

Original Research Article

A study of preoperative, intra-operative and postoperative factors responsible for postoperative wound infection

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ABSTRACT

Background: Many factors affect the incidence of surgical wound infection, in addition to the surgeon's skill and the hospital environment. Host attributes, such as age over 60 years, diabetes mellitus, malignant disease, obesity, malnutrition, length of preoperative stay or pre-existing infection may influence risk, as may such operation characteristics as site, urgency, duration and time of skin shaving. Objective was to study the preoperative, intra-operative and postoperative factors responsible for postoperative wound infection.

Methods: This descriptive study was designed to study the problem of postoperative wound infection at tertiary health care center at rural set up over a period of two years during 2014 to 2016. Initial assessment of intra operative findings divided these cases into clean, clean contaminated and contaminated cases.

Results: As the length of pre-operative stay increased, the occurrence of SSIs increased. As the duration of post operative hospital stay increased, the occurrence of SSIs also increased. The occurrence of SSI increased as the quality of surgical wound deteriorated. As the duration of surgery increased, the occurrence of SSIs increased. It was found that the order of surgery was not related to occurrence of SSIs. It was found that the rate of SSI was more (21.55%) when the drain was used in comparison to only 8.04% when the drain was not used. The most common organism found to cause SSIs was staphylococcus aureus in 33.07% of cases.

Conclusions: Slightly low incidence of SSIs in our study may be attributed to the better infection control practices though it must be concluded that more stringent aseptic measures including rational antibiotic policy will be contributory in lowering the SSI rate further.

Keywords: Diabetes mellitus, Length of preoperative stay, Postoperative wound infection

INTRODUCTION

Many factors affect the incidence of surgical wound infection, in addition to the surgeon's skill and the hospital environment. Host attributes, such as age over 60 years, diabetes mellitus, malignant disease, obesity, malnutrition, length of preoperative stay or pre-existing infection may influence risk, as may such operation characteristics as site, urgency, duration and time of skin shaving.¹⁻³ Infection of a wound may be defined as invasion of organisms through tissues following a

breakdown of local and systemic host defences. In 1992, the US Centers for Disease Control (CDC) revised its definition of 'wound infection', by creating the definition, 'surgical site infection' (SSI), to prevent the confusion between the infection of a surgical incision and the infection of a traumatic wound.⁴ Most of the SSIs are superficial, but even so, they contribute greatly to the morbidity and the mortality which are associated with the surgeries.^{5,6} A system of classification for operative wounds that was based on the degree of microbial contamination was developed by the US National

Research Council group in 1964. Four wound classes with an increasing risk of SSIs were described: clean, clean-contaminated, contaminated and dirty. The simplicity of this system of classification has resulted in it being widely used to predict the rate of infection after a surgery. The CDC definition states that only the infections that occur within 30 days of a surgery (or within a year in the case of implants) should be classified as SSIs.⁷ Major wound infection is seen when a wound discharges pus and may need a secondary procedure to be sure of adequate drainage; there may be systemic signs or delay in return home. In minor wound infection there is discharge of pus or serous fluid without associated excessive discomfort or systemic signs.⁸ The usual clinical presentation of uncomplicated (involving only the skin and subcutaneous tissues) wound infection includes local incisional pain and tenderness, swelling, redness, and increased warmth and elevated body temperature, which most often begin between the fourth and eighth post-operative day. In such cases exogenous *Staphylococcus aureus* is the usual cause of infection. Such infections can be treated with operative drainage and local wound care.⁹ Studies have shown that surgical techniques, skin preparations and the timing and the method of the wound closure are the significant factors that can influence the incidence of the subsequent infections. An antibiotic prophylaxis has also had a positive impact after certain types of surgeries.¹⁰ Many other factors have been identified as having an effect on the potential for infection and healthcare professionals should consider these before, during and after surgeries. With this view the present study was undertaken to focus some light on etiology, and management of postoperative wound infection. Whether such a study can help us to devise the method to prevent or curtail the incidence of postoperative sepsis and there by recurrent drain in hospital finances was also studied.

