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# THE DIAGNOSTIC SIGNIFICANCE OF THE SII AND SIRI INFLAMMATION INDICES IN PREGNANCIES WITH LATE-ONSET FETAL GROWTH RESTRICTION AND THEIR ASSOCIATION WITH MORPHOLOGICAL CHANGES IN THE PLACENTA

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***Abstract.***

*Low-grade chronic inflammation, as a manifestation of impaired immune tolerance between mother and fetus, is regarded as a pathogenic mechanisms underlying late-onset fetal growth restriction (FGR). Inflammatory indices derived from a complete blood count may serve as useful routine markers for the initial assessment of inflammatory or immune activity. Assessment of the pro-inflammatory environment in maternal serum and its impact on placental morphological changes resulting in reduced fetal growth during the third trimester is equally warranted.*

***Objective:*** *to evaluate the significance of the SII and SIRI indices as markers of inflammation in pregnant women with late-onset FGR and their association with inflammatory changes in the placenta.*

***Materials and methods.*** *The SII and SIRI inflammation indices were calculated in pregnant women with established late-onset FGR during outpatient follow-up, who were divided into two subgroups: G1-14 pregnant women with late-onset FGR and normal blood pressure (BP), G2-12 pregnant women with late-onset FGR and gestational hypertension (GH). The control group (CG) comprised 12 apparently healthy pregnant women with normal fetal biometric parameters. A histological and morphometric study was conducted on the placentas of 26 women diagnosed with late-onset FGR, who delivered at 36-39 weeks of gestation, and on placentas of 12 women with uncomplicated pregnancies and deliveries who gave birth to infants with normal anthropometric measurements. Morphological studies were conducted at the Danylo Halytsky Lviv National Medical University. After delivery, each placenta was weighed and measured, then fixed in formalin for histopathological analysis. Samples for microscopy were taken from the central and peripheral regions of the organ. The study protocol was approved by the Ethics Committee of Danylo Halytsky Lviv National Medical University (Protocol No. 1 dated January 26, 2026). The study complies with the requirements of the Declaration of Helsinki, the Council of Europe Convention, ICH GCP guidelines, and Ukrainian legislation. Normality was tested using the Shapiro-Wilk test. Data with a normal distribution were described as $X \pm SD$ and compared using Student's t-test; Pearson's correlation coefficient was used for correlation analysis. For non-normal distributions, Me [25%; 75%] range, the Mann-Whitney U-test, and Spearman's correlation coefficient were applied. Results were considered statistically significant at $p < 0.05$. Data analysis was performed in RStudio (v. 1.1.442) and R Commander (v. 2.4-4). This study is part of the planned research work of the Department of Obstetrics, Gynecology, and Reproductive Medicine at Danylo Halytsky Lviv National Medical University entitled «Improving the Prevention of Intrapartum Fetal Injury in Cases of Abnormal Uterine Contractions» (State Registration No. 0122U000166, duration: 2022-2026)*

***Results.*** *The SIRI score was significantly elevated in pregnancies complicated by FGR compared to the control group, indicating a latent chronic immune-inflammatory process in these patients associated with activation of the monocyte-macrophage pathway. The SII index was significantly elevated in patients with late-onset FGR with hypertension compared to both the control group and patients with late-onset FGR and normal blood pressure, reflecting neutrophil-platelet activation. Histological examination of placentas from women with late-onset FGR in group G1 revealed focal productive basal deciduitis in 85.7% of cases. Morphological examination of placentas from women in group G2 demonstrated progression of inflammatory changes – acute focal basal and parietal deciduitis – in 66.7% of cases. The distribution of inflammation, primarily involving the basal plate of the placenta, adjacent chorionic villi, and the decidual membrane, may indicate a maternal origin.*

***Conclusions.*** *1. In pregnancies complicated by late-onset FGR, a gradual accumulation of systemic inflammatory burden is observed, reflected in increased values of the SIRI and SII inflammatory indices. 2. The pro-inflammatory state detected in maternal serum was associated with the development of inflammatory changes in the placenta.*

***Keywords:*** *Late-Onset Fetal Growth Restriction; Systemic Inflammatory Indices SIRI and SII; Placenta.*

## Introduction

Fetal growth restriction (FGR) describes the inability of the fetus to reach its growth potential. Understanding the pathophysiology of FGR is important because it represents the strongest risk factor for stillbirth, adverse short-term neonatal complications, and increased long-term morbidity [1].

