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Spectrum of urogenital infections in pregnant women with fetal growth restriction

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Urogenital infections during pregnancy may contribute to placental dysfunction, fetal growth restriction (FGR), and adverse perinatal outcomes, though their impact on maternal-placental-fetal circulation is not well understood.

Aim – to evaluate the prevalence of urogenital infections in pregnant women with FGR and their impact on Doppler parameters, cardiotocography (CTG), and perinatal outcomes.

Materials and methods. A prospective cohort study was conducted from 2023 to 2025, including 90 pregnant women: 45 with FGR and 45 with uncomplicated pregnancies. Assessments included laboratory testing for *Ureaplasma spp., Mycoplasma spp., Chlamydia trachomatis*, and human papillomavirus; Doppler ultrasound of uterine, umbilical, and fetal middle cerebral arteries; cerebroplacental ratio (CPR); CTG; and perinatal outcomes. Statistical analysis used t-tests, χ^2 tests, and odds ratios (OR) with 95% confidence intervals; $p<0.05$ was considered significant.

Results. Urogenital infections were more common in the FGR group, but differences were not statistically significant. Monoinfections predominated (28.9%). Infected women showed higher uterine (1.34±0.27 vs 1.11±0.22) and umbilical artery pulsatility indices (0.98±0.17 vs 0.81±0.15), lower CPR (1.49±0.36 vs 1.96±0.41), and more frequent CTG abnormalities (33.3% vs 8.7%). Perinatal outcomes were worse: lower birth weight (2450±310 g vs 3220±280 g), higher preterm birth (20% vs 6.7%), and low birth weight (<2500 g, 24.4% vs 4.4%).

Conclusions. Urogenital infections may cause placental dysfunction and fetal hypoxia. Infected women showed Doppler and CTG changes, highlighting the need for early detection and treatment to improve perinatal outcomes.

The study was performed in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Local Ethics Committee of the institution mentioned in the work. Informed consent of the patients was obtained for the research. The authors declare no conflict of interest.

Keywords: urogenital infections, fetal growth restriction, Doppler ultrasound, cerebroplacental ratio, maternal-placental-fetal circulation, pregnancy complications.

Спектр урогенітальних інфекцій у вагітних жінок із затримкою росту плода

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Урогенітальні інфекції під час вагітності можуть сприяти дисфункції плаценти, затримці росту плода (ЗРП) та несприятливим перинатальним наслідкам, хоча їхній вплив на материнсько-плацентарно-плодовий кровообіг недостатньо вивчено.

Мета – оцінити поширеність урогенітальних інфекцій у вагітних жінок із ЗРП та їхній вплив на параметри доплера, кардіотокографію (КТГ) та перинатальні результати.

Матеріали та методи. Із 2023 по 2025 рік було проведено проспективне когортне дослідження, яке охопило 90 вагітних жінок: 45 із ЗРП та 45 із неускладненою вагітністю. Оцінювання включало лабораторне тестування на *Ureaplasma spp., Mycoplasma spp., Chlamydia trachomatis* та вірус папіломи людини; доплерівське ультразвукове дослідження маткових, пупкових та середньомозкових артерій плода; цереброплацентарне співвідношення (ЦПР); КТГ; та перинатальні результати. У статистичному аналізі використовували t-тести, χ^2-тести та відношення шансів (ВШ) із 95% довірчими інтервалами; значення $p < 0,05$ вважалося значущим.

Результати. Урогенітальні інфекції були частішими у групі ЗРП, але відмінності не були статистично значущими. Переважали моноінфекції (28,9%). В інфікованих жінок виявлені вищі показники пульсації матки (1,34±0,27 проти 1,11±0,22) та пупкової артерії (0,98±0,17 проти 0,81±0,15), нижчу серцево-легеневу рецидивну гіперактивність (1,49±0,36 проти 1,96±0,41) та частіші порушення на КТГ (33,3% проти 8,7%). Перинатальні результати були гіршими: нижча вага під час народження (2450±310 г проти 3220±280 г), вища частота передчасних пологів (20% проти 6,7%) та низька вага при народженні (<2500 г, 24,4% проти 4,4%).

