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Post-Cesarean Sepsis Causes and Biomarkers

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Objective: The determination of procalcitonin and lactate levels in the early diagnosis of sepsis is clinically significant and the higher the lactate level increases the greater the risk of mortality. In order to improve prevention and treatment of post-caesarean sepsis, in the present study we aimed to determine the serum biomarkers of Mongolian patients undergoing a cesarean section. **Methods:** Procalcitonin was determined by "E - 411" which is a fully automated analyzer and also by enzyme binding assay. Lactate, C-reactive protein, and lactate dehydrogenase was determined by "E - 411 only. Statistical analysis was performed by a SPSS - 20 software program, and statistics process by the chi-square test, Fisher test, and t-test. The confirmation rate was 95 % $p < 0.05$. **Results:** Women who gave childbirth in 2016 - 2020 and women who developed sepsis and who did not develop sepsis following C-section in the Clinical Maternity Hospital No.1 and in the Maternal and Child Health National Center were compared and studied. A total of 361 mothers were involved in the study. **Conclusions:** E. coli 29,4 %, intestinal bacteria 9,1 %, Staphylococcus epidermidis 8,9 %, Staphylococcus aureus 7,2 %, gram-negative bacteria 6,6 %, Streptococcus 5,3 %, gram-positive bacteria 2,8 %, Candida albicans 1,4 %, and Mycoplasma 1,1 % were responsible for bacteremia. Infection was caused by one bacterium in 141 cases (39,1 %), by two germs in 56 cases (15,5 %), by three microbes in 2 cases (0,6 %), and without any detection of bacteria in 162 cases (44,9 %).

Keywords: Bloodstream Infection, Pyemia, Septicemia, Severe Sepsis, Bacteremia, Cesarean Section, Delivery

Introduction

The WHO recommends the ideal rate for cesarean section to be 15 % of total births, but researchers are still attracting attention to the fact that in recent years the rates have been steadily increasing and the risk is not decreasing worldwide. Incidence of post-cesarean section inflammation and infection is 8 - 10 times higher than vaginal birth [1 - 3]. Puerperal infection following cesarean section remains a major cause of maternal morbidity and mortality. It is still one of real problems in the field of Obstetrics and has an incidenced rate of 2 -10 %. It has been estimated that there are 150 000 maternal deaths annually due to infection worldwide. Despite the tendency to declining septicemia after C-section due to wide usage of antibiotics in obstetrical practice, postpartum infection has increased in the last decade [4, 5].

The Post-Cesarean sepsis incidence rate is above 20 % [6 - 10]. An assortment of pathologic agents may cause puerperal infection including bacteria, virus and parasites. Antibiotic sensitivity has declined in recent years due to the mixed etiology of infection especially anaerobic bacteria such as Bacteroid, Clostroid, Protei, and Candida. Nowadays an assortment of gram-positive and –negative aerobic bacteria, Chlamydia, Micoplasma and viruses causes infection. Dhar et al conducted a cross-sectional study of 211 post-cesarean section cases with surgical site infections. The most common organisms responsible for the infection were Staphylococcus aureus (66, 31.27 %) and the gram-negative Escherichia coli group (40, 18.95 %). The most sensitive antibiotics were aminoglycoside and cephalosporin [11]. Gram stains and cultures on exudates from open wounds of 1319 cases following caesarean section showed the incidence of post-caesarean wound infection was 8.1 %. Further, 86.9 % of 107 infected wounds were culture positive, with Staphylococcus aureus the most frequently found organism (42 %). Organisms seen by Gram stain yielded a sensitivity of 96.6 %, specificity of 88.9 %, positive predictive value of 97.7 % and negative predictive value of 84.2 % when used to predict positive culture results for bacterial wound infection [12]. Kankuri et al analyzed clinical and microbiological features of maternal sepsis in the peripartum period (7 days before to 7 days after delivery) to determine possible risk factors, optimal treatment and outcome. Preterm deliveries were associated with a crude 2.7-fold risk for peripartum sepsis as compared to term deliveries. Antepartum sepsis was associated with a crude 2.6-fold risk for cesarean section, while postpartum sepsis was 3.2 times more likely to occur after cesarean section than after vaginal delivery [13]. In our previous study, we have determined the incidence of post-cesarean sepsis in patients undergoing a cesarean section (CS) and to identify risk factors and the impact of antibiotic prophylaxis on this condition. Here, 47.4 % (361/761) of cases were complicated by wound infection [14].