A disruption of immune tolerance between the pregnant woman and the fetus is regarded as a pathogenic mechanism underlying late-onset FGR [2, 3]. In placentas from pregnancies affected by this complication, nonspecific inflammation has been observed, including villitis of noninfectious etiology, chronic basal deciduitis, and chronic histiocytic intervillitis [5,16]. An aseptic inflammatory reaction in the placenta with villous damage may result from impaired maternal immune tolerance to the fetus, which morphologically manifests as villous infiltration by both maternal lymphocytes and macrophages of fetal origin [6]. Inflammatory changes in the chorionic villi can lead to the release of placental antigens into the maternal bloodstream. When immunological tolerance is impaired, this process may exacerbate the autoimmune response, creating a «vicious cycle» of inflammation and tissue damage in the placenta [7, 8]. Elevated levels of pro-inflammatory markers and associated damage to molecular structures are detected in both the placenta and

maternal serum during pregnancy complicated by late-onset FGR [22].

Although the gold standard for diagnosing systemic inflammation is the measurement of pro-inflammatory cytokine levels – such as IL-1β, IL-6, IL-8, IL-12, IL-17, and TNF-α – these methods are expensive, exhibit high variability in results, and are not readily available for routine clinical practice [11]. The systemic inflammatory indices SII (Systemic Immune-Inflammation Index) and SIRI (Systemic Inflammation Response Index) are therefore attracting increasing attention. These indices are derived from complete blood count parameters, specifically neutrophil, lymphocyte, monocyte, and platelet counts [12, 13]. Given that oxidative and nitrosative stress, which play a key role in the pathogenesis of FGR [14], are triggers of inflammatory changes, SII and SIRI may serve as useful routine markers for the initial assessment of inflammatory or immune activity. Assessment of the pro-inflammatory environment in maternal serum and its impact on placental morphological changes resulting in reduced fetal growth during the third trimester is equally warranted. Systemic inflammation indices – SII and SIRI in particular – thus merit attention as accessible, non-invasive, and informative biomarkers capable of improving the accuracy of inflammatory status assessment and prognosis in patients with late-onset FGR.

**The aim** of present study was to evaluate the significance of the SII and SIRI indices as markers of inflammation in pregnant women with late-onset FGR and their association with inflammatory changes in the placenta.

**Materials and Methods.** A retrospective cohort study was conducted. Pregnant women with diagnosed late-stage fetal growth restriction (FGR) during antenatal care were examined and divided into two subgroups: G1-14 pregnant women with late-stage FGR and normal blood pressure (BP), G2-12 pregnant women with late FGR and gestational hypertension (GH). The control group (CG) comprised 12 apparently healthy pregnant women with normal fetal biometric parameters. The diagnosis of fetal growth restriction was established in accordance with the Medical Care Standard «Fetal Growth Restriction» dated October 2, 2023, No. 1718.

All procedures were performed following written informed consent obtained from each participant. Exclusion criteria included clinical signs of infection at the time of examination, antiphospholipid syndrome, severe extragenital pathology, multiple pregnancy, and pregnancy resulting from assisted reproductive technology.

Inflammatory indices were calculated as follows: SIRI as the ratio (neutrophils × monocytes) / lymphocytes, and SII as (platelets × neutrophils) / lymphocytes.

The study included placentas from 26 parturients diagnosed with late-onset FGR who delivered at 36-39 weeks of gestation. A control group comprising 12 placentas from women with physiological pregnancies and deliveries who gave birth to infants with normal anthropometric parameters was formed for comparative analysis of placental findings. Histological and morphometric examinations of the placentas from the study groups were performed using a standard method – hematoxylin-eosin staining – with a LOMO light microscope at standard magnifications: ×10, ×20, ×40, and ×100. Morphological studies were conducted at the Department of Histology, Cytology, and Embryology of Danylo Halytsky Lviv National Medical University. Immediately after delivery, each placenta was collected, weighed, and measured macroscopically. The material was then fixed in formalin solution and transported for histopathological examination. Tissue samples for histological sectioning were collected from the central and peripheral zones of the placenta. The study protocol was approved by the Ethics Committee of Danylo Halytsky Lviv National Medical University (Protocol No. 1 dated January 26, 2026). The study complies was conducted in compliance with the Declaration of Helsinki, the Council of Europe Convention, ICH GCP, and Ukrainian legislation.

The normality of quantitative data distribution was assessed using the Shapiro-Wilk test. Data conforming to a Gaussian distribution were described as the arithmetic mean and standard deviation ($X \pm SD$). Differences between two means were evaluated using Student's t-test for normally distributed data and the Mann–Whitney U-test for non-Gaussian distributions. A difference was considered significant at $p < 0.05$. All statistical calculations were performed using RStudio v. 1.1.442 and R Commander v. 2.4-4.

This study is part of the planned research of the Department of Obstetrics, Gynecology, and Reproductive Medicine at Danylo Halytsky Lviv National Medical University, titled «Improving the Prevention of Intrapartum Fetal Injury in Cases of Abnormal Uterine Contractions» (State Registration No. 0122U000166, duration: 2022-2026)

## Results and Discussion

The levels of the SIRI and SII inflammatory indices were determined across three study groups: G1-14 pregnant women with late-onset FGR and normal blood pressure; G2-12 pregnant women with late-onset FGR and gestational hypertension; CG – 12 apparently healthy pregnant women. The examination was conducted at 36-39 weeks of gestation. The results are presented in Table 1.

