Original Article

Surgical Wound Infection in Clean-Contaminated and Contaminated Laparotomy Wounds at Muhimbili National Hospital.

E.V. Ussiri[1], C.A. Mkony[2], M.R. Aziz[2].
[1]Specialist Surgeon, [2]Associate Professor, Muhimbili University College of Health Sciences.
Correspondence to: Dr. Ussiri EV, Department of Surgery, Box 65000, Dar es Salaam.
Email: eussiri@yahoo.com

Background: Surgical wound (site) infection is the commonest complication following laparotomy for clean-contaminated and contaminated abdominal operations. Good surgical technique and perioperative prophylactic antibiotics in clean-contaminated and contaminated abdominal operations contribute to the low rate of surgical wound infection and its complications. The objectives of this study were to determine the prevalence and complications of surgical wound infection following laparotomy for clean-contaminated and contaminated abdominal operations at Muhimbili National Hospital.
Methods: This was a prospective descriptive study done over a period of nine months from January 2001. The study population included patients assessed to have clean-contaminated and contaminated laparotomy wounds
Results: The study revealed that surgical wound infection was the commonest complication accounting for 15.6%. Other complications include mortality rate of 8.9% and wound dehiscence (1.1%).
Conclusion: It was concluded that another study is required in order to determine the cost of surgical wound infection in this hospital that is in transition towards cost-sharing and health management reform. Also, a long follow up study is required to determine the prevalence of incisional hernia in these wounds.

Introduction

Surgical wound (site) infection is clinically defined as presence of pain at surgical wound, which is accompanied by erythema, induration and local tenderness or presence of purulent discharge at wound site[1]. This is the most common complication of the laparotomy wounds following clean-contaminated and contaminated abdominal operations. Surgical wound infection rate can be minimized by different considerations such as use of surgical incise drapes, use of perioperative prophylactic antibiotics and leaving open heavily contaminated or infected wounds in addition to a good surgical technique.

Surgical wound infection rate for clean-contaminated and contaminated wound has been found to be less than 10% and approximately 20% respectively when principles of surgery are adhered to[2]. Complications of surgical wound infection

include delayed wound healing with subsequent high cost and prolonged hospital stay[3,4,5,6,7], high morbidity and mortality[4,6,8,9,10,11] and wound dehiscence or incisional hernia[12, 13, 14, 15]. This study was aimed at determining the prevalence and complications of clean-contaminated and contaminated laparotomy wounds at Muhimbili National Hospital.

Patients and Methods

This was a prospective descriptive study done to determine the prevalence surgical wound infection and dehiscence and mortality following laparotomy for clean-contaminated and contaminated abdominal operations at Muhimbili National hospital. The study was undertaken from January to September 2001 and included patients of all age groups and both sexes admitted in the Department of Surgery, Muhimbili National Hospital who were assessed as having clean-contaminated and contaminated laparotomy wounds.

All patients received intravenous injection Ceftriaxone (Powercef®) 1gm in adults and 50 mg per kilogram body weight (not more than 2 gm) in children below 12 years at the induction of anaesthesia as a prophylactic antibiotic. All patients with jaundice, diabetes mellitus, advanced malignancy, on steroids, patients aged above 65 years and those who at laparotomy for

penetrating abdominal injury were found to have no perforation to the hollow viscus were excluded from the study.

The deep abdominal wall (peritoneum and fascia) was closed without tension using non-absorbable, monofilament suture number "0"or "1" in adults and number 2/0 in children either interrupted or continuous with needle entry not less than 1cm from the edge. The patients were reviewed on the 5th day, 10th day and 28th day to assess for any complications related to the wound. Questionnaire forms were used to record the data.

Results

A total of 90 patients with clean-contaminated and contaminated abdominal wounds were admitted in the Department of General Surgery which included Paediatric Surgery and met the inclusion criteria. They included 50 operated upon on emergency basis and 40 as elective operations. All study subjects were reviewed on 5th and 10th post laparotomy day. On 28th day of laparotomy 97.8% of patients were available for follow up.

Age and Sex. The median age was 32.0 years with a standard deviation of 16.7. The peak age was 20-40 that accounted for 50% of the studied patients. The extremes of age had a minority of patients whereby, twenty years of age or below accounted for 14.5% and above sixty years of age accounted for 13.3% of the studied population. There were 67 males and 23 females giving a male to female ratio of 2.9 to 1 (Table 1).

