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White blood cell count rating and neutrophil percentage during labor and in early postpartum period

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Abstract

Objectives: To characterize postpartum WBC count and neutrophil percentage in relation to mode of delivery in various clinical situations.

Material and methods: 317 participants near term of labor were included to the study and then divided into four groups:

1. Group PROM (n=97) - women with labor onset after membranes rupture and spontaneous vaginal delivery (PROM – premature rupture of membranes)
2. Group non-PROM (n=133) - women with labor onset at intact membranes and spontaneous vaginal delivery
3. Group ELCS (n=58) - women who delivered by cesarean section for elective indications (ELCS – elective cesarean section)
4. Group EMCS (n=29) - women who delivered by cesarean section for emergency indications.

Venous blood sampling for WBC count and neutrophils percentage calculation was done in the course of labor or strictly before elective caesarean section and, subsequently, on the second day of puerperium.

Results: A statistically significant difference in the WBC count during labor in women with PROM relative to non-PROM and EMCS groups was found. In non-PROM group WBC count was higher than in ELCS patients. In EMCS patients leukocyte count was higher than in ELCS group. The percentage of neutrophils during labor in EMCS group was higher than in the PROM and ELCS groups.

On the second postpartum day WBC count of PROM, ELCS and EMCS patients was significantly higher than in the non-PROM group. Higher leukocyte count at the second day of puerperium was also found in the group of EMCS, relative to ELCS. The percentage of neutrophils in the blood at the second day after delivery in ELCS and EMCS groups was higher than in the patients with intact, as well as with ruptured membranes. WBC count on the second day post-delivery was higher than its values in labor in ELCS, EMCS and PROM groups. The percentage of neutrophils in labor in PROM and non-PROM groups significantly exceeded its values on the second postpartum day.

Conclusions:

1. WBC count values in early puerperium in women after cesarean section are higher than in women whose labor was started at intact fetal membranes and was finished in natural way.
2. WBC count values in early puerperium are higher after emergency cesarean section than after elective cesarean delivery.

3. The percentage of neutrophils in the early puerperium in patients after cesarean section is higher than in those after natural delivery.
4. A significant increase in the value of WBC count on the second day after delivery, in relation to its intrapartum values, occurs in women whose fetal membranes rupture occurs before the beginning of labor, as well as in women after cesarean section.
5. After natural delivery, regardless of the state of the fetal membranes, there is an increase in the percentage of neutrophils which is not observed after cesarean section.
6. Assessment of WBC count, as well as neutrophil percentage in the early puerperium are not useful as a sole markers for the presence of infectious morbidity and for making decisions about the implementation of antibiotic therapy.

Key words: cesarean section, early puerperium, labor, neutrophil percentage, white blood cell count,

Introduction

Pregnancy is associated with a gradual increase in the white blood cell (WBC) count [1]. At the end of pregnancy it rises up even to 15G/L [2], and during labor the maximal leukocytosis may exceed this value [3,4]. At the immediate postpartum period WBC count may peak to levels of up to three times of the average normal WBC count [5]. The etiology and mechanism of this phenomenon remains largely unknown, although it is recognized also with other non-obstetrical, but stress-related conditions, like these in acute phase reaction [5,6]. During pregnancy and in labor an increased leukocytosis may also be associated with infectious morbidity, such as intraamniotic infection [7,8]. Neutrophils are the major type of leucocytes. In pregnancy, also neutrophil phenotype is altered and cells are activated, which results in the marked neutrophilia [9]. In the third trimester of pregnancy neutrophil percentage rises up to 70% [10]. Although, normal reference ranges of WBC count and neutrophils percentage throughout pregnancy are widely available, there is few data as to their postpartum values, as well as to the effect of various interventions during labor onto these values.

In this study we aimed to characterize postpartum WBC count and neutrophil percentage in relation to mode of delivery in various clinical situations.

