A Study Of Various Factors Influencing Surgical Site Infection Rates In A Tertiary Cancer Research Hospital

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ABSTRACT:

Health Care-Associated Infections (HAIs) remain an important public health concern. Amongst the prominent HAIs, Surgical Site Infections (SSIs) contribute to substantial rate of mortality, significant morbidity, considerable prolongation in length of hospitalization and added treatment expenses [1]. Several factors are known to increase the risk for SSIs, including obesity, advanced age, diabetes mellitus, malnutrition, prolonged preoperative stay, infection at a remote site, duration of surgery, surgery technique, presence of drains, inappropriate use of antimicrobial prophylaxis, perioperative temperature, and poor postoperative glycemic control. Optimizing perioperative conditions can certainly help decrease infection risk [2]. The SSI rates in developing countries like India are higher than those reported by CDC-NHSN but are comparable to INICC rates [3].

This study was carried out to assess the influence of the various risk factors for developing SSI so that measures could be implemented to reduce the SSI rates. The length of preoperative stay, timing of pre operative antibiotic administration, duration of antibiotic prophylaxis, and method of hair removal were some of the factors studied and they had an important role in determining the development of SSI's.

Some of the changes which were recommended for implementation based on this study are, reducing the pre operative hospital stay, no surgical prophylaxis to be given in the wards and shifting from shaving to clipping for surgical hair removal.

Commitment at all levels of the health care system is necessary to implement these changes which can eventually reduce the incidence of SSI and thus reduce the cost burden of treating these infections.

Abbreviations: HAIs- Health Care-Associated Infections, SSIs- Surgical Site Infections, CDC-NHSN- Centers for Disease Control and Prevention-National Healthcare Safety Network, INICC- International Nosocomial Infection Control Consortium.

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Introduction:

Health Care-Associated Infections (HAIs) remain an important public health concern. Amongst the prominent HAIs, Surgical Site Infections (SSIs) contribute to substantial rate of mortality, significant morbidity, considerable prolongation in length of hospitalization and added treatment expenses [1]. Several risk factors are known to increase the risk for SSIs, including obesity, advanced age, diabetes mellitus, malnutrition, prolonged preoperative stay, infection at a remote site, duration of surgery, surgery technique, presence of drains, inappropriate use of antimicrobial prophylaxis, perioperative temperature, and poor postoperative glycemic control. Many of these are beyond practitioner control, but optimizing perioperative conditions can certainly help decrease infection risk [2].

The SSI rates in developing countries like India are higher than those reported by Centers for Disease Control and Prevention-National Healthcare Safety Network (CDC-NHSN) but are comparable to International Nosocomial Infection Control Consortium (INICC) rates [3]. Apart from patient endogenous factors, the role of external risk factors in the pathogenesis of SSI is well recognized. However, among the various measures to prevent SSI, only some are based on strong evidence, and there is insufficient evidence to show whether one method is superior to other method [4].

Some of the factors influencing the development of Surgical Site Infections are**:**

Duration of pre operative stay

Prolonged preoperative hospital stay has been correlated with a risk of SSI. Ideally the patient should have the operation within 24 hours of admission before the skin has a chance to become significantly colonized by the "hospital bugs". Recently, hospitalized patients are more likely to be colonized by antibiotic resistant, virulent bacteria. In addition, hospitalized patients are more likely to receive interventions which can predispose to infection [5].

Timing of antimicrobial prophylaxis

Antibiotic prophylaxis plays an important part in prevention of wound infections. The efficacy of antibiotic prophylaxis has been demonstrated to be significant; however, antibiotic prophylaxis cannot be a substitute for any other preventive measure. The scientific basis for the perioperative use of antibiotics was established by Burke. Polk and Stone confirmed the hypothesis in clinical studies and laid the ground for antibiotic prophylaxis in surgery [6].

