ORIGINAL ARTICLE

Study of Bacteriology of Post-Operative Wound Infection

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Abstract:

Background: While many patients are admitted to hospital for treatment of infections, some acquire infection during their stay in the hospital. These infections are called as nosocomial infections. Surgical site infection or post operative wound infection is one of them. It is defined as infection of previously sterile tissue incised to gain exposure for operating deeper spaces operatively exposed or organs manipulated by a surgeon. It is one of the feared complications of surgery as it increases morbidity as well as cost of medical care. *Aims and Objectives:* Study was conducted to find out incidence of surgical site infection rate in surgical ward, evaluate various factors contributing to infection and to identify causative pathogens and their antibiogram patterns. *Material and Methods:* All clean and clean contaminated operative cases admitted in surgery ward in study period of 18 months were included. Preoperative, operative and post-operative management protocols of the cases were recorded in detail. *Results:* A total of 1082 operated cases were studied among which 59 infected cases were found. Surgical Site Infection (SSI) rate was 5.45%. *E. coli* and *Staphylococcus aureus* were the commonest pathogen isolated from the infected wound. 50 % were Methicillin Resistant Staphylococcus Aureus (MRSA) among them and 50% of Enterobacteriaceae group were resistant to 3rd generation Cephalosporins. *Conclusion:* Surgical site infection rate of a hospital can be reduced easily by following proper pre-operative protocol for the patients. Those patients with surgical site infection can be treated effectively by following the antibiotic policy as provided by the Department of Microbiology.

Keywords: Antibiotics, Hospital stay, Infection Surgical Site

Introduction:

Surgical site infections are the most dreaded complications of surgical services provided in a hospital. In spite of introduction of variety of antibiotics and practices of aspesis, it still haunts the whole world. It increases morbidity of patient, cost of prolonged hospital stay, time lost from work and a legal liability. No single measure can be expected to achieve more than partial control of infection and even combined use of several preventive measures cannot eliminate the problem completely. This study was conducted with an aim of evaluating the incidences of SSI in our hospital. Various factors contributing to its incidence were also studied and the preventive measures were evaluated.

Material and Methods:

This study was conducted for 18 months from November 2009 to April 2010 in Dr. Shankarrao Chavan Government Medical College, Nanded with the aim of evaluating the rate of surgical site infection in the hospital and also the various factors contributing the infection. The study group included 1082 operated cases from the Unit I and Unit II of the surgical wards. Cases were selected depending the CDC criteria for defining the type of wound [1]. Inclusion Criteria were as follows:

1. All clean and clean contaminated surgeries.
2. All planned / elective surgeries.

Those excluded were contaminated and dirty surgeries and those operated under emergency.

Among 1082, uninfected cases were considered as the controls. Patient's details including method of preoperative preparation, type of pre and post-operative antibiotic prophylaxis according to antibiotic policy of the hospital, use of drain, total days of pre and post-operative hospital stay were also noted.

Patients operated under Unit I were not given any pre–operative antimicrobial prophylaxis. Patients of Unit II were given antimicrobial prophylaxis with cefotaxime 200 mg orally 8 hours before surgery. Normal flora of the patient was studied by taking swabs from the skin. The swabs were then inoculated on blood agar and Macconkey's agar. The colonies were studied in detail for its characteristics including biochemical tests and antibiogram pattern. The patients were then followed till surgeries were done. Post-operative antibiotics were given to all the patients till discharge. In case of wound infection post-operatively, the responsible organisms causing infection were isolated and antibiotics were given according to the antibiogram pattern [2].

The patients were treated with appropriate antibiotics and regular dressing of surgical wound and then discharged from the hospital.

Results:

A total of 1082 cases were included among which 59 cases i.e. 5.45% cases were found infected. The observations were as follows:

Table 1 shows the classification of wound and SSI in accordance to wound class.

Table 1: Surgical Site Infection (SSI) Rate According to Wound Class

Class of Wound	Total Cases	Cases Infected	SSI (%)
Clean	440	11	2.50
Clean contaminated	642	48	7.48
Total	1082	59	5.45

X^2=11.595 and p value = <0.001 (Significant)

Clean wound criteria: Elective, primarily closed, no technique break, and no acute inflammation, involving transaction of gastrointestinal, oropharyngeal, genitourinary, biliary or tracheobronchial tracts. Clean contaminated wound criteria: Emergency cases that are otherwise clean, minimum technique break, Controlled opening of gastrointestinal, oropharyngeal, biliary or tracheobronchail tract, reoperation via clean incision within 7 days [1].

Table 2 shows different types of organisms isolated from the infected wound of operated cases. E. coli is the most common organisms causing the wound infections.

Table 2: Microorganisms Isolated from Infected Wounds

Microorganisms Isolated	Number of Isolates
E. coli	22
S. aureus	15
P. aeruginosa	9
S. epidermidis	9
K. pneumonia	5
Sterile	6

Table 3 shows various types of surgeries done under the surgical unit and SSI rate with each surgery. The infection rate was highest with oesophageal and gastric, small bowel surgeries followed by hepatobiliary and lower urinary tract surgeries.

