**e-ISSN: 0975-1556, p-ISSN:2820-2643**

**Available online on www.ijpcr.com**

**International Journal of Pharmaceutical and Clinical Research 2023; 15(6); 165-172**

**Original Research Article**

# Risk Factors and Etiological Analysis of Surgical Site Infections Following Abdominal Caesareans

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**Received: 25-03-2023 / Revised: 21-04-2023 / Accepted: 15-05-2023**

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**Conflict of interest: Nil**

**Abstract**

**Background:** The present study aimed to analyse the risk factors and etiological agent of Surgical site infection (SSI) following abdominal caesareans. Change in microbial profile and their sensitivity compel clinicians to conduct periodic analysis of SSI in their area.

**Material & Methods:** This was a cross-sectional prospective analytical study conducted on 264 cases undergoing abdominal caesareans. Risk factors were asses that cause SSI. Patients were followed from the day of surgery till 30 days after the discharge. Samples collected from the wounds were processed by conventional microbiological methods, and AST was performed by using the Kirby Bauer disk diffusion method.

**Result:** Postoperative hospital stay (65.4%), emergency procedures (81.8%), and patients with anaemia (96.3%) are significantly associated with the occurrence of SSI. The most common pathogen causing SSI was *E coli* (25.4%), followed by Pseudomonas aeruginosa (21.8%) and Staphylococcus aureus (16.3%), while the least isolated organism was Proteus (3.63%) and Acinetobacter (3.63%).

**Conclusion:** To decrease the chances of SSI, a proper assessment of risk factors should be carefully done, and also, we should have to decrease the duration of surgeries, focus on antimicrobial audit, and ensures proper management. Also, conduct periodic surveillance to check on SSI.

**Keywords:** SSI, Caesarean, Emergency Procedures, Antimicrobial Susceptibility Pattern.



## Introduction

Surgical site infection (SSI) is a common, generic postoperative event that causes considerable morbidity but sometimes leads to death. Surveillance of SSI is an important infection control activity [1]. SSIs are responsible for increasing the treatment cost, length of hospital stay, and significant morbidity and mortality.

Despite the technical advances in infection control and surgical practices, SSI still continues to be a major problem, even in hospitals with the most modern facilities [2]. These infections are usually caused by both exogenous and endogenous microorganisms, which were enter the operative wound either during the surgery (primary infection) or after the surgery (secondary infection). Primary infections are usually more serious than secondary infections, appearing within five to seven days of surgery [3]. Most of the SSIs are uncomplicated and involve only the skin and subcutaneous tissue but sometimes can progress to the internal organ or body cavity, causing tissue necrosis. The usual presentation of infected surgical wounds can be identified by pain, tenderness, warmth, erythema, swelling, and pus formation [4,5]. Surgical site infections remain a major cause of hospital-acquired infections irrespective of improvements being done in operating room practices, instrument sterilization methods, better surgical techniques, and the best efforts of infection prevention strategies. SSI rates are still increasing globally, even in hospitals with the most modern facilities and standard protocols of preoperative preparation and antibiotic prophylaxis[6].

Most research on surgical site infections in abdominal caesarean section patients has been conducted outside India[7].As a result, not much information is accessible on the rates of SSI taking after abdominal caesarean segment in Indian clinics, particularly in Kanpur, U.P. The data also lack knowledge of common pathogens causing surgical site infection in abdominal caesarean. Therefore, there is a need to investigate intraoperative and postoperative risk factors and microbial analysis for SSI after abdominal caesarean.

## Material & Methods

This was a prospective cross-sectional study was carried out in the Department of Microbiology and Department of Obstetrics and Gynaecology, Rama Medical College Hospital & Research Centre Mandhana, Kanpur, from July 2022 to April 2023. The institutional ethical committee approved the study protocol.

The patients were observed for any sign and symptoms of SSI for 30 days. Patients developed SSI were screened for microbial investigations**.** Pus discharge was collected from the surgical incision site with sterile cotton swabs. The bacterial isolates obtained were identified as per standard identification procedures [8].

The antimicrobial sensitivity testing for all the isolates were done on Muller Hinton agar (Himedia, Mumbai) by Kirby-Bauer disc diffusion method McFarland 0.5 standard. The antibiotic susceptibility test result were interpreted as per CLSI 2022 guidelines. Data was recorded on a predesigned study questionnaire and managed on an Excel spreadsheet.

**Inclusion Criteria:** All female patient undergone abdominal surgery below 40 years of age were included in this study.

**Exclusion Criteria:** The HIV infected patients and patients on steroidal therapy excluded.

## Ethical Approval

Permission to collect samples was obtained from Rama Medical College, Hospital &Research Centre, Kanpur. Informed consent was obtained from all patients or guardian.

## Result

Out of 264 caesarean cases, 69 (26.5%) showed indication of SSI, while 195 (73.9%) showed no signs of SSI. Out of 69 cases, 55 (79.7%) samples were culture positive, while 14 (20.2%) were culture negative. The majority of the patients ( 62.5%) were in the age group of 21-30 years, followed by those in the age group 31-40 ( 33.3%), while only 4.16% were below the age group of 20 year (Table 1).

