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Prediction of the development of inflammatory complications in the postpartum period

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Abstract

Background. The main etiological reasons for the still high level of serious postpartum complications are frequent isolation of aggressive pathogenic microorganism associations, an increase in their virulence and antibiotic resistance, and an increase in the frequency of surgical methods of delivery.

Aim. Assessment of the significance of clinical, instrumental and laboratory parameters in the diagnosis of early inflammatory complications of the postpartum period.

Material and methods. To study the risk factors for the development of the inflammatory process, they were registered in the postpartum period during the examination of 150 patients who underwent inpatient treatment at the Scientific Research Institute of Obstetrics and Gynecology in Baku for the period 2017–2020. Depending on the presence or absence of the studied pathology, the patients were divided into two groups: the main group included puerperas with developed postpartum complications (n=100), the comparison group included puerperas with a physiological course of the postpartum period (n=50). The average age of puerperas in groups was 29.9±0.64 and 30.3±0.86 years, respectively (p=0.679). Complications were diagnosed based on the analysis of the results of clinical and laboratory studies, the study of anamnestic data and the results of ultrasound examination. The information content of the obtained data was determined by the Kullback method.

Results. In the course of research, it was found that an important reason for the development of postpartum complications of an inflammatory nature is the long-term use of contraception. Women of the main group more often use means for intrauterine contraception and barrier contraceptives — 24 and 29%, and in the comparison group — 6 and 12% (p=0.006; p=0.024). When studying the structure of clinical manifestations of complications of the early postpartum period, pain in the lower abdominal cavity was most often recorded — 89.0±3.13%, and in the comparison group — 6.0±3.36% (p <0.0001). Among the studied ultrasound diagnostic criteria for inflammatory complications in the postpartum period, cases of an increase in the size of the uterus and thickening of the endometrium were detected in 98 and 97 out of 100 people in the main group and only in 1 case out of 50 patients in the comparison group (p <0.0001). The absolute number of T-lymphocytes, hemoglobin, the concentration of the pro-inflammatory cytokine interleukin-6, and the erythrocyte sedimentation rate are recognized as the most informative diagnostic indicators of biochemical studies in patients with postpartum complications.

Conclusion. The reasons for the development of inflammatory complications in the postpartum period are the presence of a history of spontaneous abortions, intrauterine contraception and the use of barrier contraceptives.

Keywords: postpartum complications, contraceptives, information content, ultrasound, blood test.

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Background

The main etiological causes of the still high incidence of serious postpartum complications are the frequent isolation of aggressive pathogenic microorganisms, increase in their virulence and antibiotic resistance, increased surgical methods of delivery, irrational prescription of potent drugs, such as antibiotics, etc. [1, 2]. The involvement of the representatives of vaginal and cervical flora in endometrial infection and the development of pathological uterine disorders with infectious and inflammatory genesis is evidenced by changes in quantitative and qualitative indicators of the microbiome in the cervical canal [3]. According to Ngonzi et al., the high incidence of postpartum complications is caused by severe infections in pregnant women, parturient women, and puerperas with herpes simplex viruses, candidiasis, bacterial

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vaginosis, and chlamydia. Infection by other microorganisms, which can also have negative effects on the body, is also significant [4].

Along with a high risk of acute and recurrent pyelonephritis, which is associated with ascending infection, in the process of pathological changes in the early puerperal period, the high isolation rate of gram-negative microorganisms, mycoplasma, and often mixed microflora from the genitourinary system, is noteworthy [5].

A high prevalence of postpartum infectious complications is typical for puerperas with chronic somatic diseases, particularly diabetes mellitus (endocrine system) and arterial hypertension (cardiovascular system), overweight, collagenoses, etc. [6]. When assessing the degree of influence of general somatic pathologies on the increase in the incidence of postpartum inflammatory diseases, Akintomide et al. revealed that the combined development of the above diseases was conclusively significant [7].

The incidence of inflammatory complications during intrauterine contraception varies significantly and can reach 10.3%–30% of cases, and in the range of postpartum complications associated with this risk factor, endomyometritis and combined lesions of the uterus and appendages are predominant [8]. In female patients using intrauterine contraceptives, in the area of their contact with the surface layers of the endometrium, aseptic inflammatory changes are diagnosed; moreover, opportunistic bacteria can penetrate from the vagina and cervix to other parts of the reproductive system [9].

