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# Pilot Study of the Influence of Intra-Abdominal Pressure of Parturient Women with Obesity on the Neurologic Status of a Newborn

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## Abstract

**Introduction:** Given in the literature, there is a possible link between perinatal pathology and intra-abdominal pressure (IAP) in pregnant women. Since intra-abdominal hypertension (IAH) is the companion of obesity, we can assume that there is a casual relation of perinatal complications of high frequency which obese patients with a level of IAP have.

**Methods:** A pilot study involving 407 patients: 135 of those were patients with the spontaneous labor, 273 were patients with the abdominal delivery. Patients, depending on their body mass index (BMI) were divided into four groups: group I - control (n=117), group II - patients with I degree of obesity (n=158), group III - with II degree of obesity (n=84), group IV - with III degree of obesity (n=48). The groups were divided into subgroups according to the neurological status of a newborn. IAP research was carried out using the indirect method through the bladder. The assessment of mental status of the newborn was performed with the help of NACS scale.

**Results:** The frequency and severity of the neurological deficit in newborns depended on the level of IAP before delivery and IAP in delivery. The correlational analysis of the degree of asphyxia and neonatal neurologic status is the presence of an average bond strength (r=-0.66, p<0.001). In subgroups where the epidural analgesia was introduced during labor, the overall score on NACS scale was significantly higher (p<0.001). In the groups of patients with severe obesity, the total score on the NACS scale was significantly lower (p<0.05) compared with other methods of anesthesia.

**Conclusion:** The results of the limited pilot study indicate the impact of the level of IAP of parturient women with obesity on the severity of asphyxia and the neurological status of the newborn in the early neonatal period.

**Keywords:** Obesity; Intra-abdominal pressure; Neurological status of the newborn.

## Introduction

According to the literature, pregnant women with obesity are at increased risk of perinatal morbidity and mortality compared to women with normal weight [1-4].

In recent years, experimental and clinical studies suggest a possible link between complications of pregnancy, childbirth, perinatal pathology and IAP in pregnant women [5-9]. Since IAH is a constant companion of obesity [10-13], it is logical to assume the presence of a causal connection of high incidence of perinatal complications in patients with obesity and the level of IAP.

## Aim

To study the influence of intra-abdominal pressure in women with obesity on the neurological status of a newborn in the early neonatal period.

## Materials and Methods

An open prospective cohort study was performed, involving 407 patients who were delivered at the Saratov City Clinical Hospital №1 n. a. I. Y. Gordeev in the period from 01.08.2011 to 01.01.2013. Natural delivery was in 135 patients and 273 were delivered with the help of cesarean operation. The permission of the ethical committee of Saratov State Medical University was obtained for this study. The informed consent of patients for participation in the declared research was obligatory. Criteria for inclusion in the research are the followings: a term single pregnancy; an uncomplicated spontaneous delivery; a planned cesarean section in conditions of general (GA), spinal (CA) and epidural anesthesia (EA). Exclusion criteria are the followings: a presence of extragenital pathology in the sub- and decompensation stage; a complicated pregnancy. The study did not include patients with premature, induced labor; operated because of urgent and emergency indications; and patients with a complicated intraoperative period.

All patients, depending on the BMI recorded before 6 weeks of pregnancy, were divided into IV groups: group I - control group included patients with a baseline BMI ranging from 18.5 to 24.9 kg/m$^2$ (n=117), group II - patients with I degree of obesity (n=158), group III - with II degree of obesity (n=84), group IV - with III degree of obesity (n=48). The severity of obesity in patients was determined according to WHO criteria (1997). The groups were divided into subgroups according to the neurological status of a newborn **(Table 1).**

All subgroups were comparable in age, mass-growth parameters, volume and time of performed operative intervention, intraoperative blood loss and quantitative and qualitative composition of infusion therapy. In all cases, standard monitoring with non-invasive measurement of arterial pressure, oxygen saturation, and IAP level was used.

