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RESEARCH ARTICLE

BACTERIOLOGICAL PROFILE AND ANTIBIOGRAM OF SUPERFICIAL INCISIONAL SURGICAL SITE INFECTIONS AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Context (Background): Surgical site infections (SSIs) are the most common healthcare-associated infections. The high rate of SSIs is associated with higher morbidity and mortality among the patients undergoing surgery. SSIs are a major cause of concern among health care practitioners, as advances in infection control practices have not completely eradicated the problem of SSI due to development of drug resistance. An infected wound complicates the postoperative course, results in prolonged stay in the hospital, causes delayed recovery and adds to burden on financial resources.

Aims: The present study was undertaken to isolate and characterize the bacterial pathogens causing superficial insicional SSI and to know their antimicrobial susceptibility pattern.

Methods and Material: This prospective study was carried out between March and September 2013 at tertiary care hospital attached to our Medical College. Patients who underwent surgery during the above mentioned study period were followed up for thirty days to look for development of SSI as per CDC guidelines.

Results and Conclusions: A total of 65 samples from patients with SSIs were included for the present study. Out of 65 samples, 15 showed no growth, whereas 50 samples yielded growth on culture. From 50 samples, total of 56 isolates were obtained. Among 56 isolates 40 (71.4%) were Gram negative bacilli and 16 (28.6%) were Gram positive cocci. Commonest pathogen was *Escherichia coli* 15 (26.8%), followed by *Staphylococcus aureus* 13 (23.2 %). Multidrug resistance including ESBL (22.5%) and Amp C (22.5%) production was found among Gram negative pathogens. MRSA prevalence was found to be high (53.9 %). Inducible clindamycin resistance was noted in 01/13 (7.7 %) isolates of *Staphylococcus aureus*.

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INTRODUCTION

Surgical site infections (SSIs) are the commonest of all healthcare-associated infections (HAI) and account for 31% of all HAIs among hospitalized patients (Magill *et al*., 2012). About 77% of the deaths of surgical patients are related to SSIs (Nutanbala N. Goswami *et al*., 2011). The control of SSI has become challenging due to varying bacteriological profile and wide spread bacterial resistance to antimicrobials. Antimicrobial resistance can increase complications and costs associated with the surgical procedure and treatment. Therefore, knowledge of the aetiological agents and antibiogram of SSI proves to be helpful. As per CDC guidelines, surgical wounds are classified as Class I/ Clean, Class II/ Clean-Contaminated, Class III/ Contaminated, Class IV/ Dirty-Infected.

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SSI criteria as per CDC include superficial incisional, deep incisional and organ/space SSI. Superficial incisional SSI is the one which involves only skin and subcutaneous tissue of the incision and in addition also fulfills other criteria as per CDC (Mangram *et al*., 1999). SSIs can be caused by either exogenous or endogenous bacteria (Shriyan *et al*., 2010). *Staphylococcus aureus, Escherichia coli, Klebsiella spp, Proteus spp* and *Pseudomonas aeruginosa* are often found to be common organisms implicated in SSI (Jan *et al*., 2006). Methicillin resistant *Staphylococcus aureus* (MRSA), ESβL and Amp C producing Enterobacteriaceae and *Pseudomonas aeruginosa* are known to be multidrug resistant and hence difficult to treat (Shriyan *et al*., 2010). SSIs are known be a nightmare of every surgeon since a long time and continue to be so even today. Problem of drug resistance has made control of SSIs difficult, in spite of advances in infection control and availability of newer antibiotics (Anguzu and Olila, 2007). Development of SSI depends on many factors which are interrelated, viz host factors like diabetes and malnutrition, environmental, surgery related factors like preoperative stay,

tissue trauma and organism related factors like virulence along with antibiotic resistance (Reichman *et al*., 2009). Further, identification and surveillance of SSIs has been made more challenging by shorter hospital stays and the increasing use of outpatient surgery. Though, SSIs are a potential danger to surgical patients all over the world, developing countries face this problem on a larger scale because of the infrastructural and economic limitations in many hospitals (Jan and Christoph, 2006). This emphasizes the need for monitoring postoperative patients for SSI, evaluating new management approaches to the prevention and treatment of SSIs, and the need for a workable classification system that will facilitate the collection of data in a geographically and clinically diverse population (Robert H Rubin, 2006). Also, antibiotic susceptibility pattern of organisms causing SSI may vary depending on study population and antibiotic usage in a hospital. Hence the present study was undertaken, to know the bacteriological profile and antibiogram of superficial incisional surgical site infections.

