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RESEARCH ARTICLE

Proper use of surgical antibiotic prophylaxis for prevention of surgical site infections: Pre-operative timing and duration of prophylaxis

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ABSTRACT

Background: Surgical site infection (SSI) is an infection that occurs at or near a surgical incision within 30 days of surgery or within 1 year if an implant is left in place. They are the most common nosocomial infections in surgical patients, accounting for approximately 500,000 infections annually. The cost of care for patients with SSIs is nearly three-fold higher than that for surgical patients without the infections. **Aim and Objective:** The main objectives for conducting current study are to know incidence of SSI, to check proper use of surgical antibiotic prophylaxis and prepare data for health-care improvement. **Materials and Methods:** The study was observational, prospective in nature and conducted after getting institutional ethical clearance. All post-operative patients in surgical wards that fulfill the inclusion criteria were included in the study over the period of 2 months. Data were collected in questionnaire Google forms by both direct interview and referring indoor files. **Result:** Total 198 patients were included and evaluated. Total six patients were not given any antibiotic. Incidence of SSI was 7.57% in total 198 patients. Most of the cases were from general surgery, followed by orthopedic, gynecology, and obstetrics. Total 124 patients were given antibiotics for <24 h. In all the patients, antibiotics were started minimum ½-h before surgical incision. **Conclusion:** The pre-operative timing and duration of prophylactic antibiotic administration should be appropriate according to guidelines to reduce SSI and its burden on society.

KEY WORDS: Surgical Antibiotic Prophylaxis; Surgical Site Infection; WHO-Guidelines; Duration; Incidence

INTRODUCTION

Surgical site infection (SSI) is an infection that occurs at or near a surgical incision within 30 days of surgery or within 1 year if an implant is left in place.[1,2] They are one of the most common nosocomial infections in surgical patients, accounting for approximately 500,000 infections annually.[3]

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Common pathogens causing SSIs are *Staphylococcus aureus*, Coagulase-negative Staphylococci, Enterococci, Group B streptococci, etc. SSIs are common and occur in 2–5% of surgeries involving incisions in the United States.[3] Rates of SSIs differ according to the type and duration of surgery. Global estimate of SSI, according to studies, is from 0.5% to 15%. While in India, it accounts on higher side, ranges from 23% to 38%, which becomes one of the main problems a surgeon faces after an operation. It is one of the main cause of hospital acquired infections.[4]

The cost of care for patients with SSIs is nearly three-fold higher than that for surgical patients without the infections.[3] These infections reduce patients' quality of life postoperatively and account for 3.7 million excess hospital days and more than

$1.6 billion in excess costs annually, overall.[5,6] Furthermore, patients who develop SSIs are 5 times more likely to be readmitted to the hospital, 60% more likely to spend time in the intensive care unit, and twice as likely to die compared with surgical patients without the infections.[7]

Surgical antibiotic prophylaxis (SAP) means antibiotic that is given to surgery patient, before surgery, for prophylaxis of SSIs. There are various guidelines such as, WHO global guidelines, American Society of Health-System Pharmacists, guidelines from the society of thoracic surgeons for proper use of such antibiotics. The aim of using appropriate prophylactic antibiotics in surgical patients is to ensure effective serum and tissue levels of the drug to prevent such SSI.

So we had conducted this study of SAP, after looking at the severity and impact of SSIs on the health and wealth of the Indian population. It is important to take steps for the prevention of the condition rather than cure of it.

MATERIALS AND METHODS

The study was observational and prospective in nature conducted over the period of 2 months. The study was conducted after getting ethical clearance from institutional ethical committee. All post-operative patients in all surgical wards, willing to participate in the study and also fulfill the inclusion criteria, were included after filling up the informed consent form. Data were collected in questionnaire Google forms by both personal interview and referring indoor patient files. Collected data were compiled in Microsoft office Excel and analyzed further.