**Table 1** Epidemiological characteristics of patients studied groups.

| Variables | Group I (n=117) | Group II (n=158) | Group III (n=84) | Group IV (n=48) | P-value |
|---|---|---|---|---|---|
| Age, year | 27.0 ± 5.1 | 27.3 ± 5.5 | 28.7 ± 4.9 | 29.9 ± 4.7 | NS |
| BMI up to 6 weeks gestation, kg/m$^2$ | 21.7 ± 1.9 | 32.31 ± 1.2a | 37.3 ± 1.6$^{a,b}$ | 44.5 ± 1.1$^{a,b,c}$ | p<0.05 |
| BMI before delivery, kg/m$^2$ | 28.3 ± 1.6 | 37.2 ± 1.3a | 40.2 ± 2.1$^{a,b}$ | 46.2 ± 2.0 $^{a,b,c}$ | p<0.05 |
| Android type of obesity | - | 40/25.3 | 32/38.1$^{b}$ | 18/37.5$^{b}$ | p<0.05 |
| Gynoid type of obesity | - | 58/36.7 | 25/29.8 | 12/25.0$^{b}$ | p<0.05 |
| Mixed type of obesity | - | 60/37.9 | 27/32.1 | 18/37.5 | NS |
| Primipara | 44/37.6 | 57/36.1 | 27/32.1 | 15/31.3 | NS |
| Deutipara | 73/62.4 | 101/63.9 | 57/67.9 | 33/68.7 | NS |
| Anemia of pregnant women | 63/53.8 | 94/59.5 | 48/57.1 | 26/54.2 | NS |
| The threat of premature childbirth | 13/11.1 | 20/12.7 | 12/14.3 | 8/16.7 | NS |
| Chronic prenatal fetal hypoxia | 38/32.5 | 57/36.1 | 33/39.3 | 21/43.6$^{a}$ | p<0.05 |
| Fetoplacental insufficiency | 7/5.9 | 12/7.6 | 11/13.1$^{a}$ | 8/16.7$^{a}$ | p<0.05 |
| Retarded fetal development | 5/4.3 | 6/3.8 | 3/3.6 | 2/4.2 | NS |
| Mass newborn, g | 3318.4 ± 367.3 | 3458.3 ± 361.2 | 3416.4 ± 340.4 | 3441.0 ± 422.8 | NS |
| Delivery, n/% | 38/32.7 | 36/22.8 | 40/47.6 | 21/43.7 | |
| Duration of the first period of delivery, h | 9.2 ± 1.4 | 9.4 ± 1.2 | 9.6 ± 2.4 | 9.9 ± 2.8 | NS |
| Duration of II period of delivery, min | 25.8 ± 4.1 | 25.4 ± 4.2 | 26.9 ± 4.2 | 25.2 ± 2.5 | NS |
| CS, n/% | 79/67.5 | 122/77.2 | 44/52.4 | 27/56.3 | |
| Time to fetus extraction, min | 3.5 ± 0.2 | 3.6 ± 0.2 | 3.6 ± 0.3 | 3.8 ± 0.2 | NS |
| Anesthesia of delivery with opioids | 16/42.1 | 18/50.0 | 20/50.0 | 10/47.6 | NS |
| Anesthesia of delivery of EA | 22/57.9 | 18/50.0 | 20/50.0 | 11/52.4 | NS |
| GA in CS | 23/29.1 | 25/20.5 | 12/27.3 | 5/18.5 | NS |
| SA in CS | 30/37.9 | 59/48.4 | 18/40.9 | 11/40.7 | NS |
| EA in CS | 26/32.9 | 38/31.1 | 14/31.8 | 11/40.7 | NS |

BMI: Body Mass Index; CS: Cesarean Section; N: Number of Patients; EA: Epidural Anesthesia; GA: General Anesthesia; SA: Spinal Anesthesia; NS: Not Significant

$^{a}$ - P<0.05 vs. Group I; $^{b}$ - P<0.05 vs. Group II; $^{c}$ - P<0.05 vs. Group III