**Table 1**

**Values of the SIRI and SII indices in the study groups**

| Indicators | G1 | G2 | CG | p |
|---|---|---|---|---|
| SIRI | 3.45 ± 0.67 | 6.87 ± 1.43 | 1.75 ± 0.31 | p1= 0.05; p2 = 0.06; p3 = 0.008 |
| SII | 539.86 ± 3.43 | 1662.51 ± 75.54 | 420.4 3± 44.56 | p1 = 0.001; p2 =0.561; p3 =0.008 |

*Notes: differences in the values of the systemic inflammatory indices SIRI and SII in patients with late-onset FGR and normal blood pressure (G1), late-onset FGR and gestational hypertension (G2), and in the control group (CG): p1 – differences between G1 and G2; p2 – between G1 and CG; p3 – between G2 and CG.*

As shown in the table, the SIRI index demonstrated significantly higher values in patients with late-onset FGR. A significant increase in this index was also observed in G2– patients with late-onset FGR and gestational hypertension. Regarding SII, although a tendency toward an increase was observed in patients with late-onset FGR and normal blood pressure, no statistically significant differences were identified compared to the control group. Statistical analysis revealed a significant difference between G1 and G2, and between G2 and CG, indicating that gestational hypertension causes an increase in SII.

Pro-inflammatory changes in the serum of pregnant women with late-onset FGR prompted analysis placental histopathology, which remains the only reliable method for diagnosing placental dysfunction.

Macroscopic examination revealed that the mean placental weight in women with late-onset FGR was significantly lower than in the control group: 335.3 ± 11.5 g versus 430.6 ± 13.7 g ($p < 0.05$). The fetal-placental ratio was 0.12 ± 0.06 versus 0.17 ± 0.05 in the control group ($p>0.05$), likely reflecting low placental weight and the birth of low-birth-weight infants (2240.6 ± 260.6 g and 3470.7 ± 220.5 g, respectively). Visual examination of placentas from patients with late-onset FGR revealed uneven maturation of the cotyledons with pronounced compensatory and adaptive processes, multiple calcifications of varying sizes in different placental structures, and pseudo- and ischemic infarcts. White-yellow infarcts of varying sizes were located predominantly in the subbasal areas and along the periphery of the placenta. Hemorrhagic infarcts were observed in 34.6% of the study group. The umbilical cord vessels consisted of two arteries and one vein. In one case in the G2 group, a single umbilical artery was present. Postnatal umbilical cord hyperflexibility was observed in 26.9% of the main group. Umbilical cord attachment in both groups was predominantly paracentral; marginal attachment was recorded in three cases and membranous attachment in one case in the main group.

Histological examination of placentas in group G1 revealed moderately pronounced focal infiltration of lymphocytes and macrophages in the basal lamina, along with petrifications of varying sizes, ramification cysts, and focal hemorrhages (Figure 1).

In placentas from women in group G2, foci of necrosis with a significant number of neutrophils were observed alongside signs of focal round-cell infiltration (Figure 2).

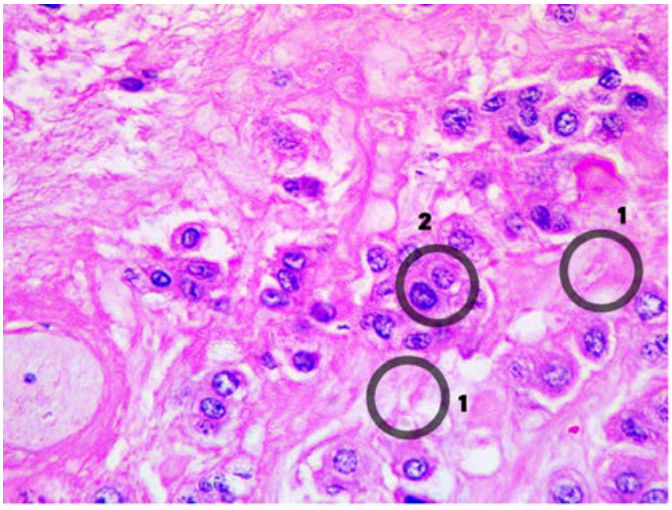


**Figure 1. Maternal portion of the placenta. Disorganization of the intercellular matrix of the endometrium (1), dystrophic changes in decidual cells (2). Hematoxylin and eosin stain. Magnification ×400.**

