ORIGINAL ARTICLE

Effects of antibiotic prophylaxis on surgical wounds: A study in a tertiary care centre of central Kerala

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ABSTRACT

Background and Objectives: Effectiveness of prophylactic antibiotics is based on the susceptibility of the common potential pathogens to those antibiotics. Irrational use of drugs has an adverse impact on treatment outcome and financial burden to patients. **Aims:** Objective of this study was to evaluate the effect of antibiotic prophylaxis on surgical site infections and wound colonisation. **Materials and Methods:** A cross-sectional study was conducted among the patients of general surgery wards of a tertiary care hospital of central Kerala. Swabs collected from surgical wound sites after 48 h of surgery were analysed for bacteriological profile and antibiotic prophylaxis given. Statistical analysis was done by Epi Info. **Results:** Three hundred and ten cases were studied including 75.5% elective and 24.5% emergency cases. Cefotaxime (55.2%) and third generation cephalosporin combination with β-lactamase inhibitors (35.5%) were commonly used for antibiotic prophylaxis. Infection rates were 2.1% in clean surgeries, 8.1% in clean-contaminated and 22.8% in contaminated types of surgeries with an overall infection rate of 8.1%. *Escherichia coli* (45%) and *Staphylococcus aureus* (34.5%) were the predominant wound pathogens. Colonisation in 28.1% wounds with *S. aureus* as the major coloniser (72.8%) was noticed. Susceptibility of *E. coli* to Cefotaxime was 15.4% in infections and 20% in colonisation. Infection rates were higher in the group with multiple antibiotic usages for 5 days (40%) or above (52%). Colonisation increased on prolonged administration of multiple antibiotics (40%) and without using antibiotics (39%). Clean wounds without antibiotic prophylaxis were not infected. **Conclusions:** This study revealed that antibiotic prophylaxis is not required for clean wounds. Short duration of antibiotics usage based on the local susceptibility pattern is to be adopted. Antibiotic usage has to be restricted, and prophylactic regime with third-generation cephalosporin has to be curtailed.

Key words: Antibiotic prophylaxis, antibiotic susceptibility, surgical site infection, wound colonisation

INTRODUCTION

Antimicrobial prophylaxis is used to reduce the incidence of post-operative wound infections. Surgical site infection (SSI) is defined as infections that occur within 30 days at the site of surgery. The effectiveness of prophylactic antibiotics is based on the microbial resistance pattern of the potential pathogens prevalent in that region. The prophylactic regimen need not eradicate every pathogen. Irrational use of drugs increases the incidence of antibiotic resistance and makes a significant impact on treatment outcomes and economic burden to the patients.

Commonly, the source of the infecting organism in SSIs is the patient's own flora or the hospital environment. Hand hygiene measures are important to prevent cross infection through the colonised hands.

The Centres for Disease Control and Prevention guidelines for the prevention of SSIs emphasise the importance of good patient preparation, aseptic practice, attention to surgical technique and appropriate antimicrobial prophylaxis.[1]

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MATERIALS AND METHODS

A cross-sectional study was conducted in 310 patients in a tertiary care hospital of Kerala state in South India after the approval of the Institutional Review Board. Patients of either sex above 15 years and admitted in general surgery wards were included in the study during a period 1st September 2010–31st August 2011, one year. Critically ill patients and cases with dirty surgical wounds where incision is through infected area were excluded.