Surgical Wound Infection Rate

The proportion of patients with wound infection at different time intervals is shown in Table 2.

Complications Following Clean-Contaminated and Contaminated Laparotomy Wounds

Among the commonest complications found in clean-contaminated and contaminated laparotomy surgical wound infection accounted for 15.6%, mortality rate of 8.9% and wound dehiscence rate was 1.1%. Table 3 summarizes this information.

Complications Associated With Surgical Wound Infection

The most common complication associated with surgical wound infection includes wound dehiscence or burst abdomen (one versus none). No death was associated with surgical wound sepsis.

Table 1. Distribution of patients by age and sex

Age Group (Yrs)	**Sex**		**Total (%)**
	Male	**Female**	
≤20	9	4	13 (14.5)
21 – 40	36	9	45 (50.0)
41 – 60	16	4	20 (22.2)
61 – 65	6	6	12 (13.3)
Total	**67 (74.4%)**	**23 (25.6%)**	**90 (100%)**

Table 2. Proportion of surgical wound infection

Follow-Up	**Not Infected (%)**	**Infected (%)**	**Total (%)**
5th day	76 (84.4)	14 (15.6)	90 (100)
6th to 10th day	77 (85.6)	13 (14.4)	90 (100)
11th to 28th day	83 (92.0)	7 (8.0)	90 (100)

Table 3. **Complication following clean-contaminated and contaminated laparotomy wounds**

Complication	**Complicated (%)**	**No Complication (%)**	**Total (%)**
Surgical wound infection	76 (84.4)	14 (15.6)	90 (100)
Mortality	82 (91.1)	8 (8.9)	90 (100)
Wound dehiscence	89 (98.9)	1 (1.1)	90 (100)

Table 4. The common pathogens isolated from infected wounds [20]

Organism	**Number of isolates**	**Percent (%)**
Staphylococcus aureus	22	36.1
Klebsiella spp	19	31.2
Escherichia coli	9	14.8
Pseudomonas spp	4	6.6
Proteus spp	3	4.9
β -haemolytic streptococcus	2	3.2
Streptococcus spp	1	1.6
Unidentified coliform	1	1.6
Total	**61**	**100**

Discussion

Surgical wound (site) infection is the commonest complication following laparotomy for clean-contaminated and contaminated abdominal operations. Surgical infection rates in these wounds ranges from 10% to 20% when perioperative antibiotics are given in addition to a good surgical technique. The complications for surgical wound infection include high morbidity and mortality, wound dehiscence and incisional hernia. These complications are attributable to high cost and prolonged hospital stay.

A good surgical technique and perioperative prophylactic antibiotics in clean-contaminated and contaminated abdominal operations plays part in low rate of surgical wound infection and its complications. The wound infection rate of 15.6% in this study is comparable to that reported in other studies[7,16,17,18] that range from 10% to 20%. This could be explained by the adherence to standard surgical technique as well as use of antimicrobial surgical prophylaxis. Ceftriaxone is effective against both gram-negative and gram-positive microorganisms as well as some anaerobes, mainly *Bacteroides fragilis* [19].

According to a study by Wayi[20], the common pathogens isolated from infected surgical wounds are shown in Table 4. The susceptibility of Staphylococcus to; Methicillin was 100%, Erythromycin was 72.7%, Tetracycline was 85.7% and 100% resistant to Penicillin G. Sensitivity of Klebsiella species to; Ceftriaxone was 93.3%, Augmentin was 76.5% and Gentamycin was 64.7% and the susceptibility of Pseudomonas species was 100% with Ceftriaxone compared to 75% with Gentamycin.

Costs and Hospital Stay

Surgical wound infection is associated with prolonged hospital stay and high costs to the patient as well as the health sector. In this study the hospital stay and cost for the infected group were not assessed. Kotisso and Aseffa[3] found that, surgical wound infection accounted for delay in the discharge of 14.7% of patients. Renvall et al[4] found the nursing time for patients with wound infection to be 7 days longer than in the uninfected patients.

Plowman et al[5] studied 4000 patients and found that surgical wound infection prolonged hospital stay to an average of 15 days with mean cost per patient of £3500. Kirkland et al[6] when determining the costs attributable to surgical wound infection on 255 patients admitted to the Intensive Care Unit (ICU) found that 29% were related to the surgical wound infection versus 18% for uninfected group. In the same study, re-admission was 41% for infected group versus 7% for uninfected group and median direct cost of hospitalization was $7531 for infected group versus $3844 for uninfected group.

