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REVIEW
Radiological evaluation of internal abdominal hernias

İnternal abdominal hernilerde radyolojik değerlendirme

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An internal abdominal herniation is the protrusion of a viscus through a normal or abnormal mesenteric or peritoneal aperture. Internal abdominal herniations can either be acquired through a trauma or surgical procedure, or constitutional and related to congenital peritoneal defects. Paraduodenal hernias are the most common type of internal abdominal hernias, accounting for over one-half of reported cases, and thus are a significant clinical entity. Other internal hernias include pericecal, transmesenteric, transomental, intersigmoid, supravesical hernias and herniation through the foramen of Winslow. Because internal abdominal herniations are rare, their diagnosis remains a challenge for both the clinician and the radiologist. Symptoms of internal abdominal herniations are nonspecific. We present our experience with the radiological evaluation of internal abdominal herniations and review the main radiologic findings on barium as well as computed tomography studies.

Key words: Hernia, abdominal, intestinal obstruction, internal, computed tomography, barium studies

İnternal abdominal herni tanımı, viseral bir organın periton ya da mezenterdeki normal ya da anormal bir açıklıktan herniasyonunu ifade eder. İnternal abdominal herniler travma ya da cerrahi girişimler sonrası gelişebileceği gibi, konjenital peritoneal defektlerle ilişkili olarak da ortaya çıkabilir. Paraduodenal herniler, internal abdominal hernilerin en sık rastlanan tipi olup, olguların yarıdan fazlasını oluştrmaktadır. Periçekal, trasmezenterik, transomental, intersigmoid, supravezikal ve foramen Winslow hernileri diğer internal hernilerdir. Oldukça nadir ve klinik bulguları nonspesifik olduğundan, tanıları klinisyenler ve radyologlar açısından güçlük teşkil etmektedir. Bu yazıda internal abdominal hernilerin radyolojik değerlendirmesindeki deneyimlerimiz ile baryumlu çalışmalardaki ve bilgisayarlı tomografideki ana radyolojik bulguları derlenmiştir.

Anahtar kelimeler: Herni, abdominal, intestinal obstrüksiyon, internal, bilgisayarlı tomografi, baryumlu çalışmalar

INTRODUCTION

Internal abdominal hernias are infrequent, accounting for only a small percentage (0. 2-0. 9%) of all instances of intestinal obstruction, and lead to 0. 5 to 4. 1% of the cases of acute intestinal obstruction caused by hernias (1-5). An internal hernia is formed by protrusion of a viscus through a peritoneal or mesenteric aperture within the confines of the peritoneal cavity. The hernial orifice is usually a preexisting anatomic structure, such as the foramen of Winslow, or a pathologic defect of congenital or acquired origin. Congenital anomalies of the intestinal rotation and peritoneal attachments are important factors which predispose to internal herniation. Postsurgical or traumatic defects of the mesentery and omentum are also potential sites for herniation. In general, the herniated viscus is the small bowel. This herniation may be persistent or intermittent. Because of the risk of strangulation of the hernia contents, even small internal hernias are dangerous and may be lethal.

Paraduodenal hernias are the most common type of internal abdominal hernias, accounting for over one-half of reported cases (1-5). The other types of internal hernia that have been described include transmesenteric, pericecal, supravesical, intersigmoid, foramen of Winslow and rarely omental hernias. Transmesenteric hernias have been described after surgical procedures such as gastric bypass surgery in which a Roux-en-Y loop that predisposes the development of internal hernia is constructed (7-9).

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Small and easily reducible hernias can remain relatively asymptomatic during life. In other cases, the patients present with a history of intermittent attacks of vague epigastric discomfort accompanied by a feeling of distention, colicky periumbilical pain, nausea, vomiting-especially after a large meal-and recurrent intestinal obstruction.

Many patients have undergone extensive workup of the chronic pain, which has been negative for gastroesophageal reflux, gastritis, and biliary colic. Internal hernia should be suspected in patients with signs and symptoms of intestinal obstruction, particularly in the absence of inflammatory intestinal diseases, external hernia or previous laparotomy. The diagnosis of internal hernia should always be considered when the cause of obstruction remains unknown despite detailed diagnostic workup.