Current guidelines issued by professional societies or national authorities, such as the American Society of Health-System Pharmacists (ASHP), the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) recommend administration within 60 minutes prior to incision. Findings indicate that adequate tissue concentrations of the antibiotic should be present at the time of the incision and throughout the procedure for Surgical Antibiotic Prophylaxis (SAP) to be effective. This necessitates antibiotic administration prior to incision. Low tissue concentration of antibiotics at the time of wound closure is associated with higher SSI rates. Antibiotics with short half-lives may be less effective if given early. [7].

Surgical antibiotic prophylaxis prolongation:

Evidence shows that a single preoperative dose of SAP (and possible additional intra operative doses according to the duration of the operation) is not inferior to additional postoperative multiple doses for the prevention of SSI [8].

Guidelines published by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) and the American Society of Health Care Pharmacists (ASHP) recommend discontinuing SAP within 24 hours after surgery [9].

Method of hair removal

Removal of hair from the intended site of surgical incision has traditionally been part of the routine preoperative preparation of patients undergoing surgery. Hair removal inversely increases the risk of SSI by causing microscopic trauma of the skin. To minimize the potential of skin trauma, the use of clippers instead of razors has been proposed for preoperative hair removal. Clippers cut the hair close to the skin without touching it, whereas razors involve a sharp blade drawn directly over the skin [10].
This study has been carried out to study the influence of the various risk factors for development of SSI so that changes could be implemented to reduce the SSI rates in a tertiary cancer research hospital. We evaluated SSI prevention practices in our hospital to assess concordance with published international evidence-based SSI prevention guidelines.

Aims and objectives:

Retrospective study of the following practices in influencing development of surgical site infections was carried out

1. Length of pre-operative stay
2. Timing of antibiotic prophylaxis
3. Surgical antibiotic prophylaxis prolongation
4. Method of hair removal

Objective is to establish the influence of these practices so that changes could be implemented to reduce the SSI rates.

Study Design: Retrospective study carried out in a Tertiary Cancer Research Hospital, Jaipur

Patients undergoing elective cancer surgeries from June 2023 to November 2023 were randomly selected and included in the study, and the risk factors were analyzed.

Sample size: 50 oncology surgery cases

Inclusion Criteria: 50 randomly selected clean, Clean –contaminated and contaminated onco surgeries in adults conducted during the study period.
Exclusion criteria: Dirty or infected and paediatric cases were not included in the study.

Material and Methods:

50 random elective surgery cases between June 2023 to November 2023 covering clean, clean contaminated and contaminated cases were included in the study.

The practices studied included

1. Length of pre-operative stay: 0–1-day v/s 2-6 days
2. Timing of antibiotic prophylaxis: 1-2 hours before surgery v/s earlier dosing (started previous day)
3. Surgical antibiotic prophylaxis prolongation: Stat dose v/s prolonging by more than 2 doses
4. Method of hair removal: Shaving v/s Clipping

The data was recorded as per the performa and the correlation of the risk factors with infection rates was calculated.

Results:

In the 50 elective onco surgeries included in the study, 6 were cases of Carcinoma breast undergoing Modified Radical Mastectomy, 21 cases included clean contaminated surgeries of the upper GI tract (pancreas, gall bladder, oesophagus, stomach,) urinary bladder and Kidney. 23 cases were class 3 contaminated surgeries which included cases of carcinoma rectum and oral cancers.

Previously infected cases were not included in the study. The study included only adult patients between 40-70 years of age. A total of 14 patients had co morbidities like Diabetes mellitus, Hypertension and Coronary artery disease. Of the 50 patients, 20 patients developed surgical site infections. All cases were culture positive and the predominant pathogens were Gram Negative bacilli.

A. Length of pre-operative stay:

28 patients were admitted the previous evening and 22 patients were admitted 2-6 days prior to surgery, reasons for earlier admission were for investigations, stabilization of HTN and sugar levels.7 out of 28 patients with less than 1day of pre operative stay and 13 out of 22 patients with pre operative stay between 2-6 days, developed SSI.

