

Neonatal gastrointestinal perforation is a major challenge; A retrospective study

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ABSTRACT

Objectives: The objective of our study was to study the outcome of the perforated gut in the neonatal age group in our institute in relation to the personal data (age, sex), the operative details (abdominal incision, peritonitis & collection, the type of the performed procedure, the type, site and cause of the perforation) and the length of the hospital stay.

Material and methods: The records of all neonates with perforated gut, who were admitted to the Pediatric Surgery Department, Faculty of Medicine, Alexandria University, between January 2015 and November 2017 were retrospectively reviewed. The personal data (age, sex), the operative details (abdominal incision, peritonitis & collection, the type of the performed procedure, the type, site, and cause of the perforation) and the length of the hospital stay were collected and analyzed. All of the previously enumerated factors were correlated to the final outcome of the patients. Patients with incomplete data were excluded from our study.

Results: Our study included 44 neonates; all of them were under one month old. The patients were divided into three groups (A, B, and C) according to their final outcome. Patients of group A were those who had been discharged after surgical exploration, patients of group B were those who died after surgical exploration and patients of group C who died before any surgical exploration. So the actual mortality rate in our study, including both patients of group B and group C (18 patient) was 40%. Sealed perforation was found in 2 patients, solitary perforation in 28 patients and only nine patients had multiple perforations. Nothing had been done for the two patients with sealed perforation; however, four patients had direct closure of their perforated loop, three patients had resection anastomosis of the perforated loop, and 31 patients had a stoma. Birth weight, prematurity, and the amount of peritoneal collection were the only factors which had a statistically significant effect on the fate of our studied patients.

Conclusion: Neonatal perforated gut had a high mortality rate which could be affected by birth weight, prematurity and the amount of peritoneal collection

Key words: Perforation, gastrointestinal, pediatric, mortality, stoma

Introduction

Perforated gut in the neonatal age group is considered one of the major abdominal emergencies in this age group and presents a special challenge. This is due to its high mortality rate reaching 15-70% especially in

premature patients [1]. These high mortality rates occur despite the great advancement in anesthesia and neonatal care [2].

Many causes may be responsible for this situation including necrotizing entero-colitis, intestinal atresia,

malrotation, Hirschsprung's disease etc [3].

Treatment of perforated gut is mainly surgical except in certain situations. One of these situations is when anesthesia is considered unsafe as in case of severe associated co-morbidities &/or multi-organ failure. Another indication of conservative management of perforated gut in neonates is the absence of radiological evidence of perforation as in case of sealed perforation.

The surgical approach depends upon the local abdominal findings and the abdominal exploration usually begins by drainage of any peritoneal collection followed by the treatment of the site of perforation either by direct closure, resection-anastomosis or by stoma construction. An abdominal drain may or may not be inserted and the final diagnosis is usually confirmed by intestinal biopsy. However, no single approach proved to change the morbidity and mortality of perforated gut in the neonatal age group [4].

The aim of the work

The aim of our work was to study the final outcome of neonates with perforated gut in our institute in relation to their personal data (age, sex), operative details (abdominal incision, peritonitis & collection, type of procedure done, type & site & cause of perforation) and the length of hospital stay.

Materials and Methods

In less than three years extending from January 2015 to November 2017; 44 neonates with perforated gut were admitted and treated at our institute. The hospital records of these patients were reviewed retrospectively and the following data were collected including: personal data (age at presentation, sex), operative details (type of abdominal incision, peritonitis & peritoneal collection, type of the procedure done, details of the perforation) and the length of hospital stay.

The studied patients were divided into 3 groups according to their final outcome: group A, group B and group C. Group A included the patients who had been explored, improved and discharged from the hospital after surgery, group B included the patients who had been explored but died after surgery and group C included the patients who died before any surgical exploration due to their bad general condition at presentation. These groups of patients were compared according to the previously enumerated data.

Results

Group A included 26 patients (59.1%), group B included 13 patients (29.5%) and group C included only 5 patients (11.4%). So the actual mortality rate in our study including both patients of group B and group C (18 patient) was 40%.

