

Prevention of Post-operative Wound Infection and Sepsis in Abdominal Surgery

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Abstract

Background and Objectives: Wound infection in abdominal surgery is a common surgical complication that an abdominal surgeon comes across in his day to day career. Even today in the modern antibiotic era, the incidence of wound infection has not significantly come down. Here is an attempt to made to enlighten the various causes of wound infection in each abdominal procedures, the skill full ways of preventive measures to eradicate them, the bacteriology, pathophysiology, and epidemiology are reviewed and preventive aspects discussed in detail.

Materials and Methods: Out of 2000 cases operated for abdominal problems, we have taken 350 patients in a randomized fashion for study. Factors were tabulated and statistically analyzed to study their contribution.

Results: In our study, the overall wound infection rate was 12.5%. Emergency cases had more infection than elective. Infection rate was higher if the age is >60 years. The wound infection rate is high up to 30% with the patient who stayed more than 1 month. Increased infection rate seen in skin preparation done more than 6 h before surgery.

Conclusion: Prevention of wound infection and sepsis in abdominal surgery shortens the hospital stay, minimize the expenditure, and avoids the morbidity and mortality. It is a joint responsibility of the surgical team paramedical staff, patient, and also the bacteriologists.

Key words: Antibiotic prophylaxis and skin preparation, Emergency and elective surgeries, Sepsis

INTRODUCTION

The biological state of human being is not a germ-free environment.¹ It is a symbiotic relationship between the host defense mechanism and its microbial flora. If any alteration occurs, infection will be the end result. Even today in the modern antibiotic era, the incidence of wound infection has not significantly come down.² Tracing the history of wound infection in abdominal procedures, we can see retrospectively that certain fundamental requirement to be fulfilled first for better understanding and prevention. First, all the normal biological flora of the abdomen is to be understood. Second, the source of sepsis

is to be identified, and third, the preventive measures at every step - Pre-, intra-, and post-operative periods have to be carried out strictly.

After world war, it has been understood that despite antiseptic techniques, wound become infected either by initial contamination or cross infection.^{1,2} Then, came the beginning of antibiotic era. The greatest advance in abdominal bacteriology in the last decade has been the realization of anaerobic organisms as a cause of sepsis.

MATERIALS AND METHODS

Out of 2000 cases operated for abdominal problems, we have taken 350 patients in a randomized fashion for study. Factors were tabulated and statistically analyzed to study their contribution. The following data were included in the study:

1. Age/sex
 - Date of admission
 - Date of surgery.

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2. Diagnosis - Procedure done
 - Duration of procedure
 - Post-operative study
 - Suture removal/presence of post-operative infection
 - Wound culture sensitivity.

RESULTS AND OBSERVATIONS

In spite of the strict aseptic precautions, antibiotic prophylaxis, and meticulous surgical techniques, prevention of wound infection is still a problem to the surgeon. In our study of 350 patients including 200 elective and 150 emergency cases, we met with an overall infection rate of 12.5%.

Referring to Table 1, we had more number of infected patients in an emergency (25) rather than elective (18). This may be attributed to inadequate preparation of the patient, inadequate antibiotics, failure in aseptic precautions, and more complications in emergency cases.

Referring to Table 2, even though the number of wound infection were relatively more among the male sex compared to female, there is no significant influence of sex among the incidence of wound infection rate.

Table 1: Comparison for elective and emergency

Abdominal surgical procedure	Total cases	Number of cases infected	Percentage
Overall procedures	350	43	12.29
Elective	200	18	9
Emergency	150	25	16.67

Table 2: Number of infected cases in female and male

Sex	Total cases	Number of cases infected	Percentage
Male			
Elective	150	11	7.33
Emergency	110	22	20
Female			
Elective	50	7	14
Emergency	40	3	7.5