METHODS

This descriptive study was designed to study the problem of postoperative wound infection at Tertiary health care center at rural set up over a period of two years during 2014 to 2016.

Inclusion criteria

- Planned surgery operated for various procedures included in study period.
- Those given consent in study.
- Operated cases with signs of systemic infection.
- Cases with frank wound infection post operatively such as pus, gaping, burst, etc.

Exclusion criteria

- Cases operated for minor procedures like excision sebaceous cyst, lipoma, etc.
- Emergency surgery (laparotomy, amputations, debridement, incision and drainage)

The evaluation of the patients included:

Preoperative phase

- Detail history
- Physical examination
- Laboratory and radiological investigation according to proforma
- Age
- Sex
- Socioeconomic status
- Nutrition

Intra operative phase

Initial assessment of intra operative findings divided these cases into clean, clean contaminated and contaminated cases.

Clean wound

- Elective, primarily closed and no drain used.
- Non-traumatic, uninfected.
- No acute inflammation encountered.
- No entrance of respiratory, alimentary, genitourinary or oropharyngeal tracts.
- No break in aseptic technique.

Clean-contaminated wound

Alimentary, respiratory or genitourinary tracts entered under controlled conditions and without unusual contamination.

- Appendectomy
- Oropharynx entered
- Genitourinary tract entered in absence of culture positive urine.
- Biliary tract entered in absence of infected bile.
- Minor break in sterile technique.
- Mechanical drainage.
- Reoperation through the incision within 7days.

Contaminated wound

- Open fresh traumatic wounds.
- Gross spillage from gastrointestinal tract,
- Entrance of genitourinary or biliary tracts in presence of infected urine or bile.
- Major break in sterile technique.
- Incisions in which acute non purulent inflammation is present.

Postoperative phase

- In the post operative period,
- the frequency of opening dressing,
- wound hematoma, seroma,

- the quantity and duration of drainage from drains,
- Gaping of wounds, pain, fever and subsequently the detailed assessment of the wound will be recorded such as Cellulitis, induration, Minor stich abscesses, localized pus collection, minor wound gaping wound draining pus and soaked dressing, septicemia and toxemia.
- Increase in hospital stay

Methods of sending culture swab

From bacteriology Department, the sterile test tubes with sterile swab stick were obtained. After wetting the cotton on the swab sticks with sterile normal saline they were rubbed against the material to be tested and put in the sterile test tube and taken for culture study immediately. In the laboratory, they were placed on culture media and incubated for 24 hours for bacterial colonization. After the growth was noticed the organisms were identified by Gram stain and other biochemical tests and colony characteristics. The colonies were placed on antibiotic sensitivity media for testing sensitivity pattern of specific organisms.

Antibiotics

Preoperative and postoperative antibiotics commonly used were combination of injection gentamicin, injection metronidazole, injection cefotaxime in therapeutic doses. The secondary antibiotics were used when infection resolution did not occur. They were selected according to the sensitivity pattern.

Measures to control postoperative SSI

Measures to control postoperative wound infections were applied by following principles of asepsis and antisepsis during and after surgery. This includes:

- Preoperative treatment of any infection or any other associated disease in that particular patient.
- Preoperative preparation of patient.
- Throughout surgical scrubbing of hands by doctors and nurses etc.
- Maintaining operation theatre environment clean, wearing gown, gloves and masks.
- Gentle and minimum handling of tissues.
- Intra operative antibiotic for major surgery.
- Ward care: proper dressing technique.
- Careful observation of wound for earlier detection of postoperative wound infection.

Follow up patients

The end point of the study was considered as the total time taken for complete healing of the wounds and discharge of the patients. Hospital stay of the patients depended upon the total time taken for healing and

coincided with the end point of healing and discharge in the entire patient.

RESULTS

Table 1 shows the length of pre-operative stay and occurrence of SSIs. It is clear from above table that as the length of pre-operative stay increased, the occurrence of SSIs increased. The occurrence rate was only 4.58% among those whose stay was one day. It increased to almost double i.e. 8.61% when the length of hospital stay was 1-7 days. The occurrence rate became 75% when the stay was for more than one week in the hospital.

