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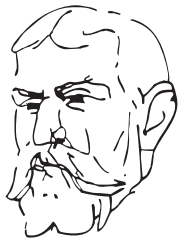

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ORIGINAL ARTICLE
PRACA ORYGINALNA

COMPARATIVE ANALYSIS OF INTRAOPERATIVE BLOOD LOSS DURING THE CLASSICAL CESAREAN SECTION DE SCRIBED BY M. STARK AND THE MODIFIED CESAREAN SECTION

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ABSTRACT

Introduction: According to the WHO, obstetric bleeding keeps a leading position among the top three causes of maternal mortality. The incidence of abnormal blood loss (BL) varies widely from 1.5% to 22%, and the incidence of acute blood loss reaches up to 1,7%, with the variation from 0% to 4%. Every year, this complication causes death in 128 women that amounts to 1.7% per 1,000 deliveries

The aim of this study is a comparative analysis of intraoperative blood loss during the classical cesarean section described by M. Stark and modified cesarean section was performed.

Materials and metods: The study has been conducted on the basis of the Obstetrics department of the Kherson regional clinical hospital. Patients were selected according to the type of surgery (the classical technique described by M. Stark or the modified method) for the period from 2015 to 2018. The formation of the 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 comparative estimation of intraoperative blood loss volumes was carried out using a direct (gravimetric) method.

Results: The proposed modification of abdominal delivery is based on the rational teamwork of a surgeon and an assistant, with the modernization of the surgical stages allowed halving the surgery duration as compared to the classical cesarean section technique introduced by M. Stark. And the improved surgical technique of abdominal delivery contributes to the reduction in the volume of intraoperative blood loss by 200 ml ($p < 0,001$).

Conclusions: Modified cesarean section allows avoiding massive obstetric hemorrhage, thereby creating an additional reserve for improving the safety of the operative delivery in general.

KEY WORDS: cesarean section, intraoperative blood loss, a technique, modification

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INTRODUCTION

According to the World Health Organization, obstetrical bleeding (OB) remains unchanged as one of the main causes of maternal mortality. The incidence of abnormal blood loss (BL) varies widely from 1.5% to 22%, and the incidence of acute blood loss reaches up to 1.7%, with the variation from 0% to 4%. During cesarean section, blood loss of more than 1000 ml occurs 14 times more often than during vaginal delivery. Every year, this complication causes death in 128 women that amounts to 1.7% per 1,000 deliveries [1, 2, 3, 4]. This is uterine atony that may be caused by the disadvantages of the used surgical technique and is the main reason for the hysterectomy that is done in almost half of all cases during abdominal delivery [3, 5, 6]. The method of abdominal delivery, which was developed by a group of physicians headed by M. Stark, made the c-section more technically-available to operators. One of the goals of this method is to exclude all unnecessary actions so that surgery was performed faster and with less blood loss. However, the development of medicine is on the go all time and thus the technical aspects of surgery should be constantly improved. To date, the basic principles of surgical techniques differ from the generally accepted ideas to a certain extent and tend towards minimal invasiveness at all surgical stages. The above-mentioned data reflect the urgency of the problem of OB during cesarean section what is the reason to improve the surgical technique for abdominal delivery, develop and implement new techniques for reducing blood loss during surgery, reduce the incidence of hysterectomies, and maintain women's reproductive health and save their lives.

THE AIM

To carry out a comparative analysis of intraoperative blood loss during the classical cesarean section described by M. Stark and a modified method of cesarean section to prevent massive obstetric hemorrhage and improve maternal outcomes.

