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General Surgery

CLINICO-BACTERIOLOGICAL STUDY OF POST OPERATIVE WOUND INFECTION WITH ANTIBIOTIC SENSITIVITY PATTERN IN TERTIARY CARE HOSPITAL IN NORTH INDIA

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ABSTRACT **Background:** Surgical site infections (SSI), one of the most common causes of nosocomial infections are a common complication associated with surgery, with a reported incidence rates of 2-20%. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality.

Aims : To study of post operative bacterial wound infection in surgery wards and culture sensitivity pattern

Objective : To determine the incidence of post operative wound infection in various wound class and their bacteriology pattern .

Settings and Design: Prospective Cross sectional study

Methods: All patient underwent emergency and elective surgery, excluding dirty wound class, was post operatively evaluated for surgical site infection involving superficial or deep incisional or organ space infection. Incidence rate in various type of surgery according to procedure, wound class was observed. Causative bacteria was aseptically obtained from wound and culture & antibiotic sensitivity pattern were carried in department of microbiology .

Results: In our study, 1230 patients underwent different surgical procedures of which 80(6.5%) patients developed surgical site infection. Surgical site infection was observed maximum (15.06%) with contaminated wounds. Gram negative bacteria were commonest isolates from patients with wound infection whereas Staphylococcus aureus is commonest bacteria which cause post operative wound infection.

Conclusions: Surgical site infection is a common surgical complication leading to greater morbidity and mortality. early diagnosis of SSI and knowledge of its bacteriological pattern can improve the outcomes and treatment cast of surgery.

KEYWORDS : Surgical Site Infections, Contaminated Wounds

INTRODUCTION

Post operative wound infection also known as surgical site infections (SSIs) are defined as infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site.

Surgical site infections (SSI), one of the most common causes of nosocomial infections are a common complication associated with surgery, with a reported incidence rates of 2-20%. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality.

Despite the technical advances in infection control and surgical practices, SSI still continue to be a major problem, even in hospitals with most modern facilities. These infections are usually caused by exogenous and/or endogenous micro organisms that enter the operative wound either during the surgery (primary infection) or after the surgery (secondary infection).

Primary infections are usually more serious, appearing within five to seven days of surgery .Majority of SSIs are uncomplicated involving only skin and subcutaneous tissue but sometimes can progress to necrotizing infections. The usual presentation of infected surgical wound can be characterized by pain, tenderness, warmth, erythema, swelling and pus formation.

The present study has been conducted to identify the spectrum of bacteria isolated from case of wound infection and to study the antibiotic sensitivity pattern of these isolates against commonly used antibiotics. Purpose of this study is also to evaluate the various responsible factors like wound class, procedure, Duration of surgery use of drain for post operative wound infection.

MATERIAL AND METHODS

The present crosssectional prospective study was conducted in the Department of general surgery at GSVM Medical College and LLR Hospital, Kanpur. The study period was from Jan 2020 to Sept 2021. Institutional ethics committee approval was obtained prior to the start of the study.

SELECTION OF STUDY SUBJECTS:

INCLUSION CRITERION :-

The study population included Patients of both sex, age > 12 years, who had surgical wound pus discharge, with serous or seropurulent discharge and with signs of sepsis present concurrently (warmth, erythema, induration, tenderness, pain, raised local temperature) occurring from 36 hours to 30 days after various emergency and elective surgeries conducted in surgery department of our hospital. We include only Clean surgeries (Class I operative wounds) Clean-contaminated surgeries (Class II operative wounds and Contaminated surgeries (Class III operative wounds)

EXCLUSION CRITERION:-

we exclude Dirty surgeries (Class IV operative wounds) and Immunocompromised patient .

