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ORIGINAL ARTICLE

Risk factors, microbiology and clinical outcomes of puerperal sepsis.

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ABSTRACT… Objective: To determine the factors leading to the development puerperal sepsis. A secondary objective was to determine the pattern of bacterial spectrum in-hospital mortality to puerperal sepsis in our local population. **Study Design:** Descriptive Cross-sectional study. **Setting:** A Tertiary Care Hospital Department of Gynaecology and Obstetrics, Unit 3, Civil Hospital Karachi. **Period:** 4th March 2022 to 22nd September 2022. **Methods:** The study recruited post-delivery women with clinical diagnosis of puerperal sepsis. Socio-demographic, clinical and obstetric information, factors leading of termination of pregnancy and in-hospital mortality were collected. **Results:** 177 Puerperal sepsis patients presenting with fever, lower abdominal pain, and foul-smelling lochia were analysed. The average age of the patients was 30.2 (± 7.4) years, ranging between 20-45 years. Mean gestational age was 37.9 (± 3.4) weeks. Majority (85%) were delivered after 36 weeks. Risk factors for puerperal sepsis included caesarean section in 137 (77.4%), anaemia in 105(59.3%) and diabetes in 4 (7.9%). A total of 108 (61.1%) blood cultures were positive. The most common organism was staphylococci aureus (32.2%) followed by E. coli (14.7%), klebsiella pneumonia (7.9%) and streptococcus pyogenes (1.1%). Both pseudomonas and proteus were observed in 2.8% cases. It has observed that 16 (9%) died during hospital stay. **Conclusion:** Caesarean delivery, anaemia and diabetes were associated with high risk of puerperal sepsis. Most of the bacterial infection was found to be caused by Staphylococcus Aureus which accounted for 57 [32.2%].

Key words: Antimicrobial Susceptibility, Blood Culture, Bacterial Spectrum, In-hospital Mortality, Puerperal Sepsis, Termination of Pregnancy, World Health Organization (WHO).

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INTRODUCTION

The World Health Organization (WHO) defines puerperal sepsis as an infection of the genital tract that occurs during labour or within 42 days following childbirth.[1] It is a highly preventable and treatable condition, occurring in 1-8% of all deliveries, associated with significant morbidity and mortality. Half of the maternal deaths related to childbirth during the 18th and 19th century, were due to puerperal sepsis and it was the single most common cause of maternal mortality. Puerperal Sepsis was the most common cause of maternal mortality (30.9%), followed by obstetric haemorrhage and hypertensive disorders of pregnancy according to a study conducted in a tertiary care hospital of Uganda.[2] According to the WHO, 15% of the 358,000 maternal deaths occurring during labour and childbirth were attributed to sepsis.[3] Now when we are in the 21st century, it is still one of the main obstetric clinical complications in developed and developing countries both, despite the availability of low-cost antibiotics and the application of standard aseptic techniques. Home deliveries in unhygienic conditions, low socioeconomic status, poor nutrition, primiparity, anaemia, prolong rupture of membranes, multiple vaginal examinations and caesarean sections are key predisposing factors that contribute to the development of sepsis.[4] Delivery by an untrained traditional birth attendant/ Dai, traditional practices such as insertion of foreign objects and substances into vagina, delay in reaching appropriate level of health facility due to lack of transportation and resources, cultural factors which delay care seeking behaviour also contribute to this major public health problem and posing a significant challenge to overburdened health care system. Puerperal sepsis is caused by a variety of different aerobic and anaerobia microorganisms and is frequently a polymicrobial infection. Escherichia Coli is commonly reported as a major cause of severe maternal sepsis originating from the genital tract.[5,6]

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Additionally, Group A Streptococcus, Staphylococcus aureus, Streptococcus spp., Klebsiella species, Pseudomonas spp. and anaerobes are implicated in the majority of cases.[6] Among these group A streptococci is the most feared pathogen.[7] Puerperal infections delay postpartum restoration, requires women to be hospitalized for prolonged period and interfere with the bonding between mother and newborn.