Early suspicion of the post-cesarean sepsis could lead to a valuation which helps patient's prognosis and outcome. The above mentioned microbiological culture is the gold standard for the diagnosis, however it requires 24 - 48 hours to complete. And so, serum biomarkers such as procalcitonin and lactate level are used to diagnose and manage severe infections. A prospective cohort study conducted by Do et al showed that the procalcitonin level following delivery was higher among women with vs without an intraamniotic infection (0.142 vs 0.091 ng/mL; adjusted p = 0.03) [15]. Miyazaki et al also used C-reactive protein as a predictive marker after cesarean section. Here, serum C-reactive protein levels were significantly higher in the infected group and this difference became more evident on postoperative days 3 and 6 [16].

Despite there has been no ideal biomarker yet identified, some researchers suggest that the determination of procalcitonin and lactate levels in the early diagnosis of sepsis is clinically significant and the higher the lactate level increases the greater the risk of mortality. On the other hand, some researchers claim that C-reactive protein and procalcitonin are induced in both inflammatory and infectious diseases however they lack sensitivity. In connection with these reasons, in order to improve prevention and treatment of post-caesarean sepsis, in the present study we aimed to determine the serum biomarkers of Mongolian patients undergoing a cesarean section.

Materials and Methods

Research design

We carried out a retrospective case-control study, each group has 400 participants. The case groups were defined by patients with sepsis after receiving cesarean section and the controls did not have sepsis. We matched the study groups by age. The study was conducted in 2 maternal hospitals in Ulaanbaatar at Urguu Maternity Hospital and National Center for Maternal and Child Health, over 2 years from October first 2013 to October first 2015. The hospitals were randomly selected from Ulaanbaatar city. All sample were selected preoperatively to achieve the goals of these studies regardless of the surgeon's technic or whether antibiotic prophylactic was used. Patients were followed from prior to operation till after operation. Accurate wound infections samples were selected as a case-control group. 47.4 % (361/761) of cases were complicated with wound infection and the control group was without wound infection in 52.6 % (400/761) of cases. Cesarean section was performed using an agreed upon protocol and through a Pfannenstiel incision followed by a vertical lower segment cesarean section. When patients revisited the hospital they were interviewed. Women who had a cesarean section through a midline sub umbilical vertical skin incision was excluded from analysis as per protocol.

Subjects

Patients were serially enrolled until the sample size was reached. The sample size was calculated using the retrospective study as examined for specific factors associated with post cesarean wound infection and classified as either having wound infection or no wound infection in controls. The occurrence rate used was the rate of post cesarean wound infection among patients with skin incision both transverse and vertical. The minimum sample size obtained was 721, but the study enrolled 800 pregnant women. Four hundred patients for each group.

The inclusion criteria for enrollment in the study were pregnant patients who underwent cesarean section and having d of sepsis after the operative procedure. The routine of infection control evaluation included all patients who had cesarean section up till day 30 from the procedure. Control patients were determined after the inclusion of case patients and adhered to the following inclusion criteria: similar age (± 2 years), cesarean section, procedure performed on the same day as the case patient, no history of post-cesarean infectious complication up to the 13th day, and taking into account the CDC/NHSN criteria.

The cases were excluded if a control patient meeting the inclusion requirements could not be identified or if patient records were not available. The medical records of the case and control patients were reviewed with respect to sociodemographic characteristics, elective or emergency cesarean, comorbidities, duration of labor, use of appropriate antibiotic prophylaxis and duration of membrane rupture, number of internal vaginal examinations, and length of hospitalization. Appropriate prophylaxis was defined as the antibiotic administered 30 - 60 min before the procedure.

Post cesarean sepsis

Prevention (CDC) state that post cesarean wound infection should be suspected within 30 days of a surgical procedure if at least one of the following symptoms are present: localized swelling, with or without purulent discharge from the wound, pain or tenderness, redness, malodor or fever. Procalcitonin was determined by "E - 411", the fully automated analyzer and also by enzyme binding assay while lactate, C-reactive protein, and lactate dehydrogenase was determined by "E - 311" the fully automated analyzer only.