The analysis of literature data reveals the need for a rational approach to the study of inflammatory complications during the postpartum period and, in accordance with the established information value of significant risk factors, to identify optimal diagnostic criteria and improve methods for their prevention and treatment.

Aim

The study aimed to assess the significance of clinical, instrumental, and laboratory parameters in the diagnostics of early inflammatory complications during the postpartum period.

Materials and methods of research

The study enrolled female patients undergoing inpatient treatment at the Scientific Research Institute of Obstetrics and Gynecology in Baku. A total of 150 puerperas who gave written informed consent to participate in the clinical and laboratory studies were distributed into two groups: the main group included puerperas who had postpartum complications (n = 100), whereas the control group included puerperas with a physiological course of the postpartum period (n = 50). The average age of the puerperas in these groups was 29.9 ± 0.64 and 30.3 ± 0.86 years, respectively ($p = 0.679$).

The study protocol was approved by the ethics committee of the Azerbaijan Medical University (Protocol No. 11, December 29, 2019).

The inclusion criteria were as follows: clinical and laboratory signs of inflammatory complications (complaints of pain in the lower abdomen, weakness, and fever), pathological changes in hematological parameters [particularly increased leukocyte count in the blood and erythrocyte sedimentation rate (ESR)], and ultrasound signs of changes in the pelvic organs (such as uterine subinvolution, enlargement, and expansion, etc.).

In puerperas, parameters that reflected the timing of the first menstruation, history of concomitant extragenital and gynecological diseases, and physiological or pathological course of the pregnancy were analyzed.

Factors that increase the probability of occurrence and development of inflammatory complications in the postpartum period were also evaluated, such as sexual risk factors, age indicators, contraceptive use, and behavioral risk factors, particularly the regularity of visits to the doctor and exact fulfillment of medical prescriptions.

Ultrasound studies during the postpartum period assessed the volume of the uterine cavity and its condition; specifically, the length, width, and height were determined.

According to the rules regulated by the Clinical and Laboratory Standards Institute and International Federation of Clinical Chemistry and Laboratory Medicine guidelines, as a result of laboratory studies, data changes in eight hematological indicators were identified [10]. In all examined puerperas, whole blood was evaluated using automatic hematological analyzers by flow cytofluorometry on a Coulter Epix XL cytofluorimeter (Beckman Coulter, CA, USA).

Medical history data were collected from medical records, case histories, and outpatient medical records at the departments of outpatient diagnostics, pathology of pregnancy, and gynecology of the Research Institute of Obstetrics and Gynecology of the Ministry of Health of the Republic of Azerbaijan.

Quantitative attributes were statistically processed by calculating the arithmetic mean and its error. The significance of the differences revealed between the values was determined by calculating Student's *t*-test. The significance level with $p < 0.05$ was used as the minimum allowable value. Fisher's

Table 1. Use of contraceptives by the main and control groups (%).

Contraceptive methods	Main group, *n* = 100		Control group, *n* = 50		*p**
	n	%	n	%	
Intrauterine contraception	24	24.0	3	6.0	0.006
Coitus interruptus	32	32.0	26	52.0	0.021
Chemical contraception	6	6.0	3	6.0	1.000
Barrier contraceptives	29	29.0	6	12.0	0.024
Oral contraceptives	7	7.0	5	10.0	0.535
Rhythm method	3	3.0	7	14.0	0.016

Note: *Fisher's exact test.

Table 2. Results of the analysis of anamnestic data in the main and control groups (%)

Criterion	Main group, *n* = 100	Control group, *n* = 50	*p**
Therapeutic abortion	37 (37.0 ± 4.83)	7 (14.0 ± 4.91)	0.004
Spontaneous abortion	30 (30.0 ± 4.58)	6 (12.0 ± 4.60)	0.015
Regular sexual activity	81 (81.0 ± 3.92)	30 (60.0 ± 6.93)	0.009
Married	35 (35.0 ± 4.77)	27 (54.0 ± 7.05)	0.034
Single	30 (30.0 ± 4.58)	5 (10.0 ± 4.24)	0.007

Note: *Fisher's exact test.

exact test was used to select the most informative signs. For all risk factors or signs under study, their information value and predictive value were determined according to the generally accepted method using the Kullback equation [11, 12]. The Kullback information value was calculated as follows:

$$J = 10 \lg^{P} - \times 0.5 \times (Pi - P2)$$

where J is the information value of risk factors, Pi is the prevalence of the risk factor in the comparison group, and P_2 is the prevalence of this risk factor in the main group.

