

## Perinatal Outcomes in Women with Extragenital Diseases

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### Abstract

An increase in the incidence of extragenital diseases (EGDs) in the population against the background of the rise in the birth rate actualizes the problems of pregnancy management in women with EGD. Pregnancy-induced physiological changes in the body lead to a worsening of the course of diseases that were at the stage of unsustainable compensation before pregnancy. The purpose of our study was to determine the effectiveness of hyperbaric oxygenation (HBO) in the prevention of obstetric complications in pregnant women with EGD and neonatal morbidity. The inclusion of HBO in a complex of therapeutic and prophylactic measures in pregnant women with high perinatal risk contributed to a significant reduction in premature birth and a statistically significant improvement in neonatal morbidity parameters. (**International Journal of Biomedicine. 2017;7(2):115-119.**)

**Key Words:** extragenital diseases • hyperbaric oxygenation • neonatal morbidity • perinatal risk

### Abbreviations

**EGDs**, extragenital diseases; **HBO**, hyperbaric oxygenation; **HIBI**, hypoxic–ischemic brain injury; **LBWN**, low-birth-weight newborns; **PL**, premature labor; **PB**, premature birth; **SMs**, spontaneous miscarriages.

### Introduction

Over the past 20 years there has been an increase in the prevalence of EGD in pregnant women; the same can be noted for complications of pregnancy, including chronic fetal hypoxia.<sup>(1)</sup> According to the Federal State Statistics Service,<sup>(2)</sup> during the period from 1990 to 2014, the anemia rate increased from 12.1% to 32.0%, urinary system diseases - from 5.9% to 17.0%, arterial hypertension (AH) - from 5.1% to 9.0%. EGDs significantly increase the risk of developing various obstetric complications.<sup>(3)</sup> In recent years, EGDs have occupied a leading position (28%) in the structure of causes of maternal mortality in developed countries and Russia (23%).<sup>(2)</sup>

The onset and development of pregnancy against the background of such EGDs as anemia, AH, and chronic

pyelonephritis (ChP), occurs in conditions of angiopathy, primarily of the uterus vessels.<sup>(4)</sup> Angiopathy contributes to the unavoidable development of placental insufficiency during all EGDs.<sup>(1)</sup>

The literature data indicate that an excessive “medication” of the gestational process leads to a decrease in adaptive resources of the mother and fetus and affects the health of children.<sup>(1)</sup> Currently, the search for safe means and technologies, including non-medicinal products that will enable a woman to go through pregnancy and childbirth without difficulties, is especially important. Issues related to the prevention of obstetric and perinatal complications in pregnant women with EGDs are still open. Therefore, there is a need for an in-depth study of the possibilities of using non-medicament means of influencing the mother-placenta-fetus system, including HBO, in order to reduce reproductive losses.

The purpose of our study was to determine the effectiveness of HBO courses in the prevention of obstetric complications in pregnant women with EGDs and neonatal morbidity.

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## Material and Methods

The study was performed in Municipal clinical hospital #29 named after N.E. Bauman. The study was conducted in accordance with ethical principles of the Declaration of Helsinki.

A total of 235 pregnant women were examined prospectively at 5 to 40 weeks of gestation. Depending on the presence of EGD, the women were divided into 2 groups. The main group included 191 pregnant women with EGD; the control group included 44 women with physiological pregnancy without EGD.

Depending on the nature of the EGD, the main group was divided into three subgroups: subgroup Ia comprised 88 pregnant women with anemia (code ICD-X: O99.0 - anemia complicating pregnancy, childbirth and the puerperium), subgroup Ib comprised 50 pregnant women with AH (code ICD-X: O10 - pre-existing hypertension complicating pregnancy, childbirth and the puerperium), and subgroup Ic comprised 53 pregnant women with ChP (code ICD-X: O23.0 - kidney infection in pregnancy). In turn, the three subgroups were divided into sub-subgroups, depending on the nature of the therapy: standard therapy (ST) or ST+HBO. All examined women with EGD belonged to a group with high perinatal risk (PR). We identified the degree of PR based on the scale developed by O.G. Frolova and E.I. Nikolaeva (1981) and modified in 2003 by V.E. Radzinsky et al.<sup>(5)</sup> According to this modified scale, there is three level of PR: low risk (<15 points), moderate risk (from 15 to 20 points), and high risk ( $\geq 25$  points).

Inclusion criteria were singleton pregnancy, high PR, and voluntary informed consent to HBO. Exclusion criteria were cancer, multiple pregnancies, and the contraindications to the use of HBO.