MATERIALS AND METHODS

This prospective study was carried out between March and September 2013 at tertiary care hospital attached to Bangalore Medical College and Research Institute, Bangalore. Inclusion Criteria: Patients who underwent surgery during the above mentioned study period were followed up for upto thirty days to look for development of superficial incisional SSI, as per CDC criteria. Total of sixty five post operative in-patients in surgical wards during the above mentioned period, were included in the study. Exclusion Criteria: Patients who developed stitch abscess, deep incisional SSI and organ space SSI. After selecting the patient for study, oral informed consent of the patient was obtained in their native language and data was collected using a Proforma. Samples were collected from the surgical site with two sterile cotton swabs taking all aseptic precautions and transported to the microbiology laboratory without delay.

In the microbiology laboratory, the samples (one swab each) were subjected for culture and microscopy (By Gram's stain). The samples for culture were inoculated on Blood agar and MacConkey agar (from Hi Media, Mumbai). All the bacterial isolates thus obtained were characterized and identified by studying their Gram stain morphology, cultural characters and standard biochemical tests (Forbes *et al*., 2007). Antimicrobial susceptibility testing was carried out by modified Kirby-Bauer disc diffusion method according to the Clinical Laboratory Standard Institute (CLSI) guidelines (CLSI, 2013). MRSA detection was done as per CLSI guidelines using Cefoxitin disc (30µg). ESβL detection was done as per CLSI guidelines using Ceftazidime (30µg) disc for Initial Screen Test and a disc each of Ceftazidime (30µg) and Ceftazidime+Clavulanic acid (30/10µg) for Phenotypic Confirmatory Test. For Amp C detection, a disc containing 30 µg of Cefoxitin and another containing 30 µg of Cefoxitin with 400 µg of boronic acid were used (Hemalatha *et al*., 2007). ATCC *Escherichia coli* 25922, ATCC *Staphylococcus aureus* 25923 and ATCC *Pseudomonas aeruginosa* 27853 were used as controls.

RESULTS

A total of 65 samples from patients with SSIs were included for the present study. Out of 65 samples, 50 samples yielded growth on culture, whereas 15 showed no growth. From 50 samples, total of 56 isolates were obtained. Among 56 isolates 40 (71.4%) were Gram negative bacilli and 16 (28.6%) were Gram positive cocci. Monomicrobial etiology was seen in 43/ 50(86%) samples whereas polymicrobial etiology was found in 07/50 (14%) samples. Out of 50 patients, who showed growth on culture, 26 (52%) were males and 24 (48%) were females. The age group ranged from 10 days to 73 years, majority of patients were more than 50 years old (Figure 1). Majority of the cases were from General surgery department 26 (52 %) followed by Obstetrics and Gynaecology 12 (24 %) and least were from Cardiothoracic surgery 01(02%) (Figure 2). Co morbid conditions were noted in 25 (50%) of the patients, commonest co morbid condition were Diabetes mellitus and smoking seen in 11(22%) patients followed by alcoholism and hypertension seen in 04 (08%) of patients.

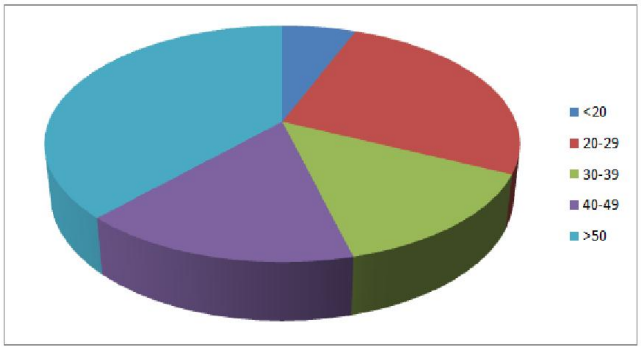

Figure 1. Age Distribution of Patients (N=50)