Patients of group C who died before any surgical exploration were excluded from the statistical analysis as the final diagnosis was not confirmed because they had not been explored and the diagnostic biopsy was not taken and so we were not sure about the final diagnosis. Again it is not allowed in our country to do autopsy routinely and so we did not confirm the final diagnosis among those patients. The analytic study compared patients of group A and patients of group B (39 patients) according to different parameters.

There was a male predominance with a male: female ratio being 3:1. However, the difference in sex distribution among the studied patients didn't affect the outcome significantly (Monte Carlo test, $X^2=1.292$, $P=0.606$).

The weight of the studied patients was 0.7-4.7 kg with a mean of 2.78 ± 1.49 kg. The mean weight was higher in group A (3.64 ± 1.01 kg) than in group B (1.07 ± 0.40 kg); this difference had a statistically significant effect on the outcome. (Student t test, $t=8.7149$, $p<0.00001$)

All of the studied patients were in the neonatal age group with a mean age of 11.2 ± 9.8 days; this difference didn't exert a statistically significant effect on the outcome (Kruskal Wallis test, $X^2=0.737$, $P=0.96$).

From the 39 explored patients; 17 patients were premature and 22 patient were full term; premature patients had a higher mortality rate (64%) than full term neonates (9%). This difference was statistically significant (chi-square test, $p=0.000259$). Our study included only 4 patients with associated congenital heart disease in the form of patent foramen oval and VSD.

All of the studied patients had a plain X-ray abdomen standing which was done on admission. It revealed air under diaphragm, radio-opaque evidence of peritoneal collection and air fluid levels in all patients.

The length of the hospital stay varied among the studied patients from 1 day to 25 days with a mean of 8.5 ± 6.23 days; however, this variation didn't show

Table 1. The fate of different diseases with perforated gut.

Disease	Group A	Group B	Total
HD	5	1	6
NEC	16	10	26
Hernia	1	0	1
Gastritis	2	0	2
Appendicitis	0	2	2
Ileal atresia	2	0	2
Total	26	13	39

Fisher's Exact, P=0.38

Table 2. The types, frequency, and effect of exploratory incisions on the outcome.

	Group A	Group B	Total
Right transverse	14	6	20
Midline	9	4	13
Left paramedian	2	0	2
Supraumbilical	0	1	1
Left transverse	1	2	3
Total	26	13	39

Monte Carlo
X²=4.638
P=0.336

Table 3. Type of peritoneal collection.

	Group A	Group B	Total
Feculent	21	11	32
Pyogenic	4	2	6
Hemorrhagic	1	0	1
Total	26	13	39

Monte Carlo
X²=4.638
P=0.336

statistical significance (Kruskal Wallis test, X²=5.67, P=0.059).

The explored patients showed different causes of perforation. The highest incidence was due to NEC which was detected in about 67% of patients followed by perforated Hirschsprung's disease in 15% of patients. Different disease frequencies among our studied patients and their relation with the final outcome is shown in table 1. This difference in the cause of perforation didn't affect the outcome significantly (Fisher's Exact, P=0.38). The predisposing factor of perforation was confirmed by the result of the biopsy.

There were different exploratory incisions according to the doctors' preference, the expected cause of perforation, and the planned management strategy. The preferred incision was the right transverse supra-

Table 4. Table showing the number of perforations among the studied patients.

	Group A	Group B	Total
Solitary	20 (71.4%)	8 (28.6%)	28 (100%)
Multiple	4 (44.4%)	5 (55.6%)	9 (100%)
Sealed	2 (100%)	0 (0%)	2 (100%)
Total	26 (66.7%)	13 (33.3%)	39 (100%)

Monte Carlo
X²=3.286
P=0.225

Table 5. Table showing the site of perforations among the studied patients.

	Group A	Group B	Total
Rectum	1	1	2
Sigmoid colon	10	3	13
Transverse colon	2	1	3
Caecum	4	0	4
Ileum	4	7	11
Stomach	2	0	2
Sigmoid and ascending colon	1	0	1
Caecum and ileum	1	0	1
Sealed	1	1	2
Total	26	13	39

Monte Carlo
X²=9.682
P=0.293

Table 6. Table showing the type and frequency procedure done among the studied patients.

