Imaging of Neonatal Upper Gastro-Intestinal Atresia Beyond the Esophagus in Correlation with Surgical Findings

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Abstract

Background: Neonatal intestinal atresia is commonly encountered congenital anomaly in the early days of life. Imaging is important for early diagnosis.

Objective: This study was conducted for detecting radiological findings of different types of upper gastro-intestinal atresia (other than esophageal atresia) in correlation with surgical data.

Patients and Methods: From April 2009 to April 2014, 38 neonates (21 boys and 17 girls) were diagnosed as upper gastro-intestinal atresia (excluding esophageal atresia) were referred for abdominal ultrasound, abdominal X-Ray and contrast imaging were done to identify the level of obstruction. All cases were managed surgically by one pediatric surgeon in the Pediatric Surgery Unit at Sohag University Hospitals. The radiological data were correlated with surgical diagnosis. Other causes of small intestinal obstruction were excluded from the study.

Results: Our study included 38 neonates. Twenty five of them were diagnosed to have jejuno-ileal atresia (JIA) (13 jejunal and 12 ileal), 10 cases with duodenal atresia (DA) and 3 cases with pyloric atresia. Radiological examinations were diagnostic in all cases and consistent with surgical findings.

Conclusion: Intestinal atresia is an important entity to be diagnosed by radiological imaging and managed early by suitable surgical repair.

Key Words: Neonatal – Gastro-intestinal atresia – Ultrasound – Contrast imaging – Neonatal surgery.

Introduction

ATRESIA is a common congenital anomaly that causes intestinal obstruction in neonates [1]. It may affect any part of gastro-intestinal tract from the esophagus down to anus. Some cases are diagnosed prentally by US [2]. However; many cases are discovered on neonatal period especially in developing countries. Neonates present early by vomiting; especially bilious vomiting ad also failure to pass meconium [3]. Sometimes cases of intestinal atresia may associated by other congenital anomalies [4,5]. Ultrasonography (US), X-Ray and contrast studies are the most reported modalities to evaluate neonates whom were suspected to have intestinal atresia [3].

Aim of the work:

This study aims to evaluate imaging of neonatal upper intestinal atresia beyond the esophagus (namely, pylorus, duodenum, jejunum and ileum) and their correlation with surgical data.

Patients and Methods

This study was done in a retrospective manner. The radiological and surgical data were analyzed for neonates proved to have small intestinal atresia from the pylorus to the ileum. Thirty eight neonates (21 boys and 17 girls) were referred to the Diagnostic Radiology Department at Sohag University Hospital and private sectors from April 2009 to April 2014 to investigate the suspected surgical causes of upper gastro-intestinal obstruction. Some cases were also referred based upon their antenatal data and prenatal ultrasonography.

Written informed consent was taken from the patients parents in accord with the ethical standards of the institutional committee.

For all patients abdominal ultrasound using linear or sector high-frequency probe (7.5 and 5MHz), Siemens G50 with Doppler examination was performed to all patients. We started the US examination when the neonate is calm or during sleep with his/her abdominal wall is relaxed to guard against noise artifact. We use the compression technique from epigastric region down to the pelvis.

Abbreviations:

US : Ultrasonography,
MRI : Magnetic resonance imaging.
The examination was started from the stomach to follow-up the pylorus, duodenum and evaluate their size. Then the examination concentrated upon the size of the visualized small intestinal loops with abrupt termination (the suspected atretic segment), to determine the level of obstruction.

Plain abdominal X-Ray was done to all patients. Contrast imaging using water soluble contrast meal and follow through or enema (using 7-10ml Omnipaque with fluoroscopic guidance) were done to all patients to declare the anatomy and confirm the US findings and prove the diagnosis.

Standard pre-operative and post-operative neonatal care was considered at neonatal intensive care unit. All cases were managed surgically in Pediatric Surgery Unit at Sohag University Hospitals and private sectors. Definite diagnosis was established during laparotomy. Finally the radiographic diagnoses were compared with operative diagnoses.