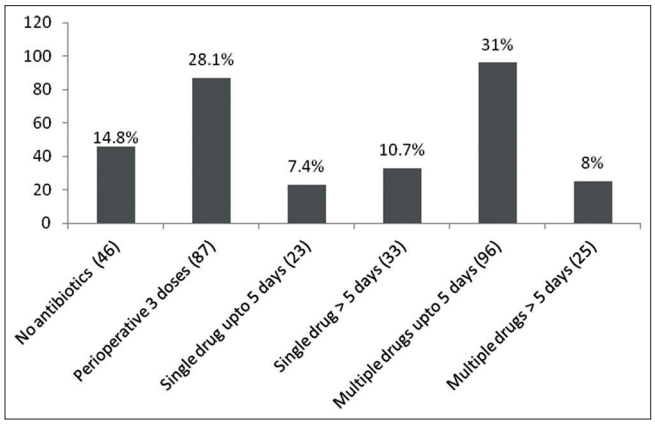

Figure 1: Category of prophylactic antibiotic usage

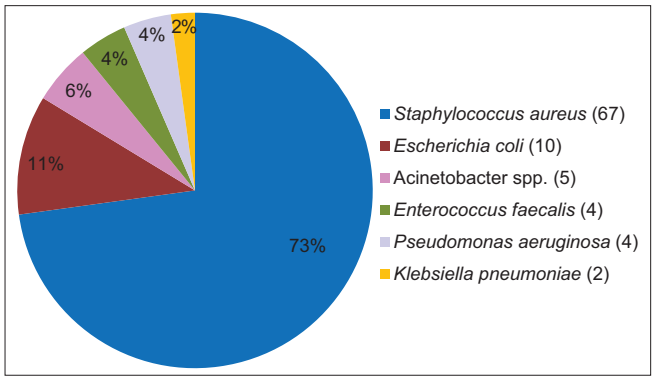

Figure 2: Bacterial isolates from colonised wounds

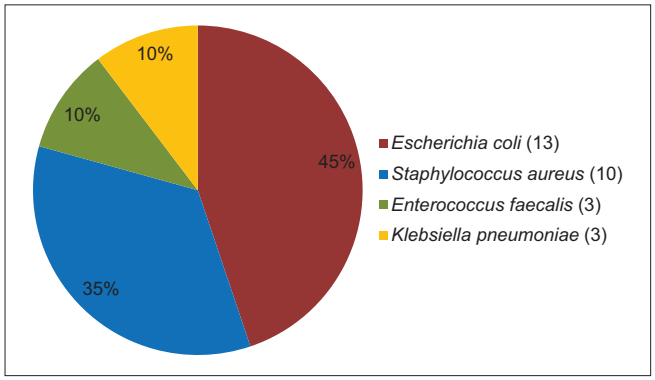

Figure 3: Bacterial isolates from wound infection

Patient's data were collected in a pre-designed pro forma which included age, sex, type of surgical procedure, risk factors, antibiotics prescribed, dose, time and duration of administration. After 48 h of surgery, dressings on the surgical wounds were removed. Any evidence of wound infection was indicated by local inflammatory change or discharge from wound site. Swabs were collected from the wound site for bacteriological analysis and antibiotic susceptibility using standard laboratory methods. Colonisers were defined based on the appearance of wound, where there was no inflammation or discharge and Gram staining where pus cells were absent or only occasional. Each case was followed up till the day of discharge. The cases were categorised into six groups based on the number and duration of antibiotic administration. The effect of antibiotics on wound colonisation and infection were analysed for each category. Statistical analysis was done using Epi Info-7 Software (Developed by CDC).

RESULTS

A total of 310 cases were studied including 234 (75.5%) elective and 76 (24.5%) emergency surgeries. There were 194 clean wounds (62.6%), 37 clean contaminated (11.9%) and 79 contaminated (25.5%) types.

The antibiotics were given based on the type of surgeries and risk factors. Only the clean cases were operated without prophylactic antibiotics or had perioperative doses. Out of 310 patients, 264 (85.2%) cases received prophylactic antibiotics. Twenty-five patients (8.1%) developed SSI and colonisers were isolated in 87 (28.1%) cases. The categories of antibiotic use [Figure 1] and the patterns of bacterial growth in each category are shown in Table 1.

Cefotaxime was given for 171 patients (55.2%). There were 49 (28.7%) colonised and 12 (7%) infected cases in this group. Among the 110 patients (35.5%) who received third generation cephalosporin-sulbactam combination, 30 cases (27.3%) had wound colonisers and 5 (4.5%) developed infection. In clean-contaminated and contaminated surgeries, Metronidazole was added. Other drugs used were Ciprofloxacin (2.9%), Piperacillin-Tazobactam combination (1.9%), Gentamicin (1.9%), Amikacin (1.6%), Penicillin (1.3%), and Ampicillin (1.3%).

Staphylococcus aureus was isolated as the major (73%) wound coloniser [Figure 2]. The most common pathogen isolated was *Escherichia coli* (45%) followed by *S. aureus* (35%) [Figure 3].

