SAS Journal of Surgery ISSN 2454-5104
SAS J. Surg., Volume-2; Issue-5 (Sep-Oct, 2016); p-214-224
Available online at http://sassociety.com/sasjs/

Original Research Article

A Prospective Comparative Study of Risk Factors and Role of Preoperative Antibiotic Prophylaxis in Prevention of Surgical Site Infection

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Abstract: Infection is the most common complication of wound healing and is a constant threat to all types of surgery. The basic consideration in choosing antimicrobials is its efficacy, toxicity and cost effectiveness. The purpose of this study was to identify the need of using antibiotic prophylaxis in clean and clean-contaminated surgical wounds and to study comparatively with various risk factors. This study involved 94 clean or clean-contaminated surgeries done in our hospital, split into group A and group B (47 cases each) with only Group A being given broad spectrum preoperative antibiotic prophylaxis. The overall infection rate was 8.51% (2 % in clean cases and 15.91% in clean-contaminated cases). The contribution of obesity (P value = 0.000005) and prolonged operative time (P value = 0.0243) for the development of SSI was significant whereas contribution of age was not significant. Escherichia coli was found to be the most common organism rather than Staphylococcus aureus. It also showed that clean-contaminated surgical wounds were more prone to develop surgical site infection and prophylactic antibiotic was not found to be useful in clean cases but shown to have a definite role in avoiding surgical site infection in clean-contaminated surgical cases particularly in patients associated with unavoidable risk factors.

Keywords: Surgical site infection, Prophylactic antibiotics, Risk factors for SSI

INTRODUCTION

Surgical site infections are infections of the tissues, organs and spaces exposed by surgeons during performance of an invasive procedure. SSI are classified into incisional and organ/space infection and the former is further sub-classified into superficial and deep incisional categories [1]. The surgical wounds are classified based on the presumed magnitude of the bacterial load at the time of surgery as clean, clean-contaminated, contaminated and dirty [2].

Infection is the most common complication of wound healing. Infection is a constant threat to all types of surgery and it is essential to understand the nature and management of the problem. Surgical infections are usually caused by bacteria, but fungal and viral infections can also occur especially as postoperative infections in immunocompromised hosts. *Staphylococcus aureus* is the most common pathogen isolated from wound infections. Factors involved in the pathogenesis of wound infection are (i) nature of surgery (ii) exogenous infection (cross-infection) (iii) infecting organism and (iv) host resistance.

Risk factors [3] for development of surgical site infections are: A] Patient factors – i) older age ii) immunosuppression iii) obesity iv) diabetes mellitus v) chronic inflammatory process vi) malnutrition vii) peripheral vascular disease viii) anemia ix) radiation x) chronic skin disease. B] Local Factors – i) poor skin preparation ii) contamination of instruments iii) inadequate antibiotic prophylaxis iv) prolonged procedure v) local tissue necrosis vi) hypoxia, hypothermia and C] Microbial Factors – i) prolonged hospitalization ii) toxin secretion.

Methods used in prevention of Surgical Site Infection [4] are: A] Endogenous infections - Reduce bacterial content of hollow viscera by preventing access of bacteria to wound, mechanical cleansing of wound and prophylactic antibiotics. B] Exogenous infection – Aseptic technique [5] by proper designing of surgical wards, isolation of infected patients, laminar flow operating room ventilation and prophylactic systemic antibiotics. C] Host resistance – Meticulous surgical technique [6] like delayed primary suturing of contaminated wounds.

The classical signs of infection i.e. heat, redness, swelling, pain and loss of function may or may not be present. In most of the cases the diagnosis is finally established with the discharge of pus from the wound either spontaneously or by deliberate opening of the wound by surgeon [7]. The peak incidence of onset of symptoms and signs of wound infection occur 3-10 days after surgery.

Laboratory diagnosis is by microscopic examination of Gram stain and culture on aerobic and anaerobic media. Generally surgical infections are characterized by leucocytosis. Wound swab from the local site of suspected infection should be cultured. The specimen should be inoculated on two plates of blood agar, one for incubation in 37^0C aerobically, preferably in air plus 5-l0% CO_2, the other for incubation anaerobically in nitrogen/hydrogen plus 5-10% CO_2. The agar plate also has antibiotic walls to identify sensitivity. The culture plates are examined after overnight incubations at 37^oC for 18-24 hours. If no growth, plate should be re-incubated for another 24 hours [8]. Most surgical infections can be managed well by using standard disc diffusion antibiotic susceptibility data and providing dosage of standard amount of antibiotics as required. Other techniques such as gas liquid chromatography are used to identify footprints that are short chain fatty acids of anaerobes [9].