MATERIALS AND METHODS

The study has been conducted on the basis of the Obstetrics department of the Kherson regional clinical hospital. Patients were selected according to the type of surgery (the classical technique described by M. Stark or the modified method) for the period from 2015 to 2018. The formation

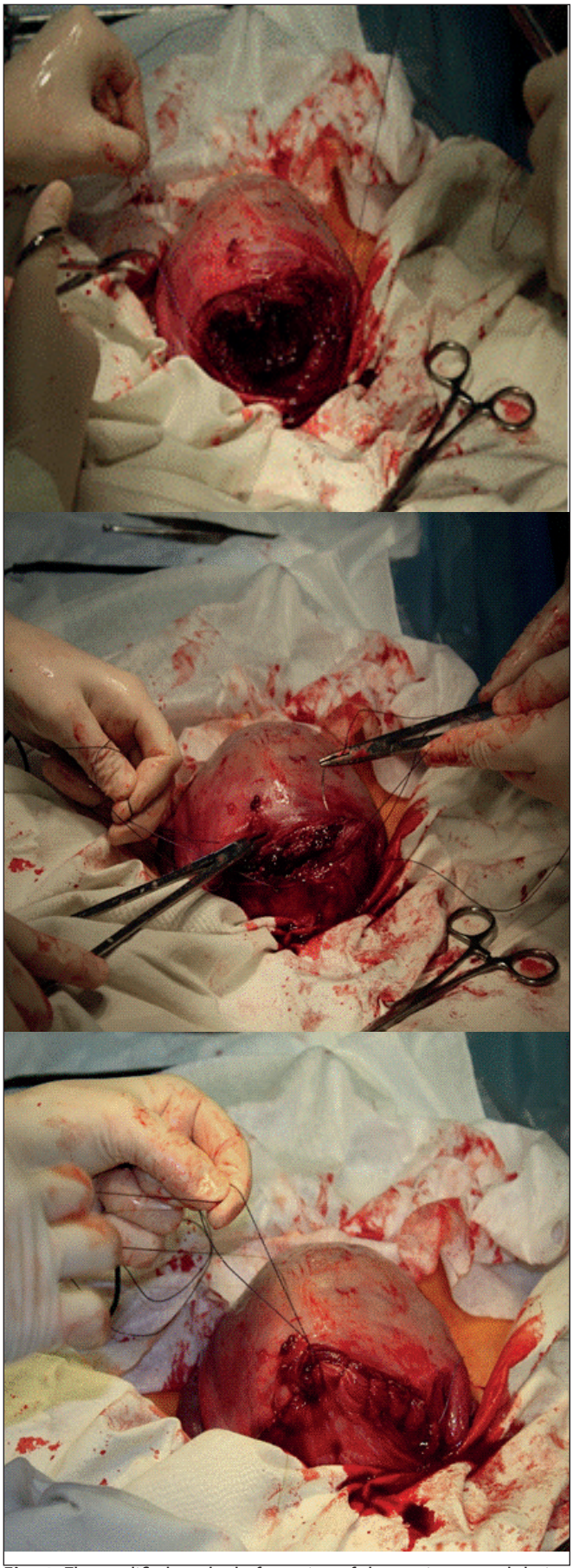

Fig. 1. The modified method of suturing of the uterine wound during cesarean section.

of the 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 I clinical group included 108 patients, who underwent a cesarean section performed in accordance with the offered modified method [7, 8]. The comparative group (II clinical group) included 97 pregnant women, who underwent the classical cesarean section described by M. Stark.

The differences between the given cesarean section technique and the modified method are as follows:

1. Unlike the Joel-Cohen incision, during the modified method of cesarean section, a laparotomy is performed just above the womb, on the lower skin fold, and the cut is 10-12 cm long.
2. In contrast to the cesarean section technique described by M. Stark, the dissection of the fascia is performed without scissors. To form access to the abdominal cavity, a cut in the midline of the fascia with the length of up to 2 cm is made, the peritoneum is seized with an index finger and all the layers of the anterior wall are stretched by blunt dissection by two surgeons simultaneously.
3. In case of a repeat cesarean section, the uterine incision is performed above the previous scar.
4. There is no routine instrumental curetting of the uterine cavity.
5. The fundamental of the proposed method is based on the teamwork of a surgeon and an assistant. The main differentiating feature of this method of the cesarean section consists in the simultaneous suturing of the uterus wound by two operators, starting from the corners of the wound edges with a continuous Vicryl suture with fixation forceps on each end of two surgical sutures (Fig. 1).
6. The fascia and skin are sutured for an analogy.

