

ORIGINAL RESEARCH PAPER

A study on isolation and identification of bacterial agents responsible for postoperative wound infection

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ABSTRACT

Introduction: The term post operative wound infection, also known by the term surgical site infection (SSI) is as old as the beginning of surgery. The majority of post operative wound infection (SSI) become apparent within 30 days of an operative procedure and most often between 5th and 10th post operative days. **Materials and methods:** This was a hospital based observational, descriptive study carried out on 2685 SSI wound samples were included in the present study collected from General Surgery, Orthopedic, Obstetrics and Gynaecology Departments. **Results:** In the present study in the clean wound category with no obvious source of contamination, 65.8% of the cultured infected wounds were of monomicrobial etiology. The isolates when compared with the duration of surgery, it was found that with longer durations of surgery, the wound was infected with polymicrobial agents, The incidence of Klebsiella, E.coli and Pseudomonas increased with longer durations of surgery. This suggests that the organisms might be transferred to the wound by prolonged contact with the operating staff and equipment, as airborne spread of the Gram negative organisms is rare. **Conclusion:** The present study has enlightened the relationship between SSI, preoperative hospitalization and duration of surgery. There was increase in the incidence of infection, in patients with longer preoperative hospitalization and longer durations of surgery. There was an increase in poly-microbial etiological agents in these cases. Klebsiella was found to be the main etiological agent followed by E. coli, Pseudomonas, Coagulase negative staphylococci, etc.

Keyword: Surgical site infection (SSI); polymicrobial agents; cultures positive; cultures negative; coagulase positive; coagulase negative.

INTRODUCTION

The term post operative wound infection, also now by the term surgical site infection (SSI)¹ is as old as the beginning

of surgery. Survey on post operative wound infection (SSI) by different workers show that the incidence is still alarming which frightens both surgeons and patient.^{2, 3}

The majority of post operative wound infection (SSI) become apparent within 30 days of an operative procedure and most often between 5th and 10th post operative days. However, where a prosthetic implant is used, infection affecting the deeper tissues may occur several month after the operation.^{4,5,6} Altimeter stated that the principal organisms of SSI were staphylococcus (both coagulase positive and negative) Escherichia coli, proteous, klebsiella, pseudomonas, bacteroides, streptococcus and Clostridium perfringens. Since last 25 year,^{7,8,9} the incidence of wound infection due to gram negative organisms is increasing though, staphylococcal infection was more common earlier.¹⁰

The C.D.C. definition describes three level of post operative wound infection (SSI)

- Superficial incisional, affecting the skin and subcutaneous tissue.
- Deep incisional affecting the facial or muscle layers.
- Organ or space infection, which involves any part of the anatomy other than the incision that is opened or manipulated during the surgical procedure, for example joint or peritoneum.

This paper has aimed to isolate and identify the bacterial agents

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responsible for postoperative wound infection (SSI).

MATERIALS AND METHODS

A total of 2685 S.S.I. wound sample were included in the present study. It was carried out in the Department of, Microbiology, Gauhati Medical College and Hospital for a period of one year. The materials were obtained from patients in the General Surgery, Obstetrics & Gynaecology and Orthopaedic Departments of GMCH, who had undergone operations and had developed Signs and Symptoms of post-operative wound infections. Cases of Clean and Clean contaminated surgeries are included for the study, whereas procedures in which healthy skin was not incised such as opening of an abscess, burn injuries and donor sites of split skin grafts, contaminated and dirty surgeries are excluded from study samples.

Collection and transportation of material

The wounds were examined for suggestive Signs/Symptoms of infection in the post operative period, during wound dressing or when the dressings were soaked, until the patient was discharged from the hospital and also in the Out-patient department after discharge. All the specimens collected were transported immediately to the laboratory for further processing. The Nutrient broth and Robertson’s cooked meat broth (RCMB) were incubated at 37° C.

Methods: The samples collected were processed as follows

- a) Direct microscopic examination of gram stained smear. The smear was screened for pus cells, the gram reaction, morphology, arrangement and number of types of the organisms were noted.
- b) Inoculation of the samples onto different culture media for aerobic and anaerobic onto plates of MacConkey agar and 5% Sheep blood agar.
- c) Preliminary identification.
- d) Bio-chemical tests.

RESULTS

The following results were made from the study.

Table 1 Age and sex distribution of cases

Age Group (in Years)	Total No. of Cases Surgeries Performed	Male	Female
0-10	28	21	7
11-20	175	134	41
21-30	526	439	87
31-40	752	588	164
41-50	711	622	89
51-60	348	246	102
Above 60	93	74	19
Total	2685	2124	561

Table 1 Shows that maximum number of samples 752(28%) were 31-40 years, followed by 711(26.5%)- 50 years and 93(3.5%) samples were above the age of 70 years. Male and female ratio found to be 4:1.