Table1: Correlation of infection rate with length of pre-operative stay

Pre-operative hospital stay (days)	Total no of patients	No of infected patients	Infection rate (%)
0-1	**28**	**7**	**25%**
2-6	**22**	**13**	**59.1%**

B. Timing of Surgical antibiotic prophylaxis:
37 patients received the prophylactic antibiotic dose just before surgery and 13 patients were started on the prophylaxis the previous day and second dose given in the morning of surgery.13 out of 37 patients developed SSI and 7 of the 13 patients receiving earlier prophylactic dose developed SSI.

Table2: Correlation of infection rate with timing of antibiotic prophylaxis

Timing of antibiotic prophylaxis (hrs before surgery)	Total no of patients	No of infected patients	Infection rate (%)
1-2hrs	37	13	35.1%
> 2hrs	13	7	53.8%

Prolongation of surgical antibiotic prophylaxis:
20 patients received stat does of prophylactic antibiotic while 30 patients received more than 2 doses of the prophylactic antibiotic. 2 cases receiving stat dose and 18 patients with prolonged prophylaxis developed SSI.

Table3: Correlation of infection rate with surgical antibiotic prophylaxis prolongation

Duration of antibiotic prophylaxis prolongation (days after surgery)	Total no of patients	No of infected patients	Infection rate (%)
Stat dose	20	2	10%
Continuation (>2 doses)	30	18	60%

C. **Method of pre operative hair removal**:
Shaving was done in 39 cases and in 11 cases clippers were used for hair removal. 16 and 4 cases respectively developed SSI.

Table4: Correlation of infection rate with method of hair removal

Method of hair removal	Total no of patients	No of infected patients	Infection rate (%)
Shaving	39	16	41.0%
Clipping	11	4	36.4%

An odds ratio to assess the risk of developing SSI was calculated for the four modifiable risk factors.

1. Odds ratio for developing surgical site infecton in patients with preoperative stay of 2-6 days

SSI	2-6 days pre operative hospital stay cases	NOT 2-6 days pre operative hospital stay cases	Total
Developed SSI	13	7	20
Did not develop SSI	9	21	30
Total	22	28	50

ODDS RATIO – 4.33 (95% CI – 1.3, 14.47)

The odds of developing a SSI are 4.33 times more likely amongst patients who have a preoperative hospital stay of 2- 6 days as compared to patients who have a preoperative hospital stay of less than 2-6 days.

2. Odds ratio for developing Surgical Site Infection in patients with antibiotic prophylaxis given >2 h before surgery

SSI	Prophylaxis >2h before surgery	Prophylaxis not >2h before surgery	Total
Developed SSI	7	13	20
Did not develop SSI	6	24	30
Total	13	37	50

ODDS RATIO – 2.15 (95% CI – 0.6, 7.77)

The odds of developing a SSI are 2.15 times more likely amongst patients who have been given antibiotic prophylaxis > 2 hrs before surgery as compared to patients who have been given the prophylaxis just before surgery.

3. Odds ratio for developing Surgical Site Infection in patients with continuation dose (> 2 doses) of prophylactic antibiotic

SSI	Continuation >2 doses	Continuation not >2doses	Total
Developed SSI	18	2	20
Did not develop SSI	12	18	30
Total	30	20	50

ODDS RATIO – 13.5 (95% CI – 2.64, 69.13)

The odds of developing a SSI are 13.5 times more likely amongst patients who have been given continuation of more than 2 doses of prophylactic antibiotic as compared to patients who have been given only the stat dose.

4. Odds ratio for developing Surgical Site Infection in patients with shaving for hair removal before surgery

SSI	Shaving	Not shaving	Total
Developed SSI	16	4	20
Did not develop SSI	23	7	30
Total	39	11	50

ODDS RATIO – 1.22 (95% CI – 0.3, 4.86)

The odds of developing a SSI in patients who have undergone shaving are 1.22 times more at risk as compared to those who have undergone clipping.