Furthermore, the value of modern diagnostic imaging tools in the specific diagnosis of internal hernia, particularly computed tomography (CT), is in practice limited to cases of partial obstruction in which surgical management is usually not required. As a result, internal hernias are usually diagnosed during laparotomy for acute intestinal obstruction. Only rarely is an internal hernia correctly diagnosed preoperatively.

The small bowel examination provides the most useful diagnostic hallmarks, which include (1) abnormal location and disturbed arrangement of the small intestine; (2) fixed encapsulation and crowding of several small bowel loops within the hernial sac; and (3) segmental dilatation and prolonged stasis within the herniated loops. Contrast studies or CT examinations are most likely to provide the correct diagnosis when performed during symptomatic periods (2). Once the hernia is reduced spontaneously, however, radiologic studies tend to be negative, and the patient may be mislabeled as psychoneurotic (2, 3).

In the last 3000 abdominal radiologic investigations performed at our institution, only five (0. 16%) internal hernia cases were detected. Two of the cases were paraduodenal, one was transomental, one was foramen of Winslow hernia and one was supravesical hernia.

PARADUODENAL HERNIAS

Paraduodenal hernias are the most common type of internal herniation and account for over half of the reported cases (1-5). Approximately 75% occur on the left and involve the paraduodenal fossa of Landzert. This peritoneal pocket is observed in 2% of autopsies (2). It is located lateral to the fourth segment of the duodenum, beneath a peritoneal fold elevated by the inferior mesenteric vein and ascending left colic artery. Small bowel loops enter the sac and protrude further posteriorly and to the left, essentially herniating into the descending mesocolon and distal portion of the transverse mesocolon (1-3).

Twenty-five percent of paraduodenal hernias develop on the right side of the abdomen and typically involve the mesentericoparietal fossa of Waldeyer. This abnormal pocket in the jejunal mesentery is found in 1% of autopsies. Its orifice is located immediately behind the superior mesenteric artery and inferior to the transverse segment of the duodenum. However, the peritoneal pocket itself extends to the right and downward, directly in front of the posterior parietal peritoneum. Accordingly, the right paraduodenal hernia can be viewed as small bowel herniation into the ascending mesocolon (2, 10-20).

The clinical manifestations of paraduodenal hernias range from intermittent and mild digestive complaints to acute intestinal obstruction. With bowel obstruction, the mortality rate is expected to be as high as 20% (3). Radiographic examinations are crucial in the preoperative diagnosis of paraduodenal hernias; however, the features may be distinct.

In a left paraduodenal hernia, a circumscribed ovoid mass of multiple jejunal loops occupies the left upper quadrant immediately lateral to the ascending duodenum. The herniating loops may rise cephalad to the duodenojejunal junction, mildly displacing it medially. The hernia indents the posterior gastric wall and depresses the distal transverse colon. Fluoroscopy and serial radiographs reveal a separation of encapsulated jejunal loops from the remaining small intestine. Dilatation of herniated loops and stasis of barium may also be evident. Only the efferent segment of the small intestine passes through the hernial orifice, since the afferent loop enters posteriorly because of the retroperitoneal position of the duodenum.

Barium contrast studies are best performed during a symptomatic period. Examination in intervals between recurrent herniation may be negative or may demonstrate mild degrees of dilatation, stasis, and perhaps edematous mucosal folds,

which may be falsely attributed solely to adhesions. Diligent serial filming is essential to diagnosis. Furthermore, the inferior mesenteric vein and ascending left colic artery lie in the anteromedial border of the left paraduodenal hernia, findings best appreciated during arteriography or laparotomy (1-3).

The CT findings in left paraduodenal hernia involve: encapsulation of bowel loops at the level of duodenojejunal junction or interposed between the stomach and pancreas, or behind the descending colon, dilatation and air-fluid levels in the trapped loops, anterior and leftward displacement of the superior mesenteric vein, and abnormal take-off of the superior or inferior mesenteric artery (15, 20-24).