The CDC identifies four surgical wound classification categories that are:

Clean	Uninfected operative wounds without inflammation; respiratory, alimentary, genital or uninfected urinary tracts are not entered
Clean/ Contaminated	Operative wounds in the respiratory, alimentary, genital or uninfected urinary tracts are electively entered; without unusual contamination
Contaminated	Open, fresh, accidental wounds, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered
Dirty	Old traumatic wounds with retained devitalized tissue or those that involve existing clinical infection or perforated viscera

- Certain risk factors like — class of surgical wound, elective or emergency surgery, duration of surgery, presence or absence of drain and any underlying or predisposing conditions were studied.
- Aseptically, collection was done using sterile cotton swabs, pus swabs/ wound swabs were from each patient suspected of having SSI.
- The swab was inoculated on 5% sheep blood agar (BA) and Mac Conkey agar (MA) plates and incubated at 37°C for 48 hours for screening of bacterial growth . Growth on culture plates was identified by its colony characters and the battery of standard biochemical tests (TSI, Urease, indore, catalase, oxidase, mannitol reduction, MR, VP).

- Antimicrobial sensitivity testing (AST) was carried out by modified Kirby Bauer disc diffusion method on Muller Hinton agar and results were interpreted in accordance with Clinical Laboratory Standards Institute guidelines.

OBSERVATION AND DISCUSSION

Table-1: Shows Rate Of Wound Infection As Per Procedure Done In Emergency Or Elective. (Excluding Type IV Wound Class Surgeries)

Emergency	67	405	16.54
Elective	13	825	1.57
Total	80	1230	6.5

In the present study, 1230 patients underwent different surgical procedures of which 80(6.5%) patients developed surgical site infection. This compares favourably with 7.4% wound infection reported by **Weisjelt JA** et al. (1987), 7.5% by I. **Onihe et al.** (2004) and 5.89% **Kimura K et al** (2007) in their respective studies. Similarly, **Lilani SP et al. (2005) and Young B** et al (2011) have reported a wound infection in 8.95% and 8.3% of patients in their respective study which is not much different from present study.

The present study has also shown that post operative wound infection was significantly more in patients operated in emergency (16.54%) as compared to patients operated in elective group where only 1.57% developed wound infection . The result points towards more contaminated nature of surgical procedure carried out in emergency which leads to higher rate of wound complications as compared to clean cases in elective procedures.

Sorenson LT et al. (2005) reported post operative wound infection in 16% of patients in emergency as compared to 6% patients in elective group which is similar to our study. **S.H. Waqar et al. (2005)** reported wound dehiscence in 12% of patients undergoing emergency surgery as compared to 4% in elective surgery. The main reason given by **Waqar et al.** (2005) for patient having higher rate of surgical site infection in emergency surgery were :

- Emergency surgery is usually performed for acute abdomen case most of which have been deteriorated due to course of acute illness as well as mismanagement by at least 3 to 4 intermediate persons.
- Second factor for this high incidence of wound infection especially in emergency surgery may be lack of proper sterilization in emergency set up.
- Third factor is lack of experience on part of surgeon. The emergency surgery is performed most of the times by surgical residents.

Table 2. Shows Rate Of Wound Infection According To Wound Class

Wound class	No. of patients with SSI	Total no of patients in group	%
Clean	08	633	1.26
Clean contaminated	14	212	6.60
Contaminated	58	385	15.06

In the present study, a direct relationship was observed between incidence of wound infection and wound class. Surgical site infection was observed in 1.26% of patients with clean wounds, 6.66% with clean contaminated wound, and 15.06% with contaminated wounds.

Brote L. (1976) reported that wound infection is a more common complication in contaminated operations as compared to clean operation. **Horan et al. (1999)** also reported wound infection in 2% of clean surgery, 10% of clean contaminated, and 15 to 20% of contaminated which are very much comparable to result of our study. **Inigo JJ et al.** (2001) reported wound dehiscence in 2.27% of clean and 11.40% of contaminated surgery . **Lilani SP et al. (2005)** reported wound infection in 3.03% of patients undergoing clean surgery as compared to 20% undergoing contaminated surgery which is not different from the present study. Similar to our study, **Le The Anh et al. (2006)** observed wound infection in 4.6% of clean procedures as compared to 14.34% in contaminated .

