

RISK FACTORS AND CLINICAL OUTCOMES OF PUERPERAL SEPSIS: A RETROSPECTIVE STUDY FROM A TERTIARY CARE HOSPITAL IN DERA ISMAIL KHAN

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ABSTRACT

Background: Puerperal sepsis is a significant contributor to maternal morbidity and mortality, especially in low and middle-income countries where delayed diagnosis, obstetric complications and limited access to timely treatment exacerbates severe maternal outcomes. To optimize maternal care, it is crucial to identify clinical and obstetric risks of poor outcomes.

Objective: The aims of this study were to evaluate the maternal, obstetric, healthcare-related, clinical and microbiological risk factors that are associated with adverse maternal outcomes among women with puerperal sepsis and to determine independent factors for adverse maternal outcomes.

Methods: A retrospective cohort study was carried out in 250 women with puerperal sepsis admitted at the Department of Obstetrics and Gynecology, Women and Children Hospital, Dera Ismail Khan, KP, Pakistan. Demographic features, obstetric history, health care components, clinical features, laboratory parameters, microbiological profiles and maternal parameters were analysed. Descriptive statistics, univariable logistic regression and multivariable logistic regression were done. Adverse maternal outcomes were assessed for independent predictors after adjusting for other risk factors, using adjusted odds ratios (AORs) with 95% confidence intervals (CIs).

Results: Of 250 women, 88 (35.2%) had adverse maternal outcomes. Extended hospitalisation (32.8%), admission to intensive care unit (16.4%) and septic shock (13.6%) were the most common complications. Culture positivity was noted in 56.8% of cases with the main organisms being *Escherichia coli* (33.8%) and *Klebsiella* species (21.1%). Hypotension at presentation was found to be the strongest predictor of adverse outcomes using the multivariable analysis (AOR=6.39; 95% CI=2.57-15.89; $p<0.001$). Other significant predictors included retained products of conception (AOR=4.58; 95% CI: 1.81-11.61; $p=0.001$), postpartum haemorrhage (AOR=3.21; 95% CI: 1.45-7.13; $p=0.004$), prolonged labour >12 hours (AOR=2.83; 95% CI: 1.37-5.86; $p=0.005$), prolonged rupture of membranes >18 hours (AOR=2.60; 95% CI: 1.33-5.10; $p=0.005$), CRP >120 mg/L (AOR=2.53; 95% CI: 1.22-5.22; $p=0.012$), and caesarean delivery (AOR=2.24; 95% CI: 1.20-4.17; $p=0.011$).

Conclusion: The maternal morbidity associated with puerperal sepsis was significant, and adverse outcomes were primarily related to haemodynamic instability, obstetric complications and indicators of severe infection. To minimize severe maternal outcomes, it is crucial that high-risk patients are identified early, that appropriate antimicrobial therapy is promptly started, and obstetric care is delivered effectively.

KEYWORDS: Puerperal sepsis, maternal sepsis, postpartum infection, Maternal morbidity, Obstetric complications, Septic shock, Logistic regression, Maternal outcomes, Risk factors, Pakistan.

1. INTRODUCTION

Despite advances in obstetric practices, infection control, and antimicrobial use and critical care, puerperal sepsis still contributes to maternal morbidity and mortality and is a largely preventable condition. There is a general understanding that maternal sepsis is a life-threatening organ dysfunction due to infection during pregnancy, labour, post-abortion and/or the puerperium period, with puerperal sepsis being a concern focused on infection during labour or post-birth. It is now recognized that maternal sepsis can be a fast-moving condition and should be identified, evaluated and treated at the earliest opportunity to avoid organ dysfunction, septic shock and death [1,2]. The problem is especially relevant as the normal physiological state of pregnancy and puerperium may alter normal clinical and laboratory parameters and lead to difficulty in the early detection of infection [2,3]. Maternal mortality continues to be a significant public health problem all over the world. The latest World Health Organization (WHO) estimates show that in 2023, around 260,000 women died due to pregnancy and childbirth-related causes, with over 90% of these deaths in low- and lower-middle-income countries (LMICs) [4]. The vast majority of maternal deaths (more than 70%) are still occurring in Southern Asia and sub-Saharan Africa [4,5]. While haemorrhage and hypertensive disorders still contribute to most maternal deaths, infections during

pregnancy and sepsis still play a significant role in preventable deaths [5,6]. Further evidence of the disproportionate burden of infection-related severe maternal outcomes coming from recent analysis of the WHO Global Maternal Sepsis Study clearly highlights the need for rapid diagnosis, referral and antimicrobial treatment and access to critical care in resource-limited settings [7].

