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COMPREHENSIVE ASSESSMENT OF THE PELVIC FLOOR IN WOMEN: NEW APPROACHES TO THE PREDICTION OF PELVIC ORGAN PROLAPSE

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▪ ***Hypothesis/aims of study.*** Despite the growing prevalence of pelvic floor dysfunction in women in the postpartum period, there is still no consensus on its etiology and pathogenesis. The prerequisite for serious disorders to occur in the future is the initial stages of pelvic floor dysfunction after childbirth, despite the fact that they occur without severe symptoms and, remaining undiagnosed in a timely manner, further reduce the quality of life of women. Despite the availability of information on causal relationships between childbirth and the appearance of pelvic floor dysfunctions, this knowledge among women of reproductive age is still limited, which warrants further study. A number of methods have been developed to assess the pelvic floor, among which are non-invasive techniques, including a quantitative assessment of the strength of contractions of the pelvic floor muscles, as well as techniques that assess the microcirculation of the vaginal wall. The aim of this study was to evaluate the parameters of the strength of contractions of the pelvic floor muscles and to identify possible correlations between the obtained parameters.

Study design, materials and methods. The study was carried out using methods for measuring the blood microcirculation of the vaginal wall using laser Doppler blood flowmetry in women after the first birth.

Results. We obtained indicators of the strength of contractions of the pelvic floor muscles and indicators of the blood microcirculation of the vaginal wall in primary women, and we revealed the dependence of the obtained indicators on the weight and age of the mother, as well as the weight of the fetus at birth.

Conclusion. The obtained indicators will allow a comprehensive assessment of the pelvic floor in primiparous women, as well as to identify possible risk groups for genital prolapse development in the future.

▪ **Keywords:** pelvic floor; genital prolapse; pelvic floor muscles; vaginal microcirculation; laser Doppler flowmetry; pelvic floor dysfunction.

КОМПЛЕКСНАЯ ОЦЕНКА СОСТОЯНИЯ ТАЗОВОГО ДНА У ЖЕНЩИН, НОВЫЕ ПОДХОДЫ К ПРЕДИКАЦИИ ПРОЛАПСА

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▪ ***Актуальность.*** Несмотря на растущую распространенность дисфункции тазового дна у женщин в послеродовом периоде, единого мнения об этиологии и патогенезе до сих пор нет. Фоном для возникновения серьезных нарушений в будущем является дисфункция тазового дна, возникающая после родов. На начальных стадиях это состояние клинически проявляется мало и долго остается недиагностированным, что снижает в дальнейшем качество жизни. Проведено множество исследований, в которых установлена причинно-следственная связь между родами и возникновением дисфункции тазового дна, тем не менее необходимо дальнейшее изучение этого вопроса. Разработано много способов оценки состояния тазового дна. Среди них — неинвазивные методики, включающие количественную оценку силы сокращений мышц тазового дна, а также методики, позволяющие оценить состояние микроциркуляции в стенках влагалища.

Цель — оценить параметры силы сокращений мышц тазового дна, а также выявить возможную корреляцию между полученными показателями.

Материалы и методы исследования. Исследование проводили с помощью манометра и показателей микроциркуляции крови в стенках влагалища методом лазерной допплеровской флоуметрии крови у женщин после первых родов.

Результаты исследования. Были получены показатели силы сокращений мышц тазового дна, показатели микроциркуляции крови в стенках влагалища у первородящих женщин, выявлена зависимость полученных данных от веса и возраста матери, а также массы плода при рождении.

Заключение. Данные показатели позволят комплексно оценить состояние тазового дна у первородящих женщин, а также определить возможные группы риска по развитию пролапса гениталий в дальнейшем.

▪ **Ключевые слова:** тазовое дно; пролапс гениталий; мышцы тазового дна; микроциркуляция в стенках влагалища; лазерная допплеровская флоуметрия; дисфункция тазового дна.