The basic consideration in choosing antimicrobials is its efficacy, toxicity and cost effectiveness. Effective antimicrobial agent must be active against the pathogens causing the infection and must be able to reach the site of infection in adequate concentration; ideally the tissue concentration of antibiotics should exceed the minimum inhibitory concentration. Tissue penetration depends on protein binding of antibiotics. Only the unbound form of antibiotic will pass through capillary wall or act to inhibit the bacterial growth. Lipid solubility is also an important factor in tissue penetration. Bactericidal antibiotics should be chosen when appropriate. Timing of prophylactic antibiotic is critical. The drug should be administered within 30 minutes and certainly within 2 hours of the time of incision. The first dose should always be given before the skin incision is performed. For longer procedures, re-administration of drug is indicated at intervals of one or two times the half-life of the drug.

MATERIAL AND METHODS

This was an institution-based, prospective and comparative study where the material consist of cases admitted in Medical College and Hospital, Kolkata from January 2013 to September 2014 (19 months). During this period, 94 cases were selected for our study purpose, all of which were clean or clean-contaminated elective surgeries done under meticulous surgical technique. Informed consent was taken from all the patients. The study got clearance from Institutional Ethical Committee.

Inclusion Criteria

The following patients were included in the study population:-

a) Clean surgical cases.
b) Clean-contaminated surgical cases.

Exclusion Criteria

The following patients were excluded from the study population:-

a) Non-surgical wounds.
b) Contaminated surgical cases.
c) Patients less than twelve years of age and greater than seventy years of age.
d) Patients who refuses to be part of study.

The study group involved 94 clean or clean-contaminated surgeries done in our hospital who were split into group A and group B of 47 cases each. Group A comprised of patients who received a single dose of a broad spectrum preoperative antibiotic prophylaxis (after skin sensitivity testing). Clean cases were given a single dose of intravenous Amoxicillin-Clavulanic acid and clean-contaminated cases were given a single dose of intravenous Ceftriaxone. Group B received no such prophylactic antibiotic. The groups were split into two taking into consideration the type of surgeries, the age and sex of the patients, the presence or absence of risk factors for development of SSI, and associated medical conditions, all of which were represented in both the groups almost equally and a comparative clinical study was made.

On admission to the hospital, a detailed proforma was completed which include the diagnosis, preoperative investigations and meticulous preoperative patient preparation. All the patients were followed up to ten days postoperatively. Wound swabs were sent for culture and sensitivity in the infected cases. Patients were categorized as clean or clean-contaminated cases depending on their complaints, clinical examination and diagnosis. Patients with remote infections like respiratory tract infections or urinary tract infections were treated on an out-patient basis and taken up for surgery after 2 weeks.

All patients were admitted 2 days prior to surgery after getting thoroughly investigated to clinch the diagnosis. Preoperative hospital stay was minimized to prevent access to hospital infections. Patients with diabetes mellitus were treated appropriately with injectable insulin. Preoperative skin preparation was done meticulously. Patients were allowed to take a through scrub bath. Patients were given single dose of broad spectrum intravenous antibiotic half an hour before the surgery after skin sensitivity testing. All the cases were done in the morning hours. Patients were anesthetized under aseptic precaution. Patient’s skin was painted with povidone-iodine solution followed by sterile draping. Surgery was performed by senior surgeons and residents. Whenever necessary closed drains were placed and wound was closed with sterile dressings.

First inspection of wound was done on third postoperative day; any sign of inflammation or infection were noted down and findings were entered in the proforma. If infected, wound swab was taken and sent for culture and sensitivity and antibiotic was started immediately in all infected cases. The antibiotic was changed accordingly when the sensitivity report arrived. Drains were removed when less than 30 cc collection was seen in drainage bag for three consecutive days. Sutures were removed accordingly. Patients were followed up in the postoperative period up to 30 days. The available results and outcomes in both groups were studied and analyzed and then they were compared with the available previous studies and final conclusions were drawn. P value of less than 0.05 was considered significant. All statistical analyses were performed with SPSS® software version 21.0 for Windows 8.1 (SPSS, Chicago, IL, USA) and p value < 0.05 was considered significant.

RESULTS

The study involved 94 clean and clean-contaminated elective surgical cases admitted in Medical College and Hospital, Kolkata who were divided equally into two groups, Group A included 47 cases who received a single prophylactic dose of a broad spectrum antibiotic (clean cases received Amoxicillin-Clavulanic acid and clean-contaminated cases received Ceftriaxone), given intravenously half an hour before surgery after skin sensitivity testing and Group B included 47 cases who did not receive any such antibiotic prior to surgery.

Infection Rate

Group A had 25 clean and 22 clean-contaminated surgical cases. One clean-contaminated case was infected (4.55 %). In group B out of 25 clean cases, 1 case (4 %) was infected and out of 22 clean-contaminated cases 6 were infected (27.27 %). Overall 8 patients were infected out of 94 total patients (8.51 %).

