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Original Research Article

Study of bacteriological profile and sensitivity to various drugs in a case of wound dehiscence in tertiary care centre

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ABSTRACT

Background: Surgical wound infection is a common post-operative complication causing significant post-operative morbidity and mortality, prolonged hospital stays and adds between 10-20% to hospital cost.
Methods: This is a prospective study conducted in Department of General Surgery and Department of Microbiology, M.L.N. Medical College and Swaroop Rani Nehru Hospital, Allahabad. The study group comprised of all patients who underwent surgery during the period from October 2017 to September 2018 and were diagnosed with postoperative surgical site infection and wound dehiscence.
Results: A total of 1640 patients were followed during one year of study. 540 (32.92%) patients were operated as emergency cases while 1100 (67.08%) were operated as elective cases.
Conclusions: Wound dehiscence is a common surgical complication occurring in about 6.5% of surgical procedures. Emergency operative procedures are associated with higher incidence (16.67%) of wound dehiscence as compared to elective surgical procedures (1.67%). Male gender is more commonly associated with wound dehiscence especially in case of emergency surgical procedures with male to female ration of 1.67:1.Incidence of wound dehiscence increases with increasing age being maximum in older age group. Malnutrition is the most common risk factor present in surgical patients predisposing to wound dehiscence.

Keywords: *Staphylococcus aureus*, Surgical site infection, Wound dehiscence

INTRODUCTION

Surgical wound infection is a common post-operative complication causing significant post-operative morbidity and mortality, prolonged hospital stays and adds between 10-20% to hospital cost.[1] Surgical Site Infection splits into three groups:

- Superficial surgical site infection
- Deep surgical site infection
- Organ/space surgical site infection

Surgical site infections are recognized as a common surgical complication occurring in about 3% of all surgical procedures and in up to 20% of patient undergoing emergency intra-abdominal procedures.[2]

The present study has been conducted to identify the spectrum of bacteria isolated from case of wound dehiscence and to study the antibiotic sensitivity pattern of these isolates against commonly used antibiotics.[3,4] Purpose of this study is also to evaluate the various risk factors responsible for post-operative wound infection.[5,6]

METHODS

This is a prospective study conducted in Department of General Surgery and Department of Microbiology, M.L.N. Medical College and Swaroop Rani Nehru Hospital, Allahabad.

The study group comprised of all patients who underwent surgery during the period from October 2017 to September 2018 and were diagnosed with postoperative surgical site infection and wound dehiscence. All patients in whom a skin incision was not used (e.g. transurethral resection of prostate) and operations in which wounds were not closed at end of operation (e.g. parietal wall abscess, fistula in ano) were not included in the study.

Particulars of the patients was noted particularly name, age, sex date of admission.

The detailed history, examination, complete blood and radiological investigation of the patients was taken. The complaints of the patient along with the duration they were present was recorded. History regarding high risk factors for wound infection like previous history of surgical intervention, history of prolong antibiotic and steroid intake, comorbid medical illness e.g. diabetes mellitus, tuberculosis, COPD and chronic smoking was also taken.[9]

The preoperative record was maintained with special reference to the following points

- Whether surgical procedure was elective or emergency.
- Whether surgery was performed by a consultant surgeon or the resident.
- Type of wound.
- Type of the surgery done.
- The duration of the surgery.
- Number of drains used.
- Type of the closure done.

Wound condition was studied on the third, fifth and seventh post-operative day or immediately when there was any unexplained sign of inflammation[4]

- Abscess
- Discharge which may be viscous in nature, discolored and purulent
- Delayed healing not previously anticipated
- Discoloration of tissue both within and at the wound margins
- Friable bleeding granulation tissue despite gentle handling of and the non-adhesive nature of wound management materials used
- Unexpected pain and/or tenderness either at the time of dressing change or reported by the patient as associated specifically with the wound even when the sound dressing is in palace.
- Abnormal smell.
- Wound breakdown associated with wound pocketing bridging at base of wound

Once the wound infection was diagnosed, regular dressing of the wound was done and wound was done and wound checked for dehiscence, which is defined as: separation of fascial layers early in the post-operative courser, an event that usually leads to emergency action.

Collection of the specimen was done in the form of

- Sterile swab
- Infected tissue
- Pus/discharge Sterile swab was the most common method for collection of specimens. The specimens, following collection were transported to the microbiology laboratory as soon as possible with all necessary precautions.

The specimen collected was divided into three parts

- First part was used to make gram's smear. The stained smear was observed in 100x oil immersion lens and findings noted.
- Second part of the sample was plated directly on the blood agar and Mc-Conkey agar and incubated at 37^0C for 18-24 hours.
- Third part of the sample was inoculated in Brain Heart infusion broth or Trypticase Soya broth and incubated overnight at 37^0C.