Statistical analysis

We expressed continuous variables including age, procalcitonin, birth weight, C-reactive protein, Apgar score, leucocyte count, temperature and lactate dehydrogenase. The mean and standard deviation and assessed normally distributed data was expressed using the Kolmogorov-Smirnov test. Categorical data such as sex, education level, number of abortions, miscarriage, and pregnancy was presented by frequencies and percentages. For categorical variables, a Chi-square and Fisher's exact tests were carried out. The continuous variables between two groups were compared by the unpaired t-test and the one-way ANOVA test followed by Tukey test as multiple comparisons. The significance level was set at $p < 0.017$ ($p = 0.05/3$). Statistical analysis was performed using STATA 13.0 software.

Results

Women who gave childbirth in 2016 - 2020 and women who developed sepsis and who did not develop sepsis following C-section in Clinical Maternity Hospital No.1 and in Maternal and Child Health National Center were compared and studied.

A total of 800 mothers were involved in the study. The mean age of the study cohort was 31.2 ± 6.28 years. Sociodemographic data showed that 49.7 % of case group had active work, while 29 % of control group was actively working (Table 1).

Abortion and miscarriage history are shown in Table 2. Two hundred seventy-nine patients in the case group and 230 from the control group had no history of abortion. On the other hand, only 40 from the case group had a normal pregnancy compared to 209 in control group. Also 21.5 % in the case group had a miscarriage compared to 1.7 % in the control group, and 24.5 % had a premature delivery which was significantly higher than the control group. As for morning sickness, 15.8 % of the case group had severe symptoms as compared to 7.2 % in the control group.

We confirmed pregnancy characteristics (Table 3). Birthweight of the case group was 3213.07 ± 747.14 gms while it was 3460.4 ± 610.96 in the control group. Procalcitonin was significantly higher in the case group (3.22 ± 6.05) compared to the control group (0.29 ± 0.12). Also lactate dehydrogenase was significantly higher in the case group (473.94 ± 586.11) than the control group (275.89 ± 284.39). Parturition time was 5.77 ± 5.82 which is almost four-time longer than the control

Table 1. Demographic characteristics of study population.

Variables	Case n = 400	Control n = 400	Total n = 800	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Age, years	30.36 ± 6.83	32.04 ± 5.59	31.2 ± 6.28	0.000
	N (%)	N (%)	N (%)	
Education				
Elementary	19 (5.0)	46 (11.5)	55 (8.07)	0.000
Middle	200 (50)	142 (36)	342 (42.8)	
College	181 (45)	212 (53)	393 (49.1)	
Working place				
Student	57 (14.3)	84 (21)	141 (17.6)	0.000
Active working	198 (49.7)	116 (29)	314 (39.2)	
Stay home	145 (36.3)	200 (50.0)	345 (43.2)	
Housing				
Traditional tent	231 (57.8)	206 (51.4)	437 (54.6)	0.000
Flat	162 (40.5)	161 (40.3)	323 (40.4)	
House	7 (1.7)	33 (8.3)	40 (0.05)	

Table 2. Abortion and miscarriage history.

Variables	Case n = 400	Control n = 400	Total n = 800	p-value
	N (%)	N (%)	N (%)	
Abortion				
No	279 (69.7)	230 (57.5)	509 (63.6)	0.000
One	77 (19.2)	102 (25.5)	179 (22.3)	
2-4 times	40 (10.0)	63 (16.6)	107 (13.6)	
5 <	5 (1.1)	5 (0.4)	5 (0.23)	
Miscarriage				
No	320 (80)	309 (77.3)	629 (78.6)	0.330
One	64 (16)	80 (20)	144 (18)	
2-4 times	16 (4.0)	11 (2.7)	27 (3.4)	
Pregnancy				
Normal	48 (12)	229 (57.3)	277 (34.6)	
Morning sickness	129 (32.2)	139 (34.7)	268 (33.5)	
Miscarriage	86 (21.5)	7 (1.7)	93 (11.6)	
Premature	98 (24.5)	15 (3.7)	113 (14.1)	
Chronic diseases	21 (5.2)	7 (1.7)	28 (3.5)	
Infectious diseases	18 (4.6)	3 (0.9)	21 (2.7)	
Medical history				
Normal	227 (56.8)	128 (32)	355 (44.4)	
Preeclamsia	2 (0.5)	3 (0.7)	5 (0.6)	
Abortions	28 (7)	32 (8)	60 (7.5)	
Infertility	3 (0.7)	3 (0.7)	6 (0.7)	
Postpartum Hemorrhage	5 (1.2)	4 (1)	9 (1.3)	

