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**Original Research Article**

# A prospective study of surgical site infections and related risk factors in a teaching hospital

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## ABSTRACT

**Background:** Surgical site infections are the most common nosocomial infection causes morbidity and mortality among inpatients of hospital. Surgical site infection (SSI) varies hospital to hospital. The present study was designed to find out the incidence and various risk factors associated with surgical site infection in the surgical wards of MNR hospital, Sangareddy, Telanagana, India.
**Methods:** The study was carried out on 248 patients who underwent various surgeries in the General Surgery department of MNR hospital, Sangareddy, Telangana, India. A predesigned protocol was used to collect the data. Surgical site infections were examined and graded. All the samples were collected aseptically and were processed by the standard microbiological techniques. Data was analysed by SPSS.20 software.
**Results:** Among 248 patients, 45 developed surgical site infection. Among 45 patients, 25 were grade 3 and 20 were grade 4 type of infection. Surgical site infections (SSIs) were most commonly found among males, aged, diabetics, anaemic, underweight and overweight, hypertensive, blood transfusion and patients with longer hospital stay. Surgical Site Infections were higher in emergency cases than elective surgeries. *Staphylococcus aureus* was the most common organism isolated from surgical site infections. Multidrug resistance organisms were predominant in surgical site infections.
**Conclusions:** The incidence of surgical site infection is high. Age, sex, diabetic, blood transfusion, prolonged hospital stay are the important risk factors for SSIs. So implementing proper antibiotic policies and infection control measures can reduce SSIs to great extent.

**Keywords:** Infection control, Risk factors, Surgical site infections

## INTRODUCTION

Surgical site infections are one of the most common complications of surgery and causes morbidity and mortality among inpatients of hospitals. Apart from the aseptic techniques, antimicrobial drugs, sterilization, surgical site infections continue to be a major problem in all-surgical departments in the hospital.[1] According to National nosocomial infections surveillance report, SSIs are the 3rd most frequently reported nosocomial infections.[2-4] WHO reported nosocomial infections are one of the major infectious diseases having large economic impact.[5,6] The pathogens that causes SSIs can be a part of the patients normal flora or from the hospital environment.[7,8] So the aim of this study was to determine the rate of SSIs and to find out the various factors and etiological agents, which influence SSI.

## METHODS

The present study was carried out from July 2015 to August 2016. Institutional Ethical Committee approved

the study. Surgical wounds were categorized as per CDC criteria.[9] Surgical wounds were graded on the following scale: grade 1= normal healing, grade 2 = suture line erythema <1 cm, grade 3 = suture line erythema > 1 cm, grade 4 = purulent discharge.[10]

Detail history regarding each cases were recorded, such as age, sex, co-morbid conditions, blood transfusion, antibiotic therapy and preoperative hospital stay. All the samples were processed as per standard microbiological protocol. Antibiogram was obtained from culture sensitivity reports. Statistical analysis was done using SPSS.20 software. Chi-square test was applied to analyse the data (P value <0.05 as significant).

## RESULTS

During the study period 248 surgical wounds were included. Among them abdominal surgeries (47.17%) were most common, followed by limb surgeries (35.48%).

Other surgeries such as thyroid, tumour excisions, diabetic foot and other related ulcers (Table 1). Out of 248 patients, 45 (18.14%) developed SSIs. Among 45 SSIs, 25 (55.5%) were grade 3 type of infections and 20 (44.4%) were grade 4 type infections (Table 2).

**Table 1: Distribution of surgical sites in percentage.**

| Surgical site | Number (%) |
|---|---|
| Abdominal | 117 (47.17%) |
| Limb | 88 (35.48%) |
| Others | 43 (17.34%) |

**Table 2: Surgical site infections according to infection grade.**

| Grade of infection | Number (%) |
|---|---|
| Grade 3 | 24 (53.33%) |
| Grade 4 | 21 (46.66%) |

Majority of patients belongs to older age group. Among 188 male patients, 37 (19.68%) were developed SSIs and out of 60 female patients 8 (13.3%) were developed SSIs. Diabetes mellitus, hypertension and anaemia were the major co-morbid conditions studied. Out of 53 diabetes patients 29 (54.7%) were developed SSIs and 31 (83.78%) out of 37 anaemic patients developed SSIs. Among 46 hypertensive patients, 27 (58.69%) were developed SSIs. Out of 248 patients, 89 (35.88%) were received blood transfusion. Among them 33 (37.07%) developed SSIs, 12 (7.54%) patients who did not go through any blood transfusion developed SSIs.

