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RETROSPECTIVE STUDY OF SUPERFICIAL AND DEEP SURGICAL SITE INFECTIONS DUE TO GRAM NEGATIVE ORGANISMS IN TERTIARY HEALTH CARE CENTRE IN SHILLONG

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ABSTRACT

Objectives: Objective of this study is to know the prevalence of surgical site infection among the postoperative patients in various surgical departments of tertiary healthcare centre and to identify the relationship between SSI and etiological pathogens along with their antimicrobial susceptibility.
Methods: A retrospective case study conducted among patients admitted to the surgical departments during the period between January 1st and December 31st 2016. Swabs and aspirates from the surgical sites were collected under sterile conditions and standard bacteriological tests were performed for identification and appropriate statistical methods were employed to look for association between SSI and etiological pathogens.
Results: Out of the 1284 samples included in the study, 192 samples showed evidence of SSI yielding an infection rate of 14.9%. The most commonly isolated bacteria were: *Escherichia coli and Acinetobacter baumanii* of the gram negative isolates 6.2% were multidrug resistant of which 19% were carbapenem resistant.
Conclusion: SSI with multiple drug resistance strains and polymicrobial etiology reflects therapeutic failure. The outcome of the SSI surveillance in our hospital revealed that in order to decrease the incidence of SSI we would have to: a) incorporate a proper antibiotic stewardship b) conduct periodic surveillance to keep a check on SSI d) educate medical staffs regarding the prevention of surgical site infection.

INTRODUCTION

Surgical site infection (SSI) previously termed postoperative wound infection is defined as that infection presenting up to 30 days after a surgical procedure if no prosthetic is placed and up to 1 year if a prosthetic is implanted in the patient[1]. SSI is the third most commonly reported nosocomial infection having adverse impact on the hospital as well as on the patient. The CDC healthcare-associated infection (HAI) prevalence survey in 183 hospitals of USA, reported 157,500 surgical site infections associated with inpatient surgeries in 2011[2]. With the increase in incidence of nosocomial infections and multi drug resistance a continuous surveillance is called for, to keep a check on the occurrence of SSI. It is responsible for prolonged stay of patient in hospital which results in social and economic loss to the patients and their family. Various studies on SSI in India shows the prevalence range of 5-30% depending on the surgical procedure performed, risk factors involved, hospital stay etc which is remarkably high when compared to CDC guidelines[3,4,5]. Aim of this study is to identify the various bacterial isolates responsible for SSI, their antibiotic resistance pattern in our institute and analysis of underlying risk factors. Since the prevalence of SSI varies from region to region, this is the first study of its kind conducted in our hospital.

MATERIAL AND METHODS

This retrospective case series was conducted in the Department of Microbiology at tertiary health care centre in North east India, during the period between January 1st and December 31st 2016.

The samples for this study was obtained from the patients who had undergone clean and clean contaminated operations in various surgical departments like Obstetrics, Surgery, Orthopaedics, Neurosurgery, Urology etc. Procedures like draining of abscess, burn injuries and donor sites of split skin graft were excluded as per CDC guidelines.

In the post operative period, surgical wounds were examined for any signs of infection. When infection was clinically suspected, under aseptic condition the exudates were collected from the depth of the wound using sterile cotton swabs. The

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specimens were gram stained and examined for the presence of organisms and pus and cultured aerobically on blood agar and MacConkey agar as well as in cooked meat broth to observe any anaerobic growth. Bacterial isolates were identified using conventional biochemical tests. Antimicrobial susceptibility was performed by the Kirby Bauer method and interpreted as per CLSI guidelines 2015.

The statistical significance of various parameters affecting SSI had been tested using 'p' test at 95% confidence level ($p< 0.05$). The Statistical Package for the Social Sciences (SPSS) software word version 16.0 was used to analyze the data. Chi square ($\chi 2$) test was used to observe the association.

RESULTS

During the study period, a total of 4385 surgeries were performed. Out of the total surgeries 64.1% were major and 35.9% were minor procedures. On the basis of clinical suspicion of SSI during postoperative period, 1284 patients were included in the study. Of the 1284 patients 885 (69%) were males and 399 (31%) were females. Among the cases studied, 1027 (79.9%) were clean surgery cases and 257 (20.1%) were clean contaminated cases, of which 1164 (90.6%) were elective and 120 (9.4%) were emergency surgical procedures. Out of 1284 patients studied, 231 organisms were isolated from 192 samples.