The calculation of the information value with the determination of the diagnostic coefficient of risk factors enables identification of the items requiring the highest priority and allows implementing measures to reduce their effect on the development of postpartum pathological process.

Results

In the main group, the age of the female patients ranged from 18 to 41 (mean age, 29.9 ± 0.64) years, and in the control group, it ranged from 18 to 42 (mean age 30.3 ± 0.86) years ($p = 0.679$). According to our data, one of the causes of postpartum complications was the use of contraceptive methods. Contraceptive use was more often recorded in the main group (Table 1), particularly barrier contraceptives. The frequency of using contraceptive methods also differed in the compared groups of puerperas and accounted for 24.0% of female patients in the main group in comparison with 6.0% in the control group. The control group, as opposed to the main group, in most cases used combined oral contraceptives and the rhythm method.

Combined oral contraceptives ranked third among the considered contraceptive methods. No difference was found in the history of chemical contraceptive use between the groups. In a comparative analysis of our data (Table 2), in the anamnesis, regular sexual activity was most frequently registered in the main group. Moreover, the prevalence of a single-parent family as a risk factor was quite high in the main group compared with that in the control group.

The high incidence of postpartum complications in the main group was possibly due to a history of therapeutic and spontaneous abortions. Thus, spontaneous abortions were higher in the main group than in the control group.

Based on the complaints of the main group, pain in the lower parts of the abdominal cavity was most often recorded in the early postpartum period (Table 3). An informative clinical symptom of postpartum inflammation was an increase in body temperature over 38°C.

In the vaginal and cervical examination, a high prevalence of fever with body temperature >38°C was simultaneously established among the puerperas ($p < 0.0001$). Clinical symptoms of inflammatory complications, such as blood-tinged and purulent discharge, were predominant in the main group, and blood-tinged discharge was detected significantly more often. Pain and fever were

Table 3. Incidence of the main clinical symptoms of postpartum complications in the puerperas examined

Clinical symptoms	Main group, *n* = 100		Control group, *n* = 50		Information value	*p**
	n	%	n	%		
Pain	89	89.0 ± 3.13	3	6.0 ± 3.36	486.1 (2)	<0.0001
Pain irradiation	3	3.0 ± 1.71	1	2.0 ± 1.98	0.9 (9)	1.00
Fever	70	70.0 ± 4.58	1	2.0 ± 1.98	525.0 (1)	<0.0001
Blood-tinged discharge	58	58.0 ± 4.94	2	4.0 ± 2.77	313.6 (4)	<0.0001
Purulent discharge	41	41.0 ± 4.92	2	4.0 ± 2.77	187.0 (8)	<0.0001
Mucosal edema	59	59.0 ± 4.92	4	8.0 ± 3.84	221.3 (6)	<0.0001
Mucosal hemophilia	50	50.0 ± 5.00	2	4.0 ± 2.77	252.3 (5)	<0.0001

Note: *Fisher's exact test.

Table 4. Frequency and information value of ultrasound changes in the uterus in female patients with postpartum complications

Ultrasound sign	Main group, *n* = 100		Control group, *n* = 50		Information value	*p**
	n	%	n	%		
Myometrial heterogeneity	38	38.0 ± 4.85	3	6.0 ± 3.36	128.3 (4)	0.0001
Endometrial thickening	98	98.0 ± 1.40	1	2.0 ± 1.98	811.3 (1)	<0.0001
Uterine enlargement	97	97.0 ± 1.71	1	2.0 ± 1.98	800.7 (2)	<0.0001
Uneven enlargement of the uterine cavity	93	93.0 ± 2.55	1	2.0 ± 1.98	758.7 (3)	<0.0001
Ovarian enlargement	10	10.0 ± 3.00	1	2.0 ± 1.98	28.0 (5)	0.1007

Note: *Fisher's exact test.

characterized by significant Kullback information values of 486.1 and 525.0, respectively. The information value of pain irradiation indicators in the pathology considered was significantly lower at 0.9, which corresponded to the last ranking place.