Bacterial identification was done by

- Gram staining character and morphology
- Motility
- Colony characteristics
- A set of biochemical tests including Catalase test, Coagulase test, methyl red, Indole test, Voges Proskauer test, Urease test, Citrate test, Nitrate reduction test and Oxidase test etc.

RESULTS

A total of 1640 patients were followed during one year of study. 540(32.92%) patients were operated as emergency cases while 1100 (67.08%) were operated as elective cases. In emergency patients the age ranges from 8 years to 75 years. Maximum number of patients (33.33%) were between 30 to 45 years age, followed by 30.74% in 15 to 30 years age group. In elective group of patients, the age ranges from 6 months to 70 years. Maximum number of patients 34.17% were between 30 to 45 years of age followed by 27.3% in 45 to 60 years.

Out of all emergency patients 64.81% were males and 35.19% were females while in elective surgery 59.09% were male and 40.91% were female. The male to female ratio in emergency1.67:1. In the emergency group among

the risk factors predisposing to wound dehiscence malnutrition was commonest factor in 250 (46.3%) patients, followed by shock which was present in 12 0(22.2%) patients while no risk factor was present in 240 (44.44%) patients (Table 1).

Table 1: Risk factors.

Preoperative risk factors	Emergency			Elective			Z value	P value
	Patients with SWD	Total no. of patients	%	Patients with SWD	Total no. of patients	%		
Malnutrition	60	250	24	2	80	2.5	4.28	<0.05
Obesity	1	26	3.8	6	140	4.2	0.09	>0.05
Diabetes	2	20	10	5	60	8.3	0.23	>0.05
Shock	40	120	33.3	-	-	-	-	-

Table 2: Antibiotics senstivity.

Antibiotics	Sensitivity	Resistance	Sensitivity (%)
Piperacillin tazobactum	10	19	34.48%
Amikacin	14	15	48.27%
Chloramphenicol	2	27	6.8%
Gatifloxacin	11	18	37.93%
Ofloxacin	22	7	75.86%
ciprofloxacin	11	18	37.93%
Linezolid	23	7	79.37%
Vancomycin	10	19	34.48%
Immipenem	4	25	13.6%
Cefuroxime	3	26	10.3%
Azithromycin	8	21	27.5%
Methicillin	10	19	34.4%
Amoxicillin clavulanate	4	25	13.6%
Ceftriaxone	5	24	17.29%

In emergency group 540 patients underwent surgery. Exploratory laparotomy was commonest surgical procedure carried out in 225 patients, followed by surgery for traumatic brain injury in 170 patients. Exploratory laparotomy was done for both infected and uninfected cases.

In present study 1640 patients underwent different surgical procedures out of which 108 (6.5%) patients developed wound dehiscence. Wound dehiscence was significantly more in patients operated in emergency (16.67%) as compared to patients operated in elective (1.67%).

The mean age of patients of emergency group who developed wound dehiscence was 37.34±16.47 year. Wound dehiscence was highest (2%) in patients of less than 15 years age and in patients of 45 to 60 years age, 1.6% in more than 60 years age and lowest (1%) in patients between 15-30 years age. Thus, no direct relationship was found between patients' age group and wound dehiscence. Wound dehiscence was 19.42% in males and 1.57%. Hence a male predominance was found in emergency operations but in elective surgery it was nearly equal in both sexes.

In present study, malnutrition was common in both elective and emergency patients. However, percentage of patients with malnutrition who developed wound dehiscence were higher in emergency patients (24%) as compared to patients of elective surgery (2.5%). The value was significant with p value <0.05.

Obesity and diabetes were present in greater number of patients in elective group however percentage of patients who developed wound dehiscence were comparable in both with p value >0.05 in both. Shock was present only in emergency patients of which 33.3% patients developed wound dehiscence. Wound dehiscence was present in 1% of patients with clean wound, 7% of patients with clean contaminated wound, 15.8% of patients with contaminated wound and 39.9% patients with dirty infected wound. Hence a direct relationship was found between wound class and wound dehiscence.

In emergency, 90 Patients developed wound dehiscence out of which 16 (17.78%) had clean contaminated wound, 15 (16.67%) had contaminated wound and 59 (65.55%) had dirty infected wound at time of operation. In elective group 18 patients developed wound dehiscence out of which 10 (55.56%) had clean wound and 8 (44.44%) clean contaminated wound at time of operation.

