Laparoscopic Repair of a Right Paraduodenal Hernia

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ABSTRACT

Background and Objectives: Right paraduodenal hernia (PDH) results from a primitive gut malrotation. The resultant jejunal mesenteric defect posterior to the superior mesenteric vessels allows decompressed jejunum to herniate retroperitoneally. PDH make up 53% of all internal hernias, but account for only 0.2% to 5.8% of all cases of intestinal obstruction. In addition, PDH exhibits male and left-sided predominance. Ours is the second report to describe the preoperative diagnosis and totally laparoscopic repair of a right PDH.

Methods: We report the case of a 26-year-old female with symptoms suggestive of partial small bowel obstruction and a 6-year history of intermittent abdominal pain. Physical examination demonstrated lower quadrant tenderness. Plain abdominal radiographs and ultrasonography were nondiagnostic. Contrasted computed tomography of the abdomen revealed jejunum encased within the right upper quadrant suspicious for right PDH.

Results: The patient underwent successful laparoscopic right PDH repair and was discharged home on postoperative day 1 without late sequelae.

Conclusions: In the outpatient setting, clinical suspicion and comprehensive radiological investigation permit preoperative diagnosis of right PDH. In acute situations, clinical presentation, plain radiographs, and then diagnostic laparoscopy may be an expedient diagnostic algorithm. Subsequent laparoscopic repair of right PDH is feasible and may shorten hospital length of stay.

Key Words: Paraduodenal hernia, Mesocolic hernia, Internal hernia, Intestinal malrotation, Embryology, Small bowel obstruction, Gastrointestinal radiology, Laparoscopic repair.

INTRODUCTION

Internal hernias are reported to cause 0.2% to 5.8% of all cases of small bowel obstruction.1–3 Paraduodenal hernias (PDH), also called congenital mesocolic hernias, are the most common type of internal hernia, accounting for up to 53% of cases. They most frequently occur between the fourth and sixth decades of life in males and to the left side.4,5

Right and left PDH vary in embryonic origin and anatomic structure, present differently, and may pose a diagnostic dilemma. Right PDH results from abnormal rotation of the midgut during embryonic development; in particular, the incomplete 180-degree counterclockwise rotation of the prearterial jejunum. Definitive preoperative diagnosis of PDH remains a challenge, because patients can present with varied symptoms of acute small bowel obstruction or intermittent pain associated with nausea, vomiting, or postprandial distention.5,6 Physical examination and abdominal plain radiographs are unlikely to confirm the specific diagnosis.5 Thus, nonspecific gastrointestinal symptoms and unrevealing clinical examination complicate preoperative diagnosis of PDH. However, reports describe the utility of other tools, such as contrasted upper gastrointestinal series, abdominal ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) to reach the correct diagnosis of PDH preoperatively.5,7–9 Just one prior report describes an elective laparoscopic repair of a right PDH in an adult, while articles detailing the open surgical technique are more prevalent.6,9–12
We describe herein the preoperative radiographic diagnosis and successful laparoscopic repair of a right PDH in a young adult female. Moreover, we present an up-to-date review of right PDH embryonic development, radiographic characteristics, and minimally invasive management.

**CASE REPORT**

A 26-year-old female presented with intermittent, bilateral inguinal and epigastric pain associated with nausea and emesis. Further questioning revealed a 6-year history of cramping and intermittent abdominal pain that worsened during menstruation. Physical examination demonstrated only mild bilateral lower quadrant tenderness without peritoneal signs. The patient’s symptoms led to abdominal ultrasonography and appropriate laboratory studies that demonstrated no abnormalities. Due to nondiagnostic presentation and imaging, the patient underwent helical CT of the abdomen with oral and intravenous contrast. This study revealed proximal jejunum passing through a defect in the first part of the small bowel mesentery. Segments of jejunum appeared posterior to the superior mesenteric artery (SMA) and inferior to the third portion of the duodenum while loops of small bowel existed within the right upper quadrant of the abdomen (Figure 1). Depictions of normal and right paraduodenal hernia anatomy are shown in Figures 2 and 3, respectively.

