

# Sociodemographic profile, clinical spectrum, and centers for disease control and prevention categorical evaluation of wound sepsis: Experience in a tertiary care hospital in India



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## ABSTRACT

**Background:** Over the last decade, the rate of cesarean sections has steadily increased owing to various reasons, and along with it the incidence of wound sepsis. Different risk factors identified are maternal age, socioeconomic status, educational status, antenatal visits, pregestational diabetes, obesity, recurrent pregnancy losses, duration of surgery, preterm rupture of membranes, etc. Hence, assessing infections and their management is an integral part of health care, as it helps develop strategies for prevention, better management of infection, reducing the hospital stay, and cost of healthcare. **Aims and Objectives:** The aim of the study was to assess and note the variability of social and demographic profiles of patients undergoing cesarean sections and developing wound infection, along with its various presentations and categories. **Materials and Methods:** A prospective observational study was conducted on patients who developed wound sepsis after undergoing cesarean section at a tertiary center in India. **Results:** Among the patients enrolled, 35.83% were illiterate and 45.83% were educated up to the tenth standard. About 74% of patients were not registered during the antenatal period. Furthermore, the majority of patients were overweight and obese (74%) and were from lower socioeconomic strata. About 85% of the patients who developed wound infection had their surgery lasting for more than 60 minutes. About 87.50% developed a superficial category of infection, and 68.33% presented within the first 5 days of surgery. Patients with deep infected wounds had significantly bigger wounds and longer hospitalization. **Conclusion:** Illiteracy and lower socioeconomic conditions predispose women to wound sepsis. A longer duration of surgery was associated with a higher risk of infection. Superficial wounds are the most common type of infection encountered. Deep and organ space categories of wound infection are associated with increased morbidity and longer hospitalization warranting aggressive management. Reducing the incidence of wound sepsis can help to reduce morbidity by identifying risk factors before pregnancy and supporting the implementation of preconception counseling centers and prenatal programs to educate and raise awareness among patients.

**Key words:** Wound sepsis; Superficial and deep infection; Wound reclosure

## INTRODUCTION

Motherhood is an unforgettable moment in a woman's life, thus good prenatal and postnatal care is of the utmost

importance. Cesarean section deliveries are one of the most common operative procedures performed by obstetricians. It is considered as a lifesaving procedure for emergency obstetrical conditions; hence, ensuring its access is an

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essential strategy to meet the Sustainable Development Goals for reducing perinatal mortality.<sup>1</sup>

Wound infection is an infection that affects the incisional site within 30 days of surgery and can be grouped as superficial, deep, or organ space, depending on the extent of the infection. Various risk variables have been observed including maternal age, socioeconomic status, educational status, prenatal visits, pregestational diabetes, obesity, repeated pregnancy losses, operation duration, and preterm rupture of membranes.

The risk factors can be classified as either modifiable or non-modifiable. Modifiable factors include glycemic management, dyslipidemia, hypertension, lack of physical exercise, addictions, and abdominal obesity. Few non-modifiable factors are old age, emergency surgery, duration of labor, duration of surgery, and complicated pregnancy. They are the most common of all hospital-acquired infections, accounting for 20% of all infections.<sup>2,3</sup> The average risk of infections (New NSQIP data) for clean contaminated wounds for superficial, deep, and organ/space are 3.94%, 0.86%, and 1.87%, respectively. Similarly, for contaminated wounds, average risks for superficial, deep, and organ/space infections are 4.75%, 1.31%, and 2.55%, respectively.<sup>4</sup>

### Aims and objectives

We aim to share our experience in a tertiary care hospital regarding the sociodemographic variations, clinical manifestations, and types of wound sepsis after caesarean.

## MATERIALS AND METHODS

### Study design and setting

A prospective comparative observational study was conducted after obtaining clearance from Ethical Committee at a tertiary care institute catering to all private and government care centers of the state.

### Study period

The study spans for 1 year, from January 2023 to December 2023.

### Study population

The study was conducted on 120 patients who developed wound infection after cesarean.

### Exclusion criteria

HIV-positive females or patients with pyrexia or features of pre-existing sepsis.

### Sample size

The sample size was obtained at a 5% level of precision

at 95% confidence level yielding a sample size of 120 at a power of 99% to detect difference at a significant level of 0.05.

A comprehensive medical history was taken from all participants, including their sociodemographic profile, and history of comorbidities such as diabetes mellitus, hypertension, or previous surgeries. Duration of procedure (time from incision to skin closure), and intraoperative complications were recorded. Clinical presentation of infections was noted and the wound was classified as superficial, deep, or organ-space infection as per centers for disease control and prevention (CDC) standards.<sup>5</sup> Management of wound sepsis as per the standard protocol of the department. Swabs were taken from the wound and culture growth obtained was documented. Data were recorded on a predesigned pro forma.

