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# MRSA in Post Cesarean Patients with Surgical Site Infections

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## ABSTRACT

**Introduction**: SSI is among the most common causes of nosocomial infections. Cesarean section carries fiveto 20-fold increased risk of infection compared to vaginal deliveryMethicillin Resistant Staphylococcus aureus (MRSA) is major problem in dealing with postoperative wound infections.

**Aim**: To determine the prevalence of SSI caused by MRSA and the antibiotic sensitivity pattern of MRSA.

**Materials and Methods**: A prospective study was conducted in the Departments of Microbiology and Obstetrics & Gynaecology, Pt. B.D. Sharma Post Graduate Institute of Medical Sciences, Rohtak over a period of one year. A total of 150 patients with post cesarean surgical wound infection were enrolled for the study. Samples were processed according to CLSI, 2007 guidelines. The isolated strains of Staphylococcus aureus were screened for MRSA by detection of resistance to Cefoxitin disc (zone of inhibition was ≤21 mm).

**Results:** The evaluation of bacteriological profile of samples received from 150 samples revealed that majority of the cultures were sterile i.e. 127 (84.6%) and bacterial growth was seen in 23 (15.33%) patients in the study population.Among these *Staphylococcus* spp.was the most common isolate (43.75%) followed by*Escherichia coli*(25%) *and Pseudomonas* spp.(12.5%), while *Acinetobacter spp*, *Enterobacter* spp. and *Klebsiella* spp.(6.25%) isolates were in equal proportion.Prevalence of MRSA was came out to be 62.5% that is 5 out of total 8 isolates and All the MRSA strains have been found to be 100% sensitive to linezolid and Doxycycline followed by Co-trimoxazole,Erythromycin,Clindamycin and other drugs ang highly resistant to penicillin.

**Conclusion**: Staphylococcus aureus being the predominant organism causing SSIs, MRSA needs the attention for its resistance to commonly used antibiotics in the hospital . Mainstay of treatment for MRSA infections still depends on glycopeptides and linezolid. Compilation of local data on SSIs and feedback are the fundamental concern for the formulation of a proper guideline for peri-operative prophylaxis of antibiotics to mitigate the rate SSIs in the hospital

**Keyword:** SSI, MRSA, Post operative wound infection, Antibiotic resistance

## INTRODUCTION

A surgical site infection (SSI) is defined as an infection which occurs at the incision / operative site (including drains) within 30 days after surgical operation. SSI is among the most common causes of nosocomial infections with a reported incidence rates of 2-20% in the literature.[1]Cesarean section carries fiveto 20-fold increased risk of infection compared to vaginal delivery. Depending upon the surveillance methods used to identify infections, the patient population, and the use of preoperative antibiotic prophylaxis, the rate of SSI after cesarean section is found to be in the range of 3% to 15%. The problem of SSI continues to be a problem even after maintaining the standard protocol of pre-operative preparations and antibiotic prophylaxis. Multi and single centered studies showed that the majority of organisms causing SSI are gram positive cocci e.g. *S. aureus* and gram negative bacilli e.g. *E. coli, Klebsiella, Pseudomonas* and *Enterobacter* spp.[2,3] However, the most significant change in the microbiology of SSI has been the increased involvement of resistant organisms like MRSA.

MRSA is now responsible for 30% or more of all serious infections and is always not very easy to deal with.[4,5] The prolonged stay in hospital, arbitrary use of antibiotics, lack of awareness, over the counter dispensing of antibiotics etc. are the potential predisposing factors for emergence of MRSA.[5]

Methicillin resistance is due to the acquisition of mecA gene which encodes a unique penicillin-binding protein, designated PBP 2′ or PBP 2a. This reduces affinity for β-lactams and allows effective cell wall synthesis even in the presence of penicillins including anti-staphylococcal penicillins, as well as cephalosporins and carbapenems.[6] Therefore, the choice of drugs becomes limited to combat the MRSA strains.

Therefore this study was designed to determine current spectrum of organism like MRSA in SSI and their antibiotic susceptibility in post cesarean patients so that results could be helpful for treating obstetricians in post operative care and management.