Table 1: Infection Rate seen in the clean cases

	Number of clean cases	Number of cases infected	Rate of Infection
Group A	25	Nil	-
Group B	25	1	4 %
Total	50	1	2 %

Table 2: Infection Rate seen in the clean-contaminated cases

	Number of clean contaminated cases	Number of cases infected	Rate of Infection
Group A	22	1	4.55 %
Group B	22	6	27.27 %
Total	44	7	15.91 %

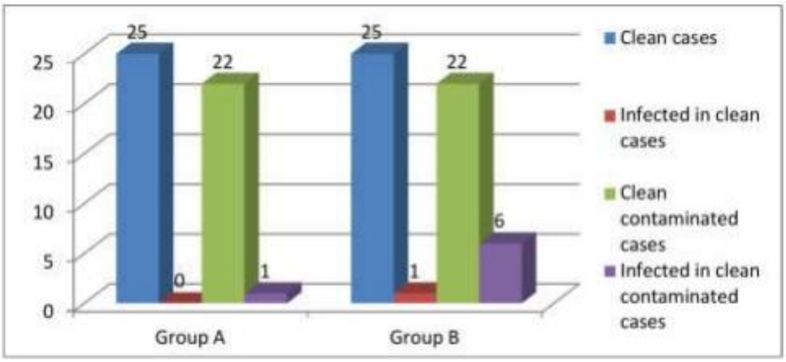

Fig-1: Representation of Infected cases in both the groups

Age Distribution

The age incidence varied from 16 to 69 years but maximum number of patients belonged to 31 to 40 years age group. 7 patients in group B were infected; one belonged to 41-50 years age group and two each in 31-40, 51-60 and 61-70 years age groups. The patient infected in group A was 67 years old. Age distribution in both the groups were similar (fig-2).

Table 3: Showing Age Distribution of patients in the Present Study Group

Group A

Age in years	Number of total cases	Number of cases Infected	Percentage
11 - 20	4	-	-
21 - 30	9	-	-
31 - 40	13	-	-
41 - 50	8	-	-
51 - 60	7	-	-
61 - 70	6	1	16.67 %

Group B

Age in years	Number of total cases	Number of cases Infected	Percentage
11 - 20	3	-	-
21 - 30	9	-	-
31 - 40	14	2	14.28 %
41 - 50	8	1	12.5 %
51 - 60	8	2	25 %
61 - 70	5	2	40 %

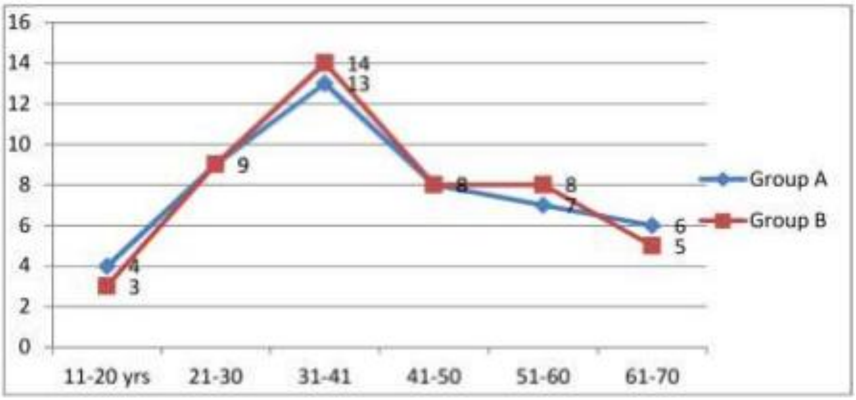

Fig-2: Age Distribution in both groups

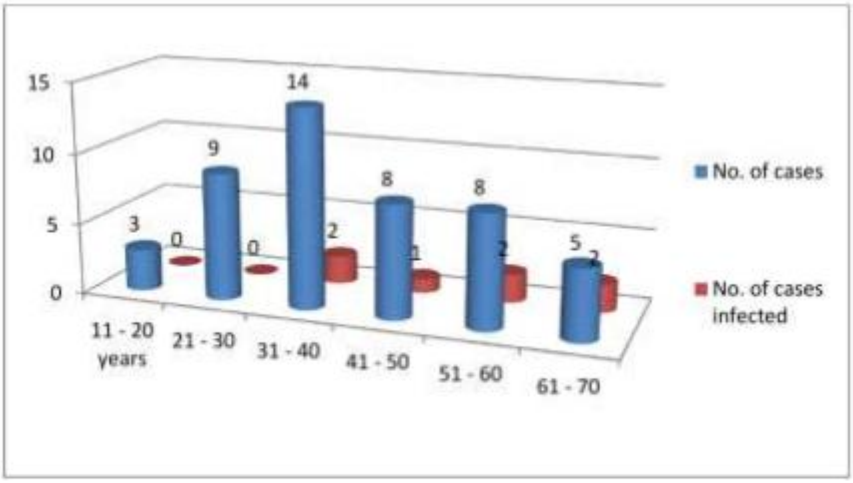

Fig-3: Representation of Infection with age in Group B

Sex Distribution

Each group had 26 male cases (55.32 %) and 21 female cases (44.68 %). Only one female was infected in group A. Three female and three male cases were infected in group B among clean-contaminated cases (50 % each) and one clean case was infected in group B who was a female. Definite proof of any sexual preponderance could not be deduced.

