ORIGINAL RESEARCH ARTICLE

Evaluation of Antibiotic Prophylaxis in Prevention of Surgical Site Infections

Sridhar Punyapu[1], Sravanthi Kanumuri[2], Anusha Mynam[3], Satyanarayana Gorthi[4]

[1]Senior Consultant Surgeon, Department of General Surgery, Kamineni Hospital, LB Nagar, Hyderabad. Telangana, [2]Assistant Professor, Department of General Surgery, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad, Telangana, [3]Junior Resident, Department of General Surgery, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad. Telangana, [4]Professor, Department of General Surgery and Dean, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad. Telangana, India.

Corresponding author: Dr. Sridhar Punyapu, Senior Consultant Surgeon, Department of General Surgery, Kamineni Hospital, LB Nagar, Hyderabad. Telangana, India

DOI: http://dx.doi.org/10.21276/ijcmsr.2021.6.3.8

How to cite this article: Sridhar Punyapu, Sravanthi Kanumuri, Anusha Mynam, Satyanarayana Gorthi. Evaluation of antibiotic prophylaxis in prevention of surgical site infections. International Journal of Contemporary Medicine Surgery and Radiology. 2021;6(3):C30-C35.

A B S T R A C T

Introduction: Invasive surgical procedure involves incision of the skin or other body surfaces to reach the surgical site. Post-operative infections of the incisions and the surgical site are generally referred to as surgical site infections (SSIs) and they account for approximately a quarter of all nosocomial infections. Surgical site infection (SSI) is a major cause of mortality and morbidity in surgical patients. These nosocomial infections continue to consume a considerable proportion of health care finances.

Material and Methods: A hospital based prospective observational study was conducted on patients operated on elective basis admitted to the hospital, the study was conducted from January 2019 to December 2020 in Kamineni Hospitals, L B Nagar, Hyderabad. A series of 960 cases was compiled for this study during this period. The role of preoperative antibiotic prophylaxis in preventing of Surgical Site infections and the outcome were studied. The Analytical data obtained was compared and discussed with the data available in the literature.

Results: A total of 960 cases of class I and class II cases of elective surgical cases were studied. 510 cases (53.13%) were clean and 450 cases (46.87%) were clean- contaminated cases. The incidence of post-operative pain at operative site even after two weeks was found to be 12.5%. the incidence of post-operative swelling was found to be 8.3%. Only 20 patients had developed SSI surgical site infection. The incidence of Surgical Site Infection SSI was only 2.08%.

Conclusion: Judicious use of appropriate preoperative antibiotic prophylaxis significantly reduces the burden of Surgical Site infection (SSI) in clean and clean contaminated elective surgical procedures there by decreasing the hospital stay and unnecessary expenditure on antibiotics and thus prevent antibiotic resistance.

Keywords: Surgical site infection, Antibiotic Prophylaxis, Clean Wound, Clean- Contaminated Wound.

INTRODUCTION

Surgical site infection (SSI) may be a difficult term to define accurately because it's a good spectrum of possible clinical features. Although it is defined as an infection that occurs at or near a surgical incision within 30 days of the procedure or within one year if an implant is left in place.[1,2] The Centres for Disease Control and Prevention (CDC) estimates that approximately 500,000 surgical site infections occur annually within the us.[3] they're the leading explanation for nosocomial infections after surgery, accounting for nearly 40 percent of nosocomial infections in surgical patients. The cost of look after patients with surgical site infections is almost threefold above that for surgical patients without the infections during the primary eight weeks after hospital discharge. 3 These infections reduce patients' quality of life and account for 3.7 million excess hospital days and more than $1.6 billion in excess costs annually.[4,5] Furthermore, patients who develop surgical site infections are five times more likely to be readmitted to the hospital, 60 percent more likely to spend time in the intensive care unit, and twice as likely to die compared with surgical patients without the infections.[6]

Surgical site infection (SSI) classified in to Superficial incisional SSI and Deep incisional SSI. Superficial Incisional SSI Infection occurs within 30 days afterthe operation and infection involves only skin or subcutaneous tissue of the incision. Deep Incisional SSI Infection occurs within 30 days after the operation if no implant is left in situ or within 1 year if implant is in situ and therefore the infection appears to be associated with the operation and infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision.[7]

