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Clinical and anamnestic, pre- and intraoperative predictors of maternal and neonatal complications of cesarean section

I. Z. Gladchuk, Yu. V. Herman, D. O. Hryhurko

Odessa National medical University

Department of Obstetrics and Gynecology #1

Abstract

The progressive decline in the world population's health index causes the need for a comprehensive set of measures to ensure the safety of caesarean section. There are a number of purely technical problems, the solution of which largely depends on the outcome of the operation for the mother and the fetus.

In spite of the technical simplicity of caesarean section, this is a cavitary operation and should be classified as complex surgical interventions, with possible intraoperative and postoperative complications.

The aggregate index of the incidence of intraoperative, early and late complications of abdominal rozdorosheniya varies widely within the range - from 4.5 to 18.5% [1, 2].

The incidence of obstetric and perinatal complications is directly related to the increase in the frequency of cesarean section. The group of increased risk of operational degeneration include: first-born babies, patients with obstructed obstetric history, pregnant women with scarring on the uterus after cesarean section, women with multiple pregnancy, preeclampsia, extragenital and genital diseases.

The identification of some important clinical and anamnestic, pre- and intraoperative predictors of prenatal risk can significantly reduce the incidence of possible complications during abdominal delivery, as well as improve maternal and perinatal outcomes during the later postoperative periods.

Key words: cesarean section, maternal complications, perinatal outcomes.

Background

An ominous tendency of the last decades towards the increasing incidence of abdominal delivery places the problem of cesarean section into the category of the most urgent issues in modern obstetrics. Despite the apparent technical simplicity, cesarean section is an abdominal operation, often complex, with inherent risks of maternal and neonatal complications. The overall incidence of intraoperative, early and late complications of abdominal birth varies widely (from 4.2 to 18.9%) depending on the used surgery method, level of the surgical technique and conditions for its implementation, the obstetric situation, and the accompanying somatic pathology [1, 2, 4]. All of this, on the one hand, dictates the need to identify the predictors of maternal and neonatal complications of surgery among the wide range of clinical and anamnestic data and, on the other hand, to improve the surgery method and enhance the surgical technique when performing surgery [1, 3].

Objectives

To determine the role of some clinical and anamnestic pre- and intraoperative predictors in the occurrence of maternal and neonatal complications associated with the classical cesarean section described by M.Stark and a modified method for improving maternal and fetal consequences of abdominal delivery.

Materials and methods

The patient selection for a comparative study was performed in accordance with the type of the surgeries (the classical technique described by M.Stark or a modified method), which were performed on the basis of the Obstetrics department of the Kherson regional clinical hospital for the period from 2015 to 2018 under the principle of randomization. The formation of clinical groups was performed in accordance with the retrospective data retrieved from the labor and delivery records of 205 patients, who delivered via cesarean section. The primary group (I clinical) consisted of 108 patients, who underwent a cesarean section performed in accordance

with the offered modified method [7]. The main idea behind this method is to suture a wound on an uterus by two operators simultaneously, starting from the corners of the wound edges (areas, where large blood vessels pass and, as a rule, large hematomas appear) with a continuous Vicryl suture with fixation forceps on each end of two surgical sutures; an aponeurosis and skin are sutured for an analogy. On average, the surgery lasts for 10 -15 minutes, the main source of bleeding (an uterus) is eliminated 3 - 4 minutes after the laparotomy began. The comparative group (II clinical) consisted of 97 patients, who underwent the classical cesarean section described by M.Stark. All women went through general clinical, physical, laboratory, and instrumental examinations in accordance with the industry standards [5, 6]. A comparative analysis of some clinical and anamnestic and preoperative factors indicates a statistically insignificant discrepancy ($p > 0.05\%$) meaning that the data of the examined patients in both clinical groups were practically identical in the preoperative phase (Table 1, 2).

A statistical analysis of the obtained results was carried out using the application R. The quantitative indicators, central tendency, and variability of the features were analyzed using the arithmetical mean value and the error of the mean value calculation. To compare the incidences between the groups of patients, the Fisher's exact test and the Pearson Chi-square test were used. The qualitative indicators were measured in absolute and relative (percentage) values. The probability of differences between parametric characteristics in the appropriate groups was estimated using the Student's t-test and analysis of variance (ANOVA) followed by a posteriori analysis for more than two categories. To calculate statistical power, the Cohen's d and η^2 criteria were used. During the calculations, the statistical significance level of 95%, and the differences were considered statistically significant if the probability of the null-hypothesis (pH_0) was equal to or less than 0.05%.

