

ORIGINAL ARTICLE

Internal hernias and their mimics: How would radiologists help?



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Abstract *Purpose:* Trying to define the most valuable radiological sign(s) for the diagnosis of internal hernias and their mimics; mainly cocoon syndrome and adhesions.

Review: Nowadays with the increasing number of bariatric surgeries, the number of diagnosed internal hernias has increased significantly. Adhesions and cocoon syndrome are among the differential diagnosis. Although many signs were suggested for the diagnosis of such conditions, yet no single sign is enough to diagnose each of the above.

Method and subjects: This is a retrospective study. In a period of 32 consecutive months, from June 2010 to February 2013 a total of 240 patients were admitted with abdominal pain with signs of remittent or persistent intestinal obstruction. All cases are subjected to multislice CT examination. Several criteria are used to diagnose internal hernia. Informed consents were taken from all patients and organizational ethics committee were informed.

Results: The age of the patients varies between 22 and 63 years with average age of 36 ± 2.3 years. Most of the patients were females with ratio of 2:1. Commonest presentation was abdominal pain present in all cases. The study diagnosed 13 cases/internal hernias, 14/adhesions, two cases/cocoon syndrome, two cases/intussusceptions and one case/malrotation. The most important signs used are Swirl's sign, localized bowel gathering and segmental bowel dilatation.

Conclusion: A single sign is not enough for the diagnosis of internal hernia, rather the use of more than one sign is essential to narrow the differential diagnosis.

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Clinical relevance/application: The prevalence of internal hernia is increasing due to increased rate of operative abdominal intervention. Prompt radiological diagnosis is crucial to avoid unwanted surgery in a non-virgin abdomen.

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1. Purpose

- Trying to define the most valuable radiological sign(s) for the diagnosis of internal hernias and their mimics; mainly cocoon syndrome and adhesions.

2. Literature review

Meyers, MA wrote in 1970 defining internal hernia as the herniation of a viscus through a normal or abnormal aperture within the confines of the peritoneal cavity. He stated that by that time only 400 cases of internal hernia were diagnosed and most of them were paraduodenal hernias. Meyers used arteriography in 1969 and barium follow through in 1970 to diagnose internal hernias. Before that speaking of internal hernia may reached 1930s and 40s (1–3).

Early reports utilizing CT in diagnosing internal hernia started almost at 1982. Harbin WP stated that CT demonstrated a sac like mass of dilated loops of the small bowel which displaced the right ureter laterally, indicating its retroperitoneal location. Failure of oral gastrografen to enter the loops implied small bowel obstruction. Dilatation of loops within and outside the sac was strongly suggestive of vascular compromise of the entire small bowel secondary to volvulus. The constellation of findings is diagnostic of an internal hernia of the retroperitoneal type which mostly are paraduodenal hernias (4) (see Figs. 1–7).

Nowadays with the increasing number of abdominal surgeries and advent of bariatric surgeries entailing surgical bypasses; the number of diagnosed internal hernias has increased significantly. In 2001; reports stated that transmesenteric hernias are becoming more common than paraduodenal hernias. Numerous signs have been suggested for the diagnosis of internal hernias using CT throughout the years. Blachar et al. suggested signs like:

1. Cluster of SB anterior and lateral to pancreas.
2. Sac like mass or encapsulated small bowel.
3. Mass effect on posterior wall of stomach and caudal displacement of duodeno-jejunal junction.
4. Crowding, stretching and engorgement of mesenteric vessels.
5. Displacement of mesenteric trunk.
6. Caudal or dorsal displacement of transverse colon.
7. Medial displacement of ascending or descending colon.
8. Distended small bowel.
9. Point of transition.
10. SB obstruction (5–10).

In 2009; Carucci et al. suggested signs like atypical bowel configuration, clustered bowel, and staple line change to diagnose internal hernia following Roux-en-Y gastric bypass surgery (11).