Statistical analysis was performed using the SPSS for Windows. Baseline characteristics were summarized as frequencies and percentages for categorical variables and as mean (M) and standard error of the mean (SEM) for continuous variables. Group comparisons with respect to categorical variables are performed using chi-square tests. Multiple comparisons were performed with one-way ANOVA. A probability value of  $P < 0.05$  was considered statistically significant.

## Results and Discussion

98 women of the main group received, besides ST for EGD, the HBO sessions (excess air pressure 1.3-1.5 atm. in a pressure chamber). We used a single-system OKA-MT (Russia), equipped with air-conditioning 54–58 A and designed to conduct sessions in a high-pressure oxygen environment. The mode is one excess atmosphere.<sup>(6)</sup> The course includes 5–7 daily sessions lasting 40 minutes each. The first course was carried out in 6–8 weeks, the second in 16–18 weeks, and the third in 22–24 weeks of pregnancy.<sup>(7)</sup>

The inclusion of HBO in a complex of therapeutic and prophylactic measures contributed to a significant reduction in PL ( $P < 0.05$ ). Thus, the PL incidence decreased 3-fold in

subgroup Ia, 2.3-fold in subgroup Ic, and 1.7-fold in subgroup Ib. Terms delivery are presented in Table 1. The type of therapy influenced the choice of the delivery method only in subgroup Ic (Table 2). In subgroup Ic, on the background of ST+HBO, the rate of programmed births was significantly higher compared to ST: 7.7% and 17.4% ( $P < 0.05$ ).

**Table 1.**

**Terms delivery depending on the nature of the therapy.**

Group/ Subgroup			Timely delivery	Premature labor	Delay delivery
Main group	Anemia	ST (n=42)	31 (73.8%)	11 (26.2%)*	0
		ST+HBO (n=46)	42 (91.3%)	4 (8.7%)**	0
	AH	ST (n=25)	20 (80.0%)	5 (20.0%)*	0
		ST+HBO (n=25)	22 (78.0%)	3 (12.0%)	0
	ChP	ST (n=26)	15 (57.7%)	11 (42.3%)*	0
		ST+HBO (n=27)	22 (81.5%)	5 (18.5%)*	0
Control group (n=44)			40 (90.9%)	1 (2.3%)	3 (6.8%)
Total (n=235)			192 (81.7%)	40 (17.0%)	3 (1.2%)

\* -  $P < 0.05$  vs. the control group; \*\*  $P < 0.05$  between anemia subgroups.

**Table 2.**

**The choice of the delivery method depending on the nature of the therapy.**

Group/ Subgroup			Spontaneous labor	Cesarean delivery	Programmed births
Main group	Anemia	ST (n=42)	3 (7.1%)*	33 (78.6%)*	6 (14.3%)*
		ST+HBO (n=46)	5 (10.9%)*	33 (71.7%)*	8 (17.4%)*
	AH	ST (n=25)	2 (8.0%)*	21 (42.0%)*	4 (16.0%)
		ST+HBO (n=25)	2 (8.0%)*	21 (42.0%)*	4 (16.0%)
	ChP	ST (n=26)	7 (26.9%)*	17 (65.4%)*	2 (7.7%)
		ST+HBO (n=27)	5 (18.5%)*	17 (62.9%)*	5 (18.5%)*
Control group (n=44)			42 (95.4%)	1 (2.3%)	1 (2.3%)
Total (n=235)			64 (27.2%)	143 (60.8%)	30 (12.7%)

\* -  $P < 0.05$  vs. the control group

Maternal and perinatal mortality has not been documented in any of the subgroups. A total of 235 newborns were born. Parameters of body height and weight of newborns

are presented in Table 3. Using ANOVA, we found differences among the subgroups in terms of weight, height, and circumference of the head and chest. In the comparison of subgroups, the Dunnett criterion was used.

**Table 3.**

**Anthropometric indicators of newborns.**

Group/ Subgroup			Weight, g	Height, sm	Circumference of the head , sm	Circumference of the chest, sm
Main group	Anemia	ST (n=42)	2707±337.5 *	47.3±2.3 *	32.9±1.8 *	30.4±2.0 *
		ST+HBO (n=46)	3255±211.7 **	51.7±1.7 **	34.9±0.8 **	32.4±0.6 **
	AH	ST (n=25)	2920±370.5 *	47.3±2.3 *	32.9±1.8 *	30.4±2.0 *
		ST+HBO (n=25)	3250±210.2 **	51.4±1.7 **	34.5±0.8 **	32.0±0.8 **
	ChP	ST (n=26)	2507±556.7 *	46.3±2.5 *	32.5±1.8 *	30.1±2.0 *
		ST+HBO (n=27)	3105±210.1 *, **	49.7±1.7 **	34.0±0.8 **	32.4±0.5 **
Control group(n=44)			3457±504.6	51.1±2.0	34.1±0.9	32.1±0.9
Total(n=235)			3028±343.0	42.1±2.0	33.6±1.0	31.4±1.2

