases and is associated with systemic complications, among which thromboembolic events are among the most serious. Contemporary reviews emphasize that NS is associated with a substantially increased risk of venous thromboembolism (VTE), which contributes significantly to patient morbidity and mortality, while the evidence base regarding optimal prophylactic strategies remains largely limited to observational studies [1-3].

The pathophysiology of hypercoagulability in NS is multifactorial and involves several interconnected mechanisms, including alterations in plasma coagulation factors, platelet function, fibrinolysis, and endothelial function. A key component is the imbalance between procoagulant and anticoagulant factors, which develops as a result of increased hepatic synthesis of prothrombotic proteins (particularly fibrinogen and certain clotting factors) combined with the urinary loss of various hemostatic proteins and regulatory molecules [4, 5]. In this context, deficiencies of natural anticoagulants—antithrombin III (AT-

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III), protein C, and protein S—are considered a potentially key mechanism underlying the development of a prothrombotic phenotype. However, their actual contribution to hypercoagulability and clinical events may vary substantially depending on the patient population, the activity of NS, and concomitant risk factors [6, 7].

Antithrombin III functions as the dominant inhibitor of thrombin and factor Xa, and its anticoagulant properties are substantially potentiated by heparin, which is crucial for clinical antithrombotic strategies [8]. In patients with NS, reduced AT-III levels have traditionally been attributed primarily to its urinary loss due to increased glomerular permeability, and according to the concept of "urinary loss of anticoagulants," this mechanism may contribute to the development of hypercoagulability [9].

However, emerging evidence suggests that the relationship between AT-III levels and laboratory markers of hypercoagulability is not always straightforward. In a multi-cohort study and meta-analysis, Abdelghani et al. demonstrated that AT-III deficiency is present in a substantial proportion of patients with NS; however, its associations with the severity of proteinuria/hypoalbuminemia and its contribution to hypercoagulability may be limited and heterogeneous [8]. These findings underscore the need for further studies with clearly defined laboratory endpoints and appropriate adjustment for NS activity and concomitant risk factors.

In addition to AT-III, protein C and protein S (a cofactor of activated protein C) are important regulators of coagulation. Their deficiency—whether inherited or acquired—is associated with thrombophilia. In the context of NS, particular attention has been drawn to the urinary loss of the "free" fraction of protein S and the resulting shift in the protein C/S system toward a prothrombotic state [10]. Despite this, assessment of protein C and protein S in patients with NS is not routinely performed in clinical practice, partly due to methodological challenges (including the effects of inflammation, hepatic dysfunction, and vitamin K antagonist therapy) and partly because of the lack of robust data demonstrating that measurement of these parameters improves VTE risk stratification or informs prophylactic decision-making.

An important direction in contemporary NS research is the shift from "static" coagulation tests toward functional assessments of hypercoagulability. In particular, it has been shown that hypercoagulability may increase proportionally with NS activity when evaluated using thrombin generation assays, and multivariable regression models allow for a more accurate characterization of the relationship between NS severity and hypercoagulability [11]. This provides a rationale for studies that simultaneously assess levels of natural anticoagulants and their associations with laboratory markers of hypercoagulability (such as D-dimer, fibrinogen, and parameters of thrombin generation or thromboelastography), as well as with clinical outcomes.

From the perspective of clinical guidelines, KDIGO 2021 emphasizes that prophylactic anticoagulation in adults with NS should be considered when the individual risk of thromboembolism outweighs the risk of bleeding; at the same time, it highlights the limited strength of available evidence and the need for a personalized approach [12]. In this context, the search for biomarkers that more accurately reflect hypercoagulability and thromboembolic risk remains highly relevant, and levels of natural anticoagulants represent one of the potential candidates.

