Original Article

Access this article online
Website: www.afrjpaedsurg.org
DOI: 10.4103/0189-6725.125429
Quick Response Code:

Role of damage control enterostomy in management of children with peritonitis from acute intestinal disease

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ABSTRACT

Background: Intestinal anastomosis in severely ill children with peritonitis from intestinal perforation, intestinal gangrene or anastomotic dehiscence (acute intestinal disease) is associated with high morbidity and mortality. Enterostomy as a damage control measure may be an option to minimize the high morbidity and mortality. This report evaluates the role of damage control enterostomy in the treatment of these patients. **Materials and Methods:** A retrospective review of 52 children with acute intestinal disease who had enterostomy as a damage control measure in 12 years. **Results:** There were 34 (65.4%) boys and 18 (34.6%) girls aged 3 days–13 years (median 9 months), comprising 27 (51.9%) neonates and infants and 25 (48.1%) older children. The primary indication for enterostomy in neonates and infants was intestinal gangrene 25 (92.6%) and perforated typhoid ileitis 22 (88%) in older children. Enterostomy was performed as the initial surgery in 33 (63.5%) patients and as a salvage procedure following anastomotic dehiscence in 19 (36.5%) patients. Enterostomy-related complications occurred in 19 (36.5%) patients, including 11 (21.2%) patients with skin excoriations and eight (15.4%) with hypokalaemia. There were four (7.7%) deaths (aged 19 days, 3 months, 3½ years and 10 years, respectively) directly related to the enterostomy, from hypokalaemia at 4, 12, 20 and 28 days postoperatively, respectively. Twenty other patients died shortly after surgery from their primary disease. Twenty of 28 surviving patients have had their enterostomy closed without complications, while eight are awaiting enterostomy closure. **Conclusion:** Damage-control enterostomy is useful in management of severely ill children with intestinal perforation or gangrene. Careful and meticulous attention to fluid and electrolyte balance, and stoma care, especially in the first several days following surgery, are important in preventing morbidity and mortality.

Key words: Anastomotic dehiscence, damage control, entetorostomy, intestinal gangrene, intestinal perforation, peritonitis

INTRODUCTION

The morbidity and mortality rate following intestinal resection and anastomosis in very ill patients, for intestinal perforation or intestinal gangrene with peritonitis can be high in sub Saharan Africa,[1-3] with mortalities reaching 26–56% in neonates and infants.[2,3] Postoperative complications following anastomotic leak is also high especially in very ill patients. An alternative to intestinal anastomosis, in these situations, is the creation of an enterostomy as a temporizing measure (damage control or salvage). Such use of enterostomy, however, often generates controversy, especially in children, due to apprehension that the enterostomy is difficult to manage particularly in settings with limited resources.

This report evaluates the role of enterostomy as a damage control measure in a selected group of children with intestinal perforation or gangrene in presence of peritonitis.

MATERIALS AND METHODS

In the period January 2000-November 2012, 52 severely ill children had damage control enterostomy for extensive peritonitis (faeces, pus or both) from acute intestinal disease (intestinal perforation, intestinal gangrene or dehiscence of an intestinal anastomosis) at the Ahmadu Bello University Teaching Hospital, Zaria, Nigeria. The hospital records of the patients have been retrospectively reviewed.

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This paper was presented in part at the 11th Annual Meeting and Scientific Conference of the Association of Paediatric Surgeons of Nigeria (APSON) in Port Harcourt, Nigeria, 22-24 September 2011.

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Demographics, indications for surgery, location of enterostomy, post-operative complications and outcome were retrieved from the patient's case notes and operation notes. Decision to create an enterostomy was taken if the child was critically ill, and there was intraopereative finding of extensive peritoneal contamination with faeces or pus, grossly oedematous intestine after resecting macroscopically diseased intestine, intestine of questionable viability or gangrene, or leaking/dehisced intestinal anastomosis. Following enterostomy, the postoperative management protocol included:

1. Fluid and electrolyte administration and monitoring: In addition to fluid maintenance, ostomy effluent was replaced with appropriate intravenous fluid while waiting for re-establishment of bowel function; in the later part of the study, in those with high ostomy effluent, the proximal effluent was collected and infused into the distal stoma (mucus fistula), if there was no ileus.
2. Application of stoma appliance once proximal stoma begins to function with monitoring of stoma effluent, application of barrier cream (zinc oxide or petroleum jelly) to the peri-stoma skin, intravenous antibiotics administration and early and appropriate post-operative enteral nutrition as the patient's condition permitted.