Right paraduodenal hernias present a similar ovoid grouping of several small bowel loops just lateral and inferior to the descending duodenum. They are usually more massive and fixed than those on the left side. Both the afferent and efferent intestinal loops pass through the hernia orifice, where they are closely apposed and narrowed. Lateral films are particularly useful for demonstrating the retroperitoneal displacement of the hernial contents. Since the superior mesenteric artery and its ileocolic branches are situated in the anterior wall of the right paraduodenal hernia sac, the passage of herniated loops behind these vessels produces changes which are detectable angiographically (2, 3). Not only the intestinal loops, but their mesentery and vessels as well are incorporated into the hernia. Visualization of these vessels, particularly of the position of their branches supplying the small bowel loops, can assist in the radiologic diagnosis of paraduodenal hernias.

In right paraduodenal hernia, the major CT findings are: clustering or encapsulation of small bowel loops in the right mid-abdomen, and looping of jejunal branches of the superior mesenteric artery and vein to the right and posterior in a fashion analogous to the arteriographic findings (2, 3).

On a small bowel series, relationship of the hernia sac with surrounding organs cannot be shown. In addition, a small bowel series should not be performed on a patient with an ileus. Arteriography may also be helpful in making this diagnosis because it can demonstrate vascular anomalies. However, it is invasive and is not suitable for patients with acute bowel obstruction. CT can demonstrate not only an encapsulated cluster of small bowel loops but also the hernia sac, the relationship of the loops to the surrounding organs, and vascular anomalies. CT can also be performed on patients with an ileus.

Magnetic resonance imaging (MRI) can image in multiple planes and can also be used on patients with an ileus. MRI showed not only findings similar to the small bowel series but also the relationship to surrounding organs and hernia sac. In general, MRI is not good for imaging the small intestine due to motion artifacts. Paraduodenal hernias, however, are fixed to the retroperitoneum and are often adhered to the hernia sac, and thus motion artifacts are limited. Thus, MRI may be useful for imaging most paraduodenal hernias (19).

Both of the paraduodenal hernia cases diagnosed in our clinic had a history of repeated subileus attacks, and the examinations were performed during the symptomatic period. One of the cases was diagnosed with CT and enteroclysis examination (Figure 1a, 1b), the other was diagnosed with enteroclysis (Figure 2).

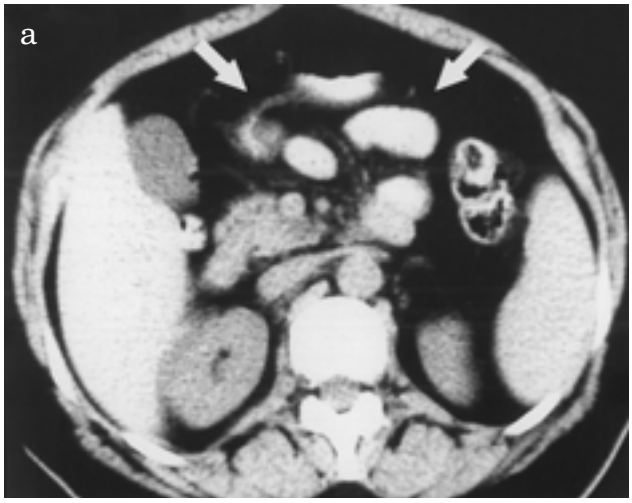

Figure 1: a) Left paraduodenal hernia. Axial CT image shows grouping of intestinal loops (white arrows) in front of the pancreas

TRANSMESENTERIC HERNIAS

Approximately 5 to 10% of all internal hernias occur through defects in the mesentery of the small bowel (3). These have no limiting sac, but their functional significance is otherwise quite similar to the true internal hernias. Nearly 35% of transmesenteric hernias manifest in the pediatric age group, in which they constitute the most common type of internal herniation (3). A causal relations-

