

## Prevalence and Clinical Significance of Postpartum Endometritis and Wound Infection

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### ABSTRACT

**Objective:** To correlate clinical variables (gestational age, severe pregnancy-induced hypertension, gestational diabetes mellitus, history of previous cesarean sections, fetal distress, perinatal mortality, postpartum anemia, Apgar score  $\leq 3$  at 1 minute and  $\leq 7$  at 5 minutes, and instrumental delivery) with postpartum endometritis (PPE) and wound infection.

**Methods:** Descriptive cross-sectional study of the outcome of 75,947 term and preterm singleton deliveries; vaginally and by cesarean section from 1989–1997.

**Results:** The prevalence of PPE after vaginal deliveries was 0.17% (120/68,273). Gestational age of less than 37 weeks, severe pregnancy-induced hypertension, fetal distress, instrumental deliveries, neonatal mortality, postpartum anemia, and Apgar scores of  $< 7$  after 5 minutes were significantly associated with PPE. Gestational diabetes and an Apgar score of  $< 3$  after 1 minute showed similar frequency with and without PPE. The prevalence of PPE after cesarean section was 2.63% (202/7,677). Preterm cesarean sections, history of previous cesarean sections, anemia, and low Apgar scores were seen more frequently with PPE than without. The incidence of cesarean delivery with gestational diabetes mellitus, fetal distress, and perinatal mortality was similar in presence and absence of PPE. The rate of wound infection after cesarean section was 3.97% (318/7,995). Gestational diabetes mellitus, history of previous cesarean deliveries, and low Apgar scores were significantly more frequent with than without wound infection. Gestational age, severe pregnancy-induced hypertension, fetal distress, perinatal mortality, and postpartum anemia were not associated with wound infection.

**Conclusions:** Awareness of the aforementioned associations may prevent and shorten hospital stay by early diagnosis and appropriate treatment. *Infect. Dis. Obstet. Gynecol.* 8:77–82; 2000.

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### KEY WORDS

anemia; fetal distress; perinatal mortality; postpartum morbidity

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Endometritis constitutes the most common febrile complication after delivery,<sup>1</sup> being more frequent and severe after cesarean section, where its incidence ranges between 5% and 85%.<sup>2</sup> The incidence increases when cesarean section is performed after labor is established or after mem-

branes have ruptured. Other conditions that have been shown to increase the incidence of PPE are the presence of bacterial vaginosis,<sup>3</sup> multiple vaginal examinations, the use of internal fetal monitoring, and low neonatal birthweight.<sup>1</sup> PPE has been defined as the presence of puerperal fever (38°C or

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higher) in association with one or more of the following: uterine tenderness, foul smelling lochia, and leukocytosis of >12,000 after exclusion of another site of infection, which develop within the first 5 days after delivery.<sup>4</sup> Considering that PPE is mainly the result of ascending infection and as such is polymicrobial, various prophylactic antibiotic treatments have been suggested and instituted in almost every maternity center. In spite of the prophylactic use of antibiotics, antibiotic failure rates are high after endometritis that develops after cesarean section.<sup>5</sup> However, broad-spectrum antibiotics have diminished the incidence of serious PPE complications such as pelvic deep vein thrombophlebitis. The main interest of investigations has been focused on PPE associated with cesarean sections. PPE following spontaneous vaginal deliveries has rarely been investigated.

Abdominal wound infection following cesarean section is a common complication as well. Its incidence ranges between 3% and 15% in the different studies. A recent study showed a 6.9% incidence of wound infection in spite of the use of prophylactic intravenous antibiotic treatment at cesarean section.<sup>6</sup>

The purpose of this study was to analyze whether and to what extent other clinical variables might be correlated to PPE and wound infection.

