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Single Dose Antibiotic Prophylaxis for Prevention of Surgical Site Infection in Elective Surgeries—An Institutional Experience

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Abstract

Background: Surgical site infections (SSI) develops when there is seeding of the operative site from a distant site of infection or by endogenous flora and other factors include host defences, bacterial inoculums and virulence, preoperative care and intraoperative management. They are associated with prolonged hospital stays and increased costs and complications associated with antibiotic administration.

Objective: To assess the efficacy of single dose prophylactic antibiotic for prevention of Surgical site infection in clean and clean contaminated surgeries.

Materials and Methods: A prospective study was conducted which included 1002 patients undergoing elective surgery in an institutional setup, over a period of nine years and patients enrolled considering inclusion and exclusion criteria. Ceftriaxone was used preoperatively 30 min prior to incision and its impact on postoperative wound infection was studied.

Results: We had 1002 cases in our study with equal number in both sexes 52.3% males and 47.7% females with mean age of 38 years, we had predominantly clean surgeries 96.7% and 3.3% clean contaminated surgeries done and had 0.9 % incidence of superficial surgical site infection.

Conclusion: A single preoperative dose of antibiotic is effective to prevent surgical site infection in clean and clean contaminated cases. It will help in decreasing healthcare cost, antibiotic related drug toxicity, prevents development of resistance due to overuse of antibiotics. It also paves way for the development of newer studies studying the impact of no prophylactic antibiotic prior to elective surgeries on surgical site infection.

Keywords: Prophylactic antiobiotics; Clean operative procedure; Single dose antibiotic; Surgical site infection

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Introduction

Surgical site infections (SSIs) are the most common nosocomial infection in low and mid-income countries, accounting for 38% of all infections among surgical patients and overall SSI incidence between five to nine percent.[1]A patient who develops an SSI is 15 times more likely to get readmitted to the hospital within 30 days after discharge and incurs extra hospital stay of 6.5 days, leading to direct cost of additional charges.[2]

Over the last two decades the efficacy of antibiotic prophylaxis in clean surgery has been well established.The guiding principle of systemic antibiotic prophylaxis is the belief that antibiotics in the host tissues can augment natural immune defense mechanisms and help to kill bacteria that are inoculated into the wound.[1] Perioperative antibiotics and aseptic techniques have become routine aspects of care in most major surgical

procedures.[1] The efficacy of prophylactic antibiotics has now been verified for most major surgical procedures, when care has been given to provide adequate serum and tissue levels of antibiotics (above minimum inhibitory concentration of the pathogens of concern) during the surgical procedure.[1]

Administer single dose of antibiotic intravenously on starting of anaesthesia. Give a repeat dose of antibiotic prophylaxis when the operation is longer than the half-life of the antibiotic given.[3] The World Health Organisation (WHO) panel recommends the administration of Surgical antibiotic prophylaxis (SAP) within 120 minutes before incision, while considering the half-life of the antibiotic.[4] Trial to Reduce Antimicrobial Prophylaxis Errors (TRAPE) investigators found that SSI risk was lowest in those patients who received prophylaxis within 30 minutes (if given cephalosporins) or within one hour (if given vancomycin or a fluoroquinolone) prior to incision.[5]

Our aim of the study was to evaluate the effectiveness of single dose antibiotic prophylaxis in elective surgeries for prevention of SSI. Another objective was to determine the incidence of SSI when prophylactic antibioticwas given 30 minutes prior to incision in elective surgeries.

Materials and Methods

This was a prospective study conducted over a period of nine years (2011-2019) and all consenting consecutive patients undergoing elective surgery (clean and clean contaminated cases) under the Department of General Surgery in a teaching hospital were enrolled considering exclusion and inclusion criteria.The study was approved by the Institutional Ethics Committee.1002 patients, who were admitted for elective surgery, having no evidence of prior infection were included in study. None of the patients had received antibiotics two weeks prior to surgery.Patients who did not give informed consent, patients on steroids or other immunosuppressive drugs, with comorbidities like (diabetes, asthma etc.) and patients allergic to cephalosporins/β-lactam antibiotics, were excluded from study.

In the preoperative phase, patients had a bath using a non-medicated soap the day before surgery. Preparation of operative field was done by shaving with razor one day prior to surgery. Clippers were not used. Patients also received scrubbing (povidone-iodine based) of the operative field three hours prior to the surgery. The operating team washed their hands prior to every operation following the WHO steps of handwashing. Surgeons and assisting staff wore sterile autoclaved gowns during the surgery. Two pairs of sterile gloves were used. Preparation of the skin at the surgical site immediately before incision using an antiseptic povidone-iodine was done.