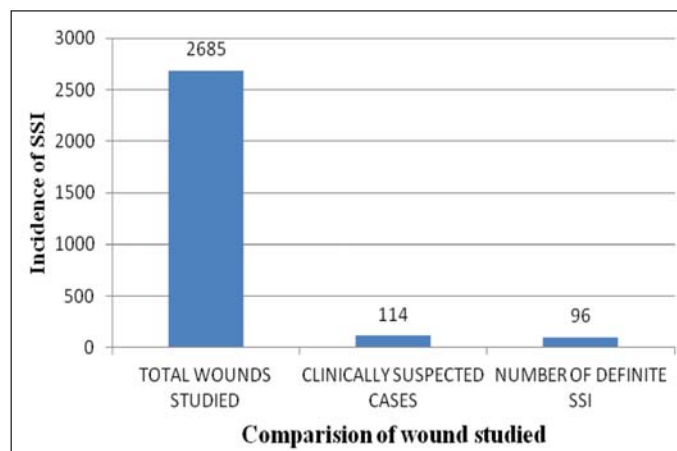


Figure 1 Incidence of SSI

Figure 1 depicts out of the 2685 cases with surgical wounds, 114 cases (4.2%) were suspected to be clinically infected. Amongst 114(4.2%) infected wounds, 96(3.6%) were found culture positive and were considered definite cases of surgical site infection.

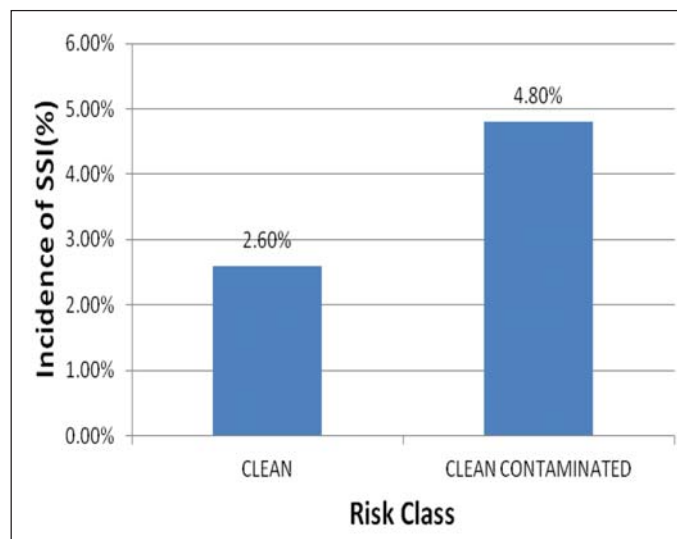


Figure 2 Comparison of incidence of SSI according to risk class

Figure 2 depicts out of the 1471 operations included in the clean wound category, 38 cases (2.6%) were infected. The incidence of wound infection was significantly high in the clean contaminated wounds, with 58 cases (4.8%) being infected in 1214 surgeries.

Table 2 shows, out of the 50 wounds clinically suspected to be infected and studied in the clean wound category, 38(76%) were culture positive. In the 64 clinically infected cases of the clean contaminated category, 58

cases (90.6%) were culture positive for various organisms. 18 samples (15.8%) of the 114 samples studied were cultures negative. Organisms in all the

positive cultures were identified as strict aerobe and facultative anaerobe where as none could be identified as strict anaerobe.

Table 2 Aerobic culture positivity in the wound studied

Risk class		Clinically Infected		Culture Positive		Culture Negative	
	No.	No.	%	No.	%	No.	%
Clean	1471	50	3.4	38	76	12	2.4
Clean Contaminated	1211	64	5.3	58	90.6	6	9.4
Total	2685	114	4.2	96	84.2	18	15.8

Table 3 Comparison of wounds and culture positive cases with pre-operative hospitalization

Pre-operative Hospitalization	Surgeries Performed		Culture Positive cases	
	No	%	No	%
Upto 1 day	1546	57.7	21	1.3
2 days to 1 week	683	25.4	43	6.2
More than 1 week	456	16.9	32	7.01

The above table (**Table 3**) shows, there is an appreciable increase of surgical site infection in patients with a longer pre-operative hospital stay. Among the 1546 patients (57.71%) who had a preoperative hospitalization of upto 1 day and the infection rate was 1.3%. The rate of infection showed an increase to 6.2% in the 683 patients (25.4%) hospitalized 2 to 7 days before surgery. The rate further increased to 7.01% in the 456(16.9%) patients admitted for more than 7 days prior to surgery.

