Journal of Pediatric Surgery 49 (2014) 395–398

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

# The contribution of hiatal hernia to severe gastroesophageal reflux disease in patients with gastroschisis

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ARTICLE INFO

*Article history:*
Received 1 May 2013
Received in revised form 5 September 2013
Accepted 6 September 2013

*Key words:*
Gastroschisis
Hiatal hernia
Gastroesophageal reflux
Anti-reflux surgery

ABSTRACT

*Background:* A relationship between gastroschisis-associated gastroesophageal reflux (GER) and hiatal hernia (HH) has not been previously reported. In reviewing our experience with gastroschisis-related GER, we noted a surprising incidence of associated HH in patients requiring antireflux procedures.
*Methods:* A single center retrospective chart review focused on GER in all gastroschisis patients repaired between January 1, 2000 and December 31, 2012 was performed.
*Results:* Of the 141 patients surviving initial gastroschisis repair and hospitalization, 16 (11.3%) were noted to have an associated HH (12 Type I, 3 Type II, 1 Type III) on upper gastrointestinal series for severe reflux. Ten of the 13 (76.9%) patients who required an antireflux procedure had an associated HH. The time to initiation of feeds was similar in all patients, 19 and 23 days. However, time to full feedings and discharge was delayed until a median of 80 and 96 days, respectively, in HH patients.
*Conclusions:* This study describes a high incidence of associated HH in gastroschisis patients. The presence of large associated HH correlated with severe GER, delayed feeding, requirement for antireflux surgery, and a prolonged hospital stay. Patients with gastroschisis and clinically severe GER should undergo early assessment for associated HH.



With advances in prenatal diagnosis of gastroschisis and improvements in neonatal intensive care, survival exceeds 90% [1]. Improvements in mortality have further exposed associated morbidities with gastroschisis. Chief among these are feeding problems attributed to intestinal dysmotility and gastroesophageal reflux (GER) [1,2]. While feeding problems are commonly associated with gastroschisis, reflux is rarely examined independent of downstream intestinal dysmotility in these patients. In reviewing our experience with gastroschisis-related GER, we noted a high incidence of associated large hiatal hernias (HH) in patients requiring antireflux procedures.

## 1. Materials and methods

After approval of the study by the Children's Hospital of Philadelphia (CHOP) Institutional Review Board (IRB# 11-008214) a retrospective search was performed for patients with a diagnosis of gastroschisis who underwent initial surgery at CHOP between January 1, 2000 and December 31, 2011. Our primary objective was to determine the rate of surgical intervention for GER following gastroschisis repair. Our secondary aim was to identify associations related to severe GER in gastroschisis patients. Patients who were diagnosed with gastroschisis but had initial repair performed at a different institution were excluded from this study. Closure of the abdominal wall defect was performed either by primary repair, or by spring-loaded silastic silo placement and staged reduction depending upon the initial ease of reduction of the eviscerated intestine.

Patients with feeding intolerance and vomiting were assumed to have GER and were empirically treated medically by modifications of their feeding regimen and administration of anti-secretory and prokinetic medications. Diagnostic evaluation for GER (upper gastrointestinal — UGI series and/or technetium milk scans) was reserved for patients who failed medical management and could not be advanced to full gastric feedings or had suboptimal enteric caloric intake due to vomiting. The decision to perform anti-reflux surgery was based on clinical evidence of GER insufficiently controlled medically, and on radiologic studies that excluded mechanical or physiological distal obstruction. Hiatal hernias were classified as: Type 1, a sliding hernia with the gastroesophageal junction above the diaphragm; Type II, a paraesophageal hernia with a normal position of the gastroesophageal junction and protrusion of the stomach alongside the esophagus; and Type III, a combination of sliding and paraesophageal hernias with the GE junction above the diaphragm and the stomach rolling through the hiatus [3,4]. The size of the HH was subjectively described as large or small according to the radiologists reading. For analysis, patients were divided into three groups: Group 1) Patients without clinical evidence of GER or with evidence of GER that was controlled with medical treatment; Group 2) Patients with clinical evidence of GER refractory

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http://dx.doi.org/10.1016/j.jpedsurg.2013.09.005

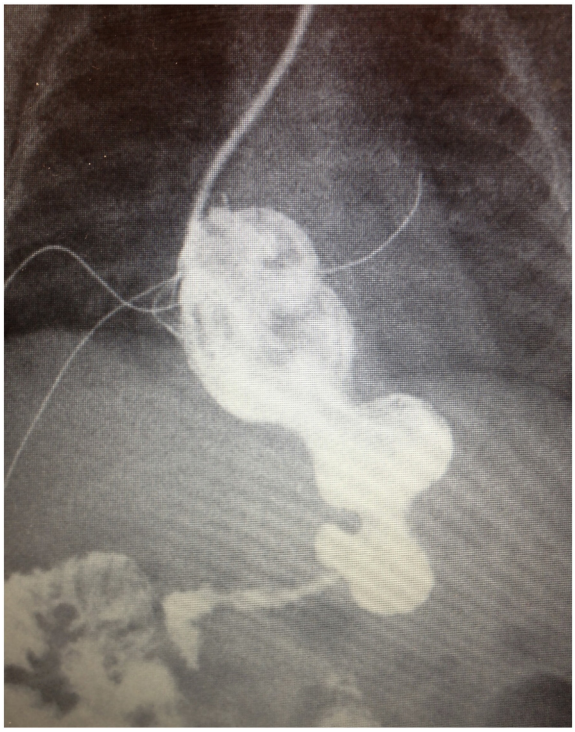

**Fig. 1.** Representative example of the appearance of a large Type I Hiatal Hernia on upper GI contrast study in a patient post reduction of gastroschisis.

to medical management (severe GER as defined above); and Group 3) Patients with severe GER that were diagnosed to have an associated HH by upper GI series.

