Original Research Article

Pattern of antibiotic use and risk factors associated with surgical site infections in general surgery wards at tertiary care hospital of India

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Abstract

Objective: A prospective observational study was carried out to find out the incidence of postoperative surgical site infections (SSI) along with the major risk factors in patients admitted at a tertiary care Hospital. **Method:** A total number of 938 patients admitted to the general surgical ward of Guru Gobindsingh Hospital and Medical College, Jamnagar were included in the study. Regular postoperative follow-up was maintained. Patient data were collected using case report form and analysed. **Results:** The study showed postoperative wound infection rate of 11.72%. Predominant organisms isolated from postoperative wound infections were Staphylococcus aureus (26.23%) Risk factors associated with a higher incidence of SSI were found to be age (>50 years),emergency surgeries (21.73%), wound class (highest in dirty wounds19.19%) prolonged duration of hospital stay (13% if >7days), type of surgery, nutritional status and built of patient (18% in malnourished), quality of operation theatre with presence no of persons (13.75% if >10 person) no antibiotic prophylaxis (15.03%) or inappropriate antibiotic prophylaxis as single antibiotic (19.04%) or prophylaxis for more than 24 hour (9.96%). **Conclusion:** Type of surgery as well as other risk factors like patient's age, other comorbid disease and preoperative prophylactic preparation affect incidence of postoperative wound infection. Availability and awareness creation on the antibiotic drugs and the guidelines are important interventions for appropriate surgical antimicrobial use. Prevention of SSIs requires a multipronged approach with particular emphasis on optimising preoperative issues, adhering strict protocols during the intra operative period and addressing and optimising metabolic and nutritional status in postoperative period.
Key Word: SSIs; Postoperative; Surgical site, Prophylaxis

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INTRODUCTION

A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. The four wound classifications available include clean, clean-contaminated, contaminated and dirty/infected. (the wound class system used in NHSN is adapted from the American College of Surgeons wound classification schema.)[12] Surgical site infections is the leading infection in settings with limited resources, affecting up to one-third of operated patients; this is up to nine times higher than in developed countries. The CDC healthcare-associated infection (HAI) prevalence survey found that 1.7 million cases annually in the United States with approximately 100,000 deaths.[2]Known risk factors

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for SSI are related to the environment, surgeon, and patient like advanced age and diabetes mellitus, immuno-suppression and other severe underlying patient conditions, high-risk and sophisticated procedures, poor infrastructure, insufficient equipment, understaffing, overcrowding, lack of procedure, lack of knowledge of injection and blood transfusion safety, absence of local and national guidelines and policies, prolonged and inappropriate use of invasive devices and antibiotics etc.[3,4]As is the case for many other patient safety issues, health care-associated infections create additional suffering and come at a high cost for patients and their families. Infections prolong hospital stays, create long-term disability, increase resistance to antimicrobials, represent a massive additional financial burden for health systems, generate high costs for patients and their family, and cause unnecessary deaths.[3,4]The best data are obtained if prophylactic antibiotics are distinguished from antibiotics used for treatment. Efforts should be made to optimize antimicrobial prophylaxis for surgical procedures, optimize selection of the first choice antibiotic and duration of empiric antimicrobial therapy, and improve antimicrobial prescribing practices.[5] The use of antibiotics to prevent postoperative infections plays an important role in reducing the incidence of postoperative infections, duration of stay in hospital, cost of treatment, mortality, and helps the patient go back to the normal life more quickly[6]19, increasing the incidence of infectious diseases caused by bacterial resistance against antibiotics, emerging and re-emerging of infectious diseases, and mortality of nosocomial infections are mostly due to the incorrect use of antibiotics that is a major health problem in the country[7] 20 Unnecessary use of antibiotics and prolonged antibiotic prophylaxis (more than 48 hours) are significantly associated with increased risk of antimicrobial resistant microorganisms[2] Antimicrobial prophylaxis contributes to the reduction in incidence of SSI and is standard practice for the surgeries doing in general surgery department. Specific recommendations are available regarding the choice of the antibiotic, duration of prophylaxis, and timing of the first dose[8]Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk.[9]