The collected data were analyzed using the program Social Package of Scientific Statistics (SPSS) version 19. Initially, simple frequencies, means and standard deviations were described. To compare means, the Student t test and analysis of variance (ANOVA) test were used. In qualitative data, chi square test and Fischer exact test were used to detect significance. In all tests made, a level of significance of \( p \)-value <0.05 was accepted.

Other causes of small intestinal obstruction were excluded from the study.

**Results**

Our study describes a series of 38 neonates. All cases are proved to have upper intestinal atresia beyond the esophagus according to the radiological and surgical data. Their age range from 1 to 7 days with the mean age is 3 days.

In order of descending frequency, the levels of atresia found in our study are jejuno-ileal, found in 25 (66%) cases, and followed by duodenal atresia found in 10 (26%) cases, then pyloric atresia found in 3 (8%) cases (Table 1).

The twenty five neonates who are diagnosed and treated for jejuno-ileal atresia, 13 cases had jejunal atresia and 12 cases were ileal atresia. They were 13 male and 12 female. Male to female ratio in cases of small intestinal atresia in our study was 1.1:1 \( (p<0.05) \). Their gestational age ranged between 28 and 40 weeks gestation (mean=33.5 weeks) and prematurity was reported in 8 (32%) cases.

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Fig. (1): A neonate of 3 days old with jejunal atresia. (A, B) Prenatal examination showing dilated stomach, duodenum and proximal jejunum (arrows). (C) Plain X-Ray showing dilated stomach and duodenum and proximal jejunum. (D) Contrast examination showing jejunal obstruction. (E, F) Photos of during surgery and surgical repair.
Table (1): Types of intestinal atresia and number of patients in our study.

<table>
<thead>
<tr>
<th>Type of atresia</th>
<th>Number of patients</th>
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</thead>
<tbody>
<tr>
<td>Jejunal atresia</td>
<td>13</td>
</tr>
<tr>
<td>Ileal atresia</td>
<td>12</td>
</tr>
<tr>
<td>Duodenal atresia</td>
<td>10</td>
</tr>
<tr>
<td>Pyloric atresia</td>
<td>3</td>
</tr>
</tbody>
</table>

Prenatal diagnosis of jejuno-ileal atresia by fetal imaging was reported in 5 (20%) cases Fig. (1). The findings were polyhydramnios (5 cases), persistently dilated bowel loops on serial sonograms (5 cases).

Neonatal abdominal ultrasonography findings in jejunal atresia are dilated stomach, duodenum and short segment of small intestine. In ileal atresia US found dilated stomach duodenum and a long segment of the small intestine [Fig. (2), (Table 2).] Plain abdominal radiographs findings in jejunal atresia were few air-levels but in ileal atresia multiple air-fluid levels were encountered (Table 3). Upper gastro-intestinal series were performed in all cases of jejuno-ileal atresia and showed gastric, duodenal and small intestinal dilatation according to the level of obstruction Fig. (3). No contrast could be seen beyond that level. Enema study was performed in 8 cases using water soluble contrast agent to exclude associated colonic atresia and it showed small unused colon Fig. (4).

Table (2): Ultrasonography findings in examined neonates.

<table>
<thead>
<tr>
<th>Type of atresia</th>
<th>Short part of small intestine</th>
<th>Long part of small intestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jejunal atresia</td>
<td>Dilated</td>
<td>Dilated</td>
</tr>
<tr>
<td>Ileal atresia</td>
<td>Dilated</td>
<td>Dilated</td>
</tr>
<tr>
<td>Duodenal atresia</td>
<td>Dilated</td>
<td>Not dilated</td>
</tr>
<tr>
<td>Pyloric atresia</td>
<td>Dilated</td>
<td>Not dilated</td>
</tr>
</tbody>
</table>

Table (3): Plain X-Ray findings in 38 patients.

<table>
<thead>
<tr>
<th>Type of atresia</th>
<th>Plain X-Ray findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jejunal atresia</td>
<td>Distended stomach, duodenum and proximal jejunum by gases</td>
</tr>
<tr>
<td>Ileal atresia</td>
<td>Distended stomach by gases multiple air-fluid levels</td>
</tr>
<tr>
<td>Duodenal atresia</td>
<td>Double bubble sign</td>
</tr>
<tr>
<td>Pyloric atresia</td>
<td>Distended stomach by gases and no abdominal air beyond it</td>
</tr>
</tbody>
</table>

Fig. (2): A neonate with ileal atresia. (A, B) US images showing dilated loops with fluid (arrows). (C) Plain abdominal X-Ray revealing multiple air-fluid levels.