Most of the SSI cases are found in the age group between 21-30 (10.2%), in which superficial wound was most common (96.3%), followed by deep infection(3.6%). (Table 2). A total of nine types of organisms were isolated from pus culture in which *E.coli* (25.4%) was most common, followed by *Pseudomonas* (21.8%), *Staphylococcus aureus* (16.3%); other isolated organisms were *MRSA* (5.45%), *MSSA*(10.9%), *CONS*(7.2%), *Klebsiella spp* (5.45%), *Proteus* (3.63%) and *Acinetobacter* (3.63%) (Table 3).

Risk factors include Anaemia (96.3%), Emergency procedures (81.8%). Duration of postoperative hospital (65.4%) were the most common factor associated with surgical site infections. Table 4 lists the risk factors associated with SSI. The most effective antibiotic against gram-negative bacilli were Piperacillin-tazobactam followed by Meropenem and Imipenem, colistin (Table 5 ). Amikacin was the most effective drug against gram-positive cocci, followed by Vancomycin, Teicoplanin & Linezolid. (Table 6).

**Table 1: Age-Wise Distribution of SSI**

| Age Group | SSI Cases | Percentage |
|---|---|---|
| 11-20 | 2 | 0.75% |
| 21-30 | **27** | **10.2%** |
| 31-40 | 26 | 9.84% |

**Table 2: Distribution of Wound Type**

| Type of Wound | Numbers | Percentage (%) |
|---|---|---|
| Superficial | **53** | **96.3%** |
| Organ-Specific | 0 | 0% |
| Deep | 2 | 3.6% |

**Table 3: Types of Organisms Isolated**

| Organism Isolated | Numbers | Percentage |
|---|---|---|
| Staphylococcus aureus | 9 | 16.3% |
| MRSA | 3 | 5.45% |
| MSSA | 6 | 10.9% |
| Cons | 4 | 7.2% |
| **E.coli** | **14** | **25.4%** |
| Klebsiella Spp. | 3 | 5.45% |
| Proteus spp | 2 | 3.63% |
| Pseudomonas spp | 12 | 21.8% |
| Acinetobacter spp | 2 | 3.63% |
| **Total** | **55** | |

**Table 4: Common Risk Factors Associated with SSI**

| Risk Factors | Range | Number of Patients |
|---|---|---|
| BMI | >25 | 40 |
| Hb | <11 | 53 |
| Post-Hospital Stay | >5 | 36 |
| Diabetic Mellitus | - | 9 |
| Elective Surgery | - | 10 |
| **Emergency Surgery** | **-** | **45** |

**Table 5: Antimicrobial Susceptibility Pattern of Gram-Negative Bacilli**

| Antibiotics Used | E.coli (n=14) | Pseudomonas spp. (n=12) | Proteus spp. (n=2) | Acinetobacter spp. (n=2) | Klebseilla spp. (n=3) |
|---|---|---|---|---|---|
| **COT** | 85% | 44% | 100% | 100% | 100% |
| **GEN** | 78% | 58% | 100% | 100% | 66% |
| **AK** | 92% | 91% | 100% | 100% | 66% |
| **TOB** | 71% | 16% | 100% | 100% | 66% |
| **TE** | 85% | 91% | 50% | 100% | 100% |
| **CIP** | 85% | 58% | 50% | 0% | 33% |
| **CTR** | 57% | 0% | 100% | 0% | 100% |
| **CPM** | 78% | 0% | 100% | 0% | 66% |
| **CTX** | 64% | 0% | 100% | 0% | 100% |
| **CAZ** | 85% | 33% | 100% | 100% | 100% |
| **CFS** | 100% | 41% | 100% | 50% | 100% |
| **LE** | 85% | 91% | 50% | 100% | 100% |
| **OF** | 64% | 75% | 50% | 100% | 100% |
| **AMC** | 57% | 0% | 50% | 0% | 0% |
| **IPM** | 100% | 100% | 100% | 100% | 100% |
| **MRP** | 100% | 100% | 100% | 100% | 100% |
| **PI** | 78% | 91% | 100% | 50% | 66% |
| **NET** | 92.8% | 83% | 100% | 50% | 100% |
| **A/S** | 42% | 0% | 50% | 0% | 0% |
| **CPT** | 64% | 0% | 50% | 0% | 100% |
| **AMP** | 64% | 0% | 100% | 100% | 100% |
| **TCC** | 71% | 41% | 50% | 100% | 0% |
| **TGC** | 100% | 16% | 50% | 50% | 66% |
| **PB** | 100% | 100% | 0% | 100% | 100% |
| **CL** | 100% | 100% | 0% | 100% | 100% |
| **AT** | 92% | 75% | 100% | 50% | 100% |
| **PTZ** | 100% | 100% | 100% | 100% | 100% |