Data from local cohorts further support the clinical relevance of this issue. In our population of patients with primary glomerulonephritis (GN) and NS, reduced AT-III levels were observed in 68.4 % of cases and were associated with lower serum albumin, higher proteinuria, and increased levels of D-dimer and fibrinogen, consistent with the concept of "NS activity ↔ hypercoagulability" [13].

In summary, these results provide grounds for examining other natural anticoagulants, such as protein C and protein S, and for conducting a comparative analysis of their deficiencies and their links to laboratory markers of hypercoagulability.

The aim of the study is to comprehensively assess the levels of AT-III, protein C, and protein S in patients with NS and to examine their relationships with markers of hypercoagulability and disease activity. Such analysis may have practical implications for improving thrombotic risk stratification and guiding prophylactic anticoagulation strategies.

Object and methods of research. This study, designed as a cross-sectional observational analysis, involved 76 patients with primary GN and NS who were hospitalized at the Ivano-Frankivsk Regional Clinical Hospital (Ukraine) during the period 2022–2024.

The study was carried out in compliance with internationally recognized ethical guidelines for human research and biospecimen collection, including the World Medical Association (WMA) Declaration of Helsinki ("Ethical Principles for Medical Research Involving Human Subjects") and the UNESCO Universal Declaration on Bioethics and Human Rights. The protocol was approved by the Local Ethics Committee of the Ivano-Frankivsk National Medical University. Written informed consent was obtained from all participants prior to inclusion. Additionally, a control group of 40 apparently healthy individuals, matched to the study population, was incorporated into the analysis.

The study population consisted of 62 men (81.6 %; 95 % CI 71.0–89.5) and 14 women (18.4 %; 95 % CI 10.5–29.0), with a median age of 45 years (IQR 40–49). Eligibility criteria included age ≥18 years, a diagnosis of nephrotic syndrome established within the preceding month, and a glomerular filtration rate (GFR) exceeding 60 mL/min/1.73 m². Exclusion criteria comprised refusal to participate, age <18 years, systemic connective tissue disorders, systemic vasculitis, type 1 or type 2 diabetes mellitus, prior thromboembolic or cardiovascular events, chronic heart failure class III–IV according to the New York Heart Association (NYHA), acute infectious diseases of any origin, active malignancy, acute or chronic liver failure, and psychiatric conditions.

In all 76 participants, the diagnosis of glomerulonephritis (GN) was morphologically confirmed. The distribution of histological variants was as follows: mesangioproliferative GN in 23 patients (30.3 %; 95 % CI 20.2–41.9), membranous GN in 21 patients (27.6 %; 95 % CI 18.0–39.1), focal segmental glomerulosclerosis in 14 patients (18.4 %; 95 % CI 10.5–29.0), minimal change disease in 11 patients (14.5 %; 95 % CI 7.5–24.4), and

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membranoproliferative (mesangiocapillary) GN in 7 patients (9.2 %; 95 % CI 3.8–18.1).

Immunosuppressive regimens were selected according to the histopathological subtype and involved corticosteroids, cyclophosphamide, cyclosporine, and mycophenolate mofetil. Every patient was receiving either angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, while 48 patients (63.2%; 95% CI 51.3–73.9) were also on sodium–glucose cotransporter-2 inhibitor therapy.

The clinical diagnosis was established using standard diagnostic procedures in accordance with the Classification of Kidney Diseases and current clinical practice guidelines for the management of glomerular disorders [12]. All participants underwent a comprehensive evaluation that included clinical assessment, biochemical analyses, and instrumental investigations.

Laboratory biochemical parameters were analyzed at Ivano-Frankivsk Regional Clinical Hospital. The estimation of GFR was based on the CKD-EPI equation, and daily protein excretion (DPE) was assessed using a colorimetric assay (Dialab, Austria).

AT-III) activity was determined using a chromogenic functional assay (Granum, Ukraine), based on the inhibition of activated factor Xa in the presence of heparin, followed by spectrophotometric measurement of residual enzymatic activity.