**Operative Technique**

After general anesthesia was administered, the patient was placed in the supine position. Using the Veress needle technique, pneumoperitoneum (15mm Hg) was achieved. One infraumbilical and 3 additional abdominal trocars were placed (Figure 4). Initial investigation revealed a right retrocolic mass defect from herniated jejunum within the PDH sac and a decreased volume of small bowel in the pelvis. To better visualize the mesenteric defect, the transverse colon was elevated. The laparoscope in the left lower quadrant trocar permitted visualization of 2 limbs of jejunum posterior to the SMA and inferior to the third portion of the duodenum (Figure 5). The inferior mesenteric vein was easily identified running in the thickened mesentery anterior to the defect. The proximal segment of small bowel was contiguous with the ligament of Treitz, and the distal segment was freely mobile but extrinsically compressed as it passed through the mesenteric defect. The laparoscope was advanced toward the mesenteric defect to thoroughly delineate the hernia aperture before and during reduction. The distal limb was then reduced by using atraumatic bowel graspers. Following reduction of the small bowel, the patient was placed in a head-down position with the table tilted to the patient’s left side to facilitate exposure and bowel manipulation. Next, the ascending colon was mobilized from its lateral peritoneal attachments along the white line of Toldt by using a combination of sharp scissors and Harmonic scalpel dissection, limiting electrocautery. As the dissection progressed cephalad, care was taken to delineate and protect the right kidney, ureter, and duodenum.

After significant mobilization of the right colon, a peritonealized space was subsequently entered consistent with the hernia sac itself. The small bowel mesenteric defect was not widely patent, so continued dissection between the right mesocolon medially and perinephric space laterally was used to ensure an open hernia aperture (Figure 6). The patient was then moved to a head-up position with the table tilted to the patient’s right side for maximum visualization of the mesenteric defect from the left abdo-
To confirm the complete reduction of small bowel contents and adequate opening of the mesenteric defect, blunt-tip forceps were inserted near the ligament of Treitz in a medial-to-lateral fashion through the defect (Figure 7). This demonstrated the widely patent mesenteric defect posterior to the superior mesenteric vessels behind the right mesocolon. Lastly, the entire small bowel was examined carefully from terminal ileum to the ligament of Treitz with no evidence of twisting or injury. Trocar wounds greater than 5 mm in diameter were closed with trans fascial sutures then skin was approximated in a subcuticular fashion.

RESULTS

Contrasted CT of the abdomen allowed for preoperative diagnosis of right PDH, and diagnostic laparoscopy confirmed radiological results. The patient successfully underwent laparoscopic repair of a right PDH. No intraoperative or immediate postoperative complications occurred. The patient tolerated liquids immediately, and her mild incisonal pain was adequately controlled with nonsteroidal anti-inflammatory drugs. She was discharged on the morning of the first postoperative day and subsequently returned to work on postoperative day 2. The patient was without complaints or sequelae at 3, 6, and 12 months postoperatively.

DISCUSSION

In general, PDH is a congenital error of midgut rotation and as such is rarely reported. Previous articles describe the rarity as well as the sex-related and left-sided predominance of PDH, but the exact incidence and prevalence of this specific pathology is unknown.\textsuperscript{4,12,13} In clinical series,\textsuperscript{2,5,12,14} PDH defects account for a very small proportion (0.2% to 0.9%) of symptomatic small bowel obstructions, similar to the autopsy incidence of PDH (0.2%). A history of chronic symptoms preceding an acute, severe episode of abdominal pain is reported to occur in approximately 70% of patients with a median duration of symptoms of 1.8 years.\textsuperscript{15} Adults with PDH are likely to present between the fourth and sixth decades of life (mean age of diagnosis is 38.5 years).\textsuperscript{5} Also, they are more frequently
males (3:1) and have left PDH (3:1). In contrast to the common presentation of PDH, this report highlights a female patient who was 12 years younger than the average age at the time of diagnosis and had a right-sided PDH.

To better appreciate the development of right PDH, it is imperative to understand typical intestinal embryology. During normal gestation of the human embryo, primitive gut development begins in Carnegie stage 5 (12 days); however, the 3 divisions (foregut, midgut, and hindgut) are not discernable until stage 11 (24 days). By stage 13 (28 days), the prearterial and postarterial segments of intestine are located within the abdomen at the 12 o’clock and 6 o’clock positions, respectively (viewed from the ventral side of the embryo) and suspended by a dorsal mesentery. During stages 15 through 17 (33 to 41 days), the intestinal loop first rotates 90-degrees counterclockwise around the SMA axis then begins to extrude through the umbilical cord. Within these stages, the herniated cecal diverticulum grows more distinct as well (Figures 8 and 9). In stages 18 and 19, the herniated prearterial limb grows longitudinally and subsequently coils due to marked elongation, yet the postarterial limb remains straight. Between stages 20 through 23 (51 to 57 days), the intestinal loop undergoes another 90-degree counterclockwise rotation such that the prearterial limb is at the 6

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**Figure 3.** The depiction illustrates a patent Waldeyer’s fossa in the root of the small bowel mesentery complete with herniated (A) proximal and (B) distal segments of jejunum.