Cocoon syndrome or primary encapsulating peritonitis is characterized by a thick fibrotic peritoneum that wraps the bowel in a concertina-like fashion with some adhesions. This

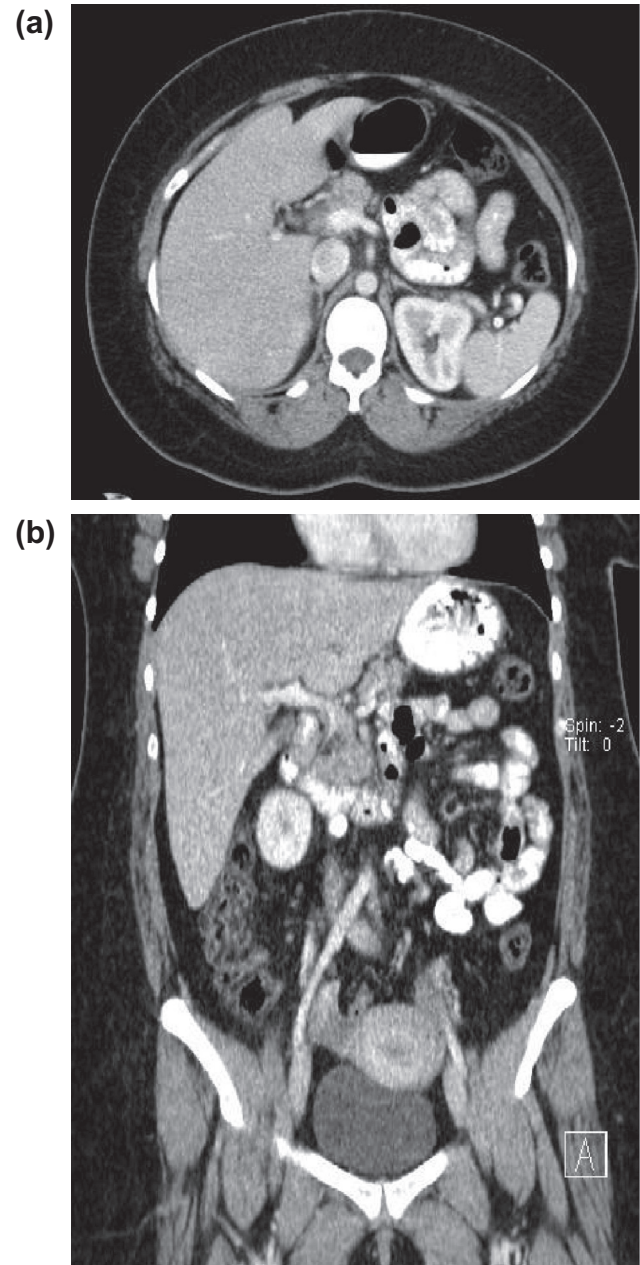


Fig. 1 (a) Axial & (b) coronal reformatted image of the abdomen showing localized bowel gathering at the left side with no bowel dilatation ... paraduodenal hernia.