Continued

Premature	22 (5.5)	36 (9)	58 (7.2)	
Surgery	108 (28)	190 (47.6)	298 (37.2)	
Placental abruption	5 (1.2)	4 (1)	7 (1.1)	
Preeclamsia				
No	245 (61.2)	259 (64.8)	504 (63)	0.001
Mild	92 (23)	112 (28)	204 (25.5)	
Severe	63 (15.8)	29 (7.2)	92 (11.5)	

Table 3. Pregnancy characteristics.

Variables	Case n = 400	Control n = 400	Total n = 800	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Pregnancy	2.82 ± 1.73	3.23 ± 1.58	3.02 ± 1.66	0.000
Gestation	32.93 ± 2.87	39.56 ± 15.46	38.74 ± 11.14	0.038
Birth weight	3213.07 ± 747.14	3460.4 ± 610.96	3336.74 ± 693.16	0.000
CRB	116.87 ± 80.99	50.35 ± 50.41	89.32 ± 77.15	0.000
Procalcitonin	3.22 ± 6.05	0.29 ± 0.12	2.01 ± 4.85	0.000
Lactate	3.41 ± 1.82	2.91 ± 0.97	3.21 ± 1.55	0.024
Lactate dehydrogenase	473.94 ± 586.11	275.89 ± 284.39	391.75 ± 493.1	0.000
Apgar score	6.91 ± 1.90	7.26 ± 0.94	7.09 ± 1.51	0.001
Delivery	2.13 ± 1.15	2.27 ± 0.92	2.2 ± 1.04	0.045
Parturition time	5.77 ± 5.82	1.43 ± 2.76	3.60 ± 5.04	0.000
Temperature	37.83 ± 0.81	36.20 ± 0.47	37.01 ± 1.05	0.000
HB	82.43 ± 48.69	92.12 ± 43.24	87.27 ± 46.27	0.003
ER	3.72 ± 0.66	4.07 ± 6.43	3.89 ± 4.57	0.281
LEU	12.98 ± 6.36	11.65 ± 4.85	12.32 ± 5.69	0.001
Gematocrit	31.96 ± 5.79	32.28 ± 5.06	32.12 ± 5.44	0.406
Tr	287.73 ± 139.77	225.87 ± 78.30	256.8 ± 117.37	0.000
PCT	0.12 ± 0.55	-0.54 ± 0.26	-0.15 ± 0.56	0.000

Table 4. Antibiotics and bacteria.

Variables	Case n = 400	Control n = 400	Total n = 800	p-value
	N (%)	N (%)	N (%)	
Vancomycin				
No	367 (91.8)	400 (100)	767 (95.8)	
Yes	33 (8.2)	-	33 (4.2)	
Staphylococcus aureus				
No	356 (89)	400 (100)	756 (94.5)	
Yes	44 (11)	-	44 (5.5)	
PCT				
No	35 (29.9)	75 (90.4)	110 (55)	0.000
Yes	82 (70.1)	8 (9.6)	90 (45)	
Sepsis				
No	320 (80)	400 (100)	720 (90)	