Surgical Wound classification. 1. Class I Clean, an uninfected operative wound in which no inflammation

is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage system. 2. Class II Clean contaminated, an operative wound during which the respiratory, alimentary, genitourinary tracts are entered under controlled conditions and with minimal contamination. 3. Class III Contaminated Open, fresh, traumatic wounds; uncontrolled spillage from an unprepared hollow viscus; minor break in sterile technique. 4. Class IV Dirty-infected Old traumatic wounds with retained devitalized tissue and people that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present within the field before the operation.[8]

Wound infection may be primary or secondary. Primary wound infection is the result of bacterial contamination of the wound occurring during surgery. Secondary wound infection occurs within the postoperative environment when bacteria gain access to the wound either through the wound suture line or through another portal such as a drainage tube or drainage track. The majority of wound infections are primary of type. A complex interplay between host, microbial, and surgical factors ultimately determines the prevention or establishment of a wound infection.

Modern surgery can be said to have its roots in the 19th century with the development of asepsis.[9] A survey sponsored by the World Health Organization demonstrated a prevalence of nosocomial infections in the range of 3-21%, with wound infections accounting for 5-34% of the total.[10] The overall incidence of surgical site infection (SSI) has been estimated to be 2.8% in the United States, according to the U.S. Centres for Disease Control and Prevention, although the data may under-represent the true incidence of such infections owing to inherent problems with voluntary self-reporting by surgeons of infections that occur in the ambulatory surgical setting.[11]

In 2002, the Centres for Medicare and Medicaid Services (CMS), collaborating with the CDC, developed and implemented the Surgical Infection Prevention Project. Its goal was to supply evidence-based performance measures for the acceptable selection, preventive measures before, during and after surgery.[12] In 2003, the CDC, CMS, and 10 additional national organizations developed the Surgical Care Improvement Project (SCIP).[13] The Surgical Infection Prevention Project measures were subsequently incorporated into the SCIP, which has been widely disseminated.[13,14]

Publicly reported SCIP performance measures targeted at reducing postoperative surgical site infections include the following.[15]

- Prophylactic antibiotics appropriate for their specific procedure.
- Prophylactic antibiotic prophylaxis should be initiated within one hour before surgical incision, or within two hours if the patient is receiving vancomycin or fluoroquinolones.
- Postoperative 6 a.m. blood glucose levels should be controlled (140 mg per dL [11.10 mmol per L] or less) in patients undergoing cardiac surgery.
- Surgical site hair removal should be appropriate for the location and procedure (e.g., clippers, depilation or no hair removal).
- Patients undergoing colorectal surgery should be normothermic (96.8°F [36°C] or greater) within the first 15 minutes after leaving the operating room.

Pathogenesis: Microbial contamination of the surgical site may be a necessary precursor of SSI. The risk of SSI can be conceptualized according to the following relationship.16 Quantitatively, it has been shown that if a surgical site is contaminated with >105 microorganisms per gram of tissue, the risk of SSI is markedly increased.[17]

Dose of bacterial contamination × virulence = Risk of surgical site infection.

Resistance of the host patient

Patient characteristics that may influence the risk of Surgical Site Infection SSI development are Age, Nutritional status, Diabetes, Smoking, Obesity, Coexistent infections at a remote body site, Colonization with microorganisms, Altered immune response, Length of preoperative stay. Operation characteristics that may influence the risk of Surgical Site Infection SSI development are Duration of surgical scrub, Skin antisepsis, Preoperative shaving, Preoperative skin prep, Duration of operation, Antimicrobial prophylaxis, Operating room ventilation, Inadequate sterilization of instruments, Foreign material in the surgical site, Surgical drains, Surgical technique, like Poor haemostasis, Failure to obliterate dead space and Tissue trauma.[18]