In Pakistan, specially in rural areas still a big proportion of women are delivering at home by untrained personnel in unhygienic environment resulting in an increased incidence of puerperal sepsis accounting for about 16.3% of maternal mortalities.[8] According to a study conducted in Civil Hospital Karachi Gynae unit III in 2005-2008, 6.7% maternal mortalities were due to puerperal sepsis.[9] It causes a considerable impact on the neonate, with 1 million neonatal deaths attributed to maternal infection or sepsis annually.[10] Incidence and mortality rate varies among different studies conducted in different regions of Pakistan as many cases go undiagnosed and unreported. Kajeguka et al evaluated patients presenting with puerperal sepsis and factors leading to its development (postpartum haemorrhage 57.1%, caesarean delivery 66.7%, vaginal delivery 33.7%, diabetes mellitus type II 4.8% and anaemia 66.7%).[10] Tamboli et al study showed klebsiella pneumonia (28.26%), staphylococci aureus (21.73%), pseudomonas aeruginosa (19.5%), proteus (10.8%), E. Coli (8.69%) and streptococcus (6.52) isolated in patients with puerperal sepsis.[11] Khaskheli et al found in-hospital mortality in puerperal sepsis to be 8.52%.[12] Among the leading causes of preventable maternal morbidity and mortality in developing countries are maternal infection or sepsis. The progression of sepsis is lethal hence early identification may help reduce further complications.

Very few research has been conducted locally, particularly on bacterial aetiology relating to puerperal sepsis. It is widely recognized that bacterial infection patterns and their antimicrobial resistance are constantly evolving, making regular surveillance of this critical issue essential in all healthcare settings. Hence in this study patients presenting with puerperal sepsis will be analysed so the findings of this study may help to plan implementation of preventive measures and early recognition of this complication that would remarkably reduce the morbidity and mortality associated with it.

OBJECTIVES

1. To determine the factors leading to the development of puerperal sepsis at Civil Hospital Karachi, Sindh.
2. To determine the pattern of bacterial spectrum in patient presenting with puerperal sepsis.
3. To determine the in-hospital mortality in patient presenting with puerperal sepsis.

METHODS

A descriptive, observational, cross-sectional study was conducted at the Department of Gynaecology and Obstetrics, Unit 3, Civil Hospital Karachi from March 4, 2022, to September 22, 2022.

A total of 176 patients were included in the study. The sample size was determined using a Prevalence rate of vaginal delivery of 33.7%[10], a margin of error of 7% and a confidence level (C.I) of 95%. The WHO sample size calculator was employed to compute the required sample size.

- **Inclusion Criteria**

Patients presenting with fever, lower abdominal pain, and foul-smelling lochia after delivery were included in the study after receiving a valid informed consent from the patients.

- **Exclusion Criteria**

Patients who presented with fever either during pregnancy, after delivery or following a miscarriage and whose symptoms persisted for more than 42 days were excluded from the study. Additionally, patients presenting with fever due to other medical conditions such as Malaria, Dengue, Typhoid, wound infection (other than episiotomy and C/S), mastitis, UTI or thrombophlebitis were also excluded from the study.

Data Collection Procedure

This study was carried out after seeking a formal approval from the College of Physicians and Surgeons Pakistan (CPCP/REU/OBG-2019-183-9591-30-10-23). Patients presenting to department