\* -  $P < 0.05$  vs. the control group; \*\*  $P < 0.05$  - between subgroups depending on the nature of the therapy

Thus, newborns born to mothers of subgroup Ia who received only ST were significantly less in weight, height, and circumference of the head and chest when compared with newborns born to mothers who received ST+HBO ( $P < 0.05$ ) and newborns in the control group. The data obtained were quite expected, since a significantly higher incidence of PB and fetal growth retardation ( $P < 0.05$ ) was noted in women of subgroup Ia, who received ST for anemia during pregnancy.

The average weight of the newborns of the subgroup Ic mothers against the background of ST was  $2507 \pm 556.7$  g compared to  $3105 \pm 210.1$  g ( $P < 0.05$ ) against the background of ST+HBO. In pregnant women who received ST+HBO, the body weight, height, and circumference of the head and chest of the newborns were significantly higher when compared to those measurements in newborns born to mothers who received only ST ( $P < 0.05$ ). However, the analyzed anthropometric indices in both subgroups significantly lagged behind those of the control group ( $P < 0.05$ ).

Newborns born to mothers of subgroup Ib, who received ST+HBO, did not significantly differ in anthropometric parameters from children born to mothers of the control group. Moreover, in newborns born to mothers who received only ST, weight, height, and circumference of the head and chest were significantly less compared to the control group and newborns whose mothers received ST+HBO ( $P < 0.05$ ) during pregnancy.

First- and fifth-minute Apgar scores (AS) revealed statistically significant differences in subgroups ( $P < 0.05$ )

(Table 4). It was established that first-minute ASs in all newborns born to mothers of the main group were significantly lower compared to the control group ( $P < 0.05$ ). A similar situation was observed when assessing fifth-minute ASs. There was no statistically significant effect of HBO on AS in newborns born to mothers of subgroups Ia and Ib, only a tendency for AS to increase. Statistical differences were observed in newborns born to mothers of subgroup Ic compared to subgroups Ia and Ib. Thus, in newborns born to mothers who received only ST, first- and fifth-minute ASs were significantly lower compared to newborns born to mothers who received ST+HBO ( $6.7 \pm 1$  and  $7.2 \pm 0.8$  points versus  $7.5 \pm 0.7$  and  $7.9 \pm 0.5$  points, respectively).

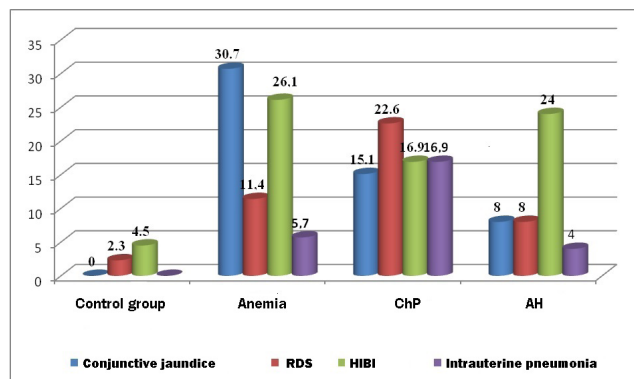
**Table 4.**

**Apgar scores in newborns.**

Group/ Subgroup			AS	
			First-minute	Fifth-minute
Main group	Anemia	ST (n=42)	7.2±0.6*	7.4±0.4*
		ST+HBO (n=46)	7.3±0.7*	8.0±0.5
	AH	ST (n=25)	7.1±0.7*	7.7±0.5*
		ST+HBO (n=25)	7.5±0.7*	7.7±0.5*
	ChP	ST( n=26)	6.7±1.0*	7.2±0.8*
		ST+HBO (n=27)	7.5±0.7*/**	7.9±0.5**
Control group (n=44)			8.2±0.7	8.8±0.5
Total (n=235)			7.3±0.7	7.8±0.7

\* -  $P < 0.05$  vs. the control group; \*\*  $P < 0.05$  - between subgroups depending on the nature of the therapy

Analysis of neonatal morbidity showed that this indicator was  $654.4\%$  in newborns born to mothers with EGDs, while in cases of the control group it was  $68\%$  (Fig.1).



**Fig. 1.** Neonatal morbidity (%) in studied groups.

Conjunctive jaundice was diagnosed in 30.7% of newborns of the subgroup Ia, which was significantly more

frequent compared to the control (0) and subgroups Ic (15.1%) and Ib (8%).

