Disclosure

Authors do not have any financial or other relevant disclosures.
Clustered bowel Segments

- Clustered or unusual crowded appearance of bowel segments is typically seen with entero-enteric or inter-loop adhesions, classically referred to as “matted bowel”.
- This finding has a high predictive value for bowel adhesions.
- This finding can also be seen with intra-abdominal infections such as with abdominal tuberculosis.

Coronal contrast enhanced CT image shows closely clustered small bowel loops in the right lower quadrant consistent with high grade entero-enteric adhesions (green arrows). No thickened overlying peritoneum to suggest abdominal cocoon.
Overview & Content Organization

- Review the etiologies, timeline and clinical significance of bowel adhesions
- Complications that can result secondarily
- Review **spectrum of imaging findings** related to bowel adhesions on multi-detector computed tomography (MDCT) and MRI
  - Emphasis on recognition of specific patterns and signs for bowel adhesions
  - Assessment of severity as pertains to future risk of obstruction and possible bowel injury during surgical procedures, due to underlying adhesions
- Role of the radiologist in identifying & reporting significant adhesions
Adhesions: Facts not fiction

• The **most frequent cause** of abdominal adhesions is abdominal surgery. Other etiologies include trauma, peritoneal dialysis, infection such as tuberculosis

• **Almost all patients** who undergo abdominal surgery will develop adhesions of varying degree; minimal to significant

• The **risk is greater** after **lower abdomen and pelvic surgeries** when compared to upper abdominal surgeries eg: bowel & gynecologic procedures

• **IMPORTANT POINT:** Adhesions can become larger and tighter over time causing problems, years after surgery
Causes of abdominal adhesions include surgery and contact of tissues with foreign materials, such as gauze, surgical gloves, and sutures as well as retained blood.

Gynecological surgeries, such as hysterectomy, are more prone to adhesion development than most general abdominal surgeries.

A less common cause is inflammation such as ruptured appendicitis, inflammatory bowel disease, abdominal TB and other infections, radiation treatment for cancer among others.

Rarely, abdominal adhesions form without apparent cause, ie de novo!
Types of bowel adhesions on cross-sectional imaging

Entero-Enteric
Adhesions between adjacent bowel loops

Entero-Visceral
Adhesions between bowel and adjacent organs

Entero-peritoneal or Entero-Parietal
Adhesions between bowel and parietal peritoneum
Bowel Findings of Adhesions

1. **Unchanged location** of bowel segments on successive exams (inertia)
2. **Loss of fat planes** behind the rectus sheath and anterior peritoneum
3. Focal **clustering or crowding** of bowel loops
4. **Kinking and angulation** of bowel loops
5. **Caliber change** of bowel
6. **Asymmetric thickness** of the bowel wall
7. **Fat notch** sign
8. Localized **stasis** within bowel segments
9. “**Star sign**” of adhesions which may also signify underlying fistulization
10. **Enteric-Orga**n adhesions
Mesenteric Findings of underlying adhesions

- Focal increased attenuation of mesentery
- Mesenteric Vascular crowding
- Focal localized fluid
Peritoneal Changes associated with Adhesions

- Focal or diffuse **peritoneal thickening** and enhancement
- Peritoneal **calcifications** and **Sclerosing Peritonitis**
- **Loculated fluid** in between loops of bowel
- **Peritoneal inclusion cyst**
Entero-peritoneal adhesions with unchanged bowel location over time

Axial CT images were obtained almost 2 years apart: Note location of small bowel loops in the same location, abutting the right anterior abdominal wall with obliteration of the right post-rectus fat plane (yellow arrows). Normal left post rectus fat plane (green arrows)
Loss of fat planes posterior to the rectus sheath and anterior peritoneum

Normal bowel segments are nearly always separated from the posterior aspect of the rectus muscles by mesenteric and omental fat. Following intra-abdominal and pelvic surgeries, the tissue disturbance at the level of the visceral peritoneum results in closely applied adherence of the small bowel with resultant loss of the retro-rectus fat planes.

50 year old female patient status post cholecystectomy, shows unchanged location of bowel loops along the anterior peritoneum on studies over a period of 9 months with loss of posterior rectus sheath fat plane (yellow arrows).
Clustered bowel Segments

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- This finding can also be seen with intra-abdominal infections such as with abdominal tuberculosis.

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Clustered bowel loops

60 year-old female patient status post hysterectomy. Contrast enhanced axial and sagittal CT images show matted bowel loops clustered in the lower abdomen & pelvis (green arrows).
42 year old female status post hysterectomy, 3 years ago, presenting with chronic lower abdominal pain. Axial CT images demonstrate acute angulation and kinking of multiple bowel loops (red arrows).