Continued

Yes	80 (20)	-	80 (10)	
Mastitis				
No	391 (97.7)	400 (100)	791 (98.8)	
Yes	9 (2.3)	-	9 (1.2)	
Endometritis				
No	194 (48.5)	398 (99.5)	592 (74)	0.000
Yes	206 (51.5)	2 (0.5)	208 (26)	
Surgical wound infection				
No	275 (68.7)	399 (99.7)	674 (84.2)	0.000
Yes	125 (31.3)	1 (0.3)	126 (15.8)	
Metroendometritis				
No	184 (46)	398 (99.5)	582 (72.8)	0.000
Yes	216 (54)	1 (0.5)	218 (27.2)	
Lactate				
No	89 (76.1)	70 (87.8)	161 (80.9)	0.058
Yes	28 (23.9)	10 (12.2)	38 (19.1)	
LDG				
No	64 (55.2)	29 (34.9)	93 (46.7)	0.007
Yes	52 (44.8)	54 (65.1)	106 (53.3)	
PCT				
No	35 (29.9)	75 (90.4)	110 (55)	0.000
Yes	82 (70.1)	8 (9.6)	90 (45P)	

Table 5. Biomarkers for septic infection.

Biomarkers	**SIRS**	**Sepsis**	**Severe sepsis**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	***p-value**
Lactate dehydrogenase (u/l) [a]	749.4 ± 162.1	944.9 ± 164.0	1034.8 ± 260.1	0.016
Procalcitonin (ng/ml) [b]	4.2 ± 2.6	6.0 ± 2.3	6.8 ± 3.9	0.013
C-reactive protein(mg/dl)	114.6 ± 23.0	138.2 ± 21.7	140.3 ± 26.9	0.184
Lactate(mg/dl)	3.7 ± 0.6	4.6 ± 0.7	5.1 ± 1.2	0.122

*One-way ANOVA; multiple comparison (Tukey): [a]SIRS vs. Severe sepsis, $p < 0.041$; [b]SIRS vs. Severe sepsis, $p < 0.000$.

Table 6. Sensitivity and specificity of procalcitonin in sepsis.

Rates and Confidence Intervals		**95% CI**			
Measure	Value	Lower	Upper	Formula	Calculation
Sensitivity (TPR)	0.658	0.576	0.733	A / (A + C)	98/149
Specificity (TNR)	0.961	0.865	0.995	D / (B + D)	49/51
Likelihood Odds Ratio	47.08	11.00	201.5	LR+/LR-	167718/0.36

Table 7. Sensitivity and specificity of lactate in sepsis.

Rates and Confidence Intervals		95% CI			
Measures	Value	Lower	Upper	Formula	Calculation
Sensitivity (TPR)	0.57	0.49	0.65	A / (A + C)	82/145
Specificity (TNR)	0.67	0.53	0.79	D / (B + D)	37/55
Likelihood Odds Ratio	2.68	1.39	5.14	LR+/LR-	6459

Lactate resulted in sensitivity of 56, but with only 67 specificities.