There are two paediatric surgeons in this hospital and the decision to create a stoma is a division policy once the above mentioned conditions for creating an enterostomy were present.

RESULTS

There were 34 boys (65.4%) and 18 girls (34.6%) aged 3 days–13 years (median 9 months).

There were 27 neonates and infants aged <1 year [Table 1]. The indications for enterostomy in these patients were gangrenous intussusceptions 13 (48.1%), intestinal malrotation with gangrenous midgut volvulus 12 (44.4%), intestinal atresia one (3.7%) and necrotising enterocolitis one (3.7%). In 22 (81.5%) of these patients, enterostomy was a primary procedure and salvage procedure in five (18.5%). In 14 (51.9%) patients, the stoma was sited in the ileum with mucus fistula in colon, ileum alone in nine (33.3%) and in colon alone four (14.8%).

Twenty one (77.8%) of these patients developed postoperative complications, nine (42.9%) of which were directly related to the enterostomy procedure (enterostomy related complication rate of 33.3%) and 12 (57.1%) related to the primary disease [Table 2].

Fourteen (51.9%) of the patients in this age group died, 12 died shortly after surgery from the primary disease and two deaths were related to the enterostomy procedure (these two deaths were aged 19 days and 3 months and died from hypokalaemia after 4 and 12 days, respectively).

There were 25 children aged one year and older. The indications for enterostomy in these patients were typhoid ileal perforation 22 (88%), gangrenous intussusceptions 2 (8%) and intestinal malrotation

Table 1: Age and primary disease condition in 52 children requiring damage control enterostomy

Age (Years)	Typhoid ileal perforation	Intussusception	Intestinal malrotation and midgut volvulus	Intestinal atresia	Necrotizing enterocolitis	Total (%)
<1month	—	—	7	1	1	9 (17.3)
<1	—	13	5	—	—	18 (34.4)
1-4	4	1	1	—	—	6 (11.5)
5-9	9	—	—	—	—	9 (17.3)
10+	9	1	—	—	—	10 (19.2)
Total (%)	22 (42.3)	15 (28.8)	13 (25.0)	1 (1.9)	1 (1.9)	52 (100)

Table 2: Post-operative complications following enterostomy in 52 patients

Postoperative complications	Age (Years)					Total (%)
	<1 month	<1	1-4	5-9	10+	*n*=44
Related to primary disease						24 (54.5)
Septicaemia	4	4	1	4	1	14
Surgical site infections	—	4	1	3	2	10
Related to enterostomy						20 (45.4)
Skin excoriation	1	5	2	1	3	12
Hypokalaemia	1	2	1	2	2	8

with gangrenous midgut volvulus one (4%). In 14 (56%) patients, enterostomy was a salvage procedure and primary procedure in 11 (44%). The stoma was sited in the ileum in 24 (96%) patients and colon in one (4%).

Twenty three (92%) of the patients in this age group developed postoperative complications, 12 (52.2%) of which were related to the primary procedure and 11 (47.8%) were related to the enterostomy procedure (enterostomy related complication rate of 44%).

Ten (40%) of these patients died: Eight patients died shortly after surgery from the primary disease and two deaths were directly related to the enterostomy procedure (these were aged 3½ years and 10 years, and died after 20 and 28 days, respectively, from hypokalaemia).

Overall, the primary condition warranting enterostomy were mostly perforated typhoid ileitis 22 (42.3%), intussusceptions with intestinal gangrene 15 (28.8%) and intestinal malrotation with gangrenous midgut volvulus 13 (25%).

Overall, 14 of 33 (42.4%) patients, who had enterostomy as a primary procedure, died from the primary disease and 10 of 19 patients who had enterostomy as a salvage procedure following anastomotic dehiscence died. Twenty four (46.2%) patients died (typhoid ileal perforation 13, malrotation with gangrenous midgut volvulus six, intussusceptions with intestinal gangrene four and anorectal anomaly with ileal atresia one). Twenty (38.5%) mortalities were related to the primary disease and four (7.7%) were directly related to the enterostomy procedure.