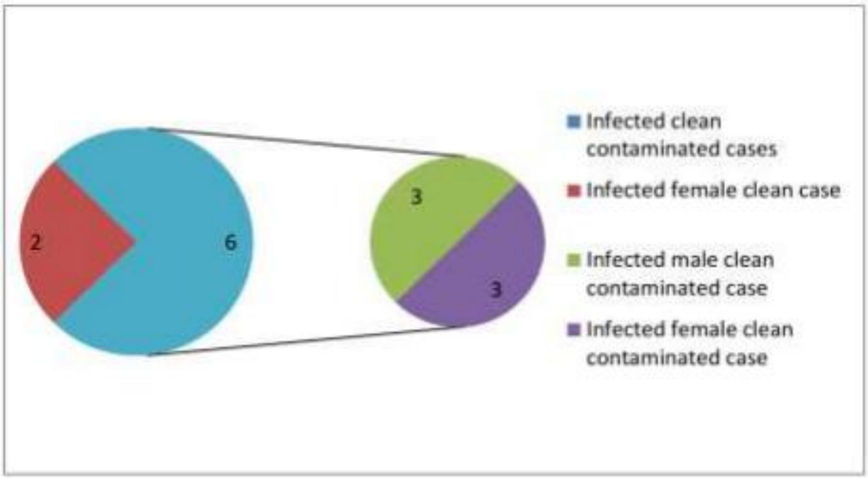

Fig-4: Sex Distribution of Infected cases in the present study

Risk Factor Distribution

Out of 94 cases taken 40 patients were identified to have risk factors for development of SSI. Some of the patients had multiple risk factors. Anemia, diabetes, old age, obesity, and prolonged duration of surgery were taken into account as these were commonly present. Hemoglobin level of less than 10 g/dl was taken as the cut off for diagnosis of anemia in my study. Fasting plasma glucose level of 125 mg/dl or post-prandial plasma glucose level of 200 mg/dl or both or HbA1c of greater than 6.5% was taken as the cut off for diagnosis of diabetes mellitus (WHO recommendation). Anemia was corrected and diabetes was controlled before surgery. Patients above 60 years were considered as old age. Body Mass Index (BMI = weight in kg / height in metre^2) of 30 and above were considered as obese. When operative time took longer than 75th percentile for the given procedure it was considered as prolonged duration of surgery. The risk factors were distributed almost equally in the two groups (vide table 4).

Table 4: Distribution Risk Factor in both groups

Risk Factors*	No. of cases (Group A + B)	No. Of cases Infected	Percentage
Anemia	4 + 5	0 + 1	11.11 %
Diabetes	5 + 5	1 + 1	20 %
Old Age	6 + 5	1 + 2	27.27 %
Obesity	5 + 7	1 + 5	50 %
Prolonged duration of Surgery	9 + 7	1 + 3	25 %

*Few patients had multiple risk factors (they are considered individually here)

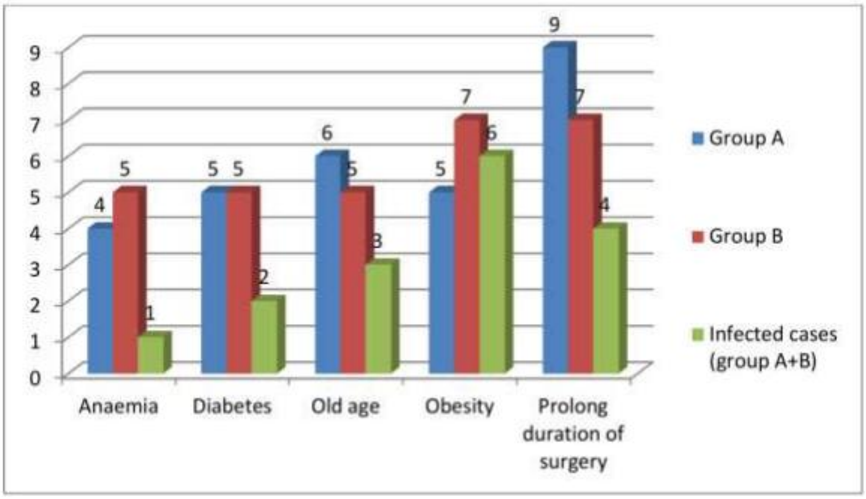

Fig-5: Distribution of individual Risk Factors in the present study

Subgroup analysis of risk factors

In the present study, one patient from group A got infected who had four risk factors and they are diabetes, old age, obesity and prolonged operative time. In group B, 5 patients with obesity were found to have infection. Prolonged duration of surgery contributed for infection in three patients. Out of five patients with diabetes mellitus whose diabetic status were controlled prior to surgery and out of five patients with anemia (corrected prior to surgery), one patient developed SSI in each case. Diabetes or anemia did not result in SSI when present alone as a risk factor. Out of 5 patients with old age two developed SSI who had other associated risk factors.

