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ORIGINAL ARTICLE

Evaluation of Gastrointestinal Perforations in Newborns: A Single Center Experience

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Abstract

Introduction: Gastrointestinal perforations (GIPs) are problems with high mortality in the neonatal period. In the present study, the purpose was to share our experiences on GIPs in the neonatal period.

Methods: A total of 28 patients who were followed up and treated in the Neonatal Intensive Care Unit between 2005 and 2020 were evaluated retrospectively with risk factors, characteristics, clinical and laboratory findings, and mortality rates.

Results: There were a total of 16 male (57.1%) and 12 female (42.9%) patients 15 of whom were (53.6%) preterm, 13 (46.4%) were term. The mean birth weight was 2162±855 g. The most common cause of perforation was necrotizing enterocolitis with 16 cases. Perforation sides were jejunoileal in 17 cases, colon in eight cases, duodenum in two cases, and stomach in one case. A total of 12 of the cases (42.8%) were lost due to perforation. Statistically significant relations were detected between birth weight and gestational age and mortality.

Discussion and Conclusion: GIPs appear as an important reason for mortality during the neonatal period. It is important to be careful because of perforation-related mortality in infants with low birth weight and low gestational age.

Keywords: Gastrointestinal perforation; mortality; newborn.

The prevalence of neonatal gastrointestinal perforation (GIP) is reported to be 0.6–1.3%[1,2]. Despite the improvements in intensive care and anesthesia, the mortality of GIP varies in different series is as high as 15–70% during this period[3-5]. The perforation may be related to a variety of reasons such as necrotizing enterocolitis (NEC), intestinal atresia, malrotation, Hirschsprung's Disease, etc. Radiographically detected pneumoperitoneum on clinical suspicious patients is considered to be an indicator for intestinal perforation, showing the necessity of surgery in treatment.

This study was conducted to evaluate the risk factors, clinical and laboratory findings, and mortality rates of patients diagnosed with neonatal GIP in the neonatal intensive care unit (NICU), to investigate the factors affecting prognosis, and to review our experience.

Materials and Methods

Twenty-eight patients with GIP, among the 3217 patients who were followed up in the NICU between 2005 and 2020, were included in the study. The data were obtained from the Patient Registration Program of the institution. Patients whose file data could not be obtained, or who had missing data, patients who underwent primary peritoneal drainage, and whose perforation was not surgically treated were excluded from the study. The surgical decision was made according to the deteriorating of the patient's clinical findings, free air, air-fluid level, and constant intestinal loop in the roentgenography. Oral nutrition was stopped in all patients who were clinically considered to have intra-abdominal pathology. Parenteral nutrition and intravenous antibiotic therapy were started. Antibiotic treatment was

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revised according to the response and culture analysis results of the patient. The diagnosis of perforation was based on the presence of pneumoperitoneum on X-ray and/or operative findings. This study was approved by the Local Ethics Committee (2020-11/26).

Patients data were retrospectively evaluated and recorded in terms of gender, gestational week, type of birth, birth weight, APGAR score, need for resuscitation in the delivery room, need for respiratory support, graphical findings, presence of anomalies, causes of perforation, side of perforation, laboratory findings, and mortality.

The patients were classified by gestational week and also birth weight. According to the gestational week, the cases were divided into two groups; Group A (n=6) consisted of patients born under 32 weeks, and Group B (n=22) consisted of patients born at 32 weeks or more. According to the birth weight, the cases were divided into four groups. Those with a birth weight below 1000 g were classified as Group 1, 1000–1500 g Group 2, those between 1500 and 2500 g as Group 3, and those above 2500 g were classified as Group 4.

Statistical Analysis

Statistical analysis was performed using the SPSS version 23.0 for Windows (SPSS, Inc., Chicago, IL, USA). Comparisons of the variables with the normal distribution were carried out using the Shapiro-Wilk Test. The Pearson's Chi-square and the Fisher Exact tests were used for comparisons of the categorical variables. Statistical analysis was performed between dependent variables and independent variables using binary logistic regression. The values for all parameters were expressed as mean ± standard deviation, and a $p<0.05$ was considered indicative of statistical significance.

Results

A total of 28 neonates with GIP, 12 girls (42.9%) and 16 boys (57.1%), whose weights varied between 910 and 3550 g (mean 2162±855 g) were evaluated retrospectively. Gestational weeks were between 26 and 40 weeks. Among these cases, 64.3% were born with cesarean delivery and 35.7% were born with normal vaginal birth. Mothers' mean age was 29.6±6 years, and 8 mothers were nulliparous (28.6%), 20 mothers (71.4%) were multiparous. A total of 14 neonates (50%) underwent resuscitation in the delivery room. Respiratory support (Mechanical ventilation, Positive Pressure Ventilation, Hood or Nasal Oxygen) was needed in 17 cases (60.7%). A total of 15 of the cases with a median gestational week of 35.5 weeks (53.6%) were preterm, 13 (46.4%) were term (Table 1).

