Peritoneal drainage for newborn intestinal perforation: primary treatment or unnecessary delay?

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Background **Peritoneal drainage (PD) was introduced 30 years ago as a temporizing treatment for extremely ill newborns with intestinal perforation (IP). Subsequent reports have shown it to be helpful as a definitive treatment, whereas others have labeled it as an unnecessary delay before laparotomy.**

Methods **This is a retrospective analysis of all newborns (2004–2009) with presumed IP treated with PD irrespective of gestational age or weight. Drainage was achieved with a single Penrose drain placed between incisions in each lower quadrant. This was followed by extensive irrigation. Laparotomy was performed if needed for progressive sepsis, intestinal stricture, or persistent leak. Parameters analyzed included gestational age and weight, time before IP, findings at drain placement, and need for subsequent operations.**

Results **Drains were placed in 24 consecutive newborns with IP. The median gestational age was 29 weeks and weight was 755 g. IP was confirmed in nine (38%) by free air on radiograph. In 15 newborns, PD was performed for progressive sepsis and succus was identified in 11 (73%). The overall mortality rate was 33% (25% in newborns <1500 g, 75% in those >1500 g). No parameters were statistically significant in predicting mortality. PD served as a definitive treatment without the need for further laparotomy in 50% of survivors.**

Conclusion **PD with extensive irrigation for newborns with IP has an acceptable mortality rate. It is not a delay tactic but serves as a definitive treatment for 50% of survivors. Children weighing more than 1500 g and those without succus at the time of drain placement should, however, receive laparotomy as the primary treatment. *Ann Pediatr Surg* 9:54–57 © 2013 Annals of Pediatric Surgery.**

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Introduction

Peritoneal drainage (PD) was first described as a temporizing measure for the treatment of extremely ill newborns with intestinal perforation (IP) [1]. Subsequent reports advocate PD as a definitive treatment in selected subgroups [2–4], whereas others consider PD to be simply an unnecessary delay in treatment [5]. This study evaluates the use of PD, with a more extensive drainage technique than described previously, as the initial treatment for all newborns with IP from perforated necrotizing enterocolitis (NEC) or spontaneous IP.

Materials and methods

This is a retrospective review of newborns receiving PD as the initial treatment for IP by a single pediatric surgeon (D.E.M.) in four hospitals (Del Sol Medical Center, Las Palmas Medical Center, Providence Memorial Hospital, and Thomason General Hospital) in El Paso, Texas, USA. Permission was obtained from the IRB of each hospital. The diagnosis of IP was made by identifying free air on abdominal radiograph or by clinical deterioration of the newborn while on maximum medical treatment. All newborns with suspected IP, irrespective of weight or gestational age, were treated with PD performed in the newborn ICU using local anesthesia and intravenous analgesia. A 1/4-inch (0.6 cm) incision was made in the left lower abdominal quadrant. The peritoneum was entered bluntly and a hemostat was gently directed just inside the peritoneal cavity to the right lower abdominal quadrant. A counter incision was made in the right lower quadrant onto the hemostat. A 1/4-inch Penrose drain was then placed between the two incisions. Peritoneal irrigation, with the neonate sedated, was performed at the time of PD and once or twice per day until no further intestinal contents were obtained. During irrigation, the Penrose drain ends were lifted anteriorly to functionally open the drainage incisions. Warm normal saline was irrigated with the tip of a 60 ml catheter tip irrigating syringe placed into one drain tract at a time allowing egress through the opposite side. The abdomen was then massaged to facilitate further egress. Normally, much more succus was evacuated with manipulation than when the irrigant was simply left in the abdomen to egress spontaneously (Fig. 1). In one patient, the drainage hole was made too large, resulting in a small evisceration. After a simple reduction, a single suture was placed under direct vision to return the functional size of the incision to 1/4-inch, which prevented further evisceration. If the child did not show improvement within the first 24 h after drain placement or if there was deterioration at any time, laparotomy was performed. Enteral feeds were started when the child was stooling and the gastric residuals were low. The drain was discontinued 24 h after there was no further drainage of intestinal contents. Contrast radiographs were obtained only for signs of stricture or leak. Subsequent operative procedures were performed as needed for stricture or

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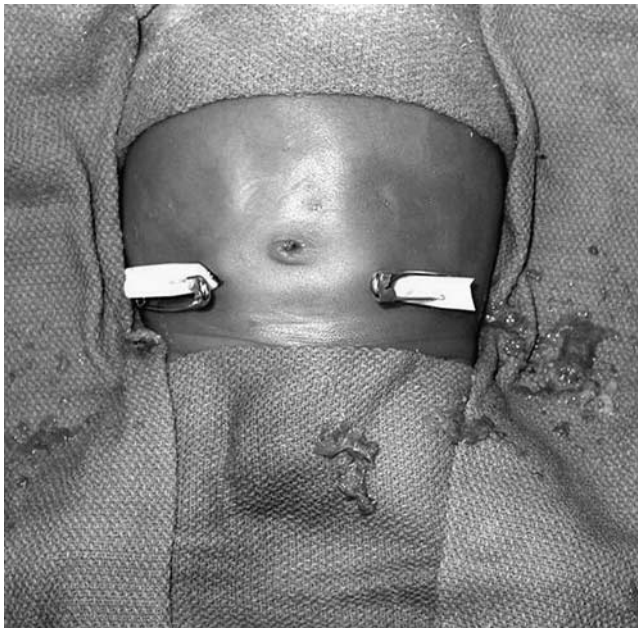
Fig. 1



Succus entericus well evacuated after Penrose drain placement and copious irrigation (see text).

other intestinal complications. Data analysis included gestational age and weight, time from birth to IP, findings at PD, need for subsequent operations, and 90-day mortality rate as the ultimate outcome parameter.