**Table 3: Distribution of factors associated with SSIS.**

| Factors | | SSI | No SSI | P value |
|---|---|---|---|---|
| **Age group** | | | | |
| 15-30 | | 4.68% | 95.31% | <0.023 |
| 31-40 | | 25% | 75% | |
| 41-50 | | 28% | 72% | |
| 51-60 | | 52% | 48% | |
| >60 | | 35.7% | 64.28% | |
| **Sex** | | | | |
| Male | | 19.68% | 80.31% | 0.002 |
| Female | | 13.33% | 86.66% | |
| **Co-morbid conditions** | | | | |
| Diabetes mellitus | Yes | 54.71% | 45.28% | <0.000 |
| | No | 8.2% | 91.79% | |
| Anaemia | Yes | 65.95% | 34.04% | <0.000 |
| | No | 6.96% | 93.03% | |
| Hypertension | Yes | 58.69% | 41.30% | <0.001 |
| | No | 8.91% | 91.08% | |
| Blood transfusion | No | 7.55% | 92.45% | <002 |
| | 1-2 units | 34.14% | 65.85% | |
| | >3 units | 71.42% | 28.57% | |
| Pre-operative waiting | <3 days | 6.14% | 93.85% | <0.000 |
| | 3-7 days | 53.65% | 46.34% | |
| | >7 days | 42.85% | 57.14% | |
| Prophylactic antibiotic | Yes | 6.8% | 93.18% | 0.0257 |
| | No | 20.58% | 79.41% | |

* P value <0.05 as significant.

**Table 4: Antibiotic resistant pattern of different isolates (%).**

| Microorganisms isolated (No.) | Percentage of antibiotic resistant |
|---|---|
| *Staphylococcus aureus* (24) | P (85.96), Ox (65.7), Cx (65.7), Va (0), Gen (68.76), Tob (67.88), Ak (67.75), Cd (54.53), Lz (11.3), Le (34.4), C (64.5), Mo (5.67), Cip (44.35), Azm (56.66) |
| *Pseudomonas aeruginosa* (16) | Caz (39.6), Gen (82.19), Tob (54.3), Pit (56.66), Ak (57.67), At (34.4), Cpm (33.39), Cip (55.67), Le (46.7), Imp (55.34), Mrp (57.56), Dor (52.78) |
| *Klebsiella pneumonia* (12) | Amp (76.56), Cz (78.67), Gen (68.66), Tob (68.75), Ak (74.56), A/S (57.55), C (84.56), Te (88.45), Amc (76.5), Pit (65.4), Cxm (89.67), Cpm (34.67), Cx (87.76), Ctx (75.66), Cip (67.6), Le (78.76), Imp (45.56), Mrp (34.7), Dor (39.78), Etp (56.6), Cot (56.7), At (78.6), Caz (57.8) |
| *Escherichiae coli* (8) | Amp (66.57), Cz (78.76), Gen (63.66), Tob (64.75), Ak (54.56), A/S (37.55), C (64.56), Te (78.45), Amc (56.5), Pit (45), Cxm (79.7), Cpm (44.57), Cx (67.76), Ctx (55.66), Cip (47.6), Le (68.6), Imp (42.56), Mrp (35.7), Dor (37.78), Etp (46.6), Cot (58.7), At (58.6), Caz (67.8) |
| *Proteus mirabilis* (6) | Amp (78.56), Cz (79.67), Gen (78.56), Tob (63.75), Ak (64.56), A/S (67.45), C (64.56), Te (78.45), Amc (73.5), Pit (55.4), Cxm (69.67), Cpm (33.67), Cx (57.76), Ctx (65.66), Cip (48.6), Le (69.76), Imp (33.56), Mrp (22.7), Dor (27.78), Etp (28.6), Cot (46.7), At (38.6), Caz (23.8) |
| *Staphylococcus epidermidis* (5) | P (95.96), Ox (75.8), Cx (75.8), Va(0), Gen (78.76), Tob (77.9), Ak (77.55), Cd (56.54), Lz (25.34), Le (34.7), C(54.5), Mo(45.67), Cip(44.56), Azm(58.67) |
| *Citrobacter spp*. (4) | Amp(66.56), Cz(58.67), Gen(48.56), Tob(46.5), Ak(44.56), A/S(37.55), C(54.56), Te(58.45), Amc (66.5), Pit (35.4), Cxm (59.67), Cpm (23.7), Cx (67.6), Ctx (45.66), Cip (37.6), Le (28.76), Imp (55.56), Mrp (49.7), Dor (47.78), Etp (36.6), Cot (46.7), At (58.6), Caz (37.8) |
| *Enterobacter spp.* (5) | Amp (56.5), Cz (57.67), Gen (26.66), Tob (25.7), Ak (53.56), A/S (37.5), C (54.5), Te (58.4), Amc (18.5), Pit (25.4), Cxm (69.67), Cpm (34.7), Cx (57.6), Ctx (35.5), Cip (47.6), Le (58.7), Imp (35.5), Mrp (24.7), Dor (27.78), Etp (36.6), Cot (46.7), At (59.6), Caz (27.8) |