Table 3. Shows Rate Of Wound Infection According To Duration Of Operative Procedure

Time	Patients with SSI	Total no. of patients	%
≤ 1 hr	06	520	1.15
≥ 1hr < 2hr	14	225	6.22
≥ 2hr < 3hr	28	280	10.00
≥ 3 hr	32	105	30.47

In the present study, a direct relationship was observed between duration of operation and wound infection . The incidence of surgical site infection was least 1.15% in procedures lasting less than one hour and only 6.62% in procedures lasting 1 to 2 hours. However, significant increases in incidence of wound infection (10.00%) was noted when operative procedure lasted for 2 to 3 hours and 30.47% in procedure lasting more than 3 hours.

John A Weisjelt (1987) has reported wound infection in 4.7% and 8.8% of patients for procedure lasting less than 2 and 2 to 4 hours respectively. However for procedure lasting more than 4 hours it was present in 16%. Hence a direct relationship was shown between operative duration and wound infection by them also. **Razani et al. (2005)** reported wound infection in 5.4% patients for procedures lasting less than 1.5 hours and 19.5% for procedures lasting 1.5 to 4 hours,which was very similar to our study.

Keith S Kaye et al. (2005) reported wound dehiscence in 43.6% of patients with operative duration greater than 75th percentile of standard operative duration while only 26% of the patients developed wound infection where operative duration was less than 75th percentile of standard operative duration

Table 4 : Rate Of Wound Infection In Accordance With The Drain Use

	Total No. of patients	Patients with SSI	%
Operations in which drain was used	810	74	9.13%
Operations in which drain was not used	420	06	1.42%

In the present study procedures in which drain was used postoperatively, were more commonly associated with wound infection (9.13%) as compared to procedures in which drain was not used (1.42%). **Cruse and Foord (1973)** reported wound infection in 15% procedures where drain was used as compared to 2% where drain was not used, which is not different from our study. **Phillip Barrie (2005)** has pointed out that drain used after surgical procedure becomes a conduit for invasion of wound by pathogens colonizing the skin.

However, **Lilani SP et al. (2005)** reported 22.41% surgical site infection in procedures where drain was used as compared to 3.03% procedures where drain was not used. Hence, a direct relationship was shown by them also.

Bacteriology

In the present study, 8 different species of bacteria were isolated from post operative wound infection. In emergency, where exploratory laparotomy was the most common operation performed for peritonitis, gram negative bacteria were more common isolates (48 out of 67) with gram positive to gram negative ratio being 1:2.52. In the elective group of patients gram positive bacteria were more common isolate (8 out of 13) than gram negative with the ratio of 1.6:1.

Brote L (1976) has reported that gram negative bacteria dominate in isolates from infected wounds after contaminated operation, while Staphylococcus aureus is the most common bacteria in wound infection after clean surgery which is similar to our study.

Table-5: Shows Pattern Of Bacteria Isolated In Accordance With Wound Class.

Bacterial isolated	Total no. of isolates	Clean	Clean contaminated	Contaminated
Staph. Aureus	27 (33.75%)	5	7	15
E. coli	25(31.25%)	-	1	24
Klebsiella	16(20.00%)	-	1	15
Pseudomonas	07(8.75%)	3	4	-
Citrobacter	02(2.5%)	-	-	2
Proteus	01(1.25%)	-	1	-
Enterobacter	01(1.25%)	-	-	1
Acinetobacter	01(1.25%)	-	-	1

Wallace et al. (2000) in a retrospective study to review changing bacteriological profile have stated that gram positive organism were the most common organisms isolated in 1960s, this was followed by methicillin resistant Staphylococcus in 1970 to 80s and currently resistant gram negative bacteria are the most common isolates. **Brook**

I et al. (2002) reported that enteric gram negative rods, Group D *enterococcus* and *bacteroides* predominate in wound related to gut flora while gram positive bacteria predominated most of the other wounds.

Lopiso D et al (2013) reported that *S. aureus* was the most frequent isolates (37.3%); followed by *E. coli* (25.4%), *Klebsiella* species *(13.6%)*, *Proteus* (10.2%), *P. aeruginosa* (10.2%).