Results

The study revealed a reliable link between some clinical and anamnestic, pre- and intraoperative factors that influence the incidence of maternal and neonatal complications.

Table 1

The comparative characteristics of some preoperative predictors in pregnant women in two clinical groups (n=205)

Index	Clinical group I (primary) (n=108)		Clinical group II (comparative) (n=97)			Σ (n=205) (%)	p	d Cohen
	N (%)	Mean value (M \pm m)	N (%)	Mean value (M \pm m)	Range			
Age profile	108	29,97 \pm 5,59	97	28,71 \pm 5,65	18 - 46	29,38 \pm 5,64	0,11	0,22 95% CI: 0,18 - 0,26
Body weight (kg)	108	80,7 \pm 18,88	97	77,58 \pm 13,74	50 - 170	79,22 \pm 16,68	0,181	0,19 95% CI: 0,15 - 0,23
Parity rate	108	1,5 \pm 0,73	97	1,36 \pm 0,58	1 - 4	1,44 \pm 0,67	0,124	0,22 95% CI: 0,18 - 0,26
Gestation period (weeks)	108	37 \pm 3,84	97	37 \pm 4,5	30 - 41	37 \pm 4,06	1	0 95% CI: 0,61 - 0,61
Uterine scar after cesarean section	40 (37,0 %)	1,33 \pm 0,67	30 (30,9%)	1,21 \pm 0,77	1 - 3	70 (34,15 %)	0,379	1 95% CI: 0,13 - 0,21
Type of procedure (urgent)	34 (31,05 %)		43 (44,3%)			70 (34,15 %)	0,062	

Table 2

The comparative characteristics of extragenital and genital pathology in the clinical groups (n=205)

Index	Study group				Σ N (205)		P
	Clinical group I (primary) N (108)		Clinical group II (comparative) N (97)				
	n	%	n	%	n	%	
Pathological changes in the cervix	2	1.9%	0	0.0%	2	1.0%	0,499
Violation of the menstrual cycle	24	22.2%	15	15.5%	39	19.0%	0,285
Chronic inflammatory processes of uterine appendages	44	40.7%	13	13.4%	57	27.8%	<0,001
Candida colitis	6	5.6%	3	3.1%	9	4.4%	0,504
Uterine fibroids	7	6.5%	1	1.0%	8	3.9%	0,068
Ovarian cysts	3	2.8%	1	1.0%	4	2.0%	0,623
Gynecological surgery	8	7.4%	0	0.0%	8	3.9%	0,007
Renal system diseases	13	12.0%	10	10.3%	23	11.2%	0,825
Endocrine disorders	20	18.5%	15	15.5%	35	17.1%	0,583
Eye diseases	6	5.6%	0	0.0%	6	2.9%	0,03
Heart and cardiovascular diseases	15	13.9%	16	16.5%	31	15.1%	0,697
Anemia during pregnancy	43	39,8%	32	33%	75	36,6%	0,384
Musculoskeletal system diseases	1	0.9%	0	0.0%	1	0.5%	1
Respiratory system diseases	3	2.8%	5	5.2%	8	3.9%	0,48
Nervous system diseases	6	5.6%	8	8.2%	14	6.8%	0,58

Table 3

The indications for cesarean section in the clinical groups

The indications for cesarean section were different for both clinical groups, but no statistically significant dependence was detected.

