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Assesment of Platelet Indices in Post-Cesarean Section Surgical Site Infections

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Abstract

Background: We aimed to investigate the association of platelet count (PLT) and MPV/PLT ratio with the development of surgical site infections (SSI) in patients who have undergone elective cesarean section (CS).

Materials and Methods: We retrospectively evaluated patients who underwent elective cesarean section and 44 patients (mean age 28.7±7.3 years) who encountered surgical site infection (infection group) and 42 patients (mean age 27.8±6.1 years) without surgical site infection after cesarean section (normal group) were enrolled in the study.

Results: Platelet count (291.7±46.8 103/µL vs. 235.4 ± 64.7 103/µL; p< 0.001) was decreased and MPV/PLT ratio (0.035±0.006 vs 0.047±0.02; p= 0.01) was statistically increased in infection group.

Conclusions: Patients undergoing elective cesarean section and experiencing surgical site infections have higher MPV/PLT ratio than patients without SSI. These measurements may provide clues for the development of SSI and allow clinicians to recognize and monitor patients under substantial risk for development of SSI and offers an opportunity to evolve systematic approaches to eliminate or reduce risk factors.

Key words: *Platelet count, Mean platelet volume, Platelet ratio, cesarean section, surgical site infection*

Introduction

Cesarean section (CS), which is a major obstetrical surgical procedure, is continuing to be performed with an increased rate worldwide. Parallel to the increase in numbers of CS, the incidence of the complications related to CS is also expected to increase. Surgical site infections (SSI) following CS constitute an origin for further complications which are associated with increased mortality, increased hospital stay, repeated surgery and excessive medical costs (1). Thus, to predict, recognize and treat SSI within the appropriate time is imperative to avoid complications associated with SSI.

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Platelets (PLT) are enucleated cells which are traditionally assumed to be solely involved in primary hemostasis and coagulation as a response to various kinds of physiologic triggers. However, accumulating evidence implicates their additional functions in other physiopathological processes including inflammation, tissue regeneration and wound healing (2,3). Their ability in releasing cytokines, guiding and activating neutrophils and corroborating leukocyte response in addition to their interaction with bacteria and endothelium demonstrate how platelets promote inflammation in localized infections (4). Nevertheless, little is known regarding the role of platelets in SSI. In this study, we aimed to investigate the association of MPV/PLT ratio with the development of SSIs in patients who have undergone CS and been subject to SSI despite prophylactic antimicrobial agents.

Material and methods

Subject selection

This study was approved by the Institutional Ethical Committee of Kanuni Education and Training Hospital, Istanbul-Turkey, and the study was performed in accordance with the most recent version of Helsinki Declaration. We retrospectively evaluated patients who underwent elective cesarean section for term pregnancy and 42 patients who encountered surgical site infection (infection group) and 44 patients without surgical site infection after cesarean section (normal group) were enrolled in the study. Gestational diabetes, preeclampsia, premature rupture of the membranes, chorioamnionitis, obesity, fetal prematurity, postpartum hemorrhage, and smoking were the exclusion criteria. All patients received preoperative and postoperative antibiotic prophylaxis, SWI was diagnosed according to clinical and laboratory results. SSI, which refers to the infection observed at cutaneous or subcutaneous tissue beneath the incision, was diagnosed if at least one of the indicated signs or symptoms of infection was documented (pain or tenderness, localized swelling, redness, heat or dehiscence). Patients were given medical therapy including proper antibiotics, anti-inflammatory agents. We compared demographic data, preoperative platelet, hemoglobin, mean corpuscular volume, mean platelet volume and mean platelet volume/platelet ratio between groups.

Laboratory measurements

Blood samples were drawn the day before the operation from a forearm vein, collected into tubes containing ethylene diamine tetra acetic acid (EDTA) and stored at room temperature until measurement, which was performed in all cases within 1 h after venipuncture. Blood measurements were analyzed by automated hematology analysis system (CELL-DYN Sapphire) that provided platelet count (103/μL) and MPV in femtoliter (fL) mean corpuscular volume (fL), red blood cell count (106/μL).

Statistical analyses

Statistical analysis was performed using SPSS for Windows, version 17 (SPSS, Chicago, IL, USA). All date were distributed normally. Comparisons among groups with respect to demographic data, hemoglobin, mean corpuscular volume (MCV), red blood cell (RBC) count, platelet count, mean platelet volume and mean platelet volume/platelet count were evaluated using student t-test and Mann Whitney-U test. Two-sided $p \leq 0.05$ was interpreted as statistically significant.

Results

Demographic variables including age, body mass index (BMI), gravidity, parity were not significantly different between groups (p>0.05). The demographic characteristics of cases are demonstrated in Table 1.

Table 2 summarizes the laboratory findings of the patients. Hemoglobin (HGB), MPV, mean corpuscular volume (MCV), were not significantly different between groups. PLT was statistically decreased (291.7±46.8 103/µL vs. 235.4 ± 64.7 103/µL; p< 0.001) and MPV/PLT ratio (0.035±0.006 vs 0.047±0.02; p= 0.01) was statistically increased in infection group.

Table 1. Demographic characteristics of the patients.

	Normal group (n:44)	Infection group (n:42)	P value
Age mean (years)	28.7±7.3	27.8±6.1	NS
Body mass index (kg/m2)	29.8±2.7	29.9 ± 2.6	NS
Gravidity	3.2±1.5	3.0±1.6	NS
Parity	1.8 ±1.2	1.9±1.2	NS

NS= Not significant, kg=kilogram, m=meter, fL=femtoliter

Table 2. Laboratory findings of the patients.