RESULTS

Total 198 patients were included and evaluated in the study. Incidence of SSI was reported in 15 (7.57%) patients [Figure 1]. While remaining, 183 patients were discharged healthy without developing any SSI. Out of 198 patients, six patients were not given any antibiotics. Among these, six patients, none has developed SSI [Figure 2]. Most of the cases were from general surgery, followed by orthopedic, gynecology, and obstetrics department. Out of 198 patients, 124 patients were given antibiotics for < 24 h and remaining patients for >24 h [Figure 3]. In all the patients, antibiotics were given minimum ½-h before incision.

DISCUSSION

Antimicrobial therapy can be categorized into: Prophylaxis, preemptive, empiric, definitive, and suppressive. Out of these categories, prophylaxis therapy is given to those subjects who are not yet infected or developed any disease. Wound infection can result when a critical number of bacteria is present in the wound at the time of closure. Chemoprophylaxis is given to prevent such wound infections after surgical procedures.[8] In our study, total 198 patients were enrolled and evaluated. Out of these, total 192 patients were given SAP and no antibiotics in six patients. Total 183 patients (out of 198) were not get infected by SSIs. In all the patients, antibiotics were given ½-h before incision and total 124 patients received antibiotic prophylaxis for <24 h.

In total six patients out of 198, no antibiotics were given and none of them suffered from SSI. According to surgeons, there were non-traumatic surgeries and no viscera or tract entered during surgeries. According to National Research