### Statistical analysis

Data were evaluated with statistical software. Descriptive statistics represented demographic and clinical features. The Chi-square test was used for categorical variables and analysis of variance for continuous variables to compare outcomes.  $P < 0.05$  was regarded as statistically significant.

### Ethical considerations

The study protocol was approved by the Institutional Biomedical Research Ethics Committee, Pt. BD Sharma PGIMS/UHS, Rohtak, Haryana, India, vide number BREC/22/TH/OBG-18. The study was conducted in accordance with ethical guidelines and standards. Informed consent was obtained from all participants.

## RESULTS

The results of this study were focused on identifying the various factors at play for the development of post-cesarean wound infection. Mean age of patients enrolled was 26.73 years, and the majority of the patients were either illiterate (35.83%) or had studied only up to the secondary level, that is, tenth grade (45.83%). Another factor noted was lower socioeconomic status. Majority of patients were from the lower strata of the society (63.33%). There was a paucity of regular antenatal visits in the study population developing infections (74.17% of patients were unbooked). A significant number of patients also had one or more comorbidities as depicted in Figure 1. Most of the cesareans were done at term (83.3%) and indications are shown in Figure 2.

The presentation of the infections and its categorization has been depicted in Table 1. Most of the patients presented with either wound dehiscence or induration around the

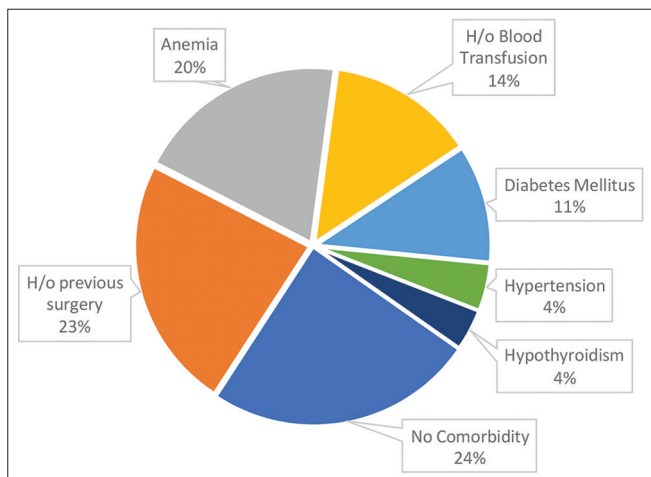


Figure 1: Distribution of comorbidities in the study population

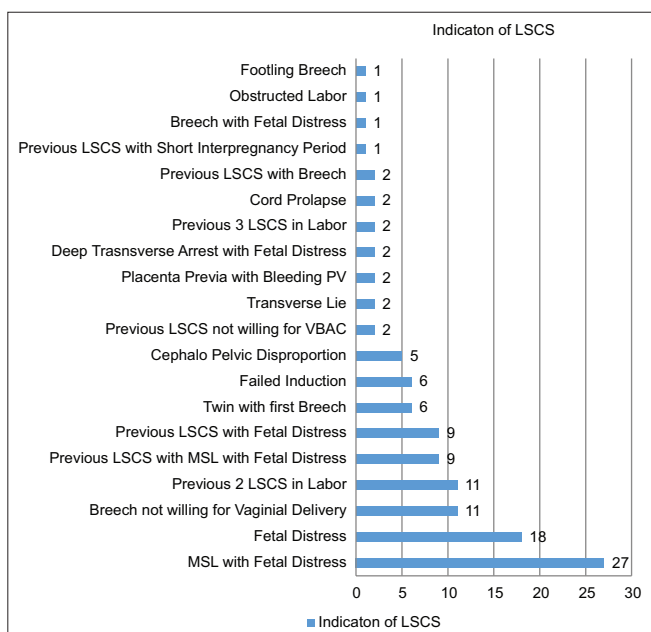


Figure 2: Indications of cesarean section

suture line (62.50%), followed by redness and warmth. Burst abdomen was observed in the 15 patients (12.50%) in our study. Serous discharge was present in 54.17% of patients, and on culture of wound discharge, 59 patients (49.17%) had organisms identified. The most common type of infection was superficial type (105 patients, 87.50%), and 68.33% (82) of infections were identified within 5 days of surgery.

Table 2 further helps to elucidate the individual characteristics of types of wound sepsis identified in the study. Length of wound and growth of infective organisms were found to be significantly high in deep or organ space infections ( $P < 0.05$ ). The average duration of hospitalization for superficial was 8.5 days, for deep, it was 15 days and nearly 26 days for organ space infection.