Table 4 Comparison of wound and culture positive cases with duration of surgery

Duration of surgery (minutes)	Surgeries Performed		Culture Positive cases	
	No	%	No	%
0-60	1865	69.5	46	2.5
61-120	691	25.7	33	4.8
Above 121	130	4.8	17	13.07

The above table(**Table 4**) shows, the duration of surgery in majority of the cases was less than 1 hour. The infection rate showed a marked increase with longer duration of surgery. In 1865 cases which took less than 1 hour, 46 cases (2.5%) were infected. In 691 cases which took 1 hour to 2 hour, 33 cases (4.8%) were infected. Among the 30 cases which took more than 2 hours 17 cases (13.07%) were infected.

Table 5 Organisms isolated in 96 SSI

Organism	No.	%
Klebsiella species	35	22.3
Staphylococcus aureus	31	19.4
E.coli	24	15.3
Pseudomonas	20	12.7
Cons	18	11.5
Acinetobacter	07	4.5
Proteus species	07	4.5
Diphtheroids	05	3.2
Citrobacter	03	1.9
Enterococci	02	1.3
S.pyogenes	02	1.3
Candida	03	1.9
Total	157	—

DISCUSSION

One of the most known important factors influencing the incidence of post operative wound infections is wound contamination class. Among the Clean wounds, which accounted for more than half the number of cases, the rate of infection was only 2.6%. But in Clean contaminated cases, the rate of infection almost doubled to 4.8%. probably because of profound influence of endogenous contamination.

The present study confirms the understanding that there is a gradual rise in incidence of wound infection as age advances. The incidence showed a gradual rise from 2.5% in the 21-30 age group to 8.6% in patients more than 60 years. The finding is similar with study carried out by Cruse and Foord.^{4,11}

The surgical patient is colonized by microorganisms, during his stay in the hospital. Longer preoperative hospitalization is associated with wound infection. In present study, the incidence

was 1.3% in the patients hospitalized up to 1 day, 6.2% in patients hospitalized for 2 days to 1 week and 7.01 % in patients hospitalized for more than a week. It was consistent with study of Anvikar.¹²

In the present study, majority of the surgical procedures lasted for less than 1 hour and the infection rate among these cases was 2.5%. The rate roughly doubled to 4.8% when the duration of the procedure was 1 hour to 2 hours, and trebled to 13.07%, in procedures lasting for more than 2 hours. This finding is in consistent with study carried out by Cruse and Foord.¹¹

The increased incidence of infection may be due to contamination of the wound, by bacteria sedimented from exogenous sources over the duration of time. The length of incision is usually less, in surgeries which take a shorter duration, than in longer surgeries where the area exposed to the environment is more due to longer incisions and also a larger degree of damage to tissues and local disruption.

In the present study, on direct microscopy 84.2% samples yielded growth on culture and this finding was in consistent with study of Anvikar et al.¹²

There is a change in the bacterial etiology of surgical infections from time to time. A century ago, the most feared and frequent pathogen was *Streptococcus*, twenty years ago the Coagulase positive staphylococcus was the principal offender, Gram negative bacilli are now replacing staphylococcus.^{3,13,14}

The present study shows the emergence of Gram negative bacilli accounting for 61% of the isolates, as the principal offenders of surgical wound infection. In the present study anaerobic organisms were not isolated on culture, probably because the patients were treated with prophylactic and therapeutic antibiotics against anaerobes.

In the present study of 114 clinically suspected SSI, 96 yielded aerobic bacterial growth accounting for a total of 157 organisms. Mono-microbial isolates were encountered in 52(54.4%) of the wounds, 44 wounds (45.8%) yielded polymicrobial agents, Gram positive and Gram negative organisms were frequently involved in the mixed infections. *Staphylococcus aureus* and *E.Coli* were the commonest combination present in 7 cases (15.9%). Similar spectrum of organisms was observed by Giacometti, et al, who isolated 1060 bacterial strains from 614 individuals.¹¹

The clean wound category with no obvious source of contamination, 65.8% of the cultured infected wounds were of monomicrobial etiology. The isolates when compared with the duration of surgery, it was found that with longer durations of surgery, the wound was infected with polymicrobial agents, The incidence of *Klebsiella*, *E.coli* and *Pseudomonas* increased with longer durations of surgery. This suggests that the organisms might be transferred to the wound by prolonged contact with the operating staff and equipment, as airborne spread of the Gram negative organisms is rare.^{15,16}

CONCLUSION

The present that was conducted in Gauhati Medical College Hospital, Guwahati has enlighten the relationship between SSI, preoperative hospitalization and duration of surgery. There was increase in the incidence of infection, in patients with longer preoperative hospitalization and longer durations of surgery. There was an increase in poly-microbial etiological agents in these cases. *Klebsiella* was found to be the main etiological agent followed by *E Coli*, *Pseudomonas*, Coagulase negative staphylococci etc. It was observed that the gram negative bacilli were the main offenders in Clean contaminated operations, in patients with longer preoperative hospitalization and in surgeries with increased duration. Based on the above observations preventive and prophylactic measures can be enhance to lower down the incidence of post operative wound infection (SSI)

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