Висновки. Урогенітальні інфекції можуть спричиняти дисфункцію плаценти та гіпоксію плода. В інфікованих жінок спостерігалися зміни на доплерівських зображеннях та КТГ, що підкреслює необхідність раннього виявлення та лікування для покращення перинатальних результатів.

Дослідження було проведено відповідно до принципів Гельсінської декларації. Протокол дослідження схвалено Місцевим етичним комітетом установи, згаданої в роботі. На дослідження було отримано інформовану згоду пацієнток. Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: урогенітальні інфекції, затримка росту плода, доплерівське ультразвукове дослідження, цереброплацентарне співвідношення, материнсько-плацентарно-плодовий кровообіг, ускладнення вагітності.

Introduction

Genital infections play an important role in obstetric practice, as they are considered one of the leading risk factors for preterm birth. The etiology of preterm birth is generally categorized into several main types: spontaneous onset of labor, preterm birth following premature rupture of membranes, and medically indicated delivery due to maternal or fetal complications, such as preeclampsia, which often results in iatrogenic preterm birth [2,4].

It is well established that there is an inverse relationship between gestational age at birth and the economic costs of medical care: the lower the gestational age, the higher the expenses for neonatal treatment, as well as the cumulative costs of hospitalization and medical follow-up in subsequent years. In addition, preterm infants are characterized by a higher overall morbidity, including an increased risk of respiratory, cardiovascular, endocrine, and neurological disorders. The adverse consequences of preterm birth may persist not only during childhood but also into adulthood [1,2].

Strategies for the prevention of preterm birth are largely focused on the timely identification and treatment of genital infections, which are considered a significant and potentially modifiable risk factor for adverse pregnancy outcomes. Among the microorganisms most commonly detected in the female urogenital tract, *Mycoplasma* and *Ureaplasma* species occupy a prominent place, as they can be present both in symptomatic and asymptomatic infections [3,6,7,9,11].

Mycoplasma hominis, *Ureaplasma parvum*, and *Ureaplasma urealyticum*, collectively referred to as genital mycoplasmas, are widely distributed in the female urogenital tract and are often detected simultaneously. In non-pregnant women, these microorganisms frequently colonize the mucosal surfaces without causing overt clinical symptoms and are generally not associated with significant pathological consequences [13].

At the same time, numerous studies have indicated that colonization of the genital tract with mycoplasmas during pregnancy may be associated with an increased risk of various adverse obstetric and perinatal outcomes. These include preterm birth, low birth weight, premature rupture of membranes, spontaneous abortion, as well as perinatal and neonatal mortality [5,8,10,12].

These findings suggest a potential role of genital mycoplasmas in the development of pregnancy complications and underscore the need for further investigation into their clinical significance. Accordingly, reducing the incidence of preterm birth is of considerable importance not only for the affected women and their families but also for healthcare systems as a whole, as it may help mitigate the medical and socio-economic consequences of prematurity.

Aim – to evaluate the prevalence of urogenital infections in pregnant women with fetal growth restriction (FGR) and their impact on Doppler parameters, cardiotocography (CTG), and perinatal outcomes.

Materials and methods of the study

Study design and setting. A prospective cohort study was conducted from 2023 to 2025 at the Department of Obstetrics and Gynecology II of Azerbaijan Medical University (AMU) and at the laboratory of the Educational Surgical Clinic of AMU.

Study population. The study included data from 90 pregnant women: 45 comprised the Main group with FGR, and 45 formed the Control group with physiologically progressing pregnancies. The mean age of the participants was 29.8±4.5 years.

Inclusion and exclusion criteria. The study included pregnant women aged 20–40 years with fetoplacental insufficiency (FPI) and FGR who provided written informed consent to participate. Exclusion criteria comprised women with malignant neoplasms, chronic kidney disease, stage 3 arterial hypertension, as well as pregnant women younger than 20 or older than 40 years, or those who declined participation in the study.

