



Closure of Abdominal Incisions Following Laparotomy for Peritonitis in Children: Primary Closure or Delayed Primary Closure?

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Abstract

Background: There is need to determine the optimal management strategy for dirty abdominal surgical wounds. The aim of this study was to evaluate the post-operative wound complications in children whose dirty surgical wounds were closed primarily, in relation to those closed by delayed primary closure.

Materials and Methods: This was a prospective evaluation of children, aged 15 years and younger, who had laparotomy for peritonitis in a teaching hospital in Enugu, Nigeria. This study covered a 5-year period. The following data were evaluated: patients' age, gender, presenting symptoms, laboratory results at presentation, duration of symptoms before presentation, time interval between presentation and intervention, intra-operative finding, definitive operative procedure performed, complications of treatment, and outcome of treatment of the 2 groups of patients.

Results: A total of 204 cases of peritonitis in children were operated upon during the study period. The incisions were closed by primary closure (Group A) in 104 (51%) while 100 (49%) surgical wounds were closed by delayed primary closure (Group B). More males were involved. All the patients had abdominal pain and about half the patients were anemic and had electrolyte imbalance at presentation. Typhoid intestinal perforation was the most common cause of peritonitis and closure of ileal perforation was the most frequent performed surgical procedure. Comparing the 2 groups of patients, surgical site infection and stitch related were less common in group B patients whose surgical incisions were closed by delayed primary closure.

Conclusion: Delayed primary closure of dirty laparotomy incisions has less complication in terms of surgical site infection and stitch related complications. Therefore, delayed primary closure of dirty laparotomy wounds is advocated in pediatric population.

Keywords: Abdominal; Children Delayed; Incision; Primary Closure

Introduction

The job of a surgeon entails making incisions to access different organs and closure of the incisions. And a

laparotomy is a surgical procedure that involves a surgeon making a large incision in the abdomen and such incisions leave surgical wounds. Generally, wounds including surgically created wounds are classified based on the possible risk

of the wound infections. For instance, the risk of wound infection is more in dirty wounds such as seen in peritonitis [1,2]. The options of wound closure in peritonitis include primary closure or delayed primary closure and controversy exists pertaining to the preferred method of closure [3]. There are opinions that wound complications such as surgical site infections are more common in primary closure of laparotomy wounds in a background of peritonitis and therefore some authors advocate delayed primary closure of the skin and subcutaneous tissue [4,5]. Allowing surgical wounds open and managing the wounds by dressing used to be a common practice after laparotomy for peritonitis. However, the open management protocol is associated with attendant morbidity, increased hospital stay and financial cost [6]. The benefit of this study to clinical practice would be the adoption of the wound management strategy that reduces surgical site infection and its associated sequel. This study aimed to evaluate the post-operative wound complications in children whose dirty surgical wounds were closed primarily, in relation to those closed by delayed primary closure. For the purposes of this study, dirty surgical wounds refer to wounds in which there is a known infection (eg peritonitis) at the time of surgery. Delayed primary wound closure is a procedure of suturing a surgical wound after proper dressing for 3 to 5 days [7].

Materials and Methods

This was a prospective study of children aged 15 years and younger who had laparotomy for peritonitis between January 2016 and December 2020 at the pediatric surgery unit of Enugu State University Teaching Hospital (ESUTH) Enugu, Nigeria. Only children who were operated upon for peritonitis were recruited; those who were managed non-operatively (primary peritonitis) were excluded from the study. Consecutive patients with peritonitis who presented during the study period were recruited into the study. Children who had abdominal surgeries, resulting in peritonitis, in the peripheral hospital before presentation to ESUTH for reoperation were also recruited into the study. However, patients older than 15 years of age and those without peritonitis were excluded from the study. ESUTH is a tertiary hospital located in Enugu, South East Nigeria. The hospital serves the whole of Enugu State, which according to the 2016 estimates of the National Population Commission and Nigerian National Bureau of Statistics, has a population of about 4 million people and a population density of 616.0/km². The hospital also receives referrals from its neighboring state.

Pre-operative Protocol

On presentation to the outpatient clinic with abdominal and systemic symptoms, the patients were evaluated and

resuscitation. Counseling was done and informed consent obtained from the patients' caregivers. Specimens were collected for hematological and biochemical investigations. The patients were also sent for radiological investigations. Any derangements in the patients' results were corrected accordingly and patients were prepared for surgery. Diagnosis of peritonitis was made based on clinical examination (surgical abdomen) with or without radiological investigations. Ethical approval was obtained from the ethics and research committee of ESUTH.