Protein C activity was measured using a clot-based functional assay (Renam, Ukraine), which evaluates the prolongation of activated partial thromboplastin time (aPTT) after specific activation of endogenous protein C.

Free protein S activity was assessed using a clot-based functional assay (Renam, Ukraine), based on its role as a cofactor of activated protein C in the inactivation of factors Va and VIIIa, reflected by prolongation of clotting time.

All measurements were performed in citrated platelet-poor plasma at 37°C using a semi-automated coagulation analyzer, in accordance with the manufacturers' instructions. Internal quality control was ensured by parallel analysis of normal and pathological control plasmas.

Results were expressed as percentages of activity relative to normal pooled plasma. According to laboratory reference intervals, normal ranges were 80–120 % for AT-III, 70–140 % for protein C, and 60–130 % for free protein S. Values below the lower reference limit were considered decreased.

Statistical processing was performed using STATISTICA. Categorical data were presented as frequencies and percentages with 95% confidence intervals, formatted as n (%; 95% CI). Normality of continuous variables was assessed with the Shapiro–Wilk test. Normally distributed variables were expressed as mean ± SD, while non-normal data were reported as median (IQR). Group comparisons were conducted using the Student's t-test or the Mann–Whitney U test, depending on distribution. Fisher's exact test was applied for categorical variables.

Associations between variables were examined using Pearson or Spearman correlation coefficients as appropriate. To determine independent predictors of decreased natural anticoagulants and hypercoagulability markers, multivariable linear regression analysis was performed. Variables with $p < 0.10$ in univariate analysis were included in the final models. Regression coefficients (β) with 95% CI were reported, and multicollinearity was evaluated using VIF. Statistical significance was defined as $p < 0.05$ (two-sided).

Research results and their discussion. Hemostatic characteristics of patients with primary GN and NS versus the control group are detailed in Table 1.

Table 1

Hemostatic parameters in patients with primary glomerulonephritis and nephrotic syndrome (n = 76)

Parameter	Control group (n=40)	GN with NS group (n=76)
D-dimer, mg/L; median (IQR)	0.28 (0.11–0.52)	1.49 (0.95–1.93) p=0.015
Platelet Count (*10^9/L); median (IQR)	212 (176–293)	253 (221–312) p=0.738
INR; median (IQR)	0.9 (0.8–1.0)	1.0 (0.9–1.1) p=0.856
APTT (seconds); median (IQR)	44 (34–56)	42 (36–52) p=0.759
PT (seconds); median (IQR)	12 (11–13)	12 (11–14) p=0.686
Fibrinogen (g/L); median (IQR)	3.4 (2.6–4.7)	6.4 (5.3–7.2) p=0.035
Antithrombin III (%); median (IQR)	92 (80–119)	52 (45–68) p=0.024
Protein C (%); median (IQR)	96 (75–122)	56 (48–65) p=0.013
Free Protein S (%); median (IQR)	78 (65–98)	41 (34 –52) p=0.016

Note: Data are expressed as median (IQR). Between-group differences were evaluated using the Mann–Whitney U test. A two-tailed p-value <0.05 was considered statistically significant. Abbreviations: INR – international normalized ratio; APTT – activated partial thromboplastin time; PT – prothrombin time.

Patients with NS demonstrated significant disturbances in coagulation-related markers, reflecting activation of the hemostatic system. Notably, D-dimer and fibrinogen levels were significantly increased compared

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with the control group (p=0.015 and p=0.035, respectively).

At the same time, markers of natural anticoagulant activity were significantly reduced, as evidenced by lower levels of AT-III, protein C, and free protein S in NS patients (p=0.024, p=0.013, and p=0.016, respectively).

Conversely, platelet count, INR, APTT, and PT did not differ significantly between the groups (p>0.05).

Overall, these findings indicate that NS is associated with a prothrombotic hemostatic profile characterized by activation of coagulation and concomitant depletion of natural anticoagulants.