MATERIALS AND METHODS

This prospective, observational, hospital-based cohort study was carried out after prior approval by Institutional Ethics Committee. Total 938 patients of both gender in different age groups admitted to the general surgery wards of Guru Gobindsingh Hospital and M.P.Shah Medical College, Jamnagar, were enrolled in the study. In all cases, preoperative, intraoperative, and postoperative details were studied. Information was collected in a case record form for age, sex, date of admission, associated co-morbid condition, reason for admission, type of surgery: emergency or planned, procedure, duration of surgery, preoperative and postoperative stay, preoperative antibiotic prophylaxis data on the use of antibiotic prophylaxis included timing of first antibiotic prophylaxis dose, antibiotic agent, and duration of antibiotic therapy, these were obtained from patients' medical and anaesthetic records and type of wound weather clean, clean-contaminated, contaminated and dirty/infected wound. All patients were followed up in wards till discharge from the hospital. The data were statistically analysed. We used criteria of the US Centers for Disease Control and Prevention (CDC) NNIS System to diagnose SSI. Infections were classified as superficial incisional, deep incisional, or organ/space SSI[7]

RESULTS

Out of 938 surgeries, 110 (11.73%) cases developed postoperative wound infections. Predominant organisms isolated from postoperative wound infections were Staphylococcus aureus (26.23%) followed by Klebsiellaaerogens (20.77%) and Pseudomonas aeruginosa (20.22%) Maximum number of patients (62.73%) was from 5th, 6th, and 7th decade of age group. Postoperative wound infection rate was 7.28% in clean surgeries, 9.63% in potentially infected surgical wounds and 19.19% in frankly infected wounds.

Table 1: Type of surgical procedure with incidence of postoperative wound infection

No	Type of surgery	No.of operation performed (%)	No. of postoperative infection (%)
1	Hydrocele	59 (6.29%)	2(3.39%)
2	Inguinal hernia	68 (7.25%)	3(4.41%)
3	Other hernia	52(5.54%)	5(9.62%)
4	Appendix	98(10.45%)	7(7.14%)
5	Hepatobilliary	42(4.48%)	4(9.52%)
6	Breast (malignancy)	18(1.92%)	2(11.11%)
7	Breast (benign and other)	32(3.41%)	4(12.50%)
8	Lung and thoracic surgery	3(0.32%)	0(0%)

9	Thyroid and parathyroid	16(1.71%)	1(6.25%)
10	Upper urinary	36(3.84%)	4(11.11%)
11	Lower urinary and genital	56(5.97%)	5(8.93%)
12	Oesophageal and gastric and small bowel	14(1.49%)	1(7.14%)
13	Large bowel	35(3.73%)	7(20%)
14	Diabetic foot	98(10.45%)	22(22.45%)
15	Traumatic injury	45(4.80%)	3(6.67%)
16	Gangrene	30(3.20%)	9(30%)
17	Cellulitis	58(6.18%)	9(15.52%)
18	Abscess	66(7.04%)	12(18.18%)
19	Ulcer	45(4.80%)	5(11.11%)
20	Soft tissue selling	25(2.67%)	2(8%)
21	Others	42(4.48%)	3(7.14%)
	Total	938(100%)	110(11.73%)

Table 1 shows the rate of postoperative wound infections was higher in gangrene (30.0%), diabetic foot (22.45%), surgeries on large bowel (20.0%), abscess (18.18%), and in cellulites (15.52%).