Clinical and functional methods. Data were collected on maternal history, course of pregnancy, complications, and the condition of the newborn.

Ultrasound examinations and Doppler studies were performed to assess the pulsatility index (PI) of the uterine and umbilical arteries, the fetal middle cerebral artery, and to calculate the cerebroplacental ratio (CPR). Measurements were taken when the fetus was at rest, with three consecutive readings recorded and averaged. Reference values were based on ISUOG (2023) guidelines: uterine artery PI 0.8–1.4, umbilical artery PI 0.6–0.9, and CPR>1.08.

Laboratory methods. To assess urogenital infections, the following investigations were performed:

– bacteriological examination of vaginal and urethral swabs;

– PCR diagnostics for *Chlamydia*, *Mycoplasma*, *Ureaplasma*, *Trichomonas*, and viruses when indicated;

Table 1

Clinical characteristics of the studied pregnant women

Parameter	Main (FGR) group (n=45)	Control group (n=45)	p-value
Mean age (years)	28.6±4.2	27.9±3.8	0.42
Primigravida	24 (53.3%)	21 (46.7%)	0.51
Multigravida	21 (46.7%)	24 (53.3%)	0.51
Chronic diseases	11 (24.4%)	7 (15.6%)	0.29

Table 2

Spectrum of urogenital infections in study groups

Infection	Main (FGR) group (n=45)	Control group (n=45)	OR	95% CI	p
Ureaplasma spp.	8 (17.8%)	4 (8.9%)	2.2	0.6–7.9	0.18
HPV	7 (15.6%)	3 (6.7%)	2.6	0.6–10.4	0.17
Mycoplasma spp.	5 (11.1%)	2 (4.4%)	2.7	0.5–13.9	0.23
Chlamydia trachomatis	3 (6.7%)	1 (2.2%)	3.1	0.3–31.2	0.29

– complete blood count and urinalysis to detect inflammatory changes and anemia.

Perinatal outcomes of newborns. The following outcomes were recorded: neonatal birth weight, preterm birth, low birth weight (<2500 g), cardiovascular and respiratory abnormalities, as well as the presence of urogenital infections in the newborn.

Statistical analysis. All data were processed using SPSS v.25.0. Continuous variables are presented as mean ± standard deviation (M±SD), odds ratio (OR), calculated for binary outcomes and 95% confidence intervals (CI), while categorical variables are expressed as absolute numbers and percentages. Group comparisons were performed using Student's t-test, ANOVA, and non-parametric tests as appropriate. Correlations were assessed with Pearson's and Spearman's coefficients. Statistical significance was set at $p<0.05$.

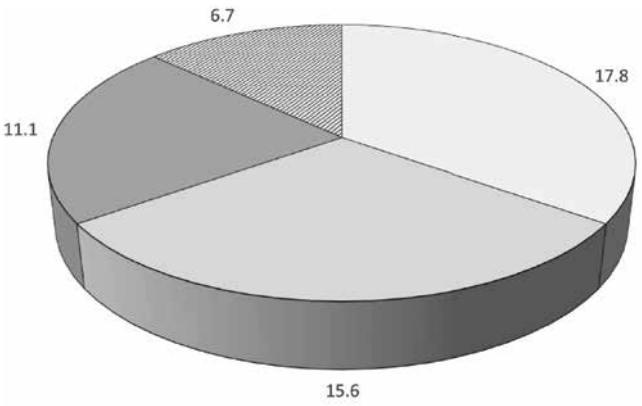

Fig. 1. Prevalence of urogenital infections in examined women, %

Ethical considerations. The study was conducted in accordance with the Declaration of Helsinki (2013) and was approved by the Local Ethics Committee of Azerbaijan Medical University. All participants provided written informed consent to participate.