Table 1: Pre-operative hospital stay and occurrence of SSIs.

Hospital stay	No. of cases n=1250	SSIs
1 day	698	32 (4.58%)
1-7 days	476	41 (8.61%)
>7 days	76	57 (75%)

Table 2 shows the length of post operative hospital stay and the occurrence of SSIs. Just like the duration of pre-operative stay, the post operative stay also affected the occurrence of SSIs. As the duration of post operative hospital stay increased, the occurrence of SSIs also increased. It was only 3.72% among those who stayed for less than two days. It increased to 10.92% among those who were in hospital for 3-5 days. It became 13.40% when the stay was 6-10 days. And it increased to 22.22% when the post operative stay was more than 10 days.

Table 2: Post-operative hospital stay and occurrence of SSIs.

Hospital stay	No. of cases	SSIs
<2 days	483	18 (3.72%)
3-5 days	302	33 (10.92%)
6-10 days	276	37 (13.40%)
>10 days	189	42 (22.22%)

Table 3: Occurrence of SSI as per the CDC criteria of classification of surgical wounds.

Classification	No. of cases	SSIs
Clean	776	52 (6.70%)
Clean-contaminated	314	27 (8.59%)
Contaminated	112	24 (21.42%)
Dirty	48	27 (56.25%)
Total	1250	130 (10.4%)

Table 3 shows occurrence of SSI depending upon the type of surgical wound. The occurrence of SSI increased as the quality of surgical wound deteriorated. It was lowest (6.7%) when the surgical wound was clean. It increased to 8.59% when the wound was clean and contaminated. In case of contaminated surgical wound it

became 21.42% and in case of dirty surgical wound it was found to be 56.25%.

Table 4: Duration of surgery and occurrence of SSIs.

Duration of surgery	No. of cases	SSIs
<1 hour	318	16 (5.03%)
1-2 hours	406	34 (8.37%)
>2 hours	526	80 (15.20%)

Table 4 shows association between duration of surgery and occurrence of SSIs. As the duration of surgery increased, the occurrence of SSIs increased. It was only 5.03% when the duration of surgery was less than an hour and it increased to 8.37% and 15.20% when the duration of surgery was 1-2 hours and more than two hours respectively.

Table 5: Order of surgery and occurrence of SSIs.

Order of surgery	No. of cases	SSIs
First	378	21 (8.57%)
Second	343	31 (9.03%)
Third	284	36 (9.52%)
>Third	245	42 (14.78%)

Table 5 shows the order of surgery and the occurrence of SSIs. It was found that the order of surgery was not related to occurrence of SSIs. The rates of SSIs were almost similar in all groups of order of surgery. It ranged from 8.57% among those who underwent surgery for the first time to 14.78% among those who underwent surgery for more than three times.

Table 6: Surgical site infection rate in relation to use of drain.

Duration of drainage	Drain used	Drain not used
Total surgeries, (n=1250)	218	1032
Cases infected, (n=130)	47	83
Cases not infected, (n=1120)	171	949
SSIs %	21.55	8.04

Table 7: Frequency of organisms causing SSIs.

Organism isolated	No.	Percentage
<i>Staphylococcus aureus</i>	43	33.07
<i>Escherichia coli</i>	18	13.84
<i>Pseudomonas aeruginosa</i>	31	23.84
<i>Klebsiella pneumonia</i>	19	14.61
<i>Proteus spp.</i>	5	3.84
<i>Citrobacter spp.</i>	2	1.53
<i>Acinetobacter spp.</i>	2	1.53
<i>Staphylococcus aureus + E. coli</i>	7	5.38
No growth	3	2.30

Table 6 shows the SSIs rate in relation to use of drain. It was found that the rate of SSI was more (21.55%) when the drain was used in comparison to only 8.04% when the drain was not used.