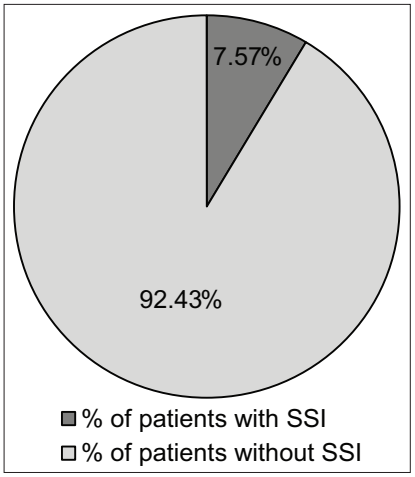

Figure 1: Total percentage of patients with surgical site infection

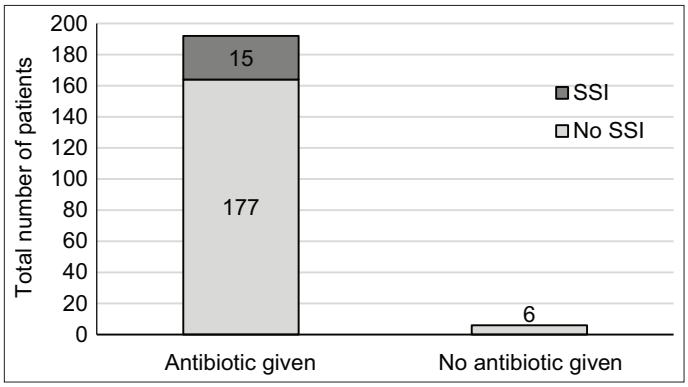

Figure 2: Total number of patients given antibiotic

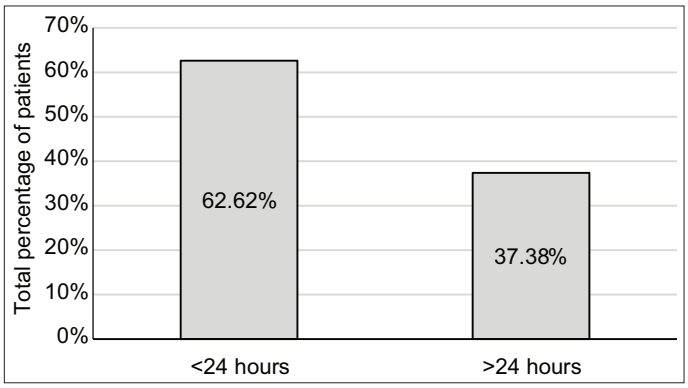

Figure 3: Duration of antibiotic in patients

Council criteria for operative wounds classification, it is classified as clean wound where elective, non-traumatic surgery done, no viscera or tract (respiratory, g.i, biliary, and genitourinary) entered, no infection at site, and no break in technique appear. Such clean surgery in healthy individual is associated with very low risk of SSI.[9] In the WHO released guidelines, 2017, for prevention of SSI, given examples of procedures which do not require SAP are clean orthopedic operations not involving implantation of foreign materials or low-risk elective laparoscopic procedures.[10] In our study, all six patients were operated in general surgery or orthopedic department for minor operative procedures (e.g., hernia repair, and elbow dislocation). None of these patients developed SSI. Hence, findings of our study are similar regarding not to give antibiotics in all the cases. Rampant misuse of antibiotics prophylaxis is not required at every time during surgery to prevent SSI.

In this study, total 15 patients were suffered from SSI and the incidence of SSI was 7.57%. Incidence of SSI in our study is within the range of the global estimate of SSI, that is, 0.5–15%.[3,4] Despite of giving SAP, occurrence of SSI (e.g., at the rate of 7.57%) is suggesting of failure of therapy. Lack of proper timing and duration of SAP and emergence of resistant strain of microbes can be the root cause of such failure of antimicrobial therapy. We have tried to focus on all these points one by one in study.

In terms of duration of SAP, out of 198 patients, 124 patients were given antibiotics for <24 h and remaining patients were given for >24 h. An important finding in the field of microbes has been the understanding of the roles of the human native microbiome as critical defense against dangerous infections. Thus, during prolonged chemoprophylaxis, which can also kill the native biome, we need to consider following point to preserve it:

Limit the duration of prophylaxis to be as short as the time in which maximum contamination is expected (e.g., during incisions and the surgical procedure) and does not prolong beyond this time.[8]

According to current guidelines by the WHO, given prophylactic antibiotics should end within 24 h of surgery completion. There is no documented benefit of antibiotics after wound closure in the reduction of SSIs. However, there is some difference in the guidelines from the Society of Thoracic Surgeons in terms of duration. It recommends that antibiotic prophylaxis should be continued for 48 h after the completion of cardiothoracic surgery due to the effects of cardiopulmonary bypass on immune function and antibiotic pharmacokinetics.[10,11] For cardiac surgeries, there was some evidence from two randomized control trial (RCTs), that prolonging antibiotic administration after completion of the operation may be beneficial in reducing the risk of SSI. By contrast, other 7 RCTs showed no benefit of prolonging antibiotic prophylaxis beyond 24 h.[10,12,13] In vascular surgery also, there was some evidence from one RCT that prolonging antibiotic prophylaxis until intravenous lines and tubes are removed may be beneficial in reducing the risk of SSI when compared to single-dose prophylaxis.[10,14] In our study, out of 68 patients who received SAP for >24 h, total 22 patients had undergone cardiothoracic surgeries. Despite of giving SAP for >24 h, one patient still developed SSI. There are chances of increase in adverse effects of antibiotics, killing of native biome and foster resistant organism, by giving SAP for more than 24 h. Hence, such longer use of SAP should be discouraged in surgical practice.

In all the patients enrolled under study, antibiotics had been started minimum ½-h before incision. According to the WHO guidelines for global prevention of SSI, it is recommended that the administration of SAP within 120 min before incision is strongly recommended.[10] In one of the multicenter study of 29 hospitals in the United States, administration of SAP within 1 h before incision is supported and also showed that administration within 30 min before incision may reduce the risk even further.[11,15] Overall, administration of SAP after incision is more harmful with significant increase of the SSI risk than before incision. Adequate tissue concentration of antibiotic is required both at the time of incision and throughout the procedure. We conclude from our study that the administration of SAP before incision, minimum ½-h, is necessary to reduce the incidence of SSI.