Prophylactic Antibiotics: Ever since antibiotics became available, they need been wont to prevent infection in surgical practice. It has greatly evolved and gained much attention in the last 25 years. The objective of most antibiotic prophylaxis is to achieve a high tissue level of an appropriate choice of antibiotic.[19] An appropriate prophylactic antibiotic should be 1. Effective against microorganisms anticipated to cause infection. 2. Achieve adequate local tissue levels. 3. Cause minimal side effects 4. Be relatively inexpensive.[20]

Timing of Prophylactic Antibiotic Agents: It has been observed in laboratory that the effectiveness of antimicrobial agents in preventing infection diminishes as the time between contamination and the initial administration of the antimicrobial agent is lengthened. Timing of administration is critical. The drug should be administered 30 to 60 minutes prior to surgery and for longer procedures, re-administration of drug is indicated i.e additional dose should be given when the duration of surgery exceeds 2 hours from the time of incision. The first dose should always be given before the skin incision is performed.[21] This ensures adequate tissue levels throughout the duration of the procedure. For clean procedures, only single dose with long half-life in high dose is preferred. The duration of administration is extended only in special circumstances such as gross contamination secondary to ruptured viscus or trauma.[22]

Prophylactic Agents: The ideal prophylactic antibiotic needs to achieve a balance between safety and efficacy. Some commonly used agents are Beta - Lactam Antibiotics. The most common and largest class of antibiotics in current usage the term is derived from the presence of a unique four

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

member beta-lactam ring in all agents in this class. These include penicillin, cephalosporins, the monobactams and the thiocyanins.[23]

Cephalosporins are the largest group of beta-lactams in common usage. Cephalosporins have developed into series of generation with each generation representing a broadening of the antibiotic spectrum and activity. The agent within a given generation possesses similar antibacterial characteristics First generation cephalosporins are most active against gram positive organisms like staphylococcus and streptococcus and are generally ineffective against anaerobes and many gram negative organisms. Second generation cephalosporins possess an increased activity over gram negative organisms, although their activity against gram positive organisms is less than the first generation, they are also effective against anaerobes. Third generation cephalosporins are beta lactamase resistant, thus have enhanced activity against aerobic gram negative bacteria they possess little activity against anaerobes. Fourth generation cephalosporins include have broader activity and are effective against gram positive as well as gram negative organisms.

Vancomycin: This Glycopeptide is most active against Gram-positive bacteria and has proved most effect against MRSA. It is effective against C.difficile and given orally in cases of pseudomembranous colitis. Carbapenems: Meropenem, ertapenem and imepenem are members of this group. They are stable to beta lactamases and have useful broad spectrum anaerobic as well as Gram positive activity. Imidazoles: Metronidazole is most widely used member and is active against all anaerobic bacteria. Infection with anaerobic cocci and strains of Bacteroids and Clostridia are often treated or prevented by its use.

Methods used in Prevention of Surgical Site Infection [24]

1. Endogenous infections – Reduce bacterial content of hollow viscera, Prevent to access of bacteria to wound, Mechanical cleansing of wound, Prophylactic antibiotics
2. Exogenous infection –Aseptic technique, Design of surgical wards, Isolation of infected patients, Non-woven operating room clothing, Laminar flow operating room ventilation, Prophylactic systemic antibodies.

Study aimed to evaluate the effectiveness of Antibiotic Prophylaxis in clean and clean-contaminated surgeries. With primary objective to find out the incidence rate of surgical site infections in various clean and clean-contaminated surgeries. And secondary bbjective was to recognize preventable risk factors of surgical site infections. To assess the co-morbidities in patients undergoing surgeries. To improve the rational dosing of antibiotics.

MATERIAL AND METHODS

Study Sample Size: SSI rate has been found to be between 2.5%-41.9% by institutional infection control team. Assuming 25% as the basic percentage of development of surgical site infections patients requesting a 95% confidence interval for the proportion with width no higher than 25%, the minimum sample size needed is 900. A conservative estimate gave a sample size as 960.

Place of study: The study has been conducted at Kamineni Hospitals, L.B.Nagar, Hyderabad. The study was conducted for a period of 24 months, i.e. from January-2019 to December-2020.

Study Design: This is a Prospective Observational study.

