

**Original article**

## **Factors affecting the incidence of Post Operative Wound Infection in Open Surgical Procedures: A Clinical Review**

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**Abstract:**

Post operative wound infection is a frequent cause of morbidity and mortality in surgical patients. The economical, physical and psychological impact of postoperative wound infection mandates the use of preventive methods to decrease the incidence of such complication. The present study was carried out to find out the incidence of post operative wound infection & to evaluate the factors responsible for wound infection. In this study, total 1540 cases were included which were grouped in 3 categories like clean, clean contaminated and contaminated cases. Different antibiotics were given in 18 different groups. Patients were observed till discharge from the hospital. In this study, we found that the incidence of wound infection was more in old patients, patients undergoing longer duration of surgeries, having more degree of contamination, having intraoperative focus of infection & in emergency operations. The incidence of infection was more or less same in both sexes.

**Keywords:** Post operative wound infection, Contamination, Surgical procedures

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**INTRODUCTION**

Since the beginning of medicine, surgeons have made major and continuous efforts to eliminate sepsis and these strivings for a zero postoperative bacterial complication rate continue today. Postoperative wound infection is still a major limiting factor in surgery, inspite of a considerable progress in both prevention and treatment of infection.

Postoperative wound infection is a frequent cause of morbidity and mortality in surgical patients. The economical, physical and psychological impact of postoperative wound infection mandates the use of preventive methods to decrease the incidence of such

complication. In abdominal surgery in emergency operations, contamination remains the main problem in association with other factors responsible for wound infection all over the world. With modern sterile techniques, bacterial contamination of surgical wounds can be reduced to a very small amount. These small number of bacteria gaining entrance to the wound will be immediately eliminated by the patient's natural antibacterial mechanisms which have been brought to normal function by repair or replacement and supplemented by externally delivered antibacterials such as antibiotics.

The present study was carried out to find out the incidence of wound infection, to evaluate the various factors responsible for wound infection, especially in the present operation theatre conditions & to study the bacteriology of surgical wound infection and its treatment by therapeutic agents.

#### **AIMS & OBJECTIVES**

1. To find out the incidence of post operative wound infection in open surgical cases.
2. To evaluate the factors responsible for wound infection, especially in the present operation theatre conditions.
3. To study the bacteriology of surgical wound infection and treatment by therapeutic agent.

#### **MATERIALS & METHODS**

This study was carried out in a two year period at Government Medical College. Out of the total operations carried out in the department of surgery, only 1540 cases were included in this study, which were clean, clean contaminated and contaminated cases. The study was carried out after the prior permission from the institution's local ethical committee. All the patients agreed to take part in the present study. Patients from all age groups and of both sexes were studied. Blood investigations including hemogram, liver function tests, kidney function tests, blood sugar level, serum proteins and urine examination were done. Patients were observed till discharge from the hospital. According to the National Research Council wound classification criteria, the cases were classified as clean, clean-contaminated & contaminated cases. Wound was said to be infected when there was pus discharge,

minor wound gape and major wound gape with infection. Pus swab was sent for culture and sensitivity from every infected wound. Operative area was cleaned with providone iodine scrub, providone iodine solution and spirit. Bowel preparation was done according to standard methods in elective bowel surgeries. Except in clean abdominal operations peritoneal lavage was given with providone iodine diluted with normal saline. Before closure of wound, all wounds were irrigated with providone iodine solution. The different antibiotics used were ampicillin, cefotaxime, ciprofloxacin, cotrimoxazole, amoxicillin + clavulanic acid, cefoperazone, cefixime, gentamicin, amikacin, tetracycline and metronidazole. Ampicillin, cefotaxime, ciprofloxacin and cefoperazone were used singly or in combination with metronidazole and/or getamicin or amikacin. Other antibiotics were added according to culture sensitivity of pus after the development of wound infection. Intraoperative antibiotics were used where operations lasted for more than 2 hours. In clean cases, 10 patients received no antibiotics at all. Different antibiotics were given in 18 different groups. In clean and clean-contaminated (1033) cases, prophylactic antibiotics were used in 8 different groups & in clean-contaminated and contaminated (497) cases, empirical antibiotic therapy was used in 10 different groups. In all infected cases, the antibiotic therapy was continued for 3 days, 7 days and more than 7 days according to culture sensitivity of organisms till the infection was subsided.

**RESULTS**

Following observations were made from study.

**Table I :- Clean surgery without antibiotics and incidence of wound infection.**

Antibiotics	Cases	Cases infected	Percentage
No antibiotics	10	Nil	Nil

The above observation table shows that the infection rate was nil in clean cases where patients received no antibiotics at all.

