Original Article

Primary versus Delayed Primary Closure of Laparotomy Wounds in Children Following Typhoid Ileal Perforation in Ile-Ife, Nigeria

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Abstract

Background: The optimal management strategy for dirty abdominal wounds has yet to be determined, but studies indicate that delayed primary closure (DPC) may be a reliable method of reducing surgical site infection (SSI) rate in these wounds. In this study, of dirty laparotomy wounds following typhoid ileal perforation (TIP), the SSI rate, incidence of wound dehiscence, and length of hospital stay (LOS) are compared in wounds primarily closed to those closed in the delayed primary fashion. **Patients and Methods:** The study was conducted over a 12-month period. Consecutive patients aged between 0 and 15 years with typhoid ileal perforation (TIP) were enrolled and prospectively randomized to test (DPC) group and control (PC) group. Data including age, sex, diagnosis, type of wound closure, SSI, wound dehiscence, time to wound healing, and LOS were obtained and analyzed using SPSS version 16. **Results:** Fifteen patients were recruited into DPC group while 19 patients were allocated to the PC group. The SSI rate was 80% in the DPC group compared to 63.2% in the PC group ($P = 0.451$). 17.6% of patients in the DPC group and 8.8% in the PC group had wound dehiscence, respectively ($P = 0.139$). The difference in LOS although longer in the DPC group was not statistically significant (DPC 23.47 ± 9.2, PC 17.68 ± 18.9, $P = 0.123$). **Conclusion:** DPC did not reduce the incidence of SSI and wound dehiscence, nor shorten LOS compared to PC. Therefore, PC of dirty wounds appears safe for the pediatric population and should be advocated.

Keywords: Children, delayed primary closure, dirty abdominal wounds, primary closure, wound outcome

Introduction

In spite of recent advances in the control of infection, surgical site infection (SSI) rate in laparotomy wounds following Typhoid ileal perforation (TIP) in our environment is extremely high (59%–70%).[1,2] Delayed primary closure (DPC) of skin and subcutaneous tissue is said to be effective in lowering SSI rate in dirty wounds.[3,4] The wound management strategy that reduces SSI rate and length of hospital stay (LOS) will be particularly suitable for pediatric patients who are often too used to home environments.

The aim of this study, therefore, was to compare the SSI rate and other wound-related morbidities in DPC wounds to the wounds closed in the primary fashion.

Patients and Methods

This study was conducted over a period of 12 months from July 2007 to June 2008 at the Obafemi Awolowo University Teaching Hospitals' Comlpex, Ile-Ife, Osun State, Nigeria.

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All patients aged 15 years and below with a preoperative diagnosis of peritonitis secondary to TIP who met the inclusion criteria were recruited into the study after vigorous resuscitation. A detailed clinical history and physical examination were then performed as well as evaluation of relevant radiological investigations. Fifty sealed envelopes, each containing a small piece of paper on which was marked PC (25) or DPC (25) were used to divide the patients into two groups: PC or Control group and DPC or test group by simple random sampling technique. All the envelopes were mixed, and a parent was asked to pick any one of them, the content of which determined the patient's group. The sample size was influenced by

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the short period of the study and paucity of cases of TIP in the study population.

All patients underwent laparotomy through the right lower transverse abdominal and muscle-cutting incision. The inclusion criteria were patients aged 0–15 years, patients whose parents/guardians consented to the procedure, confirmed intra-operative diagnosis of TIP as well as patients who were available for postoperative follow-up. Those who did not meet the criteria were excluded from the study. Patients were excluded from the study if they had severe chest infection, congestive heart failure, severe liver disease, immunosuppressive disease and therapy, and unconfirmed intra-operative diagnosis. Approval for the study was obtained from the hospital's Ethics and Research Committee.

Intravenous antibiotics – ciprofloxacin (10 mg/kg/dose) and metronidazole (7.5 mg/kg/dose) in divided doses were given preoperatively to all patients and continued postoperatively irrespective of the study group. Peritoneal and wound irrigation were routinely done with warm normal saline and where necessary, bowel decompression was performed. The definitive procedure was dictated by intra-operative findings. The muscle and fascial closures were in layers with vicryl and nylon sutures, respectively. Skin and subcutaneous tissues were approximated with simple interrupted nylon 3/0 suture in the PC group while in wounds designated for DPC, the subcutaneous tissue and skin were packed with gauze and closed on postoperative day (POD) 5 in the absence of infection. Dressing changes (without antiseptic packs) were made on POD 3 and 5, and skin sutures were inserted at bedside on POD 5 under local xylocaine infiltration. All wounds were inspected by the author and other competent colleagues in the unit, who were also conversant with the protocol of the study, on the 3rd, 5th, 8th, and 14th days after surgery, respectively for evidence of SSI (using the Centers for Disease Control [CDC] criteria)[5] and other wound complications. The CDC criteria for the diagnosis of SSI include the presence of one of the following: purulent discharge/documented abscess, culture-positive serous discharge, signs and symptoms of infection or diagnosis of infection by the attending physician, or surgeon. Wound swabs from infected wounds were subjected to aerobic cultures and then drained by removing skin sutures and instituting daily dressing with honey until spontaneous or secondary closure was achieved. The cost of anaerobic culture was considered prohibitive. Patients who developed space infection had reoperation and drainage. The final wound assessment was done on POD 30.