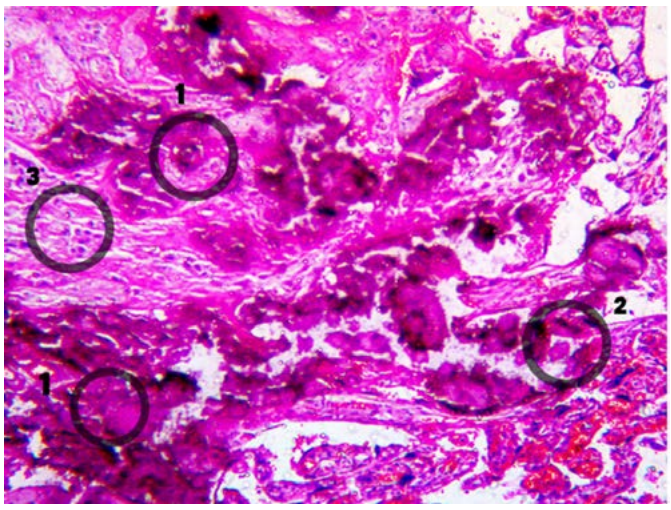


**Figure 2. Post-infarction necrotic changes in the basal lamina of the endometrium (1) with disintegration of adjacent chorionic villi (2). Pyknotic changes in decidual cells (3). Hematoxylin and eosin stain. Magnification ×200.**

In the interstitial space, an excessive amount of fibrinoid, focal hemorrhages, and multiple pseudo- and ischemic infarcts were identified; petrifications of varying sizes were present in some infarcts and fibrinoid deposits. Isolated neutrophils among fibrinoid deposits were observed in the subchorial and central interstitial spaces (Figure 3).

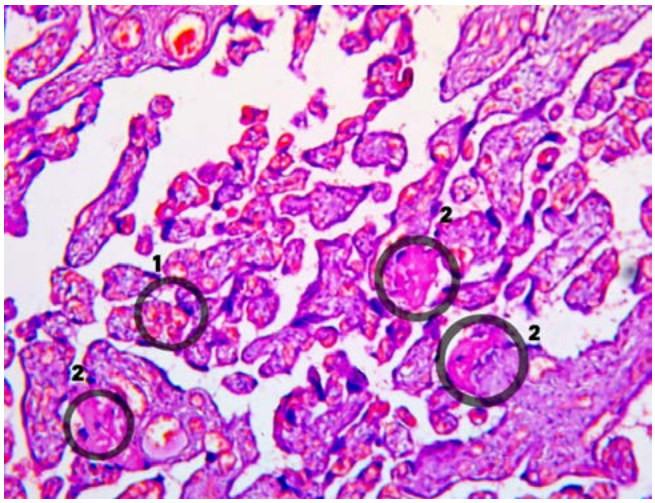


**Figure 3. Circulatory changes in the chorionic villi (1), with accumulation of Langhans fibrinoid in these areas (2). Hematoxylin and eosin stain. Magnification ×200.**

Uneven narrowing of the intervillous space with the development of non-functional zones was observed in 38.5% of cases; acute thrombosis was recorded in 30.8% of casesIn 34.6% of cases, villi showed moderate lymphocytic infiltration, stromal edema, and focal fibrinoid necrosis of the villous epithelium with petrification. In the vast majority of cases, among the villi of the branched chorion appropriate for gestational age, isolated intermediate immature and intermediate mature villi are observed. Some villi exhibit marked angiomatosis and multiple syncytial buds, while others show stromal sclerosis and small calcifications. Additionally, isolated villi contain solitary vessels with thickened walls (Figure 4).

Examination of placentas in the control group revealed characteristic morphological features of physiological placental aging, accompanied by pronounced compensatory reactions.

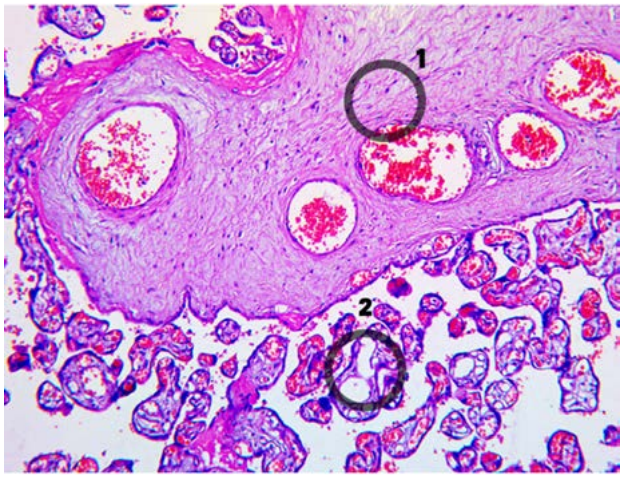


**Fig. 4. Angiomatosis of the anchor villi of the chorion (1), edema in the tertiary villi with the formation of pseudocysts (2). Hematoxylin and eosin stain. Magnification ×100**

## Discussion

The study results confirm the growing interest in inflammatory indices, particularly SII and SIRI, as routinely available, inexpensive, yet informative markers of systemic inflammation [15].