**Table II :- Prophylactic antibiotics and incidence of wound infection in clean and clean-contaminated surgery:**

Antibiotics	Cases	Cases infected	Percentage
Prophylactic	1033	71	6.87

The above observation table shows that in clean and clean contaminated surgery where prophylactic antibiotics were used, the infection rate was 6.87%.

**Table III :- Empirical antibiotics and incidence of wound infection in clean-contaminated and contaminated surgery :**

Antibiotics	Cases	Cases infected	Percentage
Empirical	497	174	35.01

The above observation table shows that in clean-contaminated and contaminated surgery where empirical antibiotics were used, the infection rate was 35.01% .

**Table IV :- Overall incidence of wound infection in open surgical procedures :**

Total cases	Cases infected	Percentage
1540	245	15.90

The above observation table shows that the overall infection rate in this study of 1540 open surgical procedures was 15.90%.

**Table V :- Incidence of wound infection in relation with age of patient**

Age (Years)	Cases	Cases infected	Percentage
< 10	192	8	04.16
11-20	213	27	12.67
21-30	291	31	10.65
31-40	359	39	10.86
41-50	223	23	10.31
51 & above	262	117	44.65

It is observed from above table that the infection rate was more i.e. (44.65%) in patients more than 50 years of age and (4.16%) i.e. less in the younger age group (less than 10 years of age).

**Table VI :- Incidence of wound infection in relation with sex of patient**

Sex	Cases	Cases Infected	Percentage
Male	1050	176	16.76
Female	490	69	14.08

Above table reveals that the infection rate in male patients was 16.76% and in female patients was 14.08% i.e. more or less same.

**Table VII :- Emergency / plan operations and wound infection**

Operation	Cases	Cases Infected	Percentage
Plan	1048	86	8.20
Emergency	492	159	32.31

Above table shows that the infection rate was more in emergency operations i.e. 32.31% than that of plan operations i.e. 8.20%.

**Table VIII :- Incidence of wound infection and duration of surgery in emergency and plan cases :**

Duration of surgery (Min)	No. of emergency cases	No. of cases infected	Percentage	No. of plan cases	No. of cases infected	Percentage
Upto 60	322	96	29.81	583	44	07.54
61-90	144	50	34.72	416	27	06.49
91-120	14	5	35.71	25	7	28.00
121 & above	12	8	66.66	24	8	33.33
<b>Total</b>	<b>492</b>	<b>159</b>	<b>32.31</b>	<b>1048</b>	<b>86</b>	<b>08.20</b>

The above observation table shows that the infection rate was more in operations which last for more than two hours i.e. 66.66% in emergency operations and 33.33% in plan operations than the operations which last for less than two hours.

**Table IX :- Site of operation and incidence of wound infection :**

Site of operation	Cases	Cases Infected	Percentage
Abdomen	553	166	30.01
Anterior neck	58	6	10.34
Breast	130	18	13.84
Inguinal region	375	11	02.93
Scrotal region	52	7	13.46
Suprapubic region	131	13	09.92
Lumbar region	53	3	05.66
Other	188	21	11.17

Above table shows that the infection rate was maximum in 166 cases (30.01%) undergoing operations involving the abdomen.

**Table X :- Infection rate and amount of contamination**

Operation	Cases	Cases infected	Percentage
Clean	783	59	7.53
Clean-contaminated	590	90	15.25
Contaminated	167	96	57.48
Total	1540	245	15.90

Above table shows that the infection rate was maximum i.e. 57.48% in contaminated operations and minimum i.e. 7.53% in clean operations.

**Table XI :- Intraoperative focus of infection and incidence of wound infection**

Intraoperative focus of infection	Cases	No. of cases infected	Percentage
Present	207	114	55.07
Absent	1333	131	09.82

The above table shows that the infection rate was more (55.07%) in patients having presence of intraoperative focus of infection and less (9.82%) where there was no intraoperative focus of infection.

**Table XII :- Micro-organisms isolated in relation with wound class**

Micro-organism	Clean		Clean-contaminated		Contaminated	
	Cases	Percentage	Cases	Percentage	Cases	Percentage
<i>Staph. aureus</i>	40	67.79	33	36.66	40	41.66
<i>E. coli</i>	1	1.69	7	7.77	3	3.12

<i>Pseudomonas</i>	5	8.47	8	8.88	6	6.25
<i>Klebsiella</i>	1	1.69	4	4.44	2	2.08
<i>Proteus</i>	1	1.69	0	0	0	0
Mixed type of infection	1	1.69	22	24.44	27	28.12
Sterile	10	16.94	16	17.77	18	18.75

Above table shows that in all types of wounds, the commonest causative organisms found were *Staphylococcus aureus* and mixed type of infection, followed by *Pseudomonas*, *E. coli* and *Klebsiella*.