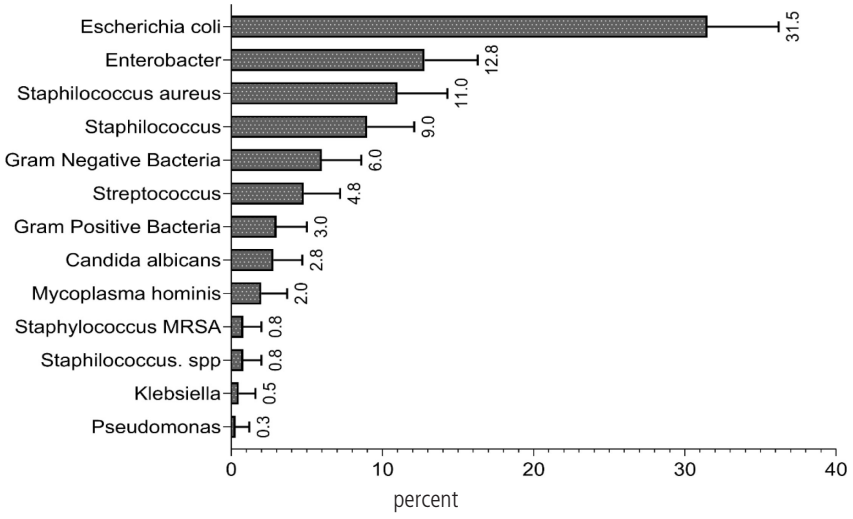

Figure 1. The causes of septic complication

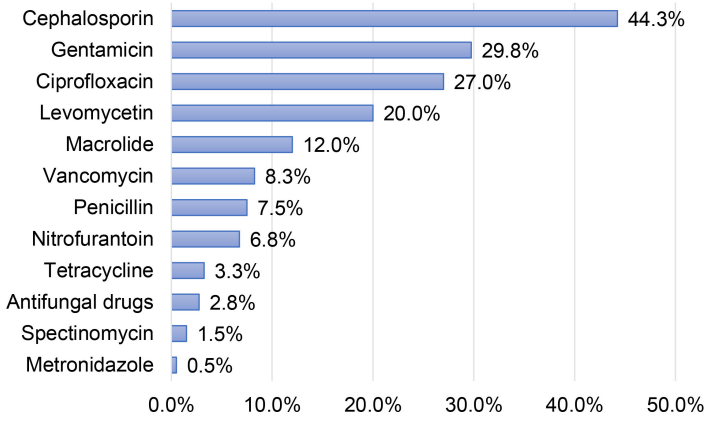

Figure 2. Antibiotic sensitivity for infection

group (1.43 ± 2.76).

Table 4 shows antibiotics and bacterial infection. The Case group had 44 patients who had Staphylococcus aureus infection. Further nine patients from the case group had mastitis while no mastitis was detected in the control group. As for wounds, 31.3 % of the case group had severe wounds compared to only 1 % in the control group. Procalcitonin level was determined in 70.1 % in the case group while it was only 9.6 % in the control group.

We show correlation between biomarker and sepsis in Table 5. The lactate dehydrogenase was significantly higher in patients with severe sepsis (1034.8 u/l) and procalcitonin was also high (6.8 ng/mL) in the same patients. Moreover, the C-reactive protein was detected higher in patients with severe sepsis (140.3 mg/dl) but not statistically significant.

The result of the study shows that the procalcitonin sensitivity was 65 %, and the specificity was 96 %. On the other hand, lactate resulted in a sensitivity of 56 %, but with only 67 % specificities in the diagnosis of sepsis (Table 6 and 7).

The most common cause of septic complication was undetected (44.9 %), followed by E-coli (29.4 %) (Figure1). Regarding the antibiotics, ceftrixone was the most sensitive for infection (Figure 2).

Discussion

The inflammatory complications associated with the increase in the frequency of caesarean surgery are still one of the main problems in obstetric science practice [17 - 20]. In obstetrical practice, the above-mentioned disorders associated with the use of antibiotics have decreased, but in the last 10 years, postpartum infections have increased in all countries around the world, with an average of 150,000 mothers per year due to obstetric complications. Many factors influence postpartum infections [21 - 23] such as maternal anemia in postoperative uterine mucus, ulcer infection, uterus fat tissue, urinary tract and abdominal pleura, and mild pelvic purulent abscesses, diseases of the organ system (chronic hypertension, cardiovascular disease, renal disorders), late pregnancy poisoning, fluid in the fetus, fluid in the vicinity of the fetus, multiple vaginal examinations, emergency caesarian surgery as well as twin pregnancies

In the present study, we have shown that procalcitonin (PCT) is more effective than CRP, TNF, and IL-6 markers in the diagnosis of the severity of bacterial infections. Procalcitonin is a plasma prohormone that increases during the body's response to severe tissue injury and systemic inflammation, especially severe bacterial infections [24]. PCT is excreted from various tissues as a response to endotoxin and inflammatory mediators. In the first 2 - 4 hours of severe bacterial infections, the PCT level increases significantly in blood and can be used for the diagnosis of patterns that require an early antibiotic treatment start. The level of PCT decreases as infection is treated. The half-life of PKT in plasma is 25 hours so measuring it is important to monitor the effectiveness of treatment [25]. Paccolat et al revealed that the median levels of PCT were: 24 - 28 weeks: 0.043 µg/L (range 0.010 - 0.080); 36 - 40 weeks: 0.061 µg/L (range 0.010 - 0.110); at delivery: 0.068 µg/L (range 0.010 - 0.170); days 2 - 3: 0.200 µg/L (range 0.030 - 5.00); and day 10: 0.060 µg/L (range 0.020 - 0.120). At days 2 - 3 postpartum, three women had a PCT level between 0.25 µg/L and 0.5 µg/L and two women had a level higher than 0.5 µg/L. Also, the sensitivity of PST assay was 0.06 µg/L [26]. In our study, PCT level was 6.8 ng/mL (range 2.9 - 10.7) in severe sepsis, and 6.0 ng/mL (range 3.7 - 8.3) in sepsis, which is significantly higher than the cohort of Paccolat et al. Another cross-sectional study by Joyce et al demonstrated that the maximum procalcitonin value at term pregnancy was 0.1 µg/L (day 1 postpartum, 90 % and 86.8 % of procalcitonin for vaginal delivery and caesarean section, respectively). The specificity of procalcitonin to rule out infection in the reference population was 91.5 % [27]. In our study, the specificity was 96 % for procalcitonin detection.