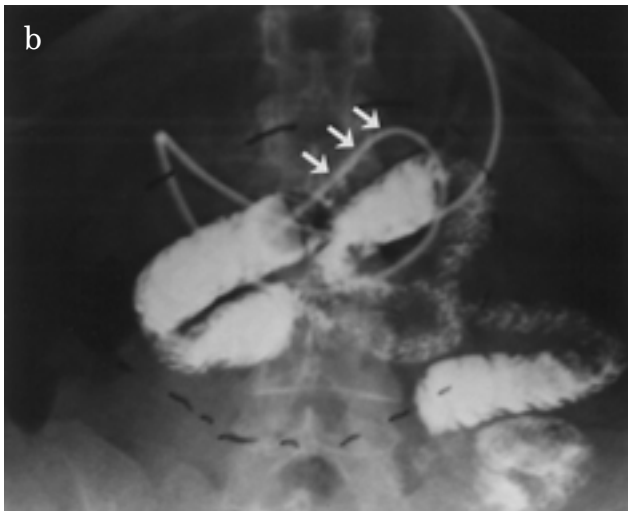

Figure 1: b) Left paraduodenal hernia. Enteroclysis examination, catheterization phase, reveals an abnormal direction (white arrows) of the catheter tip within the lumen of the proximal jejunum to the right side at the level of the Treitz ligament

hip to prenatal ischemic accidents seems likely. In adults, however, most mesenteric defects are probably the result of previous gastrointestinal operations, abdominal trauma, or intraperitoneal inflammation (3, 7-9)

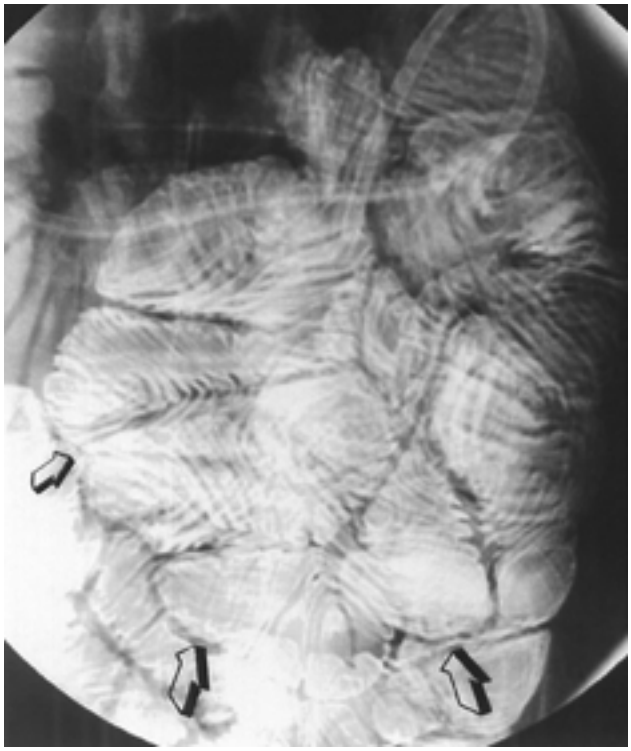

Figure 2. Left paraduodenal hernia. Enteroclysis examination shows fixed and encapsulated small bowel loops (arrows) in left upper quadrant of the abdomen

These hernias are usually not encapsulated, not enveloped in a sac and, therefore, not easy to detect, and a considerable length of small bowel may protrude through the mesenteric aperture. Their location is more variable, but the herniated bowel loops are usually adjacent to the abdominal wall.

Plain radiographs of the abdomen demonstrate a mechanical small bowel obstruction, and occasionally a single distended "closed loop". Small bowel examination may disclose a constriction around the closely approximated afferent and efferent limbs of the herniated intestine (3).

Computed tomography features include a cluster of dilated bowel lying adjacent to the abdominal wall without overlying omental fat with central displacement of the adjacent colon, and mesenteric vessel abnormalities, including crowding, stretching and engorgement, as well as displacement of the main mesenteric trunk to the right. Volvulus and ischemia of the herniated small bowel are frequent complications of transmesenteric hernia (7-9).

TRANSOMENTAL HERNIAS

Transomental hernias through the greater or lesser omentum are even rarer, accounting for approximately 1-4% of all internal hernias; hernias occurring through the lesser omentum are extremely rare (3, 6, 25-27).