A pre-tested pre-structured proforma was used to record history details, including duration of Diabetes, Hypertension, Hypothyroidism, history of Malignancy, History of Smoking and consuming Alcohol and habit of Tobacco chewing, type of surgery, duration of surgery, type of preoperative antibiotic prophylaxis administered, duration of stay, Pain score and any evidence of Surgical site Infection.

Cotton swab was collected from the wound post operatively whenever infection was suspected. Special care was taken to avoid contaminating the specimen with commensal organisms from the skin, as far as possible specimen from the wound was collected before antiseptic dressing was applied. Using sterile technique up to 5 ml of pus was collected from the drainage tube which was transferred to a leak-proof sterile container. When pus is not being discharged, a sterile cotton-wool swab was used to collect the sample from infected site. Special care was taken to send the specimen with a completed request form to reach the Microbiology laboratory within 6 hours.

One swab was used to make a smear of the material collected on clean slide for gram staining on day one. Other swab was used for culture. Media used for pus culture were blood agar and nutrient agar plates incubated for 24 hours aerobically. Isolates identified based on colony morphology and coagulation test. If culture turns out to be positive then antibiotic sensitivity was performed (Muller Hilton method).

Inclusion Criteria: In-Patients who are undergoing elective surgeries.

Exclusion Criteria: Patients who are not willing to enrol in to the present study. Patients with surgical procedures with implants. Emergency surgeries (with contaminated and dirty wounds).

This is an observational prospective study and does not have a control group. The results were analysed and the findings were compared with similar studies in the existing literature. Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Chi-square test was used as test of significance for qualitative data. p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

A total of 960 cases were studied over a period of 24 months from January 2019 to December 2020. The age range was in between 1 year old to 95 years old. The median age group in this study was found to be in between 51-60 years. Maximum patients were in 4th to 6th decade of age. The sex ratio 60% were males and 40% were females. Of the 960 patients 50 patient had Diabetes, 150 had Hypertension, 170 patients had both Diabetes and Hypertension, 42 had Hypothyroidism and 60 patients had history of Malignancy. In the present study 50 patients are Smokers, 150 patients were consuming Alcohol and 10 patients had habit of Tobacco chewing.

Of the total 960 cases 510(53.13%) were clean and 450 (46.87%) were clean- contaminated cases. The pain score was monitored regularly immediate postoperative period up to 2 weeks duration. The pain scoring was zero (0) in 520 patients (54.16%), one (1) in 190 patients (19.79%), two (2) in 160 patients (16.67%), three (3) in 50 patients (5.20%) and four (4) in 10 patients (1.04%). At the end of 2 weeks of postoperative period 120 patients still experiencing some grade of pain. Out of 120 patients only 20 patients had SSI surgical site infection and the rest 100 patients did not have any SSI. In the present study the incidence of post-operative pain at operative site even after two weeks was found to be 12.5%. 60 patients had post- operative without any surgical site infection, whereas 20 patients of surgical site infection SSI had post- operative swelling. In the present study the incidence of post-operative swelling was found to be 8.3%.

Type of Surgical procedures were Open inguinal hernioplasty-220, Open incisional Hernioplasty- 148, Laparoscopic hernioplasty 17, Laparoscopic Cholecystectomy- 240, Open Cholecystectomy -20, CBD Exploration- 21, Hemi/ Total thyroidectomy- 18, Laparoscopic Appendectomy- 86, Open Appendectomy- 08, Excision biopsy- 86, Exploratory Laparotomy 36, Mastectomy -12, Varicose veins- 28, Hemi colectomy-13, Splenectomy- 04, Superficial Parotidectomy-03. In the present study 617 surgical procedures (64.27%) were open surgeries and 343 (35.73%) were laparoscopic surgical procedures.

Antibiotic prophylaxis: In the present study cephalosporins were used in all cases within 60 minutes of incision of the procedure. When surgery was prolonged duration for more than 3 hours repeat dose of antibiotic was given. In general inj. Cefotaxime was the antibiotic of choice in clean cases. Inj. Cefoperazone/ Salbactum with or without Inj. Metronidazole was the antibiotic of choice in clean-contaminated cases. Inj. Ceftrioxone was specifically used for prophylaxis against subacute endocarditis when ever indicated.