Material and methods

The study participants were 317 women near term of labor who gave birth in Department of Obstetrics and Gynaecology of Pomeranian Medical University from November 2014 to November 2016. The consent of the bioethics commission for the research was obtained and the project was approved by a resolution KB-0012/111/14. The participants were divided into four groups:

1. Group PROM (n=97) - women with labor onset after membranes rupture and spontaneous vaginal delivery (PROM – premature rupture of membranes)
2. Group non-PROM (n=133) - women with labor onset at intact membranes and spontaneous vaginal delivery
3. Group ELCS (n=58) - women who delivered by caesarean section for elective indications (ELCS – elective cesarean section)
4. Group EMCS (n=29) - women who delivered by caesarean section for emergency indications.

Venous blood sampling for WBC count and neutrophils percentage calculation was done in the course of labor or strictly before elective caesarean section (WBC 1, Neutrophil percentage 1) and, subsequently, on the second day of puerperium (WBC 2, Neutrophil percentage 2). White blood cell count and neutrophils percentage were calculated using optical laser and impedance measurement with Abbot 's Cell-Dyn 3500 and Cell-Dyn 3700.

Statistical differences analysis between groups was made with U Mann-Whitney test. The result was considered significant at $p < 0,05$. Results at $p < 0,01$ were considered very significant and those at $p < 0,001$ – highly significant. Statistical analysis was made with dedicated program STATA 11.

Results

It has been found a statistically significant difference in the WBC count during labor in women with PROM relative to non-PROM and EMCS groups ($p < 0,01$), but relative to the ELCS group these values were comparable. WBC in the blood during labor in a non-PROM group was significantly higher than in the ELCS

patients ($p < 0.05$), while in groups of non-PROM and the EMCS were comparable. Statistically significant difference was noted between the groups ELCS and EMCS ($p < 0.05$). In the group of EMCS leukocyte count was higher (Table 1).

Table 1. Comparison of WBC count during labor between the studied groups.

Group	n	WBC 1 (G / L)				
		Min.	Max.	Q1	Median	Q3
PROM	97	0.70	23.40	7.75	10.43	12.40
non-PROM	133	3.10	21.22	9.44	11.19	12.82
ELCS	58	6.32	19.38	8.90	10.09	11.88
EMCS	29	5.50	43.30	9.90	11.88	14.22

PROM vs. non-PROM: $p < 0.01$ PROM vs. ELCS: NS PROM vs. EMCS: $p < 0.01$
 non-PROM vs. ELCS: $p < 0.05$ non-PROM vs. EMCS: NS ELCS vs. EMCS: $p < 0.05$

The percentage of neutrophils during labor in EMCS group was significantly higher than in the PROM and ELCS groups ($p < 0.05$). Other comparisons between the studied groups showed no difference (Table 2).

Table 2. Comparison of the percentage of neutrophils in the blood during labor between the studied groups.

Group	n	Neutrophil percentage 1 (%)				
		Min.	Max.	Q1	Median	Q3
PROM	97	54.20	83.80	68.10	72.15	77.10
non-PROM	133	55.80	90.70	70.60	73.55	78.20
ELCS	58	56.70	86.70	69.40	72.80	76.40
EMCS	29	61.60	86.70	72.40	76.35	78.60

PROM vs. non-PROM: NS PROM vs. ELCS: NS PROM vs. EMCS: $p < 0.05$
 PROM vs. non-ELCS: NS non-PROM vs. EMCS: NS ELCS vs. EMCS: $p < 0.05$

In terms of the WBC count in the second day of puerperium it was found a highly significant difference between the groups of non-PROM and the PROM ($p < 0.001$). In

the latter WBC count was higher, while in relation to the EMCS and ELCS groups was comparable. WBC in the blood at the second day post-partum in ELCS group was significantly higher than in the non-PROM ($p < 0.05$). A highly statistically significant difference was also observed between the groups of non-PROM and EMCS ($p < 0.001$). In the group of EMCS it was significantly higher. Very significantly higher leukocyte count in the blood at the second day of puerperium was also found in the group of EMCS, relative to ELCS ($p < 0.01$) (Table 3).