All women went through general clinical, physical, laboratory, and instrumental examinations in accordance with the industry standards [1, 8].

The comparative estimation of intraoperative blood loss volumes was carried out using a direct (gravimetric) method [9]. The desired value was determined by the difference in mass of dry and blood-impregnated sponges, beads, diapers, dressing gowns, and the volume of the blood that was collected in measuring containers during surgery and calculated by using the formula of Libov:

The volume of blood loss = B / 2 * k, where

B / 2 - total weight of the material impregnated with blood,

k = 15% for blood loss <1000 ml,

k = 30% for blood loss> 1000 ml.

The amniotic fluid volume was estimated by determining the amniotic index, which is the sum of the largest vertical water pockets in the four quadrants, and the results were compared with the normative values.

The analysis of the investigated clinical and anamnestic and preoperative factors indicates that there are no statistically significant differences (p> 0,05%) in the patients of both clinical groups (Table I). There were no cases of a low lying placenta, placenta previa, and abnormally invasive placenta observed in both groups.

Table I. Comparative characteristics of the investigated preoperative predictors in pregnant women in two clinical groups (n = 205)

Index	Primary group (n=108)		Comparative group (n=97)		Σ (n=205) (%)	p
	n (%)	Medium (M ± m)	n (%)	Medium (M ± m)		
Age profile (years old)	108	29,97±5,59	97	28,71±5,65	29,38±5,64	0,11
Weight (kg)	108	80,7±18,88	97	77,58±13,74	79,22±16,68	0,181
Parity rate	108	1,5±0,73	97	1,36±0,58	1,44±0,67	0,124
Gestation age (weeks)	108	37±3,84	97	37±4,5	37±4,06	1
Uterine scar after cesarean section	40 (37,0)	1,33±0,67	30 (30,9)	1,21±0,77	70 (34,15)	0,379
Hemoglobin level at the preoperational stage (g/l)	108	112,56±13,68	97	113,89±14,91	113,22±14,28	0,518
Hematocrit volume at the preoperative stage (%)	108	32,76±4,04	97	32,86±5,21	32,81±4,57	0,899
Platelet count at the preoperative stage (x10^9/l)	108	224,49±53,7	97	220,12±62,9	222,39±58,16	0,623
Type of procedure (urgent)	34 (31,05)		43 (44,3)		77 (37,6)	0,062

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. 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). During the calculations, the statistical significance level of 95% was used.

RESULTS AND DISCUSSION

Introduced by M. Stark in 1990, the cesarean section technique brought a transformational change into abdominal obstetrics and increased the safety of this surgical intervention as a whole. However, the maternal mortality rate associated with cesarean section (about 40 per 100,000 live births) remains 4 times higher than for all types of vaginal births (10 per 100,000 live births), and 8 times higher than for normal delivery (5 per 100,000 live births) [5].

The progressive increase in abdominal deliveries worldwide along with the lered health index of pregnant women makes it necessary to solve a number of problems associated with cold-technical stages of cesarean section to improve maternal and fetal outcomes.

In both clinical groups, cesarean section was performed by experienced physicians whose surgical skills correspond to the highest qualification category and do not affect the quality of any of the investigated parameters (Table II).