Table 5: Subgroup analysis of individual risk factors in Group B

Risk Factors	Present/ Absent	No. of cases infected	No. of cases not infected	P value
Anemia	Present	1	4	0.73 (Not Significant)
	Absent	6	36	
Diabetes	Present	1	4	0.73 (Not Significant)
	Absent	6	36	
Old Age	Present	2	3	0.095 (Not Significant)
	Absent	5	37	
Obesity	Present	5	2	0.000005 (Significant)
	Absent	2	38	
Prolonged Duration of Surgery	Present	3	4	0.0243 (Significant)
	Absent	4	36	

Hence, it can be said from the present study that risk factors which are corrected prior to surgery do not pose significant amount of risk for the development of surgical site infection such as anemia and diabetes. Obesity is an important risk factor for the development of SSI. Operative time for any surgical procedure should be minimized in order to minimize SSI. Old age patients are usually associated with multiple risk factors which in combination pose a threat to develop SSI.

Effect of Drains

In the present study, 20 patients were provided with closed suction drainage and two of them got infected whereas six out of 33 patients got infected who were given intra-peritoneal drains. Patients in whom drains were not used had no SSI; contributing to the use of closed suction drainage to prevent surgical wound infection wherever possible.

Table 6: Drain placement and wound infection rate

Drain	Group A	Group B	Infection (Group A+B)	Percentage
Closed suction drain	10	10	0 + 2	10 %
Intraperitoneal drain	16	17	1 + 5	18.18 %
No drain placed	21	20	Nil	-
Total	47	47	1 + 7	8.51 %

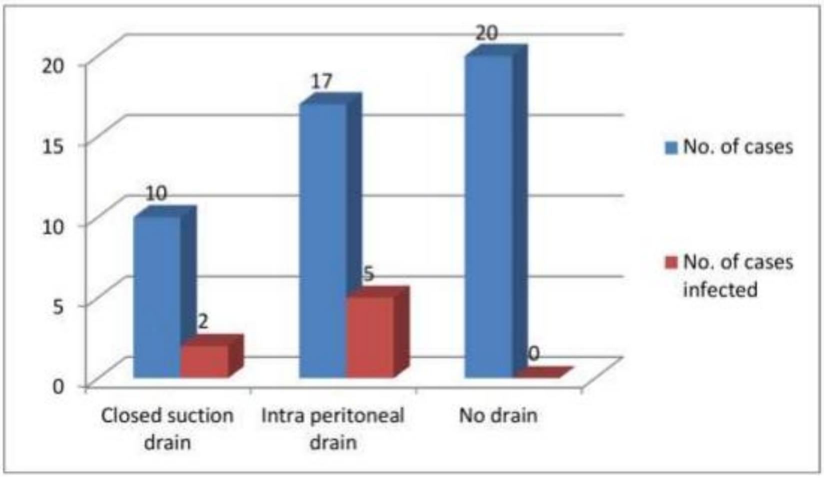

Fig-6: Representation of wound infection with drains in Groups B

Microbiology of Surgical Site Infection

Wound swabs were sent from all the eight infected patients. Isolated organisms were *Escherichia coli* in three cases which were sensitive to Cefoperazone-Sulbactam, Amikacin and Fluoroquinolones mainly. Coagulase negative *Staphylococcus aureus* were detected in two cases which were sensitive to Linezolid, Meropenem and few third generation cephalosporins. *Pseudomonas aeruginosa* were isolated in two cases and were found to be sensitive to Piperacillin-Tazobactam, Meropenem, etc. Klebsiella sp. was found in one case which had sensitivity profile similar to *E. coli*.