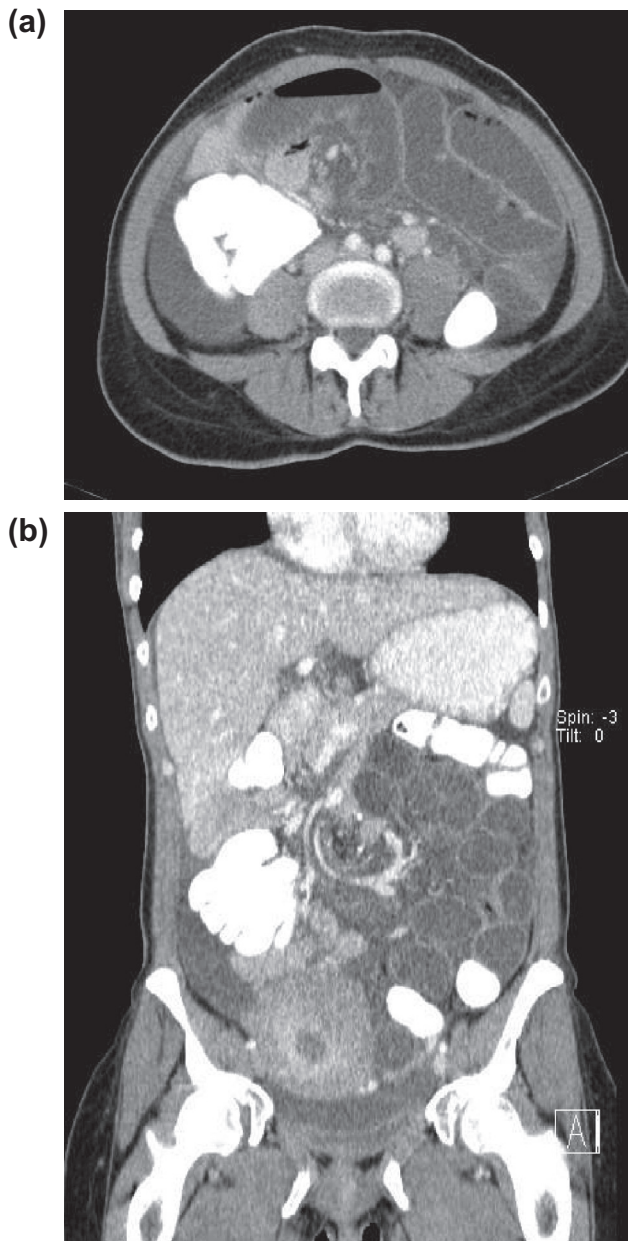


Fig. 2 (a) Axial & (b) coronal reformatted image of the abdomen showing swirl sign, dilated bowel and ascites ... internal hernia.

rare disease is usually described in young adolescent females although a few case reports were also males (12–16).

The diagnosis of adhesions is perhaps the commonest cause of organic intestinal obstruction and almost always due to previous operative intervention though few cases are due to peritonitis. The diagnosis of abdominal adhesions is that of exclusion because adhesive bands are not seen in most of cases. Dilated bowel with a zone of transition usually gives the diagnosis in absence of other obvious pathology (17–21).

Malrotation shows abnormal position of the bowel with abnormal duodeno-jejunal junction, small bowel on the right side and reversal of the superior mesenteric artery and vein. It is not common, usually silent and can be easily mistaking for internal hernia (22).

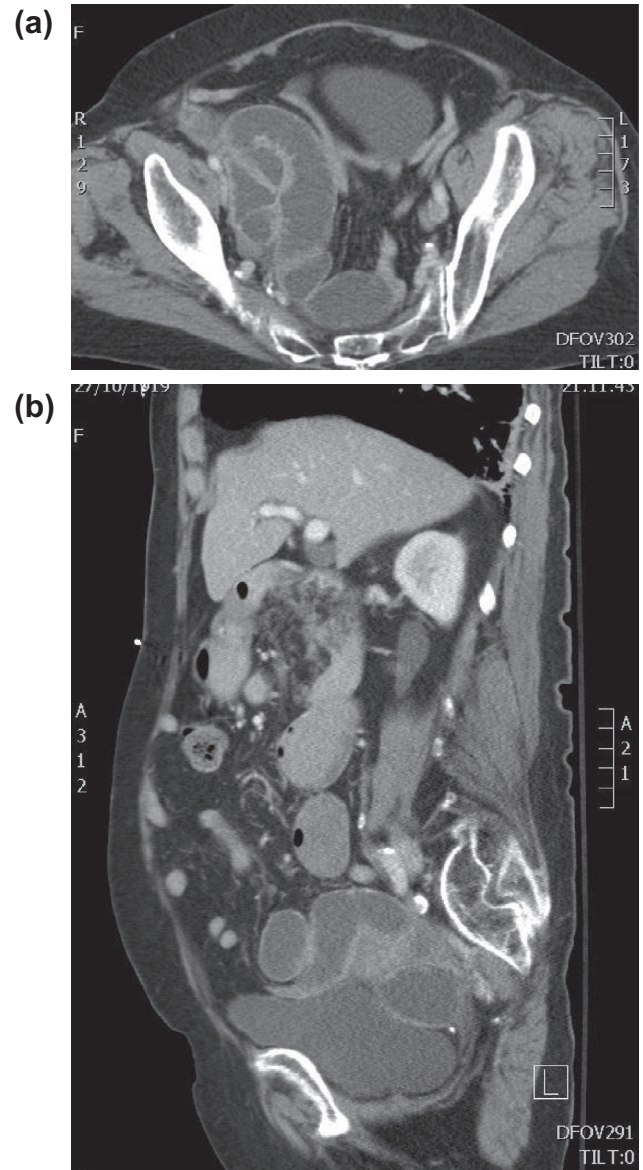


Fig. 3 (a) Axial & (b) coronal images of the abdomen and pelvis showing dilated bowel, gathered encapsulated bowel and bowel kink ... internal hernia following rectal anastomosis.

3. Method and subjects

This is a retrospective study. Data were extracted via the hospital HIS/RIS system and images were taken from the Department PACS system.

In a period of 32 consecutive months; from June 2010 to February 2013 a total of 240 patients were admitted with abdominal pain with signs of remittent or persistent intestinal obstruction. Among those patients; 180 cases had a history of previous abdominal operative intervention. All cases are subjected to multislice CT examination (Siemens 16 slice-Somatom sensation – Germany) of the abdomen and pelvis using IV contrast and positive water soluble oral contrast 30 min prior to the examination. The examination is done in a single porto-venous phase. In only two cases non contrast initial series was done and then followed by oral contrast series.