## SUBJECTS AND METHODS

The study population consisted of the outcome of 75,947 deliveries that occurred between 1 January 1989 and 31 December 1997 at the Soroka University Medical Center. Deliveries included were term as well as preterm singleton deliveries (between 24 and 36 gestational weeks). Patients with lack of prenatal care defined as less than three visits at our prenatal care facilities and multiple gestation were excluded from the study population. Mothers whose postpartum fever was clearly associated with other known causes such as urinary tract infection, mastitis, upper respiratory tract infection, or deep vein thrombosis were also excluded. Preventive antibiotic therapy at our medical center routinely includes three 1 g doses of Cephazolin that are administered intravenously: one dose before cesarean section, and two doses after, at 8-hour intervals.

In this cross-sectional study, two groups of patients were identified: patients who delivered vagi-

nally and those who delivered by cesarean section. The group of women who delivered vaginally was subdivided into two groups: those who developed PPE and those who did not develop PPE. The group of women delivered by cesarean section was divided into three groups: women with PPE, women who developed wound infection, and women presenting neither PPE nor wound infection. A very small group of 14 women presenting wound infection and endometritis simultaneously was excluded from both the post-cesarean endometritis and post-cesarean wound infection groups. We defined wound infection as the presence of fever, induration and tenderness (cellulitis) that eventually developed into a serous, hematic or purulent collection that drained spontaneously or required artificial drainage by the partial or complete opening of the abdominal wound.

The following variables were correlated with the presence or absence of PPE and wound infection: gestational age, severe pregnancy-induced hypertension (Davey and MacGillivray's definition),<sup>7</sup> gestational diabetes mellitus,<sup>8</sup> previous cesarean sections, fetal distress, perinatal mortality (antepartum, intrapartum, and postpartum death), postpartum anemia (hemoglobin level of less than 10 g/dl), an Apgar score of  $\leq 3$  at 1 minute and  $\leq 7$  at 5 minutes, and instrumental delivery by forceps or vacuum extraction.

## Statistical Analysis

Statistical analysis was performed with the SPSS package. Student *t*-test was used for comparison of continuous variables, whereas comparison of proportions was performed with chi-square test or Fisher's exact test as required.  $P < 0.05$  was considered statistically significant. Perinatal mortality was analyzed by stratification of gestational age at delivery: 24–27, 28–31, 32–36 and >37 gestational weeks.

All variables included in the univariate analysis were used for the multivariate analysis, which was based on stepwise, forward selection, the criteria for inclusion was a significant ( $P < 0.05$ ) contribution to the model.

## RESULTS

During the study period, 75,947 women delivered at the Soroka University Medical Center. The prevalence of PPE after vaginal deliveries was

TABLE 1. Selected clinical characteristics in women with and without postpartum endometritis (PPE) after vaginal deliveries (N = 68,273)

Clinical variables	PPE (N = 120)	Without PPE (N = 68,153)	P	Odds Ratio (Adjusted) <sup>1</sup>
Gestational age <37 weeks	17 (14.2)	3918 (5.7)	0.00008	2.0074
Severe PIH <sup>2</sup>	4 (3.3)	384 (0.6)	0.00006	3.3070
Gestational diabetes mellitus	3 (2.5)	3465 (5.1)	N.S.	
Fetal distress	10 (8.3)	1102 (1.6)	<0.00001	4.1673
Instrumental deliveries	8 (6.6)	1953 (2.8)	0.037	
Total perinatal mortality	5 (4.2)	512 (0.8)	0.00002	3.2856
APD <sup>3</sup>	3 (2.5)	340 (0.5)	0.002	
IPD <sup>4</sup>	1 (0.8)	21 (0.03)	<0.00001	
PPD <sup>5</sup>	1 (0.8)	151 (0.2)	N.S.	
Postpartum anemia	45 (37.5)	8387 (12.3)	<0.00001	3.8394
Apgar score 1 min <3	1 (0.8)	285 (0.4)	N.S.	
Apgar score 5 min <7	2 (1.7)	261 (0.4)	0.002	

<sup>1</sup>Adjusted Odds Ratio from the final model of the stepwise logistic regression.