The age at diagnosis is usually older than 50 years and most occur in the right side of the greater omentum (26). The hernial orifice is usually a slit-like opening of up to 10 cm in size located in the periphery of the greater omentum. Most have a congenital origin, but trauma and inflammation may also produce omental perforations and weak areas (3). Such defects can subsequently serve as potential sites for transomental herniation of the small bowel and other mobile segments such as the cecum or sigmoid colon. No sac is ever found and, in general, the strangulated viscus is the small bowel. In these cases, the clinical presentation is that of an intestinal obstruction (26). The clinical and radiologic findings are almost identical with those of the transmesenteric hernias.

The intestinal loops in herniations through the lesser omentum were confined between the stomach, liver and pancreas and were crowded in appearances in the lesser sac. Herniation could be persistent or intermittent based on the defect and the herniated loops. In this type of herniation,

strangulation cases have been reported as well (6). Two of the internal hernias diagnosed in our clinic were hernias into the lesser sac. One of them resulted from the defect of the gastrocolic ligament. Due to epigastric pain and tenderness, CT was ordered, which revealed intestinal loops placed between the pancreas and stomach in the lesser sac (Figure 3a, 3b). Herniation through the gastrocolic ligament into the lesser sac was detected at laparotomy.

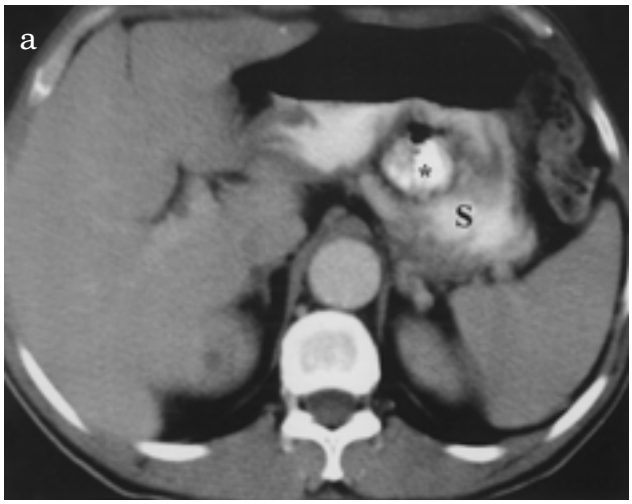

Figure 3: a) Transomental hernia. Axial CT image reveals that intestinal loops (asterisk) are placed between the pancreas and stomach (S) in the lesser sac

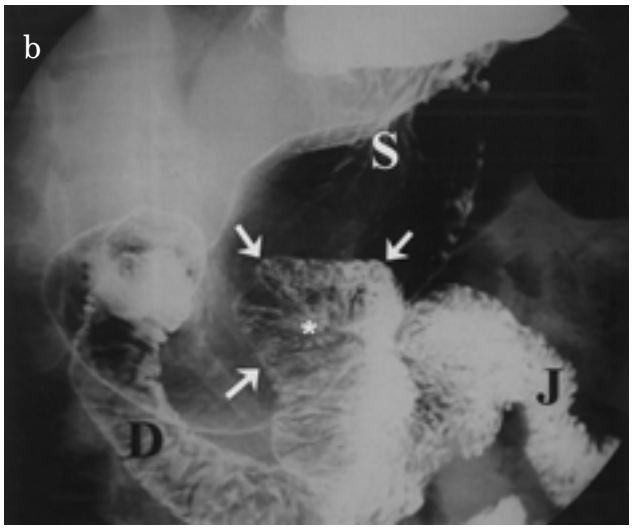

Figure 3: b) Transomental hernia. Upper gastrointestinal barium study shows the herniated small bowel segment (white arrows and asterisk) into the lesser sac (S, stomach; D, duodenum; J, jejunum)

PERICECAL HERNIAS

Four peritoneal fossae located in the ileocecal region, as well as congenital and acquired defects in the mesentery of the cecum or appendix, may lead to development of a pericecal hernia (3, 28). Anatomically, there are four types of peritoneal recesses of various sizes and depths identified in the pericecal region, including the superior ileocecal recess, inferior ileocecal recess, retrocecal recess and paracolic sulci. Furthermore, several supplementary fossae or recesses possibly develop in the ileocecal area due to individual variations in the process of bowel rotation and peritoneal fusion (29). These structures may also conceivably result in a pericecal hernia.