Data are presented as mean ± standard deviation

IAP was measured strictly according to WSACS recommendations [14]. The measurement of IAP was carried out indirectly using a closed system for measuring intravesical pressure UnometrTM Abdo-Pressure TM (Unomedical). In the supine position, the bladder was catheterized by the Foley urinary catheter, to which the UnometrTM Abdo-Pressure TM connector was connected, then 20 ml of warm, sterile isotonic sodium chloride solution was injected into the bladder via the Kombi KonTM needle-free port. After the system was filled with a solution, the measuring part of the instrument was moved to the vertical position. A zero scale value was established in the symphysis and IAP was measured. The study was carried out with the inclusion of the results of measurement of IAP directly before delivery (beginning of I stage of labor before the anesthesia), in the first stage of labor during the contraction and before the operative delivery.

The degree of asphyxia in the newborn was assessed on the Apgar scale. In order to exclude the effect of the drug depression on the degree of asphyxia in a newborn, the analysis included results obtained only at the fifth minute after birth. The evaluation of the neuropsychological status of a newborn child was assessed according to the NACS (Neurologic and Adaptive Capacity Score) scale [15]. Based on the results of the outcomes of the delivery, the patients were divided into 2 subgroups: with a total score on the NACS scale of<35 and a total score of > 35 on the NACS scale. Score on the NACS scale was conducted 2, 24 and 72 hours after birth.

The statistical processing was carried out using the STATISTICA software package (StatSoft Inc., USA, version 10.0). The results of the description of the quantitative characteristics, the empirical distributions of which did not show a statistically significant difference from the normal distribution law, are represented in the form (M ± σ), where M is the sample mean, σ is the sample standard deviation. In the case when the difference between the empirical distribution and the normal law was statistically significant the results were represented in the form of a median and interquartile interval (Me [Q1; Q3]), where Me is the median; Q1 - 1 (25%) quartile; Q3 - 3 (75%) quartile). To determine the differences between the groups by qualitative characteristics, the χ2 criterion was used with the Yates correction, in connection with the small values of the compared frequencies. The relationships between the quantitative indicators were estimated using the Spearman's rank correlation coefficient (r). The significance level for testing statistical hypotheses on the reliability of the difference was assumed to be 0.05.

## Results

Analysis of the outcomes of births showed that the frequency of newborn's asphyxia in patients with initially normal weight was 5.5%, with obesity of I degree – 5.7%, with II – 14.3% and with III – 16.7%. There was no significant difference between the groups.

Investigating the effect of the level of IAP on the development of newborn's asphyxia in patients with obesity, the first stage was the calculation of the average values of IAP in patients with newborn's asphyxia and without newborn's asphyxia at various stages of labor. The desire to detail the results of the study, depending on the degree of obesity, predetermined a small number of observations of neonatal asphyxia in each subgroup, which led to statistical unreliability of the differences **(Table 2)**.

**Table 2** Average values of IAP in patients with newborn's asphyxia and without newborn's asphyxia at various stages of labor (mmHg).

| Variables | Group I | Group II | Group III | Group IV |
|---|---|---|---|---|
| **The beginning of the I period of labor** | | | | |
| Without asphyxia | n=36 | n=34 | n=35 | n=18 |
| | 17.6 ± 3.4 | 20.8 ± 1.7 | 22.1 ± 1.5 | 23.6 ± 1.1 |
| Asphyxia moderate | n=1 | n=2 | n=4 | n=2 |
| | 23.0 ± 0.0 | 23.0 ± 0.0 | 24.0 ± 0.0 [a] | 23.0 ± 1.4 |
| Asphyxia Heavy | n=1 | n=0 | n=1 | n=1 |
| | 24.0 ± 0.0 | - | 26.0 ± 0.0 | 25.0 ± 0.0 |
| **I period of labor/contraction** | | | | |
| Without Asphyxia | n=36 | n=34 | n=42 | n=18 |
| | 20.1 ± 4.1 | 22.6 ± 2.9 | 23.5 ± 2.5 | 24.4 ± 1.9 |
| Asphyxia moderate | n=1 | n=2 | n=4 | n=2 |
| | 26.0 ± 0.0 | 27.5 ± 0.7 [a] | 24.0 ± 0.0 [a] | 30.0 ± 0.0 [a] |
| Asphyxia Heavy | n=1 | n=0 | n=1 | n=1 |
| | 30.0 ± 0.0 | - | 29.0 ± 0.0 | 35.0 ± 0.0 |

n - number of patients in the subgroup; [a] - P<0.05 IAP vs. IAP in subgroup without asphyxia