Introduction

Despite the increasing prevalence of pelvic floor dysfunction, including symptoms of pelvic organ prolapse, urinary and fecal incontinence, as well as sexual dysfunction and pelvic pain, among women in the postpartum period, experts still have no consensus on the etiology and pathogenesis of this disease [1].

The major risk factors that are associated with the development of pelvic floor muscles dysfunction include pregnancy, vaginal delivery, perineal trauma during labor, and hereditary predispositions, such as systemic connective tissue dysplasia [2].

According to various literature sources, the incidence of pelvic floor dysfunction among reproductive age women ranges from 26% to 63.1% [3].

Several methods have been developed to assess the function of the pelvic floor muscles. They include functional methods that help to assess the ability of muscles to contract, and quantitative methods to measure the strength of the pelvic floor muscles [4].

The possibility to use minimally invasive diagnostic interventions is extremely important for contemporary medicine. One of the non-invasive techniques is laser Doppler flowmetry. Due to the small diameter of microvessels and the extended branching of the vascular networks, perfusion assessment faces certain technical difficulties [5].

Although the pelvic floor dysfunction is not clinically manifested at the initial stages, the woman's quality of life steadily decreases as the condition progresses. Many studies have established a causal relationship between childbirth and the occurrence of pelvic floor dysfunction; however, this issue requires further study [6–9].

This study aimed to assess the contraction strength parameters of the pelvic floor muscles and the blood microcirculation indicators in the vaginal walls of women after the first delivery, as well as to identify the correlation between these parameters.

Materials and methods of the study

The study enrolled 189 women after the first delivery (including operative and vaginal deliveries). The examination and clinical follow-up of the patients was performed in the Republican Clinical Perinatal Center of the Ministry of Health, Republic of Bashkortostan. All the patients gave their written voluntary informed consent to participate in the study and for the publication the materials.

All the patients underwent general and gynecological examination, body weight was measured, markers of connective tissue dysplasia were evaluated, laser Doppler flowmetry of the microvasculature from the anterior and posterior walls of the vagina, and the dynamometry of the pelvic floor muscles were performed. The microcirculation condition was assessed using a single-channel laser analyzer of the microcirculation of blood LAKK-01 (Lazma, Russia). The method is based on the Doppler effect; the indicators are recorded when probing the vaginal wall with a laser beam and the blood flow is characterized in a volume of up to 1.5 mm^3 of tissue. The data were obtained from two points, the first point was the middle of the conventional line connecting the external opening of the urethra and the external opening of the cervical canal, and the second point was the middle of the conventional line connecting the anus and the external opening of the cervical canal. The data were processed using the software supplied with the LAKK-01 device.

A Vagiton pneumo simulator with a manometer was used to assess the strength of contractions of the pelvic floor muscles. Dynamometry of the pelvic floor muscles was performed with a simultaneous contraction of the vaginal muscles, external anal sphincter, as well as the lower abdominal muscles.

Statistical processing of the results was performed in the Windows 7 operating system using the statistical programs Statistica 6.0 and IBM SPSS Statistics 20.

The study was conducted 2 months after the first delivery. The patients who did not undergo a complete examination with registration of all the indicators were not included from the follow-up. To exclude the effect of progesterone on the perfusion indices and pelvic floor muscle tone, the study included only non-lactating women.

Results and discussion

The age of the women in this study ranged from 23 to 39 years, and the average age was 26.11 ± 3.18 years ($p > 0.05$). The weight of the patients ranged from 50 to 84 kg and the average weight was 69.00 ± 4.70 kg ($p > 0.05$). Fetal weight at birth ranged from 2,700 g to 4,200 g and the average fetal weight at birth was 3,385.52 ± 322.12 g ($p > 0.05$). This pregnancy was the first in all the patients. All the women had delivered at a full term of 38–40 weeks. The study enrolled only women who had undergone a cesarean section delivery, and the surgery was performed in a scheduled manner.