Puerperal sepsis is multifactorial and represents a combination of factors related to the mother and the obstetric events and exposures including healthcare. More recent pieces of evidence have shown that some factors influence the occurrence of infection related maternal complications including prolonged rupture of membranes, prolonged labour, repeated vaginal examinations, caesarean delivery, postpartum haemorrhage, previous caesarean section, hospital-acquired infections and underlying medical conditions [8,9]. Another systematic review and meta-analysis found in 2025, caesarean delivery, multiple vaginal exams, lack of proper prenatal care, long labor, premature rupture of membranes, home delivery, and rural delivery as risk factors for puerperal sepsis [10]. The fact that these findings indicate that a significant number of risk factors are potentially modifiable with better antenatal care, adequate intrapartum surveillance, rational obstetric interventions and infection prevention measures highlights the importance of these modifiable factors. In Pakistan, the problem is significant as access to maternal health services, referral systems and seeking antenatal care are significant barriers. Two tertiary care hospitals in South Punjab have recently revealed that anaemia and gestational age less than 37 weeks, and absence of antenatal booking were significant risk factors in maternal sepsis [11]. In that study, *Escherichia coli* was the most common organism detected and women who had sepsis were significantly more likely to die than the control group [11]. Other recent international studies have shown links between puerperal sepsis and lack of antenatal care, anaemia, caesarean section, post natal haemorrhage, and prolonged rupture of membranes and prolonged labour [9,12]. The observations further support the need to identify the determinants relevant to each local population as the distribution of the risk factors to the mother, obstetric practices, referral patterns and healthcare resources can differ significantly between populations and institutions. Puerperal sepsis can range from relatively localized infection to a serious systemic disease. If left untreated and untreated, women can suffer from septic shock, acute kidney injury, coagulopathy, respiratory failure, multiorgan dysfunction and death [1,3]. In recent maternal-sepsis guidance, therefore, the rapid clinical assessment of the mother, early administration of antimicrobials, adequate fluid resuscitation, source identification and control, and timely escalation to critical care if necessary, are strongly emphasized [1,2]. Early-warning strategies also may help to identify women who are at risk of serious maternal complications; cross-national evidence has recently emerged that some obstetric early-warning systems have high sensitivity for identifying women at risk of complications related to serious maternal infection [13]. In addition, improved infection prevention and management initiatives have recently been demonstrated to decrease the risk of severe maternal infection and its consequences, thereby supporting the preventable nature of many of the burden [14].

Anyhow this current international evidence, locally generated data on the determinants and outcome of puerperal sepsis in southern Khyber Pakhtunkhwa are still scarce, especially at the Women and Children Hospital, Dera Ismail Khan. This is clearly identified in the proposal as an important research gap. Thus, the present study aims to describe maternal demographic and obstetric characteristics of women diagnosed with puerperal sepsis; to determine maternal, obstetric and healthcare-related risk factors; to evaluate clinical features and laboratory findings; to assess maternal outcomes and complications of puerperal sepsis, such as recovery, admission to intensive care unit, septic shock, disseminated intravascular coagulation, acute kidney injury, hysterectomy, length of hospital stay and death; and to identify independent risk factors associated with poor clinical outcomes in mothers with puerperal sepsis.

2. METHODOLOGY

2.1 Study Design

Retrospective cohort study design was employed to assess maternal, obstetric, healthcare related, clinical and laboratory factors associated with adverse maternal outcomes among women who developed puerperal sepsis. Puerperal sepsis was included under the umbrella of maternal sepsis – defined as infection that can occur during labour, at the time of childbirth or during the postpartum period which may lead to severe organ dysfunction and death [16,20,21]. The retrospective cohort design allowed for the assessment of possible risk factors and their association with the clinical outcomes of the mother in the future, using routinely collected clinical information.

2.2 Study Setting

This is an observational study which was done in the Department of Obstetrics and Gynaecology, Women and Children Hospital, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. The hospital is a tertiary healthcare center, offering full range of maternal healthcare services such as antenatal, intrapartum, emergency obstetric, operative and postpartum services. It is also a primary referral hospital for Dera Ismail Khan and adjoining districts that take care of high risk pregnancy, obstetric complications including puerperal sepsis. To ensure that all efforts are directed towards preventing maternal infection and reducing the burden of maternal morbidity and mortality, puerperal sepsis outcomes in tertiary-care settings need to be continually monitored [15–17].

2.3 Sample Size

During the study period from 1 January 2022 to 31 December 2025, a total of 250 women diagnosed with puerperal sepsis were identified and included in the study. The sample size was determined based on the total number of eligible puerperal sepsis cases admitted during the three-year study period, as specified in the study

protocol. Including all eligible cases through universal sampling ensured full utilization of available clinical records and minimized the risk of selection bias.

2.4 Sampling Technique

A universal sampling method was used and all eligible cases who met the pre-formed inclusion criteria were selected for the study. The women included were those who suffered puerperal sepsis during labour or in the first 42 days after delivery, and had adequate clinical data for assessment of disease course and maternal outcome. Established definitions of maternal and obstetric sepsis [18–21] were used to diagnose puerperal sepsis. Those who were not included in the analysis had inadequate clinical data or were not related to pregnancy-associated sepsis.

