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Analysis of Blood Biochemical Parameters in Predicting Early Toxicosis Severity in Pregnancy and Gestosi

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Abstract

Early toxicosis commonly emerges during the initial trimester of pregnancy, usually manifesting between the second and approximately the 12-15 week of gestation. This condition often presents with symptoms such as excessive salivation, fatigue, nausea, and frequent vomiting in pregnant women, all of which reflect disruptions in both the central and autonomic nervous systems. Recognized as a multifactorial disorder, early toxicosis represents a complex constellation of gestational complications. Among its diverse etiological factors, chorionic gonadotropin is considered a primary driver influencing the maternal physiological response. In more severe and resistant forms, women may develop pronounced electrolyte imbalances and metabolic alkalosis. Although there are no universally accepted guidelines for assessing the severity of gestosis, clinicians rely on a combination of laboratory findings and clinical assessment, with emphasis on markers related to cardiovascular, hepatic, and renal function. The current research focuses on identifying specific biochemical blood parameters that can serve as reliable indicators for determining the intensity of early toxicosis during pregnancy.

Keywords: Gestosis, Early toxicosis, Pregnancy, Vomiting of pregnant women

Introduction

Early toxicosis is a complex pathological condition with multiple contributing factors, typically emerging during the first trimester of pregnancy and, in some instances, persisting until delivery [1, 2]. Among its more severe outcomes are disturbances in metabolic processes, notably electrolyte imbalances, the onset of alkalosis or ketonuria, and states of dehydration [3, 4]. These complications are often reflected in abnormal laboratory findings in both blood and urine analyses [5, 6]. Globally, early toxicosis is reported to affect approximately 70% of all pregnancies [7]. In the context of the Russian Federation, around 60% of pregnant women report symptoms limited to nausea and vomiting of pregnant women, while roughly 2% are diagnosed with more severe forms of early toxicosis that require inpatient treatment [8, 9]. Although uncommon, such severe cases can occasionally result in maternal death [10]. The emergence of early toxicosis is frequently linked to hereditary factors, disorders of the gastrointestinal tract, hormonal fluctuations, and neurological dysfunctions [11]. Among the contributing risks, the presence of coexisting medical conditions is of particular significance (**Figure 1**).

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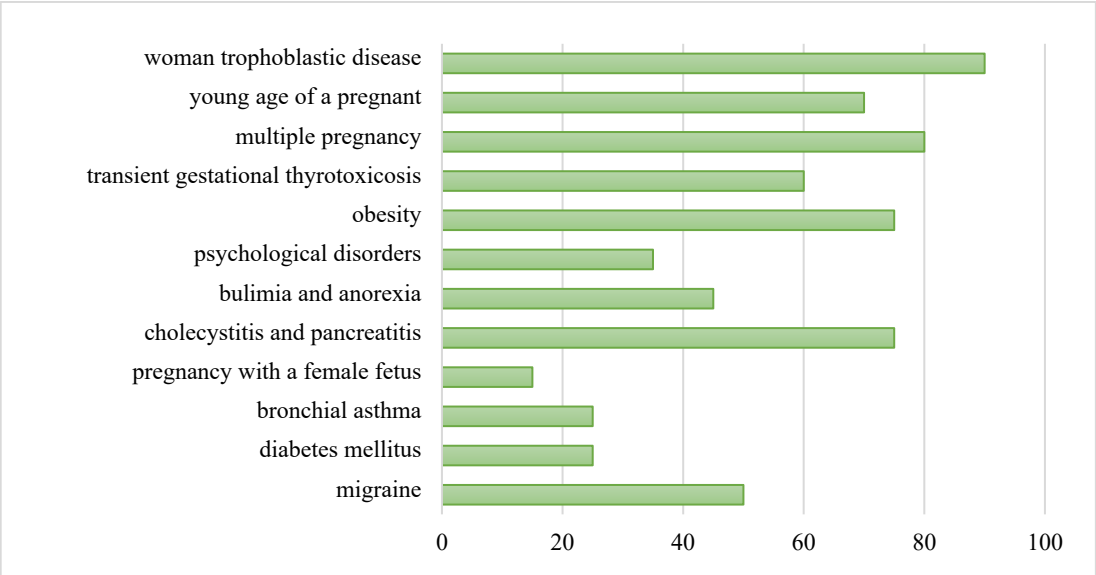