Antibiotic prophylaxis Injection Ceftriaxone 1gm intravenously (I.V) approximately 30 minutes prior to incision was given. Wound irrigation with povidone-iodine solution/normal saline was practiced as and when required.

Intraoperative complete hemostasis achieved throughout the procedure. Sterile dressing was done at the end of the surgery. Aseptic precautions were taken during postoperative wound dressings, which were done on post-operative day two/three depending on the procedure.

The wounds were examined for suggestive clinical evidences of infection in the post-operative follow up period and were defined according to Centers for Disease Control and Prevention(CDC) criteria for SSI.When SSI was encountered, sterile cotton swabs or pus was sent for culture sensitivity. Broad spectrum antibiotics were started and then switched over to specific antibiotics after culture and sensitivity report. The obtained data was analysed.

Post operatively all patients were followed up on Day 7, Day 14 and Day 30.

The classification of operative wounds has been represented in Table 1.

The Centers for Disease Control and Prevention (CDC) term for infections associated with surgical procedures was changed from surgical wound infection to surgical site infection in 1992.[7] Incisional site infection are further divided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue-muscle and fascia).

Superficial incisional SSI: infection occurs within 30 days after the operation and infection involves only skin or subcutaneous tissue of the incision and at least one of the following-

- Purulent drainage, with or without laboratory confirmation, from the superficial incision
- Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision

- At least one of the following signs or symptoms of infection- pain or tenderness, localized swelling, redness, or heat.

Table 1: Surgical Wound Classification According to Degree of Contamination.[8]

Wound	Definition
Clean	An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or infected urinary tract is not entered. Wounds are closed primarily and, if necessary, drained with closed drainage. Surgical wounds after blunt trauma should be included in this category if they meet the criteria.
Clean-Contaminated	An operative wound in which the respiratory, alimentary, genital, or urinary tract is entered under controlled conditions and without unusual contamination.
Contaminated	Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract and incisions in which acute, nonpurulent inflammation is encountered are included in this category.
Dirty	Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

Deep incision SSI: infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision and at least one of the following-

- Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
- A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms- fever (>38^{o}C), localized pain, or tenderness, unless site is culture-negative.
- An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
- Diagnosis of a deep incisional SSI by a surgeon or attending physician.
- Organ/space SSI: infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following-
- Purulent drainage from a drain that is placed through a stab wound into the organ/space
- Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space
- An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination
- Diagnosis of an organ/space SSI by a surgeon or attending physician.

Results

Over a period of nine years 1002 consecutive cases were taken into our study which included clean and clean contaminated cases. Similar preoperative preparations were administered to all patients. The duration of majority surgeries in this study was less than two hours.The baseline characteristics of enrolled patients are depicted in Table 2.

In our study there were 528 males and 474females. Mean age was 38 years. Age group ranged from 7 years to 85 years. The mean Body mass index (BMI) was 23.5Kg/m2. There were 970 Clean surgeries and 32 Clean contaminated surgeries among the study group.

The incidence of SSI was found to be 0.9%. Six cases of meshplasty, two cases of open appendicectomy, one anatomical repair and one case of thyroidectomy had developed SSI.All the ten cases of SSI were superficial incisional SSI and sterile cotton swabs or pus was sent for culture sensitivity. Four of them required secondary suturing whereas the other six of them underwent healing by secondary intention with repeated dressings and oral antibiotics administered based on culture and sensitivity. The most common organism isolated was Staphylococcus aureus.

Table 2: Baseline Patient'scharacteristics.

Charactersitic	Mean (%)
Male, N	528 (52.7)
Female, N	474 (47.3)
Age	38 Years
Bmi	23.5 Kg/M2
Clean Surgeries	970 (96.9)
Clean Contaminated Surgeries	32 (3.1)

Table 3: Distribution of patients according to surgical procedures.