The clinical manifestations are usually intermittent episodes of colicky right lower abdominal pain associated with small bowel distention, nausea, and vomiting. In most cases, an ileal segment herniates through a defect in the mesentery of the cecum and occupies the right paracolic gutter. Urgent surgical intervention to prevent strangulation, which is responsible for high mortality, is imperative (28).

The correct diagnosis may be suggested on plain radiographs of the abdomen provided that the unusual relationship of the ileum to the cecum is recognized in association with small bowel obstruction signs. The delayed radiographs of the small bowel series or a barium enema examination with retrograde opacification of the terminal ileum are more useful. Careful fluoroscopic evaluation and filming in lateral and oblique projections are particularly valuable for the demonstration of the fixed position of the herniated ileal loop posterolateral to the cecum.

In CT examination, if there is dilatation of small intestine loops with transitional zone adjacent to the cecum or edematous small bowel located lateral to the cecum, pericecal hernia can be diagnosed with high certainty (29).

INTERSIGMOID HERNIAS

These hernias involve the intersigmoid fossae, a peritoneal pouch located between the two loops of the sigmoid colon and its mesentery. This pocket is found in 65% of autopsies (28). Intersigmoid hernias are usually reducible and are an incidental finding during laparatomy. Their radiologic diagnosis is made by barium enema study whereby retrograde filling of the small bowel has been achi-

eved. This examination reveals a portion of small bowel encapsulated between the sigmoid loops (3).

Rotation of the mesentery along with dilated and encapsulated intestinal loops in the pelvis and accompanying strangulation findings could be observed in CT (12, 30).

SUPRAVESICAL HERNIAS

Supravesical hernia is rare. It involves a hernia between the median and medial umbilical ligament and is classified as two types: internal supravesical hernia and external supravesical hernia (32). External supravesical hernia is more common than internal supravesical hernia, and it is difficult to make differential diagnosis from inguinal hernia. Most patients with internal supravesical hernia presented with intestinal obstruction and strangulation. Most patients with external supravesical hernia presented with inguinal swelling and were diagnosed as having direct inguinal hernia.

The supravesical fossa is the area of the abdominal wall between the remnants of the median and the left or right medial umbilical ligaments. In the fossa, an incarcerated intestinal hernia is a defect in the integrity of the transversus abdominis and fascia transversalis. The sac may remain above the pelvis and form an external supravesical hernia or pass downward and form an internal supravesical hernia. The external type usually presents as a direct inguinal hernia.

Skandalakis et al. (33) proposed the simpler terms "anterior supravesical", "right or left lateral supravesical", and "posterior supravesical" depending on whether the hernia passed in front of, beside, or behind the bladder, respectively. Anterior and lateral hernias pass into the retropubic space of Retzius. The posterior hernia is rare and passes into the retrovesical space.

The characteristic CT finding of the supravesical hernia is the incarcerated small bowel loops in front of the bladder. External supravesical hernia also exhibits inguinal swelling. We performed enteroclysis examination on a patient with recurrent abdominal pain, which revealed encapsulated and fixed ileal loops in the minor pelvis (Figure 4). The patient was operated and an internal supravesical hernia was determined.

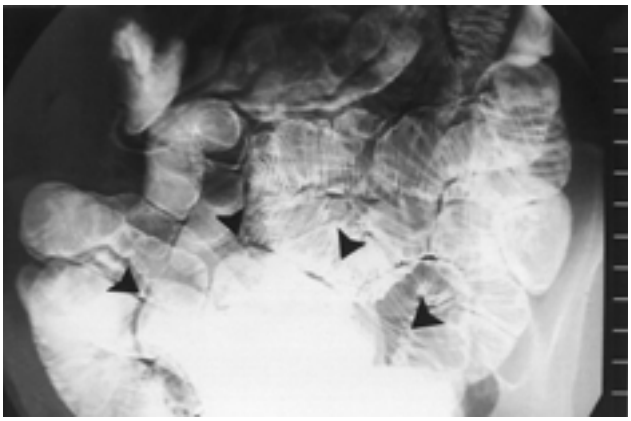

Figure 4. Supravesical hernia. Enteroclysis examination reveals encapsulated and fixed ileal loops (arrowheads) in the minor pelvis