Fig. (3): (A, B, C) Contrast examinations of three different neonates with jejunal atresia. The stomach, duodenum and proximal jejunum are dilated.
For cases with jejuno-ileal atresia, primary anastomosis was used in all cases aimed to minimize bowel loss with sequences of short bowel. Primary single layer end to back anastomosis after resection of dilated proximal bulb was done in 17 cases and it was done after enteroplasty in 8 cases. Moreover, the anastomosis was single in 23 cases and more than one anastomosis in two cases.

Fig. (4): (A, B, C, D) Contrast enemas of 4 different neonates with small intestinal atresia showing small unused colon.

Fig. (5): A neonate of 2 days old with duodenal atresia. (A) Prenatal examination showing dilated stomach and proximal duodenum. (B) Plain X-Ray showing double bubble sign. (C) Contrast examination showing duodenal obstruction. (D) Photo of surgical repair by diamond shape duoden-duodenostomy.
Prenatal diagnoses of duodenal atresia were reported in 2 cases in our series. The prenatal images were similar to the double-bubble sign Fig. (5). Abdominal US findings in duodenal atresia were dilated stomach, and duodenum in all cases. All neonates with duodenal atresia were diagnosed by the pathognomonic double bubble sign with gasless distal bowel in plain abdominal erect X-Ray. Contrast studies were done to confirm the diagnosis Fig. (6). A contrast enhanced upper gastrointestinal series was performed in all 10 cases and showed gastric dilatation and dilated proximal duodenum down to a blind pouch these cases.

For cases with duodenal atresia, diamond shaped duodeno-duodenostomy was the technique of choice and performed in all cases.

The remaining 3 cases were pyloric atresia Fig. (7). At sonography pyloric atresia has two distinct characters; one of them is dilated stomach and the other is gasless abdomen beyond the pylorus. Plain abdominal X-Ray reported distended stomach with gases and no gas beyond the stomach. No contrast beyond the pylorus could be seen in those patients and also dilated stomach with contrast was observed Fig. (8).

Neonates with pyloric atresia were managed operatively by gastro-duodenostomy. Postoperatively, neonates were closely monitored in neonatal intensive care unit. Thermoregulation was important and maintenance fluids were administrated. Vital signs, activity, abdominal girth and oxygen saturation all were monitored. Then each case was managed accordingly.
Fig. (8): (A, B) Contrast examinations of two different neonates with pyloric atresia. The stomach is markedly dilated. No contrast could be detected beyond the stomach.

Fig. (9): (A, B, C, D) Plain abdominal X-Ray examinations of four different neonates with atresia showing the distribution of air in different types of atresia. (A) Showing dilated stomach (S) in a 1 day old neonate with pyloric atresia. (B) Revealing dilated stomach (S) and duodenum (d) (double bubble sign) in a 2 days old neonate with duodenal atresia. (C) Demonstrating dilated stomach (S), duodenum (d) and proximal jejunum (j) in a 4 days old neonate with jejunal atresia. (D) Depicting dilated stomach (S), duodenum (d), jejunum (j) and proximal ileum (I) with multiple air-fluid levels in a 6 days old neonate with ileal atresia.

Discussion

Neonatal intestinal obstruction is commonly encountered in pediatric imaging. Many causes may lead to bowel obstruction in the neonatal period [3]. Intestinal atresia constitutes more than one third of cases with intestinal obstruction in neonates [1]. Intestinal atresia may be due to incomplete embryonic re-canalization. These events mostly are due to vascular impairment during early fetal life [6,7].