2.5 Data Collection

A structured data-collection framework was developed based on the study objectives and used to collect data. Information obtained included admission registers, patient medical records, labour-room registers, delivery registers, operative notes, nursing records, laboratory reports, microbiology reports, intensive care records and discharge registers. Demographic variables collected were maternal age, place of residence, maternal education, occupation, and socioeconomic variables. Obstetric variables were gravidity, parity, gestational age, antenatal-care attendance, referral status, place of delivery, mode of delivery, duration of labour, prolonged rupture of membranes, and number of vaginal examinations, history of blood transfusion and retained products of conception (RPOC) and postpartum Haemorrhage (PPH). Factors related to healthcare comprised delay in referral, delay in administering antibiotics and past history of poor aseptic technique. Fever, pelvic pain, foul-smelling lochia, uterine tenderness, tachycardia, and hypotension were some of the clinical parameters noted at presentation. Laboratory examinations assessed hemoglobin concentration, white blood cell count, platelet count, concentration of C-reactive protein (CRP) and microbiological culture results. Anaemia was defined by the World Health Organization criteria as a hemoglobin concentration of <11 g/dL [22]. The definitions of puerperal sepsis and maternal infection were taken from final recommendations of WHO [18–20]. Septic shock was considered according to Sepsis-3 definition which is defined as persistent hypotension despite adequate fluid resuscitation that requires vasopressor treatment [21]. The main outcome measure was maternal clinical outcome (favorable or adverse). Maternal complications were septic shock, intensive care admission, disseminated intravascular coagulation, acute kidney injury, hysterectomy, mechanical ventilation, long hospitalization and maternal death. Maternal mortality was defined following the internationally accepted definitions of the 'maternal mortality period', which refers to deaths within 42 days of the end of pregnancy [17,24].

2.6 Statistical Analysis

Data were checked for completeness and consistency prior to statistical analysis. IBM SPSS Statistics (version 27) (IBM Corp. Armonk, NY, USA) was used for statistical analysis. Shapiro–Wilk test was used to evaluate the distribution of continuous variables. Continuous variables (which were not normally distributed) were summarized as median (IQR), while continuous variables (which were normally distributed) were summarized as mean $\pm$ SD. Categorical variables were presented in frequency and percentage. Demographic characteristics, obstetric variables, healthcare-related factors, clinical manifestations, laboratory findings, microbiological profiles and maternal outcomes were analyzed by descriptive analysis. The chi-square test or Fisher's exact test was used to make comparisons between favorable and adverse maternal outcomes for categorical variables. For continuous variables, the independent-samples t-test was used for normally distributed data and Mann–Whitney U test was used for non-normally distributed data.

Univariable logistic regression was used to evaluate associations between potential predictors and adverse maternal outcomes. Crude odds ratios (ORs), 95% confidence intervals (CIs) and p-values were computed. All variables with a p-value <0.20 in the univariable analysis and clinically relevant variables were added to a multivariable binary logistic regression model. To identify independent predictors of adverse maternal outcomes, adjusted odds ratios (AORs) with 95% confidence intervals were computed. The likelihood-ratio test and the pseudo- R^2 value of McFadden were used for model performance evaluation. A two-sided p value less than 0.05 was regarded as being statistically significant. A forest plot of odds ratios (with 95% confidence intervals) was used to present the final regression results.

2.7 Ethical Approval

The study was then approved by the appropriate Institutional Research and Ethics Committee prior to the study. Patient confidentiality was protected by using unique study identification numbers, de-identifying the collected data, limiting access to the collected data and by analyzing them anonymized. This was a retrospective record-based study, which did not involve any direct interaction or intervention with the patients, hence informed consent was not required as per institutional ethical guidelines.

3. RESULTS

For Table 1, the demographic and obstetric characteristics of women with Puerperal Sepsis were analyzed and interpreted. The demographic and obstetric data of the 250 women diagnosed with puerperal sepsis are given in Table 1. The mean age of mothers was 28.4 ± 6.1 years and most women were in the reproductive age (20–34 years, 72.8%). Women aged ≥ 35 years comprised 17.2% and women aged less than 20 years comprised 10.0% of the study population. It was observed that majority of women were from rural areas, 66.8% were from rural areas

and 33.2% were from urban areas, that is, there are more rural women affected by puerperal sepsis than urban women. Concerning the level of education, the most frequent educational level was secondary education (37.6%) followed by primary education (29.6%). However, there were a significant number of women who were not educated (22.4%), while only 10.4% of women were higher educated. There was a high prevalence of puerperal sepsis among multiparous women, as the median gravidity was 4 (IQR: 3–5) and the median parity was 1 (IQR: 0–2). Gestational age at delivery was 38.2 ± 1.8 weeks with the mean age being at term pregnancy, indicating that most of the women had developed puerperal sepsis at term pregnancy. The median number of ante natal care visits was 4 (IQR 2- 5). The important role of referral pathways in severe maternal infections was highlighted with referral cases being made up of a significant proportion of women (62.8%). Sixty-eight point eight per cent of women had reported delivery in the hospital while the rest were either referred after delivery elsewhere or delivered at home. As per mode of delivery, the most common one was vaginal delivery (54.4%), followed by instrumental delivery (2.4%) and caesarean delivery (43.2%). The overall demographic profile shows that women of reproductive age were most affected by puerperal sepsis, especially those from rural areas and those who needed to be referred for care.