Table 2: The association between risk factors and surgical site infections

Risk factors		No. of cases (total 938)	no. of postoperative wound infection (total110)
Duration of operation	<30 minute	194	33 (17.01%)
	30 to 60 minute	336	25 (7.44%)
	> 60 minute	408	52 (12.74%)
Age group	0-30 years	152	16(10.52%)
	31-50years	532	49(9.21%)
	>50 years	254	39(15.35%)
Gender	Male	516	66(12.79%)
	female	422	44(10.42%)
Type of operation	Elective	662	50(7.55%)
	Emergency	276	60(21.73%)
Preoperative duration of stay	≤ 7 days	608	67(11.01%)
	>7days	330	43(13%)
General condition of patient	Good,mild to moderately nourished and well built	722	71(9.83%)
	Malnourished and not well built	216	39(18%)
No of persons in operation theatre	≤ 10	342	28(8.18%)
	>10	596	82(13.75%)

Table 2 shows Higher infection rate was noted in males (12.79%) as compared to females (10.42%). We observed higher rate of postoperative wound infections in emergency surgical procedure (21.73%), longer postoperative duration of stay (13%). It was observed that malnourished and not well built persons were more susceptible to SSI(18%). More numbers of persons present in operation theatre have been correlated as higher SSI rate (13.75%). The rate of postoperative wound infections was observed higher in duration of operation less than 30 minutes (17.01%) because of short surgical procedure on infected lesions like abscess debridement, gangrene etc.

Table 3: Characteristics of antibiotic prophylaxis administration in planned surgery

Antibiotic pattern	No. of cases(total 938)	Incidence of SSI(total 110)
1. No prophylaxis	286	43 (15.03%)
2. Preoperative prophylaxis		
a. Single antibiotic	42	8(19.04%)
b. Used in combination	610	59(9.67%)
3.Duration of use as Preoperative prophylaxis		
a. Within 24 hours	326 (34.75%)	29(8.89%)
b. Before 24 hours	612 (65.24%)	61(9.96%)

In our study, we observed antibiotics used singly or in combination for pre-surgical prophylaxis were crystalline penicillin, ampicillin, cloxacillin, cefadroxil, cefotaxime, ceftriaxone, ceftazidime, cotrimoxazole, ciprofloxacin, norfloxacin, gentamicin, amikacin, and metronidazole. All the patients had received two to four antibiotics in varying combinations. Most commonly used combinations were: Beta lactum antibiotics (crystalline penicillin / ampicillin / cefotaxime) ± cloxacillin / aminoglycosides (gentamicin, amikacin) / metronidazole and fluroquinolone (ciprofloxacin) ± cloxacillin / aminoglycosides (gentamicin, amikacin) / metronidazole. In our study we observed that higher rate of postoperative wound infections were observed in case not received any prophylactic antibiotics. (15.03%) Single antibiotic prophylaxis as well as inadequately longer period for prophylaxis found responsible to raise postoperative wound infection rate. (19.04% and 9.96 % respectively)