Table 1: Clinical profile of the patients

Characteristics	Frequency	Percentage
<b>Clinical presentation</b>		
Pain	66	55
Redness	73	60.83
Warmth	70	58.33
Dehiscence	75	62.50
Induration	75	62.50
Burst abdomen	15	12.5
<b>Wound discharge characteristics</b>		
Serous	65	54.17
Serosanguinous	2	1.67
Purulent	53	44.17
<b>CDC category</b>		
Superficial	105	87.50
Deep	11	9.17
Organ/space	4	3.33
<b>Day of identification (days)</b>		
3≤5	82	68.33
5≤7	32	26.67
>7	6	5
<b>Duration of surgery (min)</b>		
<60	18	15
More than 60	102	85

CDC: Centers for disease control and prevention

Wound cultures were found to be infective in 49% of patients. *Acinetobacter* was found to be the most common organism identified (Table 3).

## DISCUSSION

Wound sepsis constitutes a substantial burden to health systems in developing countries. Shukkur et al., in 2020 observed that 55% of patients were older than 25 years.<sup>6</sup> Another study by Wloch et al., the median age of patients with wound sepsis was 31 years.<sup>7</sup> In the present study, the mean age of patients with wound infection was 26.73 years. Evidence suggests that up to the age of 65 years, there is an increased risk of infection more generally, possibly due to an impaired immune system. An increase in age-related comorbidities could also increase the risk of developing an infection post-cesarean.<sup>8,9</sup>

The majority of women were either illiterate or had completed their secondary school. Jabbar et al., also observed the association of educational status with surgical site infection (SSI) as 15% and 14% infection in patients with primary and secondary level education, with the percentage dropping to 10% and 6% with increased education level, that is, intermediate and graduation, with a significant  $P = 0.049$ .<sup>10</sup>

Another factor observed was lower socio economic status, which was also described in the study by Olsen et al.<sup>11</sup> This can be explained by the resultant poor hygiene and nutrition. Nearly three-fourths of patients were unbooked in our

**Table 2: Categorization of surgical wound infection and its variations**

Variables	Superficial (n=105)	Deep (n=11)	Organ (n=4)	Total (n=120)	P-value
Mean age	26.83±4.61	26.73±4.67	24.25±1.70	26.87±3.99	0.2101
Unbooked patients, n (%)	76 (72.38)	9 (81.82)	4 (100)	89 (74.17)	0.3859
Mean BMI (kg/m <sup>2</sup> )	26.59±3.77	30.42±4.54	24.80±4.17	26.73±4.55	0.7059
Mean parity	1.05	1.09	1.00	1.05	0.8126
Mean infected wound length (cm)	6.32	9.54	10.00	6.74	0.0000
Membranes ruptured, n (%)	59 (56.73)	7 (63.64)	2 (50)	68 (57.14)	0.9109
Mean duration of PROM (h)	1.20	1.27	1.00	1.20	0.9654
Mean duration of surgery (min)	68.98	74.54	77.5	69.77	0.2890
Infected culture growth, n (%)	45 (42.86)	11 (100)	3 (75)	59 (49.17)	0.0009
Amnion graft application, n (%)	46 (43.81)	7 (63.64)	0	53 (44.17)	0.0926
Wound debridement, n (%)	70 (66.67)	10 (90.91)	3 (75)	83 (69.17)	0.2454
Wound reclosure, n (%)	76 (72.38)	10 (90.91)	1 (25)	87 (72.50)	0.0408
Duration of hospitalization (days)	8.54	15.00	25.75	9.63	0.0000

BMI: Body mass index

**Table 3: Distribution of various organisms identified on wound cultures**

Organisms identified (n=59)	Number	Percent
<i>Acinetobacter</i>	21	35.6
<i>Klebsiella</i>	14	23.7
<i>Escherichia coli</i>	13	22.0
<i>Proteus</i>	3	5.1
<i>Pseudomonas</i>	3	5.1
<i>Staphylococcus aureus</i>	3	5.1
<i>Citrobacter</i>	2	3.4

study, which was supported by He et al.,<sup>12</sup> and Gomaa et al.,<sup>13</sup> in their observations of irregular or no antenatal care (ANC) visits associated with higher infection rates. Regular ANC visits help in the early identification of various modifiable risk factors and help reduce the risk of infections.