Nevertheless, these tables could be considered as indicative - absolute average values of IAP in subgroups with complicated outcomes significantly exceeded those at birth of children without asphyxia. The differences in the average level of IAP were reliable only during the birth pangs. The differences in average values of IAP between the subgroups of patients with I degree of obesity, were less pronounced (p=0.027), but the average Apgar score in the subgroups differed more than 2 times (4.00 ± 0.0 vs. 8.6 ± 0.6 points). If we speak about women with obesity of II and III degree, the differences between the subgroup differences of the IAP were more statistically significant (p=0.000), and the Apgar score decreased (6.3 ± 1.7 vs. 8.0 ± 0.0 and 6.5 ± 0.7 vs. 8.0 ± 0.0 points, in groups, respectively).

As it could be seen from the **Table 3**, the neurologic status in newborns was also associated with the higher values of IAP during labor.

**Table 3** Average values of IAP in the parturient women depending on the neurological status of the newborn (mmHg)

| Variables | Group I | Group II | Group III | Group IV |
|---|---|---|---|---|
| **The beginning of the I period of labor** | | | | |
| NACS> 35 points/2 h | n=25 | n=20 | n=23 | n=7 |
| | 16.9 ± 3.3 | 20.5 ± 1.9 [b] | 21.7 ± 1.3 [b, c] | 23.0 ± 0.8 [b, c, d] |
| NACS<35 points/2 h | n=13 | n=16 | n=17 | n=14 |
| | 19.8 ± 3.7 [a] | 21.5 ± 1.3 | 23.3 ± 1.7 [a, b, c] | 23.9 ± 1.2 [b, c] |
| NACS > 35 points/24 h | n=34 | n=30 | n=31 | n=14 |
| | 17.3 ± 1.3 | 20.9 ± 1.8 [b] | 22.1 ± 1.4 [b, c] | 23.4 ± 1.6 [b, c, d] |
| NACS<35 points/24 h | n=4 | n=6 | n=9 | n=7 |
| | 22.8 ± 1.6 [a] | 21.3 ± 1.6 | 23.4 ± 2.2 [a] | 23.9 ± 0.9 [c] |
| NACS > 35 points/72 h | n=36 | n=34 | n=37 | n=18 |
| | 17.6 ± 3.5 | 20.8 ± 1.7 [b] | 22.2 ± 1.5 [b, c] | 23.4 ± 1.2 [b, c, d] |
| NACS<35 points/72 h | n=2 | n=2 | n=3 | n=3 |
| | 23.5 ± 0.7 [a] | 23.0 ± 0.0 | 25.0 ± 1.0 [a] | 24.3 ± 1.2 |
| **I period of labor/Contraction** | | | | |
| NACS > 35 points/2 h | n=25 | n=20 | n=23 | n=7 |
| | 18.8 ± 4.1 | 21.4 ± 2.5 [b] | 22.7 ± 2.0 [b] | 22.57 ± 0.8 [b] |
| NACS<35 points/2 h | n=13 | n=16 | n=17 | n=14 |
| | 23.7 ± 3.1 [a] | 24.9 ± 2.7 [a] | 25.8 ± 2.7 [a] | 26.9 ± 3.1 [a, b] |
| NACS > 35 points/24 h | n=34 | n=30 | n=31 | n=14 |
| | 19.9 ± 4.1 | 22.2 ± 2.8 [b] | 23.3 ± 2.4 [b] | 24.0 ± 1.9 [b, c] |
| NACS<35 points/24 h | n=4 | n=6 | n=9 | n=7 |
| | 26.3 ± 2.9 [a] | 26.7 ± 0.8 | 26.7 ± 2.7 [a] | 28.3 ± 3.6 [a] |
| NACS > 35 points/72 h | n=36 | n=34 | n=37 | n=18 |
| | 20.1 ± 4.1 | 22.6 ± 2.9 [b] | 23.7 ± 2.6 [b] | 24.8 ± 2.6 [b, c] |
| NACS<35 points/72 h | n=2 | n=2 | n=3 | n=3 |
| | 28.0 ± 2.8 [a] | 27.5 ± 0.7 [a] | 28.0 ± 1.0 [a] | 29.0 ± 5.3 [a] |