Small intestinal atresia may be diagnosed early especially during fetal period by sonography [2] or even by magnetic resonance imaging (MRI) [8]. Unfortunately; most of cases are diagnosed during neonatal period; especially in developing countries with absent or irregular prenatal care. Our study included 5 cases diagnosed prenatally as jejuno-ileal atresia and found dilated stomach, small bowel loops on serial sonograms and 2 cases with duodenal atresia. These findings were associated with polyhydramnios. Our results are going with other results and reported polyhydramnios and dilated stomach in jejuno-ileal atresia [2].

Several imaging modalities can be used to determine the level of small intestinal atresia. Ultrasound scanning is commonly used because it is available, safe, and simple and it becomes familiar with all pediatric imaging [3]. With the use of compression technique we can detect the size of the stomach and follow the small intestine from the pylorus downwards to determine the exact level of atresia (Table 2). US also can also exclude other causes of neonatal vomiting such as congenital
hypertrophic pyloric stenosis or midgut volvulus. Plain abdominal radiography is usually done in neonate suspected to have intestinal obstruction. The distributions of air within the stomach, duodenum small bowel are very beneficial in diagnosis ([Table 3] & Fig. (9)]. Upper gastro-intestinal series are mandatory to opacify the stomach, duodenum and proximal intestine. The contrast study determines the level of atresia and it is the reference of the pediatric surgeon.

In this study, jejuno-ileal atresia was the commonest neonatal atresia (66%), followed by duodenal atresia (26%) and then pyloric atresia (8%). This order of frequency was expected considering the previously reported incidences of these pathologies. Jejuno-ileal atresia incidence were variably reported in literature from 1 per 330 to one per 5000 and the incidence of duodenal atresia is 1 in 3400 live births) [5,9,10].

There is a high association of jejuno-ileal atresia with prematurity [11]. In this study, prematurity was reported in 32% of cases of small intestinal atresia (p-value is significant; it is >0.05). No associated congenital anomalies were reported. Male to female ratio in cases of small intestinal atresia in our study was 1.1:1. No sex predilection was reported in previous literature [11].

Imaging of neonatal jejuno-ileal atresia including US, plain X-Ray and contrast follow through [12,13]. Ultrasonography followed-up the dilated bowel loops from the pylorus down to the atretic segment and could tell us about its level. Plain X-ray showed air-fluid levels. The frequency of air-fluid levels depends on the level of obstruction. Contrast study also opacify the dilated loops to the obstructed part of the intestine. US correlate well with findings of contrast study. Dalla et al., [12] found 128 cases with jejuno-ileal atresia and classify them to four types.

Duodenal atresia is frequently seen in our series (26%); double bubble sign in X-Ray, contrast study and sonography could diagnose all cases. Ultrasoundography and contrast study are correlated well. Alhoseni et al., [3] found 4 cases in their series examined by sonography. Another study [12] found duodenal atresia in a big number of patients (92 neonates).

Pyloric atresia is a very rare congenital anomaly. It is found in one per 100, 000 live births. It constitutes 1% of all congenital intestinal atresia [14]. Usually the child comes early with non-bilious vomiting. At sonography; it is very easy to examine the abdomen without gas beyond the pylorus. The plain X-Ray showed dilated stomach without gas beyond it. On examination with contrast meal; the contrast never passed through the pylorus. In our study; we found 3 cases with pyloric atresia. Al-salem et al., [15] examine 20 cases with pyloric atresia. Pyloric atresia was also reported with many other studies [16,17].

Our study has some limitations. Not all cases have prenatal sonography or MRI. Also; we did not assess the incidence of atresia in the general population and we did not include other atresia such as esophageal and colonic.

Also our study have benefit that US could replace contrast study. This issue confirmed another study [3] in a neonatal bilious vomiting.

Conclusion:

Intestinal atresia is a frequently seen disease which may be diagnosed in prenatal care or in the neonatal period. Our study confirms that the most common atresia is jejuno-ileal atresia, followed by duodenal atresia. Neonatal imaging plays an important role in diagnosis of neonatal atresia and determines its level. Moreover; ultrasonography alone can detect intestinal atresia without the hazards of neonatal radiation and physical manipulation. Also; ultrasonography can exclude other causes of intestinal obstruction.

Conflict of interest:

We have no conflict of interest to declare.

References