Indications for cesarean section	Investigated Group				Σ		P
	I clinical group (primary)		II clinical group (comparative)		n	%	
	n	%	n	%			
Uterine scar after cesarean section	40	37,0%	30	30,9%	70	34,1%	0,379
Breech presentation of a fetus	5	4,6%	9	9,3%	14	6,8%	0,268
Twins	1	0,9%	5	5,2%	6	2,9%	0,103
Central placenta previa	2	1,9%	2	2,1%	4	2,0%	1
Extragenital pathology	2	1,9%	2	2,1%	4	2,0%	1
Pre-eclampsia	1	0,9%	1	1,0%	2	1,0%	1
High viral load	0	0,0%	3	3,1%	3	1,5%	0,104
Failed attempt to induce labor	1	0,9%	3	3,1%	4	2,0%	0,346
Pre-eclampsia	2	1,9%	4	4,1%	6	2,9%	0,425
Placental abruption	3	2,8%	4	4,1%	7	3,4%	0,71
Clinically narrow pelvis	3	2,8%	8	8,2%	11	5,4%	0,12
Fetal distress	3	2,8%	9	9,3%	12	5,9%	0,072
Weakness of labor activity	3	2,8%	2	2,1%	5	2,4%	1
Failed attempt to induce labor	1	0,9%	3	3,1%	4	2,0%	0,346
High viral load	0	0,0%	2	2,1%	2	1,0%	0,223

Table 4

The overall incidence of complications depending on the procedure for conducting cesarean section

Type of Procedure	Overall incidence of complications (n – 205)	
	Observed	Not observed
Elective	31 (15,12%)	97 (47,32%)
Urgent	29 (14,15%)	48 (23,41%)
Total	60 (29,27%)	145 (70,73%)
Odds ratio = 0,53 (95% CI 0,29 - 0,98) p = 0,056		

Complications occurred more often ($p = 0,056$; 95% CI 0,29 - 0,98) after urgent cesarean section than after elective surgery.

Table 5

The amount of blood loss during cesarean section depending on the degree of obesity in clinical groups

Clinical group	Distribution of blood loss (ml) depending on the degree of obesity(BMI)				Σ	p
	Normal weight	Class I obesity	Class II obesity	Class III obesity		
I clinical group (primary) N - 108	322,88±7,4 95% CI: 308,37 - 337,38 250 - 600 n = 66	308±7 95% CI: 294,27 - 321,73 250 - 450 n = 30	300±22,36 95% CI: 256,17 - 343,83 250 - 350 n = 5	396,86±74,1 95% CI: 251,62 - 542,09 250 - 828 n = 7	322,48±7 95% CI: 308,77 - 336,2 250 - 828 n = 108	0,0271
II clinical group (comparative) N - 97	542,5±27,02 95% CI: 489,53 - 595,46 351,6509433962 26 - 1600 n = 59	513,25±22,6 95% CI: 468,96 - 557,55 404,7 - 1000 n = 29	457,14±13,04 95% CI: 431,58 - 482,7 400 - 500 n = 7	575±75 95% CI: 428 - 722 500 - 650 n = 2	528,27±17,92 95% CI: 493,14 - 563,39 351,650943396 226 - 1600 n = 97	0,606
Σ N - 205	426,54±16,53 95% CI: 394,14 - 458,94 250 - 1600 n = 125	408,89±17,75 95% CI: 374,09 - 443,68 250 - 1000 n = 59	391,67±25,99 95% CI: 340,73 - 442,61 250 - 500 n = 12	436,44±63,6 95% CI: 311,79 - 561,1 250 - 828 n = 9	419,85±11,7 95% CI: 396,93 - 442,78 250 - 1600 n = 205	0,832
p	<0,001	<0,001	<0,001	0,271	<0,001	0,864
	3-0	(p=0,047), 3-1	(p=0,018), 3-2		(p=0,095).	

The amount of blood loss in the women in labor was significantly higher ($p = 0,0271$, 95% CI: 308,77 - 336,2) in class III obese obstetric patients.

Table 6

The incidence of neonatal complications in the clinical groups depending on the gestation age

Index N 205 (%)	Incidence of neonatal complications			p
	N (%)	N (%)	Σ (%)	
Gestation age	30 - 34 weeks	34 - 41 weeks		
I clinical group (n – 108)	11 (10,1%)	3 (2,7%)	14 (12,9%)	0,039
II clinical group (n – 97)	15 (15,4%)	8 (8,2%)	23 (23,7%)	0,035

Cesarean section at 34 weeks of gestation is followed by a statistically significant increase ($p < 0,039$) in the incidence of neonatal complications in both clinical groups.