Tyburski et al[7] when comparing the effectiveness of two regimens of prophylactic antibiotics for penetrating abdominal injuries, found that the overall wound infection was 18%. Infection increased length of hospital stay from 8.7±3.5 days to 23.3±10.9 days and hospital charges from $24507 ± $9860 to 104920 ±49083 (P< 0.001).

Morbidity and Mortality

Morbidity in this study was mainly due to surgical wound infection and wound dehiscence, which together accounted for 16.7% while the mortality rate was 8.9% (Table 3). There was no death associated with surgical wound infection. Ule et al[8] on one stage procedure in management of acute sigmoid volvulus on 30 patients, found that wound infection rate was 13.3% with no mortality. McArdle et al[9] did colorectal surgery on 169 patients with an overall wound infection rate of 17%. Another study by DiPiro[10] on 12,384 patients found higher rates of postoperative wound infection, 22% following colorectal procedures and 25% following upper gastrointestinal procedures.

A study done by Renvall et al[4] on 696 abdominal operations revealed higher mortality rate due to wound infection of 11.8% versus 1.6% for patients with no wound infection. Martnez et al[11] conducted a study on postoperative complications following gastric cancer surgery and found that morbidity in terms of infection accounted for 17.07% with mortality of 13.33%. Kirkland et al[6] when determining the morbidity and mortality attributable to surgical wound infection on 255 patients found that there was a high rate of mortality in infected group, 7.8% versus 3.5% for uninfected group.

Wound Dehiscence and Incisional Hernia

The commonest predisposing factors to the development of wound dehiscence and incisional hernia include surgical wound infection and faulty suture technique. Wound infection is associated with 10-fold increase in the incidence of wound dehiscence and incisional hernia[12]. In this study the proportion of wound dehiscence was 1.1% (Table 3) and was related to wound infection. The low rate of wound dehiscence was attributable to a good suture technique that included the use of monofilament suture, at least 1 cm distance of needle entry from the wound edge without tension. Incision hernia was not assessed in this study as it needs a longer follow up of at least one-year duration.

Senbanjo and Ajayi[13] when evaluating 8632 laparotomies found that the incidence of abdominal wound dehiscence was 2.5%. Wound dehiscence was most common in contaminated wounds (19%), prolonged duration of hospitalization (35 days), and carried a mortality of 7%. Israelsson et al[14] randomized 861 patients following midline laparotomy wound closure with monofilament, 1/0 nylon continuous, mass-closure with follow-up of 12 months. The results revealed an overall rate of burst abdomen of 0.6% and incisional hernia of 15%. Incisional hernia was related to wound infection and suture length-wound length ratio such that, presence of infection contributed to incisional hernia in 27% compared to 14% with no wound infection. The rate of incisional hernia for those sutured with suture length-wound length ratio of less than 4 was 22% compared to 9% for those sutured with suture length-wound length ratio of or more than 4.

Another study by Israelsson et al[15] on 467 patients studied the influence of suture technique on healing of midline laparotomy wound closure by continuous, monofilament, mass closure with follow up of 12 months found that the overall rate of wound infection was 11%, overall wound dehiscence was 0.4% and this was associated with wound infection, and an overall incisional hernia rate was 11%. Among those patients with incisional hernia, suture length: wound length ratio of, less than 4 accounted for 18%, 4 to 4.9 accounted for 5% and of 5 or more accounted for 12%. Therefore, the optimal suture length: wound length ratio recommended is 4 to 5. This ratio has an advantage of optimal interval between stitches and distance from wound edge (> 2 cm.).

Conclusion

1. A good surgical technique and judicious use of perioperative prophylactic antibiotics in clean-contaminated and contaminated abdominal operations are associated with a low rate of surgical wound infection and its complications.

2. Surgical wound infection is the commonest complication following clean-contaminated and contaminated abdominal operation and it carries a high morbidity and mortality.
3. Another study is required to determine the cost of surgical wound infection in this hospital, which is in a transition from free health care to cost sharing and cost recovery under Health Sector Reforms. A follow up of one year or longer is required to study the prevalence of incisional hernia.

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