Table 1. Demographic and Obstetric Characteristics of Women with Puerperal Sepsis (N = 250)

Characteristic	n (%) / Mean $\pm$ SD / Median (IQR)
Age (years), mean $\pm$ SD	28.4 $\pm$ 6.1
<20 years	25 (10.0)
20–34 years	182 (72.8)
≥ 35 years	43 (17.2)
Residence	
Rural	167 (66.8)
Urban	83 (33.2)
Education	
No formal education	56 (22.4)
Primary	74 (29.6)
Secondary	94 (37.6)
Higher	26 (10.4)
Gravidity, median (IQR)	4 (3–5)
Parity, median (IQR)	1 (0–2)
Gestational age (weeks), mean $\pm$ SD	38.2 $\pm$ 1.8
ANC visits, median (IQR)	4 (2–5)
Referred cases	157 (62.8)
Hospital delivery	172 (68.8)
Mode of delivery	
Vaginal	136 (54.4)
Caesarean	108 (43.2)
Instrumental	6 (2.4)

The clinical, laboratory and microbiologic aspects of puerperal sepsis are summarized in table 2. The most common clinical manifestations were fever $\geq 38^\circ\text{C}$ (87.2%), tachycardia (62.4%), pelvic pain (60.4%), uterine tenderness (57.2%) and foul-smelling lochia (54.0%). A subset of women with more severe infection (14.0%) presented with hypotension. Laboratory tests confirmed signs of systemic inflammation and changes in physiological state. Affected women were predominantly anaemic with a median hemoglobin of 9.9 g/dL (IQR: 8.9–11.0). The median WCC was $14.9 \times 10^9/\text{L}$ (IQR 11.4–18.1) reflecting an active inflammatory response. The median platelet count was $219 \times 10^9/\text{L}$ (IQR: 164.0–273.8), while the median CRP concentration was 77.5 mg/L (IQR: 46.8–113.4), reflecting elevated inflammatory activity. Microbiological cultures were positive in 56.8% of cases. Within culture-positive samples, *Escherichia coli* was the most common organism found with 33.8% followed by *Klebsiella* species (21.1%). Positive cultures were polymicrobial (15.5%), due to *Streptococcus* species (11.3%), due to *Enterococcus* species (5.6%), or due to *Staphylococcus aureus* (8.5%). It shows that Gram-negative bacterial infection is the more predominant infection in the women suffering from puerperal sepsis.

TABLE 2. Clinical, Laboratory and Microbiological Characteristics of Women with Puerperal Sepsis (N = 250)

Characteristic	Result
Clinical features, n (%)	
Fever $\geq 38^\circ\text{C}$	218 (87.2)
Tachycardia	156 (62.4)
Pelvic pain	151 (60.4)
Uterine tenderness	143 (57.2)

Foul-smelling lochia	135 (54.0)
Hypotension at presentation	35 (14.0)
Laboratory findings, median (IQR)	
Haemoglobin (g/dL)	9.9 (8.9–11.0)
WBC ($\times 10^9/L$)	14.9 (11.4–18.1)
Platelets ($\times 10^9/L$)	219 (164.0–273.8)
CRP (mg/L)	77.5 (46.8–113.4)
Culture positive, n (%)	142 (56.8)
Organisms among culture-positive cases (n=142)	
Escherichia coli	48 (33.8)
Klebsiella spp.	30 (21.1)
Mixed/polymicrobial	22 (15.5)
Streptococcus spp.	16 (11.3)
Staphylococcus aureus	12 (8.5)
Enterococcus spp.	8 (5.6)
Other organisms	6 (4.2)

Table 3 shows the distribution of maternal, obstetric, health service-attributable factors and maternal outcomes of women who developed puerperal sepsis. Anaemia was the most prevalent maternal condition (54.8%) while repeated vaginal checks ≥ 5 times (57.2%) was the second. 43.2% of women delivered by caesarean and 30.4% of women had prolonged rupture of membranes (PRM) of over 18 hours. 22.8% of cases experienced prolonged labour (>12 hours). Postpartum haemorrhage (16.8%) and retained products of conception (12.4%) were other obstetric complications. Important issues were identified with timely maternal care, with issues related to health care being significant. Low antenatal-care attendance (<4 visits) was nearly half of the women (47.6%). Sixty-two and a half percent of cases were referred, and 32 percent of women had referral delay of more than six hours. Of the cases, 33.6% had delayed antibiotic administration more than one hour and 21.6% had poor aseptic history. In terms of maternal outcomes, there were adverse maternal outcomes for 35.2% of women. The average hospital stay was over 7 days (32.8%) and 16.4% required admission to the intensive care unit. Septic shock occurred in 13.6% of women. Mechanical ventilation (6.8%), acute kidney injury (6.4%), hysterectomy (3.6%) and disseminated intravascular coagulation (2.4%) were less common but clinically significant complications. Of the women who died, 2.0% were maternal deaths, and 98.0% of women recovered. Hospitalization was for a median of 6 days (IQR: 4–9).