Results of the study

Analysis of clinical and demographic characteristics showed that the groups were comparable in terms of key parameters, including age, reproductive history, and the presence of comorbidities. The mean age of women in the Main group was 28.6±4.2 years, while in the Control group it was 27.9±3.8 years, with no statistically significant differences between the groups ($p>0.05$). Detailed characteristics of the studied pregnant women are presented in Table 1.

Laboratory examination of the pregnant women revealed the presence of various urogenital pathogens (Figure 1).

Ureaplasma infection was diagnosed in 8 (17.8%) women in the Main (FGR) group, compared to 4 (8.9%) women in the Control group. However, the difference between the groups was not statistically significant (OR=2.2; 95% CI: 0.6–7.9; p=0.18). Chlamydial infection was relatively rare, detected in 3 (6.7%) patients in the Main (FGR) group and in 1 (2.2%) woman in the Control group, with the difference also not reaching statistical significance (OR=3.1; 95% CI: 0.3–31.2; p=0.29).

Human papillomavirus (HPV) was detected in 7 (15.6%) pregnant women in the Main (FGR) group, compared to 3 (6.7%) women in the Control group

(OR=2.6; 95% CI: 0.6–10.4; p=0.17). Mycoplasma infection was recorded in 5 (11.1%) women in the Main (FGR) group and in 2 (4.4%) women in the Control group (OR=2.7; 95% CI: 0.5–13.9; p=0.23).

Thus, urogenital infections were somewhat more frequently detected in pregnant women with FGR; however, no statistically significant differences between the groups were observed, which may indicate a possible, but not primary, role of these infections in the development of FGR. Data on the prevalence of urogenital infections are presented in Table 2.

Additional analysis revealed that some pregnant women had combined infections. The presence of mixed infections may contribute to an enhanced inflammatory response in the mother – placenta – fetus system and potentially increase the risk of adverse pregnancy outcomes. The distribution of mono- and mixed infections is presented in Table 3.

In the Main group, monoinfection was detected in 13 cases, accounting for 28.9±6.2% (95% CI: 16.1–41.7%). Two simultaneous infections were observed in 6 women (13.3±4.5%, 95% CI: 4.0–22.6%), and three infections were found in 2 women (4.4±3.0%, 95% CI: 0–8.9%). No infections were detected in 24 women.

To assess the significance of differences in the frequency of mono- and multiple infections, the Pearson's χ^2 test was applied. The results demonstrated statistically significant differences in the distribution of infection types (χ^2=8.7, df=2, p=0.013), indicating that monoinfections occurred significantly more frequently than multiple infections.

Thus, despite the presence of combined infections, the majority of detected urogenital infections in pregnant women were monoinfections, which is important for planning preventive and therapeutic interventions. Comparative analysis showed that urogenital infections were somewhat more common in women with FRG. However, statistical analysis revealed that the differences between the groups did not reach significance (p>0.05), which may be related to the relatively small sample size.

Table 3

Distribution of mono- and poly-infections of the urogenital spectrum in Main group

Infection type	n	%	95% CI (%)
Monoinfection	13	28.9±6.2	16.1–41.7
Two infections	6	13.3±4.5	4.0–22.6
Three infections	2	4.4±3.0	0–8.9
Total	21	100.0	—

Nevertheless, these findings suggest a possible role of urogenital infections in the development of chronic inflammatory processes within the placental system.

Analysis of perinatal outcomes showed that the mean birth weight of newborns in the Main (FGR) group was significantly lower compared to the Control group.

The mean birth weight in the Main (FGR) group was significantly lower (2450±310 g) compared to the Control group (3220±280 g, t=6.12, p<0.001). Preterm births occurred in 20% of women with FGR, which was nearly 3.5 times higher than in the Control group (OR=3.50; 95% CI: 0.91–13.45; p=0.04). The incidence of low birth weight (<2500 g) among FGR newborns was also higher (24.4% vs 4.4%, OR=7.33; 95% CI: 1.60–33.57; p=0.009). Differences in cardiovascular and respiratory system anomalies were not statistically significant, likely due to the small sample size for these rare outcomes (Figure 2).