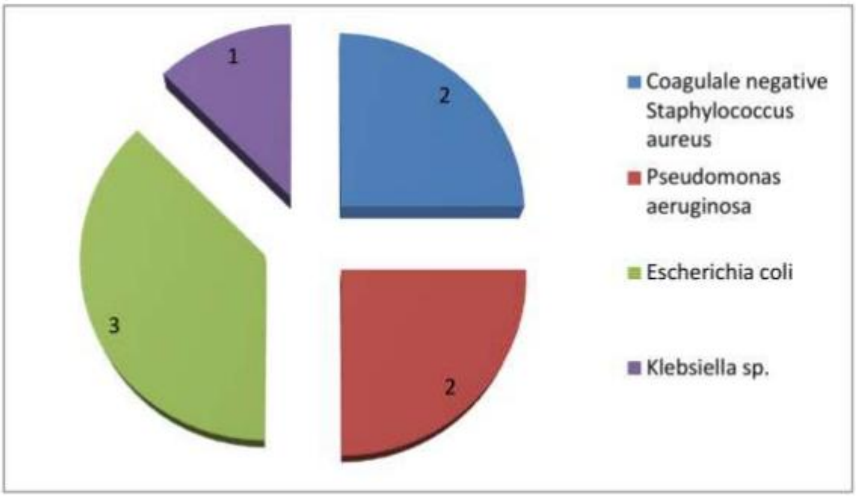

Fig-7: Representation of infecting organisms

Role of prophylactic antibiotic

Both groups had 25 clean and 22 clean-contaminated surgical cases. All the 47 patients in group A received single dose of broad spectrum prophylactic antibiotic after skin sensitivity testing half an hour before surgery. Patients in group B were not given any antibiotic. One clean-contaminated case was infected in group A out of 47 cases. In group B, 1 clean and 6 clean-contaminated surgical cases were infected out of 25 clean and 22 clean-contaminated surgical cases respectively.

Table 7: Comparison of the role of prophylactic antibiotic in the two groups

For clean surgical cases

	Group A	Group B	P value
Infected	0	1	0.312 (Not Significant)
Not infected	25	24	

For clean contaminated surgical cases

	Group A	Group B	P value
Infected	1	6	0.039 (Significant)
Not infected	21	16	

Thus, from the present comparative prospective study it can be concluded that prophylactic antibiotic has a definite role in preventing surgical site infection in clean-contaminated surgical cases. In clean surgical cases prophylactic antibiotic has not proved to have a significant role in preventing SSI. The role of associated risk factors is to be kept in the mind of the surgeon in order to prevent SSI in clean surgical cases.

Effect on hospital stay

As a result of infection the length of hospital stay was increased in the affected patients leading to an increased cost of treatment.

Table 8: Mean hospital stay of patients

Mean hospital stay of 8 infected patients	16 days
Mean hospital stay of 86 non infected patients	5.56 days

The p value calculated by Student T-test is 0.001346 which means that the difference in mean hospital stay between the infected patients and the non-infected patients is statistically significant.

DISCUSSION

Surgical site infection, though has been documented ever since the origin of surgery, has not been able to be mastered. Its incidence can be reduced by strict asepsis, meticulous surgical techniques which include good hemostasis, tissue respect and washing of wound (skin and subcutaneous tissue) with normal saline. Prophylactic antibiotics have drastically reduced the incidence of SSI.

At present, the expected surgical site infection rate worldwide is 1 – 9.5 % in clean and clean-contaminated surgical cases [10]. In my study the overall infection rate was 8.51 %; the infection rate in clean cases was 2 % and in clean-contaminated cases was 15.91 % which is in close agreement with previous studies.

The age incidence in the present study varied from 16 to 69 years but maximum number of patients belonged to 31 to 40 years age group. Older age group is considered a risk factor for development of SSI. In the present study, 5 cases were infected above 50 years age group out of 8 infected cases (62.5 %). Rao *et al.* showed in their study that SSI incidence is doubled in the older age group of 50-70 years and the incidence of severe complications also increases in both the extremes of ages i.e. less than 10 years and more than 60 years [11]. In my study the P value for old age as an individual risk factor was 0.0095 which was not statistically significant. This was probably due to lesser number of cases in that age group.

In both groups, sexes and risk factors (anemia, diabetes, old age, obesity and prolonged operative time) were distributed almost equally. In the present study the patient factors when controlled prior to surgery did not cause any infection. Whereas in group B, five patients who were obese and three patients who underwent prolonged duration of surgery had infection. Twelve patients in the present study were obese (5 in group A; 7 in group B). Six out of these twelve patients (1 from group A and 5 from group B) subsequently developed surgical site infection.

The contribution of obesity for the development of SSI in the present study was significant (P value = 0.000005). The contribution of prolonged operative time for the development of SSI was also significant (P value = 0.0243) in the present study. Five infected cases belonged to more than 50 years age group. These patients also had other associated risk factors. It can be said from the present study that presence of more than one risk factor has a significant impact on the development of surgical site infection and when not provided with adequate antibiotic coverage (prophylactic antibiotic dose) are definitely at an increased risk of developing surgical site infection.

Cruise and Ford have demonstrated that presence of obesity acts as a single independent risk factor for development of SSI. Prolonged duration of surgery also increases the incidence of surgical site infection [12]. Possible explanations for the increase in the infection rate with the duration of the operation are:

1. Dosage of bacterial contamination increases with time.
2. Wound cells are damaged due to drying by exposure to air.
3. Increase amount of suture and electrocoagulation may reduce the local resistance of the wound.
4. Longer procedures are more liable to be associated with blood loss and thereby reducing the general resistance of the patient.