The duration of surgery was less than 1 hour in 120 cases, 1-2 hours in 380 cases, more than 2 hours in 460 cases. Out of the 120 cases (<I hour) 20 cases were clean contaminated cases. Out of 380 cases (1-2 hours) 140 cases were clean contaminated cases. Out of 460 cases (>2 hours) 290 cases were clean contaminated.

In the present study the incidence of Surgical Site Infection SSI was only 2.08% (20 cases). The remaining 940 cases (97.92%) did not develop any Surgical Site Infection SSI. In the present study 20 patients developed SSI's. 16 patients developed superficial SSI and 4 patients had developed deep SSI. The incidence of SSI in the present study was 2.08%. The incidence of SSI rate among the clean is 0.20% (2 cases) and clean contaminated cases is 1.87% (18 cases) in the present study.

Out of 20 cases 18 cases cultures were grown in which Staphylococcus Aureus is grown in 14 cases out of which 5 cases are found to be MRSA (Methicllin resistant Staphylococcus Aureus) and out of 4 cases of Escherichia Coli grown 2 cases were ESBL producing organism.

DISCUSSION

The surgical Site Infection (SSI) is considered as one of the surgeon's nightmare, though this complication while seemingly infrequent and almost never lethal, adds morbidity. Al though surgical wound infections cannot be completely eliminated, a decrease of infection rate to a minimal level could have significant benefits, by reducing postoperative morbidity, mortality and wastage of health care resources. Pre existing medical illness, prolonged operating time, the wound class, and wound contamination strongly predispose to surgical site infection. Risk factors for development of SSI should be identified if present and patient factors, like Anaemia or DM, are to be corrected adequately prior to an elective surgery.

While the global estimates of SSI have varied from 0.5–15%.25 while it differed considerably in Indian set up varying from 2.5% to 41.9%. The incidence of SSI's in various studies is Sands K [26] et al USA is 2.4%, Borade SVet al India[27], is 3% ,Haley et al, USA.[28] is 4.75%, Kaya et al, Turkey[29] is 12.8%, Sangrasi et al,[Pakistan30] is 13%, Kamat et al, India [31] is 30.7%. The overall infection rate in the present study is 2.08% comparable with various other studies where the incidence ranged from 2.4%-30.7%.

Surgical site infection affects all the age groups and its incidence increases with the age. In our present study the maximum number of cases were represented in age group 51-60 years. Older age group is considered a risk factor for development of SSI, Rao et al showed in their study that SSI incidence doubled in older age group 50-70 years.[32]

In the present study it was found that in 97.96% of cases prophylactic antibiotics administered prior to surgery were effective in preventing Surgical Site Infection. The incidence of SSI rate among the clean is 0.20% and clean contaminated cases is 1.87% in the present study. The incidence of SSI rate in clean and clean contaminated surgeries is Anvikar et al[33] 4.04% and 10.6% and 8.5%, Lilani et al[34] is 3.68% and 22.4%,.

Sohil A Khan et al[35] had studied incidence of Surgical Site Infections is zero (0%) after implementation of the

Type of antibiotic prophylaxis given	Number of patients
Inj cefotaxime 1 gm.	440
Inj cefoperazone/ sulbactam 1.5 gm	312
Cefoperazone/ sulbactam 1.5 gm + inj metronidazole 500 mg	94
Inj cefotaxime 1 gm + inj metronidazole 500 mg.	36
Inj cefoperazone / sulbactam 1.5+ Inj amikacin 500 mg.	38
Inj cefotaxime 1 gm + inj amikacin 500 mg.	22
Inj ceftriaxone 2 gm.	18

Table-1: Distribution of patients based on prophylactic antibiotics:

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

antibiotic prophylaxis usage. Suresh karlatti et al.[36] in their study concluded that, in cases of clean surgeries there is no need for prophylactic antibiotics, as there is no statistical significance, whereas in clean contaminated cases antibiotic prophylaxis is recommended as it reduces SSI which is statistically significant. The SSI rate in the present study is lower than the SSI rate of other studies. This could be due to strict adherence to the surgical principles like operative technique, preoperative preparation and fallowing principles of asepsis and antisepsis. factors use of prophylactic antibiotics etc. The present study it is clear that antibiotic prophylaxis is recommended for clean surgeries as well as clean contaminated surgeries.