of Obstetrics and Gynaecology, Civil Hospital Karachi who met the inclusion criteria and not having the conditions specified in exclusion criteria were enrolled in the study. An informed verbal consent was taken after explaining the purpose of the study. Brief history including demographic data was taken. Patients developing puerperal sepsis were evaluated by the researcher for factors leading to its development (postpartum haemorrhage, caesarean delivery, vaginal delivery, diabetes mellitus type II and anaemia) after confirming on history and medical records at the time of delivery. Specimens for culture were obtained by the researcher. The swabs were sent to microbiology laboratory after being immersed in transport medium. These samples were stored in steriled containers before being transported to the microbiology laboratory after being stored in sterile containers. Suspected positive cultures were sub-cultured to MacConkey agar, Bile Esculin Agar, Mannitol salt Agar, Blood Agar and Chocolate Agar which were incubated for 48 hours at 37 °C in 5 % CO2. Plates which showed growth were considered positive, while those with no growth were classified as negative, as reported by the same microbiologist. Using routine microbiological methods positive growths were subsequently identified. The names of the organisms identified, and the pattern of growth were included in the laboratory data and were indicated by the number of colonies forming units on the culture for each organism, by the microbiologist and reported to the researcher. All patients were followed during stay in hospital and till 2 weeks after discharge. The findings were entered in a pre-designed proforma by the researcher.

Data Analysis

The data were analysed using SPSS Version 20. Mean and standard deviations were calculated for the quantitative variables like maternal age, length of hospital stay, and gestational age. For quantitative variables normally distributed mean and standard deviation was reported while median (IQR) was reported for the non-normality distributed quantitative variables. For the qualitative variables, including residence status, parity, gravida, antenatal care status, rupture of membrane, prolonged labour, family monthly income, educational status, occupational status, factors leading to the development puerperal sepsis, pattern of bacterial spectrum and in-hospital mortality frequencies and percentages were calculated. Effect modifiers including maternal age, residence status, parity, gravida, antenatal care status, rupture of membrane, prolonged labour, family monthly income, educational status and occupational status were controlled through stratification to see the effect of these on outcome variables. P-value of ≤ 0.05 was taken as statistically significant and applied on post stratification chi square test/Fischer test.

RESULTS

177 patients who were diagnosed clinically as Puerperal sepsis presenting with fever, lower abdominal pain, and foul-smelling lochia after delivery, having parity ≥ 1 and women aged between 20 and 45 were part of the study. The average age of the patients was 30.2 (± 7.4) years, ranging between 20-45 years, with median age was 28 years. Most of the patients are aged 20-30 years, accounting for 105 (59%). The average stay of women in the hospital was 7.8 (± 2.3) days, and 151(85.3%) had stayed >= seven days. The mean gestational age of women was 37.9 (± 3.4), and 151(85%) women belonged to gestational age more than 36 weeks. Almost 118(66.7%) women came from urban residential areas. Antenatal Care observed in 57 (32.2%) of the total women. 92 (52%) of women had gravida less than 3. 118(66.7%) women were multiparous, and the remaining 59 (33.3%) were primigravida. 132 (74.6%) women had membranes ruptured for <24 hours, and 135 (76.3%) had labour for <12 hours.

FIGURE-1

Duration of rupture of membranes in women presenting with puerperal sepsis.

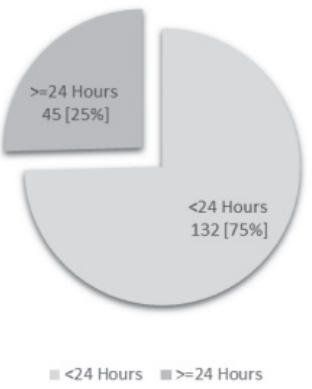


FIGURE-2

Prolonged labour in patients presenting with puerperal sepsis.