The SIRI index demonstrated a statistically significant increase in pregnant women with late-onset FGR. An increase in the SIRI index in G1 group to 3.45 ± 0.67 reflects elevated monocyte levels and serves as a marker of chronic immune-mediated inflammation. The more pronounced increase in the SIRI index in group G2 to 6.87 ± 1.43 reflects an increase in both monocyte and neutrophil counts, suggesting a gradual accumulation of systemic inflammatory burden in pregnant women with late-onset FGR and gestational hypertension. The SII index did not reveal statistically significant differences between groups G1 and CG; however, given the significantly higher SIRI values observed in group G1, this may indicate a latent chronic immune-inflammatory process associated with activation of the monocyte-macrophage pathway without systemic clinical manifestations, accompanied by the development of late-onset FGR.

The SII index was significantly elevated in patients with late-onset FGR and hypertension compared to patients with late-onset FGR and normal blood pressure and to the control group, reflecting neutrophil-platelet activation. The findings of this study may therefore indicate a correlation

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between immune and inflammatory responses in the development of late-onset FGR. An increase in these indices, as indicators of systemic inflammation, may suggest progression of the pathophysiological mechanisms underlying late-onset FGR. Immune cells play a crucial role in placental development and function, and inadequate regulation of the maternal immune system is associated with placental pathology and pregnancy complications [16]. Histological examination of placentas from women with late-onset FGR in Group G1 revealed focal productive basal deciduitis in 85.7% of cases. Moderately pronounced focal infiltration by lymphocytes and macrophages was observed in the basal lamina; in the absence of clinical signs of an infectious process, this may indicate a chronic immune-mediated inflammatory process representing the maternal immune response to the trophoblast.

Morphological changes in the placentas from 66.7% of parturients in Group G2 revealed acute placentitis (acute focal basal and parietal deciduitis). The progression of inflammatory changes in the placenta correlates with an increased shift toward a pro-inflammatory environment in the maternal serum of pregnant women with late-onset FGR and gestational hypertension.

Chronic inflammation of the placental basal lamina caused degradation of the intercellular matrix and altered metabolism of decidual cells, accompanied by cell proliferation – macrophages and fibroblasts – with the formation of fibrous tissue. Consequently, microcirculation was impaired and the risk of preeclampsia increased. Uneven maturation of the cotyledons indicates uneven blood supply or chronic stress. Compensatory-adaptive processes include angiogenesis, villous hyperplasia, increased vascularization, and thickening of the villous walls, representing the placental response to prolonged hypoxia. Collectively, these findings indicate a prolonged, low-intensity pathological process in the placenta with periods of exacerbation and compensation.

Subchorionic intervillitis is characterized by inflammation localized directly beneath the chorionic plate and may represent a manifestation of the maternal immune response. The combination of fibrinous-leukocytic intervillitis and subchorionic intervillitis indicates a mixed nature of the damage – an immunoinflammatory process with a component of impaired microcirculation and coagulation.

The complex of observed changes is consistent with chronic placental insufficiency in the setting of prolonged chronic immunoinflammatory and vascular damage to the placenta, with episodes of exacerbation and ischemic lesions. Pronounced compensatory reactions aimed at preserving placental function are noted; however, the presence of multiple infarcts, calcifications, and inflammatory infiltrates indicates a significant reduction in the organ's reserve capacity.

Reduced fetal growth rate in the third trimester was therefore accompanied by elevated levels of pro-inflammatory markers in the mother's blood and inflammatory changes in the placenta. Inflammation primarily involving the basal lamina of the placenta, adjacent chorionic villi, and the decidua may indicate a maternal origin. Despite previous hypotheses regarding the possibility of infectious placental involvement by an undetected pathogenic source, most authors currently propose that this mechanism is based on a disruption of maternal-fetal tolerance analogous to graft rejection [16,20].

As reported by Feist et al. (2021), basal deciduitis and basal villitis are diagnosed exclusively in the third trimester. This pathology was associated with late preterm birth and stillbirth in 45.0% of cases. [19].

An increased incidence in pregnancies achieved via oocyte donation indicates a link between chronic inflammatory placental damage and maternal anti-fetal rejection [20].

In the placentas of women in Group G2, alongside signs of focal round-cell infiltration by lymphocytes and macrophages, there were foci of necrosis with neutrophilic infiltration. Concurrently, significantly elevated SIRI and SII indices were observed in maternal serum as markers of systemic inflammation. This increase in SIRI and SII indices, combined with morphological manifestations of inflammatory changes in the placenta, was accompanied by the development of clinical symptoms of preeclampsia, manifested as elevated blood pressure.

Low-intensity chronic inflammation therefore serves as the underlying pathophysiological mechanism that initiates a cascade of structural changes in the placenta in late-onset FGR.