## DISCUSSION

In this study the overall infection rate in clean, clean-contaminated and contaminated operations was 15.90%. In clean and clean-contaminated operations, prophylactic antibiotics were used in 1033 cases in 8 different groups. Out of 1033 cases, 71 cases infected and the infection rate was 6.87%. Infection rate was more or less equal in all groups. In clean-contaminated and contaminated operations, empirical antibiotics were given in 497 cases in 10 different groups. Out of 497 cases, 174 cases were infected and infection rate was 35.01%. Sheridan RL *et al.* [1] in their study of patients undergoing clean breast cancer and hernia surgery found that patients treated with prophylactic antibiotics had 48 % fewer infections than those that did not receive prophylactic antibiotics. In the present study, the infection rate was 7.53% in clean cases, 15.25% in clean-contaminated cases & 57.48% in contaminated cases. Altemeier WA *et al* [2] reported overall wound infection rate of 7.41% and 9.4% in clean wounds, 13.9% in clean-contaminated and 20.4% in contaminated wounds. Garibaldi RA *et al* [3] reported the wound infection rate of 2% in clean wounds, 8% in clean- contaminated and 28% in contaminated operations. In the present study 10 clean cases were carried out without antibiotics

where the infection rate was nil. Johnstone *et al* [4] observed that there was no infection in 5 patients not given antibiotics in the study of prophylactic antibiotics. Anderson B *et al* [5] and Grottrup F *et al.* [6] observed that in placebo controlled trials, in the “no antibiotic” group wound infection rates range from 4% to 9% for simple appendicitis. Incidence of wound infection is more in old age group because of decreased immunity at older age. Old age is also associated with diabetes mellitus, obesity, vascular diseases etc. In this study, the infection rate was maximum in old age group i.e. 44.65% and minimum in younger age group i.e. 4.16%. The same observations were made by Agarwal P.K. *et al* [7]. In present study the infection rate in male patients was 16.76% and in female patients it was 14.08% i.e. more or less same which was also observed by Agarwal P.K. *et al* [7]. Several studies have shown that emergency operations are prone to wound infection because of the environmental factors and the cases are already infected. In the present study, the infection rate was more in emergency operations i.e. 32.31% than in plan operations i.e. 8.20%. Agarwal P.K. *et al* [7] & Gil-Eger MJ *et al* [8] also observed that the infection rate was more in emergency operations. The length of an operation is directly related to its complexity, long operation can

also be assumed to be associated with a larger wound, a greater amount of tissue injury and exposure to extrinsic bacterial factors. In present study, in emergency cases, the infection rate was 66.66% in operations which last for more than 120 min & in elective cases, the infection rate was 33.33% in operations which last for more than 120 min. In the present study the wound infection rate was directly related with the prolonged operation time which was also observed by Cruse PJE et al [9], Subramanian KA et al [10] and Rao and Harsha et al. [11] In the present study the site of operation having highest infection rate was abdomen, which was also observed by Dineen P et al.[12] Wound infection develops when there occurs unavoidable contamination of wound by micro-organisms. Thereafter there occurs invasive growth of these contaminants. Bacteria can gain entrance to the wound from endogenous or exogenous sources. Virtually all infections in clean-contaminated and contaminated wounds and also in the majority of clean wounds are caused by endogenous bacteria present on the skin or mucosal surfaces. In this study the infection rate was more in operations having presence of intraoperative focus of infection i.e. 55.07%. In the present study, the commonest organism isolated was *Staphylococcus aureus* followed by mixed type of infection, *Pseudomonas*, *E. coli* and *Klebsiella*. Agarwal SL et al [13] observed that *Staphylococci* were the most common causative organisms for postoperative wound infection. Platt R et al [14] in his study of single dose

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cefonicid versus placebo in patients undergoing breast surgery observed that *Staphylococcus aureus* was the principle pathogen, accounting for 78% of the isolates. Pandey M et al [15] in their study found that *Staphylococcus aureus* and *E. coli* were the two most common isolates.

## CONCLUSION

In the present study 10 clean cases were carried out without antibiotics where the infection rate was nil & the overall infection rate was 15.90%. The infection rate was directly associated with the amount of contamination; the infection rate being more in contaminated operations i.e. 57.48% and least in clean operations i.e. 7.53%. The infection rate was more or less same in both sexes. The incidence of wound infection was more in old patients, patients undergoing longer duration of surgeries, having more degree of contamination, having intraoperative focus of infection & in emergency operations. The infection rate was maximum in patients where the site of operation was abdomen . The commonest organisms isolated were *Staphylococcus aureus* (46.12%) and mixed type of organisms (20.40%) followed by *Pseudomonas* (7.75%), *E. coli* (4.48%) and *Klebsiella* (2.85%).

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