The following average indicators of blood microcirculation from the anterior and posterior walls of the vagina were calculated 2 months after childbirth; therefore, M of the anterior wall (M_{aw}) was 14.326 ± 0.683 pf. units, and M of the posterior wall (M_{pw}) was 16.72 ± 0.622 pf. units.

The average contraction strength indicator of the pelvic floor muscles was also determined as $F = 49.84 \pm 2.12$ mm Hg.

As a result of the statistical data processing, a correlation was found between the laser Doppler flowmetry parameters of blood, strength of the pelvic floor muscles contractions, weight and age of the mother, and the weight of the fetus at birth. The following regression equations were obtained.

1. M_{pw} = Inter B + Age · B + Mother's weight · B + Fetal weight · B + Contraction strength · B (note provides abbreviations used in formulas and tables).

Index	Beta	Std. err.	B	Std. err.	*t* (184)	*p*-level
Intercept			5.676134	0.848335	6.69091	0.000000
Age	0.011134	0.035183	0.004618	0.014592	0.31645	0.752018
Mother's weight	0.033716	0.051498	0.010501	0.016039	0.65470	0.513478
Fetal weight	–0.035138	0.051615	–0.000163	0.000239	–0.68078	0.496868
Contraction strength	0.881213	0.034891	0.195918	0.007757	25.25584	0.000000

2. Contraction strength = Inter B + Age · B + Mother's weight · B + Fetal weight · B + Mpw · B.

Index	Beta	Std. err.	B	Std. err.	*t* (184)	*p*-level
Intercept			–14.2028	4.122617	–3.44509	0.000707
Age	0.022081	0.035145	0.0412	0.065563	0.62829	0.530591
Mother's weight	–0.019114	0.051525	–0.0268	0.072179	–0.37097	0.711088
Fetal weight	0.034881	0.051602	0.0007	0.001075	0.67597	0.499908
M_{pw}	0.880737	0.034873	3.9614	0.156853	25.25584	0.000000

3. M_{aw} = Inter B + Age · B + Mother's weight · B + Fetal weight · B + Contraction strength · B.

Index	Beta	Std. err.	B	Std. err.	*t* (184)	*p*-level
Intercept			4.722302	0.872105	5.41483	0.000000
Age	0.019926	0.032940	0.009074	0.015001	0.60491	0.545987
Mother's weight	–0.030496	0.048216	–0.010429	0.016488	–0.63249	0.527851
Fetal weight	–0.036929	0.048325	–0.000188	0.000246	–0.76418	0.445737
Contraction strength	0.897251	0.032668	0.219033	0.007975	27.46613	0.000000

N o t e. Intercept, the value of the dependent variable if the predictor is zero; *t*, Student's test; Std. err., standard error; *p*, the level of significance; *B*, the coefficient of dependence; Inter B, the value in the table at the intersection of the Intercept and B.

4. Contraction strength = Inter B + Age · B + Mother's weight · B + Fetal weight · B + M_{aw} · B.

Index	Beta	Std. err.	B	Std. err.	*t* (184)	*p*-level
Intercept			–10.0780	3.771415	–2.67220	0.008212
Age	0.010074	0.032941	0.0188	0.061452	0.30583	0.760081
Mother's weight	0.036591	0.048158	0.0513	0.067463	0.75980	0.448348
Fetal weight	0.036533	0.048292	0.0008	0.001006	0.75650	0.450317
Maw	0.895980	0.032621	3.6703	0.133630	27.46613	0.000000

Conclusion

As a result of the study, we obtained the indicators of the contraction strength of the pelvic floor muscles, as well as indicators of blood microcirculation from the vaginal walls in primiparous women. When evaluating the *p*-criterion, the dependence of the indicators considered on the weight of the mother and the weight of the fetus at birth was revealed. This will enable to comprehensively assess the condition of the pelvic floor in primiparous women, without resorting to a large number of measurements of the various indicators, and also to identify the possible risk groups for the development of genital prolapse in the future.

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