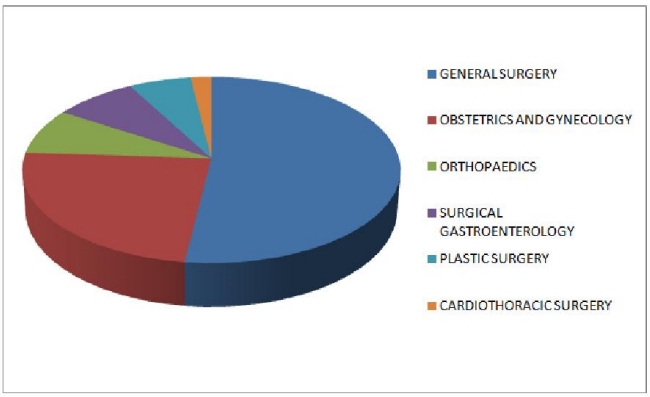

Figure 2. Department Wise Distribution of Samples

Direct smear examination was done for all 65 samples. Among 50 samples which showed growth on culture, direct smear examination correlated well with culture report in 36/50 (72%) samples, where as absence of pus cells and bacteria in 14/50 (28%). Of 15 samples which showed no growth on culture, direct Gram stain showed presence of pus cells and bacteria in 07 (46.7 %) samples and absence of pus cells and bacteria in 08(53.3 %) (Table 1). Commonest pathogen was *Escherichia coli* 15 (26.8%), followed by *Staphylococcus aureus* 13 (23.2 %), *Pseudomonas aeruginosa* and *Klebsiella spp* 09 (16.1 %) each, Gram negative non fermenters 03(05.4 %), *Enterococcus spp, Proteus spp, Citrobacter spp* 02 (03.6 %) each and Coagulase negative Staphylococcus 01(01.8 %) (Figure 3).

Table 1. Direct Smear Examination by Gram's Stain

Total samples (N=65)			
Samples with growth (N=50)		Samples without Growth (N=15)	
Positive gram's stain	Negative	Positive gram's stain	Negative
41	09	07	08
Total (N=50)		Total (N=15)	

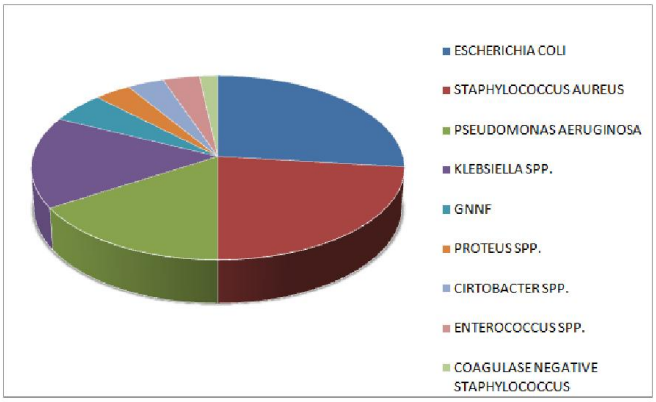

Figure 3. Organism Wise Distribution of Isolates

Extended Spectrum Beta Lactamase (ESBL) production was seen in 09/ 40 (22.5%) of isolates. Among ESBL producers *Klebsiella spp* was common ESBL producer 03/09 (33.3%) followed by *Escherichia coli* 04/15 (26.7 %). Amp C production was seen in 09/ 40 (22.5%) of isolates. ESBL producing organisms were found to be sensitive to, Amikacin, Gentamicin, Piperacillin -tazobactam and Carbapenems and resistant to Ciprofloxacin, Co-trimoxazole. Most of the isolates of *Pseudomonas aeruginosa* and Gram negative non fermenters were found to be resistant to Imipenem but showed 100 % sensitivity to Aztreonam (Table 2 & 3).

Table 3. ESBL Production among Gram Negative Bacilli

ORGANISM	ESBL POSITIVE (PERCENTAGE)
KLEBSIELLA SPP.(N=09)	03(33.3%)
ESCHERICHIA COLI(N=15)	04(26.7%)
TOTAL=24	07

and Coagulase negative staphylococci were sensitive to all antibiotics.