Table 3: Infection rate in different age groups

Age in years	Total number of cases			Number of cases infected			Percentage		
	Elective	Emergency	Total	Elective	Emergency	Total	Elective	Emergency	Total
21-30	52	49	101	2	7	9	3.85	14.29	8.91
31-40	45	27	72	3	6	9	6.67	22.22	12.5
41-50	43	14	57	5	3	8	11.63	21.43	14.04
51-60	27	10	37	1	1	2	3.70	10.00	5.41
61-70	9	4	13	1	2	3	11.11	50.00	23.08

Regarding the influence of age on wound infection, higher infection seen after the 6th decade, which may be due to low immunological and nutritional status of the patient.³ Intact those infected cases were from the emergency group because of the associated medical illness and lack of pre-operative workup. However, no infected cases in elective group due to adequate pre-operative workup, antibiotic prophylaxis (Table 3).

One of the most common sources of wound infection is acquired through a hospital stay from multiple antibiotic resistant strains such as *Staphylococcus aureus* and *Pseudomonas* in patients own site (Table 4).

Regarding the influence of pre-operative stay in hospital, the wound infection rate is high up to 30% with the stay more than 1-month duration. This proves that reducing the number of days of stay will definitely reduce the infection rate.

Prolonged surgical time increases the incidence of wound infection rate, especially wound dehiscence or burst abdomen.⁴ In our study, we met with an infection rate of 27% in 15 surgeries lasting for more than 2 h when compared with the group of <2 h. We also found that there is little increase in the infection rate in <1 h group also about 21%. This can be attributed to the inadequate skin preparation, improper hemostasis, peritoneal lavage, proper drainage, and rough surgical techniques. So, these results tell us that the surgeon should take adequate time for preparation, perfect hemostasis, debridement, drainage, gentle handling of tissues, strict aseptic precautions, and laparoscopic procedures will minimize the operation time (Table 5).⁵

In abdominal surgeries, the main source of infection is from endogenous contamination both aerobic and anaerobic organisms in one study; the sensitivity of pus showed mainly *Klebsiella*, *Escherichia coli*, and *S. aureus* is the most common multiple organisms seen in 5 cases.⁵ We have done cultures of peritoneal fluid in 12 cases. *E. coli* growth seen in two cases no growth in 5 cases. Multiple organisms seen in 5 cases (Table 6).

Table 7 depicts the influence of the type of surgical procedures on infection rates.⁶ Our study proved that

infection rate is more in bowel perforation, appendicectomy, and colorectal surgeries. More infection rate is seen in infected and contaminated dirty wounds. Wound infection rate in relation to the surgical team shows a relatively low incidence (7%) among the group operated by the senior

Table 4: Number of days in preoperative stay in the hospital

Pre-operative stay in hospital (days)	Total cases	Number of cases infected	Percentage
0*	110	20	18.18
0-7	120	8	6.67
8-14	54	6	11.11
15-21	22	2	9.09
22-30	13	4	30.77

*All acute emergencies

Table 5: Infection rate in relation to time of surgery

Duration of surgery	Total cases	Number of cases infected	Percentage
Up to 30 min	44	6	13.64
30 min-1 h	116	24	20.69
1-2 h	98	16	16.33
>2 h	15	4	26.67

Table 6: Types of infection and antibiotic sensitivity

Organisms	Number of cases (%)	Antibiotics—highly sensitive					
		Amoxicillin	Ampicillin	GM	Ciprofloxacin	Norfolk	Cephalexin
<i>S. aureus</i>	5 (10.4)		+	+	+	+	
<i>E. coli</i>	14 (29.2)	+		+	+	+	+
<i>Proteus</i>	5 (10.4)	+			+		
<i>Klebsiella</i>	15 (31.3)	+		+	+		+
<i>Pseudomonas</i>	8 (16.7)	+					+
Peptococci	1 (2.1)						+
Multiple organism	5 (10.4)						+
No growth	3 (6.3)						

GM: Gentamicin, *S. aureus*: *Staphylococcus aureus*, *E. coli*: *Escherichia coli*