Table 3. Maternal, Obstetric and Healthcare-Related Factors and Maternal Outcomes (N = 250)

Variable	n (%)
Maternal/obstetric factors	
Anaemia	137 (54.8)
Caesarean delivery	108 (43.2)
PROM >18 hours	76 (30.4)
Prolonged labour >12 hours	57 (22.8)
Repeated vaginal examinations ≥ 5	143 (57.2)
Retained products of conception	31 (12.4)
Postpartum haemorrhage	42 (16.8)
Diabetes mellitus	25 (10.0)
Hypertension	36 (14.4)
Obesity	38 (15.2)
Healthcare-related factors	
Low ANC attendance (<4 visits)	119 (47.6)
Referred case	157 (62.8)
Referral delay >6 hours	80 (32.0)
Antibiotic delay >1 hour	84 (33.6)
Poor aseptic history	54 (21.6)
Maternal outcomes	
Adverse maternal outcome*	88 (35.2)
Prolonged hospital stay >7 days	82 (32.8)
ICU admission	41 (16.4)
Septic shock	34 (13.6)
Mechanical ventilation	17 (6.8)
Acute kidney injury	16 (6.4)
Hysterectomy	9 (3.6)
DIC	6 (2.4)

Maternal death	5 (2.0)
Recovery	245 (98.0)
Length of hospital stay, median (IQR), days	6 (4–9)

Table 4 shows that age and race are the most significant factors associated with adverse maternal outcomes among women who developed puerperal sepsis. Among women who had developed puerperal sepsis, age and race were the most important factors associated with adverse maternal outcomes, as seen in Table 4. The results of logistic regression analyses, univariable and multivariable are given in Table 4 and were used to determine factors associated with adverse maternal outcomes. After adjusting for other factors, hypotension at presentation was the most significant independent predictor of adverse maternal outcomes. The odds of adverse outcomes were over six times higher in women with hypotension compared to women without hypotension (AOR=6.39; 95% CI: 2.57–15.89; $p<0.001$). Poor maternal outcomes was also independently associated with retained products of conception, (AOR=4.58, 95% CI: 1.81–11.61; $p=0.001$), highlighting the need to ensure that the intrauterine material is removed effectively. Postpartum haemorrhage was found to be a important factor that increased the odds of the adverse outcomes, (AOR=3.21; 95% CI: 1.45–7.13; $p=0.004$). Prolonged labour exceeding 12 hours was associated with increased risk of poor outcomes (AOR=2.83; 95% CI: 1.37–5.86; $p=0.005$), while prolonged rupture of membranes >18 hours also remained a significant predictor (AOR=2.60; 95% CI: 1.33–5.10; $p=0.005$). Higher CRP levels (>120 mg/L) were associated with worse outcomes, even after adjusting for other factors, indicative of the greater inflammatory burden being associated with the severity of disease (AOR=2.53; 95% CI: 1.22–5.22; $p=0.012$). Also, the odds of having adverse maternal outcomes was higher for women who had the cesarean delivery compared to women who were delivered vaginally (AOR=2.24; 95% CI: 1.20–4.17; $p=0.011$). However, other factors such as referral delay, antibiotic delay, anaemia and low antenatal-care attendance, were not statistically significant after adjustment. Overall, the regression analysis shows that clinical severity markers and obstetric complications were the most important independent factors associated with adverse maternal outcomes in women who developed puerperal sepsis.

Table 4. Factors Associated with Adverse Maternal Outcomes among Women with Puerperal Sepsis

Predictor	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Hypotension at presentation	5.15 (2.38–11.13)	<0.001	6.39 (2.57–15.89)	<0.001
Retained products	3.44 (1.58–7.49)	0.001	4.58 (1.81–11.61)	0.001
Postpartum haemorrhage	2.66 (1.36–5.23)	0.004	3.21 (1.45–7.13)	0.004
Prolonged labour >12 h	2.59 (1.41–4.73)	0.002	2.83 (1.37–5.86)	0.005
PROM >18 h	1.80 (1.03–3.13)	0.037	2.60 (1.33–5.10)	0.005
CRP >120 mg/L	2.33 (1.27–4.29)	0.006	2.53 (1.22–5.22)	0.012
Caesarean delivery	2.36 (1.39–4.01)	0.001	2.24 (1.20–4.17)	0.011
Referral delay >6 h	—	—	1.70 (0.89–3.28)	0.110
Antibiotic delay >1 h	1.78 (1.03–3.05)	0.037	1.64 (0.86–3.12)	0.132
Anaemia	—	—	1.34 (0.72–2.52)	0.358
Low ANC (<4 visits)	—	—	0.78 (0.42–1.46)	0.437