Table 1. Characteristics of cases according to gestational age and birth weight

	Gestational Age		Birth Weight			
	Group A (<32 weeks)	Group B (≥32 weeks)	Group 1 (<1000 g)	Group 2 (1000–1500 g)	Group 3 (1500–2500 g)	Group 4 (≥2500 g)
n (%)	6 (21.4)	22 (78.6)	3 (10.7)	5 (17.9)	10 (35.7)	10 (35.7)
Female/Male	2/4	10/12	0/3	3/2	4/6	5/5
Gestational age (weeks), mean±SD	27.5±1	36.2±2.4	28.5±3.87	29.1±2.24	35.4±2.83	37.7±0.67
Birth weight (g), mean±SD	1084±153	2455±716	951±37	1152±121	2071±210	3121±243
Hospitalization time, days, mean±SD	1±00	2.4±2.7	1.3±0.57	1±00	1±00	4±3.43
Operation time, days, mean±SD	15.6±9.89	8.09±7.13	13.3±14.97	17.6±9.31	6.9±4.50	7.5±6.43
Perforation cause						
NEC	5 (83.3%)	11 (50%)	2 (66.6%)	5 (100%)	5 (50%)	4 (40%)
NonNEC	1 (16.7%)	11 (50%)	1 (33.4%)	0 (0%)	5 (50%)	6 (60%)
Perforation area						
Stomach	0	1	0	0	1	0
Duodenum	0	2	0	0	2	7
Jejunoileal	4	13	2	3	5	3
Colon	2	6	1	2	2	0
Length of stay, days, mean±SD	27.5±12.6	38.5±30.9	32±19.28	24.2±9.23	39.1±18.7	40.6±42.7
Result						
Discharge	1	15	0	1	7	8
Death	5	7	3	4	3	2

NICU: Neonatal intensive care unit; NEC: Necrotizing enterocolitis; Non-NEC: Non-Necrotizing enterocolitis; SD: Standard deviation.

When we classified them according to birth weight, there is six patients in Group A (Gestational week <32 weeks) and 22 patients in Group B (Gestational week ≥32). Group 1 consisted of 3 patients (10,7%) and 2 of them died with a diagnosis of NEC and one with a diagnosis of spontaneous intestinal perforation (SIP). Five cases (17.9%) were followed up due to NEC in Group 2 and 4 cases died. Three of 10 cases (35,7%) died in group 3 and the reasons for perforation were NEC in two patients and duodenal atresia in one case. Two of 10 cases (35.7%) died in Group 4. These two cases were diagnosed with Type 3B jejunoileal atresia (Table 1).

A total of 13 cases (46.4%) had additional anomalies, and 15 (53.6%) did not have any anomalies. Duodenal Atresia was detected in three cases, Hirschsprung's Disease was detected in 2 cases. The other anomalies were ileal atresia, malrotation, colonic atresia, cystic fibrosis, renal agenesia, hepatosplenomegaly, hydrocephalus, and syndromic appearance.

Abdominal distension was the first finding in 82.1% of the cases, and bile-vomiting and inability to defecate were the first findings in only 5 cases. Surgery was decided according to the direct X-ray and clinical conditions of all patients. Free air was detected in 84.3% of the cases with X-ray; air-fluid level, gas-free abdomen, and constant dilated intestinal loop were found in the other cases.

The mean ages of surgery, mortality, and discharge of the cases were 9.7±8.23 (1–30) days, 12±10.2 (1–30) days, and 7.9±6.03 (2–24) days, respectively. The mean length of stay in the hospital was 36.2±28.2 (2–127) days. This period was 29.4±19.4 (2–74) days in cases that died, and 41.3±32.9 (3–127) days in discharged cases. Ileal perforation was detected in 15 of the cases, colonic in eight, jejunal in two, duodenal in two, and gastric perforation in one case (Table 2).

A statistically significant relation was detected between gestational week and mortality (p=0.024), the mortality rates were 83.3% in Group A and 31.8% in Group B. Similarly, birth weight and mortality were determined, and the mortality rate increased as birth weight decreased (p=0.02).

A Logistic regression analysis was carried out with mortality as the dependent variables, and birth weight, gestational week, maternal age, parity, APGAR score, causes of perforation, and side of perforation as the independent variables. It was demonstrated that mortality in the neonate with GIP was significantly related to the birth weight (p<0.05).

No statistically significant relations were found between mortality and route of delivery, cardiopulmonary resuscitation, respiratory support, resuscitation in the delivery room, parity, Apgar score, hemoglobin value, platelet count, c-reactive protein value, blood culture, cause of perforation, side of perforation (p>0.05).