	Group A	Group B	Total
Trimming and direct closure	2	2	4
Resection anastomosis	3	0	3
Stoma	20	11	31
Sealed perforation (Nothing)	1	1	2
Total	26	13	39

Monte Carlo
X²=3.296
P=0.213

umbilical one which was done in 20 patients (51%). No single exploratory incision showed a statistically significant effect on the final outcome of the studied patients as shown in table 2. (Monte Carlo X²=4.638 P=0.336)

The type of the peritoneal collection varied among the explored patients being feculent, pyogenic or hemorrhagic with variable frequencies. The difference in the type of abdominal collection didn't affect the outcome significantly. (Monte Carlo, X²=4.638, P=0.336, Table 3).

The amount of the peritoneal collection varied between group A and B being about 10.69±3.25 cc)

Table 7. Type and frequency of constructed stoma among the studied patients.

	Group A	Group B	Total	
Simple loop sigmoid colostomy	4	0	4	Monte Carlo X ² =18.525 P=0.13
Double divided sigmoid colostomy	1	1	2	
Simple loop left transverse colostomy	2	0	2	
Double divided left transverse colostomy	1	0	1	
Simple loop right transverse colostomy	4	1	5	
Double divided right transverse colostomy	0	1	1	
Terminal ileostomy + Ascending mucous fistula	3	1	4	
Double divided ileostomy	2	6	8	
Simple loop ileostomy	1	0	1	
Tube ileostomy	0	1	1	
Terminal transverse end colostomy+Hartmann's pouch	1	0	1	
Gastrostomy	1	0	1	
Total	20	11	31	

in group A and (27.23±8.69 cc) in group B. This difference was statistically significant (student t test, t=8.65141, p<0.00001)

Surgical exploration revealed perforated gut with variable sites and number among the studied patients. There was a single perforation in 28 patients, two perforations in 9 patients and sealed perforation in the remaining 2 patients. The number of the perforations didn't affect the outcome significantly; however, mortality was higher in patients with multiple perforations than in patients with solitary perforation. (Table 4)

The location of these perforations varied among the studied patients with the highest frequency being in the sigmoid colon and in the ileum. The site of the perforation didn't affect the final outcome significantly as shown in table 5.

The affected part of the gastrointestinal tract was managed differently among the explored patients. The two patients who had sealed perforation had nothing done to the suspected site of perforation and only peritoneal lavage with insertion of abdominal drains had been done for them. On the other hand, different procedures were done for the perforated loop among the remaining 37 studied patients according to the clinical situation and their local peritoneal and bowel condition. These procedures included: trimming and direct closure of the perforation, resection anastomosis or stoma formation with most of the explored patients (80%) had stoma without any statistically significant

effect on the final outcome as shown in table 6. (Monte Carlo X²=3.296 P=0.213). The data regarding the length of the resected bowel segment was missing from the hospital records so we have not a clear relation between that and the surgical outcome.

There were different stoma types and sites in the 31 patients who had a stoma. The different types and frequencies were shown in table 7 without any effect on the final outcome. (Monte Carlo X²=18.525 P=0.13)

A surgical abdominal drain was inserted before surgery in all of the 5 patients of group C who died before surgical exploration as well as another patient who belongs to group B. An intra-operative abdominal drain was inserted in all of the explored patients; insertion of an abdominal drain at the end of the exploration did not affect the final outcome of the studied patients significantly. (Fisher's Exact P=0.33)

Postoperative follow up revealed 2 patients with wound infection who were treated by frequent dressing and discharged after complete healing

Discussion

Perforated gut is considered a major factor of morbidity and mortality in the neonatal age group despite the great advances in anesthesia and neonatal care [5].

Our study revealed a mortality rate of 40% which was presumably attributed to that it included patients of group C who died shortly after admission before exploration due to their bad general condition. Also it included patients of group B who died postoperative

due to their deteriorated general condition as most of those patients had been diagnosed as having NEC. This mortality rate is similar to other studies in which it may reach 45%. This high mortality rate in these conditions may be explained by the fact it usually affects vulnerable premature and low birth weight neonates [2].