Majority of surgical cases operated in between 24-72 hours and among them 11 (6.14%) developed SSIs. 41 patients waited for surgery up to 1 week, among them 22 (53.65%) developed SSI. Out of 28 patients waited for more than one week 12 (42.86%) developed SSI. 44 patients were under antibiotic therapy, only 3 (6.8%) developed SSI. Remaining 204 patients' 42 (20.59%) patients developed SSI (Table 3).

Out of 45 SSIs, 45 showed growth of colonies on culture media. Staphylococcus aureus (53.33%) was the most common organism isolated from the surgical site followed by *Pseudomonas aeruginosa* (35.55%), *Klebsiella pneumonia* (26.66%), *Escherichiae coli* (17.77%), *Proteus* (13.33%), *Staphylococcus* epidermidis (11.11%), *Citrobacter* (8.88%), *Enterobacter* (11.11%). Most of the isolates were multidrug resistant (Table 4).

## DISCUSSION

Surgical site infections are most common cause of morbidity and mortality among surgery patients. It is the commonest nosocomial infection.[11,12] The rate of SSI varies hospital to hospital. The incidence of SSI varies from 2.5% to 41.9%.[13-15] As per our study the infection rate was 18.14%. Age is one of the main factors to increase the SSI rate. In our study SSI was mostly found in above 40 age group patients. The findings were comparable with other study reports.[12,14,16-18]

High SSI rates more in older age group due to co-morbid conditions and poor immune response.[18] In our study higher proportion of males (82.22%) developed SSI compared to females (17.77%). Similar findings reported by Kikkeri N et al, Varsha S et al showed in their study SSI proportion among males (7.4%) and females (5.1%) were almost similar.[19,20] Khan MA et al. reported SSI more in females (27%) than males (18%).[21] Co-morbid conditions like anaemia, hypertension and diabetes were the important risk factors for SSI. In this present study infection rate was higher in diabetes patients. Xue DQ et al, Kikkeri et al, Giles KA et al and National Academy of Science reported similar findings.[16,17,19,22] According to Kikkeri et al. and Tang R et al. blood

transfusion was an important risk factor in determining SSI.[19,23] These findings were comparable with our findings. In this present study long pre-operative stay in hospital also an important risk factor for SSI. These findings were comparable with other findings.[6,7,19] According to our study report pre-operative antibiotic usage decreased incidence of SSI.

Similar findings reported by Anvikar AR et al, Berard F et al and Wong ES.[6,24,25] *Staphylococcus aureus* was the most common organism isolated from the surgical sites. *Pseudomonas aeruginosa* was the 2nd most common organism isolated from SSIs followed by *Klebsiella, Esch. coli, Proteus,Staphylococcus epidermidis, Citrobacter* and *Enterobacter*. Kakkeri N et al, Lilani et al. and Mahesh et al. also found most common organism as Staphylococcus aureus and Pseudomonas aeruginosa in SSIs.[1,19,26]

## CONCLUSION

The higher incidence of SSI was due to the risk factors, such as age, gender, co-morbid conditions, blood transfusion, prolonged pre-operative waiting and antibiotic usage. However in this study most common factors associated with SSIs were diabetes, blood transfusion, long hospital stay and prophylactic antibiotic usage. Most common organism associated with SSI was *Staphylococcus aureus* and majority of organism were resistant to multiple drugs. So proper infection control measures and antibiotic policies can help to reduce SSIs.

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