Table 7

The overall incidence of complications depending on the presence of a uterine scar after a previous cesarean section

Uterine scar after cesarean section	Incidence of complications (n – 205)	
	Observed	Not observed
	20 (9,76%)	50 (24,39%)
Present	40 (19,51%)	95 (46,34%)
Not present	60 (29,27%)	145 (70,73%)
Odds ratio = 0,95 (95% ДИ 0,5 - 1,8)		
p = 1		

The presence of a uterine scar after a previous cesarean section doesn't influence the incidence of complications in both study groups ($p=1$; 95% CI 0,5 - 1,8).

Table 8

The incidence of maternal complications during cesarean section depending on the hemoglobin levels in pregnant women in the preoperative phase

Type of Procedure	Complications in recently delivered women depending on their hemoglobin levels		Σ	p
	Observed	Not observed		
Elective	111,26±1,4 95% CI: 108,53 - 114 80 - 143 n = 107	110,71±4,19 95% CI: 102,51 - 118,92 64 - 140 n = 21	111,17±1,35 95% CI: 108,53 - 113,81 64 - 143 n = 128	0,881
Urgent	111,61±1,99 95% CI: 107,72 - 115,51 77 - 151 n = 59	102,5±3,38 95% CI: 95,88 - 109,12 76 - 131 n = 18	109,48±1,76 95% CI: 106,03 - 112,93 76 - 151 n = 77	0,028
Σ	111,39±1,14 95% CI: 109,15 - 113,62 77 - 151 n = 166	106,92±2,79 95% CI: 101,46 - 112,38 64 - 140 n = 39	110,54±1,07 95% CI: 108,44 - 112,63 64 - 151 n = 205	0,101
p	0,884	0,144	0,445	0,119

After an urgent cesarean section in pregnant women with a low hemoglobin level before surgery (102.5 ± 3.38 , 95% CI: 95.88 - 109.12), the complications in the recently delivered women occurred more frequently than in the pregnant women with a normal hemoglobin level during an elective surgery, the difference was statistically significant ($p = 0.028$, 95% CI: 106.03 - 112.93).

Table 9

The overall incidence of complications in clinical groups during caserean section

Clinical group	Overall incidence of complications	
	Observed	Not observed
I clinical group (primary) n – 108	16 (14,8%)	92 (85,2%)
II clinical group (comparative) n – 97	44 (45,3%)	53 (54,7%)
Odds ratio = 0,21 (95% CI 0,11 - 0,41) p = <0,001		

The incidence of complications in the primary group was 7,8% compared to 21,46% observed in the comparative group ($p = <0,001$, 95% CI: 0,11 - 0,41).

Table 10

The incidence of maternal complications in the clinical groups during cesarean section

Clinical group	Maternal complications	
	Observed	Not observed
I clinical group (primary) n – 108	11 (10,2%)	97 (89,9%)
II clinical group (comparative) n – 97	32 (32,9%)	65 (67,1%)
Odds ratio = 0,14 (95% ДІ 0,06 - 0,34) p = <0,001		

The incidence of complications in the recently delivered women from the I clinical group was 3.41% compared to 15.61% observed in the II clinical group, the difference was statistically significant ($p = <0.001$, 95% CI: 0.06 - 0.34).

Таблиця 11

The incidence of neonatal complications in the clinical groups during cesarean section

Clinical Group	Neonatal complications	
	Observed	Not observed
I clinical group (primary) n – 108	9 (8,33%)	99 (91,67%)
II clinical group (comparative) n – 97	29 (29,9%)	68 (70,1%)
Odds ratio = 0,21 (95% CI 0,09 - 0,48) p = <0,001		

The incidence of complications in newborns from the I clinical group was 4.39% compared to 14.15% observed in the II clinical group ($p = <0.001$, 95% CI: 0.09-0.48).

Table 12

The ratio of the overall incidence of maternal and neonatal complications during cesarean section

Maternal complications	Neonatal Complications		Total
	Observed	Not observed	
Observed	17 (8,29%)	22 (10,73%)	39 (19,02%)
Not observed	21 (10,24%)	145 (70,73%)	166 (80,98%)
Total	38 (18,54%)	167 (81,46%)	205
Odds ratio = 5,34 (95% CI 2,44 - 11,65) p = <0,001			

The emergence of complications in the women in labor (recently delivered women) are interrelated with the overall incidence of neonatal complications ($p = <0.001$; 95% CI 2.44-11.65).