On the other hand, determining lactate in early diagnosis of fertility is of clinical importance, and the higher the lactate, the higher the risk of ending. In the study of Goyal et al, the mean value of lactic acid was significantly higher in the Intensive Care Unit (ICU) group than the Non-ICU group at 0, 24, and 48 h with values being (6.00 ± 2.46 mmol/l vs 3.25 ± 1.92 mmol/l), (4.44 ± 2.24 mmol/l vs 2.91 ± 1.77 mmol/l) and (5.65 ± 2.91 mmol/l vs 2.99 ± 1.93 mmol/l), respectively. The assay had a sensitivity of 84 % and specificity of 68 % for predicting ICU admission [28]. On the other hand, lactate value was 3.41 ± 1.82 in the case group and 2.91 ± 0.97 in the control group ($p > 0.024$) in our study. Another retrospective cohort of pregnant and postpartum patients with signs of sepsis showed that patients with higher measured lactic acid levels had higher morbidity: positive blood cultures (16.8 vs. 5.5 %, $p = 0.04$), admission to the intensive care unit (5 vs. 0.1 %, $p < 0.01$) or acute monitoring unit (17.2 vs. 0.9 %, $p < 0.01$), longer hospital stay (median 3 vs. 2 days, $p < 0.01$), and preterm delivery (18.3 vs. 10.9 %, $p = 0.05$). The mean lactic concentration was higher in patients admitted to the intensive care (2.6 vs. 1.6 mmol/L, $p = 0.04$) and telemetry unit (2.0 vs. 1.6, $p = 0.03$), and in those with positive blood cultures (2.2 vs. 1.6, $p < 0.01$). Lactic acid was positively associated with intensive care or telemetry unit admission, adjusted odds ratio per 1 mmol/L increase in lactic acid 2.34 (95 % confidence interval, 1.33 - 4.12) [29]. In the present study, we confirmed that specificity of lactate was 67 % which is close to the result of Goyal et al.

Our study has limitations. First, this study had been conducted at Urguu Maternity Hospital, Obstetrics Clinic of National Center for Maternal and Child Health of Mongolia, and Obstetrics and Gynecology Department of School of Medicine, MNUMS, thus did not cover urban maternity units. Second, we have not included socioeconomic status of patients which is significantly associated with depressive symptomatology.

Several studies concluded that actual household income could be a significant factor for delivery. Therefore, the next step of our study should conduct a study with a bigger sample size and validate more factors including socio-economic status on delivery.

Conclusion

In our study, E. coli 29,4 %, intestinal bacteria 9,1 %, Staphylococcus epidermidis 8,9 %, Staphylococcus aureus 7,2 %, gram-negative bacteria 6,6 %, Streptococcus 5,3 %, gram-positive bacteria 2,8 %, Candida albicans 1,4 %, and Mycoplasma 1,1 % were responsible for bacteremia. Infection were caused by one bacterium in 141 cases (39,1 %), by two germs in 56 cases (15,5 %), by three microbes in 2 cases (0,6 %), without any detection of bacteria 162 cases (44,9 %). The combinations of 3rd or 4th generations cephalosporins, gentamycin, chloramphenicol, and erythromycin improve the outcome. Thus, prevention measures should include vaginal bacteriology, antibiogram of women before labour, also, if needed, use of antibiotic prophylaxis. Biomarkers have a direct correlation to all stages of inflammation and infections, which are important for the diagnosis.

Conflict of interest

The authors state no conflict of interest.

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All individuals who contributed to this publication have been included as authors.

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