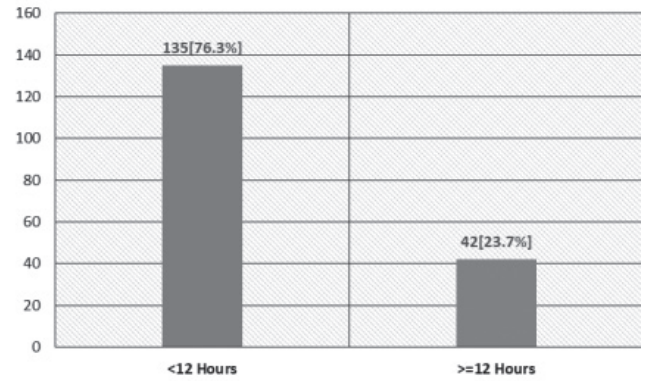
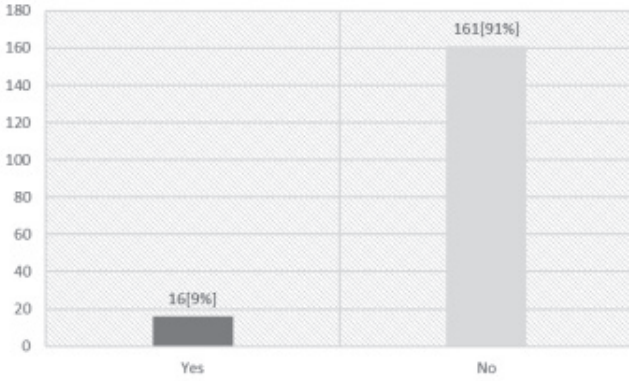


FIGURE-3

Maternal mortality in patients presenting with puerperal sepsis.



Almost all women with a family monthly income had < 50000 PKR, accounting for 176 (99.4%). Majorities were housewives, 176 (99.4%), and one woman was found to be employed. The most common risk factor was caesarean section in 37(77.4%) and anaemia in 105(59.3%) was the second most common factor. Other risk factors included prolonged rupture of membranes (25%), prolonged labour (23.7%), PPH (8.5%) and diabetes (2.3%). A total of 108 (61.1%) blood cultures were positive, with Staphylococci Aureus (32.2%) the most predominant bacteria, followed by 26[14.7%] E-coli, 7.9% were Klebsiella Pneumonia and 1.1% were Streptococcus pyogenes. In comparison, Pseudomonas aeruginosa and Proteus each accounted for 2.8%. 16 (9%) died during hospital stay due to severe sepsis.

TABLE-I

Frequency of Bacterial Spectrum in patients presenting with puerperal sepsis

Bacterial Spectrum	Yes	No
Klebsiella Pneumonia	14 [7.9%]	163 [92.1%]
Staphylococcus Aureus	57 [32.2%]	120 [67.8%]
Pseudomonas Aeruginosa	4 [2.3%]	173 [97.7%]
Proteus Mirabilis	5 [2.8%]	172 [97.2%]
Escherichia Coli	26 [14.7%]	151 [85.3%]
Streptococcus Pyogenes	2 [1.1%]	175 [98.9%]

The comparison of maternal mortality among all demographics and clinical characteristics observed that parity, prolonged duration of labour, family monthly income, and occupation status were significantly associated with maternal outcome.

In contrast diabetes mellitus does not associate with any confounding parameters. It has been observed that anaemia was statistically significantly associated with almost all study parameters. Bacterial infections were compared among all confounding of the parameters.

DISCUSSION

Globally, puerperal sepsis has been proved to be one of the primary contributors to maternal morbidity and mortality. The World Health Organization (WHO) defines puerperal sepsis as an infection of the genital tract that occurs during labour or within 42 days after childbirth. Common symptoms of puerperal sepsis/pyrexia include fever, pelvic pain, foul-smelling vaginal discharge, and delayed uterine involution.[13] In underdeveloped countries, this group of women faces significant challenges due to infective morbidities worldwide. It has several reasons such as due to poverty, illiteracy, or malnutrition. Poor nutritional status and low resistance to the infection during pregnancy leads to increased risk and these women often do not seek antenatal checkups or contraception guidance.