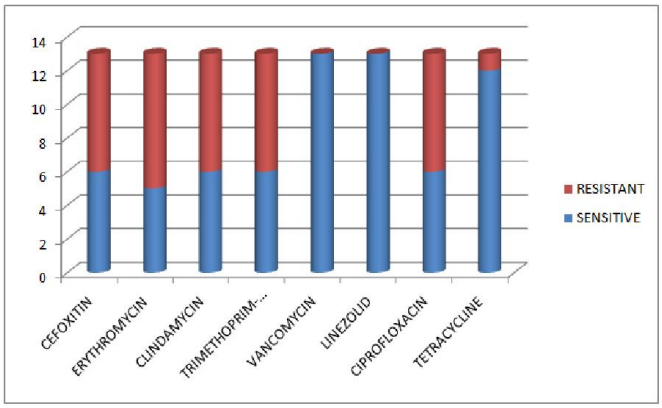

Figure 4. Antibiotic Sensitivity of Staphylococcus aureus

DISCUSSION

The present study showed that SSIs were common in patients aged more than 50 years, which could be attributed to associated co morbid conditions like diabetes mellitus, hypertension, smoking etc seen in elderly individuals. Another study has also reported higher incidence of SSI in people aged 40 years and above (Shriyan *et al*., 2010). Majority of cases were from General surgery department followed by OBG, orthopaedics and others, which is comparable with other study (Hemalatha *et al*., 2007). Direct smear examination from the sample by Grams method correlated well with majority of culture reports. Also, no growth was noted from culture in some samples, which showed positive result in direct Gram's stain. This can be attributed to the fact that patient can be already on antibiotics or the infection could be due to anaerobic organisms. This underscores importance of direct smear examination. Similar observation was also seen in other study (Chollom *et al*., 2012). Gram negative bacilli were common isolates followed by *S.aureus*, which is comparable to other studies (Etok *et al*., 2012).

Table 2. Antibiotic Sensitivity of Gram Negative Bacilli (Key: ND=Not Done)

Antibiotics	E.coli (N=15)	Pseudomonas aeruginosa (N=09)	Klebsiella (N=09)	Proteus spp (N=02)	Citrobacter spp (N=02)	GNNF (N=03)
Amikacin	12	07	07	01	01	01
Gentamicin	10	05	05	01	01	01
Ceftriaxone	02	ND	02	01	01	00
Ceftazidime	02	04	03	01	01	00
Ciprofloxacin	02	04	02	01	01	00
Piperacillin-Tazobactam	10	07	06	02	02	02
Cefotaxime	02	ND	03	01	01	01
Imipenem	12	03	07	02	02	01
Aztreonam	10	09	03	02	02	03
Colistin	ND	09	ND	ND	ND	ND
Polymixin B	ND	09	ND	ND	ND	ND

MRSA accounted for 07/13 (53.9 %) of *Staphylococcus aureus* isolates. Inducible clindamycin resistance was noted in 01/13 (7.7 %) isolate of *Staphylococcus aureus*. All *Staphylococcus aureus* isolates were sensitive to Vancomycin and Linezolid (Figure 4). Other Gram positive cocci, i.e, *Enterococcus spp*

However some studies have shown preponderance of Gram positive cocci (Sonawane *et al*., 2010). This can be due to variation in sample size, use of different antibiotics for surgical prophylaxis in different hospitals, differences in type of surgery and hence site of SSI in different study populations.

Presence of more than one organism in some SSIs noted in our study could either be due to infection from both exogenous and endogenous source or one of the organisms could have been mere coloniser, as also seen in other study (Horan *et al*., 1992). *E.coli* was the commonest isolate followed by *S.aureus* and other organisms in our study. Similar findings were noted in other studies (Chollom *et al*., 2012; Mohanty *et al*., 2004 and Khan *et al*., 2006). ESBL production among Gram negative bacilli was less compared with other studies (Etok *et al*., 2012; Mohanty *et al*., 2004 and Metri *et al*., 2011). Reduced exposure to cephalosporins and the appropriate timing and duration of perioperative antimicrobial prophylaxis is known to be associated with lower incidence of ESBL producing Gram negative bacilli. ESBL producing enterobactereciae were found to be sensitive to other antibiotics, viz Amikacin, Gentamicin and resistant to Ciprofloxacin, Co-trimoxazole. Most of the isolates of Pseudomonas aeruginosa and Gram negative non fermenters were found to be resistant to Imipenem but showed 100 % sensitivity to Aztreonam. Similar findings were seen in other studies (Etok *et al*., 2012 and Sonawane *et al*., 2010). Amp C production was less compared to other studies (Hemalatha *et al*., 2007 and Singhal *et al*., 2005). MRSA prevalence in our study was found to be higher than other studies in India (Sonawane *et al*., 2010 and Hayath *et al*., 2008).

Our study shows that advanced age with associated co morbid conditions act as risk factors for development of SSI. Direct smear examination by Gram's stain helps in correlating culture reports. Isolation of multidrug resistant organisms from cases of SSI in a tertiary care hospital has important implication for choosing drugs for empirical/ prophylactic therapy. Increased rate of isolation of ESBL and Amp C producing Gram negative bacilli emphasize the need for re-evaluation of process followed before, during and after the surgery in the management of surgical patients and regular quality control of disinfectants to re-establish their effectiveness. High prevalence of MRSA in our study stresses the need of screening of patients and health care workers for MRSA carriage. To conclude, repeated prevalence surveys are useful for monitoring trends in rates of SSIs and effectiveness of intervention strategies. The knowledge of bacteriological profile and the susceptibility patterns of the bacterial strains causing SSI in a hospital will guide the clinicians to choose appropriate and judicious antibiotics for surgical prophylaxis.

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