Table 2

Correlations between natural anticoagulants and markers of nephrotic syndrome activity and hypercoagulability

Variable	AT-III, %	Protein C, %	Protein S, %
Albumin, g/L	r = 0.53, p<0.001	r = 0.41, p=0.002	r = 0.38, p=0.004
Daily protein excretion, g/day	r = −0.46, p<0.001	r = −0.35, p=0.006	r = −0.33, p=0.009
D-dimer, mg/L	r = −0.58, p<0.001	r = −0.42, p=0.002	r = −0.39, p=0.004
Fibrinogen, g/L	r = −0.51, p<0.001	r = −0.37, p=0.005	r = −0.34, p=0.008

Note: Data are reported as correlation coefficients (r) with associated p-values. Pearson's method was used for normally distributed variables, and Spearman's rank correlation for non-normally distributed variables. A p-value <0.05 (two-sided) was considered statistically significant

Significant correlations were identified between levels of natural anticoagulants and indicators of NS activity and hypercoagulability (Table 2).

Among the studied parameters, antithrombin III showed the strongest correlations, indicating that AT-III deficiency represents the most pronounced alteration within the natural anticoagulant system. AT-III activity demonstrated a moderate positive correlation with serum albumin levels ($r = 0.53$, $p < 0.001$) and a negative correlation with daily protein excretion ($r = −0.46$, $p < 0.001$).

Furthermore, AT-III levels were strongly inversely correlated with markers of hypercoagulability, including D-dimer ($r = −0.58$, $p < 0.001$) and fibrinogen ($r = −0.51$, $p < 0.001$).

Protein C and free protein S levels showed similar trends but with weaker correlations. Protein C demonstrated negative correlations with D-dimer ($r = −0.42$, $p = 0.002$) and fibrinogen ($r = −0.37$, $p = 0.005$), while protein S showed negative correlations with D-dimer ($r = −0.39$, $p = 0.004$) and fibrinogen ($r = −0.34$, $p = 0.008$).

Overall, these findings suggest that antithrombin III deficiency represents the most prominent disturbance among natural anticoagulants and is closely associated with the hypercoagulable state in patients with nephrotic syndrome.

Table 3

Multivariable regression analysis for predictors of AT-III deficiency

Variable	β coefficient	95% CI	p-value
Albumin, g/L	0.41	0.24 – 0.57	<0.001
Daily protein excretion, g/day	−0.19	−0.37 – 0.02	0.071
D-dimer, mg/L	−0.36	−0.52 – −0.18	0.002
Fibrinogen, g/L	−0.14	−0.31 – 0.05	0.124

Note: β represents the standardized regression coefficient, and CI refers to the confidence interval. Statistical significance was defined as p <0.05.

Multivariable linear regression analysis was performed to identify independent determinants of AT-III deficiency. Variables with p <0.10 in univariate analysis were entered into the model (Table 3). The findings revealed that serum albumin and D-dimer concentrations were independently associated with AT-III deficiency, while proteinuria and fibrinogen lost their significance after multivariable adjustment.

Lower serum albumin levels were independently associated with AT-III deficiency (β = 0.41, 95 % CI 0.24–0.57, p <0.001). In addition, D-dimer levels were inversely associated with AT-III deficiency (β = −0.36, 95 % CI −0.52 – −0.18, p = 0.002), indicating that activation of coagulation pathways contributes to depletion of natural anticoagulants.

These findings suggest that both NS severity (reflected by hypoalbuminemia) and activation of coagulation (reflected by elevated D-dimer) independently contribute to the reduction of AT-III levels.

The present study provides additional evidence that NS is associated with significant disturbances of the hemostatic system characterized by activation of coagulation pathways and depletion of natural anticoagulants. Our findings demonstrate significantly elevated levels of D-dimer and fibrinogen together with deficiecy of AT-III, protein C, and free protein S in patients with NS compared with healthy individuals. These alterations collectively reflect a prothrombotic state that is widely recognized as one of the major systemic complications of NS.

