Original Article

Necrotizing Enterocolitis: Results of Surgical Treatment

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Abstract

Background: Necrotizing enterocolitis (NEC) is a common surgical emergency in developed countries and is a major cause of death in neonates. Because of the limited survival of preterm newborns, the incidence of NEC is low in developing countries. In developing countries, there is a dearth of published articles regarding the surgical management of NEC. This study evaluates the results of surgical treatment of necrotizing enterocolitis in Nigeria.

Patients and Methods: Fifty eight neonates were treated for NEC at the Jos University Hospital (JUTH) over a 14 year period. Forty-two had surgery and have been retrospectively reviewed.

Results: Twenty seven (64.3%) were males and 15 (35.7%) were females. The mean gestational age was 37.4 ± 2.4 weeks. The average birth weight was 2.1 ± 0.42 kg, while the age at presentation was 3.3 ± 1.6 days. The clinical features included constipation in 33(78.6%) patients, abdominal distension in 30(71.4%), vomiting in 19(45.2%), bloody stools in 16(38.1%) and jaundice in 10(23.8%). There were twenty three neonates with isolated NEC, 15 with multifocal NEC and 4 with pan-intestinal involvement. Fourteen (33.3%) patients had single perforations while 8(19.1%) had multiple perforations. Initial surgery was resection and primary anastomosis in 23 patients, enterostomy only in 11, and laparotomy only in 4 patients with pan NEC. In patients with isolated NEC, survival rate was higher after resection and primary anastomosis compared with enterostomy (82.4% versus 66.7%, $P < 0.05$), but in patients with multifocal NEC, survival rate was not affected by the modality of operative treatment (37.5% versus 42.9%, $P > 0.05$).

Conclusions: Early operation is advised in the management of complicated or advanced necrotizing enterocolitis in the developing countries with paucity or lack of facilities for TPN and NICU.

Keywords: NEC, resection and anastomosis, enterostomy, outcome of treatment.

Introduction

With improvements in neonatal intensive care and survival rates of low birth weight babies, necrotizing enterocolitis (NEC) has become the most common gastrointestinal emergency amongst infants in neonatal intensive care units. The incidence of NEC is increasing, but the survival rate is not[1-2]. Reports are scanty in developing countries but with improved perinatal care and the emergence of intensive care units, the incidence is expected to rise in these countries.

Medical management is usually adequate for NEC, however, surgical treatment is considered if medical treatment is inadequate to control the spread of the disease or there is evidence of complications such as intestinal gangrene or perforation. There is no consensus in the literature regarding the optimal treatment strategy for patients who require surgical intervention[1,3]. A number of surgical options are available depending on the clinical condition of the infant and the extent of the disease. This ranges from peritoneal

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drainage, diverting enterostomy, 'clip and drop', to resection of the diseased bowel and primary anastomosis[3-5]. Although resection and primary anastomosis has been proposed as a valid treatment modality in neonates with both focal and multifocal disease[4] its advantage over stoma or peritoneal drainage formation is still controversial[1,4]. The present study evaluates the results of surgical treatments of necrotizing enterocolitis (NEC) at JUTH, Jos in Nigeria.

Patients and Methods

The records of all neonates with NEC who had surgery at JUTH during the last 14 years (January 1990- September 2004) were retrospectively studied to assess the role of primary bowel resection in the outcome of surgical management of NEC. The data analysed included birth weight, gender, gestational age, clinical presentation, duration before surgical intervention, extent of disease and surgery, complication and outcome. SPSS statistical software was used to analyze the data and Chi-Square was used to test statistical significance.

Results

A total of 58 neonates were treated for NEC within the period, but records were available in 52. Forty-two of these 52 neonates who had surgical intervention were analysed. Twenty seven (64.3%) were males and 15 (35.7%) were females (M: F=1.2:1). The mean gestational age was 37.4 ± 2.4 weeks (range: 34-42 weeks). The average birth weight was 2.1 ± 0.42kg (range: 1.65-3.4kg) while the age at presentation was 3.3 ± 1.6 days (range: 1-8 days). The mean duration of symptoms before presentation was 3 ± 1.6 days (range: 1-8 days). The clinical features included constipation in 33(78.6%) patients, abdominal distension in 30(71.4%), vomiting in 19(45.2%), passage of bloody stools in 16(38.1%) and jaundice in 10(23.8%). Thirty and 15 patients each, were previously fed orally with formula feeds and mother's breast milk, respectively, for varied periods before the onset of illness. The remaining 15 patients had not been fed orally, but were on intravenous fluid infusions because their illness was suspected early enough. The mean core body temperature was 35.9^{0}C (range: 34.5-38^{0}C). More than half of the patients