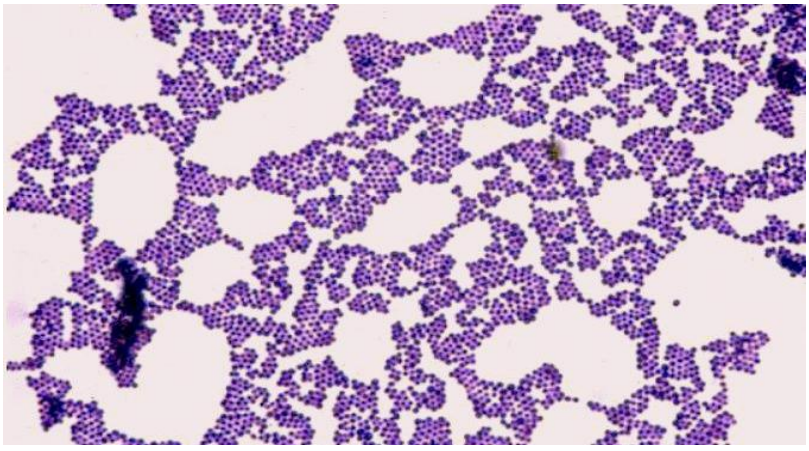
## MATERIALS AND METHODS

A prospective study was conducted in the Departments of Microbiology and Obstetrics & Gynaecology, Pt. B.D. Sharma Post Graduate Institute of Medical Sciences, Rohtak over a period of one year. A total of 150 patients with post cesarean surgical wound infection were enrolled for the study. The pus discharge from SSI was collected post operatively from patients and was processed as per standard microbiological procedure. Patient with post cesarean surgical wound pus discharge, with signs of infection present concurrently (warmth,erythema, induration, tenderness, pain, raised localtemperature) were included while patients with Chorioamnionitis, peritonitis and patients having fever prior to cesareansection are excluded from the surgery.

The pus sample from the woundwas collected with the help of two sterile swab sticks from the patient under all aseptic conditions and was transported in brain heart infusion(BHI) broth to microbiology laboratory as early as possible.Out of the two swabs one swab was used for gram staining for early presumptive diagnosis. Second swab was inoculated on blood agar and MacConkey agar plates and plates were incubated at 37°C for 24-48 hours,followed by processing and identification as per standard microbiological procedure.[7-9]

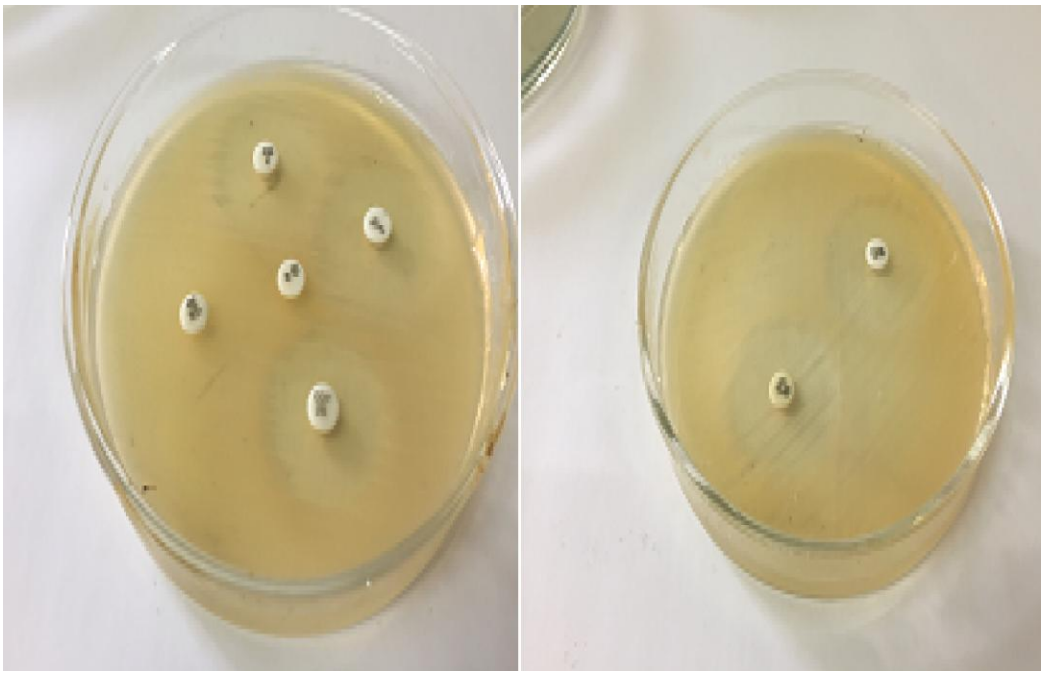
Isolates obtained from samples were identified on the basis of colony morphology, staining characteristics and biochemical reactions.All the isolates were tested for antimicrobial susceptibility testing by Kirby-Bauer disc diffusion method on Muller-Hinton agar using commercially available cefoxitin (30µg) disc (HiMedia) and the results were compared with Staphylococcus aureus *Staphylococcus aureus* ATCC 25923 control strainand results were interpreted in accordance with Clinical and Laboratory Standards Institute (CLSI) 2017 guidelines.[10]Antimicrobial discs were procured from HiMedia Laboratories, Mumbai, India. The antibiotics discs were applied using a sterile forceps and were gently pressed down to ensure complete and uniform contact of disc with the agar surface. Discs of the following antimicrobial agents, with the disc concentration in brackets were put up.The other antibiotic discs used wereerythromycin (15µg), clindamycin (2µg), penicillin (10units), trimethoprim-sulfamethoxazole (1.25/23.75µg), linezolid (30µg), doxycycline (30µg). All Staphylococcus aureus strains were screened for MRSA by detection of resistance to Cefoxitin disc (zone of inhibition was ≤21 mm) following the CLSI guidelines