CONCLUSION

Antibiotic prophylaxis with appropriate third generation cephalosporins should be given to patients when necessary and when appropriate additional antibiotics like Metronidazole can be added based on anticipated contaminants to for all class I (clean)and Class II (clean and contaminated) cases. Antibiotic prophylaxis must be given at least 30 minutes before skin incision and dose must be repeated if duration of surgery is prolonged for more than 3 hours.

Preoperative antibiotic prophylaxis is as effective as a full 5-day course of therapy assuming an uncomplicated procedure. Complicated, contaminated, or dirty procedures should receive additional postoperative antibiotics coverage. Before giving antibiotic prophylaxis consider the timing and pharmacokinetics (for example, the serum, half-life) and necessary infusion time of the antibiotic. A repeat dose of antibiotic prophylaxis should be given when the operation is longer than the half-life of the antibiotic given. Irrational use of antibiotics should be avoided, as it may lead to increase the emergence of multi drug resistant microorganisms.

The surgeons should strictly follow all other guidelines of asepsis and perioperative techniques which help in minimizing incidence of surgical site infections. Local factors and microbial factors should be borne in surgeons mind and appropriate steps need to be taken in order to decrease surgical site infections.

Ethical approval

The study was approved by the Institutional Ethics Committee

REFERENCES

1. Horan TC, Gaynes RP, Martone WJ, et al. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol. 1992;13(10):606-608
2. Alan R. Salkind MD, and Kavitha C, et al. Antibiotic prophylaxis to prevent surgical site infections. Am Fam Physician. 2011;83(5):585-590.
3. EN, Sands KE, Cosgrove SE, et al. Health and economic impact of surgical site infections diagnosed after hospital discharge. Emerg Infect Dis. 2003; 9(2):196- 203.
4. Whitehouse JD, Friedman ND, Kirkland KB, et al. 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(4): 183-189.
5. 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-S68.
6. Kirkland KB, Briggs JP, Trivette SL, et al. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiol. 1999;20(11):725-730.
7. Mannien J, Wille JC, Snoeren RL, van den Hof S. Impact of postdischarge surveillance on surgical site infection rates for several surgical procedures: results from the nosocomial surveillance network in the Netherlands. Infect Control Hosp Epidemiol 2006;27(8):809-16.
8. Ehren K ranz NT. Surgical wound infection occurrence in class operations, risk stratification for inter hospital comparisons American Journal of Medicine 1981; 70(3): 909-41.
9. Mayon-White RT, Ducel G, Kereselidze T, et al. An international survey of the prevalence of hospital-acquired infection. J Hosp Infect. 1988;Suppl A:43-8.
10. Barie PS, Surg Infect (Larchmt). 2002;3 Suppl 1:S9-21.
11. Arora A, Bharadwaj P, Chaturvedi H, Chowbey P, Gupta S, Leaper D, Mani G K, S Marya S K, Premnath R, Quadros K, Srivastava A, Tendolkar A. 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(3):1-12
12. European Centre for Disease Prevention and Control. Point prevalence survey of healthcare associated infections and antimicrobial use in European acute care hospitals. Stockholm: European Centre for Disease Prevention and Control.
13. Bratzler DW, Hunt DR. The surgical infection prevention and surgical care improvement projects: national initiatives to improve outcomes for patients having surgery. Clin Infect Dis. 2006;43(3):322–330.
14. Bratzler DW, Houck PM. Antimicrobial prophylaxis for surgery: an advisory statement from the National Surgical Infection Prevention Project. Am J Surg. 2005;189(4):395– 404.
15. Stulberg JJ, Delaney CP, Neuhauser DV, et al. Adherence to surgical care improvement project measures and the association with postoperative infections. JAMA. 2010;303(24):2479–2485.
16. Cruse PJ. Surgical wound infection. In: Wonsiewicz MJ, ed. Infectious Diseases. Philadelphia: W.B.Saunders Co; 1992. p. 758-64
17. Krizek TJ, Robson MC. Evolution of quantitative bacteriology in wound management. Am J Surg 1975;130(6):579-84
18. Centers for Disease Control and Prevention. National Nosocomial Infections Surveillance (NNIS) report, data summary from October 1986-April 1996, issued May 1996. A report from the National Nosocomial Infections Surveillance (NNIS) System. Am J Infect Control 1996;24(1):380-8.