<sup>2</sup>PIH, pregnancy-induced hypertension.

<sup>3</sup>APD, antepartum death.

<sup>4</sup>IPD, intrapartum death.

<sup>5</sup>PPD, postpartum death.

0.17% (120/68,273). Table 1 displays the comparison of clinical variables by the presence (120 cases) or absence (68,153 cases) of PPE after vaginal deliveries. PPE after vaginal deliveries was associated significantly with gestational age of less than 37 weeks, with severe pregnancy-induced hypertension, fetal distress, and instrumental deliveries. The incidence of perinatal mortality in the PPE group was significantly higher than in the group without PPE, especially intrapartum death. The difference in antepartum death was less distinctive and it was not significant in cases of neonatal postpartum death. After adjustment for gestational age at delivery, perinatal mortality remains strongly associated with PPE after vaginal delivery. Twenty percent of the cases of perinatal mortality at 32–36 weeks of gestational age were associated with PPE while 3.5% of the cases were not ( $P = 0.014$ ) and at term gestation 1.9% versus 0.3%, ( $P = 0.03$ ). PPE was also significantly associated with postpartum anemia with Apgar scores less than 7 after 5 minutes. In contrast, gestational diabetes and Apgar score less than 3 after 1 minute was observed with similar frequency in the presence of PPE.

The prevalence of PPE after cesarean section was 2.63% (202/7,677). Table 2 shows the association of clinical variables with the presence or absence of PPE after cesarean deliveries (202 cases vs. 7,475 cases, respectively). PPE was associated with preterm cesarean delivery and history of previous cesarean sections. Anemia and Apgar scores

less than 3 and 7 at 1 and 5 minutes, respectively, were also found more frequently in cases with PPE than in those without. On the other hand, in the group of PPE after cesarean delivery, the presence of gestational diabetes mellitus, fetal distress, and perinatal mortality was similar to that in cases after cesarean section without PPE.

The rate of wound infection after cesarean section was 3.97% (318/7,995). The results of correlation of the clinical variables with the presence or absence of wound infection are shown in Table 3. Gestational diabetes mellitus was more frequently observed in presence of wound infection, as was a history of previous cesarean deliveries. In the wound infection group, Apgar scores at 1 and 5 minutes were less than 3 and 7, respectively. However, perinatal mortality was not significantly more frequent in the wound infection group, but statistical significance was borderline regarding postpartum death. Wound infection was not associated with gestational age, severe pregnancy-induced hypertension (PIH), presence of fetal distress, and postpartum anemia.

## DISCUSSION

The most common obstetric infection is postpartum endometritis. Most of the authors dealing with PPE, address post-cesarean endometritis, ignoring about one-fifth of the cases that develop after vaginal deliveries. The aim of our study was to analyze different clinical maternal and neonatal variables

TABLE 2. Selected clinical characteristics in women with and without postpartum endometritis (PPE) after cesarean deliveries (N = 7,677)

Clinical variables	PPE (N = 202)	Without PPE (N = 7,475)	P	Odds Ratio (Adjusted) <sup>1</sup>
Gestational age <37 weeks	47 (23.3)	1254 (16.8)	0.015	1.4471
Severe PIH <sup>2</sup>	12 (5.9)	350 (4.7)	N.S.	
Gestational diabetes mellitus	19 (9.4)	757 (10.1)	N.S.	
Previous cesarean sections	61 (30.2)	2860 (38.3)	0.012	0.7241
Fetal distress	48 (23.8)	1557 (20.8)	N.S.	
Total perinatal mortality	3 (1.5)	78 (1.0)	N.S.	
APD <sup>3</sup>	0 (0.0)	21 (0.3)	N.S.	
IPD <sup>4</sup>	1 (0.5)	9 (0.1)	N.S.	
PPD <sup>5</sup>	2 (1.0)	48 (0.6)	N.S.	
Postpartum anemia	101 (50.0)	2706 (36.2)	0.00006	1.7699
Apgar score 1 min <3	20 (9.9)	394 (5.3)	0.004	1.7741
Apgar score 5 min <7	16 (7.9)	293 (3.9)	0.004	

<sup>1</sup>Adjusted Odds Ratio from the final model of the stepwise logistic regression.