	Normal group (n:44)	Infection group (n:42)	P value
HGB	11.3±1.5	12.3±4.6	NS
MCV (fL)	82.2±5	83.6±6.3	NS
PLT (10^3/µL)	291.7±46.8	235.4±64.7	**<0.001**
MPV (fL)	10.2 ± 1.3	10.2±1.6	NS
MPV/PLT	0.035±0.006	0.047±0.02	**0.01**

fL=femtoliter, HGB: hemoglobin MCV:mean corpuscular volume, PLT=platelet, MPV=mean platelet volume, NS= Not significant

Discussion

Results of this study reveal that patients undergoing CS and experiencing SSI have decreased PLT and higher MPV/PLT ratios compared to those with optimal wound healing following the procedure. This study, for the first time, demonstrates the relation of MPV/PLT with the development of SSI in patients undergoing CS.

Global CS rates are increased gradually over the past three decades and these procedures are currently one of the most performed major surgical procedures in developed countries (5,6). The two major driving forces behind this increase are maternal wish without medical indication and fear of litigation among healthcare professionals (7). As a consequence, complications associated with this frequent procedure are exponentially increasing. Surgical site infections including wound infections are of the most common complications following CS with an incidence of 3%–15% varying in different series according to the population studied and use of prophylactic antimicrobial agents (8). Factors known to be related with SSI in CS are preterm rupture of membranes, the excess number of vaginal examinations, use of internal fetal monitoring, and presence of chorioamnionitis (9). Additionally, some patient-related factors including maternal obesity, preexisting diabetes and hypertension, previous cesarean section and poor socio-economic condition may give rise to the development of SSI (10-12). Procedure based causes of SSI are longer duration of CS procedure, CS in the emergency setting, excessive blood loss, suboptimal use of prophylactic antimicrobial agents, non-adherence to antisepsis measures and poor surgical technique (13).

Despite administration of prophylactic antibiotics and strict adherence to antisepsis measures, postoperative infections may still develop and a minority of wounds might be obliged to be left secondary intention which may give rise to further complications and morbidities. Evidence-based measures that are beneficial to decrease the development of SSI include early administration of antibiotics prior to skin incisions (within 60 minutes), routine use of intravenous azithromycin, preferential use of chlorhexidine-alcohol solutions for skin antisepsis which is superior to povidone-iodine based solutions, preoperative chlorhexidine vaginal cleansing, suture closure of subcutaneous layers during cesarean delivery, suture skin closure instead of staple closure and dressing removal between 24 and 48 h (14-15). In the case of SSI despite the mentioned measures, incision and drainage should be performed. Non-responding wounds should be left open to heal by secondary intention (16).

Platelets normally function as “First Responders” during the wounding process and wound healing. Following the laceration of a blood vessel, platelets actively transmigrate across the leaky or inflamed vessel wall to aid in wound sterilization and tissue regeneration (17). The interaction between the subendothelial bodies and platelets initiate platelet activation and aggregation. Following activation, platelets change their shapes, release proteins, cytokines, growth factors and adhesion molecules directly activating responses for monocytes, neutrophils, T-lymphocytes and complement system (18-19). Platelets also secrete several tumor necrosis factor-α related regulators (CD95, Apo2-L, Apo3-L) that can modulate inflammatory response and apoptosis. The balance between apoptotic and anti-apoptotic activity provides elimination of cells from the wound site, which is critical for wound healing.

MPV/PLT, a derivate of MPV and platelet count is also reported to be increased in several diseases characterized with inflammation (20-27). Accumulated data clearly indicates the role of high MPV/PLT ratio in reflecting the intensity of inflammation, suggesting the higher the MPV/PLT more intense the inflammation. Although, the literature contains extensive data regarding the role of PLT and MPV/PLT ratio in chronic inflammatory diseases, the role of PLT and MPV/PLT in SSI and wound healing has not been elicited yet.

In the present study, we found that preoperative low PLT and high MPV/PLT ratio are associated with SSI and poor tissue healing in patients undergoing CS. Given its role as a surrogate marker in a variety of chronic inflammatory conditions, preoperative low PLT and MPV/PLT ratio present in individuals with SSI may indicate a preexisting undiagnosed chronic inflammatory disease which complicates tissue healing and gives rise to the development of SSI. In addition, the close relation between high MPV/PLT ratio and unfavorable preoperative risk factors including metabolic syndrome, obesity, smoking, hypertension, dyslipidemia, and diabetes may help to understand why SSI and poor tissue healing are more common in patients with a high MPV/PLT ratio. Moreover, given the primary responsive role of platelets in tissue injury, low platelet counts present in many of our study population clarifies the higher incidence of SSI and poor tissue healing existing in these patients. The negative correlation between MPV and platelet counts also suggests the consumption of small platelets and production of larger platelets due to an accelerated turnover occurring in bone marrow which is an indirect indicator of ongoing inflammation. When all findings are taken into consideration, we speculate that high MPV/PLT ratio are associated with postoperative SSI and poor wound healing in patients undergoing cesarean section. Future prospective studies with larger patient populations might be able to clearly elucidate the predictive value of these markers in development of SSI.

Limitations

Our study has some limitations to be mentioned. First, this is a single center, retrospective, cross-sectional study and do not have a follow-up period. Also, statistical analyses are based on a single MPV and platelet count. However, this preliminary study with its impressive results pave the way for future trials addressing the precise role of MPV and platelet count in surgical site infections and wound healing.

Conclusion

Low PLT and MPV/PLT ratio are associated with surgical site infections and related poor wound healing in patients undergoing cesarean section. These measurements may provide clues for SSI development and allow clinicians to recognize and monitor patients under substantial risk for SSI and offers an opportunity to develop systematic approaches to eliminate or reduce risk factors.

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