Discussion:

From the data analysis it can be inferred that modifiable risk factors play a significant role in the outcome of surgical site infection.

Shorter duration of pre operative stay in the hospital reduces the risk of SSI by preventing colonization with hospital bugs or infections with opportunistic pathogens especially in our set up of cancer patients who are immunologically compromised. Study by Elthamy et al (1995) reported a low incidence of post operative wound infection with a short pre operative stay [11]. Our study reports an infection rate of 25% in patients with 0-1 day of pre operative stay as compared to an SSI rate of 59.1% in patients with 2-6 days of pre operative stay. Further analysis of the odds ratio showed 4.33 times more risk of development of SSI in patients with longer duration of per operative stay.

Dosing of prophylactic antibiotic as close to the time of surgery can aid in achieving highest level of tissue concentration of the antibiotic at the time of incision. Classen's land mark study in 1992 described the optimal time for surgical antibiotic prophylaxis at 120 minutes prior to incision [12]. Several international bodies (IDSA, RCPI, and ASHP) recommend administration of antibiotic prophylaxis close to incision time (60-120 min). In our study there was a decreased incidence of SSI in all cases where the prophylactic dose was administered 1-2h before surgery in the OT complex 35.1% as against 53.8%. in cases who received prophylaxis the previous night in the ward and a second dose in the morning. The calculated odds ratio at 95% confidence interval showed that patients receiving earlier prophylactic doses were 2.15 times more at risk of developing SSI.

In our study SSI rates were 10% in patients receiving stat dose and 60% in patients where the prophylaxis was continued for more than 2 doses. The odds ratio of development of SSI was 13.5 times more in the continuation group. The increase cases of SSI in the continuation group of our study population may be due to a greater number of patients undergoing class 3 surgery. The presence of co morbidities was not studied which also may influence the outcome of SSI. From these results it can be inferred that prolongation of surgical antibiotic prophylaxis for more than 2 doses did not help in preventing development of SSI. For a prudent antibiotic steward ship programme it may be advised to follow only stat dose of the prophylactic drug. Our study correlates well with suggestions of several international bodies (IDSA, ASHP, and SHEA) which recommend avoiding surgical prophylaxis prolongation to promote rational use of antibiotics and antibiotic stewardship [13].

In our hospital, shaving was followed for hair removal more frequently as compared to clipping. The infection rates were 41% and 36.4% respectively. The odds ratio calculated at 95% CI showed 1.22 times

more risk of SSI where shaving was done. Our study correlates with the Cochrane review published in 2009 and updated in 2011, which suggests that there was a significant risk of infection when shaving was done for hair removal as compared to use of clippers [14].

Conclusion:

Surgical site infection is an important aspect of health care associated infections which is a serious problem in hospital practice. This study was carried out to assess the influence of the various risk factors for developing SSI so that measures could be implemented to reduce the SSI rates. The length of preoperative stay, timing and duration of antibiotic prophylaxis, and method of hair removal were some of the factors studied and they had an important role in determining the development of SSI's. Some of the changes which can be implemented are:-

- To admit patients only previous day prior to surgery
- To ensure strict adherence of giving the prophylactic dose 1-2 h before surgery, no surgical prophylaxis to be given in the wards
- Allowing only up to 2 doses of the prophylactic antibiotic for strict antibiotic stewardship in the hospital
- Shifting from shaving to clipping for surgical hair removal.
- To monitor and follow strict aseptic precautions during surgery and adhere to rational antibiotic prescriptions as per the antibiotic policy.

Commitment at all levels of the health care system is necessary to implement these changes which can eventually reduce the incidence of SSI and thus reduce the cost burden of treating these infections.

Annexure1: Performa for data collection

S. no	Pt ID/ Age & Sex	Co-morbidities	diagnosis	Name of surgery	Dt of Admission	Dt of surgery	Duration of preop stay	Timing of Antibiotic prophylaxis	Duration of prophylaxis	Shaving /clipping	Out come of SSI
1											
2											

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