Nowadays, everyone is focusing on over use of antibiotics for various reasons. Proper use of antibiotics can cure the condition and improper use can lead to antibiotic resistance. There is very fine line for margin of error. Despite of giving proper antibiotics, in terms of timing and duration, in 192 patients, total 15 patients developed SSI. Small study duration and lack of laboratory study for antimicrobial resistance are limitations of study.

CONCLUSION

Overall, proper timing and duration of given antibiotics are very important for the prevention of SSI. All the guidelines regarding prevention of SSIs are made on base of evidence of various studies. Hope our study will also provide some data for evidence in recommendations of various criteria for SAP.

REFERENCES

1. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: A modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol 1992;13:606-8.
2. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Hospital infection control practices advisory committee. Infect Control Hosp Epidemiol 1999;20:250-78.

3. Perencevich EN, Sands KE, Cosgrove SE, Guadagnoli E, Meara E, Platt R. Health and economic impact of surgical site infections diagnosed after hospital discharge. Emerg Infect Dis 2003;9:196-203.
4. Arora A, Bharadwaj P, Chaturvedi H, Chowbey P, Gupta S, Leaper D. A review of prevention of surgical site infections in Indian hospitals based on global guidelines for the prevention of surgical site infection, 2016. J Patient Saf Infect Control 2018;6:1-12.
5. Whitehouse JD, Friedman ND, Kirkland KB, Richardson WJ, Sexton DJ. The impact of surgical-site infections following orthopedic surgery at a community hospital and a university hospital: Adverse quality of life, excess length of stay, and extra cost. Infect Control Hosp Epidemiol 2002;23:183-9.
6. Martone WJ, Nichols RL. Recognition, prevention, surveillance, and management of surgical site infections: Introduction to the problem and symposium overview. Clin Infect Dis 2001;33 Suppl 2:S67-8.
7. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: Attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiol 1999;20:725-30.
8. Gumbo T. General principles of antimicrobial therapy-chemotherapy of infectious diseases. In: Goodman and Gilman's: The Pharmacological Basis of Therapeutics. 13th ed., Vol. 7. New York: McGraw-Hill Education; 2018. p. 962-3.
9. Tripathi KD. Antimicrobial drugs: General consideration. In: Essential of Medical Pharmacology. 8th ed., Vol. 12. New Delhi: Jaypee Brothers Medical Publishers; 2019. p. 752.
10. World Health Organization. Global Guidelines for Prevention of Surgical Site Infection; 2017. Available from: https://www.who.int/gpsc/global-guidelines-web.pdf. [Last accessed on 2020 Feb 20].
11. Salkind AR, Rao KC. Antibiotic prophylaxis to prevent surgical site infections. Am Fam Physician 2011;83:585-90.
12. Nooyen SM, Overbeek BP, Brutel de la Rivière A, Storm AJ, Langemeyer JJ. Prospective randomised comparison of single-dose versus multiple-dose cefuroxime for prophylaxis in coronary artery bypass grafting. Eur J Clin Microbiol Infect Dis 1994;13:1033-7.
13. Tamayo E, Gualis J, Florez S, Castrodeza J, Eiros Bouza JM, Alvarez FJ. Comparative study of single-dose and 24-hour multiple-dose antibiotic prophylaxis for cardiac surgery. J Thorac Cardiovasc Surg 2008;136:1522-7.
14. Hall JC, Christiansen KJ, Goodman M, Lawrence-Brown M, Prendergast FJ, Rosenberg P, *et al*. Duration of antimicrobial prophylaxis in vascular surgery. Am J Surg 1998;175:87-90.
15. Steinberg JP, Braun BI, Hellinger WC, Kusek L, Bozikis MR, Bush AJ, *et al*. Timing of antimicrobial prophylaxis and the risk of surgical site infections: Results from the trial to reduce antimicrobial prophylaxis errors. Ann Surg 2009;250:10-6.

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