The following data were collected: age, sex, surgical diagnosis, operative findings, types of wound closure, SSI, complications, bacteriology of wound swab, wound outcome, LOS, and patient outcome.

Chi-square test and Student *t*-test were employed to compare data using Statistical Package for Social Sciences (SPSS) statistic for windows (version 16.0 Armonk, NY; IBM Corp). $P \leq 0.05$ indicated statistical significance.

Results

Thirty-seven children were recruited into the study, but three of them were, however, later excluded on account of death before surgical intervention in one, development of fecal fistula before onset of SSI in another while in third child, no specific diagnosis could be made. Of the remaining 34 patients, there were 19 (55.9%) and 15 (44.1%) patients in the PC and DPC groups, respectively, and none defaulted. Overall, the age range at presentation was 2–14 years with a median age of 8.0 ± 3.27 years [Table 1]. There was a preponderance of boys [Table 1] resulting in 22 males and 12 females with a male:female ratio of 1:1.8.

There were 12 (35.3%) males and 7 (20.6%) females in the PC group compared to 10 (29.4%) males and 5 (14.7%) females in the DPC group. The mean age was 7.32 ± 3.48 with a range of 2–14 years in the PC group and 8.93 ± 2.84 with a range of 4–12 years in the DPC group [Table 2].

Of the 15 wounds designated for DPC, 8 (53.3%) were considered suitable for closure on POD 5. 46.7% of them could not be closed on the account of serous discharge (15.2%) or purulent discharge (31.5%).

SSI rate was not significantly higher ($P = 0.451$) in the DPC group (12 [80%]) than in the PC group (12[63.3%]).

Wound dehiscence developed in 3 (8.8%) and 6 (17.6%) of the PC and DPC wounds, respectively. Patients who were subjected to DPC stayed longer (23.47 ± 18.93) in the hospital than those whose wounds were primarily closed (17.68 ± 9.22) [Table 3].

Eighty percent of patients who had DPC were discharged with incomplete wound healing compared to 52.6% in the PC group.

Table 1: Age distribution of patients in the two study groups

Age* (in years)	Study groups			*P*
	PC	DPC	Total	
0-3	3 (15.7)	0	3	0.408
4-6	6 (31.5)	3 (20)	9	
7-9	4 (21.0)	6 (40)	10	
10-12	5 (26.3)	5 (33.3)	10	
13-15	1 (5.5)	1 (6.7)	2	
Total	19	15	34	

*Age of the patients as at the last birthday. DPC: Delayed primary closure, PC: Primary closure

Table 2: Patients characteristics, surgical site infection rate, and wound dehiscence in both groups

Closure method	Number of patients	Mean age	Onset of SSI	SSI rate	Dehiscence
PC	19	7.2±3.4	6.7±2.0	12 (63.3)	3 (8.8)
DPC	15	8.9±2.8	5.8±10.3	12 (80)	6 (17.6)
P		0.340	0.597	0.451	0.139

SSI: Surgical site infection, DPC: Delayed primary closure, PC: Primary closure

Table 3: Complications, reoperation, and length of hospital stay in both groups

Closure method	Evisceration	Sinus	Fecal fistula	LOS	Reoperation
PC	1 (2.9)	0	1 (2.9)	17.7±9.2	2 (5.8)
DPC	3 (8.8)	1 (2.5)	2 (5.8)	23±18.9	5 (14.5)
P	1.000	0.440	0.571	0.123	0.146

DPC: Delayed primary closure, PC: Primary closure, LOS: Length of hospital stay

The predominant bacterial isolates in 88.5% of the cultured cases were endogeneous enteric organisms such as *Escherichia coli* (30%) and *Klebsiella* (19.5%). *Staphylococcus aureus* was isolated in 1 (2.9%) in both groups while 2 (5.9%) culture yielded no bacterial growth.

Overall, two deaths (5.9%) were recorded (one from each group) from complications related to fecal fistula.