n - Number of patients in the subgroup; [a] - P<0.05 vs. IAP in subgroup NACS > 35 points; [b] - P<0.05 vs. IAP in group I; [c] - P<0.05 vs. IAP in group II; [d] - P<0.05 vs. IAP in group III

The average values of IAP in patients whose newborns were less than 35 on the NACS scale was significantly higher than those of parturient women whose children had a satisfactory neurological status. The most severe and prolonged neurological disorders were seen in patients whose IAP in childbirth exceeded 27 mmHg, regardless of the initial BMI. Intergroup differences in average values of IAP were mainly significant in patients whose newborns had more than 35 points on the NACS scale, while during the birth pangs the statistical difference between the IAP s in the subgroups significantly decreased. With a score of less than 35 on the NACS scale, the average values of IAP between patients separated by the BMI level were unreliable. The average values of IAP in parturient women within the same group, divided according to the neurological status of the newborn for 3 days, were also unreliable, except for patients with III degree obesity (p=0.037).

It should be noted that the frequency and severity of neurological deficit in newborns depended on the method of analgesia of childbirth. In the subgroups using EA in labor, the total score on the NACS scale was significantly higher: 2 hours after birth it was 36.4 ± 2.0 vs. 33.0 ± 6.1 (p=0.000), after 24 hours – 37.3 ± 1.5 vs. 34.6 ± 5.9 (p=0.000), after 72 hours – 37.8 ± 1.1 vs. 36.0 ± 5.4 (p=0.008). The greatest differences were seen at the day after the birth.

Carrying out a correlative analysis of the dependence of the degree of asphyxia in a newborn on the degree of obesity, the method of analgesia in labor and IAP in childbirth showed the presence of a greater dependence of the severity of asphyxia on the level of IAP. The correlation coefficient for the initial level of the IAP corresponded to the average bond strength (r=-0.63, p<0.001). This link increased within the indicators of IAP during the birth pangs, the correlation coefficient in this case was – 0.66 (p<0.001). The relationship strength of the neurological status on the NACS scale 2 hours after the birth and the initial level of the IAP corresponded to r=-0.49 (p <0.001), and from the IAP to the contraction – r=0.66 (p <0.001). Neurological status of the newborn 72 hours after birth was more dependent on IAP, recorded at the beginning of the first stage of labor (r=-0.5 vs. -0.40 with IAP during the contraction). The relationship strength between the neurological status and BMI was below average. Correlation coefficient for BMI and NACS after 2 hours – r=-0.27; in 24 hours – r =- 0.36; in 72 hours – r=-0.35 (p<0.001).

A similar analysis of the dependence of perinatal complications on the level of IAP was carried out with surgical delivery. Since the neurological status of the newborn depends on the method of anesthesia, anesthesia was considered as a variable factor, and therefore, the analysis of the neurological status of the newborn from the initial IAP in abdominal delivery was performed with the separation of patients using the method of anesthesia.

The results of the study showed that asphyxia in newborns during operative delivery also depended on the initial level of IAP, but the differences were statistically significant only in groups using regional anesthesia methods. The frequency of neonatal asphyxia with GA and SA was comparable, while in EA it was reliably lower (p<0.05). In the group I, moderate asphyxia after GA was diagnosed in 21.7%, SA – 6.7%, after EA was not detected. Severe asphyxia was detected only after SA – 3.3% of cases. In group II, moderate asphyxia after GA was diagnosed in 20.0%, SA – 5.1%, EA – 5.3%. Severe asphyxia after GA was detected in 8.0%, SA – 3.4%, EA – 2.6%. In group III, mild asphyxia after GA was diagnosed in 61.5%, SA – 61.1%, EA – 28.6%. Severe asphyxia after GA was detected in 7.6%, SA – 11.1%, after EA asphyxia of the newborn was not. In the group IV, moderate asphyxia after GA was diagnosed in 80.0%, SA – 66.7%, EA – 27.3%. Severe asphyxia was recorded only after SA in 8.3% of cases.