DISCUSSION

In this study, majority of patients who underwent surgical procedures received antimicrobial prophylaxis which is in line with another study.[10] However; proper AMP practice in this setup was not parallel with recommendations of the clinical practice guideline for antimicrobial prophylaxis in surgery.[11, 12]The most commonly prescribed drugin our study for AMP was cefotaxime, followed by crystalline penicillin, metronidazole, ciprofloxacin and amikascin. For surgical prophylaxis, it is important to select an antimicrobial with narrowest antibacterial spectrum to reduce the emergence of resistance and as for covering the most likely contaminating microorganisms for that type of surgery.[14] In all patients that received antimicrobial prophylaxis selection of antimicrobials were not consistent with the recommendations of the guidelines which may be due to the absence of their own guideline. dministration of AMP should be within 1 h prior to incision to achieve adequate protection.[13]In our study, only 34.75 % of patients received preoperative antibiotics within 24 hour prior to incision which is in agreement with Brazilian study.[5] However, AMP administration time is not recorded in 17 (18.9%) patients may be due to work overload on attending nurses, the absence of separate sheet for recording time of administration and lack of awareness to record AMP administration time which is consistent with other studies.[12]Results from other study showed that duration of AMP was longer than 24 h in 30–90% of cases after surgery[15] and similarly this was observed in nearly 65.24% of our study participants. In general, single-dose prophylaxis or prophylaxis ending within 24 h after operation is recommended by guidelines.[11] Prolonged postoperative dosing of antibiotics does not provide additional benefits and is associated with increased risk of adverse events and induction of antimicrobial resistance.[11, 12]In most part of the world depending on the set up of their hospitals and their degree of adherence to aseptic techniques, the SSI rate has varied from a low of 2.5% to a high of 41.9%. [17,18,18,20 The] incidence rate of SSIs found in the present study was 11.73 %. It is comparable to other studies from developing country hospital 14.8% [21] and higher than studies carried out in USA 7.2% .[22] Similar studies carried out in India observed SSI rate as 20.09% [23], Nigeria 20.3%[24] and Ethiopia 19.1% .[25]Comorbidal condition like diabetes mellitus have been observed to raise SSI rate in our study. Some studies have examined the use of the ASA score as a predictor of SSI risk[18,26] Study showed Emergent surgeries (24%) had higher rates of SSI than elective procedures (19.8%).[27]In our study we observed21.73 % SSI rate in emergency surgery. This is because, as emergency operations should be higher risk because of suboptimal preoperative preparation and because they are more likely to be dirty. Despite the effectiveness of prophylactic antimicrobials to prevent SSIs, the use of antibiotic prophylaxis is often inappropriate. Previous reports indicated that timing of administration, selection of the antibiotic, and duration of prophylaxis were inappropriate in the great majorities of cases. [2821] While antibiotic prophylaxis is common in surgical procedures, inappropriate use of antibiotics occurs in 25% to 50% of the general elective surgeries.[29]A complex interplay between host, microbial, and surgical factors ultimately determines the prevention or establishment of a wound infection. The most common group of bacteria responsible for SSIs are *Staphylococcus aureus*. The emergence of resistant strains has increased the morbidity and mortality associated with wound infections. These strains are beginning to develop resistance to vancomycin in North India found in study of Tiwari *et al*. and they suggested to do such study in other parts of India also because the emergence of VRSA/VISA (Vancomycin resistant *Staphylococcus aureus* / vancomycin intermediate *Styphylococcusaureus*) might also be prevalent as antibiotic misuse is equally common there. [30] Vancomycin is currently the most effective antibiotic against MRSA. This new resistance has arisen because another species of bacteria like *acinetobacter* commonly express vancomycin resistance.[31] *Pseudomonas aeruginosa* is an epitome of opportunistic nosocomial pathogen, which causes a wide spectrum of infections and leads to substantial morbidity in immuno compromised patients. Despite therapy the mortality due to nosocomial *Pseudomonal pneumonia* is approximately 70%.[32]Unfortunately, *Pseudomonas aeruginosa* developed resistance to most of antibiotics thereby jeopardizing the selection of appropriate treatment.[31]

CONCLUSION

In conclusion, we observed 11.73% SSI rate. Factors affecting SSI are type of surgery, Patient's age, other comorbid condition, type of surgery, preoperative stay, nutritional status, antiseptic usage, and sterilization techniques and quality of operation area. The current study revealed that about 69% of patients received appropriate prophylactic antibiotics. In patients receiving antibiotics, the most common mistakes were antibiotic selection followed by prolonged prophylaxis (> 24 hours), and inappropriate dose of antibiotics. Availability and awareness creation on the antibiotic drugs and the guidelines is important interventions for appropriate surgical antimicrobial use. Therefore, healthcare administration and other concerned authorities should work to improve the availability of antibiotics and ensure compliant use in accordance with guidelines. Feeding this information back to surgeons and establishing pre-operative prophylaxis guidelines as a routine activity of infection control teams could improve nosocomial infection control program. We used smaller sample size and shorter study period which might have an impact on some of the results reported.

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