TABLE-II

Comparison of maternal mortality among demographics and clinical characteristics in patients presenting with puerperal sepsis

	Total	Maternal Mortality		P- Value
		Yes	No	
Total	**177**	**16**	**161**	-
Age Groups				
20-30 years	105 [59.3%]	11 [68.8%]	94 [58.4%]	0.421
31-45 years	72 [40.7%]	5 [31.3%]	67 [41.6%]	
Gestational Age (weeks)				
≤ 36 weeks	26 [14.7%]	2 [12.5%]	24 [14.9%]	0.795
≥ 36 weeks	151 [85.3%]	14 [87.5%]	137 [85.1%]	
Length of Hospital Stay				
≤ 7 days	168 [94.9%]	15 [93.8%]	153 [95%]	
≥ 7 days	9 [5.1%]	1 [6.3%]	8 [5%]	0.824
Residence Status				
Urban	118 [66.7%]	12 [75%]	106 [65.8%]	0.458
Rural	59 [33.3%]	4 [25%]	55 [34.2%]	
Antenatal Care Status				
Booked	57 [32.2%]	2 [12.5%]	55 [34.2%]	0.077
Unbooked	120 [67.8%]	14 [87.5%]	106 [65.8%]	
Gravida				
≤ 3	92 [52%]	12 [75%]	80 [49.7%]	0.053
≥ 3	85 [48%]	4 [25%]	81 [50.3%]	
Parity				
Primigravida	59 [33.3%]	9 [56.3%]	50 [31.1%]	0.041*
Multigravida	118 [66.7%]	7 [43.8%]	111 [68.9%]	
Rupture of Membranes				
≤ 24 hours	132 [74.6%]	11 [68.8%]	121 [75.2%]	0.575
≥ 24 hours	45 [25.4%]	5 [31.3%]	40 [24.8%]	
Prolonged Labour				
≤ 12 hours	135 [76.3%]	8 [50%]	127 [78.9%]	0.01*
≥ 12 hours	42 [23.7%]	8 [50%]	34 [21.1%]	
Family monthly income				
≤ 5000 PKR	176 [99.4%]	15 [93.8%]	161 [100%]	0.001*
≥ 5000 PKR	1 [0.6%]	1 [6.3%]	0 [0%]	
Occupational Status				
Employed	1 [0.6%]	1 [6.3%]	0 [0%]	0.001*
Unemployed	176 [99.4%]	15 [93.8%]	161 [100%]	
Educational Status				
Illiterate (never went to school)	132 [74.6%]	13 [81.3%]	119 [73.9%]	
Primary (Class 1-5)	35 [19.8%]	3 [18.8%]	32 [19.9%]	0.775
Secondary (Class 6-Matric)	6 [3.4%]	0 [0%]	6 [3.7%]	
Higher (Intermediate Graduate)	4 [2.3%]	0 [0%]	4 [2.5%]	

Majority of the cases included in this study, were referrals delivered in other health facilities 176 (99.4%) and had undergone induction of labour 37 (20.9%), with inadequate sterilization and lack of aseptic techniques by unskilled personnel. This can lead to significant infective morbidities. Most of the women in our study, 135 (76.3%), had rupture of membranes with duration of less than 12 hours upon admission. In these women, a prolonged second stage of labour led to a higher rate of interventions, including emergency Caesarean section 137 (77.4%) and instrumental vaginal deliveries 22 (17.05%). Similar findings were reported by Shamshad et al.[14], Seale AC et al.[15] and Hussein J et al.[16] who emphasized that specific interventions for the prevention and treatment of infection should include proper hand hygiene, the use of antiseptic solutions and appropriate antibiotic coverage. Proper education, development of national and local guidelines and various technologies are required to control and reduce the rate of infection.[17]