Analysis of the **Table 4** gave the similar results of the dependence of neurological status from IAP in the preoperative period.

**Table 4** Average values of IAP before the operative delivery in patients, depending on the neurological status in the newborn, taking into account the method of anesthesia (mmHg)

| | Group I | Group II | Group III | Group IV |
|---|---|---|---|---|
| **General anesthesia** | | | | |
| NACS > 35 points/24 h | n=17 | n=16 | n=2 | n=0 |
| | 17.3 ± 2.6 | 19.8 ± 1.6 [b] | 21.5 ± 2.1 [b] | - |
| NACS<35 points/24 h | n=6 | n=9 | n=10 | n=5 |
| | 19.8 ± 1.3 [a] | 21.2 ± 1.6 [a] | 23.4 ± 2.2 [b,c] | 23.6 ± 1.5 [b,c] |
| NACS > 35 points/72 h | n=21 | n=20 | n=8 | n=4 |
| | 17.7 ± 2.5 | 19.8 ± 1.6 [b] | 22.0 ± 1.2 [b,c] | 23.3 ± 1.5 [b,c] |
| NACS<35 points/72 h | n=2 | n=5 | n=4 | n=1 |
| | 21.0 ± 0.8 | 22.2 ± 0.8 [a] | 24.5 ± 1.3 [a,b,c] | 25.0 [c] |
| **Spinal anesthesia** | | | | |
| NACS > 35 points/24 h | n=25 | n=45 | n=4 | n=3 |
| | 17.7 ± 3.1 | 20.0 ± 1.5 [b] | 22.0 ± 0.82 [b,c] | 22.3 ± 0.6 [b,c] |
| NACS<35 points/24 h | n=5 | n=14 | n=14 | n=8 |

| | | | | |
|---|---|---|---|---|
| | 22.0 ± 1.0 [a] | 22.1 ± 2.1 [a] | 23.4 ± 0.8 [a,b,c] | 23.7 ± 1.1 [b,c] |
| NACS > 35 points/72 h | n=28 | n=54 | n=7 | n=7 |
| | 18.1 ± 3.2 | 20.1 ± 1.6 [b] | 22.4 ± 0.9 [b,c] | 22.6 ± 0.53 [b,c] |
| NACS<35 points/72 h | n=2 | n=5 | n=11 | n=4 |
| | 23.0 ± 0.0 [a] | 22.8 ± 2.8 [a] | 23.5 ± 0.7 [a] | 24.4 ± 0.9 [a] |
| Epidural anesthesia | | | | |
| NACS > 35 points/24 h | n=24 | n=32 | n=10 | n=5 |
| | 17.7 ± 3.3 | 20.8 ± 1.5 [b] | 22.9 ± 0.7 [b,c] | 22.8 ± 0.4 [b,c] |
| NACS<35 points/24 h | n=2 | n=6 | n=4 | n=6 |
| | 22.5 ± 0.7 | 23.8 ± 0.8 [a] | 23.5 ± 1.3 | 24.7 ± 0.5 [a,b,c] |
| NACS > 35 points/72 h | n=25 | n=35 | n=13 | n=9 |
| | 17.8 ± 3.4 | 20.9 ± 1.7 [b] | 22.9 ± 0.8 [b,c] | 23.6 ± 1.0 [b,c] |
| NACS<35 points/72 h | n=1 | n=3 | n=1 | n=2 |
| | 23 | 24.3 ± 0.6 [a] | 25.0 [a] | 25.0 ± 0.0 |

n - number of patients in the subgroup; [a] - P<0.05 vs. IAP in subgroup NACS > 35 points; [b] - P<0.05 vs. IAP in group I; [c] - P<0.05 vs. IAP in group II

There were significant differences in the average values of IAP in the subgroups, divided by the magnitude of the total NACS score, regardless of the method of anesthesia. At the same time, as it can be seen from the **Table 4,** the frequency of neurologic disorders in newborns was significantly lower (p<0.05) when using EA, and the average level of IAP in the group of patients without a neurological deficit is higher compared with subgroups with GA and SA. Significant differences were found only between groups of patients with obesity.