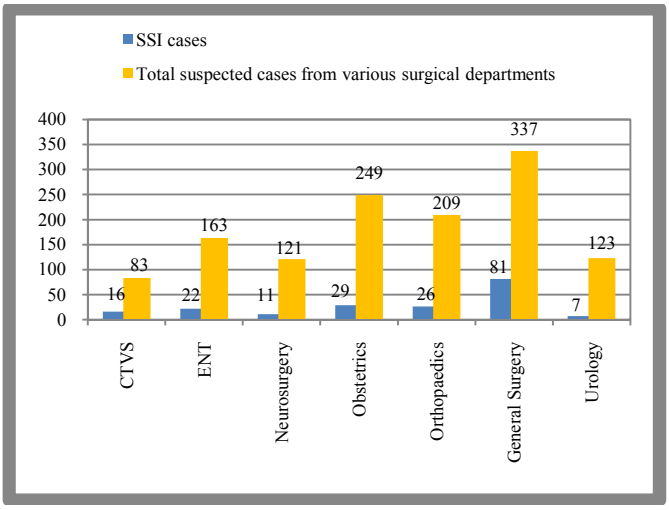

Figure 1 SSI cases in various surgical departments

Table 1 Age pattern in SSI Incidence

Age	SSI present	SSI absent	Total
>50 years	79	381	460
20-50 years	72	354	426
<20 years	41	357	398

Demographic Profile

In the present study, the incidence of SSI is higher among the male patients ($p<0.05$). It has been observed, that the incidence of SSI is significantly ($p<0.05$) higher in elderly patients above 50years of age.

Microbiological Profile

In the present study, 192 samples showed growth in culture media and total of 231 organisms were isolated. Out of 231 organisms isolated, 77% were Gram negative organisms and 23% were Gram positive organisms. Figure 3 and 4 depicts the number of various organisms isolated.

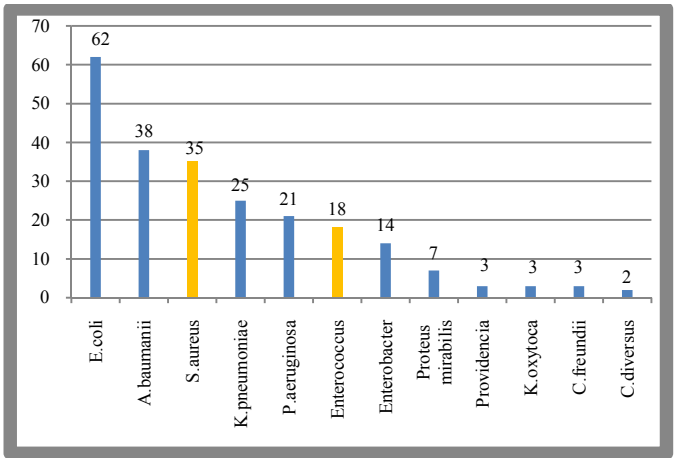

Figure 2 Distribution of various organisms isolated

Table 2 Risk factors in SSI

Risk factor	SSI present	SSI absent	Total
Non diabetic	63 (7.3%)	797	860
Diabetic	129 (30.4%)	295	424
Clean	67 (6.7%)	940	1007
Clean contaminated	125 (45%)	152	277
Elective operation	73 (7.6%)	891	964
Emergency operation	119 (37.1%)	201	320
Short stay	55 (7.9%)	638	693
Prolong stay	137 (30%)	454	591
Duration of surgery <2hrs	58 (8.1%)	654	712
Duration of surgery >2hrs	134 (23.4%)	438	572

The pathogens mainly isolated were *Escherichia coli* (26.8%), *Acinetobacter baumanii* (16.5%), *Klebsiella pneumoniae* (10.8%), *Pseudomonas aeruginosa* (9.1%), and *Enterobacter* species (6.1%). However, in the present study we also reported presence of Gram positive cocci like *Staphylococcus aureus* (15.2%) and *Enterococcus* species (7.8%) from superficial surgical site infection. There was no evidence of anaerobic organisms from deep seated surgical site infections.

In this study, *Escherichia coli* was the most common pathogen associated with clean contaminated wound. Polymicrobial aetiology was seen in 39 samples out of 192 positive culture samples. 19% of total Gram negative isolates were found to be carbapenem resistant. 6.2% of total Gram negative isolates were multidrug resistant, mainly *Acinetobacter baumanii* (11 isolates). All Gram positive organisms were sensitive to Vancomycin, Linezolid and Teicoplanin. The antibiotic susceptibility profile for various bacterial isolates against the antibiotic panel tested, using Kirby Bauer method (as per CLSI 2015 guidelines)[7].

Risk factors profile in SSI

In this study, risk factor like elderly age group, diabetes, prolong preoperative hospital stay and clean contaminated wound was significantly ($p<0.05$) associated with the incidence of Surgical Site Infections.