The mortality rate was 16 (9%), as reported by other national studies.[18] According to a study conducted in CHK Gynae unit III in 2005-2008, 6.7% maternal mortalities were due to puerperal sepsis.[9] Maternal infection or puerperal sepsis results in a considerable impact on the neonate, leading to 1 million neonatal deaths annually.[10] Incidence and mortality rate varies among different studies conducted in different areas of Pakistan as many cases go undiagnosed and unreported. Kajeguka et al evaluated patients presenting with puerperal sepsis and factors leading to its development (postpartum haemorrhage 57.1%, caesarean delivery 66.7%, vaginal delivery 33.7%, diabetes mellitus type II 4.8% and anaemia 66.7%).[10] Tamboli et al study showed klebsiella pneumonia (28.26%), staphylococci aureus (21.73%), pseudomonas aeruginosa (19.5%), proteus (10.8%), E. Coli (8.69%) and streptococcus (6.52) isolated in patients with puerperal sepsis.[11] Khaskheli et al found in-hospital mortality in puerperal sepsis to be 8.52%. (12) Managers' roles are not well specified, contributing to poor service quality.[19,20] Prophylactic antibiotics during surgery reduce the risk of endometritis by 66-75% and minimizes the rate of wound infection.[21] In this region of the world, proper education, infection prevention and control trainings regarding antiseptic techniques, and proper antibiotic cover need to be improved significantly. Prolonged rupture of membranes[22] and prolonged labour[23] are significant risk factors that contribute to infection around the time of delivery as prolonged opening of the cervix, and the impairment of natural barriers that prevent ascending infections from the vagina.[14] Multiple vaginal examinations[38] and using unclean material to control the flow of lochia[24] are significant risk factors and should be avoided during labour and delivery. Intrapartum bleeding, perineal tears, and stillbirth are other determinants during labour and delivery.[25] The low socioeconomic status of mothers[24], which may be linked to illiteracy, limited access to antenatal care, poor hygiene, and overall health[14-16,19,20,22,24], represents key community level risk factors for puerperal sepsis.

Many traditional practices have been observed to result in poor hygiene, such as not taking a bath in the postpartum period, and this highlights the need to focus on the socio-cultural reasons which might be facilitating puerperal infection. These observations align with the findings from the reviews conducted in developing countries and sub-Saharan Africa.[15] However, the relative importance of risk factors may vary depending on the region and setting. Caesarean section has been identified as a key factor contributing to puerperal infection in several reviews.[13-26]

This might explain the increasing rates of puerperal sepsis in healthcare facilities, driven by the rising trend of assisted deliveries particularly caesarean sections. In this systematic review, risk factors for puerperal sepsis were identified from the studies where it was a secondary objective and therefore the investigation was not comprehensive. Mortality from puerperal sepsis which is an essential indicator of the magnitude of this condition was not investigated as an outcome in this review. Puerperal sepsis, if not diagnosed and managed timely, can rapidly worsen resulting in significant morbidity[22], leading to severe septicaemia and ultimately death. The highest proportion of global maternal deaths in South Asia results from sepsis at 13.7%, resulting in 107,000 maternal deaths between 2003 and 2009[26] and approximately 9,400 deaths in 2013.[27] Hence, puerperal sepsis remains a significant