## Conclusions

1. In pregnancies complicated by late-onset FGR, gradual accumulation of systemic inflammatory burden is observed, as reflected in rising levels of the SIRI and SII inflammatory indices.
2. A significant increase in the SIRI index in pregnant women with late-onset FGR confirms low-grade chronic inflammation associated with the activation of the monocyte-macrophage pathway, whereas statistically significant differences in the SII index were demonstrated only in the group with late-onset FGR complicated by gestational hypertension, reflecting the activation of proinflammatory and proaggregation mechanisms in the pathogenesis of this complication.
3. The proinflammatory state of maternal serum was associated with inflammatory changes in the placenta, manifested as basal deciduitis in 85.7% of cases in the G1 group and as basal and parietal deciduitis in 66.7% of cases in the G2 group. The absence of clinical manifestations of infection suggests that immunoinflammatory changes in the placenta are attributable to maternal anti-fetal rejection.

**Prospects for further research.** Further investigation of the pathogenic mechanisms underlying the development of late-onset FGR, taking into account the proinflammatory state of maternal serum and the development of inflammatory changes in the placenta, holds promise.

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**Use of artificial intelligence.** Artificial intelligence was not used in the preparation of this manuscript.

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## References:


1. Sharps MC, Baker BC, Guevara T, Bischof H, Jones RL, Greenwood SL, et al. Increased placental macrophages and a pro-inflammatory profile in placentas and maternal serum in infants with a decreased growth rate in the third trimester of pregnancy. Am J Reprod Immunol. 2020;84(3): e13267. DOI: https://doi.org/10.1111/aji.13267

2. Freedman AA, Keenan-Devlin LS, Borders A, Miller GE, Ernst LM. Formulating a Meaningful and Comprehensive Placental Phenotypic Classification. Pediatr Dev Pathol. 2021;24(4):337-50. DOI: https://doi.org/10.1177/10935266211008444

3. Sá MI, Illa M, Guedes-Martins L. Doppler Assessment of the Fetal Brain Circulation. Diagnostics (Basel). 2026;16(2):214. DOI: https://doi.org/10.3390/diagnostics16020214

4. Marijnen MC, van der Meeren LE, Schoots MH, Freedman AA, Ernst LM, Bazyleva E, et al. Placental lesions in small for gestational age fetuses with and without clinical features of fetal growth restriction: a secondary analysis of the Doppler Ratio In fetal Growth restriction Intervention Trial At (near) Term (DRIGITAT) study. Am J Obstet Gynecol. 2025;233(5):498.e1-498.e20. DOI: https://doi.org/10.1016/j.ajog.2025.05.022

5. Pinheiro B, Sarmento-Gonçalves I, Ramalho C. Association Between Placental Pathology and Early-Onset Fetal Growth Restriction: A Systematic Review. Fetal Pediatr Pathol. 2025;44(1):40-52. DOI: https://doi.org/10.1080/15513815.2024.2437642

6. Mecacci F, Avagliano L, Lisi F, Clemenza S, Serena C, Vannuccini S, et al. Fetal Growth Restriction: Does an Integrated Maternal Hemodynamic-Placental Model Fit Better? Reprod Sci. 2021;28(9):2422-35. DOI: https://doi.org/10.1007/s43032-020-00393-2

7. Agrawal S, Parks WT, Zeng HD, Ravichandran A, Ashwal E, Windrim RC, et al. Diagnostic utility of serial circulating placental growth factor levels and uterine artery Doppler waveforms in diagnosing underlying placental diseases in pregnancies at high risk of placental dysfunction. Am J Obstet Gynecol. 2022;227(4):618.e1-618. 16p. DOI: https://doi.org/10.1016/j.ajog.2022.05.043

8. Stupak A, Gęca T, Kwaśniewska A, Mlak R, Piwowarczyk P, Nawrot R, et al. Comparative Analysis of the Placental Microbiome in Pregnancies with Late Fetal Growth Restriction versus Physiological Pregnancies. Int J Mol Sci. 2023;24(8):6922. DOI: https://doi.org/10.3390/ijms24086922

9. Bezemer RE, Schoots MH, Timmer A, Scherjon SA, Erwich JJHM, van Goor H, et al. Altered Levels of Decidual Immune Cell Subsets in Fetal Growth Restriction, Stillbirth, and Placental Pathology. Front Immunol. 2020;11:1898. DOI: https://doi.org/10.3389/fimmu.2020.01898

10. Cheloufi M, Coulomb A, Abisror N, Kayem G, Fain O, Alijotas-Reig J, et al. Massive perivillous fibrin deposition: Diagnosis, obstetrical features, and treatment. Eur J Obstet Gynecol Reprod Biol. 2024;292:125-32. DOI: https://doi.org/10.1016/j.ejogrb.2023.11.024