Table 1:
Core body temperature in 42 children with NEC

Temperature range (^{0}C)	Number of Patients	(%)
34.5 - 35.0	5	11.9
35.5 - 36.0	6	14.3
36.5 - 37.0	24	57.1
37.5 - 38.0	7	16.7

Table 2:
Sites and number of perforations in 22 children with NEC

Site and type of perforation	Number of Patients	(%)
Single perforation involving:		
Terminal ileum	8	19.0
Ascending colon	6	14.3
Multiple perforations involving:		
Terminal ileum and ascending colon	4	9.5
Terminal ileum, ascending and transverse colons	4	9.5
Total	22	52.3

Table 3:
Sites of NEC & Operative procedure in 42 children at JUTH

Site of NEC	Operative Procedures		
	Primary Anastomosis	Enterostomy Only	Laparatomy Only
Ti	14(33.3%)	3(7.1%)	-
Ac	2(4.8%)	2(4.8%)	-
Tc	1(2.4%)	3(7.1%)	-
Ti/Ac	5(11.8%)	1(2.4%)	-
Ti/Tc	2(4.8%)	0	-
Ac/Tc	1(2.4%)	2(4.8%)	-
Ti/Tc/Ac	2(4.8%)	0	-
Pan NEC	-	-	4(9.5%)
Total	27(64.3%)	11(26.2%)	4(9.5%)

PRA = Primary resection and anastomosis
TI = Terminal ileum, Ac = Ascending colon,
Tc = Transverse colon.

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Table 4:
Outcome of surgical treatment of children with NEC at JUTH

Type of NEC	Type of treatment and outcome								
	Resection and anastomosis			Enterostomy			Laparatomy only		
	Alive	Dead	Total	Alive	Dead	Total	Alive	Dead	Total
Isolated NEC	14	3	17	5	3	8	-	-	-
Multifocal NEC	4	6	10	1	2	3	-	-	-
Pan NEC	-	-	-	-	-	-	-	4	4

were hypothermic at presentation (Table 1).

Initial management consisted of nil food by mouth, passage of orogastric tube for gastric decompression, intravenous fluid infusion and broad-spectrum antibiotics. All the patients had laparotomy after the resuscitation. Twenty three patients had isolated NEC [terminal ileum in 14(33.3%), ascending colon in 5(11.9%) and transverse colon in 4(9.5%)]. Fifteen other patients had multifocal NEC, involving the terminal ileum and ascending colon simultaneously in 6(14.3%), ileum and transverse colon in 3(7.1%), ascending and transverse colon in 4(9.5%) and a combination of ileum, ascending colon and transverse colon in 2(4.8%) patients. The remaining 4 patients had pan-NEC involving the entire intestine. Intestinal perforations (with intraperitoneal abscess collection) occurred in 22(52.4%) patients, 9 (40%) of whom had associated jaundice (Table 2).

The surgical treatment included resection and primary anastomosis without enterostomy in 27 (64.3%) patients, resection and enterostomy in 11(26.2%), but the 4(9.5%) patients with pan NEC had only laparotomy with no resection or enterostomy (Table 3). Of those who had resection and primary anastomosis, 17(63.0%) had isolated NEC while 10(37.0%) had multifocal NEC. In the resection and enterostomy group, 8 (72.7%) and 3(27.3%) patients had isolated and multifocal NEC, respectively. All patients had antibiotic treatments for varying periods. The outcome of the surgical treatment is shown in Table 4.

Table 5:
Postoperative complications in children managed for NEC in a Nigeria tertiary hospital in the year 1990-2004

Complication	Number of Patients	%
Sepsis	35	15
Pneumonia	31	13
Adhesive intestinal obstruction	18	8
Anastomotic leakage	8	3
Metastatic abscesses	8	3

Postoperative complications are shown in Table 5, and included sepsis, pneumonia, adhesive obstructions, anastomotic dehiscence and intra-abdominal faecal leakage, metastatic abscesses in the scalp and subcutaneous tissues. The severity of the disease and the treatment option had no bearing on the complications observed. The overall postoperative mortality rate was 42.9%. The mortality rate in isolated NEC treated by resection and anastomosis was 17.6% while the same type of NEC treated by resection and enterostomy had a mortality rate of 33.3% ($P < 0.05$). On the other hand, multifocal NEC treated by resection and anastomosis, and by resection and enterostomy had mortality rates of 62.5% and 57.1%, respectively ($P > 0.05$). All the 4 patients with pan NEC died. There was a significant correlation between age at presentation and outcome of operative management ($P = 0.01$). The duration of symptoms correlated inversely with survival ($P = 0.01$). Ninety percent (9) of those with jaundice died ($P = 0.01$).