Table 4 shows total number of patients admitted to the surgery wards for different durations. The number of infected cases was seen increasing with increase in the preoperative days of hospitalization.

Table 5 shows correlation between SSI rate and presence of Drain. SSI rate is 10 times more in patients with drain in comparison to those where drain has not been used. In presence of drain the SSI rate is 23.6% and in the absence of drain the

Table 3: Distribution of Surgical Site Infection (SSI) Cases in Various Surgeries

Operation Performed	Total Cases	Infected Cases	SSI Rate (%)
Hydrocele	198	0	0
Inguinal hernia	375	5	1.33
Other hernia	74	9	12.16
Appendectomy	108	4	3.70
Upper urinary tract surgeries	55	8	14.55
Lower urinary tract surgeries	69	18	26.09
Hepatobiliary surgeries	7	2	28.57
Esophageal, gastric and small bowel surgeries	13	4	30.77
Thyroid and parathyroid surgeries	32	0	0
Adrenal	3	0	0
Meningomyelocele	13	2	15.38
Ca breast	37	7	18.92
Gynaecomastia	18	0	0
Phylloid tumour	4	0	0
Fibro adenoma tumour	17	0	0
Ductal ectasia	6	0	0
Lipoma, bubonocele	30	0	0
Testicular surgeries	12	0	0
Hemangioma	6	0	0
V P shunt	5	0	0

SSI rate is only 2.47%. The increase in the SSI rate is highly significant.

Table 6 shows correlation between the duration of surgeries and SSI rate. Prolonged exposure of the operative site to the environment predisposes the tissue to infection. The increase in the SSI is highly significant.

Table 7 and 8 have shown the resistance pattern of different microorganisms towards several antibiotics which expressed in terms of percentage.

Table 9 and 10 have shown the effect of pre operative antibiotics on the surgical outcome. Infection rate is less in the cases where prophylactic antibiotics were given.

Table 4: Preoperative Days of Hospitalization and Surgical Site Infection Rate

Preoperative Days of Hospitalization	Total Case Admitted for Surgery	Total Case Infected	SSI (%)
0 – 1	206	4	1.94
2 – 7	710	23	3.24
8 – 14	152	29	19.08
>15	14	3	21.43

X^2=73.34 and p value = <0.0001 (Highly significant)

Table 5: Surgical Site Infection Rate in Relation to Use of Drain

	Drain used	Drain Not Used
Total surgeries	152	930
Cases infected	36	23
Cases uninfected	116	907
SSI (%)	23.6	2.47

X^2=114.0 and p value = <0.0001 (Highly significant)

Table 6: Duration of Surgery and Surgical Site Infection Rate

Duration in hours	No of Cases	No of Infected Cases	SSI (%)
< 1.0	719	15	2.09
1 - 2	360	41	11.39
>2.0	03	03	100

X^2=63.67 and p value = <0.0001 (Highly significant)

Table 7: Resistance Pattern of Microorganisms Isolated in Percentage:

Microorganisms	Resistance Pattern in %							
	A	Cf	Ce	Ci	G	Ak	I	Pt
E. coli (22)	100	100	58	48.6	-	17	8	28
Pseudomonas aeruginosa (09)	-	100	-	77	100	70	54	48
Klebsiella penuemoniae (05)	100	100	100	58.7	-	45.8	15.6	36.7

A-Ampicillin, Cf-Ciprofloxacin, Ce-Cefotaxime, Ci-Ceftriaxone, G-Gentamicin,Ak-Amikacin, I- Imepenem, Pt-Piperacillin tazobactum

Table 8: Resistance Pattern of Microorganisms Isolated in Percentage:

Microorganisms	Resistance Pattern in %						
	P	Co	At	T	Va	Ox	G
Staphylococcus aureus	79	88	42.8	100	00	46.6	28.5
Staphylococcus epidermidis	85.7	83.8	32	52	00	33.3	14.5

P- Penicillin, Co- Cotrimoxazole, At- Azithromycin, T- tetracycline, Va- Vancomycin, Ox-Oxacillin, G-Gentamicin

Table 9: Role of Prophylactic Antibiotics and SSI Rate in Clean Cases

Unit	Infected cases	Non - infected cases	Total clean cases	SSI rate
Unit I (No prophylaxis given)	09	185	194	4.6%
Unit II (prophylaxis)	02	244	246	0.8%

X^2=7.9 and p value = <0.05 (Significant)

Table 10: Role of Prophylactic Antibiotics and SSI Rate in Clean Contaminated Cases

Unit	Infected cases	Non - infected cases	Total clean contaminated cases	SSI rate
Unit I (No prophylaxis given)	40	289	329	12.1%
Unit II (prophylaxis)	08	305	313	2.5%

X^2= 21.3 p value = <0.0001 (Highly significant)

Discussion:

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. The present study was to identify the pathogens responsible for surgical site infections and determining the factors influencing the infection rate. The SSI rate among the clean cases in the present study was 2.5% and that in clean contaminated cases was 7.48%. The profound influence of endogenous contamination becomes evident from the analysis of these results. Endogenous contamination remains the main risk factor for the development of surgical wound infection because of enormous dose of the organisms available from the bowel and other hollow muscular organs [3]. With the increasing grade of wound contamination there is more chance of SSI. Anju *et al* [4] have shown SSI rate of 4.9% with clean surgeries and 8.5% with clean contaminated surgeries. With Anvikar *et al* [3] study the SSI rate has been 4.04% in clean surgeries and 10.6% in clean contaminated surgeries. The SSI rate of respective wounds class in the present study is lower than the SSI rate of other studies. This could be due to difference in many factors like operative technique, pre-operative preparation, use of prophylactic antibiotics etc.

S P Lilani *et al* [5] have found an infection rate of 3.03% and 22.4% in clean and clean contaminated cases respectively. The results have been much higher than the present study. The commonest pathogen found in wound infection cases of surgery ward has been *E. coli* followed by *Staphylococcus aureus*. Out of the 22 isolates of *E. coli* only 3 have been from clean cases. 19 isolates have been recovered from the surgery involving opening of hollow muscular organs. Based on the type of surgical procedure, the pathogens isolated from the SSI differed.

Among the clean cases, maximum SSI rate has been with modified radical mastectomy for breast malignancies (18.92%). This is in agreement with the study of S P Lilani *et al* [5]. In clean contaminated surgeries, more cases of SSI have been seen with esophageal, gastric and small bowel surgeries (30.77%) followed by hepatobiliary (28.51%) and lower urinary tract surgeries (26.09%).

A N Yalcin *et al* [6] have also found high infection rate after gastric esophageal operation (21.1%), and cholecystectomy (17.2%). Surgical site infection rate was 25% among cases of herniorraphy. There was no infection noted after mastectomies.

Extreme ages have long been thought to influence the likelihood of wound infection perhaps owing to low immunocompetence. In our study maximum cases of SSI have been seen in the age group above 60 years. In our study drain has been used in 152 cases out of which 23.68% (n =36) developed infection. Only 2.47% SSI rate has been seen in cases where drain was not used.

M J Gil Egea *et al* [7] found an infection rate of 5.4% in drained surgical wounds and 2.4% in undrained surgical wounds. The results of the present study are comparable with the study of M J Gil Egea. Philip B Mead *et al* [8] have found significant negative impact of drains on the infection rate of clean wounds. The rate was lowest when drains were avoided entirely. The finding that drained wounds get more infections than those without drains argues in favour of the role of bacteria reaching the incision site through the drain. Therefore draining of wound should be kept to a minimum.

A prolonged preoperative stay with exposure to hospital environment and various diagnostic procedures, therapies and micro flora have shown to increase the rate of SSI. Patients admitted one day prior to surgery have shown SSI rate of 1.94% and those admitted for more than 7 days preoperatively have shown SSI rate ranging from 3.24% to 21.45%. The other study results showing SSI rate according to days of hospitalization is as follows.

Days of Pre-Operative stay	Shivaji Rao *et al* [9] (%)	Anvikar *et al* [3] (%)	Cruse & Ford *et al* [10] (%)	Present Study (%)
0 - 1	-	1.76	1.2	01.94
2 - 7	21	4.07	2.1	03.24
8 - 14	31	5.00	3.4	19.08
>15.0	44	-	-	21.43

Shivaji Rao *et al* [9] have concluded that increased preoperative stay increases colonization with nosocomial strains of Staphylococcus and gram negative bacilli there by increasing the risk of SSI in patients. Besides the patients admitted for longer time are the ones having poor general condition or serious disease or low immunity and therefore susceptible to infection.

Frequent pathogen in SSI cases of general surgery wards have been *E. coli* followed by *Staphylococcus aureus*. Almost 50% strains of *Staphylococcus aureus* have been resistant to methicillin. No strain has been found resistant to Vancomycin. 50% of enterobacteriaceae group of organisms have been resistant to 3rd generation Cephalosporins.

In this study use of pre–operative antibiotics in the Unit II patients reduced the infection rate in clean and clean-contaminated cases. As no antibiotic was given to Unit I patients, the SSI rate in them was high. The study results match very well with the rational of peri-antibiotic therapy which states that the wound infection can be prevented adequately if the body has sufficient antibiotic concentration at the time of contamination [11]. Polk & Mayer and Stone *et al* have demonstrated that the antimicrobials were most useful if they were administered before as opposed to the after operation [11]. Similarly Lt. Col P K Hota *et al* [12] has shown that single dose of antibiotic prophylaxis could be recommended safely in all major surgical procedures to reduce wound infection.

Conclusion:

It is concluded that surgical site infection rate of a hospital is governed by the pre-operative and post-operative management protocol in a patient. It increases proportionately with the increase in the extent of intra-operative contamination. Adequate Pre-operative antibiotic prophylaxis, minimum hospital stays both pre and post operatively and reduced duration of surgery can definitely reduce the infection rate.

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