

Cervical elastography in patients with cervical insufficiency and a history of anovulatory infertility

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Cervical insufficiency is one of the most frequent reasons for late miscarriage and preterm birth. Its rate is increased in women who conceived after the use of additional reproductive technologies.

The objective: to assess the parameters of cervical elastography in women with cervical insufficiency and anovulatory infertility in a history.

Materials and methods. 40 pregnant women with cervical insufficiency who conceived after treatment of infertility associated with anovulation were examined in the term of 16–20 weeks: in the I group (20 persons) pregnancy conceived after conservative treatment of infertility, in the II (20 patients) – after in vitro fertilization. 20 women with the physiological course of pregnancy without cervical insufficiency and with spontaneous gestation were controls. Cervical elastography index was used to assess the strain of cervical tissue.

Results. According to the results of compression elastography all patients in the I and II groups had red or yellow color of the internal cervical os and cervical canal. In the persons without cervical insufficiency the cervical tissue was firm (purple and blue color). The number of women with purple color of the anterior labia of the cervix in the I and II groups was in 4.67 ($p=0.001$) and 2.33 ($p=0.03$) times less compared to the controls, of the posterior labia – in 3.2 times ($p=0.001$) in both groups.

Conclusion. In women with cervical insufficiency and a history of anovulatory infertility there are considerable changes of strain in internal os and cervical canal of the cervix.

Keywords: cervical insufficiency, anovulatory infertility, elastography.

Еластографія шийки матки у жінок з істміко-цервікальною недостатністю та ановуляторним безпліддям в анамнезі

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Істміко-цервікальна недостатність є однією з найбільш частих причин пізнього викидня та передчасних пологів. Поширення даної патології зростає у жінок, які завагітніли за допомогою допоміжних репродуктивних технологій.

Мета дослідження: визначення параметрів еластографії шийки матки у жінок з істміко-цервікальною недостатністю та ановуляторним безпліддям в анамнезі.

Матеріали та методи. Обстежено 40 жінок з істміко-цервікальною недостатністю, які завагітніли після лікування безпліддя, пов'язаного з ановуляцією, в терміні 16–20 тиж: у I групі (20 жінок) вагітність настала після консервативного лікування безпліддя, у II групі (20 пацієнток) – після запліднення *in vitro*. У контрольну групу увійшли 20 жінок без істміко-цервікальної недостатності, які завагітніли самостійно.

Оцінювання деформації шийки матки проводили за допомогою індексу цервікальної еластографії.

Результати. За даними компресійної еластографії у всіх пацієнток I та II груп внутрішнє вічко шийки матки та канал шийки матки були червоного або жовтого кольору. У жінок контрольної групи тканина шийки матки була щільною, про що свідчать фіолетовий та синій кольори. Кількість жінок із фіолетовим кольором передньої губи шийки матки у I та II групах була у 4,67 ($p=0,001$) та 2,33 ($p=0,03$) рази меншою порівняно з контрольною групою; задньої губи – у 3,2 рази ($p=0,001$) меншою в обох групах.

Заключення. У жінок з істміко-цервікальною недостатністю, які завагітніли після лікування ановуляторного безпліддя, наявні виражені зміни (деформації) внутрішнього вічка та каналу шийки матки.

Ключові слова: істміко-цервікальна недостатність, ановуляторне безпліддя, еластографія.

Эластография шейки матки у женщин с истмико-цервикальной недостаточностью и ановуляторным бесплодием в анамнезе

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Истмико-цервикальная недостаточность является одной из наиболее частых причин позднего выкидыша и преждевременных родов. Частота данной патологии возрастает у женщин, забеременевших с помощью вспомогательных репродуктивных технологий.

Цель исследования: определение параметров эластографии шейки матки у женщин с истмико-цервикальной недостаточностью и ановуляторным бесплодием в анамнезе.

Материалы и методы. Обследовано 40 женщин с истмико-цервикальной недостаточностью, которые забеременели после лечения бесплодия, связанного с ановуляцией, в сроке 16–20 нед: в I группе (20 женщин) беременность наступила после консервативного лечения бесплодия, во II группе (20 пациенток) – после оплодотворения *in vitro*. В контрольную группу вошли 20 женщин без истмико-цервикальной недостаточности, которые забеременели самостоятельно. Деформацию шейки матки определяли с помощью индекса цервикальной эластографии.