Table 7: Infected case versus different surgical procedure

Surgical procedure done	Total cases	Number of cases infected (%)
Elective		
Gastric	15	2 (13.33)
Small bowel	3	1 (33.33)
Colorectal	5	2 (40.00)
Appendicectomy	40	6 (15.00)
Biliary	5	2 (40.00)
Inguinal hernia repair	110	6 (5.45)
Incisional hernia repair	17	3 (17.65)
Lumbar sympathectomy	5	0 (0)
Emergency		
Appendicectomy	64	10 (15.63)
DU perforation	40	12 (30.00)
Ileal perforation	5	3 (60.00)
Strangulated hernia	20	2 (10.00)
Acute int. obstruction	9	4 (44.44)
Abdominal trauma	10	2 (20.00)

DU: Duodenal

personnel. Because of his/her vast experience, skilled techniques, and strict aseptic precautions were achieved during surgery.

Regarding hair removal on skin preparation of the patient, we had less infection rate when shaving was done within ½ h before surgery (emergency - 10%, elective - 5%). We had no infection rate when there was sparse hair. Increased incidence of infection in shaving patients more than 6 h before surgery (Table 8).

Antibiotic prophylaxis is one of the mainstays in the prevention of wound infection.⁷ In one study of short-term pre-operative preparation using ampicillin or cefotaxime + metronidazole showed an infection rate of 12%, but the infection rate is comparatively high about 22% seen in antibiotics used postoperatively. This indicates that perioperative parenteral antibiotics maintain a better therapeutic levels during surgery (Table 9).

The wound infection in contaminated cases is mainly a subcutaneous problem. Various techniques have been employed to minimize the severity of contamination to minimize the infection rate.^{5,6} We have employed primary

closure with closed suction drain and outcome of results were encouraging when compared to primary closure without drain where the infection rate is high. The drains were brought out through the separate stab wound away from the main site. Drains were removed 2-5 days later depending on the nature of surgery (Table 10).

Table 8: Infection rate versus surgical skill

Surgeon	Total cases	Number of cases infected (%)
Unit chief	52	4 (7.69)
Assistants	220	37 (16.82)
PG	78	15 (19.23)

Table 9: Pre-operative hair removal

Hair removal	Total cases	Number of cases infected (%)
No hair removal	4	0 (0)
Shaving		
½ h before surgery	100	10 (10)
2 h before surgery	50	7 (14)

Table 10: Comparative study of DT and without DT

Method of closure	Total cases	Number of cases infected (%)
Primary closure with DT	84	10 (11.90)
Primary closure without DT	76	15 (19.74)
Laparotomy	2	-

DT: Drainage tube

Table 11: Study of organisms in peritoneal fluid

Peritoneal aspirate	Number of cases sent for c/s	Organisms grown
Perforated peptic ulcers	6	Multiple organisms in 5 cases
Perforated appendix	2	<i>E. coli</i> present in 2 cases
Gangrenous small bowel	4	No growth in 5 cases

E. coli: Escherichia coli

Table 12: Comparative study of open and close dressings

Dressings	Total cases	Number of cases infected (%)
Occlusive dressings	20	4 (20)
Exposure technique	100	11 (11)

Wound exposed on the 2nd post-operative day by removal of dressing

Table 13: Various complications following surgery

Complications	Number of cases followed	Incidence	Percentage
Burst abdomen	43	1	2.1
Bowel fistula	43	4	8.33
Post-operative intra-abdominal sepsis	43	2	4.17
Septicemia	43	2	4.17

In our study, we have seen two cases of laparotomies done for severe peritonitis (septic abortion and gangrenous bowel).^{6,8} Wound is not sutured in layers. Skin closed with few loose stitches. After 2 days, the wound opened and thorough was given. This procedure was repeated at least 3 times. After sepsis was controlled, the wound was closed in layers. Skin approximated (Table 11).

