Bacteriological Profile and Antimicrobial Resistance Pattern in Surgical Site Infection in a Tertiary Care Hospital, Central Nepal

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ABSTRACT

Introduction: Surgical site wound infections (SSI) are the third most commonly reported nosocomial infection and they account for approximately a quarter of all nosocomial infections. Apart from bacterial contamination of wound, various patient and environment related factors play a role in development and outcome of SSI. The present study is undertaken to study the frequency of SSI and the antimicrobial resistance pattern of the causative organisms isolated.

Methods: This cross-sectional prospective study was carried out over a period of one year. A total of 245 pus samples from suspected cases of surgical site infections were processed for gram staining, culture, biochemical identification tests and antimicrobial susceptibility testing using standard microbiological protocol. Data was analysed using software word version SPSS 19.

Results: The overall frequency of SSI was 13.87%. Most common isolates were staphylococcus aureus and *Escherichia coli*. All four staph aureus strains were resistant to penicillin and cefixime but were 100% sensitive to vancomycin and cloxacillin. Two out of four stains were methicillin resistant *Staph. aureus* (MRSA). Another concern in recent time is the isolation of acinetobacter from surgical wounds.

Conclusions: Preoperative antibiotics, reduced hospital stay and proper control of co-morbidities decrease the incidence of post-operative infections. Marked resistance of isolates to commonly used antibiotics signifies the need for judicious and rational use of these drugs to prevent the emergence of antibiotic resistant strains.
Keywords: Clean and clean-contaminated wound; MRSA; Post-operative wound infections; Staphylococcus aureus; Surgical site infections

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INTRODUCTION

Surgical site infection (SSI) usually appears after three to seven days post-procedure. It may however develop up to 30 days and even up to one year, especially in patients with implants. SSI are the third most commonly reported nosocomial infections and they account for approximately a quarter of all nosocomial infections.[1] It is a major cause of increased morbidity as well as mortality among post-operative patients and increased cost of healthcare in most centres all around the globe.[2] The incidence of SSI in developing countries has been reported to be around two to 40%. In many SSIs, the responsible pathogens originate from patient's endogenous flora. The causative pathogen depends on the type of surgery; the most commonly isolated organisms are staphylococcus aureus, coagulase negative staphylococci, enterococcus spp and *Escherichia coli.*[3] For any given type of surgery, SSI approximately doubles the cost of hospitalisation.[6-8] This study is aimed to provide the knowledge of the organisms causing SSI and help in rational use of antibiotics based on their resistant pattern towards different antibiotics. We intended to find the incidence of SSI and bacteriological profile of organisms causing SSI with their antibiotic resistance pattern in post-operative patients.

METHODS

The study was commenced after taking permission from Institutional Review Committee of our institute. It was a cross-sectional prospective study conducted from 1st Aug 2019 to 31st Jul 2020, at Kathmandu Medical College and Teaching Hospital, Sinamangal, Kathmandu, Nepal. Sample size was calculated from the study conducted in tertiary care hospital in India which was approximately 20%.[4]

P[4] (P= 20%)
Z = 1.96
Q = 80
Sample size $= Z^2PQ/d^2$
n= 3.84 X 20 X 80 / 25 = 245.76
Sample size = 245

Patients of either sex, admitted in the Department of Surgery, Department of Orthopaedics, Department of Gynaecology and Obstetrics, who had undergone surgical procedures during the study period were enrolled into the study after taking informed consent. Convenient sampling method was used. Surgical wound was examined on third operative day and thereafter weekly for 30 days. A total of 245 pus samples from suspected cases of surgical site were collected using two sterile swab without contaminating with skin commensals under aseptic conditions. Smear was prepared directly from sample using the first swab and stained with gram stain. Culture was done from second swab, labeled and transported to the clinical microbiology laboratory without any delay. All samples were inoculated on to blood, MacConkey and Chocolate agar plates aerobically and incubated at 37^0C for 48 hours. Organism isolates were identified by gram staining, their colony characteristics and biochemical test.

All the bacterial isolates were subjected to antimicrobial susceptibility test by modified Kirby-Bauer disc diffusion method on Mueller-Hinton agar (HI- Media). After matching with 0.5 McFarland Unit, entire MHA plate was inoculated with sterile cotton swab by lawn culture method. Antibiotics from Hi-Media were laid over it with the help of forceps. Antibiotics used were Imipenem (10 µg), Amikacin (30 µg), Amoxyclav (20/10 µg), Cloxacillin (30 µg), Cefixime (5 µg), Ceftriaxone (5µg), Azithromycin (15µg), Cotrimoxazole (23.75/1.25 µg), Piperacillin / Tazobactam (100/10 µg), Ofloxacillin (5 µg), Ampicillin (10 µg), Vancomycin (30 µg), Colistin (10 µg) and Tigecycline (15 µg). Plates were incubated aerobically for 24 hours at 37^0C.[5] The zone of inhibition were compared with the standard interpretative table as per CLSI guidelines 2012. Data was analysed by using SPSS software word version 19.