Of the 28 surviving patients, 20 have had their enterostomies closed after 8 weeks-10 months (median 6 months). There was no anostomotic leakage following ostomy closure in any of these patients and they have remained well. Eight patients are awaiting closure of their stoma.

DISCUSSION

When there is intestinal gangrene and perforation in children, the decision to resect a diseased segment of intestine is usually straightforward. However, the clinical decision to subsequently perform a primary anastomosis or end colostomy/ileostomy or protect a distal anastomosis with a defunctioning stoma is often more complicated. While most surgeons agree that primary resection and anastomosis is growing in popularity,[4] intestinal anastomosis in the presence of peritonitis has always been a surgical challenge. Various techniques have been devised to improve the safety, but all are fraught with dangers of leakage.[5] Several factors affect the healing and success of an intestinal anastomosis include,[5,6] (a) well-nourished patient with no systemic illness, (b) no faecal contamination either within gut or in the surrounding peritoneal cavity, (c) adequate exposure and access, (d) well-vascularised tissues, (e) absence of tension at anastomosis and (f) meticulous technique.

The leading primary indication for performing an enterostomy in the present report was peritonitis due to typhoid perforation which is still prevalent in many developing countries.[2,7,8] Other indications for creating an enterostomy were intussusception with gangrenous intestine (29%), malrotation with intestinal gangrene associated with volvulus (19%) and to a lesser extent, ileal atresia and necrotising enterocolitis. Infants with intussusceptions in this setting often present late and intestinal gangrene may warrant resection. Our previous experience[9] showed that anastomosis in these patients often leak and when there is a leak, the risk of further leak is high if another resection and anastomosis is done.

Anastomosis, in emergency surgery, as in the setting of acute intestinal diseases, is often performed in critically ill patients under difficult situations. Some of the patients may be malnourished or have co-morbid conditions. Anastomotic leak rate following resection and anastomosis vary from 10% to 42.8%.[3,5]

The logical use of enterostomy as a damage control measure is based on the understanding of the pathologic changes and perverted function present in diseases associated with distension of the intestine, whether from obstruction or peritonitis. In the present report, 64% (n = 33) had enterostomy performed as a primary procedure. Patients, who were critically ill with the finding of extensive faecal peritonitis, grossly oedematous resected intestine, and intestine of questionable viability/blood supply, were given enterostomy as a primary procedure. Enough blood supply required to keep a segment of intestine viable may not be adequate for healing of an anastomosis. The adequacy of blood supply to the intestines also depends on the haemodynamic status of the patient. These points should be taken into consideration when deciding on the extent of resection when there is intestinal gangrene and whether an intestinal

anastomosis is safe or an enterostomy should be done. Where conditions for safe anastomosis cannot be guaranteed, an enterostomy as a primary procedure should be done. One-third of the patient in the present report had enterostomy as a salvage procedure following anastomotic dehiscence. One report has noted a dramatic decrease in mortality from 82.5% to 33.8% and later to 20% with enterostomy in postoperative peritonitis after anastomotic dehiscence.[12]

Intestinal anastomosis may be unsafe in critically ill patients with peritonitis from intestinal perforation, intestinal gangrene or anastomotic dehiscence. In this scenario, damage control enterostomy is required. The surgical options for such enterostomy may include:

1. Exteriorisation of the bowel ends (proximal end stoma and distal mucus fistula) after resecting the diseased segment. This was the choice in most of the patients in this report.
2. Exteriorisation of the site of perforation (after excision of edges of the perforation to healthy intestine) as a loop enterostomy. This was not used in the present report as the primary pathologies warranted resection of the diseased segment of intestine. This option is most suitable in situations where the intestine adjacent to the perforation is not significantly compromised.
3. Anastomotic enterostomy: This involves exteriorisation of the anterior wall of a partially dehisced anastomosis when up to 50% of the circumference of the wall is intact (after excision of the devitalised edges). If an intestinal resection has been done, the posterior wall is anastomosed and the anterior walls exteriorised as a loop stoma. In one report of 91 patients including adults and children,[10] this method was effective. This method is thought to facilitate subsequent enterostomy closure by extraperitoneal approach. We have, however, not used this technique in any of our patients.