Table 3. Comparison of WBC count in the blood at the second day after delivery between the studied groups.

Group	n	WBC 2 (g / L)				
		Min.	Max.	Q1	Median	Q3
PROM	97	4.90	73.20	10.03	11.88	16.59
non-PROM	133	6.25	20.69	9.20	10.70	12.19
ELCS	58	7.21	23,58	10.16	11.15	13.00
EMCS	29	5.91	25.77	11.10	13.58	16:19

PROM vs. non-PROM: $p < 0.001$ PROM vs. ELCS: NS PROM vs. EMCS: NS
 non-PROM vs. ELCS: $p < 0.05$ non-PROM vs. EMCS: $p < 0.001$ ELCS vs. EMCS: $p < 0.01$

A highly statistically significant difference in the percentage of neutrophils in the blood at the second day after delivery was found between the PROM group and the groups ELCS and EMCS ($p < 0.001$) in which it was higher. The same relationship was observed between the non-PROM group and ELCS and EMCS groups ($p < 0.001$). While between the EMCS and ELCS group and non-PROM and the PROM group there was no difference in the percentage of neutrophils in the second day of puerperium (tab.4).

Table 4. Comparison of the percentage of neutrophils in the blood at the second day of puerperium between the studied groups.

Group	n	Neutrophil percentage 2 (%)				
		Min.	Max.	Q1	Median	Q3
PROM	97	53.60	85.10	63.60	67.95	72.10
non-PROM	133	53.90	81.90	62.90	67.80	71.20
ELCS	58	55.60	89.40	70.50	74.90	78.60
EMCS	29	62.00	86.50	73.60	75.70	81.00

PROM vs. non-PROM: NS PROM vs. ELCS: $p < 0.001$ PROM vs. EMCS: $p < 0.001$
 non-PROM vs. ELCS: $p < 0.001$ non-PROM vs. EMCS: $p < 0.001$ ELCS vs. EMC: NS

WBC count in peripheral blood in the second day post delivery was highly significantly higher than its values in labor in ELCS and PROM groups ($p < 0.001$). A statistically significant difference was also found in the group of EMCS ($p < 0.01$) in which the number of leukocytes in peripheral blood on the second day of puerperium significantly exceeded WBC count during labor. In contrast, the value of WBC count in the non-PROM group both in the cycle of birth and in the second day postpartum were comparable (table 5).

Table 5. Comparison of WBC count in the blood in labor and on the second postpartum day in the studied groups.

Group	n	WBC 2 (g / L)		WBC 1 (G / L)		WBC 2 - WBC 1 (G / L)		p
		mean	SD	mean	SD	mean	SD	
PROM	97	16.64	12.50	9.61	4.30	7.04	14.89	< 0.001
non-PROM	133	10.98	2.51	11.33	2.76	-0.35	2.89	NS
ELCS	58	11.94	2.98	10.68	2.92	1.26	2.80	< 0.001
EMCS	29	14.16	4.24	13.15	6.63	1.00	6.39	< 0.01

The percentage of neutrophils in labor in PROM and non-PROM groups highly significantly exceeded its values on the second postpartum day ($p < 0.001$). No

difference was found between the percentage of neutrophils in labor in relation to the postnatal values in groups ELCS and EMCS (table 6).

Table 6. Comparison of the percentage of neutrophils in the blood in labor and on the second postpartum day in the studied groups.

Group	n	Neutrophil percentage 2 (%)		Neutrophil percentage 1 (%)		Neutrophil percentage 2 - 1 (%)		p
		mean	SD	mean	SD	mean	SD	
PROM	97	68.12	6.18	72.12	6.63	-4.00	7.14	<0.001
non-PROM	133	67.54	6.22	73.77	5.97	-6.23	7.29	<0.001
ELCS	58	73.89	6.56	72.30	5.71	1.59	7.45	NS
EMCS	29	76.64	5.54	75.75	5.46	0.90	6.29	NS

Discussion

In PROM, EMCS and ELCS groups WBC count on the second day after delivery was significantly higher compared to the values during labor. Such difference was not observed in the non-PROM group. The percentage of neutrophils in non-PROM and PROM groups on the second postpartum day was lower than in labor while in ELCS and EMCS difference in this regard was not observed.