11. Nie Y, Zhou H, Wang J, Kan H. Association between systemic immune-inflammation index and diabetes: a population-based study from the NHANES. Front Endocrinol (Lausanne). 2023;14:1245199. DOI: https://doi.org/10.3389/fendo.2023.1245199

12. Zhang D, Zeng Y, Sun B, Li W, Liu W, Gao H, et al. Inflammatory indices-Systemic Immune-Inflammation Index (SII) and Systemic Inflammatory Response Index (SIRI)-during Pregnancy and Associations with Gestational Diabetes Mellitus. J Inflamm Res. 2024;17:6521-32. DOI: https://doi.org/10.2147/jir.s474154

13. Xie S, Zhang E, Gao S, Su S, Liu J, Zhang Y, et al. Associations of systemic immune-inflammation index and systemic inflammation response index with maternal gestational diabetes mellitus: Evidence from a prospective birth cohort study. Chin Med J (Engl). 2025;138(6):729-37. DOI: https://doi.org/10.1097/cm9.0000000000003236

14. Lysyy M. Aktyvnist' arhinazo-NO-syntaznoi systemy ta zminy v systemi NO v syrovattsi peryferychnoi krovi u vahitnykh iz zatrymkoiu rostu ploda [Activity of the arginase-NO synthase system and changes in the NO system in peripheral blood serum of pregnant women with fetal growth restriction]. Int J Endocrinol. 2025;21(3):300-5. DOI: https://doi.org/10.22141/2224-0721.21.3.2025.1542 (in Ukrainian)

15. Jiang P, Chen J, Li J. Association of the systemic immune-inflammatory index and systemic inflammatory response index with all-cause and cardiovascular mortality in individuals with metabolic inflammatory syndrome. Eur J Med Res. 2025;30(1):444. DOI: https://doi.org/10.1186/s40001-025-02611-6

16. Cornish EF, McDonnell T, Williams DJ. Chronic Inflammatory Placental Disorders Associated With Recurrent Adverse Pregnancy Outcome. Front Immunol. 2022;13:825075. DOI: https://doi.org/10.3389/fimmu.2022.825075

17. Lampi K, Papadogiannakis N, Sirotkina M, Pettersson K, Ajne G. Massive perivillous fibrin deposition of the placenta and pregnancy outcome: A retrospective observational study. Placenta. 2022;117:213-8. DOI: https://doi.org/10.1016/j.placenta.2021.12.013

18. Dhital R, Jacobs M, Smith CJF, Parast MM. Placental lesions in systemic lupus erythematosus pregnancies associated with small for gestational age infants. Rheumatology (Oxford). 2024;63(11):3006-14. DOI: https://doi.org/10.1093/rheumatology/keae454

19. Feist H, Bajwa S, Pecks U. Hypertensive disease, preterm birth, fetal growth restriction and chronic inflammatory disorders of the placenta: experiences in a single institution with a standardized protocol of investigation. Arch Gynecol Obstet. 2022;306(2):337-47. DOI: https://doi.org/10.1007/s00404-021-06293-3

20. Sebastian T, Ravikumar G, Crasta J. Villitis of unknown etiology (VUE): effect on placental size and association with clinical parameters. J Matern Fetal Neonatal Med. 2022;35(9):1695-702. DOI: https://doi.org/10.1080/14767058.2020.1767577

21. Jacobs A, Al-Juboori SI, Dobrinskikh E, Bolt MA, Sammel MD, Lijewski V, et al. Placental differences between severe fetal growth restriction and hypertensive disorders of pregnancy requiring early preterm delivery: morphometric analysis of the villous tree supported by artificial intelligence. Am J Obstet Gynecol. 2024;231(5):552.e1-552.e13. DOI: https://doi.org/10.1016/j.ajog.2024.02.291

22. Zhurakivska O, Yarotska Y, Govsieiev D, Ostrovska O, Rymarchuk M. Pathomorphological Patterns of Placental Dysfunction in Late Manifestation of Fetal Growth Restriction. Acta Med Litu. 2025;32(2):301-12. DOI: https://doi.org/10.15388/amed.2025.32.2.21

23. Bujorescu DL, Rațiu AC, Motoc AGM, Cîtu IC, Sas I, Gorun IF, et al. Placental pathology in early-onset fetal growth restriction: insights into fetal growth restriction mechanisms. Rom J Morphol Embryol. 2023;64(2):215-24. DOI: https://doi.org/10.47162/rjme.64.2.12

24. Joo EH, Kim N, Ryu HM, Jung SH, Ahn EH, Lee JY. Clinical factors associated with developmental delay in placental abruption. Front Med (Lausanne). 2025;12:1544679. DOI: https://doi.org/10.3389/fmed.2025.1544679

25. Giouleka S, Tsakiridis I, Mamopoulos A, Kalogiannidis I, Athanasiadis A, Dagklis T. Fetal Growth Restriction: A Comprehensive Review of Major Guidelines. Obstet Gynecol Surv. 2023;78(11):690-708. DOI: https://doi.org/10.1097/ogx.0000000000001203

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# ДІАГНОСТИЧНЕ ЗНАЧЕННЯ ІНДЕКСІВ ЗАПАЛЕННЯ SII ТА SIRI ПРИ ВАГІТНОСТІ З ПІЗНЬОЮ ЗАТРИМКОЮ РОСТУ ПЛОДА ТА ЗВ'ЯЗОК З МОРФОЛОГІЧНИМИ ЗМІНАМИ В ПЛАЦЕНТІ

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## Резюме.