All patients undergoing antireflux surgery received gastrostomy tubes at the time of surgery. Length of follow up was determined from outpatient chart review. After initial visits to the surgery clinic, patients with normal gastrointestinal function were discharged from further surgical follow-up. Statistical analysis was by Student's t-test and Chi-Squared utilizing the online GraphPad software (http://graphpad.com). A p value of less than 0.05 was considered statistically significant.

## 2. Results

We identified 141 patients who survived initial gastroschisis repair and hospitalization. Of these, 116 (82.2%) had "simple" isolated abdominal wall defects; 124 (87.9%) underwent silastic silo placement at birth with staged reduction of the bowel, with closure of the fascial defect at a median of 7 days of life. In total, 93 (65.9%) infants experienced notable vomiting and feeding intolerance, of which 68 (48.2%) had severe enough manifestations to warrant further diagnostic evaluation. Sixty-three of the 68 (92.6%) patients underwent upper GI barium contrast studies as the single diagnostic test. Five patients had pH monitoring and 14 received technetium milk scans in addition to the upper GI series. Of the 68 patients studied, 56 (82%) patients had positive diagnostic exams for GER. Of note, 16 of the 68 (23.5%) were found to have an associated hiatal hernia (12 Type I, 3 Type II, 1 Type III) on upper GI series (Fig. 1).

A comparison of the three groups of patients is shown in Table 1. The three groups were comparable in terms of gender, gestational age at birth, birth weight, incidence of prenatal diagnosis, frequency of associated anomalies, and age at fascial closure. Patients with severe GER without HH (Group 2) and severe GER with HH (Group 3) by definition were more likely to have vomiting, require treatment with anti-reflux medications, and to undergo changes in their feeding regimens than patients in Group 1 who had no or clinically mild reflux. The presence of severe GER (Groups 2 and 3) was associated with significantly longer hospital lengths of stay. When patients with severe GER without HH (Group 2) were compared to patients with severe GER and HH (Group 3) patients with HH were significantly more likely to require an anti-reflux procedure, and required a significantly longer period of time to achieve full enteric feeding although hospital length of stay was not significantly different. Of the 13 patients that required an antireflux procedure, 10 (76.9%) had an associated HH (6 Type I, 5 large and 1 small, 3 Type II, 1 Type III). The presence of an HH was not an independent indication for an anti-reflux procedure. Six additional patients had Type I hernias (5 small, 1 moderate) that were found on upper GI series, but did not require an antireflux procedure and were successfully managed medically. While the diagnosis of HH on upper GI series was made at a median of 57 days of age (range 28–109) the antireflux surgery was performed at a median of 71 days of age (range 47–143). In the cohort that did require an anti-reflux procedure, 12 patients had simple gastroschisis and 1 patient had an associated ileal atresia. One patient with a simple anomaly underwent primary repair and all others underwent staged silo reduction of the bowel and closure of the abdominal wall defect at a median of 9 days. All patients, except for 1, received open antireflux surgeries (11 Nissen, 1 Toupet). The one patient who underwent laparoscopic Nissen fundoplication did not have a hiatal hernia. In all patients antireflux surgery was effective, with advancement to full gastric feedings at a median of 12

**Table 1**
Patient characteristics.

| | Group 1) No diagnostic studies (n = 73) | Group 2) Severe GER and no HH (n = 52) | Group 3) Hiatal Hernia (n = 16) | p value (Group 2 vs. Group 3 only) |
|---|---|---|---|---|
| Male (%) | 39 (53.4) | 27 (51.9) | 11 (68.8) | 0.236 |
| Gestational age at birth (weeks)[a] | 36 (±1.8) | 36 (±2.1) | 35 (±2.6) | 0.121 |
| Weight at birth (kg)[a] | 2.37 (±.53) | 2.25 (±.51) | 2.40 (±.34) | 0. 275 |
| Prenatal diagnosis (%) | 68 (93.1) | 45 (86.) | 15 (93.3) | 0.434 |
| Isolated anomaly (%) | 66 (90.4) | 39 (75) | 10 (62.6) | 0.330 |
| Silo closure (%) | 56 (76.7) | 43 (82.7) | 16 (100) | 0.074 |
| Age at fascial closure (days)[a] | 7 (±4.9) | 7 (±7.1) | 8 (±4.6) | 0.598 |
| Vomiting (%) | 77 (61.6) | 43 (82.7) | 16 (100) | 0.074 |
| Treatment with anti-reflux medications (%) | 26 (35.6) | 37 (71.2) | 16 (100) | 0.015[b] |
| Feeding regimen changes (%) | 11 (15.1) | 24 (46.2) | 9 (56.25) | 0.0157[b] |
| Diagnostic exams (%) | 0 | 52 (100) | 16 (100) | 1 |
| GER positive exams (%) | 0 | 44 (84.6) | 16 (100) | .1830 |
| Anti-reflux surgery (%) | 0 | 3 (5.7) | 10 (62.5) | <0.0001[b] |
| Age at full feeding (days)[a] | (17 ± 16.6) | (22±22) | 80 (±29.5) | <0.0001[b] |
| Hospitalization length (days)[a] | 34 (±52) | 78 (±63) | 96 (±22) | 0.268 |

[a] Median.
[b] Difference in Group 3 (HH group) is statistically significant with $p < 0.05$ as compared to Group 2 (severe GER without HH).