Out of the total 1640 operative procedure performed, exploratory laparotomy was commonest operative procedure carried out for both infected and non-infected cases. Wound dehiscence in this group occurred in 27.2%. 12% of cases developed wound dehiscence after undergoing debridement and stitching of wound in the emergency.

Gram positive bacteria were isolated from 79 patients of which 36 (45.57%) had superficial wound dehiscence while 34 (43.03%) had deep wound dehiscence and 9 (11.4%) had organ space wound dehiscence.

Table 3: Total no. of cases and wound dehiscence.

Procedure	Patients with surgical wound dehiscence	Total no. of patients	%
Emergency	90	540	16.67
Elective	18	1100	1.67
Total	108	1640	6.5

The sensitivity of *Staphylococcus aureus* to different antibiotic was tested by disk diffusion method. Most sensitive antibiotic was linezolid in 23 of 29 isolates (79.31%). Ofloxacin was sensitive in (75.86%) of isolates. Bacterial resistance rate was very high to penicillin group of drugs, cefuroxime was sensitive in 10.3% cases only and ceftriaxone sensitive only in 17.29% cases. Ciprofloxacin and gatifloxacin was sensitive in 37.93% isolates only. 63.5% cases were vancomycin resistant and 65.52% strain were methicillin resistant pointing towards the emergence of vancomycin and methicillin resistant Staphylococcus aureus in hospital environment. Table 2.

E. coli was isolated from 16 patients and most of the isolates were multidrug resistant. Imipenem was the drug most commonly found sensitive in 13 out of 16 patients (81.25%). Amikacin was resistant in 56.25% cases. Penicillin group of drugs were also highly resistant with ceftriaxone resistant in 75% of cases and cefoperazone sulbactum resistant in 63% cases too. All the isolates were completely resistant to quinolones.

In present study, average post-operative hospitalization in uninfected patient was 6.6 days. Mean extended hospital stay in patients infected with gram positive organism was 8.06 days (S.D. 2.56). The difference between the two was significant ($p<0.001$). Thus, patient who were infected with gram negative bacteria had a prolonged hospital stay as compared to patient infected with gram positive bacteria.

DISCUSSION

In the present study, 1640 patients underwent different surgical procedures of which 108 (605%) patients developed wound dehiscence. Similarly, Soha AH et al, and Inigo JJ et al, have reported a wound dehiscence in 8% of patients in their study which is not much different from present study.[13,15] This compares favorably with 7.5% wound dehiscence reported by Brote L et al, 7.8% by Khan MN et al, and 7.5% Adedji IO et al, in their respective studies.[1,4,6]

Table 4: Age distribution.

Age group (years)	Emergency			Elective		
	Patients with SWD	Total no. of patients	%	Patients with SWD	Total no. of patients	%
<15	6	60	10	2	100	2.0
≥15-<30	23	166	13.8	2	200	1
≥30-<45	30	180	16.6	6	380	1.57
≥45-<60	19	84	22.6	6	300	2.0
≥60	12	50	24	2	120	1.67
Mean±SD	37.34±17.46			37.51±16.46		

Table 5: Sex distribution.

Sex	Emergency			Elective		
	Patients with SWD	Total no. of patients	%	Patients with SW	Total no. of patients	%
Male	68	350	19.42	11	650	1.69
Female	22	190	11.57	7	450	1.56
Total	90	540	16.67	18	1100	1.67

Table 6: Pre-operative risk factor.

Preoperative risk factors	Emergency			Elective			Z value	P value
	Patients with SWD	Total no. of patients	%	Patients with SWD	Total no. of patients	%		
Malnutrition	60	250	24	2	80	2.5	4.28	<0.05
Obesity	1	26	3.8	6	140	4.2	0.09	>0.05
Diabetes	2	20	10	5	60	8.3	0.23	>0.05
Shock	40	120	33.3	-	-	-	-	-

The present study has also shown that wound dehiscence was significantly more in patients operated in emergency (16.67%) as compared to patients operated in elective group where only 1.67% developed wound dehiscence (Table 3). 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.

Table 7: Type of case.