Discussion

Respiratory Distress Syndrome and prematurity are the first reason among the causes of death in NICU. The other reasons are sepsis, congenital anomalies, and perinatal as-

Table 2. Characteristics of cases according to discharged and mortality

	Discharge	Mortality	Total (n)
(n)	16	12	28
Female/Male	8/8	4/8	12/16
Gestational age (weeks), mean±SD	35.7±2.90	32.5±5.16	34.36±4.25
Birth weight (g), mean±SD	2503±675	1707±882	2162±855
Hospitalization time, days, mean±SD	2.81±3.08	1.16±0.38	2.1±2.45
Operation time, days, mean±SD	7.93±6.03	12.08±10.29	9.71±8.23
Perforation cause			
NEC	8	8	16
Non-NEC	8	4	12
Perforation side			
Stomach	1	0	1
Duodenum	1	1	2
Jejunoileal	10	7	17
Colon	4	4	8
Length of stay, days, mean±SD	41.31±32.97	29.41±19.71	36.21±28.25

NICU: Neonatal intensive care unit; NEC: Necrotizing enterocolitis; Non-NEC: Non-Necrotizing enterocolitis; SD: Standard deviation.

phyxia. Despite the improvements in neonatal care (ventilator management, antibiotics, and other medications, operations, and anesthesia e.g), GIPs still emerge as a serious problem with a high mortality rate (15–70%)[3-5] by causing sepsis, though it has a low incidence as a 0.6–1.3%[1-2].

Mechanical obstructions were the most important cause of GIP until the 1960s. Because of the advanced supportive care in NICU and correspondingly increases in the survival rates of premature and extremely low birth weight infants, NEC became the most common cause of intestinal perforation in neonates[4,6,7]. Mechanical ventilation, distal gastrointestinal obstructions, Hirschsprung's Disease, SIP, and iatrogenic traumas were also observed to be less common causes.

The neonatal GIP frequency was 0.87% in our study. In terms of the etiology, 16 cases (57.1%) had NEC, 9 (32.2%) cases had mechanical obstruction (duodenal atresia, jejunoileal atresia, volvulus). The other three cases were ventriculoperitoneal shunt, Hirschsprung disease, and SIP. Although meconium ileus was found to have roles between 10% and 12.5% in GIP etiology in the literature, we did not detect ın our series[6,8].

In the physical examination, in addition to the symptoms of ileus (abdominal distension, biliary vomiting, failure to pass stool), erythema, and a palpable mass in the abdominal wall can be detected[9]. Abdominal distension was detected in 82.1% of our cases, other accompanying findings were bile-vomiting and failure to pass meconium.

GIP is diagnosed after clinical suspicion with imaging methods. Standing direct abdominal or lateral decubitus radiographs allow intraperitoneal free air to be detected. Abdominal radiography was performed to evaluate GIP in our clinic, and free air was detected under the diaphragm in 18 cases (64.3%), though it may not be presented in cases with GIP. Singh et al.[10] detected pneumoperitoneum in 63% of their cases, and Saraç et al.[11] in 87% of their cases. Pneumoperitoneum was not detected in 10 of our cases, and there were constant dilate intestinal loop, air-fluid level, and gas-free abdominal graphic findings.

The mortality of patients with GIP in the neonatal period was 42.9% in our series. NEC was the most common reason for the died (67%). The relation between the side of perforation and mortality is not clear. Neonatal colonic perforation is rarely seen in this period with high mortality. Tan et al.[12] and St-Vil et al.[6] reported mortality as 19% and 40%, respectively. They also reported that the mortality rate was less in small intestine perforations, and showed that the survival rates were 82% and 91%. In our series, the mortality of patients with colon perforation was 50% (4/8), jejunoileal perforations was 41% (7/17). The higher rates may be related to the low number of cases, having severe additional anomalies, and/or low birth weights. Additional anomalies were detected in 8 cases with jejunoileal perforation, and 4 of them died. The birth weight of 4 of the cases with jejunoileal perforation, who also died, was 1500 g and below. The frequency of gastric perforations constitutes 7% of all perforations in the neonatal period[13]. In our series, gastric perforation was detected in one case with duodenal atresia, and the patient was discharged without any problems.

GIP-related NEC is seen more likely in low birth weight patients[14-16]. A total of 16 of our cases were diagnosed with NEC; 8 (50%) of whom died, and 5 were infants with low birth weights.

The risk of NEC, the probability of surgical intervention, and mortality rate increase in infants with the low birth week[17]. In our series, a total of 5 out of 6 infants with 31 weeks and earlier died; three cases had jejunoileal perforation, and two cases had colonic perforation.

Conclusion

In conclusion, NEC is currently the most important cause of neonatal GIP etiology. The prognosis of the cases is related to the gestational week, birth weight, and having additional congenital anomalies. Patients diagnosed with NEC should be followed in terms of perforation. When perforation is suspected, laparotomy should be performed without delay. Delaying the premature birth of infants with low birth weights can be able to provide preventable pathologies like NEC; perforation and mortality will be reduced, and survival will be increased.

Ethics Committee Approval: This study was approved by the Local Ethics Committee (2020-11/26).

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