The plates were examined against the transmitted light. The diameter of zone of inhibition was measured to the nearest whole millimeter using a scale, which was held at the back of inverted petri dish. Any presence of small colony (>1 colony) or a light film of growth within the zone of inhibition indicated resistance of isolate to that antimicrobial agent. The zone of inhibition was measured and interpreted as sensitive (S) or resistant (R) according to the disc- manufacturer information table. The data wascollected using Microsoft Excel spread sheet and doubly checked for errors. Quantitative data waspresented as mean and standard deviation. Qualitative data was expressed in percentage and proportions. All the data was analyzed using statistical software SPSS version 21. A p-value < 0.05 was considered as statistically significant.



**Gram stained smear showing gram positive cocci in clusters**

**Golden yellow colonies of *Staphylococcus aureus* on Blood agar**



**Antibiotic susceptibility pattern (AST) in *Staphylococcus aureus***

## RESULTS

The age of patients in our study ranged from 15-45 years with mean age of 25.10 ± 3.99. It was found that maximum numbers of patients i.e. 67 (44.6%) belong to age group 21-25 years followed by 26-30 years i.e. 53 (35.33%) with the youngest being 18 years of age and the oldest 37 years. The age distribution is elaborated in Table 1

**Table 1: Age distribution in the study population (n=150)**

| Age groups (years) | No. of patients | Percentage (%) |
|---|---|---|
| 15-20 | 15 | 10 |
| 21-25 | 67 | 44.6 |
| 26-30 | 53 | 35.33 |
| 31-35 | 13 | 8.6 |
| 36-40 | 2 | 1.33 |

The evaluation of bacteriological profile of samples received from 150 samples revealed that majority of the cultures were sterile i.e. 127 (84.6%) and bacterial growth was seen in 23 (15.33%) patients in the study population.(Table 2)

**Table 2: Bacteriological profile of samples in the study population**

| **Culture** | **No. of patients (n=150)** | **Percentage (%)** |
|---|---|---|
| Bacterial growth | 23 | 15.33% |
| Sterile culture | 127 | 84.6% |

Among these *Staphylococcus* spp.was the most common isolate (43.75%) followed by*Escherichia coli*(25%) *and Pseudomonas* spp.(12.5%), while *Acinetobacter spp, Enterobacter* spp.and *Klebsiella* spp.(6.25%) isolates were in equal proportion.(Table 3)