The hypercoagulable state in NS has been extensively described in previous studies and is considered multifactorial. It results from an imbalance between procoagulant and anticoagulant mechanisms, including increased synthesis of procoagulant factors in the liver, platelet activation, impaired fibrinolysis, and urinary loss of anticoagulant proteins such as antithrombin and free protein S [14, 15]. This dysregulation significantly increases the risk of

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venous thromboembolism, which may occur in up to 25–30 % of adult patients with NS [6, 16].

In our study, patients with NS demonstrated significantly higher D-dimer and fibrinogen levels compared with the control group. These findings indicate activation of the coagulation cascade and enhanced fibrin formation, which are well-recognized markers of hypercoagulability. Previous studies have also reported elevated fibrinogen concentrations in nephrotic syndrome due to increased hepatic synthesis as part of the acute-phase response to hypoalbuminemia and protein loss. Elevated D-dimer levels further reflect ongoing fibrin turnover and activation of the fibrinolytic system secondary to increased thrombin generation [17, 18].

One of the most important findings of the present study is the pronounced reduction in AT-III in patients with NS. AT-III is a key endogenous inhibitor of thrombin and factor Xa and plays a central role in maintaining the balance between coagulation and anticoagulation. Previous studies have shown that AT-III deficiency may occur in 40–80 % of patients with NS due to urinary loss of this relatively low-molecular-weight protein [19, 20]. Our results support this concept and demonstrate that antithrombin deficiency represents the most pronounced disturbance among natural anticoagulants in this patient population.

The reduction of other natural anticoagulants, including protein C and protein S, observed in our study is also consistent with previous reports. Both proteins are essential regulators of coagulation that inactivate factors Va and VIII a and therefore limit thrombin generation. Deficiency of protein S in particular may result from urinary loss of its free fraction, which has been described as an important contributor to hypercoagulability in NS [20, 21]. Earlier investigations have demonstrated significant alterations in the activity of antithrombin III, protein C, and protein S during active NS, with partial normalization during remission [3].

Our correlation analysis further demonstrated that AT-III showed the strongest associations with markers of NS severity and hypercoagulability. Specifically, AT-III levels were positively correlated with serum albumin and inversely correlated with proteinuria, D-dimer, and fibrinogen concentrations. These findings support the concept that loss of anticoagulant proteins and the severity of the nephrotic state are closely linked to activation of coagulation pathways.

Interestingly, recent large cohort studies have suggested that AT-III deficiency alone may not fully explain the hypercoagulable state observed in nephrotic syndrome. In a multicenter study and meta-analysis conducted by Abdelghani et al., antithrombin deficiency was present in a substantial proportion of patients but was not consistently associated with hypercoagulability in all cohorts [8]. These observations suggest that additional mechanisms—including endothelial dysfunction, platelet activation, and increased procoagulant factor synthesis—also contribute to the complex pathophysiology of thrombosis in NS.

Nevertheless, our multivariable regression analysis demonstrated that serum albumin and D-dimer levels remained independently associated with AT-III. This finding highlights the close relationship between NS severity, activation of coagulation, and depletion of natural anticoagulants. Hypoalbuminemia, a hallmark of NS, reflects the degree of urinary protein loss and has been previously identified as a strong predictor of thromboembolic risk in these patients.

From a clinical perspective, these results emphasize the potential role of natural anticoagulants as biomarkers of hypercoagulability in NS. Identification of patients with significant depletion of AT-III, protein C, or protein S may contribute to improved risk stratification for thromboembolic complications and may support decisions regarding prophylactic anticoagulation, particularly in high-risk individuals.