Additionally, preterm births were more frequent in the Main (FGR) group, confirming the adverse impact of FGR on pregnancy outcomes (Table 5).

The analysis showed that the majority of complications in both groups occurred in the third trimes-

Table 4

Perinatal outcomes in pregnant women in study groups

Parameter	Main FGR group (n=45)	Control group (n=45)	OR (95% CI)	p-value	Statistic
Birth weight, g (mean ± SD)	2450±310	3220±280	-	<0.001	t=6.12*
Preterm birth, n (%)	9 (20.0%)	3 (6.7%)	3.50 (0.91–13.45)	0.04	χ^2=4.22**
Low birth weight (<2500 g), n (%)	11 (24.4%)	2 (4.4%)	7.33 (1.60–33.57)	0.009	χ^2=7.05**
Cardiovascular anomalies, n (%)	4 (8.9%)	1 (2.2%)	4.33 (0.49–38.41)	0.19	χ^2=1.72**
Respiratory system anomalies, n (%)	3 (6.7%)	1 (2.2%)	3.17 (0.33–30.17)	0.31	χ^2=1.01**

Notes: * – for continuous data (birth weight), an independent samples t-test was used; ** – for binary outcomes (preterm birth, low birth weight, and anomalies), the χ^2 test or Fisher's exact test was applied as appropriate.

Table 5

Clinical characteristics of pregnant women by trimester and pregnancy complications

Trimester	Complication	Main (FGR) group (n=45), n (%)	Control group (n=45), n (%)	χ^2	p
I	Preterm birth	0 (0%)	0 (0%)	-	-
	Mild gestosis	0 (0%)	0 (0%)	-	-
	Anemia	1 (2.2%)	1 (2.2%)	0.00	1.0
II	Preterm birth	2 (4.4%)	1 (2.2%)	0.33	0.56
	Mild gestosis	2 (4.4%)	1 (2.2%)	0.33	0.56
	Anemia	3 (6.7%)	2 (4.4%)	0.18	0.67
III	Preterm birth	7 (15.6%)	2 (4.4%)	3.48	0.06
	Mild gestosis	4 (8.9%)	3 (6.7%)	0.15	0.70
	Preeclampsia	2 (4.4%)	1 (2.2%)	0.33	0.56
	Anemia	3 (6.7%)	2 (4.4%)	0.18	0.67
	Urogenital infections	4 (8.9%)	3 (6.7%)	0.15	0.70

ter. Preterm births were more frequent in the Main (FGR) group (15.6%) compared to the Control group (4.4%); however, the difference was not statistically significant at $p<0.05$ ($\chi^2=3.48$; $p=0.06$). Anemia and mild gestosis were observed across all trimesters, predominantly in the second and third trimesters, and did not differ significantly between the groups. Urogenital infections were detected almost exclusively in the third trimester, occurring in 8.9% of cases in the Main (FGR) group and 6.7% in the Control group (Figure 3).

The obtained data indicate a trend toward an increased number of complications in the third trimester among pregnant women with fetal growth restriction, highlighting the need for enhanced monitoring and preventive interventions.

In women with FGR, there was a tendency toward elevated PI values in the uterine and umbilical arteries, suggesting increased vascular resistance and signs of FPI (Table 6).

Further analysis demonstrated that the presence of urogenital infections in pregnant women may be associated with alterations in the uteroplacental blood flow. Patients with detected infections showed a tendency toward higher PI values in the uterine and umbilical arteries compared to women without infections. Specifically, the mean uterine artery PI in women with urogenital infections was 1.34±0.27, whereas in those without infection it was 1.11±0.22 (p=0.03). A similar trend was observed in the umbilical artery, with PI values of 0.98±0.17 versus 0.81±0.15, respectively (p=0.04) (Figure 4).

Analysis of the CPR revealed a decrease in pregnant women with urogenital infections (1.49±0.36) compared to those without infection (1.96±0.41, $p<0.05$) (Figure 5).