The antibiotic sensitivity pattern of isolates from colonisation and wound infection was compared [Tables 2 and 3].

The effect of antibiotics on wound colonisation and wound infection was analysed based on the pattern of antibiotic prophylaxis they had, using Chi-square test [Table 4].

Chi-square test was used to study the association of duration of antibiotic usage and its outcome. There was a statistically significant difference in the rate of colonisation and infection observed in multiple drug users for more than 5 days (χ^2 - 29.2, $P = 0.000$) compared to those with drugs used <5 days.

DISCUSSION

The microbial load at the wound site is important in determining wound infection even with the usage of routine antibiotic prophylaxis. The protective function of skin is disrupted by skin incision, and microbial contamination becomes inevitable in spite of adequate skin preparation.[2] Colonisation occurs with potentially pathogenic microorganism, and so any wound has the risk of infection.

Infection rate in clean cases was 2.1%. Infection rates were 8.1% in clean-contaminated and 22.8% in contaminated cases. The accepted range is 1–5% in clean, 3–11% for clean-contaminated and 10–17% for contaminated wounds.[3]

Appropriate antibiotic for prophylactic use depend on the most likely infecting organism encountered during the surgical procedure. Infections can be prevented by achieving adequate concentration of the drug in the blood and tissues during and shortly after the procedure.[4]

The antibiotics and duration differed based on the wound class and risk factors. Only the clean cases were operated without antibiotic prophylaxis or with perioperative antibiotics, and none of them were infected. Results from two other studies also highlight this fact.[5,6] In a study of 360 inguinal mesh herniorrhaphy cases, Perez *et al*. in Manila reported that single-dose pre-operative antibiotic administration markedly decrease wound infection.[5] After a study in 6123 patients, Fonseca *et al*. in Brazil reported that replacing with a single dose antibiotic prophylaxis before elective surgery was found to be sufficient rather than giving a 24 h regimen.[6]

Out of 310 patients, 264 (85.2%) cases had prophylactic antibiotics and 129 (48.9%) of them received single

Table 1: Wound infection and colonisation after antibiotic prophylaxis

Antibiotics	No growth/ skin flora (%)	Wounds with colonisation (%)	Infected wounds (%)
No antibiotics (46)	28 (60.9)	18 (39.1)	0
Perioperative antibiotics three doses (87)	63 (72.4)	24 (27.6)	0
One drug for 5 days (23)	18 (78.2)	4 (17.4)	1 (4.4)
One drug >5 days (33)	26 (78.8)	6 (18.2)	1 (3)
>One drug 5 days (96)	61 (63.5)	25 (26.1)	10 (10.4)
>One drug >5 days (25)	02 (8)	10 (40)	13 (52)

Table 2: Comparison of antibiotic sensitivity of Gram positive isolates between coloniser and pathogen

Antibiotics	*Staphylococcus aureus* (100%) (%)		*Enterococcus faecalis* (100%) (%)	
	Coloniser (*n*=67)	Pathogen (*n*=10)	Coloniser (*n*=4)	Pathogen (*n*=3)
Penicillin	3 (4.5)	1 (10)	0	0
Ampicillin	-	-	2 (50)	2 (66.7)
Erythromycin	10 (14.9)	5 (50)	-	-
Cloxacillin (cefoxitin disc)	30 (44.8)	7 (70)	-	-
Gentamicin*	47 (70)	6 (60)	4 (100)	3 (100)
Vancomycin	67 (100)	10 (100)	4 (100)	3 (100)
Linezolid	67 (100)	10 (100)	4 (100)	3 (100)

*Gentamicin 10 mcg was used for *Staphylococcus aureus* and Gentamicin 120 mcg for *Enterococcus faecalis*

Table 3: Comparison of antibiotic sensitivity among Gram negative isolates between coloniser and pathogen