There are several challenges following enterostomy. These challenges need to be carefully addressed to avoid serious complications and mortality:

1. Fluid and electrolytes: This is important especially in small bowel stoma located high in the ileum or jejunum. Due to high output of effluent, much fluid and electrolytes can be lost and need to be meticulously replaced. Intravenous replacement is critical until the intestine begins to adapt and the stoma output reduces. Hypokalaemia is common and potassium replacement should be included in the fluid management, if there are no contraindications to potassium administration.
2. Nutrition: Although parenteral nutrition is useful, this is not readily available in this setting. We have relied largely on early enteral feeding (soon as intestinal function returns) using protein-rich enteral diets. When the output is high, collecting the proximal stoma effluent (without sterilisation) and re-infusing it into the distal stoma (mucus fistula) was useful in a few patients. In one report,[11] including children and adults, it was noted that it was not necessary to sterilize the effluent before reinfusion as the bacterial concentration of the re-infused fluid averaged 10^5/ml. In another report[14] of 30 patients with peritonitis and stoma or fistula, re-infusion of proximal effluent into the distal intestine significantly reduced the proximal stoma output. This can be useful in controlling fluid and electrolyte loss, but we have only used this in a few patients.
3. Peri-stoma skin care: In small bowel stomas, peri-stoma skin excoriations can readily occur. It's important that peri-stoma skin care begins immediately after surgery to avoid the complication. In our setting, zinc oxide cream and petroleum jelly were effective. After about 4-6 weeks, the risk of excoriation often reduces as the skin appears to adapt but skin care must be maintained until the time of stoma closure.

The overall complication rate in the present report was high at 85%. Previous reports have noted a complication rate of 20.8-68% following enterostomy.[13-15] The high complication rate in the present report may be due to the fact that those enterostomies were created using intestine of tenuous viability, in patients with poor nutritional status and ongoing sepsis. However, 55% of these complications were related to the primary disease and 45% directly related to the enterostomy procedure.

Mortality has been reported with enterostomy done for peritonitis from perforation or obstruction in infants and children. More number of deaths was reported in patients operated for peritonitis than for intestinal obstruction. Many factors influencing the deaths in children are younger age, delayed presentation, longer interval between presentation and operation, sepsis, peritonitis, multi-organ failure.[3,7] The overall mortality in the present report was 46% but most were from the primary disease condition and 8% directly related to the enterostomy procedure, from hypokalaemia. Weber *et al*.,[15] evaluated enterostomies in newborns and found an overall morbidity of 28.3%. They put emphasis on

the fact that early and late mortality is due to coexisting diseases, prematurity, short-bowel syndrome, liver failure and sepsis and is not usually caused by a complicated enterostomy course. In another report of 334 children (excluding neonates, atresias, anorectal malformations, Hirschsprung's disease, trauma and tumours) with peritonitis,[16] 44 (13.2%) required terminal ileostomy. Of 290 that did not have ileostomy, 28 (9.7%) needed re-exploration for anastomotic leak, burst abdomen or faecal fistula, while three (6.8%) of the ileostomy group needed to be re-explored. Mortality in the ileostomy group was 1.8% compared to 8.4% in the group that did not have an ileostomy, and mortality from stoma closure was 2.6% from convulsion. This report and our experience suggest that enterostomy is safe and may improve outcome in children with peritonitis from acute intestinal disease.

CONCLUSION

Enterostomy as a damage control or salvage measure in very ill children with intestinal perforation and gangrene with severe peritonitis, oedematous intestine and whenever intestinal viability is in question is useful in minimizing mortality and should be used where necessary. Careful attention to technical details at stoma creation and meticulous attention to fluid and electrolyte balance and stoma care, especially in the first two weeks following surgery, are important in preventing morbidity and mortality. A randomized, controlled, comparison of damage control enterostomy with primary anastomosis would be needed but this may present ethical challenges.

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Cite this article as: Ameh EA, Ayeni MA, Kache SA, Mshelbwala PM. Role of damage control enterostomy in management of children with peritonitis from acute intestinal disease. Afr J Paediatr Surg 2013;10:315-9.

Source of Support: Nil. **Conflict of Interest:** Nil.