Results

Twenty-four consecutive newborns with presumed IP underwent drain placement from January 2004 to January 2009. The median gestational age was 29 weeks (range: 22–41 weeks) and weight was 755 g (range: 430–2101 g). The diagnosis of IP was made by finding free air on abdominal radiograph in nine (38%) children. Indications for PD in the other 15 (62%) included progressive abdominal distention, abdominal compartment syndrome, abdominal wall discoloration, and progressive sepsis despite maximum medical therapy. In 11 (73%) of these 15 children without pneumoperitoneum on radiograph, the diagnosis of IP was confirmed by finding succus entericus on placement of the drain. Eight (33%) of the 24 newborns in this series died, but only six (25%) died as a direct result of the intestinal complications. One child died from a respiratory event 11 days after drain placement and another from encephalopathy 23 days after drain placement. The mortality rate for children less than 1.5 kg was 25% (five deaths, 20 children), but it was 75% (three deaths, four children) for those greater than 1.5 kg as shown in Table 1. The median interval between drain placement and death was 4 days (range: 1–50 days). Intestinal contents (air, succus entericus) were identified at the time of drain placement in 20 (83%) newborns, and five (25%) of these subsequently died. In four (17%) of the newborns with presumed IP, intestinal contents were not identified and three (75%) died. The median time of drain removal in children who did not die or undergo laparotomy in the first 14 days after drain placement was 5 days (range: 4–9 days).

Table 1 Outcome related to weight

	Total series	<1500 g	>1500 g
Number of patients	24	20	4
Weight range (g)	430–2101	430–1323	1530–2101
Deaths [*n* (%)]	8 (33)	5 (25)	3 (75)
Survivors [*n* (%)]	16 (67)	15 (75)	1 (25)
Number of survivors not needing subsequent operations [*n* (%)]	8 (50)	7 (47)	1 (100)

Eleven children (46%) underwent operative procedures 1–51 days after drain placement. Three children underwent laparotomy within 48 h of drain placement. Only two underwent operation because of clinical deterioration after drain placement. Both of these were found at laparotomy to have NEC totalis and died. The third child improved clinically, but an IP was observed through the right lower quadrant drain site on the first postoperative day of irrigation, and this perforation was simply exteriorized as an ileostomy while peritoneal cavity irrigation continued through the left lower quadrant drain site. Subsequent operations for the other eight children (3–51 days after drain placement) included exploration for progressive or relapsing sepsis, continuing large-volume intestinal drainage, intra-abdominal abscesses, and intestinal obstruction secondary to strictures and adhesions. PD served as a definitive treatment, without the need for subsequent operations, in eight (50%) of the 16 survivors. None of the parameters analyzed in this small series reached statistical significance in predicting mortality, but weight more than 1500 g and the absence of intestinal contents at the time of drain placement were suggestive of mortality.

Discussion

There are ~17 000 births/year in El Paso, Texas, USA. El Paso County, with a population of 750 000, is the third poorest County in the USA and is grossly underserved with healthcare professionals, particularly pediatric subspecialists. Throughout the 5-year period of this study, there were no fellowship-trained pediatric anesthesiologists practicing in El Paso, and at the beginning of the treatment period, one of the authors (D.E.M.) was the only pediatric surgeon in the USA within a range of 350 miles of El Paso. The *modus operandi* was therefore to achieve the best results with the least operation possible. At the beginning of the treatment period of this study, there was no national or international consensus as to whether PD was as good as laparotomy in the management of newborns with IP, and neither was there consensus as to whether PD, if used at all, should be used as a temporizing measure or as definitive therapy. Even though more studies have been published during the treatment period [5–8], there is still no clarity as to the role of PD in the management of newborns with IP. This study was carried out retrospectively to assess the outcome of PD as the initial treatment for all newborns with IP in our locale and to compare these results with published national and international studies in order to provide evidence-based data for formulating future treatment protocols.