In our study, the influence of dressings on wound infection with exposure technique, the infection rate is lowered to 11%. Sweating and moisture favor bacterial growth.⁸ Exposure technique avoids this problem and keeps the wound dry to form a crust. Moreover, it reduces the discomfort of wound dressings and allows easy wound inspection (Table 12).

A note on complication Table 13 depicts that one case of burst abdomen in the emergency cases.⁹ Out of 43 infected cases, only 20 patients turned up or regular follow-up. There was one case of an incisional hernia following laparotomy for a strangulated hernia.

CONCLUSION

Prevention of wound infection and sepsis in abdominal surgery shortens the hospital stay, minimize the expenditure of the patient, and avoids the morbidity and mortality. It is a joint responsibility of the surgical team paramedical staff, patient, and also the bacteriologists.

From our study, we are able to draw the following conclusions into focus:

1. A thorough pre-operative preparation of the patient, especially
 - Obese patients to be persuaded to reduce their weight before surgery
 - Associated skin problems and systemic illness to be taken care of
 - Antitetanus prophylaxis is a must
 - Adequate bowel preparation.
2. Perioperative short-term antimicrobial prophylaxis to be practiced in all elective and emergency cases
3. Pre-operative hospital stay in elective cases and duration of surgery in emergency cases to be cut short
4. Surgical techniques and principles may be improved by;

- Reduced number of operating personnel (max 5/ table)
- Disposable gloving and doing
- Scrubbing up for 5 min for first case and 3 min for subsequent cases is ideal
- Glove washing before incision to identify the unnoticed holes and wash away the starch powder
- Draping of wound whenever suspect contamination
- Reoperation through same previous incision
- Thorough peritoneal wash and peritoneal drain in contaminated cases
- Effective hemostasis, limited sutures, use of more of absorbable than non-absorbable to be employed
- Skin closure with subcuticular vicryl/adhesive tapes, especially in elective cases
- In contaminated wounds, primary closure with subcutaneous drains with irrigation is ideal
- If gross sepsis is suspected entire wound is left unsutured, temporarily covered by dressing or skin closed with loose stitches. After the sepsis controlled wound is closed in layers
- Exposure technique helpful to minimize post-operative infection rate
- The number of visitors to post-operative wards to restricted and kept clean
- Infected cases to be isolated with separate

instruments, dressing, and nursing care

- A routine culture sensitivity of infected cases including quantitative culture to be done
- Laparoscopic procedure whenever necessary will reduce the infection rate.

Finally, the surgeon should adapt a checklist system regarding decision-making, and avoidance of complication is all that requires for achieving good results.

REFERENCES

1. Cuschieri A, Giles GR, Moossa AR, editors. Essential Surgical Practice - A Cuschieri. 3rd ed. Oxford, UK: Butterworth-Heinemann; 1995. p. 72-89.
2. Ellis BW, Paterson-Brown S, editors. Hamilton Bailey's Emergency Surgery. 13th ed. London: Hodder Arnold; 2000.
3. Shell DH 4th, de la Torre J, Andrades P, Vasconez LO. Open repair of ventral incisional hernias. Surg Clin North Am 2008;88(1):61-83.
4. Laufman H. Current use of skin and wound cleansers and antiseptics. Am J Surg. 1989;157:359-65.
5. Tobin GR. Closure of contaminated wounds. Biologic and technical considerations. Surg Clin North Am 1984;64:639-52.
6. Coller FA, Valk WL. The delayed closure of contaminated wounds: A preliminary report. Ann Surg 1940;112:256-70.
7. Abug C, Thore M. Single dose versus triple dose antimicrobial prophylaxis in elective abdominal surgery and the impact on bacterial ecology. J Hosp Infect 1991;18:149-54.
8. Law NW, Ellis H. Exposure of the wound - a safe economy in the NHS. Postgrad Med J 1987;63:27-8.
9. Meakins JL, Pietsch JB, Christou NV, Maclean LD. Predicting surgical infection before the operation. World J Surg 1980;4:439-50.

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