Discussion

The literature is replete with reports documenting the increased risk of SSI after surgical intervention for TIP with primary wound closure.[6,7] However, there is scant information regarding possible measures to reduce the incidence of SSI and its sequelae, such as wound dehiscence, prolonged hospital stay, and increased cost. In this series, DPC was used as an interventional strategy to lower the incidence of SSI in patients with TIP.

Nonclosure technique had been the traditional approach to the management of dirty/infected wounds. Its use gradually dwindled because of its association with numerous drawbacks, namely, discomfort, escalating cost of dressing changes, prolonged time to final (spontaneous) closure, frequent need for revision (to excise the broad scars), and perceived patient dissatisfaction. The alternative method, secondary closure, was not without significant adverse events, particularly the need for the second operation often under general anesthesia, especially in children. DPC was advocated to replace the above wound management strategy because of its simplicity, demonstrated prophylaxis against SSI, ease of closure at bedside, and other favorable wound outcome profile (nature of scar, wound strength) when compared to PC.[8]

Many authors have reported DPC as a reliable method of reducing SSI rate in dirty wounds compared to PC,[3,4,9,10] but only a few studies demonstrated the significant statistical difference.[11,12] The technique of DPC lacked uniformity in its application in different studies. During the period of delay, the frequency of dressing changes, nature of packs (saline or antiseptic soaked), time of insertion of skin sutures (at the end of operation or at the time of closure), all varied with different authors,[9-13] making comparison difficult. Beyond the 5th day of surgery, when granulation tissue appears in the wound, closure is regarded as secondary.[14] Chiang *et al*.[11] (PC 38.9% vs. DPC 2.9%) and Duttaroy *et al*.[12] (PC 42.5% vs. DPC 2.7%) showed that SSI rate was significantly higher with DPC than PC. However, both studies had early wound failures that were not recorded as such, and the closure period was extended indefinitely, thus making the closure technique in these cases secondary instead of delayed primary. DPC did not prove to be effective in lowering SSI incidence in this study [Table 2]. On the contrary, SSI rate was shown to be higher in patients who had DPC compared to those in the PC group. This observation agreed with the work of Chatwiriyacharoen,[13] who recorded SSI incidence of 9.1% in the PC group against 27.3% in the DPC group. Three systematic reviews and meta-analyses of these wound management techniques indicate that DPC was not superior to PC.[8,15,16]

DPC was said to inhibit bacterial growth and reduced SSI rate by allowing drainage of blood and serum and providing the wound surface with a protective coating of fibrin, leukocytes, and capillaries.[17] The high rate of SSI in these wounds did not support this assumption. Although one of the two cultures that grew no organism belonged to this group, the absence of bacterial growth did not translate to the absence of infection.

E. coli is clearly the most commonly cultured organism in most studies of this kind in the literature.[2,10] This agrees with findings of the present study with *Klebsiella* as the second most common bacterial isolate. With the frequent dressing changes characteristic of DPC, exogenous bacterial wound contamination and subsequent infection with *S. aureus* were expected to be high, but only a few bacterial colonies of *S. aureus* were isolated in this series.

The recorded overall rate of wound dehiscence (26.5%) in this study [Table 3] was higher than the finding (16.66%) of Mehrabi Bahar *et al*.[18] The majority of the wound dehiscence occurred in relation to SSI (100% in this study).

An indirect indicator of adverse wound outcome measured in this study-LOS showed that patients who had DPC had longer confinement in the hospital than those in the PC group. This agreed with the work of Lemieur *et al*.,[9] who recorded a shorter LOS (PC 4.3 ± 0.8 vs. DPC 6.2 ± 0.8). In his study, DPC was performed on outpatient basis, and a readmission rate of 3.5% was incurred. Whether this finding can be duplicated in our environment, where the typical typhoid patient is often too ill and has yet to attain an afebrile state at this time, when a significant number of patients (>50%) are referred from out of town and where the community health delivery system is at most rudimentary, is doubtful. The longer LOS reflected the relatively high rate of SSI in both DPC and PC groups in the study. In spite of the prolonged LOS, most patients in the DPC group were discharged before complete wound healing compared to those in the PC group on POD 30 as documented by other authors.

The mortality rate recorded in this study was lower than the finding (10%) of Adesunkanmi and Ajao[19] However, his observation that fecal fistula adversely influenced mortality was consistent with the finding of this work, wherein the

two mortalities resulted from complications related to fecal fistula.

Conclusion

The SSI rate in DPC wounds was found to be higher than what was recorded against wounds that were primarily closed. This explained the correspondingly higher incidence of wound dehiscence, evisceration, incomplete wound healing before discharge, and a longer LOS in the DPC group. Therefore, PC of dirty abdominal wounds appeared safe for the pediatric population and should be advocated.

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Conflicts of interest

There are no conflicts of interest.

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