RESULT

Among total 245 patients, SSI was 15 (44%) in surgery department, 11 (32%) in orthopaedic department and rest 8 (23%) was from gynaecology and obstetrics department. Thirty four (13.87%) patients developed SSI out of which only 10 were found to be culture positive. SSI rate was 5.5% in clean surgeries and 36.92% in clean-contaminated surgeries as shown in Table 1.

SSI rate was found to be higher among females [19(55.80%)] than male patients [15(44.11%)].

Table 1. Incidence of SSI with respect to wound class

Wound class	No. of patients (%)	Wound class (%)
Clean	180 (73.46)	10 (5.55)
Clean and contaminated	65 (26.53)	24 (36.92)
Total	245 (100)	34 (13.87)

However, this difference was not statistically significant. Highest incidence of SSI was found among age group of 40 to 60 years [15(44.11%)] and least below the age of 20 years.

S. aureus was the most common organism isolated, accounting for 40% (4 isolates) followed by *Escherichia coli* (2 isolates, 30%), *Citrobacter freundii* (2 isolates, 20%) and *coagulase negative S. aureus* (1 isolate, 10%) and *Acinetobacter boumanii* (1 isolate, 10%) as shown in table 3.

All the four s. aureus strains were 100% resistant to ampicillin and cefixime but were 100% sensitive to vancomycin and cloxacillin (0% resistant). Two out of four stains were methicillin resistant *S. aureus* (MRSA).

Antibiogram of *E. coli* exhibited 100% resistant to imipenem and piperacillin - tazobactam and showed 100% sensitive to newer drugs tigecycline and colistin. Moderate susceptibility was seen to ofloxacin, ceftriaxone, and amikacin. Acinetobacter baumanii were resistant to most of the drugs used and was having good susceptibility towards only colistin and tigecycline. On the other hand, citrobacter freundii showed resistant to the newer drugs colistin and tigecycline and was sensitive to other commonly used drugs.

Table 3. Frequency of pathogenic bacterial isolates

Organism detected	Number of isolates	% of total isolates
S aureus	4	40
E. coli	2	20
C. freundii	2	20
Acinetobacter baumanii	1	10
CONS	1	10

Table 2. Demographic characteristics of study

Character		N (%)
Gender	Female	137 (55)
	Male	108 (44)
Age category	< 20	14 (5)
	21 - 40	86 (35)
	41 - 60	108 (44)
	> 60	28 (11)

DISCUSSION

The SSI incidence rate of the present study is 13.87% which can be well correlated with the infection rates of 4.7%, 9.6%, 12.6% to 23% in Nepal conducted by Tuladhar et al., Sutariya et al., Shrestha et al. and Giri et al. respectively between 2008-2017.[9-12] Various studies conducted in developing countries including India showed SSI rate between 6% to 32%.[13-19] However, reports from other developed countries showed a lower incidence of SSI between 2.8% and 16%.[20-23] SSI rates assessed in a Canadian hospital over a prolonged period of 10 to 16 years showed a rate of only 4.7% which indicates that larger groups studied over a longer duration give a better assessment of SSI rates. The difference observed in the incidence rate of SSI in developed countries compared to developing countries, could be due to poor set-up of hospitals, poor hygiene of patients increasing colonisation of skin by bacterial flora,

Table 4. Antibiotic resistance pattern of Gram-positive bacterial isolates

Antimicrobials	MSSA		MRSA		CONS	
	N	%	N	%	N	%
Ampicillin	02	100	02	100	01	100
Azithromycin	01	50	02	100	01	100
Cefixime	02	100	02	100	01	100
Ofloxacin	00	00.0	02	100	01	100
Amikacin	00	00.0	02	100	00	00.0
Cotrimoxazole	01	50	02	100	01	100
Ceftriaxone	00	00.0	02	100	01	100
Cloxacillin	01	50	00	00.0	01	100
Vancomycin	00	00.0	00	00.0	00	00.0