**Table 3: Distribution of monomicrobial organisms isolates**

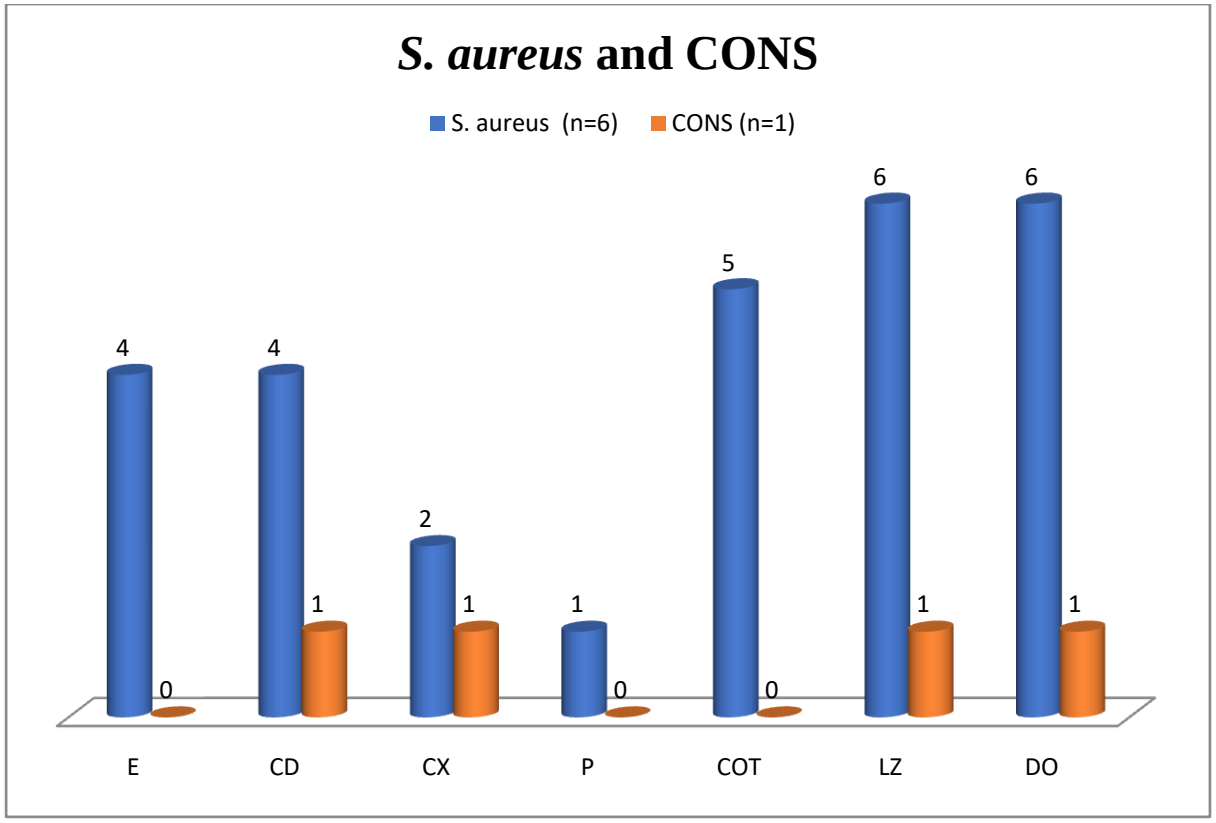
| **Organisms** | **No. of findings (n=16)** |
|---|---|
| *Staphylococcus* spp. | 7 |
| *Escherichia coli* | 4 |
| *Pseudomonas* spp. | 2 |
| *Acinetobacter* spp. | 1 |
| *Enterobacter* spp. | 1 |
| *Klebsiella* spp. | 1 |

All the strains of *staphylococcus* spp. were found sensitive to linezolid and doxycycline while variable susceptibility pattern was seen for other antimicrobial agents.(Table 4 )

**Table4: Antibiotic susceptibility pattern of *S.aureus* and CONS (coagulase negative *staphylococcus* species) in post cesarean patients**

| **Antimicrobial agents** | ***S.aureus*** **(n=6)** | **CONS (n=1)** |
|---|---|---|
| E | 4 | 0 |
| CD | 4 | 1 |
| CX | 2 | 1 |
| P | 1 | 0 |
| COT | 5 | 0 |
| LZ | 6 | 1 |
| DO | 6 | 1 |

E= Erythromycin, CD= Clindamycin, CX= Cefoxitin, P= Penicillin, COT= Co-trimoxazole, LZ= Linezolid, DO= Doxycycline




Prevalence of MRSA was came out to be 62.5% that is 5 out of total 8 isolates

| No. of isolate | Sensitive to methicilin | Resistant to methicilin |
|---|---|---|
| 8 | 3 | 5 |

All the MRSA strains have been found to be 100% sensitive to linezolid and Doxycycline followed by Co-trimoxazole,Erythromycin,Clindamycin and other drugs ang highly resistant to penicillin.

## DISCUSSION

Surgical site infections (SSIs) are the most common post-operative complications in patients who undergo abdominal surgeries- whether emergency or elective. Caesarean section carries fiveto 20-fold increased risk of infection compared to vaginal delivery.Depending upon the surveillance methods used to identify infections, the patient population, and the use of preoperative antibiotic prophylaxis, the rate of SSI after cesarean section is found to be in the range of 3% to 15%.The most important challenge of SSIs is to efficiently differentiate those cases that require immediate attention and intervention, whether medical or surgical, from those that are less severe.[11]

In the present study, age of patients ranged from 15 to 45 years with mean age as 25.10 years. The majority of patients were in 21-25 years of age (44.6%) followed by 26-30 years (35.33%). It shows most of affected patients were young individuals. Gelaw*et al.*[12]found in their study that majority of patient's age ranged from 20–34 years (89.3%). In a similar study by Budhani D *et al.*[13]maximum number of culture positive samples were found in age group of 21-30 years (33.8%) followed by 31-40 years (16.06 %). Gangania P *et al.*[14] in their study found the maximum culture positivity of the samples in the age group 16-45 years (24%) followed by 46-60 years (14%). However Sahu S *et al.*[15]study showed most affected individuals in the age group of 41 to 60 years. Sohn *et al.*[16] reported an average of 39 years and Anush S *et al.*[17] reported maximum of infection (28%) in 41-50 years of age group.