A high positive final information value of the shift of ultrasonic changes in the uterus in the main group is presented in Table 4. Among the studied ultrasound diagnostic criteria for inflammatory complications in the postpartum period, uterine enlargement and endometrial thickening accounted for the maximum number of cases. An uneven enlargement of the uterine cavity was detected in most patients of the main group. Ovarian enlargement had the minimum information value of 28.0 in assessing the frequency of diagnosing pathological changes based on history.

Thus, the most informative ultrasound criteria were endometrial thickening and uterine enlargement (the uterine body volume was within the range of 22.3–68.0 cm^3 among the main group and 19.2–24.0 cm^3 in the control group), with values of 811.3 and 800.7, respectively. Moreover, uterine thickness of 15–19 mm or less was recorded in the control group, and a thickness of ≥19 mm was registered in the control group.

In the postpartum period, the pathological process in the pelvic organs is characterized by some deviations in hematological parameters, which, in our opinion, may be of some diagnostic significance when interpreting them using clinical and instrumental data. In the main group, a clinical blood test showed a decrease in the quantitative indicators of hemoglobin and erythrocytes, as well as an increase in leukocyte count to $10.6 \pm 0.08 \times 10^9$/l in the main group versus $6.2 \pm 0.13 \times 10^9$/l in the control group ($p = 0.001$). The ESR in the main group and control group were 23.1 ± 0.22 mm/h and 8.4 ± 0.16 mm/h, respectively ($p = 0.001$).

Pathological changes in the pelvic organs during the postpartum period were manifested as an increase in the concentration of the pro-inflammatory cytokine interleukin-6 in comparison with the concentration in puerperas with a physiological course of the postpartum period ($p = 0.001$).

Thus, in predicting the development of postpartum inflammatory complications, the results of clinical and instrumental studies should be considered, paying special attention to an increase in the leukocyte count, an increase in ESR, and a decrease in the lymphocyte count and hemoglobin.

Discussion

Inflammatory diseases of the pelvic organs are common causes of the high maternal and perinatal mortality [13]. The clinical presentation of inflammatory postpartum complications is very variable, which is associated with the diversity of

body responses and the presence of various risk factors. Given the variety of options for the clinical course of postpartum diseases, according to our data, the uterine subinvolution (98.0 ± 1.40%), fever (70.0 ± 4.58%), and pain (89.0±3.13%) are the most characteristic symptoms with the highest information value.

Among the ultrasound indicators of the state of the uterus during the puerperal period in the main group, endometrial thickening and uterine enlargement have high information values. The highest values of the endometrium volume in the main group were associated with edema and hyperemia of the mucous membrane. According to the results of these studies, postpartum pathological processes are characterized by an uneven enlargement of the uterine cavity due to structures of heterogeneous echo density, which coincides with the findings of other authors [14].

Intrauterine contraception and the barrier method were used more often by the main group. Our data on the frequency of using contraceptive methods and their effect on the development of postpartum complications are confirmed by the results of previous studies [15]. The high information value of the Kullback method during the clinical examination of puerperas with postpartum complications was recorded for pain, which also coincides with the opinion of other researchers [16].

The results of laboratory studies helped establish the diagnostic efficacy of an increased level of pro-inflammatory cytokines and a decrease in the blood level of T-lymphocytes of puerperas, which were associated with the development of puerperal complications and consistent with the data of several studies [17, 18].

Conclusions

1. The most informative parameters in identifying signs of the onset and development of early postpartum inflammatory complications were an increase in body temperature, uterine enlargement, and endometrial thickening.

2. The most informative diagnostic indicators of biochemical studies in patients with postpartum complications were the absolute count of T-lymphocytes, hemoglobin, levels of the pro-inflammatory cytokine interleukin-6, and ESR.

3. Inflammatory complications in the postpartum period may be caused by a history of spontaneous abortion, intrauterine contraception, and use of barrier contraceptives.

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