In the present study, *Staphylococcus aureu*s was identified as the most common single bacteria isolated in 33.75(27.7%). Other studies carried out by **Murthy (1998), Erikson (2003), Arya (2005) and Gamal (2008)** have also identified *Staphylococcus aureus* as the most common single species isolated from post operative wound infection which is very much comparable to our study.

Study	Most common bacteria isolated	Percentage
Murthy et al. (1998)	*Staphylococcus aureus*	32%
Erikson et al. (2003)	*Staphylococcus aureus*	20%
Arya et al (2005)	*Staphylococcus aureus*	32%
Gamal Syed et al. (2008)	*Staphylococcus aureus*	23.8%
Lopiso D et al (2013)	*Staphylococcus aureus*	37.3%
Present Study	*Staphylococcus aureus*	33.75%

Antibiotics sensitivity pattern :-

In the present study, sensitivity of *Staphylococcus aureus* to different antibiotic was tested by Disk Diffusion method.most common sensitivity was seen with Linezolid and was 88.88% sensitive which matches the study of **Biswajit B et al (2012).** Linezolid is Food and Drug Association (USA) approved for the treatment of infection caused by methicillin resistant strain of Staphylococcus aureus . In our present series, bacterial resistance rate was very high to Ceftriaxone ,Ofloxacin ,Ceftazidime and Amikacin with sensitive only in 20% cases which matches very closely to studies by **Mahmood et al. (2003) and Gamal Syed (2008).**

In the present study *E. coli* strains were largely sensitive to Colistin followed by Meropenem, Piperacillin tazobactum and Cefoperazone sulbactum . Amikacin was resistant in 45.5% cases and most of the strains were resistant to quinolone. Similar to our series **Gamal Syed (2008**) reported highest rate of resistance of E.coli with quinolones followed by IIIrd generation cephalosporins (52%) while no resistance was recorded to Meropenem. **Le The Anh** (2006) reported that E. coli strain were 100% sensitive to Meropenem while high level of resistance was seen with Quinolones which is very much similar to our study.

In the present study, maximum sensitivity for *Pseudomonas* strain was noted with Colistine(100%) and meropenem (85.75%) followed by Ceftazidime and Cefoperazone sulbactum in 71.42% isolates each.High rate of resistance was found with Ceftriaxone ,Cefuroxime ,Ofloxacin And Azithromycin with sensitivity of only below 30% of isolates . **Yaman A Tasoua Y et al (2010)** reported that Meropenem was most effective antibiotic against gram –ve organisms (89%) followed by Imipenem (87.2%) and piperacillin tazobactum (66.6%) cases which is very similar to our study. **Gamal Syed (2008**) reported very high rate of resistance with ceftriaxone, ofloxacin and ciprofloxacin as in our study.

In the present study Colistine (93.7%) and Meropenem(87.5%) were sensitive to most of stains of *Klebsiella* and Piperacillin tazobactum , Cefoperazone sulbactum and ceftazidime were sensitive in 75% cases while very high resistance rate was noted with Ceftriaxone, Azithromycin, Ofloxacin And Cefuroxime. **Gamal Syed (2008)** also reported high rate of resistance to IIIrd generation cephalosporins (52%) and lowest with Meropenem similar to our study.

CONCLUSION

- Surgical site infection is a common surgical complication occurring in about 6.5% of all surgical procedures.
- Contaminated wounds were associated with higher incidence of wound infection.
- Increase in duration of operative procedure is directly related to increase in incidence of wound infection .
- Use of drains is associated with increased incidence of surgical site infection .
- Gram negative bacteria were commonest isolates from patients with wound infection whereas Staphylococcus aureus is commonest single bacteria causing post operative wound infection.

Following measures can be taken to reduce the SSI cases in our hospital:

1. Prolonged duration of surgery contributes as a risk factor for SSI, thus minimising the intra op time can help a lot.
2. Proper drain care can significantly bring down the SSI cases.
3. Time to time fumigation of operation theatres and emphasis on sterile dresssing techiques can also reduce the number of SSI cases.

early diagnosis of SSI and knowledge of its bacteriological pattern can improve the outcomes and treatment cast of surgery.

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