The figures 1-6 all illustrate the main clinical outcomes, independent predictors, microbiological profile, key maternal and obstetric factors, distribution of maternal age, and mode of delivery for women with puerperal sepsis. As seen in Figure 1, 35.2% of women had an adverse maternal outcome and 32.8% of women had a longer hospital stay greater than 7 days. 16.4% of patients were admitted to the ICU, and 13.6% were admitted with septic shock. Those complications were mechanical ventilation (6.8%), acute kidney injury (6.4%), hysterectomy (3.6%), disseminated intravascular coagulation (2.4%) and maternal death (2.0%) and were less frequent but clinically relevant. These results show that, while mortality was not that high, a large percentage of women developed severe morbidity that needed intensive management. The multivariable logistic regression results for independent predictors of adverse maternal outcomes are shown in Figure 2. The most important predictor was hypotension at presentation, with an adjusted odds ratio of 6.39 indicating that there was a significantly higher risk of an adverse outcome. Poor outcome was also strongly associated with retained products of conception, postpartum haemorrhage, prolonged labour (more than 12 hours), prolonged rupture of membranes (more than 18 hours), CRP greater than 120mg/L and caesarean delivery, which were all strongly associated with poor outcome when analyzed as separate factors. The confidence intervals for these factors were all above the null value, so the factors are statistically significant independent predictors of adverse maternal outcomes. The microbiological distribution is shown in figure 3 for 142 culture positive cases. The most common organism identified was *Escherichia coli* (33.8%) and next was *Klebsiella* species (21.1%). 15.5% of infections were mixed or polymicrobial, and 11.3% were due to *Streptococcus* species. Other organisms represented 4.2% and *Staphylococcus aureus* species 8.5% and *Enterococcus* species 5.6% of the cases. This dataset indicates that Gram-negative organisms, including *E. coli*, and *Klebsiella* spp., play a significant part in the microbiology of puerperal sepsis. The main maternal, obstetric and health care-related factors of the study sample are summarized in figure 4. One of the most prevalent factors was anaemia, which was observed in 54.8% of women, and 47.6% of women had less than four antenatal care visits. 43.2% of the cases were delivered by cesarean section. Long rupture of membranes (more than 18

hours) was noted in 30.4% of women and long labour (12 hours or longer) was present in 22.8% of women. Retained products of conception, postpartum haemorrhage, referral delay of more than 6 hours and delay in antibiotics administration of more than 1 hour were recorded at 12.4%, 16.8%, 32.0% and 33.6% respectively. The figure thus shows that the obstetric complications and the delays in seeking care were relatively high among women with puerperal sepsis. The distribution of maternal age is presented in figure 5. The mean maternal age was 28.4 ± 6.1 years, suggesting that most affected women were of reproductive age, which is usually the age group for childbirth. The highest number of cases was seen in the 20-34 age group, and the number of cases gradually decreased with age. This is similar to the general demographic profile of the cohort where most women were in the 20–34 age group. The mode of delivery of women with puerperal sepsis is as shown in figure 6. Vaginal delivery was the most common mode of delivery (54.4%), caesarean delivery (43.2%) and instrumental delivery (2.4%). Caesarean delivery was more common in this overall population, but despite that it was clinically important, having an independent association with adverse maternal outcome in the multivariable analysis. The data from Figures 1–6 altogether illustrate that puerperal sepsis had significant maternal morbidity and that the specific factors associated with this were haemodynamic instability, retained products, post-partum haemorrhage, prolonged labour and prolonged rupture of membranes, elevated inflammatory markers, and caesarean delivery.