Operative procedure	Total no. of cases	Patients with SWD	%
Appendectomy	60	2	3.3
Cholecystectomy	120	5	4.1
Herniorrhaphy / plasty	120	2	1.67
Breast	50	3	-
Nephrectomy	15	2	20
Eversion of Sac	200	-	1
Varicose vein	25	-	-
Cleft lip	20	-	-
Pyelolithotomy	60	1	1.67
Laparotomy	275	75	27.2
Traumatic brain injury	180	-	-
Space occupying lesion brain	30	1	3.3
Open prostectomy	50	2	4
VP shunt	25	-	-
Hypospadias	15	-	-
Urethroplasty	20	-	-
Scar revision	50	-	-
Cyst excision	50	-	-
Lymph node biopsy	30	-	-
Debridement and stitching	125	15	12
Miscellaneous	120	-	-
Total	1640	108	100

Sohn AH et al, Khan MN et al, and Lilani SP et al, have also identified male gender as a significant risk factor for patients developing wound dehiscence (Table 5).[6,10,15]

Sorenson LT et al, reported wound dehiscence in 16% of patients in emergency as compared to 4% patients in elective group which is similar to present study.[11] Waqar SH et al, reported wound dehiscence in 12% of patients undergoing emergency surgery as compared to 4% in elective surgery. The difference of wound elective and emergency surgery was statistically significant. In present study it was ($p < 0.01$) and in series of Waqar SH et al, it was ($p < 0.05$) (Table 3).[16]

Table 8: Type of class.

Wound class	Emergency	Elective
Clean	-	10 (55.56)
Clean contaminated	16 (17.78%)	8 (44.44)
Contaminated	15 (16.67%)	-
Dirty and infected	59 (65.55%)	-
Total	90	18

Table 9: Types of symptoms were identified preceding wound dehiscence.

Symptoms	Cases	%
Staining	54	50.00%
Pus	31	28.90%
Swelling	10	9.25%
Erythema	8	7.40%
Fever and pus	3	2.77%
Fever and staining	2	1.85%

Table 10: Duration of operation.

Wound class	Patients with SWD	Total no. of patients in group	%
≤ 1 hr	7	780	0.892
≥ 1hr < 2hr	26	450	5.7
≥ 2hr < 3hr	50	300	16.67
≥ 3hr	25	110	22.2

Out of 540 patients undergoing emergency surgery wound dehiscence was 10% below 15 years age, 22.6% in 45 to 60 years age and 24% in more than 60 years of age. Hence there4 is a linear increase in wound dehiscence rate with increase in age (Table 4). 19.42% of

males and 11.57% of female undergoing emergency surgery developed wound dehiscence. In elective surgery 1.65% males and 1.57% females developed wound dehiscence. In the present study among patients with wound dehiscence. In the present study among patients with wound dehiscence, the male to female ration is 2.7:1 (Table 5).

Razavi S et al, in their study observed wound dehiscence in 19.6% of males and 15.1% of females which matches closely with present study (Table 5).[12]

In the present study, malnutrition was commonest pre-operative risk factors in both elective and emergency group of patients. In emergency wound dehiscence was present in 24% patients with malnutrition whereas in elective it was present in only 2.5% (Table 6).

In the present study shock was present only in emergency patients, of which 33.3% developed post-operative wound dehiscence. In accordance with our study, John et al, reposted wound infection on 3% patients with preoperative or intraoperative shock. Sorenson et al, also reported perioperative blood loss as a predictor of post-operative wound dehiscence, similar to present study.[11]

In the present study, exploratory laparotomy was the most common surgical procedure performed. The incidence of wound dehiscence was also highest (27%) in patients undergoing exploratory laparotomy for peritonitis from various cause.

Sorenson et al, has also stated that wound dehiscence is more likely to occur when peritonitis with a large intraperitoneal load and bacteremia is present preoperatively.[11]

Razavi S et al, reported 3.7% wound dehiscence in 25 to 65 years age and 25.2% in more than 65 years of age which is similar to our study.[12]

In the present study 3% patients undergoing appendectomy developed wound dehiscence whereas in the study by Inigo JJ et al, were performed as emergency procedure, hence, higher incidence of wound dehiscence as compared to our study (Table 7).[13]

Wound dehiscence was observed in 1% of patients with clean wounds, 7% with clean contaminated wound, 15.8% with contaminated wounds and 39.9% with dirty wounds (Table 8).

Table 11: Operation with or without drain.

Drain	Total no. of patients	Patients with SWD	%
Operations in which Drain was used	800	100	12.5
Operations in which Drain was not used	840	8	0.95

Table 12: Organism in SWD.

Type of wound	Gram positive	Gram negative
Superficial incisional wound dehiscence	26 (89.65%)	36 (45.57%)
Deep incisional wound dehiscence	3 (10.35)	34 (43.03%)
Organ and space	-	9 (11.40%)
Total	29 (100%)	79 (100%)

Table 13: Organism involved.