<sup>2</sup>PIH, pregnancy-induced hypertension.

<sup>3</sup>APD, antepartum death.

<sup>4</sup>IPD, intrapartum death.

<sup>5</sup>PPD, postpartum death.

TABLE 3. Selected clinical characteristics in women with and without wound infection after cesarean sections (N = 7,793)

Clinical variables	Wound infection (N = 318)	Without wound infection (N = 7,475)	P	Odds Ratio (Adjusted) <sup>1</sup>
Gestational age <37 weeks	61 (19.2)	1254 (16.8)	N.S.	
Severe PIH <sup>2</sup>	22 (6.9)	350 (4.7)	N.S.	
Gestational diabetes mellitus	46 (14.5)	757 (10.1)	0.013	1.4874
Previous cesarean sections	144 (45.0)	2860 (38.3)	0.012	1.3388
Fetal distress	76 (23.9)	1557 (20.8)	N.S.	
Total perinatal mortality	6 (1.9)	78 (1.0)	N.S.	
APD <sup>3</sup>	1 (0.3)	21 (0.3)	N.S.	
IPD <sup>4</sup>	0 (0.0)	9 (0.1)	N.S.	
PPD <sup>5</sup>	5 (1.6)	48 (0.6)	N.S.	
Postpartum anemia	129 (40.6)	2706 (36.2)	N.S.	
Apgar score 1 min <3	29 (9.1)	394 (5.3)	0.003	1.8756
Apgar score 5 min <7	21 (6.6)	293 (3.9)	0.017	

<sup>1</sup>Adjusted Odds Ratio from the final model of the stepwise logistic regression.

<sup>2</sup>PIH, pregnancy-induced hypertension.

<sup>3</sup>APD, antepartum death.

<sup>4</sup>IPD, intrapartum death.

<sup>5</sup>PPD, postpartum death.

associated with PPE after vaginal as well as cesarean deliveries in our population.

The rate of PPE after cesarean section in our population was found to be fifteen times higher than that after vaginal delivery (2.6% vs. 0.17%). This difference correlates with that mentioned by others.<sup>4,9,10</sup> However, the rates observed in our study are 2 to 12 times lower for cesarean and vaginal deliveries, respectively, than those reported in the literature. It has already been mentioned that lower infection rates are reported in countries with universally available health care like Canada, Great

Britain, Finland, Denmark, Sweden, and Israel.<sup>11</sup> Nevertheless, post-cesarean delivery endometritis rates observed in Canada, for instance, were three-fold higher than those observed in our study. Most probably, this significant difference is a result of the awareness of the medical staff to well-known risk factors and the preventive measures employed to lessen their effect.<sup>12</sup> A routine reduction of the number of vaginal examinations to the minimum necessary and use of an antiseptic solution for their performance diminished the influence of this risk factor. In our Institution we use routine antibiotic

prophylaxis in cases of preterm as well as term rupture of membranes for longer than 6 hours, as well as routine preventive antibiotic therapy prior to elective and non-elective cesarean deliveries.

A very significant association of preterm vaginal delivery and a less intensely significant association of cesarean delivery with PPE must be considered a result of a more than fifteen-year world-wide accepted cause-effect relationship between preterm labor and delivery and infection.<sup>13-15</sup>

The remarkable association between severe PIH after vaginal delivery but not after cesarean delivery with PPE is difficult to explain. It may be hypothesized that a previous microbial invasion of the uterine cavity constitutes the most common base of endometritis, and that the placental vasculopathy involved in the pathophysiology of PIH could enhance microbial invasion of the uterine cavity. When cesarean delivery is the chosen mode of delivery in cases associated with severe PIH, the period of adverse influence of this state is shortened, and following the above mentioned hypothesis for interpretation, the intensity of association with PPE is lessened.