The incidence of perforated gut in the neonatal age group is more common in males than in females. Our study revealed 3:1 male to female ratio. The male frequency was double that of females in Chen JC et al study [5].

The mean age at presentation was about 11.2 ± 9.8 days which was nearly the same as in other studies discussing this topic. In Charu Tiwari et al study the mean age was about 11.4 days [6].

The weight of the studied patients affected their final outcome after surgery significantly with a higher mortality rate in low birth weight neonates who are considered as vulnerable candidates. This is similar to the findings of Hyginus EO et al study [2].

Premature neonates had a higher mortality rate than full term neonates in our study which was statistically significant. Hyginus EO et al also concluded that prematurity affects the post-operative outcome significantly in case of neonatal perforated gut [2].

NEC was responsible for most of the perforations in our study (67%). This is similar to what had been concluded in Hyginus EO et al study in which he concluded that perforated bowel has many etiologies in the neonatal age group and detected that NEC was the most common cause [2].

Surgery is the mainstay in the treatment of perforated gut in neonates, however some contraindications may preclude that. Contraindications for surgical exploration include major factors preventing safe anesthesia like heart failure, respiratory failure or multi-organ failure. Again absence of the evidence of generalized peritonitis, sealed perforation as revealed by contrast study or parental refusal are also considered as contraindication of surgery [7].

There were different approaches for the management of the perforated gut in our study. And as a basic rule in surgery is to have an incision that will be comfortable for the surgeon and provide adequate access to the area of pathology [8].

All of the studied patients suffered from peritonitis and peritoneal collection which varied in its nature being feculent, pyogenic or hemorrhagic; however without statistical significant effect on the outcome. Peritonitis usually develops in neonates with perforated gut like what had been concluded in Faltyn J et al. study in which all of the studied patients suffered from peritonitis [8].

The pattern and site of gut perforation had been changed over the last 20 year from gastric perforation to NEC perforations which became the most common cause for neonatal emergency surgery [9].

Analysis of the collected data revealed a higher incidence of perforation in splenic flexure (Griffith's point), ileocecal region and rectosigmoid region (Sudeck's point). These are the most vulnerable points for vascular insult in the colon known as watershed areas having poor or absent anastomoses of the marginal arteries [10].

Our study revealed only 2 cases with gastric perforation and the remaining 37 patients had intestinal perforations most of them due to NEC.

Patients with multiple perforations had a higher mortality rate than those with solitary perforation but without statistical significance. On the other hand, Hyginus EO et al concluded in their study that the number of perforations is a major risk factor of mortality in neonatal gut perforation [2].

All patient with gangrenous loop had been resected with approximately 80 % of these patients had a stoma due to their bad general condition, the presence of severe peritonitis with an intra-peritoneal collection or suspected Hirschsprung's disease. Stoma construction is the most common approach in the literature in the treatment of neonatal perforated gut. Occasionally bowel perforation may be sewn closed and in other condition in case of good general and local peritoneal condition; direct anastomosis could be done [8].

Insertion of an abdominal drain as a preliminary or a definitive treatment in patients with perforated gut had been studied in many studies. Pre-operative insertion of an abdominal drain is recommended in case of the bad general condition in which the surgery is contraindicated. In our study, an abdominal drain was inserted in all of the patients of group C as well as one patient of

group B on admission due to their bad general condition as well as alleviation of the high intra-abdominal pressure which was interfering with respiration. In our study, none of the patients who had preoperative abdominal drain survived due to their bad general condition before surgery; this was not statistically significant. Other studies like Donald E et al. one concluded that peritoneal drain as the primary treatment for neonates with perforated gut has a mortality rate at least comparable to that of laparotomy as the initial procedure [11].

Conclusion

Neonatal perforated gut has a high mortality rate with the highest frequency being in patients diagnosed as having NEC. Birth weight, prematurity and the type of peritoneal collection can affect this outcome significantly.

Ethical committee: The study had been approved by our ethical committee

Conflict of interest statement

The authors have no conflicts of interest to declare.

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