Figure 1. The most common risk factors for early toxicosis in pregnant women

A critical element in preventing the escalation of metabolic disturbances associated with early toxicosis from mild to severe forms lies in the timely enrollment of pregnant women in antenatal care and consistent monitoring of clinical and laboratory indicators [12]. It is essential to distinguish nausea and vomiting in pregnant women from similar symptoms arising due to gastrointestinal conditions such as those involving the esophagus, stomach, pancreas, or biliary tract [13]. The symptomatology of early toxicosis is rooted in disruptions of the embryo-placental interface [14]. Central to its pathophysiology are dysfunctions in endothelial regulation, impaired platelet activity within the hemostatic system, and increased lymphocyte apoptosis triggered by immunopathological processes originating in the placenta [15, 16]. Therefore, the development of a systematic diagnostic protocol—from medical history collection to advanced instrumental assessments—is imperative. **Table 1** outlines the principal diagnostic criteria used to evaluate the severity of early toxicosis.

Based on the data in **Table 1**, early toxicosis is categorized into three levels: mild, moderate, and severe. Evaluative parameters include the daily frequency of vomiting, pulse rate, blood pressure, weight loss over one week, body temperature, assessment of skin and scleral jaundice, signs of skin dryness, bowel movement frequency, urine output, and the extent of ketonuria [17, 18]. Diagnosis largely hinges on interpreting a combination of clinical observations and laboratory findings. Standard testing involves complete blood and urine analyses, with emphasis on hematocrit, as well as detailed biochemical profiling—measuring levels of bilirubin, residual nitrogen, urea, electrolytes, total protein and its fractions, and glucose [19–21]. Testing for urinary acetone, protein, and urobilin is also recommended to enhance diagnostic accuracy [22, 23].

In cases of severe gestosis, laboratory results often reveal increased concentrations of hemoglobin, red blood cells, and proteins in the bloodstream. Evaluating hematocrit values is crucial to determining the level of dehydration, with readings above 40% indicating significant fluid loss [24].

The objective of this study is to investigate the protein spectrum in the blood of pregnant women, alongside bilirubin, urea, and creatinine indicators, to identify diagnostic and prognostic markers associated with the progression of early toxicosis in pregnancy.

Table 1. The severity of vomiting in pregnant women

Symptoms	Severity		
	Light	**Medium**	**Heavy**
Frequency of vomiting per day	From 3 to 5 times	From 6 to 10 times	From 11 times and above
Heart rate	80-90	90-100	More than 100
Average blood pressure	110-120 mmHg	100-110 mmHg	Less than 100 mmHg
Weight loss (per week)	Up to 5% of the initial mass	6-10% of the initial mass	More than 10% of the initial mass
Subfebrile temperature	No	Rarely	Often
Jaundice of the sclera and skin	No	5-7% of patients	20-30% of patients

Hyperbilirubinemia	No	21-40 µmol/l	21-60 µmol/l
Dryness of the skin	+	++	+++
Bowel movements	Daily	1 time in 3 days	Constipation
Diuresis	900-800 ml	800-700 ml	Less than 700 ml
Ketonuria	+, ++	+, +++	+++, ++++

Materials And Methods

This investigation included a total of 40 pregnant women receiving care at antenatal facilities in Vladikavkaz, located in the Republic of North Ossetia-Alania. All participants were in the first trimester of pregnancy and were admitted for inpatient management within the conservative gynecology department. Based on the severity grading outlined in **Table 1**, participants were categorized into three distinct groups:

Group 1 consisted of 10 women exhibiting mild forms of early toxicosis. These patients maintained a generally stable condition throughout hospitalization. Vomiting of pregnant women occurred up to three times per day, typically postprandially, though occasionally it was noted upon waking. Weight reduction did not exceed 2–3 kg, body temperature remained normal, heart rates stayed under 80 beats per minute, and no significant fluctuations in blood pressure were observed. Laboratory tests of blood and urine did not reveal abnormal findings.

Group 2 included 10 patients diagnosed with a moderate manifestation of early toxicosis. Vomiting occurred between 5 and 10 times daily, with no consistent link to food intake. A weight loss of approximately 2–3 kg was observed throughout 1.5 to 2 weeks. Subfebrile temperatures were commonly recorded, and pulse rates reached up to 100 beats per minute. Acetonuria was identified in 6 of the 10 patients within this group.