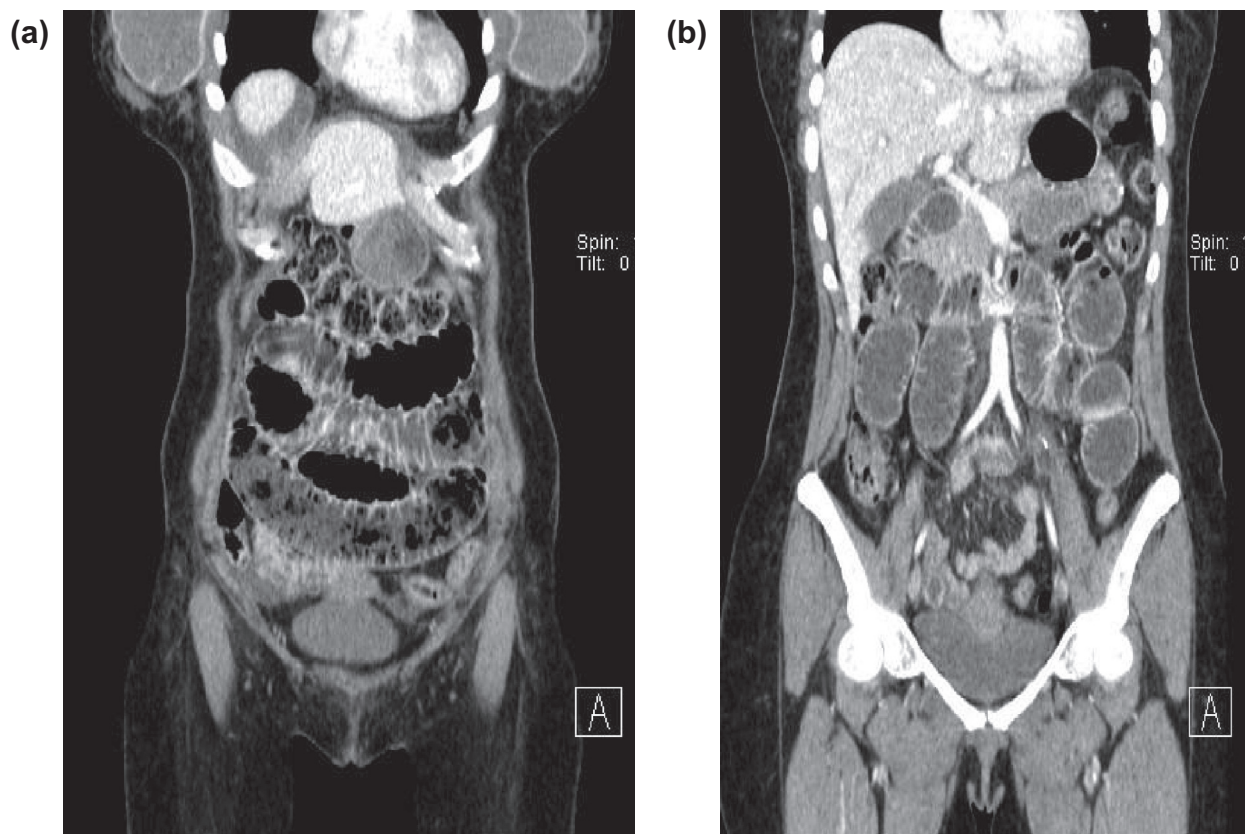


Fig. 4 (a & b) Coronal reformatted images of the abdomen and pelvis showing a rather diffuse dilatation of most of the small bowel; a) showing swirling... adhesive intestinal obstruction.

3.1. CT protocol

- Supine, foot first
- kV = 120
- Effective mAs: 300–500
- Scan time 10–12 s.
- Delay 70 s
- Single breath
- No gantry tilt
- 2 mm cuts
- Kernel medium soft
- Image matrix 256 × 256.
- **Inclusion criteria:** patients with abdominal pain showing signs of remittent or persistent intestinal obstruction.
- **Exclusion criteria:** pregnancy.
- Criteria to diagnose internal hernia used were: abnormal bowel gathering, encapsulated bowel, abnormal bowel dilatation, Swirl signs with twisting of mesenteric vessels, mesenteric vascular engorgement, dilated gastric remnant particularly following gastric bypass, abnormal orientation of the third part of the duodenum and/or abnormal duodenojejunal junction and mass effect on the related structures.
- Among the 240 cases; thirteen cases were definitely diagnosed by laparoscopy as internal hernias. The cases radiological profiles were revised in retrograde manner. The radiological diagnosis of possible internal hernia was wrong in three other cases. Two cases were finally diagnosed as cocoon syndrome.