Результаты. Согласно данным компрессионной эластографии у всех пациенток I и II групп внутренний зев шейки матки и канал шейки матки были красного или желтого цвета. У женщин контрольной группы тканей шейки матки была плотной, на что указывают ее фиолетовый и синий цвета. Количество женщин с фиолетовым цветом передней губы шейки матки в I и II группах было в 4,67 ($p=0,001$) и 2,33 ($p=0,03$) раза меньше по сравнению с контрольной группой, задней губы – в 3,2 раза ($p=0,001$) меньше в обеих группах.

Заключение. У женщин с истмико-цервикальной недостаточностью, которые забеременели после лечения ановуляторного бесплодия, имеются выраженные изменения (деформации) внутреннего зева и канала шейки матки.

Ключевые слова: истмико-цервикальная недостаточность, ановуляторное бесплодие, эластография.

Today more than 7 million children are born with the help of additional reproductive technologies (ART) [1]. Very often pregnancies after the infertility treatment have many complications. Among complications there is a high rate of premature birth which is more in pregnancies after ART (29.9%) compared to the general

population (9.9%) [9]. Infections, extragenital pathology, cervical insufficiency (CI), fetal abnormalities and so on are the risk factors of prematurity.

CI is the painless shortness and dilatation of the cervix that usually occurred in the II trimester. Diagnosis of the CI is based commonly

on the ultrasound criteria. Modern ultrasound techniques, such as elastography, improve the efficiency of diagnosis. Elastography in obstetric practice has been used relatively recently for the diagnosis of premature labor, successful induction of labor [6, 7, 11], in women with a high risk of miscarriage due to chromosomal abnormalities of the fetus in the first trimester [13]. Both compression elastography and shear wave elastography can be used for this purpose. Determination of strain of the cervix is actual for predicting of CI [15].

The objective: to assess the parameters of cervical elastography in women with cervical insufficiency and anovulatory infertility in a history.

MATERIALS AND METHODS

We examined 40 pregnant women in the term of 16–20 weeks of pregnancy. All these patients had CI and conceived after treatment of infertility associated with anovulation. The I group of women (20 persons) conceived after conservative treatment of infertility, the II group (20 patients) – after in vitro fertilization (IVF). 20 women with physiological course of pregnancy without CI and with spontaneous gestation were controls.

The diagnosis of CI was based on transvaginal ultrasound examination of the cervix: shortening of the cervix to 25 mm or less combined with dilation of the cervical canal by 1.0 cm or more or the presence of V- and U-shaped transformations of the internal os of the cervix. Diagnosis of infertility was based on the recommendations of the World Health Organization – the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse [14].

Inclusion criteria: single pregnancy, pregnancy after treatment of anovulatory infertility, CI, patient's written consent. Exclusion criteria: multiple pregnancy, antiphospholipid syndrome, thrombophilia, ovarian hyperstimulation syndrome, cytogenetic causes of miscarriage after IVF, male infertility, tubal, cervical, immunological, unspecified infertility, connective tissue dysplasia, increased risk of chromosomal fetal abnormalities by results of I and/or II genetic screening. The study was based in City Clinical Perinatal Centre and clinical diagnostic center «Med-Atlant» (Ivano-Frankivsk). Compression elastography of the cervix was carried out on the ultrasound machine Voluson E8 Expert (General Electric Medical Systems, USA) with microconvex transducer RIC4-9D for the vaginal examination with frequency 4–9 MHz. Regions of interest were internal cervical os, cervical canal, anterior and posterior labia of the cervix. Cervical elastography index (CEI) was used to assess the strain of cervical tissue and performed a five-point scale [180]. Purple color indicates a firm tissue (0 points), progressively softer tissues were blue (1 point), green (2 points), yellow (3 points) and red (4 points). If there were two colors in the region of interest, the one that corresponded to the softer parameter was taken into account.

The study was conducted following the principles of the Declaration of Helsinki and approved by the Local Ethics Committee for all participants and the commission of ethics in Ivano-Frankivsk National Medical University (protocol N 97/17, 19.10.2017).

Program Statistica 6.0 was used to assess the results. We estimated the parameters of descriptive statistics, criterion χ^2 (Yates corrected Chi-square).

RESULTS

The average age of the patients in the I (30.35±1.18 years) and II groups (31.55±0.72 years, p=0.02) was higher compared to the controls (27.90±1.13 years). Most of the women in all groups had the first pregnancy (11 (55.0%) persons in the I group, 14 (70.0%) – in the II and 12 (60.0%) – in control one); 6 (30.0%), 4 (20.0%) and 4 (20.0%) patients, respectively, had the second pregnancy, and 3 (15.0%), 2 (10.0%) and 4 (20.0%) – the third one. The number of primigravida patients was prevalent. Thus, 15 (75.0%) persons in the I groups were primigravida, 18 (90.0%) – in the II group and 14 (70.0%) – in control one; the second labor was going to have 4 (20.0%) in the I group, 2 (10.0%) – in the II, 4 (20.0%) – in control one; the third labor – 1 (5.0%) in the I group and 2 (10.0%) – in control group.