MSSA- Methicillin sensitive s. aureus, MRSA- Methicillin resistant s. aureus

Table 5. Antibiotic resistance pattern of Gram-negative bacterial isolates

Antimicrobials	E.coli		Citro-bacter freundii		Acineto-bacter baumanii	
	N	%	N	%	N	%
Imipenem	02	100	00	00.0	01	100
Azithromycin	01	50	00	00.0	01	100
Amoxyclav	01	50	01	50	01	100
Cefixime	01	50	00	00.0	01	100
Ofloxacin	01	50	00	00.0	01	100
Amikacin	01	50	00	00.0	01	100
Cotrimoxazole	01	50	00	00.0	01	100
Ceftriaxone	01	50	00	00.0	01	100
Tigecycline	00	00.0	00	00.0	00	00.0
Colistin	00	00.0	02	100	00	00.0
Piperacillin-Tazobactam	02	100	00	00.0	01	100

late presentation of patients to healthcare system leading to contaminated wounds, and overwhelmed emergency services due to population burden. A higher infection rate in developing countries emphasises the need for better implementation of infection control practices along with a proper surveillance system for the use of antibiotics.

The higher frequency of SSI observed in Department of Surgery [15 (44%)] could be because of higher number of emergency procedures conducted in this department in comparison to other departments. Highest incidence of SSI was found among age group of 40 to 60 years [15 (44.11%)]. This result was in agreement with other studies confirming that as age increases the risk occurrence of SSIs also increases.[24]

In the present study, *S. aureus* was the commonest isolate from the postoperative wound infection which is in consistent with reports from other studies.[1,20,25] Among gram negative bacilli, E. coli was the commonest isolate in the present study. Based on the type of surgical procedure, the pathogens that are isolated from SSI may vary. It is found that in clean surgical procedures, s. aureus is the usual pathogen isolated from the exogenous environment or the patient's skin flora and anterior nares. In the present study gram negative bacilli were predominantly isolated from clean-contaminated surgeries. These are the polymicrobial flora closely resembling the normal endogenous microflora of the surgically resected organ most frequently isolated.[26]

A number of studies in the literature indicate gradual increase in the emergence of antibiotic resistant microorganisms in surgical patients.[26-27] Special interest in s. aureus SSI is mainly due to its predominant role in hospital cross infection and emergence of virulent antibiotic resistant strains. In the present study, all *S. aureus* strains from the infected wound were resistant to cefixime and ampicillin. Ampicillin resistance in s. aureus has been reported in other studies also.[28] Two out of four (50%) strains of *S. aureus* strains were methicillin-resistant but none of the strains was resistant to vancomycin and cloxacillin. In the 2010 National Healthcare Safety Network (NHSN) update, the portion of SSI due to MRSA was 43.7%.[29]

E. coli was the commonest gram negative organism isolated from our study which is in accordance to a study conducted in India by Singh et al.[30] All strains of *E. coli* in our study were resistant to imipenem and piperacillin - tazobactam. Fifty percent of *E. coli* isolates were resistant to the combination of amoxicillin and clavulanate. This finding suggests that the resistance observed was mainly due to the production of β-lactamase by the organisms. In addition, most isolates were susceptible to colistin and tigecycline but 50% were resistant to ceftriaxone which is one of the drugs commonly used for prophylaxis.

SSI due to *A. baumanii*, though uncommon, does occur and is increasing in frequency. In our study, *A. baumanii* isolated were multi drug resistant and were effective only with reserved drugs colistin and tigecycline. Tigecycline has good in vitro activity against imipenem-resistant acinetobacter, showing 100% sensitivity.

Prolonged postoperative hospitalisation, which is a major concern of most of the hospitals, has been evident in patients developing SSI.[30] Though the exact increase in patient-care cost due to prolonged postoperative hospital stay could not be calculated, it is a cause of concern for any hospital. Surveillance of SSI with feedback of appropriate data to surgeons would be desirable to reduce the SSI rate. Although our study is a single centric small sized study, we believe it has been able to shed the light upon the present scenario of SSI and the common antibiotics resistance and sensitivity pattern. Another important limitation of our study is that we did not culture anaerobic bacteria. SSI with negative cultures may be positive for anaerobic bacteria.

CONCLUSIONS

We found out that SSI incidence rate to be 13.8%, which was within acceptable international ranges. However, multi-drug resistance was exhibited by MRSA, *E. coli* and *acinetobacter* isolates, leaving clinicians with few choices of drugs for the treatment of patients with SSI. Emergence of drug resistant strains of *acinetobacter* exhibit significant role in hospital acquired infection.

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