problem in South Asia, despite of having a relatively low estimated prevalence, due to potentially severe sequelae and its impact on maternal mortality. The most common microorganisms causing puerperal sepsis include Escherichia coli, staphylococcus aureus, and Streptococcus species. Other organisms include Klebsiella, Clostridium sordellii, Mycoplasma, Chlamydia, and coliform bacteria.[28] In a prospective cohort study involving 151 women with puerperal sepsis, the authors discovered that the most common bacterial isolates were E. coli (30.6%) and Klebsiella pneumoniae (15.3%), followed by coagulase-negative staphylococci and S. aureus.[29] This study observed that primiparity, lack of antenatal care, and caesarean delivery were significant factors for developing puerperal sepsis. In addition, it was observed that maternal anaemia, prolonged labour, and prolonged rupture of membranes was associated with a significantly higher risk of developing puerperal sepsis compared to other factors, as highlighted in a study by Maharaj D et al.[30] Burrows LJ et al. found that primary caesarean delivery with the trial of labour resulted in 21.2-fold increased risk of endometritis compared to spontaneous vaginal delivery. Women who underwent primary caesarean section, even without undergoing a trial of labour, were 10.3 times more likely to develop endometritis as compared to those who had spontaneous vaginal delivery.[31] This risk persisted even after prophylactic antibiotics were administered to all cases undergoing caesarean section, as recommended by the RCOG green top guidelines. Therefore, it is necessary to review our antibiotic policy and asses their effectiveness. Additionally, as the rates of caesarean sections are rising in developed as well as developing countries, it is suggested the incidence of puerperal pyrexia is expected to rise in the coming years. In a study conducted by Bako B et al., the most isolated microorganism were Staphylococcus aureus and Escherichia coli.[32] Several factors, including the mode of delivery (caesarean section), postpartum haemorrhage, moderate to severe anaemia, and prolonged labour were statistically associated with puerperal sepsis in both this study, and previous research. Puerperal sepsis was specifically correlated with the mode of delivery. Some data suggest that mothers who gave birth via spontaneous vaginal delivery were more likely to develop puerperal sepsis compared to those who had a caesarean section. These findings contrast with studies conducted in Ethiopia and Nigeria.[32] Additionally, this differs from a study in Uganda, which identified caesarean delivery was an independent risk factor for puerperal sepsis.[33]

In contrast to a study conducted in Ethiopia, which found that women who underwent caesarean sections had a lower risk of developing puerperal sepsis compared those who had a spontaneous vaginal delivery.[34] This study found that prolonged labour was strongly associated with an increased risk of puerperal sepsis. According to a study by Demisse et al.[33,35], participants with labours lasting 12 to 24 hours or longer than 25 hours had 3.1 and 4.7 times, respectively, the risk of developing puerperal sepsis compared to those with labours lasting less than 12 hours. The current study also identified anaemia as a major risk factor for puerperal sepsis. A study conducted in Kenya similarly found that anaemia is indirectly associated with both maternal mortality and puerperal sepsis.[36] To understand how anaemia contributes to puerperal sepsis more research is required. This study provides valuable insights for designing effective Reproductive Health Control Plans aimed at reducing the prevalence of puerperal sepsis and its associated morbidity among postnatal women receiving hospital care. This study also found that multiple vaginal examinations were associated with puerperal sepsis, with 77(51%) cases having undergone more than five vaginal examinations. This is consistent with a study conducted in Egypt, which found that having more than five vaginal examinations increased the risk of developing puerperal sepsis.

Similarly, a systematic review in South Asia demonstrated that frequent vaginal examination with unwashed hands significantly raised the risk of puerperal sepsis.[37] A study in Kenya reported that women who underwent two or more vaginal examinations were 3.95 times more prone to develop puerperal sepsis.[14-17,27,29,37,38] Recurrent manipulation of the genital tract increases the risk of transferring microorganisms from the lower genital tract, thereby increasing the likelihood of developing puerperal sepsis. In this study, 74 mothers (49.3%) with puerperal sepsis had prolonged labour lasting

more then 12 hours. Research from Kenya[39], Nepal[38], and Tanzania[39] summarized that the duration of labour contributes to the risk of puerperal sepsis, prolonged labour often leads to multiple and frequent vaginal examinations. Maternal sepsis is associated with significant morbidity and mortality which can be prevented by increasing awareness among antenatal women to seek regular antenatal care and visit for antenatal check-up as per the recommended schedule, identification of risk factors, and delivery in an aseptic and sterilized environment by trained healthcare personnel.

CONCLUSION

The mode of delivery, postpartum haemorrhage, prolonged labour, and anaemia are significant risk factors linked to puerperal sepsis. Majority of the bacterial infections were found to be due to Staphylococci Aureus which accounted for 57 [32.2%] of cases. However, it is recommended that to draw a firm and concrete conclusion further study with larger sample sizes may be conducted at local, regional and national levels. It is recommended that a surveillance system should be developed by the Pakistan Health Service to establish a monthly reporting system for reporting cases of puerperal sepsis.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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