The reduction in CPR may indicate a redistribution of fetal blood flow toward the brain as a compensatory response to hypoxia. Furthermore, cardiotocographic (CTG) monitoring revealed more

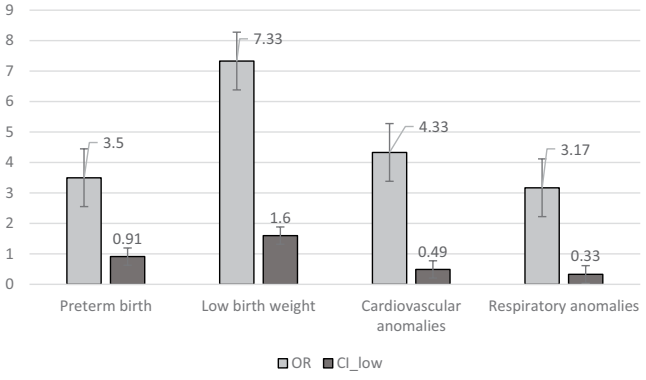

Fig. 2. Odds ratios for adverse perinatal outcomes in FGR pregnancies

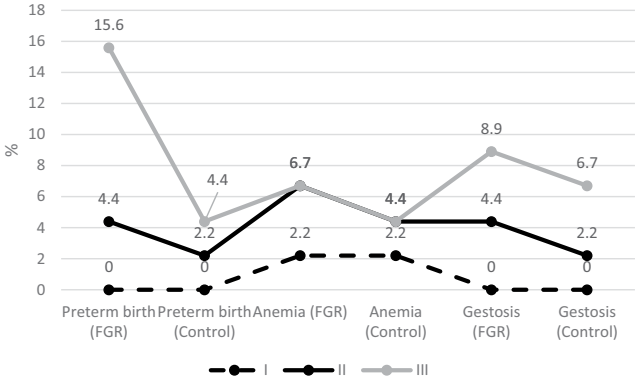

Fig. 3. Dynamics of pregnancy complications by trimester in the Main (FGR) group and in the Control group (%)

Table 6

Ultrasound and Doppler parameters in pregnant women with urogenital infections, M±SD

Parameter	Infection + (n=21)	Infection - (n=69)	p
Uterine artery (PI)	1.34±0.27	1.11±0.22	0.03
Umbilical artery (PI)	0.98±0.17	0.81±0.15	0.04
Middle cerebral artery (PI)	1.45±0.24	1.63±0.26	0.05
Cerebroplacental ratio	1.49±0.36	1.96±0.41	0.02
Estimated fetal weight (g)	2560±420	2980±390	0.01
Placental thickness (mm)	32.4±5.6	36.8±4.9	0.04

frequent signs of fetal cardiovascular stress in pregnant women with urogenital infections, including reduced heart rate variability and episodes of late decelerations. These changes were observed in 7 (33.3%) women with infections compared to 6 (8.7%) women without infections (p=0.02).

The obtained data suggest that urogenital infections may contribute to the development of a chronic inflammatory process within the mother – placenta – fetus system, which in turn can impair placental blood flow and increase the risk of intrauterine growth restriction (IUGR). Analysis revealed more pronounced alterations in uteroplacental and fetoplacental circulation among pregnant women with urogenital infections, including elevated pulsatility indices in the uterine and umbilical arteries and a reduced CPR. Additionally, pathological changes in CTG were more frequently observed in women with infections (33.3%) compared to those without infections (8.7%), indicating an increased risk of fetal hypoxia.

Discussion

In this study, we assessed the potential association between urogenital infections and the development of IUGR, as well as their impact on uteroplacental blood flow and perinatal outcomes. The results indicated that urogenital infections were slightly more common in pregnant women with IUGR compared to the Control group; however, the differences between the groups did not reach statistical significance [3,6,7,11]. At the same time, Doppler and CTG findings suggest a potential role of infectious-inflammatory processes in the development of placental dysfunction.