FORAMEN OF WINSLOW HERNIAS

The lesser sac communicates with the greater peritoneal cavity through the epiploic foramen of Winslow. This small aperture can serve as a pathway for herniation of viscera into the lesser sac, where 8% of all internal hernias occur. The small bowel is the herniated viscera in 60 to 70% of cases. The terminal ileum, cecum, and ascending colon are involved in about 25 to 30%. Other viscera such as the transverse colon, gallbladder, and omentum are occasionaly involved (3). Predisposing factors include an enlarged foramen of Winslow and excesively mobile intestinal loops because of a long mesentery or persistence of the ascending mesocolon (3, 28). The onset of herniation into the lesser sac may be provoked by a sudden increase in intra-abdominal pressure as experienced during lifting of heavy weights or parturition.

The patients present with acute onset of progressive upper abdominal pain and small bowel obstruction. Physical examination usually reveals localized tenderness and distention in the epigastric regions.

The characteristic plain film findings are demonstration of gas-containing loops of intestine within the lesser sac medial and posterior to the stomach, together with evidence of mechanical small bowel obstruction. The right ileac fossa may appear empty if the cecum and the ascending colon are the herniated segments. Upper gastointestinal examination reveals the displacement of the stomach anteriorly and to the left because of extrinsic compression by the bowel loops containing gas and fluid, which occupy the lesser sac. The first and second portions of the duodenum are also displaced to the left. Dilatation and hyperperistalsis of the loops of small bowel indicate a mecha-

nical obstruction distally. Barium enema examination may reveal a tapered narrowing of the colon near the hepatic flexure if the herniation involves the cecum and the ascending colon (34).

The CT diagnosis is established by the presence of bowel posterior to the stomach, which is characteristically displaced to the left. The herniated bowel is located posterior to the portal vein, common bile duct, and hepatic artery and anterior to the inferior vena cava (36).

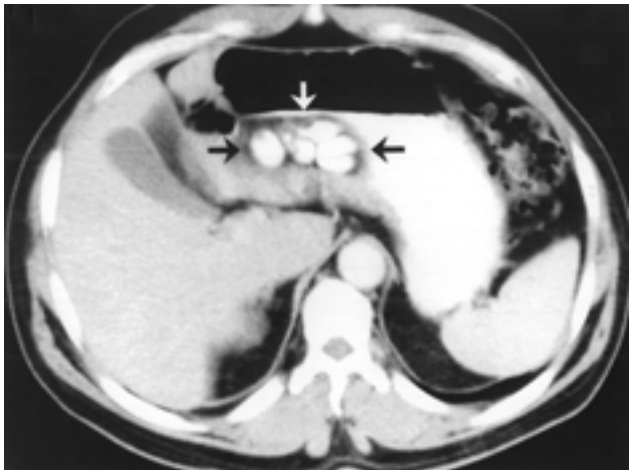

Figure 5. Foramen of Winslow hernia. Axial CT shows crowded intestinal loops (arrows) in the lesser sac

One of the diagnosed internal hernia cases in our clinic was the foramen of Winslow hernia. CT examination showed crowded intestinal loops in the lesser sac (Figure 5). This observation was verified by subsequent laparotomy.

CONCLUSION

Internal abdominal herniations are rare conditions caused by congenital or acquired defects in the mesentery or the peritoneum. Clinical presentation is generally nonspecific, and clinical and radiologic diagnosis can sometimes be challenging. Immediate diagnosis is mandatory because small-bowel damage, ischemia, and necrosis can result from misdiagnosis and consequent delay in proper treatment. As a result, radiology has an important role not only in the diagnosis but also in the prognosis of internal herniations.

In our experience, in patients with a history of recurrent and unexplained subileus attacks with undetermined cause of obstruction, carefully performed CT and/or enteroclysis are the most successful diagnostic modalities.

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