All patients in the I and II groups had red (CEI 4 points) or yellow (CEI 3 points) color of the internal cervical os and cervical canal (table). There were some cases of red and yellow color of the external part of the cervix in patients with CI. The cervical tissue in the persons without CI was firm that was indicated by its purple and blue color. The number of women with purple color of the anterior labia of the cervix in the I and II groups was in 4.67 ($\chi^2=10.23$, p=0.001) and 2.33 ($\chi^2=4.9$, p=0.03) times less compared to the controls, of the posterior labia – in 3,2 times less ($\chi^2=10.03$, p=0.001) in both groups.

The strain of the cervical tissue determines its mechanical function. The method of elastography can estimate tissue deformation. Quantitative determination of physical changes in tissue can be determined using two methods of elastography – compression and shear wave elastography [2]. It was found that low deformation in the internal os of the cervix is significantly associated with a lower risk of premature labor up to 37 weeks [4, 5]. It was found the different values of deformation in different parts of the cervix in 17–41 weeks of gestation [8]. The tissue of the anterior labia and cervical canal were softer with increasing gestational age, and the posterior labia was more firm with increasing maternal age, weight, and parity. The length of the cervix was inversely related to its softness.

The combination of soft cervical density with its short length increases the risk of premature labor till to 37 weeks of pregnancy in 18 times (p<0.001) and in 120 times till 34 weeks

Elastography parameters of the cervix in women (abs.,%)

Region of interest	Group	Points				
		0	1	2	3	4
Internal os	I	-	-	-	8 (40,0)*	12 (60,0)*
	II	-	-	-	7 (35,0)*	13 (65,0)*
	Control	11 (55,0)*	6 (30,0)*	3 (15,0)	-	-
Cervical canal	I	-	-	-	9 (45,0)*	11 (55,0)*
	II	-	-	-	6 (30,0)*	14 (70,0)*
	Control	12 (60,0)*	5 (25,0)	3 (15,0)	-	-
Anterior labia	I	3 (15,0)*	3 (15,0)	10 (50,0)*	3 (15,0)	1 (5,0)
	II	6 (30,0)*	4 (20,0)	5 (25,0)	3 (15,0)	2 (10,0)
	Control	14 (70,0)	5 (25,0)	1 (5,0)	-	-
Posterior labia	I	5 (25,0)*	5 (25,0)	9 (45,0)*	-	1 (5,0)
	II	5 (25,0)*	7 (35,0)	-	1 (5,0)	1 (5,0)
	Control	16 (80,0)	4 (20,0)	-	-	-

Note: * – significance of the difference in the indicator relative to the control group (p<0.05)

compared with women with normal cervical length ($p < 0.001$) [3]. The presence of only a soft cervix increases the probability of premature birth till 37 and 34 weeks of gestation, respectively, in 4.5 ($p = 0.0002$) and 21 times ($p = 0.0003$) compared with cases with a firm consistency. Thus, the researchers conclude that the soft consistency of the cervix at 18-24 weeks of pregnancy increases the risk of premature labor, regardless of its length.

The cervical elastography index is important in the assessment of the cervix [7]. According to the results of research of O.S. Sushkova red color (CEI 4 points) of the cervical canal and the internal os of the cervix is observed in 25.8% and 51.7% of patients with CI, respectively, yellow color (CEI 3 points) – in 63.3% and 35.8% [12]. Whereas in 60% of pregnant women with a physiological course of pregnancy without CI, these areas had a purple color (CEI 0 point). Such features indicate an increased strain of cervical tissue and its deformation by CI. The results of our study confirm the above data. All the patients with CI had

red or yellow color of the internal cervical os and cervical canal. In I group red color of the internal os was observed in 60.0% of women, yellow – in 40.0%, in the II group – respectively, in 65.0% and 35.0%. The assessment of the cervical canal according to CEI in the I group corresponded to 4 points in 55.0%, 3 points – in 45.0%, in the II group – in 70.0% and 30.0%, respectively. These indicators differed significantly from the values of women in the control group, in whom the CEI in these parts of the cervix corresponded from 0 to 2 points.

CONCLUSIONS

Cervical elastography is an effective method for assessment of the strain of cervical tissue. In women with cervical insufficiency and a history of anovulatory infertility there are considerable changes of strain in internal os and cervical canal of the cervix.

The authors declare no conflict of interest

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