19. Mangram AJ, Nichols RL. Recognition, preparation, surveillance and management of surgical site infection. Hospital infection control practices advisory Committee. Infect Control Hosp Epidermol 1999; 20(2):250.
20. Keighiey MRB, Burdon DW. Antimicrobial prophylaxis in Surgery. Pitman, London 1979.
21. Bohnen JMA, Solomkin JS et al., Guidelines for clinical care : Antiinfective agents for intra-abdominal infection. A surgical infection Society Policy Statement. Arch Surg 1992 ; 127(4):83.
22. Kaiser A B. Antimicrobial prophylaxis in surgery. N Engl J Med 1986;315(1): 1121.
23. Jauber MG, Kunz S. Influence of antibiotic dose, dosing interval and duration of therapy on outcome in experimental pneumococcal Meningitis Antimicrob Agents Chemotherapy 1989; 33(3): 418-423.
24. The choice of antibacterial drugs Med Lett Drugs Ther 1999; 41(1): 95- 104.
25. Altemeier WA. Perspectives in surgical infections. Surg Clin North Am 1980;60(6):5–13
26. Sands K, Vineyard G, Platt R. Surgical site infections occurring after hospital discharge. J. Infect. Dis. 1996; 173(6):963-70.
27. Borade SV et al. Single dose antibiotic prophylaxis for prevention of surgical site infection in elective surgery Int Surg J. 2018;5(1):27-33.
28. Haley RW, Culver DH, Morgan WM, White JW, Emori TG. Identifying patients at high risk of surgical wound infections. A simple multivariate index of patients susceptibility and wound contamination. Am J epidemiol 1985; 121(4): 206-215.
29. Kaya E, Yetim I, Dervisoglu A, Sunbul M and Bek Y. Risk factors for and Effect of a one year surveillance programme on surgical site infection at a University Hospital in Turkey. Journal of surgical infections. 2006; 7 (6): 519-26
30. Sangrasi AK, Leghari AA, Memon A, Talpur AK, Qureshi GA,. Surgical site infection rate and associated risk factors in the elective general surgery at public sector medical university in Pakistan Int wound J 2009; 5(3): 74-78
31. Kamat US, Fereirra AMA, Kulkarni MS, Motghare DD. A prospective study of surgical site infections in a teaching hospital in Goa. Indian J Surg 2009;70(1): 120-24.
32. Rao AS,Harsha M.Postoperative wound infections. Journal Indian Med Asooc 1975;64(5):90-3.
33. AnvikarAR, DeshmukhAB, Karyakarte RP, DamleAS, Patwardhan NS, Malik AK, Bichile LK, Bajaj JK, Baradkar VP, Kulkarni JD, Sachdeo SM. A one year prospective study of 3280 surgical wounds. Indian JournalofMedicalMicrobiology 1999;17(3):129– 132
34. Lilani SP, Jangale N, Choudhry A, Daver GB. Surgical site infection in clean and contaminated surgeries. Indian J Medical Microbiology 2005;23 (4):249-52.
35. Sohil Ahmed Khan, Padma G. M. Rao, Anand Rao, Gabriel Rodrigues. Survey and evaluation of antibiotic prophylaxis usage in surgery wards of tertiary level institution before and after the implementation of clinical guidelines. Indian Journal of Surgery 2006;68(3): 150-156.
36. Suresh Karlatti, Havannavar I.B, A comparative prospective study of preoperative antibiotic prophylaxis in the prevention of surgical site infections. International Surgery Journal. 2016;3(1):141-145.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 27-04-2021; **Accepted:** 10-06-2021; **Published online**: 20-09-2021