In our study, the most frequently detected pathogens were *Ureaplasma spp*., HPV, *Mycoplasma spp*., and *Chlamydia trachomatis*. These findings are consistent with published data indicating that atypical bacteria, such as ureaplasmas and mycoplasmas, are among the most common microorganisms in the urogenital tract of pregnant women and may be associated with adverse pregnancy outcomes [7,11]. Several systematic reviews and meta-analyses have demonstrated that *Mycoplasma hominis* and *Ureaplasma urealyticum* are associated with an increased risk of preterm birth, premature rupture of membranes, and low birth weight [8,10,12,13].

In our study, ureaplasma infection was the most frequently detected among pregnant women with FGR. Similar findings have been reported in other studies, where ureaplasmas are considered one of the potential factors contributing to inflammatory changes in the placenta [8,12,13]. It has been shown

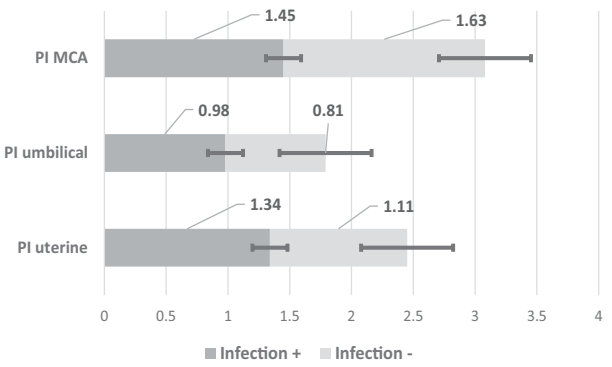

Fig. 4. Doppler indices (PI uterine, PI umbilical, PI MCA)

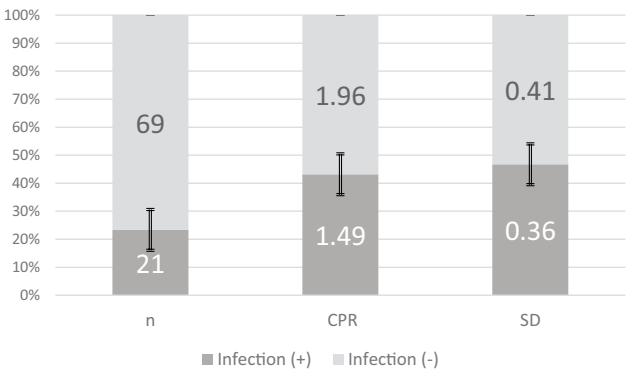

Fig. 5. Association between urogenital infections and cerebroplacental ratio in pregnant women

that the presence of ureaplasma infection may be associated with the development of chorioamnionitis, inflammatory alterations of placental tissue, and an increased risk of preterm birth.

Ascending infections of the urogenital tract are considered to play a significant role in the development of inflammatory processes within the mother – placenta – fetus system. The entry of microorganisms into the uterine cavity can trigger an immune response, increase the production of pro-inflammatory cytokines, and disrupt the development of the placental vascular network. As a result of these processes, placental insufficiency may develop, leading to impaired fetal growth.

An important observation in our study was the predominance of monoinfections compared to mixed infections. Although some patients presented with co-infections, the majority of cases involved isolated infections. Similar findings have been reported in other studies, which indicate a higher prevalence of monoinfections during routine screening of pregnant women [3,6,7,11]. Nevertheless, the presence of mixed infections may exacerbate the inflammatory response and increase the risk of pregnancy complications.

Analysis of perinatal outcomes revealed significantly worse indicators among pregnant women with IUGR compared to the Control group. In particular, newborns from the study group had significantly lower birth weights, as well as higher rates of preterm birth and low birth weight (<2500 g). These findings are consistent with numerous studies reporting that IUGR is a major risk factor for perinatal morbidity and mortality [5,8,10,12,13].