Several limitations of this study should be considered. The cross-sectional nature of the design does not permit assessment of dynamic changes in anticoagulant levels across different stages of NS, such as remission and relapse. In addition, the modest sample size may limit the external validity of the findings. Moreover, functional evaluations of overall coagulation potential, including thrombin generation and thromboelastography, were not conducted and may have offered further understanding of hypercoagulability mechanisms.

Despite these limitations, our findings contribute to the growing body of evidence highlighting the important role of natural anticoagulant depletion in the pathogenesis of hypercoagulability associated with NS. Further prospective studies with larger cohorts and comprehensive assessment of coagulation pathways are needed to better understand the mechanisms underlying thrombotic risk in this condition.

Conclusions:

1. Patients with NS demonstrate significant disturbances of the hemostatic system characterized by increased levels of D-dimer and fibrinogen and reduced activity of natural anticoagulants.
2. Among the studied anticoagulants, AT-III deficiency was the most pronounced alteration, suggesting its key role in the development of the hypercoagulable state associated with NS.
3. Serum albumin and D-dimer levels were identified as independent predictors of decreased AT-III activity, indicating a close relationship between NS severity, activation of coagulation, and depletion of natural anticoagulants.

Conflict of interest: absent.

Data Availability Statement: The data that support the fi ndings of this study are available from the corresponding author upon reasonable request

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ДЕФІЦИТ ПРИРОДНИХ АНТИКОАГУЛЯНТІВ У ПАЦІЄНТІВ ІЗ НЕФРОТИЧНИМ СИНДРОМОМ: ПОРІВНЯЛЬНА ОЦІНКА АНТИТРОМБІНУ ІІІ, ПРОТЕЇНУ С І S І ЇХНІЙ ЗВ'ЯЗОК ІЗ МАРКЕРАМИ ГІПЕРКОАГУЛЯЦІЇ

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Резюме. Нефротичний синдром (НС) асоціюється з підвищеним ризиком тромбоемболічних ускладнень, зумовлених порушеннями системи гемостазу та розвитком гіперкоагуляційного стану. Одним із ключових механізмів є дисбаланс між прокоагулянтними та антикоагулянтними факторами, зокрема дефіцит природних антикоагулянтів − антитромбіну III (АТ-III), протеїну С та протеїну S.

Мета дослідження − оцінити рівні природних антикоагулянтів у пацієнтів із НС і визначити їх зв'язок із маркерами гіперкоагуляції. У дослідження включено 76 пацієнтів із первинним гломерулонефритом (ГН) і НС, які проходили лікування у 2022–2024 роках, а також 40 практично здорових осіб контрольної групи. Показники гемостазу визначали за допомогою хромогенних та коагуляційних функціональних тестів. Статистичний аналіз включав кореляційні та багатофакторні регресійні моделі.

У групі пацієнтів із НС виявлено ознаки гіперкоагуляції: концентрації D-димеру та фібриногену були достовірно вищими, ніж у здорових осіб. Одночасно спостерігалося достовірне зниження активності природних антикоагулянтів. Рівні АТ-III, протеїну С та вільного протеїну S були значно нижчими у пацієнтів із НС. Кореляційний аналіз показав, що активність АТ-III має найсильніші зв'язки з маркерами тяжкості НС та гіперкоагуляції: позитивну кореляцію з альбуміном сироватки та негативні − з протеїнурією, D-димером і фібриногеном.

Багатофакторний регресійний аналіз показав, що рівні альбуміну та D-димеру є незалежними предикторами зниження активності АТ-III. Отримані результати свідчать, що тяжкість НС та активація коагуляційних процесів сприяють виснаженню природних антикоагулянтів. Таким чином, НС характеризується вираженим протромботичним гемостатичним профілем, у якому дефіцит антитромбіну III відіграє ключову роль у розвитку гіперкоагуляції.

Ключові слова: нефротичний синдром, антитромбін III, протеїн С, протеїн S, гіперкоагуляція, тромбоемболічний ризик.

Конфлікт інтересів: відсутній.

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