Operative Procedure

Under general anesthesia and endotracheal intubation, access was through a transverse infraumbilical or supraumbilical incision as the case may be, depending on the pathology involved. The appropriate operative procedure was performed accordingly and the surgical incision closed either primarily or by delayed primary closure. The patients were categorized into 2 groups. Patients whose surgical incisions were closed by primary closure were categorized as Group A whereas Group B patients had delayed primary closure of their surgical incisions.

Post-operative Protocol

The patients were placed on intravenous fluids, analgesics and antibiotics. Oral intake was commenced when bowel function returned. The 2 groups of patients were compared in terms of post-operative complications. Statistical Package for Social Science (SPSS) version 21 (manufactured by IBM Corporation Chicago Illinois) was used for data entry and analysis. Data were expressed as percentages, median, mean, and range. The follow-up period was 12 months.

Data Collection

The following data were collected and analyzed: patients' age, gender, presenting symptoms, laboratory results at presentation, duration of symptoms before presentation, time interval between presentation and intervention, duration of hospital stay, intra-operative finding, definitive operative procedure performed, complications of treatment, and outcome of treatment of the 2 groups of patients.

Results

Patients' Demographics

A total of 204 cases of peritonitis in children were operated upon during the study period. The incisions were closed by primary closure (Group A) in 104 (51%) while 100 (49%) surgical wounds were closed by delayed primary closure (Group B). The mean age of the patients was 10

years with a range of 1 year to 15 years. One hundred and thirty-two (64.7%) patients were males whereas 72 (35.3%) patients were females. The mean duration of symptoms before presentation to the hospital was 5 days and the median interval between presentation and surgical intervention was 2 days. There is no need to wait when the diagnosis of peritonitis is made. The mean duration of hospital stay was 13 days, range 7-21 days.

Presenting Symptoms

There was abdominal pain in 204 (100%) patients, bilious vomiting in 188 (92.2%), fever 161 (79%) and abdominal distension 101 (49.5%) patients.

Laboratory Results

One hundred and three (50.5%) patients had deranged serum electrolytes (mostly sodium and potassium) at presentation. Anemia (hemoglobin level less than 10 grams per deciliter) was present in 111 (54.4%) patients. The anemia and electrolyte deficits were corrected. One hundred and ninety-four (95.1%) patients had raised white cell count (leukocytosis). Serum proteins were not done on the patients.

Radiological Investigations

All the patients had an abdominal ultrasound and plain abdominal and chest x ray. In the abdominal ultrasound, an echo rich peritoneal fluid was found in all the patients except in 11 (5.4%) patients. The radiographs showed air under the diaphragm in 69 (33.8%) patients.

Intra-Operative Finding

The intra-operative findings (diagnoses) are shown in (Table 1).

Intra-operative findings/ Diagnosis	Number of patients (%)	
	Group A	Group B
Typhoid intestinal perforation	68 (33.3)	64 (31.4)
Perforated intussusception	27 (13.2)	25 (12.3)
Ruptured appendix	9 (4.4)	7 (3.4)
Penetrating abdominal injury	2 (1)	2 (1)

Table 1: Intra-operative findings.

Definitive Operative Procedure Performed

The operative procedures carried out were dependent on the operative findings as depicted in (Table 2).

Diagnosis	Operative procedure	Number of patients (%)
Typhoid intestinal perforation	Closure of ileal perforation	132 (64.7)
Perforated intussusception	RHC + ITA	52 (25.5)
Ruptured appendix	Appendectomy + drainage	16 (7.8)
Penetrating abdominal injury	Repair of bowel perforation	4 (2)

Table 2: Definitive operation performed.

Outcome and Complications of Treatment of The 2 Groups of Patients

All the patients achieved good recovery except 18 (8.8%) patients in each group that expired secondary to severe sepsis. Twenty-one (10.3%) patients developed complications. The post-operative complications are illustrated in (Table 3).

Treatment complications	Number of patients	
	Group A	Group B
Surgical site infection	6	4
Stitch related complications	3	2
Intra-abdominal abscess	2	2
Abnormal scars	1	1

Table 3: Complications of treatment.