Conducting the analysis of the reliability of differences in the total score on the NACS scale, depending on the method of anesthesia of caesarean section in the study groups, showed significantly better results when using EA compared to GA only in groups of women with initially normal weight and inadequate obesity.

In the cases of severe obesity, despite the visual difference in the average NACS values, the differences were unreliable due to a small sample. However if we take patients with II degree of obesity, the significant differences in the average NACS score were noted only in subgroups using SA and EA. Using SA, they were significantly lower (p<0.05). It was shown that, with pronounced obesity, the neurological status of newborns in CA was worse than in OA, but the differences in NACS mean scores were statistically unreliable.

## Discussion

The study showed the dependence of the frequency and severity of asphyxia, neurologic disorders in newborns on the level of IAP immediately before and during the delivery. The greater the level of IAP, the higher the probability of asphyxia and neurological deficit in the newborns.

The effect of IAP on perinatal complications can be explained by the induction of uterine placental ischemia due to compression of the maternal aorta and uterine arteries, resulting in the effect of "RUPP" (reduced uterine perfusion pressure) - a decrease in uterine perfusion pressure [16]. The Darcy's law, which describes the dependence of blood flow on the radius of the vessel, suggests that even a small decrease in the diameter of the blood vessel can lead to a significant increase in vascular resistance and a decrease in blood flow [17]. In our earlier works, the strong link between the level of IAP and the violations of central hemodynamics [18] and utero-feto-placental blood flow in pregnant women with obesity was confirmed [19]. In the animal experiments, not only a decrease in the blood flow to the uterus with an increase of IAP, but also a linear dependence of intra-amniotic pressure on the level of IAP was found, which can also contribute to the reduction of umbilical cord blood flow during the birth pangs [7,8].

The obtained results testify to the dependence of the neurological disorders of the fetus on the initial IAP, the highest values of which were registered in patients of groups III and IV. Since the incidence of neurological deficits in newborns was higher in patients with severe obesity, it should be concluded that this pathology is a consequence of IAH leading to severe placental insufficiency and prolonged hypoxia of the fetal brain.

The most severe and prolonged neurologic disorders were found in women whose IAP in childbirth exceeded 27 mmHg, regardless of the original BMI, while significantly more often IAP in childbirth reached these values in patients with severe obesity The decrease in the frequency and severity of neurologic disturbances in newborns with epidural analgesia compared with the data of parturient with anesthetized opioids with initially comparable indicators of IAP can be explained by a decrease in the level of IAP in childbirth due to a significant increase in compliance of the anterior abdominal wall [20].

Relatively the worse results of neonatal neurological evaluation in patients with severe obesity using SA in the abdominal delivery are explained by a decrease in perfusion pressure of the uterus due to pronounced arterial hypotension due to the development of a high sympathetic block, associated with IAP [21-23]. The negative effect of SA on perinatal outcomes in patients with obesity is confirmed by the results of the large studies [24]. When studying the dependence of the acid-base state of umbilical blood of the fetus on the level of BMI in patients (n=5742), delivered by caesarean section operation using SA , it was shown that with the increase in BMI, a significant decrease in pH and an increase in fetal blood base deficiency occur [24].

Thus, one of the likely etiopathogenetic causes of the high frequency of the perinatal morbidity and mortality in obese patients is higher rates of IAP during pregnancy and delivery compared with women with normal weight.

## Conclusion

The results of the limited pilot study indicate the impact of the level of IAP of parturient women with obesity on the severity of asphyxia and the neurological status of the newborn in the early neonatal period. To confirm the obtained intermediate results and requires further investigation with the inclusion of a larger number of observations.

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