We believe that this is the rational teamwork of surgeons along with the modernization of the surgical stages that allowed halving the surgery duration as compared to the classical cesarean section technique introduced by M. Stark. This was conditioned by the use of the modified technique for accessing the abdominal cavity and suturing the wound on the uterus and the layers of the anterior abdominal wall in accordance with the proposed method. The minimum surgery duration was observed in the I clinical study group, where it was 9 minutes, the maximum one was 43 minutes, and the medium one was 21.63 ± 7.97 minutes. In the II clinical group, the minimum surgery duration was 25 minutes, the maximum one was 1 hour 30 minutes, and the medium one was 47.26 ± 13.62 minutes, the difference was significant ($p < 0.01$).

The reduction in the duration of abdominal deliveries has a number of significant benefits, and above all, has a beneficial effect on reducing intraoperative blood loss. This is because, by optimizing the surgical stages (in particular, the refusal to access the abdominal cavity by sharp dissection), it allows performing sparing dissection of blood vessels and maintaining the appropriate architectonics, thereby minimizing the need in the further hemostasis process; the exteriorization of the uterus improves the visualization of the wound, reducing the need for using forceps that cause additional iatrogenic damage to tissue; the refusal to perform routine instrumental curettage eliminates the probability of bleeding from the placental area of the uterus. We advise draining blood from the cavity in a more secure way by using a sponge. The modified technique of suturing of the womb on the uterus described above is the key stage of the overall duration of the cesarean section and the main method to minimize inoperative blood loss. By applying this method, the main source of bleeding is eliminated on the 3d or 4th minute from the beginning of laparotomy. The incorporation of new types of energy, namely argon-plasma coagulation, into the process is an effective additional method of high-frequency electrosurgery for reducing bleeding; however, it has a number of limitations and is used for performing primary homeostasis as the coagulation depth is no more than 3 mm.

We believe that the key element for reducing intraoperative blood loss is the quality of the surgical technique used for suturing the uterus. Since the suturing process begins from two corners of

Table II. Comparative analysis of the intraoperative phase during the Stark's classical cesarean section and modified cesarean section (n = 205)

Index	Primary group (n=108)		Comparative group (n=97)		Range	Σ (n=205) (%)	p
	n (%)	Medium (M ± m)	n (%)	Medium (M ± m)			
Surgery duration (minutes)	108	21,63±7,97	97	47,26±13,62	9 – 90	33,76±16,89	<0,001
Time before a baby is removed(minutes)	108	3,78±1,77	97	7,67±4,05	1 - 20	5,62±3,63	<0,001
Body temperature (t^0 C)	108	36,6±0,11	97	36,5±0,15	36,4 – 36,8	36,6±0,78	>0,05
Use of carbetocine	15	13,8%	30	30,9%	45	21,9%	0,011
Hemotransfusion	0	0%	5	5,2%	5	2,4%	0,022
Hysterectomy	0	0	2	2,06%	2	0,97	1

Table III. Blood loss volume calculated during cesarean section in the clinical groups (n=205) (M ± m)

Clinical group	Blood loss volumes, ml					
	n	Medium	Standard average error	Standard deviation	Range	95% Confidence interval
I clinical group (primary) n - 108	108	322,48	7	72,72	250 - 850	308,77 - 336,2
II clinical group (comparative) n - 97	97	528,27	17,92	176,49	350 - 1600	493,14 - 563,39
Σ	205	419,85	11,7	167,45	250 - 1600	396,93 - 442,78
p				<0,001		
d Cohen				1,55 95% CI: 1,5 - 1,61		

the wound simultaneously, the risk of massive hematoma is minimized taking into account the topography of the vessels, and the time during which the wound remains open is reduced by 50%.

In the course of the investigation, the intraoperative blood loss volumes were estimated by using the direct method which requires the use of suction bags. We believe that since there is no credible alternative, the gravimetric method is the most informative one in estimating the amount of blood loss; however, it has some disadvantages. Technical difficulties arose when blood loss was calculated in patients with excessive body weight. In addition, during cesarean section, the amniotic fluid outflows, and its volumes vary from one individual to another and thus greatly reduce the objectivity of this method. However, according to the amniotic index data, the volumes of amniotic fluid in both clinical groups were medium and did not affect the results of the investigation.