Antibiotics	*Escherichia coli* (100%) (%)		*Klebsiella pneumoniae* (100%) (%)	
	Coloniser (*n*=10)	Pathogen (*n*=13)	Coloniser (*n*=2)	Pathogen (*n*=3)
Ampicillin	0	0	0	0
Co-trimoxazole	4 (40)	7 (53.8)	0	1 (33.3)
Cephalexin	1 (10)	1 (7.7)	0	0
Third-generation cephalosporins	2 (20)	2 (15.4)	0	2 (66.7)
Ciprofloxacin	3 (30)	4 (30.8)	0	1 (33.3)
Gentamicin	6 (60)	5 (38.5)	1 (50)	1 (33.3)
Amikacin	10 (100)	13 (100)	1 (50)	3 (100)
Imipenem	10 (100)	13 (100)	2 (100)	3 (100)
Piperacillin-Tazobactam	10 (100)	13 (100)	2 (100)	3 (100)

Table 4: Antibiotic usages with colonisation and infection (*n*=121)

Multidrug usage (days)	No growth/ normal flora (%)	Wounds with colonisation (%)	Wounds with infection (%)	Total (%)
>5	2 (8)	10 (40)	13 (52)	25 (20.7)
<5	61 (63.5)	25 (26.1)	10 (10.4)	96 (79.3)

drug. *S. aureus* was colonised in 18.2% of cases with the prolonged use of single drug beyond 5 days, and 50% of them were Methicillin-resistant *S. aureus* (MRSA). One case each was infected in the groups where single drug for 5 days or beyond was given. The wound healed with cleaning and dressing without further change of antibiotics in both the cases.

When multiple antibiotics were used for up to 5 days, colonisation was noticed in 26.1% of wounds under this category with an infection rate of 10.4%. These rates were further increased to 40% and 52%, respectively, on prolonging multiple drugs usage.

In a study from New Delhi, Rehan *et al.* reported that SSIs developed in 14% of patients even if they received prophylactic antibiotics for more than 5 days.[7]

In the present study, all the pathogenic Gram negative bacilli were resistant to Ampicillin (100%). Third generation cephalosporins were used commonly for prophylaxis as it was readily available in the hospital supply. However, *E. coli* isolates from the infected wound sites showed high resistance to first generation cephalosporins (92.3%) and third generation cephalosporins (84.6%). Resistance to Ciprofloxacin (69.2%) and Gentamicin (61.5%) were also high. In a study by Sarma *et al.*, Enterobacteriaceae isolates showed resistance to Ampicillin (100%), Amikacin (22%), Gentamicin (56%).[8] According to Mohanty and Kapil for Gram negative bacteria which account for 54.04% of the pathogenic isolates, single drug therapy would not be useful without an antibiotic sensitivity report. However, a combination of beta-lactam and beta-lactamase inhibitor would be more useful.[9]

In this study, MRSA accounted for 30% of the *S. aureus* isolates (34.5%) in wound infection. Among 40 MRSA, more (37) were colonisers and only three were real pathogens.

The prevalence of MRSA was found to be higher than other study reports. Sonawane *et al.* from Mumbai reported 29.26% of the pathogens isolated from wound infections were *S. aureus* and 27.85% of them were MRSA.[10] In another study at Nagpur by Tahnkiwale *et al.*, 26.92% of MRSA were recovered from pus and wound swabs.[11] According to Kownhar *et al.*, Chennai, one of the most prevalent bacteria was *S. aureus* (37%) that comprised 21.7% MRSA.[12] Hand hygiene recommendations are important to prevent cross-infection through the colonised hands.[13]

CONCLUSIONS

Overall SSI rate was 8.1%. *E. coli* and *S. aureus* were predominant pathogens in the study group. Among MRSA, more (37) were colonisers and only three were real pathogens. Most of the pathogens were resistant to the third generation cephalosporin. The excessive antibiotic usage and Cefotaxime prophylaxis need to be revised. This study revealed that antibiotic prophylaxis is not required for clean wounds and should be limited for patients with added risk factors. Prolonged use of antibiotics does not reduce the infections. It is necessary to adopt antibiotics for short duration based on the local susceptibility pattern. Reduce the microbial load of infected wound by debridement and cleaning which is more effective rather than changing antibiotics. Continuous monitoring of antibiotic sensitivity pattern is required to get the local information of the epidemiology of drug-resistant bacteria.

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Conflicts of interest

There are no conflicts of interest.

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