Table 7 shows the frequency of microorganisms causing SSIs. The most common organism found to cause SSIs was *Staphylococcus aureus* in 33.07% of cases followed by *Pseudomonas aeruginosa* in 23.84% of cases. *Klebsiella pneumonia* was found to be responsible in 14.61% of cases and this was followed by *Escherichia coli* in 13.84% of cases. *Staphylococcus aureus + E. coli* were found in 5.38% of cases.

DISCUSSION

Higher incidence of SSIs associated with a longer stay in the hospital reflected not only the severity of illness and co-morbid conditions but could also be due to increased colonization of patients with nosocomial strains existing in the hospital. This study also reported that mean post-operative stay in cases with post-operative infected wound was significantly higher (22.22% incidence rate in patients with more than 10 days post-operative stay) than in cases without post-operative infected wound i.e. post-operative stay is associated with infection in post-operated wound. Well comparable observations were made by other authors.^{11,12} Postoperative wound infection increases the length of stay in hospital was also observed by other authors like Michalopoulos A et al and Perl TM.^{11,13} Present findings were comparable to those of Umesh SK et al who found that the mean duration of postoperative stay in patients with SSI was 9 days.¹⁴

The present study shows that 20 (20.83%) of thyroidectomy cases had post-operative wound infection followed by laparoscopic appendectomy (17.77%), fistulectomy and other surgeries like fibro adenoma excision (16.66% each), but the difference distribution of proportion of these cases as per type of operation was not significant ($p>0.05$). In contrast to this many author¹¹ found that proportion of cases with postoperative infected wound depend upon the type of surgery.

Regarding the duration of the operation, a prolonged time is a significant risk factor for post-operative wound infections.¹⁵ In this study, a higher incidence of post-operative wound infections was observed when the duration of the operation was more than 120 minutes. So, present study reveals that post-operative wound infection rate was not associated with type of operation done but significantly higher in cases operated for long duration. Similar observations were made by some authors where more probability of post-operative wound infection in cases where duration of operation was more.¹³

An interesting observation was that the infection rate was significantly low when the patients were operated as the first case on a particular table. It was 8.57% for the patients who were operated as the first case; it was 9.03%

for the second case, 9.52% for the third case and 14.78% for more than third case. The findings of the present study, in this respect, was correlated with the findings of Ahmed M et al as this may be put down to some break in the sterility of the operation room or the instruments due to an increase in the number of micro flora of the OT environment due to the persistent movement of the OT staff and the surgical team, besides the fact that senior surgeons usually perform the first cases.¹⁶

The present study reflected increase in incidence of SSI with increased duration of drainage. 53.84% incidence of SSI observed in patients with more than 7 days drainage as compared to 17.56% in patients with drainage for 4-7 days. Umesh SK et al in their study also observed that patients with postoperative drains were 5.8 times more likely to develop SSIs compared to those without drains.¹⁴ This increased incidence of SSIs with increasing duration of postoperative drains is attributable to not only nature of operation necessitating the drainage but also the drain itself acting as portal of entry for infection.

The present study showed that maximum proportion of causative agent found in post-operative infected wound was *Staphylococcus aureus* (33.07%) followed with *Pseudomonas aeruginosa* (23.84%), *Klebsiella pneumoniae* (14.61%) and *E. coli* (13.84%). Suchitra and Lakshmidevi observed the most commonly isolated organism from SSIs as *Staphylococcus aureus* followed by *Enterococcus* and other bacteria.¹⁷ Most of the organisms located were multidrug resistant in this study, including methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus* (VRE) species. Isolation of multidrug resistant organisms underscores the need for an evidence-based antibiotic prescription policy that could promote a more rational use of antibiotics along with intensive infection control practices in the hospital.

CONCLUSION

Antimicrobial prophylaxis although effective in reducing the incidence of surgical site infection, should be used timely and cautiously to prevent resistance. Slightly low incidence of SSIs in our study may be attributed to the better infection control practices though it must be concluded that more stringent aseptic measures including rational antibiotic policy will be contributory in lowering the SSI rate further.

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