Bacterial isolated	Total no. of isolates	Clean	Clean contaminated	Contaminated	Dirty infected
Staph aureus	29	9 (8.3%)	2 (15.7%)	2 (1.85%)	1 (0.9%)
E. coli	16	-	3 (2.8%)	2 (1.85%)	11 (10.19%)
Klebsiella	11	-	1 (0.9%)	2 (1.85%)	8 (7.4%)
Pseudomonas	11	1 (0.9%)	-	-	10 (9.3%)
Citrobacter	15	-	-	5 (4.6%)	10 (9.3%)
Proteus	6	-	3 (2.8%)	-	3 (2.8%)
Morganella	5	-	-	-	5 (4.6%)
Enterobacter	10	-	-	2 (1.85%)	8 (7.4%)
Acinetobacter	5	-	-	2 (1.85%)	3 (2.8%)
Total	108	10	24	15	59

Staining of dressing is the commonest symptom preceding wound dehiscence in 50% patients. Cutting et al, have also described staining of dressing as the commonest symptom preceding wound dehiscence (Table 9).[2] Waqar SH et al, have reported serosanguinous fluid discharge as the most common symptom preceding wound dehiscence present in 57% cases which is similar to present study.[16]

The incidence of wound dehiscence was least 0.89% in procedures lasting less than one hour and only 5.7% in procedures lasting 1-52 hours. However, significant increases in incidence of wound dehiscence (16.67%)

was noted when operative procedure lasted for 2 to 3 hours and 22.2% in procedure lasting more than 3 hours (Table 10).

Sensitivity of Staphylococcus aureus to different antibiotic was tested by disk diffusion method. Most sensitive antibiotic was linezolid in 23 to 29 isolates (79.31%. Linezolid is food and Drug Association (USA) approved for the treatment of infection caused by methicillin resistant strain of *Staphylococcus aureus*. The rate of methicillin resistance is 66.67%. The value matches closely to value in the study by Sayed et al, but is lower than value reported by Jahan Y et al, (Table 13 and Figure 1).[5,14]

Bacterial resistance rate was very high to penicillin group of dregs, cefuroxime was sensitive in 10.3% cases only and ceftriaxone sensitive only in 17.29% cases (Table 2).

E. coli strains were most often sensitive to Imipenem (81.25%). Amikacin was resistant in 56.25% cases and most of the strains were resistant to quinolone.

Peperacillin tazobactum, gatifloxacin and cefipime were sensitive in all the strains of proteus isolated. Piperacillin tazobactum, gatifloxacin and doxycillin were sensitive to all strains of *Klebsiella* isolated from wound infection while very high resistance rate was noted with ceftriaxone and ceftazidime. Piperacillin tazobactum, was sensitive to all isolates of acinetobacter. Amikacin was sensitive in 60% of cases as were imipenem and ciprofloxacin.

Mean extended hospital stay in patients infected with gram positive organism was 8.06 days (S.D. 2.65) whereas in the case of gram-negative bacteria it was 13.82days (S.D. 2.65).

CONCLUSION

Wound dehiscence is a common surgical complication occurring in about 6.5% of surgical procedures. Emergency operative procedures are associated with higher incidence (16.67%) of wound dehiscence as compared to elective surgical procedures (1.67%). Male gender is more commonly associated with wound dehiscence especially in case of emergency surgical procedures with male to female ration of 1.67:1 .Incidence of wound dehiscence increases with increasing age being maximum in older age group. In the present study, malnutrition was commonest pre-operative risk factors in both elective and emergency group of patients. In emergency wound dehiscence was present in 24% patients with malnutrition whereas in elective it was present in only 2.5%. Wound dehiscence was observed in 1% of patients with clean wounds, 7% with clean contaminated wound, 15.8% with contaminated wounds and 39.9% with dirty wounds. Staining of dressing is the commonest symptom preceding wound dehiscence in 50% patients and pus is second most common in 28.9%. The incidence of wound dehiscence was least 0.89% in procedures lasting less than one hour and only 5.7% in procedures lasting 1-52 hours. However, significant increases in incidence of wound dehiscence (16.67%) was noted when operative procedure lasted for 2 to 3 hours and 22.2% in procedure lasting more than 3 hours. In the present study procedures in which drain was used postoperatively, were more commonly associated with wound dehiscence (12.5%) as compared to procedures in which drain was not used (0.95%). In emergency, where exploratory laparotomy was the most common operation performed for peritonitis, gram negative bacteria were more common isolates (74 out of 90) with gram positive to gram negative ration being 1:4.6. In the elective group of patients gram positive bacteria were common isolate (13 out of 18) with gram positive to gram negative ration of 2.6:1. The ration of gram positive to gram negative in case of clean and clean contaminated wound was 3.2:1 whereas the ratio in contaminated and dirty wound was 1:2.3.

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