- Adhesions were finally diagnosed in 14 cases; only 6 cases of them were managed by laparoscopy and the rest conservatively.
- Intussusception was noted in two cases.
- Please refer to [Table 1](#).

IBM SPSS statistics (V. 21.0, IBM Corp., USA, 2012) and GraphPad Prism 6 for Windows version 6.03 (GraphPad Software, San Diego, CA, USA) were used for data analysis.

Institution ethics committee has been informed and approved the research.

4. Results

The age of the patients varies between 22 and 63 years with an average age of 36 ± 2.3 years. Most of the patients were females with a ratio of 2:1.

The most common presentation is abdominal pain present in all cases. The degree of pain was varying among patients ranging from discomfort to severe pain.

Among the radiological signs used for the radiological diagnosis Swirl sign, local bowel gathering and bowel dilatation were the most consistent in all cases.

Swirl sign was present in all twelve cases of internal hernias but also present in the three cases that were misdiagnosed as internal hernias (false positive). Swirl sign was also seen in many cases following Roux-en-Y anastomosis as well.

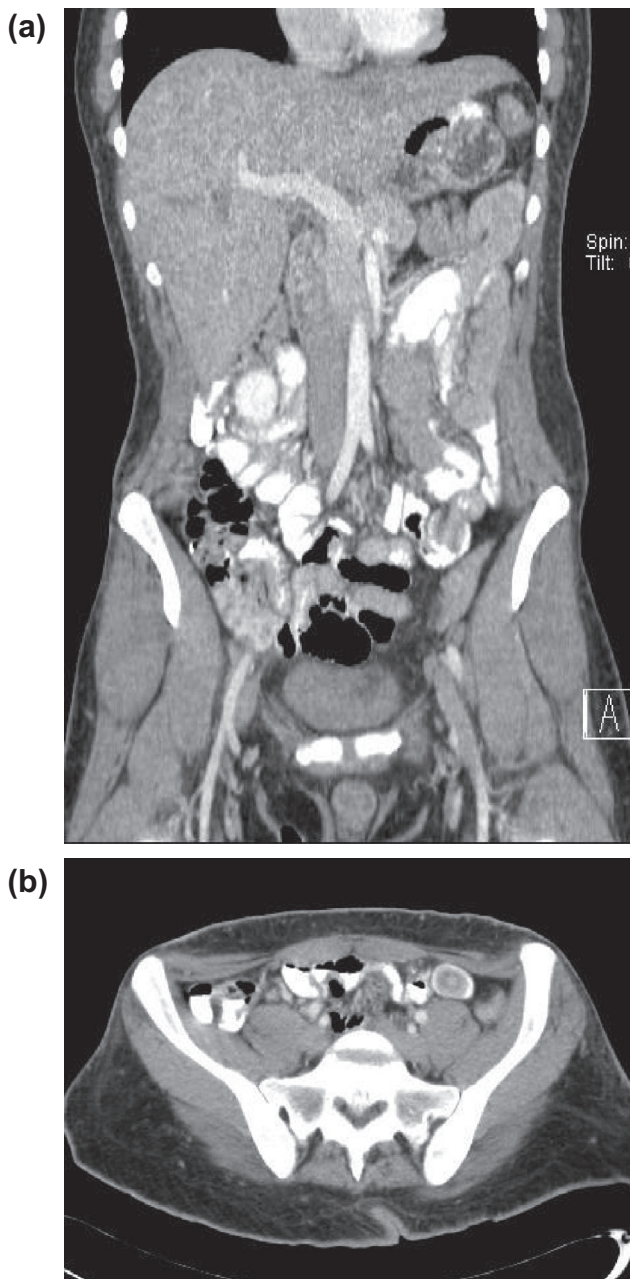


Fig. 5 (a) Coronal reformatted & (b) axial images of abdomen showing intussusception.

Local bowel gathering with/without encapsulation was definitely noted in all cases of internal hernia but also present in a case of malrotation and partly conceived in many cases following bypass operation.