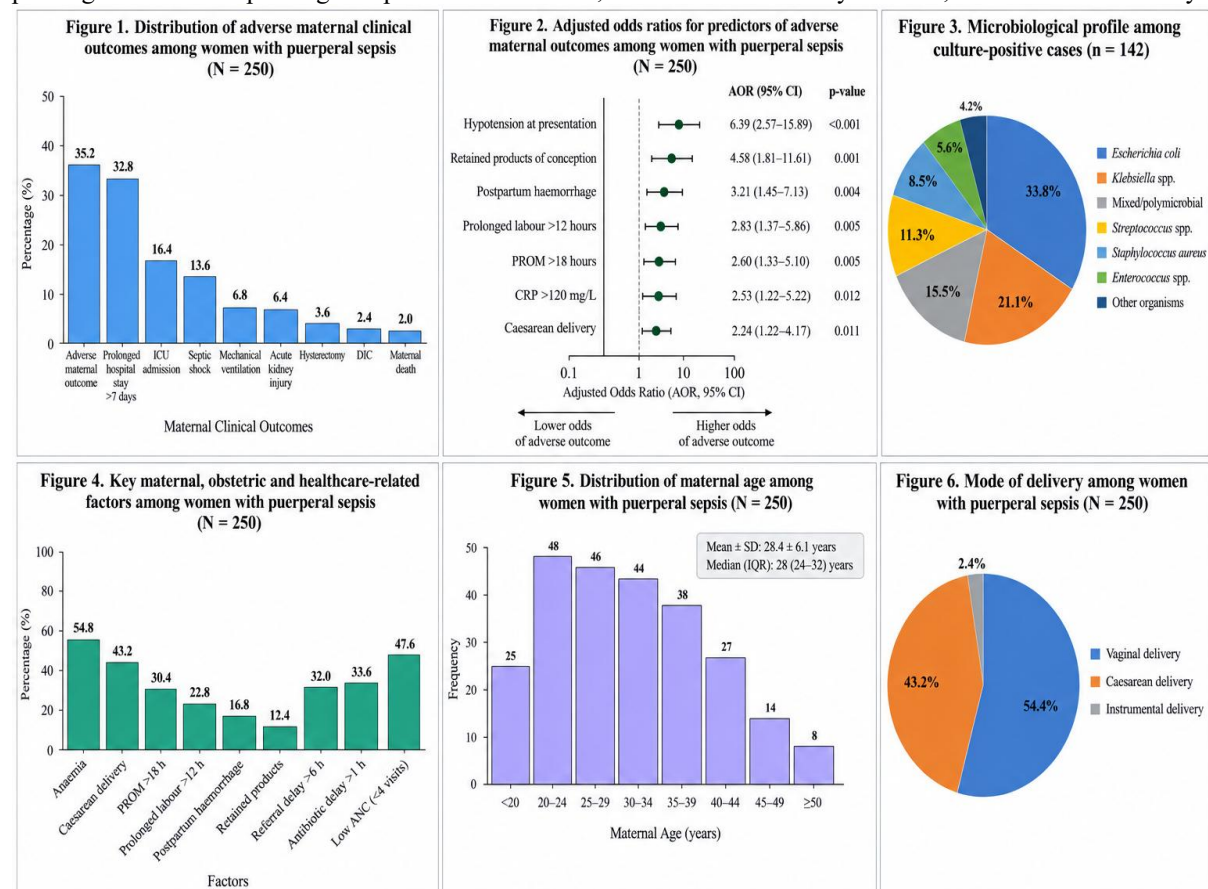


Figure 1-6. Comprehensive Overview of Clinical Characteristics, Risk Factors, Microbiological Profile, and Maternal Outcomes Among Women with Puerperal Sepsis (N = 250)

4. DISCUSSION:

This study aimed to assess the clinical features, risk factors, maternal outcomes of women with puerperal sepsis. The results showed that there is still high maternal morbidity associated with puerperal sepsis, with over one-third of women experiencing poor maternal outcomes. The most common complications were prolonged hospitalization, intensive care unit admission and septic shock. The results are similar to recent global data that show maternal sepsis remains a significant preventable cause of maternal morbidity and mortality, especially in low and middle income countries, where inadequate recognition, referral and treatment are challenges [25,26]. In this analysis, hypotension on presentation was the most powerful independent risk factor associated with adverse maternal outcome. Women who went to the hospital with hypotension were over six times more likely to experience severe complications. This discovery emphasizes the need for recognizing haemodynamic deterioration in women with puerperal sepsis early. If treatment is delayed, maternal sepsis can quickly turn into systemic inflammatory response, circulatory failure and multiple organ dysfunction. The finding of recent WHO Global Maternal Sepsis Study showed strong correlation of clinical parameters of organ dysfunction such as circulatory instability with severe maternal outcome [27]. So early detection of hypotension and prompt activation

of sepsis management pathways continues to play a crucial role in decreasing the incidence of maternal complications.

Other factors associated with adverse outcomes as independent factors were retained products of conception and postpartum haemorrhage. Infected intrauterine material can serve as a continually available source of bacterial proliferation and inflammation and may contribute to the development of complications such as severe sepsis. Likewise, postpartum haemorrhage can exacerbate the susceptibility of the mother due to hypovolaemia, decrease tissue oxygenation and increase the risk of complications from infection. Obstetric complications, such as postpartum haemorrhage and retained placental tissue have been reported as factors that contribute to severe maternal infection and poor outcome in previous studies [25]. These results justify the need for early diagnosis and treatment of uterine infections and early control of obstetric bleeding. Other factors such as prolonged labour and prolonged rupture of membranes were also found to be independently associated with adverse maternal outcomes in this study. Both diseases allow the reproductive tract to be exposed to ascending microorganisms for a longer time and can aid in bacterial invasion. A recent systematic review and meta-analysis indicated that insufficient infection prevention measures, repeated vaginal examinations, prolonged labour and premature rupture of membranes were risk factors for puerperal sepsis [26]. Similarly, in facility-based studies, a longer labor time and longer rupture of membranes have been linked to higher risk of postpartum infection and severe maternal complications. The observations highlight the need for proper intrapartum surveillance, timely decisions on the management of labour and the application of infection control measures.