One of the most common signs of bowel adhesions is **acute angulation of bowel**. Normal small bowel being freely mobile normally shows smooth curved loops usually evenly distributed in the abdomen and pelvis. With development of either entero-enteric adhesions or entero-parietal adhesions, loops become **fixed** at certain points, leading to **acutely angulated segments with kinking and changes in caliber** as seen in these images.
Axial CT images show multiple segments of angulated small bowel (arrows) from underlying adhesions in three different post surgical patients.
Caliber change of bowel and Localized stasis within bowel

Bowel adhesions may lead to caliber change of the bowel with slow transit times in focal segments of bowel. These segments may demonstrate features of stasis including fluid accumulation and fecalized appearance of small bowel loops. Finding of localized stasis may be an indirect sign of unsuspected underlying bowel adhesions.

Coronal CT image demonstrates focal caliber change of a small bowel loop in the mid abdomen (white arrow) with fecalized material present proximal to the caliber change (red arrows).
Asymmetric bowel wall thickening

Above contrast enhanced axial CT images show small bowel loops with asymmetric wall thickening from underlying adhesions after bowel surgery (orange arrows).
Fat notch sign

This sign reflects insinuation of mesenteric fat at an area of adhesions with focal caliber change. This has been described in cases of small bowel obstruction related to adhesions and is a very specific finding of adhesive small bowel obstruction.

44 year old female with past surgical history of hysterectomy presented with abdominal pain, nausea and vomiting. Axial CT image demonstrates a fat indentation at level of adhesion, the “fat notch” sign (arrow) along with associated dilated loops of small bowel.
Star Sign

32 year old female with history of Crohn’s disease. Coronal MR enterography images demonstrate thick T2 dark adhesions radiating to multiple loops of tethered small bowel in the lower abdomen (red arrows) compatible with the “Star Sign”. Accompanying entoroenteric fistulas are suspected.

This sign develops due to adhesions forming between different loops of bowel and can often be seen in the setting of enteroenteric or enterocolonic fistulas.
Examples of entero-visceral adhesions. Axial CT image on the left shows adhesions between the right ovary and adjacent bowel loop (green arrow). The middle axial CT image show an anteriorly displaced uterus secondary to entero-visceral, and entero-peritoneal adhesions (red arrow). The sagittal CT image on the right show an example of adhesions between small bowel loops and the bladder (yellow arrow).
Axial CT image shows entero-visceral adhesion to the right bladder wall with caliber change and stasis in the affected loop of small bowel (green arrow). Sagittal CT image shows entero-visceral adhesions to the bladder dome with matted appearance of small bowel loops in patient status post hysterectomy (red arrow).
Axial contrast enhanced CT images show localized increase in mesenteric attenuation in the right abdomen when compared to normal mesenteric fat in the left abdomen, related to mesenteric congestion (red arrow) secondary to underlying adhesions.
Mesenteric Vascular Crowding Associated with Adhesions

Axial contrast enhanced CT image on the right and coronal MR enterography image show localized vascular crowding in the right abdomen related to mesenteric congestion (red arrows) secondary to underlying small bowel adhesions.
Cocoon Abdomen

Cocoon abdomen refers to closely clustered bowel loops adherent within thickened peritoneum in a sac like manner. This finding is classically associated with peritoneal dialysis, with presence of underlying entero-parietal and entero-enteric adhesions.

56 year old male, status post colonic surgery presents with abdominal pain and vomiting. Axial and coronal CT images demonstrate a cluster of adherent fluid filled mildly dilated small bowel loops in pelvic region, enclosed by thickened peritoneal lining (red arrows), consistent with “cocoon abdomen” (green arrows).
Sclerosing Peritonitis with bowel adhesions

62 year old female with history of peritoneal dialysis presents with abdominal pain. Sagittal CT image demonstrates thick peritoneal and mesenteric surface calcifications (green arrows) involving multiple loops of bowel, consistent with encapsulating peritoneal sclerosis.
CONCLUSION

• It is essential for radiologist to recognize the varied imaging findings and specific signs related to presence of bowel adhesions

• Radiologists should mention the presence of non-obstructing bowel adhesions, since this has direct implications when future surgeries, especially laparoscopic procedures are being considered, due to high risk of inadvertent bowel injury and prolonged surgical time

• Adhesions are the most common cause of small bowel obstruction!

• Adhesions can also result in infertility and chronic abdominal pain among other issues
References

Thank you for viewing!