Segmental bowel dilatation ≥ 3 cm in caliber was present in 10 cases of internal hernia but also present in cases of cocoon syndrome and present in 10 more cases of adhesions.

Abnormal position of the duodenojejunal junction was noted in one case of malrotation and in two cases of paraduodenal hernias.

Bowel other than duodenum posterior to the superior mesenteric artery was not encountered in our study.

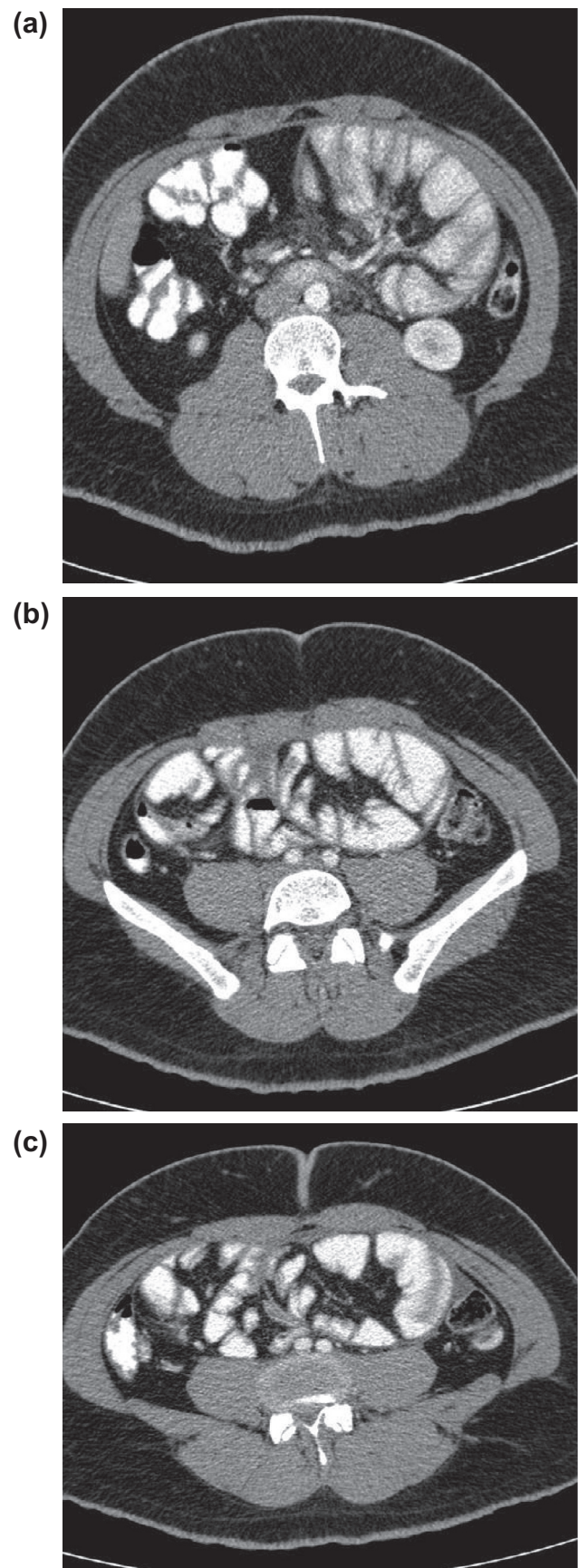


Fig. 6 Encapsulated bowel (a–c): axial images showing encapsulation and mild bowel dilatation ... cocoon syndrome.