Another important independent predictor of adverse maternal outcomes identified in the present study was cesarean delivery. Risks of puerperal infection include surgical wound injury, a prolonged hospital stay and postoperative wound problems, which can occur when the child is born by caesarean section, but can be avoided with this intervention. In recent epidemiological research, obtainment of cesarean section has been consistently considered as a significant risk factor for puerperal sepsis and for puerperal infection-related morbidity [26]. So appropriate surgical indications, proper pre and post-operative antibiotic prophylaxis and careful surveillance are essential to reduce the risk of infection related complications. Microbiological results indicated that the most common organism isolated from culture-positive samples was *Escherichia coli* followed by *Klebsiella* species and polymicrobial infections. This is similar to the dominance of Gram-negative organisms seen in recent studies from Pakistan and other resource-limited settings, where enteric Gram-negative bacteria were found to be common pathogens of maternal sepsis. Local bacterial patterns are important as antimicrobial resistance with gram-negative organisms remains a challenge for effective management in maternal infections. There is scope to enhance microbiological surveillance and rational antibiotic use, which could lead to better treatment outcomes. Women who developed puerperal sepsis were often anaemic and had poor attendance at antenatal care, but these factors were not significantly associated with puerperal sepsis in the multivariable model. There is evidence that previous studies have shown that anaemia, poor antenatal care and late use of skilled maternal services are associated with a greater risk of infection and poor maternal outcomes due to reduced physiological reserve and late detection of pregnancy-related complications. The current cohort's high prevalence of these factors reinforces the ongoing need to further build the capacity of the antenatal services and increase access to maternal health services. The results of this study has important clinical implications. The factors identified as being associated with adverse outcomes – such as hypotension, retained products of conception, postpartum haemorrhage, prolonged labour, and prolonged rupture of membranes, elevated CRP levels and caesarean delivery – offer opportunities for targeted interventions. Early detection, timely antibiotic treatment, speedy referral and multi-disciplinary treatment by obstetricians, microbiologists and critical care teams could minimize the severe consequences of puerperal sepsis [27].

5. CONCLUSION

This study points out that puerperal sepsis is still an important cause of maternal morbidity a significant number of women developing significant clinical complications. The results showed that clinical severity on presentation, obstetric issues and health care related factors were associated with adverse maternal outcomes. Due to these adverse outcomes, more than one-third of women had prolonged hospitalization, intensive care admission, septic shock, organ dysfunction and maternal death. Hypotension at presentation was found to be the best independent predictor of poor maternal outcome, highlighting the need for early detection of haemodynamic instability and swift commencement of maternal sepsis management protocols. There was also an increased risk of adverse outcome with retained products of conception, postpartum haemorrhage, prolonged labour, and prolonged rupture of membranes, elevated inflammatory markers and caesarean delivery. The findings indicate that early detection and intervention in these high-risk obstetric conditions can significantly impact the severity of maternal outcomes. Microbiological results showed that the majority of those who yielded culture were Gram-negative organisms, especially *Escherichia coli* and *Klebsiella* species. This underscores the need for enhanced microbiological surveillance, antimicrobial use and management for infections in individual institutions. Measures to plan for better outcomes among women with puerperal sepsis include better attendance of women at ante natal care and prompt referral, reducing delays in the administration of antibiotics, adherence to strict infection prevention measures during labour and early warning systems for maternal deterioration. The study offers clinically applicable information on factors associated with poor outcomes of women with puerperal sepsis at tertiary

hospital. Predictors of independence may help to stratify the women and guide more intensive care for those at higher risk.

5.1 LIMITATIONS

There are some limitations to this study. First, this is a retrospective cohort study, and clinical data that are routinely recorded may be incomplete or laboratory/clinical data may be omitted, which can affect some measurements. Second, the study was performed in a single tertiary care hospital; findings might not be generalizable to other hospitals, or other healthcare settings where the patient population and referral patterns may be different. Thirdly, since only women with puerperal sepsis were included in the study, it was not possible to identify the risk factors for the development of puerperal sepsis and also to compare it with those who did not develop puerperal sepsis. Predictors of poor outcomes in women with existing puerperal sepsis were the major finding of this analysis. Fourth, not all cases were confirmed microbiologically, which could have reduced the ability to fully assess pathogen distribution and antimicrobial resistance patterns. Finally, even after multivariable regression was used to adjust for possible confounding factors, residual confounding from unmeasured factors, like nutritional status, socioeconomic barriers, healthcare-seeking behaviour and quality of care, may remain. Further multilevel prospective studies with larger sample sizes and a control group are suggested to generate more evidence on the determinants of maternal outcome due to puerperal sepsis and prevention strategies.

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