Procedure	Males (n= 528)		Females (n= 474)		Total (n=1002)	
	No	%	No	%	No	%
Excision of swellings	125	23.7	274	57.8	399	39.9
Meshplasty	271	51.4	28	5.9	299	29.9
Anatomical Repair	36	6.8	38	8.0	74	7.5
Thyroidectomy	7	1.3	66	13.7	73	7.3
Modified Radical Mastectomy/Simple Mastectomy	3	0.8	31	5.9	34	3.3
Cholecystectomy	4	0.9	18	3.8	22	2.1
Open Appendicectomy	4	0.8	6	1.3	10	1.0
Parotidectomy	3	0.6	2	0.6	5	0.7
Herniotomy	12	2.2	3	0.6	15	1.5
Orchidectomy	11	2.0	0	0	11	1.0
Orchidopexy	7	1.3	0	0	7	0.7
Open nephrectomy	0	0	1	0.2	1	0.1
Circumcision	2	0.3	0	0	2	0.1
Venous stripping	11	2.0	0	0	11	1.0
Jaboulay's Procedure	13	2.4	0	0	13	1.3
Lord's Plication	9	1.7	0	0	9	0.9
Miscellaneous (ligation of feeding vessels, foreign body, removal)	10	1.8	7	1.4	17	1.7

Pearson's chi square= 21.6
p-value = 0.002

Table 4: Incidence of Surgical site infection.

Infection	Distribution	
	Frequency	Percentage
Present	10	0.9%
Absent	992	91.9%

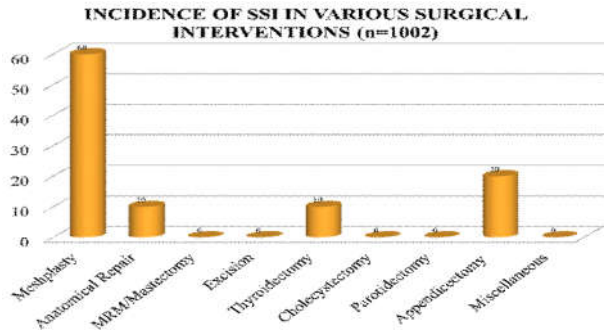

Fig. 1: Incidence of Surgical site infection in various surgical interventions.

Discussion

According to guidelines at present antibiotic prophylaxis should be given to patients before: clean surgery involving the placement of a prosthesis or implant clean-contaminated surgery contaminated surgery.[3]

Many studies have showed that properly administered prophylactic antibiotics could prevent postoperative infection.[9]

All patients included in the study underwent similar protocols of preoperative intraoperative and postoperative care. Many guidelines followed were similar to that laid down by the WHO and National Institute of Health care and excellence (NICE) guidelines. All the guidelines were not adhered to strictly due to various reasons in the institutional setup.

Among 1002 cases in our institutional study with equal number in both sexes 52.3% males and 47.7% females with mean age of 38 years, we had predominantly clean surgeries 96.9% and 3.1% clean contaminated surgeries and the incidence of superficial SSI was found to be 0.9 %.The incidence rate of SSI of 0.9% is well within the infection rates of 2.8% to 17% seen in other studies.[10]

Cruse and Ford observed that the rate of infection of clean wounds was more useful as an indicator of control of infection of surgical wounds than the overall incidence.[9]

One of the most known important factors influencing the incidence of post-operative wound infection is wound contamination class. It was evident from the various studies that wound contaminated risk class is independently predictive of infection.[10] When compared to other studies we had a lower incidence of SSI. One of the reasons that can be attributed for the lower

incidence is the less number of clean contaminated cases in our study group compared to the clean cases.

Anvikar et. al. and Olson et. al. had Staphylococcus aureus as the most common organism isolated from wound swab and pus sent for culture and sensitivity similar to our study where Staphylococcus aureus was the most common organism isolated.[11,12] This suggests that main source of surgical site infection among clean wounds are the skin commensals.

The main limitations of our study were:

- Most of the cases were clean wounds and only 3.1% were clean contaminated cases.
- Non-adherence to all standard guidelines.
- Inadequate dosing of obese patient.

Table 5: Comparison of incidence of surgical site infection among various studies.

Studies	Year	No of surgeries	Ssi (%)
Robertson	1958	1917	9.3
Public health lab. Service	1959	722	9.4
National research council	1964	17,613	7.4
Cruse and foord	1980	62,939	4.7
Edwards	1984	20,193	2.8
Anvikar et. al.	1999	1980	6.09
Eveline.P.Et. al.	2000	18,063	3.1
Borade sv and syed o	2017	100	3
Our study	2019	1002	0.9

Conclusion

A single preoperative dose of antibiotic is effective to prevent surgical site infection in clean and clean contaminated cases. It will help in decreasing healthcare cost, antibiotic related drug toxicity, prevents development of resistance due to overuse of antibiotics. It also paves way for the development of newer studies studying the impact of no prophylactic antibiotic prior to elective surgeries on surgical site infection.

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