



Prognostic factors and concomitant anomalies in neonatal gastric perforation



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ABSTRACT

Objective: Neonatal gastric perforation is a rare and serious issue. This study aimed to highlight the vital clinical features and identify prognostic factors in such cases.

Design, setting, patients, interventions, and measurements: Medical charts from January 1997 through December 2008 were reviewed retrospectively. Neonates with a diagnosis of gastric perforation were included.

Results: Thirteen patients were identified with a male:female ratio of 9:4. Five (38%) were preterm infants. The mortality rate was 30% (4/13), and the median age of onset was 3 days (range: 1–14 days). The most common presenting sign was abdominal distension, followed by respiratory distress and vomiting. Except for one patient in whom gastric perforation was diagnosed during surgical repair for gastroschisis, all patients had pneumoperitoneum on admission; 70% and 46% of patients had peritonitis and sepsis, respectively. Concomitant gastrointestinal (GI) tract anomalies or disorders included ischemic bowel/necrotizing enterocolitis (5 patients), intestinal malrotation (2), duodenal web (1), hiatal hernia (1), and gastroschisis (1), which necessitated secondary operations during hospitalization in 5 patients. Seven patients had leukopenia on admission, and 9 developed thrombocytopenia in the following 48 h. All patients who died presented with leukopenia on admission and thrombocytopenia in the following 48 h, yielding sensitivity and specificity rates of 100% and 67%, respectively. **Conclusions:** Neonatal gastric perforation is often concomitant with GI anomalies or inflammatory/infectious disease. Patients who were outborn and those with leukopenia, peritonitis, and thrombocytopenia development within 48 h were at risk for poor outcome.

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Neonatal gastric perforation (NGP) is a rare, serious, and life-threatening issue [1–4]. Although many theories regarding the pathogenesis of gastric perforation have been proposed, the etiology remains varied [5]. NGP can occur in patients with mechanical obstruction distal to the stomach, such as duodenal atresia or malrotation [5], or with iatrogenic perforation (e.g., feeding tube placement). Early diagnosis is difficult because most patients usually present with nonspecific signs such as abdominal distension and lethargy.

Although NGP has been attributed to varying causes, it is likely the end result of a variety of causes either alone or in combination [1]. Hence, the mortality and morbidity associated with NGP may be directly or indirectly related to these causes. Mortality rates as high as 70% have been reported with NGP [6], although early diagnosis and immediate

hemodynamic and respiratory management can improve these rates. The prognostic factors have been discussed but remain controversial.

The purpose of our retrospective study was to identify the anomalies associated with NGP and to determine the prognostic factors of mortality and severe sequelae.

1. Materials and methods

Between January 1997 and December 2008, neonates with gastric perforation who were admitted to the neonatal intensive care unit (NICU) at Chang Gung Memorial Hospital were identified from our database. Chang Gung Memorial Hospital is a tertiary care pediatric teaching hospital affiliated with Chang Gung University. Our NICU is a national referral center with 120 NICU beds. Here, 150 newborns are admitted per month, of which 44% are premature. The medical charts were reviewed retrospectively. Demographic data, including birth weight, gestational age at birth, gender, parity, mode of delivery, requirement for resuscitation in the delivery room, and Apgar scores, were recorded.

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A maternal history of premature membrane rupture, presence of chorioamnionitis, or administration of antenatal steroid therapy was also documented. Clinical information such as the age of onset, presenting symptoms and signs, laboratory data, results of body fluid cultures, imaging findings, use of inotropic agents, ventilator support, associated anomalies, pathological reports, and survival was reviewed. Moreover, operative findings, size and location of the perforation, and complications were documented. Leukopenia was defined as a white blood cell count <5000 per mm³, and thrombocytopenia was defined as a platelet count <100,000 per mm³. Patients with severe sequelae were defined as those who either died or exhibited complicating short bowel syndrome.

Statistical analysis was performed using SPSS for Windows (version 11.0; SPSS Inc., Chicago, IL, USA). Discrete variables were analyzed using the Fisher's exact test. Continuous variables were analyzed using the Student's t-test and the Mann–Whitney U-test for nonparametric data. Statistical significance was defined as a p-value of <0.05.

This study was reviewed by the local institutional review board and was exempt from requiring approval.

2. Results

Thirteen neonates with gastric perforation were identified. The annual incidence of NGP appeared to be approximately 1 per 1800 admissions. Demographic data are depicted in Table 1. Male babies were affected more frequently, with a male:female ratio of 9:4. Five of the 13 were preterm babies. One neonate (case 11) with gastroschisis was incidentally found to have concomitant gastric perforation. The index case did not have obvious presenting symptoms and signs of gastric perforation. Instead, the most common presenting signs in the other cases were abdominal distension and respiratory impairment, followed by vomiting and lethargy (Table 2). Pneumoperitoneum (92%) was the most common finding during radiological evaluations.

The prenatal courses were all uneventful except for those of 2 mothers, of whom 1 had poorly controlled pregnancy-induced hypertension and the other had a history of prolonged membrane rupture (18 h). Except for cases 10 and 11, all patients had Apgar scores ≥8 at 1 or 5 min. Positive pressure ventilation was used in 3 cases (Table 1). Feeding commenced before onset in 11 patients, and 3 patients had a history of feeding tube insertion.