RDS was significantly more often (22.6%) diagnosed in newborns of subgroup Ic (22.6%) compared to the control and subgroups Ia (11.4%) and Ib (8%),  $P < 0.05$  in all cases. Congenital pneumonia was recorded in 16.9% of newborns born to mothers of subgroup IC, which was significantly more often than in subgroups Ia (5.7%) and Ib (4%),  $P < 0.05$  in all cases.

HIBI was significantly higher among all newborns in the main group compared to the newborns born to mothers of the control group ( $P < 0.05$ ). HIBI frequency in subgroups Ia and Ib was 26.1% and 24%, respectively; it was 16.9% in subgroup Ic, which was significantly more often compared to the control group ( $P < 0.05$ ), but significantly less often compared to the subgroup Ia ( $P < 0.05$ ). HIBI was diagnosed in every third newborn born to mothers of subgroups Ia and Ib who received only ST (35.7% and 32%, respectively), and in 23.1% of newborns born to mothers of subgroup Ic who received only ST. The inclusion of HBO in complex therapy contributed to a 2-fold ( $P < 0.05$ ) decrease in HIBI frequency.

In order to assess the effectiveness of HBO in a complex of therapeutic and prophylactic measures in pregnant women with high PR, a comparative analysis of neonatal morbidity was performed (Table 5).

**Table 5.**

*Neonatal morbidity depending on the nature of the therapy.*

Group/ Subgroup			Conjunctive jaundice	HIBI	RDS	Intrauterine pneumonia
Main group	Anemia	ST (n=42)	18(42.8%)*	15(35.7%)*	8(19.0%)*	4(9.5%)
		ST+HBO (n=46)	9(19.6%)*/**	8(17.4%)*/**	2(4.3%)**	1(2.2%)
	AH	ST (n=25)	3(12.0%)	8(32.0%)*	3(12.0%)	3(12.0%)*
		ST+HBO (n=25)	1(4.0%)	4(16.0%)	1(4.0%)	1(4.0%)**
	ChP	ST (n=26)	6(23.1%)*	6(23.1%)*	9(34.6%)*/**	7(26.9%)*
		ST+HBO (n=27)	2(7.4%)**	3(11.1%)**	3(11.1%)	2(7.4%)**
Control group (n=44)			0	2(4.5%)	1(2.3%)	0
Total (n=235)			39(16.5%)	46(19.5%)	27(11.4%)	18 (7.6%)

\* -  $P < 0.05$  vs. the control group; \*\*  $P < 0.05$  - between subgroups depending on the nature of the therapy

Data obtained showed that conjunctive jaundice was significantly less frequent in newborns whose mothers

received HBO: 2.2 times for subgroup Ia, 3 times for subgroup Ib, and 3.1 times for subgroup Ic. Intrauterine pneumonia was more often diagnosed in newborns of the subgroup Ic mothers: 26.9% against ST, and 7.4% against ST+HBO (a 3.6-fold decrease) ( $P < 0.05$ ). The inclusion of HBO in complex therapy also contributed to a significant decrease ( $P < 0.05$ ) in RDS frequency: 4.4 times for subgroup IA, 3.1 times for subgroup IC, and 3 times for subgroup IB.

Obviously, a decrease in the frequency of PL in the subgroups of pregnant women in the main group who received ST+HBO promoted a statistically significant reduction in neonatal morbidity.

## Conclusion

The inclusion of HBO in a complex of therapeutic and prophylactic measures in pregnant women with high PR contributed to a significant decrease in all subgroups:

### In subgroup Ia:

- Threatened late SMs from 19.0% to 8.7%;
- Threatened PL from 33.3% to 19.6%;
- Preeclampsia from 30.9% to 17.4%;
- Preterm birth from 26.2% to 8.7%;
- LBWN from 26.2% to 13.0%.

### In subgroup Ib:

- Threatened late SMs from 20.0% to 12.0%;
- Threatened PL from 32.0% to 16.0%;
- Preeclampsia from 48.0% to 28.0%;
- Preterm birth from 20.0% to 12.0%;
- LBWN from 20.0% to 12.0%.

### In subgroup Ic:

- Threatened late SMs from 34.6% to 14.8%;
- Threatened PL from 69.2% to 37.0%;
- Preterm birth from 42.3% to 18.5%;
- LBWN from 23.1% to 11.1%.

A significant decrease in the incidence of LBWN in pregnant women with EGD who received ST+HBO contributed to a statistically significant improvement in neonatal morbidity parameters. The rate of neonatal morbidity significantly decreased in patients with anemia, GhP, and AH from 1071‰ to 435‰, from 1077‰ to 370.4 ‰, and from 1080‰ to 280‰, respectively.

## Competing interests

The authors declare that they have no competing interests.

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