Table 9: Infection Rate in Different Studies

Studies	Infection rate	Infection rate with risk factors
Chowdhury *et al*. [14]	3 %	8.95 %
S. S. Gill	0.76 %	10.32 %
Agarwal	1.47 %	38.46 %
Present study	Nil	20 %

One of the anemic (out of 4 in group A and 5 in group B) and two of the diabetic patients (Out of 10 patients, 5 in each group) developed infection. So it can be said that with proper control of diabetic status and optimization of anemia, infection rate can be reduced. Funary AP *et al*. in their study showed that when blood glucose level was kept strictly below 200 mg/dl during the perioperative period by continuous intravenous infusion of insulin the incidence of SSI got reduced from 24% to 6.06% which was statistically significant [13].

Culture was sent from the wound of all the eight infected patients. Isolated organisms were Escherichia coli in 3 cases, coagulase negative *Staphylococcus aureus* in 2 cases, *Pseudomonas aeruginosa* in 2 cases and Klebsiella sp. in one case. All these organisms were hospital strains. This clearly indicates that the cause for all the patients to get infected is nosocomial infection i.e. hospital acquired infection. Studies show *Staphylococcus aureus* as the most common organism isolated from SSI but that was not seen in my study. The possible explanation may be that in my study the majority of infections occurred in biliary surgeries and not in surface surgeries.

Table 10: Organism isolated from wound swab culture

Studies	No. of cases infected	No. of cases infected with S. aureus	Percentage
Lilani *et al*. [15]	17	14	82.3 %
Mangram *et al*. [16]	124	87	70.1 %
Olson MM *et al*. [17]	9066	7881	86.9 %
Present study	8	2	25 %

The class of surgical wound had significant role in development of SSI. The different studies show that clean-contaminated surgical wounds are more prone to develop surgical site infection. My finding corroborates with those of the previous studies. Out of 94 cases 50 were clean and 44 were clean-contaminated surgical cases. All types of cases were equally represented in both the groups.

Table 11: Class of Surgical wound and Infection Rate

Studies	Clean	Clean contaminated	Contaminated
Lilani *et al*. [15]	3.68 %	22.4 %	32.45 %
Cruise *et al*. [12]	7 %	18 %	> 35 %
Anne *et al*.	0.59 %	2.6 %	26 %
Sharif M *et al*. [18]	5.44 %	11.4 %	20 %
Present study	2 %	15.91 %	-

Cruise *et al.* have shown experimentally that bacteria can gain entry into the depth from the skin via open drains when compared to closed suction drains. Closed suction drainage provides an answer to the problem, although closed suction drainage using tube of smaller diameter appears to be effective rather than the use of larger tubes, especially in patients with poor wound healing, because the defect caused by a larger tube may provide a passage for retrograde entrance of bacteria into the wound.

Following an operation, blood and plasma in small quantities are found in the layers of the wound; they are beneficial in the prevention of multiplication of bacteria as this collection contains opsonin, which prevent bacterial invasion. With time the concentration of opsonin decreases and this collection then acts as a nidus for infection, therefore it is logical to use drains in situations where one expects collection of large quantities of exudates in the layers of the wound. However drains are double edged swords as they can form a tract for entry of exogenous organisms into the depth of the wound.

Table 12: Incidence of Infection with the Use of Drains

Studies	Drains placed	Drains not placed
Lilani et al. [15]	22.4 %	3.03 %
Rao et al. [11]	30.4 %	2.5 %
Cruise et al. [12]	29.1 %	4.5 %
Olson MM et al. [17]	25 %	3 %
Mangram AJ et al. [16]	17 %	3.5 %
Present study	15 %	Nil

In the present study the use of broad spectrum antibiotic as prophylaxis having a half-life up to 8 to 12 hours was justified as it took care of the wound in its initial crucial phase. It was administered half an hour before the incision to all the patients in group A and only one patient in group A got infected who eventually had multiple risk factors. Whereas in group B, where no such antibiotic was given, an incidence of infection rate of 14.89 % was seen (1 patient from clean surgeries and 6 from clean-contaminated surgeries).

In the present study, incidence of infection in clean cases in group B was 4% compared to nil in group A, that means the difference in occurrence of infection between the two study groups was found to be not significant (P value = 0.312). Whereas for clean-contaminated cases, incidence of infection in group B was 27.27% compared to 4.55 % in group A, that means the difference in occurrence of infection in the two study groups was found to be significant (P value = 0.039). Hence, prophylactic antibiotic was not found to be useful in clean cases but they have a definite role in avoiding surgical site infection in clean-contaminated surgical cases particularly in patients associated with unavoidable risk factors.