The risk of developing wound sepsis after lower segment cesarean section is multifactorial and has been found to be influenced by various factors. Diabetes mellitus, anemia, history of previous surgery, and hypertension have been reported as risk factors for the development of infection in various studies. The association between diabetes and wound infection was proven by Jabbar et al.,<sup>10</sup> as well as Krieger et al.<sup>14</sup>

The most common presentation of wound infection was either wound dehiscence or induration around the suture line in our study. Mhaske et al., had 35.7% of patient had spontaneous superficial dehiscence wound.<sup>15</sup> Kondakasseril et al., observed fever as the most common clinical manifestation of infection in 40 cases (80%) followed by local pain and induration in 25 cases (50%).<sup>16</sup>

The most common post-operative day of identification of infection was within 3–5 days in our study; similarly, by Mhaske et al., it was observed on 5±2 days and by Kondakasseril et al., it was reported on 6±3 days in their study.<sup>14,16</sup>

Similar to our study, superficial infection was the most common category of infection in the studies by Kondakasseril et al., (72%), Gomaa et al., (50%), and also by Al-Kharabsheh et al., (82.1%).<sup>13,16,17</sup> Superficial type forms the majority of all the cases, followed by deep and organ/space sepsis. Most of our patients had their surgeries lasting more than 60 min. Mhaske et al., found that prolonged duration of surgery was a significant risk factor for SSI (P=0.04).<sup>15</sup> This was also proven to be true in the study by Gomaa et al.<sup>13</sup> Statistically significant differences between the categories of wound sepsis were observed on the basis of wound size, duration of surgery, and duration of hospitalization.

Based on wound size, it was highest for the organ/space category (10 cm) followed by the deep category (9.54 cm), and the difference was statistically significant (P=0.0000). Thus, indicating that as an infection transitions from superficial to deep or organ/space, the mean wound length also increases. Mean duration of surgery was also found to be maximum when organ/space infections (77.5 min) occurred, while 68 min and 74 min were recorded in superficial and deep infection, respectively. Lawson et al., reported that patients with a deep/organ-space infection had the highest mean operation time (199.7 min), followed by patients with a superficial infection (179.5 min).<sup>18</sup> This further strengthens the observation that a longer surgery has a higher risk of sepsis and also has a higher risk of a more severe infection. The mean duration of hospitalization was also maximum for organ/space infection (25.75 days), followed by deep (15 days) and superficial infection (8.54 days). As the severity of infection increases, it increases the duration of stay required to treat the condition. Hence, the need for an experienced obstetrician to be present and responsible for the operative procedure is supported. Deep and organ space categories of infection require significantly higher incidence of wound reclosure as compared to superficial type that is treated with

more conservative approach of serial dressings. Hence, a more aggressive approach such as amnion grafting, targeted antibiotics, debridement, and wound reclosure should be followed to manage deeper infections.

Infected wound cultures were obtained in 49% of cases, *Acinetobacter* being the most frequently isolated organism. The deep type of infections is significantly associated with infective organism's growth. Shukkur et al., reported that 73% of patients showed growth of an organism, out of which, 52% had growth of *Staphylococcus aureus*.<sup>6</sup> Although most studies show *S. aureus* as the most common organism causing SSI, some Indian studies do report a predominance of Gram-negative bacteria. In a prospective study by Shanbhag et al., the most common causative organism of the post-surgical wound infections was Gram-negative organisms, followed by *S. aureus*.<sup>19</sup> Furthermore, study by Dahiya et al., reported that most of the organisms isolated were Gram negative (56.52%), most common being *Escherichia coli* (25.93%).<sup>20</sup> Predominance of Gram-negative isolates (55.3%) was also seen in comparison to Gram-positive isolates (44.7%) as cause of wound sepsis by Gupta et al.<sup>21</sup>

### Limitations of the study

The limitations of this study are related to the inclusion of data from a single institution. Further multicentric trials are needed to study the association of risk factors with infections so that the preventive strategies can be developed for wound sepsis.

## CONCLUSION

Despite breakthroughs in antibiotic prevention and treatment, wound infection remains a persistent issue in low-resource settings. The key to mitigate its occurrence and impact is implementing preventive strategies including patient-related factor alterations, pre-operative optimization, perioperative and intraoperative strategies, diligent post-operative surveillance, and timely management of emergent infections. Our study revealed a lower level of education, lower socioeconomic status, irregular or no ANC visits, a history of diabetes mellitus, and a longer duration of surgery as risk factors for wound infection. A more aggressive strategy should be taken to manage deeper categories of CDC infections, such as amnion grafting, targeted antibiotics, debridement, and wound reclosure.

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**Authors Contribution:**

**KK-** Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation; **PS-** Concept, design, clinical protocol, manuscript preparation, submission of article, editing, and manuscript revision; **SJ-** Design of study, statistical analysis and interpretation, manuscript preparation; **PD-** Review manuscript, definition of intellectual content; **MBC-** Review manuscript, definition of intellectual content; **NG-** Review manuscript, definition of intellectual content.

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