Discussion

Despite the fact that abdominal delivery increases the cumulative risk of intraoperative, early and late postoperative complications, the incidence of cesarean section continues to increase. According to the government statistics, in Ukraine in 1999, operative delivery amounted to 9.58% of the total number of births with 16,10% in 2009, 17,65% in 2011, 18,13% in 2015, 19,46% in 2016 , and 20,10% in 2017. Since 2006, along with the rise in cesarean section rate up to 14%, the increase in the perinatal mortality rate as well as the mortality rate of the women, who have delivered via surgery, is observed. In spite of this, in 2020, it is expected that the cesarean section rate will reach 56%, meaning that more than every second pregnancy will be ended with surgery [4].

It is worth mentioning that during urgent surgeries, the rate of complications reaches 18,9%, while during elective surgeries, this number is 4,2%, bleeding occurs 3 – 5 times oftener, a pulmonary embolism (PE) occurs in 2,2–3,0% of cases, purulent-septic complications after surgery occur in 12 – 75% of cases. Bladder injuries are observed in 0,14 - 0,3% of cesarean sections and in up to 0,6% of cases during a repeated surgery. In approximately 1% of cases, a fetal injury may occur [3, 4].

According to the results received from analysis of the anamnestic and clinical data, reproductive status of the women, and pregnancy complications, it is possible to notice that the patient data were practically identical in both groups in the preoperative phase.

Distribution of surgical procedures in accordance with their types (elective/urgent) was not statistically significant ($p = 0.08$; $df = 1$) in both clinical groups. But it made sense that complications in both recently delivered women and newborns occurred more often after an urgent cesarean section ($p = 0.056$; 95% CI 0.29 - 0.98) than in case of elective surgeries.

It is interesting that a uterine scar left after a previous cesarean section does not affect the incidence of maternal and neonatal complications, which indicates proper preoperative care provided for the patient before abdominal delivery as well as strong professional skills of the operators.

The conducted study proved that complications occurred more often in the pregnant women, who had a low hemoglobin level before surgery, after urgent cesarean section ($102,5 \pm 3,38$, 95% CI: 95,88 - 109,12) than in the women with a normal hemoglobin level after elective surgery, the difference is statistically significant ($p = 0.028$, 95% CI: 106.03 - 112.93). Therefore, mild anemia in pregnant women with a hemoglobin level of 102.5 ± 3.38 g/L can be referred to predictors of intra- and postoperative complications during cesarean section. In addition, the women in labor from the primary group with class III obesity statistically significantly ($p = 0,0271$, 95% CI: 308,77 - 336,2) experienced an increase in the amount of blood loss in contrast to the women with class II obesity. Probably, the increased blood loss is linked to the technical difficulties of cesarean section and complications associated with blood counting.

An analysis of the gestational age allowed to establish a clear relationship between the pregnancy length and the incidence of complications in newborns. A cesarean section performed in both the primary and comparative groups before 34 weeks of gestation is followed by a significant increase ($p < 0,039$) in the overall incidence of neonatal complications as children are born prematurely and are preterm newborns, who require resuscitation procedures and level III intensive care and treatment.

In the study, it was revealed that the incidence of maternal and neonatal complications in the clinical group II was statistically higher ($p = <0.001$) as compared to the primary group. And a significant correlation between the complications in the newborns and the women in labor was established ($p = <0.001$; 95% CI 2.44-11.65).

Conclusions

According to the results of a retrospective, randomized, and controlled study, the factors such as gynecological pathology (inflammatory diseases of a uterus and its appendages), extragenital pathology (class III obesity and mild anemia in pregnant women), gestational age (less than 34 weeks), and the procedure for cesarean section (urgent surgery) were identified as predictors that have significantly influenced the increase in the incidence of maternal and neonatal complications.

The overall incidence of maternal and neonatal complications in the primary group amounted to 7.8% as compared to 21.46% observed in the comparative group ($p = <0.001$, 95% CI: 0.11-0.41) what confirms the feasibility of using the modified method for cesarean section

and conducting further in-depth research in this field of study.

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