Ein *et al*. [1] published the first series of five newborns treated with PD as a temporizing measure for very ill, premature infants with suspected IP. Over the next 21 years, this same Toronto group published four subsequent reports. The first two [9,10] suggested that PD may actually serve as definitive therapy for IP. The third one [11] reported significantly better survival with PD in infants with a weight of less than 1000 g but better survival with laparotomy in larger infants. The last report [12], however, pointed out that because of significant advances in anesthetic, surgical, and neonatal care, most infants with IP should now be treated with laparotomy, with PD used only as a temporizing measure in small critically ill infants. Some authors [2] recommend PD as the initial treatment for all infants with IP, whereas others recommend PD as the initial treatment in newborns less than a certain weight [3,4]. Laparotomy is recommended as the preferred treatment for all infants with perforated NEC by other authors [13–15]. Two multicenter, prospective, randomized studies comparing PD with laparotomy have been published and have reached different conclusions. The first study by Moss *et al*. [6], carried out in the USA and Canada, found no difference in outcome in the entire group of 117 infants or in any of the subgroups studied. They concluded that 'the type of operation performed for perforated necrotizing enterocolitis does not influence survival or any clinically important early outcomes in preterm infants'. The second study by Rees *et al*. [5] randomized 69 patients from 18 neonatal centers in eight countries to PD or laparotomy. They concluded that 'primary intraperitoneal drainage is ineffective as either a temporizing measure or definitive treatment' for neonatal IP. Blakely *et al*. [16] and Guner *et al*. [8] concluded, after literature reviews, that the type of surgical approach initially selected likely makes no difference in the early mortality rate for IP from NEC, and that major advances in outcomes of infants with NEC and IP will probably not emerge from a better operation but from improvements in medical treatment and in the prevention of NEC.

The only generally accepted absolute indication for operation in children with NEC is IP. Clinically, however, there is a problem in the prompt and proper diagnosis of IP. Finding free air on an abdominal radiograph is certainly the most definitive way to make the diagnosis, but waiting for identification of free air can delay the recognition and treatment of IP for several hours. Abdominal paracentesis [17] has also been suggested as a method for the detection of IP. The method used in this study, in addition to serial abdominal radiographs to look for free air, was to follow the child's clinical course, including the abdominal exam (particularly progressive discoloration or increasing abdominal girth and pressure), respiratory function, and sepsis parameters. Fifteen children in this series underwent PD without radiological evidence of free air, and 11 (73%) did indeed have perforation. Three of the four children without identifiable perforation at the time of drain placement died.

The purposes of PD are to reduce intra-abdominal compartment pressure and to evacuate intestinal contents from the peritoneal cavity. The most commonly described technique for drain placement involves the placement of a Penrose drain through a small incision in either the right or the left lower abdominal quadrant with or without irrigation through the single drainage site. One investigative report [18] has described the importance of continuous peritoneal irrigation to remove endotoxin and cytokines after laparotomy for perforated NEC, but there are no published reports using continuous irrigation without laparotomy. Our technique of drainage, irrigation, and abdominal massage using a single Penrose drain passed between two lower abdominal incisions (see the Materials and methods section) provides, at least theoretically, very good abdominal compartment decompression and better egress for intestinal contents than does a single drain.

Ninety-day mortality and need for further operations after PD were the outcome measurements for this study. Our mortality rate of 33% (25% in neonates <1500 g) is comparable to the rates in the large, multicenter, randomized series [5,6]. The reason for the increased mortality (75%) in children weighing more than 1500 g in this series cannot be explained. The consensus from most published reports, even those advocating PD as the primary treatment, is that PD, if used at all in older neonates with IP, should be used only as a temporizing measure until laparotomy can be performed [11]. We now routinely perform laparotomy for stable neonates weighing more than 1500 g in our practice. Another factor that approached but did not reach statistical significance as a predictor of mortality in this series is the lack of identification of intestinal contents at the time of drain placement, with three out of four (75%) of these newborns dying. These deaths were probably from massive NEC that had not yet perforated or from overwhelming sepsis from another source causing abdominal distention from a septic ileus. The poor outcome in this small subset of our study patients, although statistically insignificant, has led to a modification in our treatment plan so that newborns without succus entericus or free air at drain placement now undergo an exploratory laparotomy to look for a treatable source of the sepsis.

Our data show that PD serves as the only operative treatment needed in a large percentage (50% of survivors) of newborns with IP. This is comparable to published rates in centers that favor PD as the primary treatment [3,4,11] and much better than the 11% rate in the international, multicenter study by Rees *et al*. [5], in which no form of irrigation through the drain was recommended for participating centers. Perhaps with aggressive drainage and irrigation, as performed in our study, more of their children could have been treated successfully with PD alone. It was quite evident while placing drains and vigorously irrigating in our series of newborns that simple drain placement without irrigation is grossly inadequate for evacuating the intestinal contents from the peritoneal cavity.

Conclusion

PD as the primary treatment for newborns with IP has a mortality rate at least comparable to that of laparotomy as the initial procedure, and 50% of our survivors after PD did not need subsequent laparotomy. As our results with

PD and aggressive irrigation as the primary procedure are at least comparable to published reports using laparotomy, we plan to continue with the *modus operandi* that 'the least (PD) is best' for our locale. However, laparotomy has replaced PD as the primary procedure in infants weighing more than 1500 g, and laparotomy is now expeditiously performed in all newborns when intestinal contents are not identified at the time of drain placement.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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