DISCUSSION

In this study we defined Surgical Site Infections following the guidelines of CDC. The incidence of Surgical Site Infection in India varies from 5% to 30% depending on the surgical procedure performed, hospital facility, risk factors associated etc which varies from region to region as per different studies.[3,4,5]

The incidence of Surgical Site Infection in our set up found to be 14.9% which was comparable with rate of SSI reported by

Sachin Patel *et al* (16%)[6]. However a lower rate of infection was reported by Anvikar AR *et al* [4](6.1%)

In present study patients were divided in three age groups. The rate of SSI was highest (41%) in age group >50 years which is comparable to other studies. This may be due to poor immune response, existing co morbidities in old patients and reduced compliance with treatment.

In various studies, the type of operation was found to affect the rate of SSI. In our study we found, that the rate of SSI was highest in patients who underwent General surgery mainly for acute abdomen cases (24%), 19% for cardiothoracic vascular surgery, however least rates were observed in Ophthalmological (0%) and Urological (5%) surgeries.

Operation which takes longer time to perform results in increased exposure of operation site to air, prolonged trauma, stress of prolonged anaesthesia and sometimes increased blood loss. The present study demonstrates the rise in cases of SSI (23%), in which duration of surgery prolonged to more than 2hours. Various authors who had conducted studies on SSI, revealed this correlation between SSI and prolonged duration of surgery.

In our study we found that prolonged preoperative hospital stay was associated with higher rate of infection, which was comparable with other studies. Prolonged preoperative hospital stay leads to colonization with antimicrobial resistant microorganisms and itself directly affects patient's susceptibility to infection by lowering host resistance.

The rate of SSI was revealed to be more with clean contaminated wounds (45%) when compared with clean wounds surgery (6.7%), it was similar to other studies in India on SSI[4,5,8].

Gram negative organisms of Enterobacteriaceae family were the predominant pathogens in our setup. *Escherichia coli* was the predominant organism among the gram negative and *Staphylococcus aureus* was more common among the gram positive organisms in this study. Studies in Europe shows higher *S. aureus* associated SSI ranges from 35-40%, however in our study we found *Staphylococcus aureus* responsible for 15.2% of SSI. The dominance trend of Gram negative organism over Gram positive organism had been reported in studies from Mumbai and Orissa[4,8]. SSI due to *Staphylococcus aureus* is mainly because of its pathogenic role in hospital infection and emergence of virulent antibiotic resistant strains. 42.9% of *Staphylococcus aureus* were revealed to be MRSA in this study. 65.7% of *S. aureus* strains were found to be resistant to penicillin. Ineffectiveness of penicillin in *S. aureus* is comparable with many reported studies[5,6,8]. MRSA infections are of great concern due to high morbidity and mortality rates. All *Staphylococcus aureus* and *Enterococcus* species isolates were sensitive to Vancomycin, Linezolid and Teicoplanin.

Apart from *Escherichia coli*, other Gram negative organisms like *Acinetobacter baumanii (16.5%), Klebsiella pneumoniae (10.8%)* and *Pseudomonas aeruginosa (9.1%)* also played an important role as pathogen in causation of SSI. This was not in concordance to other Indian studies which reported Pseudomonas aeruginosa as second leading cause of SSI. In our study 30% of SSI in clean contaminated wound was caused by *Escherichia coli* and 23% by *Klebsiella pneumoniae*. Polymicrobial aetiology of SSI in present study was mainly caused by combined growth of *Escherichia coli* and *Acinetobacter baumanii*. 70% of total Gram negative organisms isolated were sensitive to Cefoperazone and sulbactam, Piperacillin and tazobactam, Carbapenems, Amikacin and Colistin. 11 isolates of *Acinetobacter baumani* were resistant to third line of antibiotics except Colistin, which was due to the extended spectrum beta lactamase production. To conclude, in the present study we have observed that increased duration of surgical procedures (>2hours), elderly age (>50years) and diabetes like compromised immunity are responsible for Surgical Site Infection in our set up. Enterobacteriaceae (especially *Escherichia coli*), *Acinetobacter baumanii* and *Staphylococcus aureus* are the predominant pathogens showing maximum sensitivity to Carbapenem, Colistin and Vancomycin respectively.

CONCLUSION

A proper assessment of risk factors that predispose to SSI and their modification may help in reduction of SSI rates.

With rapid rise in antibiotic resistance in microorganisms due to selective pressure and production of extended spectrum beta lactamase, it becomes very necessary to adopt a proper antibiotic stewardship in every hospital, depending on the surgeries performed and organisms isolated in order to avoid the problem of SSI. Antimicrobial prophylaxis should be safe, inexpensive and with good spectrum of activity. Periodic surveillance of SSI will guide the hospital Infection Control Committee in laying down strict guidelines to further decrease the SSI incidence in our setup, which is an indicator of health care in a given system.

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