Particular attention was given to the results of Doppler ultrasonography. In our study, pregnant women with urogenital infections demonstrated increased pulsatility indices in the uterine and umbilical arteries, as well as decreased CPR. These changes indicate elevated vascular resistance and impaired placental blood flow, which are characteristic signs of placental insufficiency.

A decrease in the CPR may reflect a compensatory redistribution of fetal blood flow toward the brain, known as the «brain-sparing» effect. This mechanism develops in conditions of chronic hypoxia and aims to maintain perfusion to the fetus's vital organs.

Furthermore, in our study, pregnant women with urogenital infections more frequently exhibited pathological changes on CTG, including reduced heart rate variability and episodes of late decelerations. These alterations may indicate functional stress of the fetal cardiovascular system and an increased risk of intrauterine hypoxia.

Despite the obtained results, no statistically significant association was found between the frequency of individual urogenital infections and the development of IUGR. A likely explanation for this may be the relatively small sample size, which could have limited the statistical power of the study. The literature also notes that the impact of microorganisms on pregnancy outcomes depends on multiple factors, including pathogen load, maternal immune status, and the presence of concomitant infections.

It is important to acknowledge several limitations of the present study. First, the study included a relatively small number of participants. Second, the analysis did not cover the full spectrum of potential infectious agents that may contribute to inflammatory processes in the placental system. Future larger prospective studies with an expanded range of detectable microorganisms are needed.

In conclusion, the results of the present study indicate a potential role of urogenital infections in the development of placental dysfunction and impaired maternal – fetal – placental blood flow. Although a direct statistically significant association between infection and FGR was not observed, the detected changes in Doppler and cardiotocographic parameters suggest that infectious and inflammatory processes may influence the condition of the fetoplacental system. Early detection and timely management of urogenital infections during pregnancy may be crucial for preventing pregnancy complications and improving perinatal outcomes.

Conclusions

The results of the present study suggest that urogenital infections in pregnant women may be associated with alterations in the maternal-placental-fetal system and can affect maternal-placental blood flow and fetal condition. Although no statistically significant differences were observed in the prevalence of specific infectious agents between women with FGR and the Control group, there was a trend toward a higher frequency of urogenital infections among patients with FGR.

The most frequently detected pathogens were *Ureaplasma spp*., HPV, *Mycoplasma* spp., and *Chlamydia trachomatis*. The majority of infections were monoinfections, while combined infections were considerably less common. These findings may indicate a potential role of chronic infectious-inflammatory processes in the development of disturbances within the fetoplacental unit.

Doppler analysis revealed more pronounced alterations in uteroplacental blood flow among pregnant women with urogenital infections, including increased pulsatility indices in the uterine and umbilical arteries and decreased CPR. These changes may reflect the development of placental insufficiency and compensatory fetal adaptations to chronic hypoxia. Additionally, pathological changes in CTG were more frequently observed in women with infections, indicating potential functional stress of the fetal cardiovascular system.

Analysis of perinatal outcomes showed that pregnancies complicated by FGR were associated with a higher incidence of preterm birth and low birth weight. These findings underscore the adverse impact of placental insufficiency on pregnancy progression and neonatal condition.

Thus, the results of this study suggest that urogenital infections may play a role in the development of impaired uteroplacental blood flow and FGR through mechanisms of chronic inflammation and placental dysfunction. Early diagnosis, screening, and timely treatment of urogenital infections in pregnant women may represent an important strategy for preventing placental insufficiency and improving perinatal outcomes.

Study limitations. Despite the obtained results, this study has several limitations that should be considered when interpreting the findings.

First, the study was conducted on a relatively small sample of pregnant women, which may have limited the statistical power of the analysis and affected the detection of significant differences between groups. It is possible that with a larger sample size, some of the observed trends could reach statistical significance.

Second, the study analyzed a limited spectrum of urogenital infections. It is known, however, that other microorganisms can contribute to the development of inflammatory processes in the maternal–placental–fetal system, including opportunistic flora, bacteria associated with bacterial vaginosis, as well as certain viral infections.

The authors declare no conflict of interest.

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