Table 13: The Present Study is Compared with the Similar Studies Conducted in the Past

Studies	Antibiotic not given	Percentage of infection	Antibiotic given	Percentage of infection	P value
Kal *et al*.	100	13 %	65	18.5 %	NS*
Carlsson *et al*. [19]	58	24.1 %	60	3.3 %	NS
Anne *et al*.	427	0.94 %	414	0.2 %	NS
Rao AS *et al.*	100	2 %	100	1 %	NS
Present study (Clean and Clean-contaminated cases)	25	4 %	25	-	P = 0.312
	22	27.27 %	22	4.55 %	P = 0.039

*NS – Not Significant

The mean hospital stay statistically increased in the infected patients (P value = 0.001346; vide table 8), leading to an increased cost of treatment.

CONCLUSION

SSI is the condition that may increase the morbidity and hospital stay of the patient. In severe cases may lead to loss of hospital resources, emergence of resistant bacteria or may even lead to death of patient due to sepsis. Its incidence increases with increasing age; old age patients are the most affected. Risk factors for development of SSI should be identified if present and patient factors like anemia, DM are to be corrected prior to surgery. Obesity and prolonged duration of surgery significantly increases the risk of surgical site infection. Hence, operative time should be minimized. Prophylaxis with broad spectrum antibiotic should be given to patients with more than one risk factor and when not avoidable especially in obese patients. Wherever necessary closed section drain should be used to drain the collection.

Local factors and microbial factors should be borne in mind and appropriate steps should be taken to avoid them. When surgical site infection is diagnosed, wound swab/pus should be sent for culture sensitivity and antibiotic should be started empirically based on the common hospital strains usually found and then should be changed accordingly when sensitivity report is available. Adequate drainage of pus in case of major infection should be encouraged by release of one or more sutures and planned for secondary closure once infection is controlled. For clean surgeries there is no need for prophylactic antibiotic as it has no statistical significance, whereas in clean-contaminated cases antibiotic prophylaxis is advocated as it is proven to be statistically significant. Misuse of antibiotics should be avoided as it may lead to an increased cost of burden on the patients, and increase the emergence of resistant micro-organisms and also increase side effects with antibiotic usage.

REFERENCES

1. Brunicardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE. Schwartz’s Principles of Surgery. 9th ed. USA, Mac Graw Hill. 2010;6:113.
2. Martone WJ, Nichols RL. Recognition, prevention, surveillance and management of surgical site infections. Clin infect Dis. 2001;33:67.
3. Charles F Brunicardi. Schwartz's Principles of Surgery. 9th ed. USA, Mac Graw Hill. 2010;6:119.
4. Olson M, O'Connor M, Schwartz ML. Surgical wound infection: A 5 year prospective study of 20193 wounds at the Minneapolis VA Medical Centre. Ann Surg. 1984;19:253.
5. Laufman H. Current status of special air handling systems in operating rooms. Med Instrum. 1973;7:7.
6. Halsted WS. The employment of fine silk in preference to catgut and the advantage of transfixing tissues and vessels in controlling hemorrhage. JAMA. 1983;60:1119.
7. 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: 250.
8. Collee JG, Dugurd JP, Fraser AG, Mackie, McCartney. Practical medical Microbiology. 14th ed. Edinburgh, Churchill Livingstone. 1996;40:621-623.
9. Ronald LN. Bacteriology in Surgery: Mastery of Surgery. 2nd ed.1988;1: 83-93.
10. Townsend CM, Beauchamp RD, Evers BM, Mattox KL. Sabiston Textbook of Surgery. 19th ed. Philadelphia, Elsevier. 2012;13:285.
11. Rao AS, Harsha M. Postoperative wound infection. J India Med Assoc. 1975;44:90-3.
12. Cruise PJE, Foord R. A five year prospective study of 23,649 surgical wounds. Archives of surgery. 1913;107:206.
13. Funary AP, Zerc KJ, Grunkemeier GC, Starr A. Continuous intravenous insulin infusion reduces the incidence of deep sternal wound infection in diabetic patients after cardiac surgical procedures. Ann Thorac Surg. 1999;67:352-360.
14. Chowdary A, Jangale N. Surgical Microbiology. Journal of Medical Microbiology. 1997.
15. Lilani, Jangale N. Study of Surgical Wounds. Indian J Surg. 1997;19:90-3.
16. Mangram AJ, Horan TC. The hospital infection control practices advisory committee Guideline for prevention of SSI. Infect control Hosp Epidemol. 1999;20:241-78.

17. Olson MM, Lee JT. Continuous l0 year wound infection surveillance results: advantages and unanswered questions. Arch Surg. 1990;25:794-803.
18. Mohammed SA. Prospective study of surgical wounds. Journal of Surgery. 2001 Jan-Mar;16(1):124.
19. Carlson GE, Gonnlanakis C, Tsatsakis A. Pre-incisional single dose antibiotic for prophylaxis of surgical wound infection. American Journal of Surgery. 1995;170(4):353-5.