**Figure 4.** Trocar size and positioning used for laparoscopic repair are shown.

**Figure 5.** A laparoscopic view shows the duodenum and ligament of Treitz as well as the (A) proximal segment of jejunum, which passes through Waldeyer’s fossa, and the (B) distal segment of jejunum.
o’clock position. Before returning to the abdominal cavity, the prearterial segment reduces inferior to the SMA. Next, the primitive jejunum, distal ileum, and cecum return to the abdomen, after which the small intestine makes another 90-degree counterclockwise turn. This completes the 270-degree rotation of the primitive gut such that the small intestine comes to rest in the left upper quadrant and the cecum in the right lower quadrant. Reduction and rotation are completed by the tenth week of gestation and result in the prearterial segment localized below and to the left of the SMA while the postarterial segment lies superior and to the right. Lastly, the mesenteries of the ascending and descending colons become fused to the posterior parietal peritoneum, and the root of the small bowel mesentry, containing the SMA, extends obliquely...
from the left side of the second lumbar vertebra toward the right sacroiliac joint.\textsuperscript{16,17}

Although some debate the exact pathogenesis of right PDH, most agree that abnormal rotation of the midgut during development results in failure of the mesentery to fuse with the parietal peritoneum.\textsuperscript{16–21} In 1923, Andrews\textsuperscript{22} described PDH occurrence as a failure of the prearterial limb to complete the 270-degree counterclockwise rotation. For right PDH, counterclockwise rotation of the prearterial limb terminates prior to stage 20 (9 o’clock position), when the intestinal loop would normally undergo the second 90-degree counterclockwise rotation (Figure 10). In addition, the prearterial segment does not reduce behind the SMA; however, the postarterial segment continues to develop and rotate normally. Thus by the tenth week of gestation, the intestinal loop returns to the abdominal cavity as it would in normal development, but the prearterial segment is instead localized to the right of the SMA (Figure 11). As such, the first part of the small bowel mesentery behind the SMA and inferior to the third portion of the duodenum fails to fuse, resulting in a patent Waldeyer’s fossa. As the prearterial limb continues to elongate on the right side of the abdomen, all or part of the jejunum becomes trapped in a sac behind the proximal ascending and transverse mesocolons. When only a portion of the jejunum is encased within the hernia sac, it is due to the reentry of distal jejunum into the peritoneal cavity through Waldeyer’s fossa. The final mesenteric defect is bordered anteriorly by the superior mesenteric vessels, which may occupy a more ventral and leftward position compared with normal anatomy.\textsuperscript{5,18,22,23}

Aberrant embryologic development ultimately leads to right PDH.\textsuperscript{18} Patients with right PDH complain of chronic, intermittent episodes of diffuse abdominal pain with or without nausea and vomiting often occurring postprandially. Certain patients may describe improvement of symptoms in the recumbent position. These vague abdominal symptoms may be incorrectly attributed to gallbladder disease or completely ignored by patients until such time as the pain becomes severe. In adults with PDH who present acutely, most describe symptoms associated with small bowel obstruction.\textsuperscript{4}

Accurate and timely diagnosis of right PDH requires a high index of suspicion. Physical examination is unreliable and nonspecific in adults with right PDH. Pertinent abdominal examination findings are variable and may include diffuse or localized abdominal tenderness, distention, and the presence of a palpable mass.\textsuperscript{4} Likewise, abdominal plain radiographs are unlikely to yield a definitive diagnosis. Radiographic evidence of small bowel

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**Figure 10.** Stage 21 (day 52) of right paraduodenal hernia development where SMA = superior mesenteric artery, Prox Pre-A = proximal segment of prearterial limb and Dis Pre-A = distal segment of prearterial limb of gut, Post-A = postarterial limb of gut, Appy = appendix, and Cecal Div = cecal diverticulum.