The blood loss volume in the I clinical group was significantly lower and amounted to 322.48 ± 72.72 ml versus 528.27 ± 176.49 ml in the II clinical group, the difference was statistically significant (p^3 0.001, 95% CI: 1, 5 - 1.61). In addition, 32 (29.6%) patients from the main group had a minimum volume of blood loss, which was 250 ml, and this volume can be put equal to the average volume of blood lost during vaginal birth. The maximum intraoperative blood loss in 5 (4.6%) women in labor from the I clinical group was 850 ml, which constituted approximately 0.9% of their body weight and 17% of their blood volume and looked very like pathological OB. Instead, 12 (12.4%) women from the II clinical group, who underwent a classical cesarean section, had blood loss of 1200-600 ml, which constituted about 1.6% of their body weight and more than one third of their blood volume, and this is defined as a state of massive obstetric hemorrhage (MOH), which, in 5 (5.2%, $p < 0.022$) cases, required intraoperative blood transfusion and, in 2 (2.06%) cases, became a reason for a hysterectomy. However, this difference was statistically insignificant. In addition, the minimization of the time required for suturing of the uterus along with the ensured fast adequate hemostasis in the primary group almost halved the need to use the expensive drug, carbetocin, which was used only in 13.8% of cases in the I group by contrast to 30.9% of cases in the comparative group ($p < 0.011$) that positively affects the cost of abdominal delivery.

Since the indications for cesarean delivery were similar in two investigated groups, we can assume that both a well-organized, integrated approach to abdominal delivery and an optimized surgical technique increase the effectiveness of the prevention of the MOH and account for the elimination of blood transfusions and hysterectomies in the primary group. However, when the data regarding the volume of blood loss were analyzed, a controversial issue was raised. According to the Order of the Ministry of Health of Ukraine No. 205 dated 24.03.14. during vaginal delivery, blood loss of more than 500 ml is defined as pathological, then how is it possible that during cesarean section,

when women in labor have a massive wound surface, pathological blood loss is the one which volume exceeds 1000 ml?

In addition, the modified cesarean section has an influence over some prenatal outcomes. The reduction in the surgery duration at the stage of entering the abdominal cavity contributes to the reduction in the time needed for removing a baby in two times what is especially important during an urgent cesarean section in case of fetal distress, prolapsed umbilical cord, or placental abruption when the baby has a few minutes left. Due to the use of the enhanced access to the uterus, in the I clinical group, the fetus was removed on an average on 4 minutes earlier ($p<0,001$) than in the comparative group what improved the outcomes for the newborn during the early neonatal period.

Reduction in the duration of cesarean section makes it possible to avoid hypothermia in women in labor. Unfortunately, this phenomenon is very underestimated by experts. Hypothermia is in itself a dangerous phenomenon that can become a lethal threat even to a physically healthy person, not to mention a pregnant woman and fetus. Scientists have shown that body temperature is reduced by 0.5 ^{0}C for each additional hour of surgery, and only few maternity hospitals in Ukraine are currently equipped with heated tables or electric blankets. On the basis of the undertaken study, all the women in labor avoided hypothermia, and a slightly lower temperature was observed in the patients from the comparative group, but the difference was insignificant ($p> 0.05$). In our opinion, this is an urgent problem that requires more in-depth research. The proposed method of the cesarean section also improves the mental well-being of a woman during surgery, optimizes the work of not only a surgical department but also an obstetric one in general.

CONCLUSIONS

The improved surgical technology of abdominal delivery contributes to the reduction in the volume of intraoperative blood loss by 200 ml ($p < 0,001$), which virtually eliminates the risk of massive obstetric hemorrhage and thus creates an additional reserve for improving the safety of operative delivery in general. The received results indicate the feasibility of the implementation and application of the modified method of cesarean section and thus create prospects for further research of the peculiarities of the intra-and postoperative period.

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