Низькоінтенсивне хронічне запалення як прояв порушеної імунної толерантності між матір'ю та плодом вважається одним із патогенетичних механізмів формування пізньої затримки росту плода (ЗРП). Запальні індекси, сформовані на основі загального аналізу крові, можуть бути корисними рутинними маркерами для первинної оцінки запальної або імунної активності. Крім того, важливо оцінити вплив прозапального середовища у материнській сироватці на виникнення морфологічних змін у плаценті, внаслідок яких відбувається знижений ріст росту плода в III триместрі.

**Мета дослідження.** Оцінити значення індексів SII, SIRI як маркерів запалення у вагітних з пізньою ЗРП та їх взаємозв'язок із запальними змінами в плаценті.

**Матеріали та методи.** Обчислено індекси запалення SII та SIRI у вагітних із встановленою пізньою ЗРП на етапі спостереження в ж/к, які розділені на дві підгрупи: G1-14 вагітних із пізньою ЗРП з нормальним артеріальним тиском (АТ), G2-12 вагітних із пізньою ЗРП з гестаційною гіпертензією (ГГ) та CG – 12 умовно здорових вагітних з нормальними фетометричними показниками плода. Проведено гістологічне і морфометричне дослідження плацент 26 породіль з діагностованою пізньою ЗРП, пологи в яких відбулися в термін 36-39 тижнів, та 12 плацент породіль з фізіологічною вагітністю та пологами, які народили дітей з нормальними антропометричними показниками. Морфологічні дослідження проводили на базі ЛНМУ імені Данила Галицького. Після пологів плаценту зважували та вимірювали, після чого фіксували формаліном для патогістологічного аналізу. Зразки для мікроскопії відбирали з центральної та прикраєвих зон органа. Протокол дослідження погоджено комісією з етики ЛНМУ імені Данила Галицького (протокол № 1 від 26.01.2026). Робота відповідає вимогам Гельсінської декларації, Конвенції Ради Європи, ICH GCP та законодавству України

Перевірку на нормальність здійснювали критерієм Шапіро-Уілка. Дані з нормальним розподілом описувались як X±SD та порівнювали t-критерієм Стьюдента; для кореляції використовували коефіцієнт Пірсона. При негаусівському розподілі застосовували Me [25%; 75%], U-критерій Манна-Уітні та коефіцієнт Спірмена. Статистично значущими вважали результати при $p<0,05$. Обробку проводили в RStudio (v. 1.1.442) та R Commander (v. 2.4-4). Дослідження є фрагментом планової науково-дослідної роботи кафедри акушерства, гінекології та репродуктивної медицини ЛНМУ імені Данила Галицького «Удосконалення профілактики інтранатального пошкодження плода при аномаліях скоротливої діяльності матки» (№ держреєстрації 0122U000166, термін виконання 2022-2026рр.)

**Результати.** Значення SIRI було достовірно вищим при вагітності із ЗРП порівняно з контрольною групою, що свідчить про наявність у цих пацієнток латентного хронічного імунно-запального процесу, пов'язаного з активацією моноцитарно-макрофагальної ланки. Індекс SII був вірогідно вищим у пацієнток із пізньою ЗРП з ГГ порівняно з контрольною групою та пізньою ЗРП з нормальним АТ за рахунок нейтрофільно-тромбоцитарної активації. При гістологічному дослідженні плацент породіль із пізньою ЗРП G1 групи у 85,7% мав місце вогнищевий продуктивний базальний децидуїт. Морфологічні зміни у плацентах 66,7% породіль G2 групи виявляли прогресування запальних змін у плаценті – гострий вогнищевий базальний та парієтальний децидуїт. Наявність запалення, у першу чергу в базальній пластині плаценти, прилеглих ворсинах хоріона та децидуальній оболонці може свідчити про материнське походження.

**Висновки.** 1. При вагітності, ускладненої пізньою ЗРП, спостерігається поступове накопичення системного запального навантаження, що відображається у зростанні значень запальних індексів SIRI та SII. 2. Виявлений прозапальний стан материнської сироватки асоціювався з розвитком запальних змін у плаценті.

**Ключові слова:** пізня затримка росту плода; системні запальні індекси SIRI та SII; плацента.

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