**Figure 11.** Fetal stage (day 70+) of right paraduodenal hernia development where Duo = duodenum, SMA = superior mesenteric artery, Prox Pre-A = proximal segment of prearterial limb and Dis Pre-A = distal segment of prearterial limb of gut, Post-A = postarterial limb of gut, Appy = appendix, and Cecal Div = cecal diverticulum.
obstruction may be present on plain abdominal films, but without contrast in the bowel, it is difficult to identify right PDH unequivocally. When the clinical situation allows, a preoperative barium upper gastrointestinal study may demonstrate a collection of small bowel loops lateral and inferior to the second portion of the duodenum or behind the ascending colon. With oral and intravenous contrast, abdominal CT scan demonstrates a cluster of small bowel in the right upper quadrant behind the right mesocolon. In addition, at least one segment of jejunum is noted to traverse Waldeyer’s fossa in the root of the small bowel mesentery posterior to the superior mesenteric vessels. Due to the abnormal embryology of PDH, additional clues on CT scan include the more ventral and leftward position of the superior mesenteric vein and the absence of a normal horizontal duodenum. General signs of right PDH on CT scan also may include a saclike mass in the right upper quadrant, encapsulation of small bowel, and mass effect on the ascending colon.

PDH can be diagnosed successfully by laparoscopy when preoperative imaging studies are equivocal. For example, reports of laparoscopic surgery for left PDH appear slightly more often in the literature than do reports for right PDH. To date, 5 case reports depict the utility of laparoscopy to confirm the diagnosis of left PDH. In each of these reports, authors describe totally laparoscopic repair of left PDH without need for conversion. PDH may be encountered during laparoscopic procedures for other disease processes. One previous report describes the failure of preoperative barium lower gastrointestinal and CT studies to reveal a right PDH, which was identified during laparoscopic colon resection for known diverticulitis. The surgeon in this case converted to an open procedure due to unclear anatomy. If right PDH is identified incidentally during a laparoscopic procedure, then surgical correction should be undertaken due to a lifetime risk of incarceration approaching 50%. We recommend the use of sound surgical judgment to guide the operative approach in this situation.

Only one published abstract details elective totally laparoscopic repair of a right PDH. The authors of this abstract relate the preoperative diagnosis of right PDH by barium upper gastrointestinal study and CT scan. They obtained access to the peritoneal cavity via one perumbilical 10-mm trocar and one 5-mm trocar in each quadrant of the abdomen. The authors then opened the hernia sac widely via a lateral approach and released the small bowel into the abdominal cavity. The patient’s hospital course was uncomplicated, and she was discharged on the third postoperative day. This differs from the present case in that we elected to use 4 laparoscopic trocars with one 11-mm perumbilical, one 11-mm left lower quadrant, and two 5-mm lower quadrant trocars. Our operative approach and the patient’s hospital length of stay differed slightly as well. Following diagnostic laparoscopy, first we gently reduced the small bowel into the peritoneal cavity and altered the patient’s position to facilitate visualization of Waldeyer’s fossa, and then we completely opened the small bowel mesenteric defect from a lateral approach. The patient tolerated the procedure without complication and was discharged on postoperative day 1.

A previous literature review by Moon and colleagues shows that PDH is generally diagnosed after extensive evaluation of symptoms associated with small bowel obstruction or during exploratory laparotomy. In cases where patients tolerate protracted investigative periods or undergo open operation for PDH, hospital length of stay may be prolonged. They found 9 articles (16 patients with PDH) with reported hospital lengths of stay that ranged from 3 to 28 days, regardless of operative approach.

To expedite diagnosis and possibly shorten hospital length of stay, astute surgeons must entertain the diagnosis of PDH, particularly in adults who present acutely with symptoms associated with small bowel obstruction. Besides a high clinical suspicion, abdominal radiographs suggestive of the diagnosis may lead to further imaging studies or diagnostic laparoscopy. Although a barium upper gastrointestinal study and CT scan are appropriate in the elective setting and may confirm the diagnosis of right PDH, such investigative studies may not be warranted when right PDH presents acutely. Instead, diagnostic laparoscopy should be strongly considered because it will reveal the type of internal hernia and permit immediate repair of right PDH without a prolonged diagnostic period. For surgeons with significant experience in minimally invasive techniques, we feel physical examination and abdominal radiographs followed by diagnostic laparoscopy and definitive laparoscopic repair is a viable option for patients with acute presentation of right PDH.

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