Discussion

A wound is a disturbance in the normal structure and function of a tissue and various mechanisms including surgery can cause wounds. Wound healing is a complex process that involves interdependent pathophysiological and immunological mediators to restore the cellular integrity of damaged tissue [8]. In ancient times dating back to 3500 BC, Egyptians closed wounds using plant fibres, hair, tendons and wool threads obtained from mummified remains [9]. Incomplete closure of the abdominal wall following laparotomy for dirty operations has the some demerits; increased cost of dressing changes, prolonged time to natural closure, patient's discomfort and dissatisfaction. However, delayed primary wound closure is advocated due to its simplicity, supposed prophylaxis against infection, closure at bedside and good scar appearance [10].

In the present study, slightly more surgical incisions were closed primarily because of the wish of the parents after

counseling. However, in terms of the pathologies, the patients were equitably distributed between the 2 patient groups. Overall, more males were affected. Other published series on pediatric abdominal surgical emergencies also reported higher incidence in males [11,12]. The exact explanation for the male dominance remains unknown. The mean age of the patients was 10 years in the current study. This mean age represents the average ages of the patients who presented with the varied pathologies necessitating the laparotomy. For instance, intussusception occurs mostly in infants whereas typhoid intestinal perforation occurs more in older children. The mean duration of symptoms before presentation to the hospital of 5 days is reflective of the delayed presentation witnessed in low income countries. Parental poverty and lack of awareness may account for this late presentation. The 48 hours interval between presentation and intervention was the time required for resuscitation and optimization of patients prior to surgery.

The presenting symptoms varied from one patient to another and one pathology to another. Peritonitis results from loss of integrity of the gastrointestinal tract which results in contamination of the peritoneal cavity by endogenous and exogenous bacteria [13]. Abdominal pain was a consistent clinical symptom in the patients. This finding is in line with the report of other studies [11,14]. The abdominal pain and rebound tenderness result from irritation of the parietal peritoneum from the peritonitis. Other symptoms such as vomiting and abdominal distension could be explained by the constipation and lack of effective prograde peristalsis.

At presentation, about half of the patients had electrolyte imbalance. Delayed presentation with the associated prolonged vomiting may explain the electrolyte imbalance. Hyponatremia and hypokalemia were the most common dyselectrolytemia. These abnormalities were corrected, during resuscitation, before the patients were taken to theatre for operative treatment. Anemia was present in more than 50 percent of the patients. The anemia may be preexisting from the primary pathology or may have resulted from sepsis or inadequate oral intake.

Typhoid intestinal perforation was the most common etiology and indication for peritonitis and laparotomy respectively in the current study. Other researchers also documented typhoid intestinal perforation as a common cause of peritonitis [15,16]. Typhoid intestinal perforation is a common surgical complication of typhoid fever and is linked with some morbidity particularly in low income countries Keenan JP, et al. [17], Ajao G [18]. Typhoid is involved in the ulceration of the lymphoid tissues (Peyer's patches) located at the terminal ileum resulting in bowel perforation. This leads to leakage of bacteria leading to superinfection of the peritoneal cavity by the gut flora culminating in peritonitis

[19]. Closure of the ileal perforation resulting from typhoid perforation was the most frequent operative performed in the index study. However, one study from Kano, Nigeria reported segmental ileal resection and end to end anastomosis as a treatment option for typhoid perforation [12]. Stoma creation (ileostomy) has also been proffered as a treatment option for typhoid ileal perforation [15].

Comparing the 2 groups of patients, surgical site infection was less common in group B patients whose surgical incisions were closed by delayed primary closure. It is postulated that delayed primary wound closure decrease bacterial inoculum; increase local wound resistance from increasing wound oxygenation and blood supply from developing granulation tissue [20,21]. Stitch related complications such as stitch sinus and stitch granuloma were more common in Group A patients whose wounds were closed by primary closure. The reason for this higher stitch related complication is not known. However, the nature of the sutures (monofilament/polyfilament) and method of wound suturing may be responsible. It's been published that wound related complications are more in multifilament sutures. Although multifilament sutures are easy to handle and have favorable knot-tying qualities, bacteria can enter the interstices and escape phagocytosis leading to infection, granulomas and sinuses [22].

Conclusion

Delayed primary closure of dirty laparotomy incisions has less complication in terms of surgical site infection and stitch related complications. Therefore, delayed primary closure of dirty laparotomy wounds is advocated in pediatric population.

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