According to Acker et al. [11], leukocytosis increases gradually during pregnancy reaching during delivery by an average 14-16 G/L, and returns to the normal value on the sixth day of uncomplicated puerperium. Belo et al. [12] evaluated the change in WBC count in the group of 24 women in the course of uncomplicated pregnancy, assessing its value in each trimester. They found a gradual increase in the number of leukocytes and the percentage of neutrophils in the maternal blood, explaining this by escalation of the inflammatory response in the course of the duration of pregnancy.

Dior et al. [13] assessed the value of leukocyte and neutrophil counts in a very large group of more than 67,000 women in the early postpartum period taking into account the mode of delivery. They observed that these values were comparable with the data described by Lurie [2] at the end of the third trimester of pregnancy. However Arbib et al. [5] found a significant increase in the number of WBC count after birth, both in the entire study population of more than 20,000 women and after its division, taking into account mode of delivery, although the average value of leukocytosis in the early postpartum period did not exceed 14 G/L. They think that leukocytosis occurs as

physiological response during labor and immediately following delivery and that its rise in the absence of any clinical suspicion, is not associated with adverse maternal outcome which occurred during labor, delivery and the postpartum period. Similar results were obtained by Hartmann et al. [14], who assessed the value of maternal blood leukocytes after cesarean section in the early postpartum period. According to them, information about the difference of WBC count directly before birth and in very early postpartum period may be used only to evaluate the potential risk of developing infections.

Considering the above data it may be concluded that both, the assessment of the value of leukocytosis and the percentage of neutrophils in the second day of puerperium, are not useful to draw clinical conclusions that may affect the therapeutic treatment, although they are made on the occasion of the diagnosis of postpartum anemia because they fall within the scope of blood morphology assessment.

In our study, intrapartum values of leukocytosis in patients with PROM were very significantly higher than in patients with intact membranes who delivered vaginally, as well than in the patients of EMCS group. WBC count during labor of non-PROM group patients was significantly higher than in the ELCS group. The percentage of neutrophils during labor of women of EMCS group was significantly higher than in ELCS and PROM groups.

The study also showed that the value of WBC count on the second day after vaginal delivery were significantly higher in the case of rupture of the membranes (PROM vs. non-PROM) and that in women after a cesarean section, both emergency and elective, it was higher than in the group of women after vaginal delivery, whose membranes were intact before beginning of labor (EMCS and ELCS vs. non-PROM). Significant difference in this area was also observed between the groups that were delivered with cesarean section (EMCS vs. ELCS), as it was confirmed by observation of Harman et al [14]. The percentage of neutrophils in own material was higher in each group of women after cesarean section than after vaginal delivery. This observation is convergent with this of Dior et al [13] who noted that the percentage of neutrophils was slightly higher in the postoperative period, although they did not provide information about statistical differences.

Conclusions

1. WBC count values in early puerperium in women after cesarean section are higher than in women whose labor was started at intact fetal membranes and was finished in natural way.
2. WBC count values in early puerperium are higher after emergency cesarean section than after elective cesarean delivery.
3. The percentage of neutrophils in the early puerperium in patients after cesarean section is higher than in those after natural delivery.
4. A significant increase in the value of WBC count on the second day after delivery, in relation to its intrapartum values, occurs in women whose fetal membranes rupture occurs before the beginning of labor, as well as in women after cesarean section.
5. After natural delivery, regardless of the state of the fetal membranes, there is an increase in the percentage of neutrophils which is not observed after cesarean section.
6. Assessment of WBC count, as well as neutrophil percentage in the early puerperium are not useful as a sole markers for the presence of infectious morbidity and for making decisions about the implementation of antibiotic therapy.

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