Group 3 comprised 10 women suffering from severe early toxicosis during the first trimester of pregnancy. These patients experienced vomiting episodes ranging from 20 to 25 times per day, sometimes triggered by minor bodily movements. Sleep disturbances and extreme physical weakness (adynamia) were prevalent. Weight loss was dramatic, reaching 8–10 kg. Temperatures varied from 37.2-37.5 °C. Tachycardia was pronounced, reaching 110–120 beats per minute, accompanied by hypotension. Universally, these patients exhibited dry mucous membranes, coated tongues, and reduced skin moisture. Urine output was notably decreased in all cases, and urinalysis revealed the presence of acetonuria, protein, and urinary casts.

Across all three groups, assessments were conducted to measure total protein levels and their fractions, as well as bilirubin, creatinine, urea concentrations, and medium-weight molecular markers such as AST and ALT enzymes.

For statistical evaluation, data were processed using the "Statistica 6.0" software package (StatSoft Inc., USA). All measured variables followed a normal distribution. Differences in continuous variables across independent groups were tested for statistical significance using the Student's t-test. Quantitative data were expressed as means accompanied by their standard error, while qualitative variables were reported as percentages within the boundaries of a 95% confidence interval. Differences were considered statistically significant at a P-value of less than 0.05.

Results And Discussion

Among women classified in the first group—those with a mild presentation of early toxicosis—biochemical analysis revealed a statistically significant reduction in albumin concentrations ($P < 0.05$), alongside a marked elevation in α1-globulin levels ($P < 0.05$). Despite these shifts, total serum protein values and other major biochemical indicators remained within standard reference ranges.

In the second group, which included patients experiencing a moderate progression of early toxicosis, the findings were more complex. Alterations in protein metabolism became evident, as serum albumin concentrations stayed reduced, mirroring the pattern observed in the first group. Notably, levels of α1- and α2-globulins rose beyond those recorded in the control cohort ($P < 0.05$). While total protein values did not show a significant decline, approximately 70% of patients in this group tested positive for C-reactive protein. In addition, fibrinogen levels exhibited a pronounced elevation ($P < 0.05$). The enzymatic activity of ALT and AST was also significantly heightened ($P < 0.01$ and $P < 0.02$, respectively), indicating a progressive compromise of cellular membrane integrity and the onset of cytolytic processes. These findings collectively suggest that moderate early toxicosis is accompanied by increasingly pronounced systemic metabolic dysregulation.

In women categorized within the third group, characterized by severe early toxicosis, the most

substantial biochemical deviations were observed. Serum analysis demonstrated a sharp rise in ALT and AST activity, reinforcing evidence of hepatocellular damage. A pronounced decline in albumin levels, along with disrupted protein fractions, confirmed the presence of hypoalbuminemia and dysproteinemia. Despite these disruptions, total protein concentrations remained within the expected physiological range. C-reactive protein was detected in the blood of all individuals in this group, and fibrinogen levels not only surpassed those in the mild and moderate toxicosis groups but also significantly exceeded the control values.

Furthermore, the concentration of circulating medium-weight molecules increased in direct relation to the severity of clinical symptoms. Patients suffering from the most acute forms of early toxicosis exhibited the highest levels of these molecules—surpassing both the control and less severe groups—achieving statistical significance compared to both the control ($P < 0.01$) and groups one and two ($P < 0.05$).

Conclusion

The identification of metabolic disturbances such as dysproteinemia and hypoalbuminemia in pregnant women affected by early toxicosis—conditions whose intensity was directly associated with the clinical severity of the disorder—supports the clinical value of evaluating select comprehensive biochemical indicators. These parameters can assist in more accurately gauging the degree of early toxicosis and forecasting the potential progression of the condition. In summary, although early toxicosis remains a significant complication during pregnancy in contemporary clinical practice, early recognition combined with prompt therapeutic intervention generally results in a positive prognosis for both the expectant mother and the developing fetus.

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Conflict of Interest: None

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Ethics Statement: All research procedures were conducted following ethical standards, and participation was voluntary, with informed consent obtained from all subjects. The complete dataset supporting this study is available from the corresponding author upon reasonable request.

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