The median age of onset was 3 days (range: 1–14 days), and the median time interval between the suspected diagnosis and surgical intervention was 4 h (range: 2.5–11 h) (Table 3). All affected patients underwent gastrorrhaphy with necrotic tissue excision and drain placement. Of the patients, 46% (6/13) and 70% (9/13) developed bacteremia and peritonitis, respectively. All were treated with broad-spectrum antibiotics, including ampicillin, cefotaxime, and metronidazole. The initial

Table 2
Initial presentations in 13 neonates with gastric perforation.

| Symptoms and signs | n (%) |
|----------------------|---------|
| Abdominal distension | 11 (85) |
| Respiratory distress | 6 (46) |
| Bilious vomiting | 4 (31) |
| Nonbilious vomiting | 4 (31) |
| Lethargy | 3 (23) |
| Distended scrotum | 2 (22) |
| Cyanosis | 1 (7) |
| Fever | 1 (7) |
| Bloody stool | 1 (7) |
| Feeding intolerance | 1 (7) |

laboratory data are shown in Table 3; a high incidence of leukopenia (54%) and metabolic acidosis (69%) was observed.

The most common perforation site was at the greater curvature (62%), followed by the anterior wall of the fundus and the lesser curvature. In this study, we observed 9 patients with associated anomalies, including ischemic bowel/necrotizing enterocolitis (NEC) (5 patients), intestinal malrotation (2), duodenal web (1), hiatal hernia (1), Meckel's diverticulum (1), and gastroschisis (1); these comorbidities necessitated secondary operations during hospitalization in 56% of the patients (5/9). The median age at which secondary surgery occurred was 44 days (range: 24–77 days).

Further management included correcting malrotation via the Ladd procedure and simple duodenotomy with duodenal web excision. The patient with a hiatal hernia did not undergo a Nissen fundoplication because the hernia was small. The infant with gastroschisis underwent reduction of the extra abdominal contents, followed by abdominal wall closure.

The mortality rate in the current study was 30% (4/13). All 4 inborn neonates survived, whereas only 56% (5/9) of the outborn patients survived. None of the deceased patients were subjected to autopsy. All deceased patients presented with leukopenia on admission and developed thrombocytopenia during the following 48 h, for a sensitivity and specificity of 100% and 67%, respectively. Factors associated with severe sequelae were analyzed, and outborn birth, leukopenia, acidosis, persistent postoperative thrombocytopenia, and presence of peritonitis were found to associate significantly with severe sequelae (Table 4). The incidence of gastrointestinal (GI) tract anomalies was 46% (6/13). This rate was significantly higher among surviving patients (7/9 vs. 2/4, p < 0.05).

3. Discussion

The etiological mechanism and pathophysiology of NGP remain obscure. NGP was previously considered a spontaneous condition without contributing factors or associated GI conditions. However, in the current

Table 1
Demographic data from 13 neonates with gastric perforation.

| Patient | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|--------------------------|--------|-------|-------|-------|--------|--------|-------|-----------------------|-------|-------|-------|---------|------------|
| Birth history | | | | | | | | | | | | | |
| Sex | F | F | M | M | M | M | M | M | F | M | M | M | F |
| Gestational age (weeks) | 39 | 36 | 39 | 37 | 38 | 39 | 38 | 36 | 38 | 33 | 36 | 39 | 28 |
| Birth weight (g) | 2470 | 2550 | 3110 | 2700 | 3100 | 3170 | 3150 | 2072 | 2600 | 1280 | 2200 | 3540 | 1310 |
| Inborn/outborn | O | O | O | O | O | O | O | I | O | O | I | I | I |
| Apgar score ^a | 9 → 10 | 7 → 8 | 8 → 9 | 8 → 9 | 8 → 10 | 9 → 10 | 8 → 9 | 9 → 10 | 8 → 9 | 4 → 7 | 5 → 7 | 8 → 9 | 9 → 10 |
| Mode of delivery | NSD | NSD | NSD | C/S | NSD | NSD | C/S | C/S | NSD | C/S | C/S | NSD | C/S |
| Parity | G1P1 | G3P2 | G2P2 | G3P3 | G2P2 | G1P1 | G1P1 | G1P1, Twin | G1P1 | G3P3 | G1P1 | G3P2SA1 | G1P1, Twin |
| Maternal complications | – | – | – | – | – | – | – | GIFT, hyperthyroidism | PROM | PIH | – | – | – |
| Ventilator support | | | | | | | | | | | | | |
| Ambu bagging | – | – | – | – | – | – | – | – | – | + | + | – | – |
| CPAP | – | – | – | – | – | – | – | – | – | + | + | – | + |
| Intubated | – | – | – | – | – | – | – | – | – | + | + | – | – |
| OG insertion | – | – | – | – | – | – | – | – | – | + | + | – | + |

CPAP, continuous positive airway pressure; C/S, cesarean section; G/P, gravidity/parity.
^a Apgar score: 1 min → 5 min.

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