**Table 6: Antimicrobial Susceptibility Pattern Of Gram-Positive Cocci**

| Antibiotics Used | Staph. aureus | CONS | MRSA | MSSA |
|---|---|---|---|---|
| **COT** | 77% | 100% | 66% | 66% |
| **GEN** | 88% | 100% | 66% | 83% |
| **AK** | 100% | 100% | 100% | 100% |
| **TOB** | 55% | 100% | 33% | 66% |
| **TE** | 77% | 75% | 100% | 83% |
| **CIP** | 55% | 25% | 66% | 66% |
| **LE** | 77% | 100% | 100% | 66% |
| **OF** | 77% | 75% | 66% | 83% |
| **NET** | 66% | 100% | 100% | 83% |
| **TGC** | 88% | 100% | 66% | 83% |
| **CX** | 77% | 100% | 0% | 100% |
| **CPT** | 44% | 50% | 33% | 50% |
| **P** | 0% | 25% | 0% | 0% |
| **LZ** | 100% | 100% | 100% | 100% |
| **VA** | 100% | 100% | 100% | 100% |
| **TEI** | 100% | 100% | 100% | 83% |

| | | | | |
|---|---|---|---|---|
| **AZM** | 55% | 75% | 100% | 33% |
| **E** | 33% | 75% | 100% | 83% |
| **CD** | 33% | 75% | 100% | 83% |

## Discussion

In our study, Emergency procedures were a significant risk factor for SSI, while in an Irish case-control study by Saeed et al., emergency C.S. was delivered by 75% of women with SSI and 25% by elective C.S., and the overall rate of SSI following C.S. was 2%.[9]. Emergency C.S. was an independent risk factor for Caesarean Surgery, which was consistent with the present and other studies.[19,20]. Also, 7–12% of hospitalized patients end up with hospital-acquired infections globally, with more than 1.4 million people suffering from infectious complications acquired in the hospital [10]. Surgical site infection was an important outcome indicator after surgery. The situation was worsened by the emergence of polymicrobial-resistant strains of nosocomial pathogens [11]. The infection rate in the present study was 21%, including post-discharge surveillance, and compares favourably with other reported rates ranging from 2.5 to 41.9% [12–16]. Wound-related complication like surgical site infection following caesarean section was a major cause of morbidity and mortality, increasing both the duration of patient hospitalization and hospital costs [17]. It was the most common infection in surgical patients and constitutes 15% of nosocomial infections [18]. Most surgical site infections are caused by contamination of an incision with microorganisms present in the patient's own body during surgery [19]. Most surgical site infections are preventable [20]. Measures can be taken in the pre-, intra-, and postoperative phases of care to reduce the risk of infection [21, 22]. Proper postoperative surveillance of cases with risk factors reduces the incidence and complications of wound infection [23]. In India, the incidence of postoperative infections in various hospitals varies from 10 to 25% [24, 25, 26]. In the present study, 264 samples were tested, out of which only 55 samples were found to be positive for SSI. A body mass index of more than 25 has been shown to affect the outcome of surgery [27, 28, 29]. The local changes, such as the increase in adipose tissue, a need for larger incisions, decreased circulation to fat tissue, and an increase in local tissue trauma related to retraction, contribute to an increased incidence of SSI in these patients [30, 31]. Preoperative anaemia was an important predictor of infection and has been proved by several other studies [26, 32, 33]. In our study, SSI was significantly associated with patients who have anaemia (96.3%). Patients who received antibiotics 2 hours before surgery were found to be less prone to SSI as compared to those who did not receive it in a timely fashion. This association was found to be statistically significant, which was in accordance with other studies [34, 35, 36]. Shapiro et al. reported that with each hour of surgery, the infection rate almost doubles [37]. A prolonged preoperative stay with exposure to the hospital environment, its ubiquitous diagnostic procedures, therapies, and microflora, including multidrug-resistant organisms, have been shown to increase the rate of SSI [38] as compared to Kowli et al. found an infection rate of 17.4% when the preoperative stay was 0–7 days and an infection rate of 71.4% with the preoperative stay of more than 21 days [16] while in our study postoperative hospital stay (65.4%) more than five days were significantly associated with the occurrence of SSI while Anvikar et al. in their study demonstrated an infection rate of 1.76% when the preoperative stay was up to one day, which increased to 5% when the preoperative stay was more than one week [12].

Common causative organisms leading to post-LSCS SSI include Gram-negative bacteria, anaerobes, and Staphylococcus aureus [36], while in our study, common isolates are E.coli(25.4%), Pseudomonas(21.8%), and Staphylococcus aureus(16.3%).

## Conclusion

In this study, we concluded that to decrease the chances of SSI, a proper assessment of risk factors should be carefully done, and also we should have to decrease the duration of surgeries, focus on antimicrobial audit, and ensure proper management. Also, conduct periodic surveillance to check on SSI.

## Acknowledgement

We deeply acknowledge, Our Principal Dr. (col).B.K Prasad, Dr. R.Sujatha (HOD & Professor, Department of Microbiology),and all the teaching & non-teaching staff of RMCH&RC, Kanpur, UP India, for their encouragement and provide facilities for this research.

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