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Causes of death included infection and electrolyte imbalance. There was a strong correlation between jaundice and mortality rate (P= 0.01).

Discussion

Our study shows that laparotomy with resection and primary anastomosis is a valid treatment option in both isolated and multifocal NEC. In developed countries the surgical treatments of necrotizing enterocolitis (NEC) in neonates have impressive outcome, largely because of availability of intensive care facilities and total parenteral nutrition (TPN)[6]. In developing countries, there is a dearth of published articles regarding the surgical manage-ment of NEC. Early operative treatment may play a crucial role in the successful outcome of management of neonates with NEC in developing countries because of their inherent resource constraints[6] and lack of TPN[10]. In many developed countries, peritoneal drainage (PD) is being employed as the initial surgical treatment strategy for complicated NEC[7]. There is no doubt that PD is a useful manoeuvre in the resuscitation of critically ill infants, and may even avoid further operation completely on occasion, but 26% to 83% of patients who have PD would subsequently require laparotomy for worsening disease[7]. The role of PD in the management of NEC remains controversial. In developed countries PD is mainly employed in treating very low birth weights (usually < 1kg). In our setting such small babies hardly survive, which is why PD is hardly used to manage these patients. Moreover, laparotomy in very small neonates has become safer with improvements in anaesthesia and intensive care management in many of our institutions. With the current peri-operative management, mortality rates for initial laparotomy are comparable to those of PD[7]. Mortality rate following PD is cited as high as between 21% and 47%[3,8,9]. Hopefully, some of the questions regarding the role of PD would be addressed when the results of a randomized trial by Moss and several participating US centers (based at Yale) comparing laparotomy/resection versus PD which has been going on for almost 4 years, is finally published .

Gollin et al[3] reported a prolonged interval between PD and full enteral nutrition, and substantial incidence of non-abdominal infectious complications and cholestasis in patients managed by PD. In developing countries with a dearth of facilities like TPN[10] that is required for intensive supportive care during PD, early open operative treatment remains the preferred management option. In a study by Banieghbal and colleagues, early surgery increased survival rate from 21% to 84% in NEC patients[6]. Laparotomy must always be preceded by adequate resuscitation and clinical stability. One of the advantages of initial laparotomy is that it makes possible the assessment of the extent of disease and removing necrotic bowel, thereby hastening recovery and eventual discharge while enabling informed surgical decision making and advice to parents. One dreaded complication of NEC and its surgery is short gut syndrome. The absence of this sequela in our report may be a reflection that babies with such syndrome hardly survive in our environment.

Controversy still exists as to whether resection and primary anastomosis has any advantage over stoma formation. In the present study, enterostomy was associated with a higher mortality rate than resection and anastomosis in isolated NEC. The difference in mortality rate between resection and anastomosis and enterostomy in multifocal NEC is not statistically significant. Although our data suggest that enterostomy is a more risky operation, this is not likely the true situation because enterostomy was performed in patients with more

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severe disease and therefore the mortality associated with it is likely a reflection of the severity of disease in this group. It is difficult to conclude at this stage due to the non-randomization of this study.

Operative treatment resulted in 57.1% survival rate among our patients. This compares favourably with other reports[4,11]. Most of those who presented late beyond three days had jaundice. The jaundice could have resulted from septicaemia-induced haemolysis because most of them were also septic. The combination of late presentation and jaundice had associated 90% post-operative mortality rate. We agree that in such babies with very serious conditions, laparatomy, even under local anesthesia, and subsequent "second look" surgery[12] may suffice. The 42.9% mortality rate in our study compares favourably with those in other reports[8,11,13]. Based on our findings in this study, early operation is advised in the management of complicated or advanced necrotizing enterocolitis in the developing countries with a dearth of facilities for TPN and neonatal intensive care unit (NICU).

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