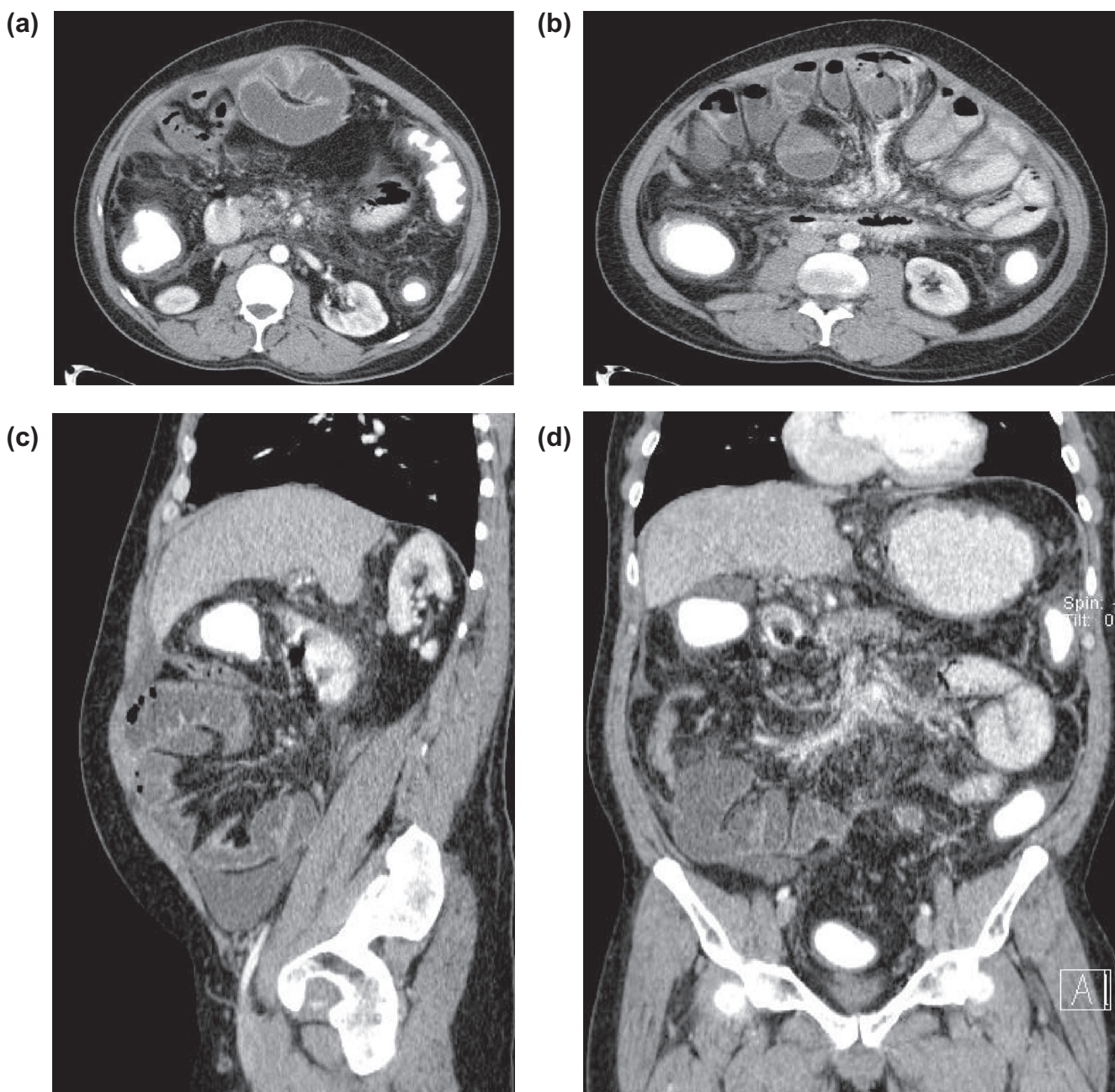


Fig. 7 (a & b) Axial, (c & d) sagittal reformatted images: encapsulated localized bowel gathering with swirling and mesenteric vascular engorgement ... cocoon syndrome.

Please refer to [Table 2](#).

The two cases of cocoon syndrome were adult males and presented with recurrent abdominal pains. There was no history of previous abdominal surgeries. The cases were interpreted in CT as internal hernias and were diagnosed by laparoscopy. One case showed a single uniform sac and the other showed an irregular multilocular sac. Both cases had no history of previous operative intervention.

One case of malrotation was noted with abnormal duodeno-jejunal junction and most of small bowel noted on the right side.

Adhesions, stomal obstruction or narrowing at the distal anastomotic site following gastric bypass were seen in 20 cases.

Table 1 Final diagnoses of cases included in our study.

Diagnosis	Number of cases	Management
Internal hernia	13	Laparoscopy
Adhesions	14	Laparoscopy in 6 cases only
Intussusception	2	Laparoscopy
Cocoon syndrome	2	Laparoscopy
Malrotation	1	Conservative

Intussusception was noted in two cases one of them was transient not seen in initial non contrast CT and noted 15 min in post contrast series.

Table 2 The prevalence of different signs in relation to the clinical diagnoses.

	Internal hernia	Adhesions	Intussusception	Cocoon syndrome	Malrotation
Swirl sign	12/13	3/14	0/2	1/2	1/1
Local bowel gathering ± encapsulation	13/13	1 /14	0/2	2/2	1/1
Segmental bowel dilatation	10/13	10/14	2/2	2/2	0/1

Table 3 Present the statistical data of the three commonest signs encountered in our study and the combination of these three.