A history of fetal distress followed by vaginal delivery in the index pregnancy was found significantly more often in women presenting PPE than in those without endometritis and may be therefore considered a reliable predictor for PPE. This association, as in the preceding case, may well be related to additional vaginal examinations, scalp pH examinations for assessment of fetal well-being that increase the likelihood of ascending microbial invasion, or an infectious background of the fetal distress. After cesarean delivery no such association with PPE was observed. This is probably due to fetal removal from the uterine cavity at an earlier stage that avoided the aforementioned interventions.

Furthermore, total perinatal mortality, the virtual worst outcome of fetal distress, is also significantly associated with PPE, mainly in the context of antepartum and intrapartum death, which are related to an intrauterine infectious phase. Therefore, no more cases of perinatal mortality as a result of postpartum death were associated with PPE. Neither was any significant association found between any form of perinatal mortality after cesarean delivery and PPE.

In our study postpartum anemia appears

strongly associated to PPE, after cesarean as well as after vaginal delivery. Some authors consider anemia a risk factor for PPE.<sup>4,16</sup> They refer mainly to post-cesarean delivery anemia, considering it a result of poor nutrition and/or a testimony of belonging to a lower socioeconomic class. In our population it seems to be rather a result of inadequate iron supplementation during pregnancy as a consequence of low intake compliance. In contrast, other authors do not mention anemia as a risk factor for PPE at all.<sup>9</sup>

A rationalization of an association between PPE and 1 and 5 minutes Apgar scores less than 3 and 7, respectively, after cesarean delivery and only after the 5 minutes Apgar score less than 7 after vaginal delivery, may be related to a deficient tissue oxygenation. The latter creates anaerobic-like conditions that enhance microbial invasion or implicate an impaired neonatal well-being most probably related to a sub-clinical or clinical infectious state.

The significant association of instrumental delivery with the development of PPE may be related to iatrogenic addition of trauma and vascular injury to the birth canal tissues, facilitating microbial invasion to the area.

The almost 4% rate of post-cesarean wound infection found in our study is sometimes similar<sup>17</sup> but usually one-half or less than rates observed by others.<sup>4,18-20</sup> Maybe in this case, in a way similar to that shown with PPE rates, which are lower thanks to universally available health care, it constitutes a result of the universal implementation of prophylactic measures in the management of patients undergoing obstetrical surgery. The cascade of events finally leading to wound infection is initiated by important changes in blood volume occurring during cesarean section that create a transient hyperperfusion mainly in regard to subcutaneous vessels whose inappropriate hemostasis originates later on the development of hematomas that may easily become infected.<sup>19</sup> When the different variables were analyzed in association with wound infection, significant association was observed between a history of previous cesarean sections and wound infection. The healing quality of or vicinity to scar tissue is impaired due to a deficient vascularization of the connective scar tissue, creating favorable conditions for infection of the blood pools accumulated in the new incision. Surprisingly, gestational diabetes mellitus, rather than other more severe types of

diabetes, was also found associated to wound infection, perhaps due to a possible delay in the healing process. Another surprising significant association of wound infection was observed with neonatal Apgar scores less than 3 and 7 at 1 and 5 minutes, respectively. This association could be related to the same causes responsible for the fetal distress, most probably those related to infectious etiology.

In conclusion, several unexpected clinical variables such as severe PIH, fetal distress, perinatal mortality, Apgar scores less than 3 and 7 after 1 and 5 minutes, respectively, were found to be significantly associated to PPE. Gestational diabetes mellitus, history of previous cesarean sections, and Apgar scores less than 3 and 7 after 1 and 5 minutes, respectively, were found to be significantly associated to wound infection. Patients in obstetrical wards presenting with one or more of these clinical characteristics should make physicians aware of that association. That awareness would be able to prevent and/or shorten expensive hospital stay by early diagnosis and appropriate treatment.

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