In the present study, SSI rate of 15.33% was obtained which compares favorably with other reported rates ranging from 2.5 to 41.9%.[18-22] Satarayana*et al.*[23] in a study reported the overall rate of SSI as 13.7%. Various other studies from India have shown that the rate of SSI varies from 6.1% to 38.7%.However the rate of infection reported from other countries is quite low, 2.8% in USA and in European countries it is reported to be 2-5% as compared to India.[99] In a study by Anvikar*et al.*[24] the commonest surgery performed was lower-segment cesarean section and prostatectomy followed by laparotomy and out of the SSI cases, 25% seen in laparotomy, followed by 20.5% in prostatectomy.Devjani D *et al.*[25] in a study in 2008-2010 identified SSI in 121 (24.2%) out of 500 patients. The Magnitude of surgical site infection following cesarean section in study by Gelaw*et al.*[26]was 26(6.8%).

In the present study,22 (73.33%) out of 30 organisms (including both monomicrobial and polymicrobial infection) were gram negative and remaining 8 (26.66%) were gram positive. Among gram negative organisms, the most common organism isolated was *Escherichia coli* 23.33% followed by *Acinetobacter* spp. 16.6%, *Pseudomonas* spp. 13.33%, *Enterobacter* spp 10%, *Klebsiella* spp.6.66% and *Citrobacter*spp. 3.33%. Among gram positive organisms only *staphylococcus*spp. was isolated. Similarly Anusha*et al*.[27] reported 65.34% gram negative and 34.66% gram positive microorganism in their study whereas Zafar *et al*.[28] concluded that gram positive and gram negative was found to be almost equal 49.54% and 50.45% respectively.[29]Devjani De *et al*.[25] in their study found, *Acinetobacter* spp. was the most common isolate (32.03%) followed by *Escherichia coli*and *Klebsiella* spp. which were responsible for 18.75% and 14.8% of SSI, respectively. Other gram negative organisms isolated were *Citrobacter freundii*, *Proteus vulgaris* and *Pseudomonas aeruginosa.*

Among the gram positive organisms, *Staphylococcus aureus* was the most common isolate (16.4%)followed by coagulase negativeStaphylococcus (4.68%) and *Enterococcus* spp. (3.12%).[26]Mpogoro*et al*.[30]concluded same results and found gram negative bacteria as predominant isolate.

These all studies are in contrast to NNIS service survey (1997–2001) that reported *Staphylococcus aureus* (47%) including MRSA and *Staphylococcusepidermidis* (CONS) as the most common organism causing SSI.[31]Also Budhani D *et al*.[32]found *S.aureus* (25.5%) as the most common pathogen isolated followed by *Escherichia coli* (23.5%), *Citrobacter* spp. (17.3%) and *Pseudomonas aeruginosa (9.9%)* respectively in their study.

All the eight strains of *Staphylococcus* species were susceptible to linezolid and doxycycline (100%). Less susceptibility was seen to clindamycin and co-trimoxazole (75%), erythromycin (62.5%), cefoxitin (37.5%) and least to penicillin (12.25). Budhani D *et al.*[32]found *S. aureus* showed maximum antibiotic sensitivity to Linezolid (96.6%) followed by vancomycin (95%), amikacin (82.5%) which is again quite comparable with our findings. Devjani D *et al.*[25] *found* 66.67% of *S. aureus* strains were found to be resistant to penicillin. Ineffectiveness of penicillin in *S. aureus* has been reported in other studies also in the literature.[33] In their study 23.8% of strains were MRSA while we obtained 62.5% MRSA in this study. MRSA infections are of great concern due to high morbidity and mortality rates. The other major concern in SSIs is that *S.aureus* originates from patients' nasal flora and may influence the outcome of surgery.The increased isolation rates of MRSAstress the need to screen and treat subjects for nasal carriage which could possibly influence etiology of SSIs.[34]

## CONCLUSION

Staphylococcus aureus is a major aetiology of SSIs in this hospital. Mainstay of treatment for MRSA infections still depends on glycopeptides and linezolid. Compilation of local data on SSIs and feedback are the fundamental concern for the formulation of a proper guideline for peri-operative prophylaxis of antibiotics to mitigate the rate SSIs in the hospital.

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