Parameter	Swirl sign	Segmental dilatation of bowel	Gathering of bowel ± encapsulation	Swirl and dilatation and gathering
Sensitivity	100	60*	93	100
Specificity	88*	86*	92	96
Positive predictive value	50*	45*	65*	81
Negative predictive value	100	96	100	100
Accuracy	78*	88*	93	95

* Significant with level of significance (0.005).

The commonest three signs seen in cases of internal hernias were swirl sign with abnormal vascular twist, abnormal segmental bowel dilatation and localized gathering of bowel loops with/without encapsulation. All show excellent negative predictive value.

Swirl sign seems promising having the highest sensitivity but unfortunately the lowest specificity seen in many patients just bypass surgeries with no pathological relevance.

Segmental dilatation of the bowel shows low sensitivity as in few cases of internal hernias there is no significant dilatation.

Gathered bowel ± encapsulation has a high sensitivity with the higher positive predictive value but it is also present in cases of malrotation.

Adhesions give a more diffuse form of bowel dilatation. No encapsulation was noted in almost all instances. Swirl sign is not a prominent feature.

Transition zone is not only seen in cases of internal hernias but also seen in some cases of adhesions.

Please refer to [Table 3](#).

Cocoon syndrome carries a diagnostic dilemma to the radiologist with no definite radiological signs that could differentiate it from genuine internal hernia. It might be noted that swirl sign of mesenteric vessels is less conspicuous in a subjective manner. Both cases of cocoon's syndrome were adult males presenting with recurrent abdominal pains with no history of previous abdominal operation. One was diagnosed as paraduodenal hernia by CT and diagnosed was revealed by laparoscopy showing a single sac. The second case was also an adult male and was diagnosed as internal hernia by CT. Laparoscopy showed multiple loculations with multiple peritoneal septa; most of them were managed by laparoscopy but due to complexity of septa; some were spared.

5. Discussion

Among the causes of organic intestinal obstruction; adhesions come to be the commonest cause (External hernias in some references). Incidence of adhesions in patients with history of abdominal surgeries may reach up to 93%.

Internal hernias; although they are not a common cause of organic intestinal obstruction, remain an important entity to be kept in mind particularly in patients with a previous history of abdominal operative intervention as they in most occasions require immediate surgical intervention.

The incidence of internal hernias in the virgin abdomen is rare. The commonest type in the literature used to be paraduodenal hernias. However, in recent studies and owing to the increase of abdominal operative intervention; transmesenteric hernias incidence start to increase and may (in many reports) exceed the incidence of paraduodenal hernias.

In our study transmesenteric hernias are the most common with abdominal surgeries being accused to be the cause particularly bariatric surgeries and Roux-en-Y gastric bypasses.

There is no single sign sufficient to diagnose internal hernias alone. Due to overlap with adhesions, malrotation and occasional accepted post-operative anatomy of the abdomen there is significant false positive results. Swirl sign is tempting as a diagnostic tool but it is occasionally seen in post-bypass cases with no pathological implication.

Segmental dilatation of the bowel is seen in many cases as an occasional finding and is usually caused by adhesions. Some internal hernias do not show significant (≥ 3 cm caliber) dilatation at time of presentation to the radiology department.

Encapsulation and localized gathering is seen in internal hernias and in malrotation as well. It is sometimes encountered incidentally in post-operative patients with no clinical relevance.

The rest of the signs are not consistent. The abnormal position of duodenojejunal junction is valid in malrotation.

A single sign always lacks precision although the three show good negative predictive value but poor specificity with poor positive predictive value. Combining the three signs together simultaneously increases specificity, positive predictive value and accuracy significantly.

Cocoon syndrome is a very rare disease primarily involving the peritoneum with creation of peritoneal sac (Uni or multi-locular as we encountered). I was lucky to meet two cases of the cocoon syndrome. I found no specific sign that could differentiate between cocoon syndrome and internal hernia though the swirl sign may appear less conspicuous.

Adhesion shows more diffuse dilatation of the small bowel with the transitional zone and if lucky (I was not) you may see the adhesion.

6. Conclusion

- A single sign is not enough for the diagnosis of internal hernia. I suggest a combination of Swirl sign, local bowel gathering and bowel dilatation in appropriate clinical settings for the diagnosis of internal hernia. Still diseases like the cocoon syndrome will remain difficult to diagnosis radiologically.

Conflict of interest

None declared.

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