Abdominal Wall Hernias

What should radiologists be aware of?

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Objectives

- Present the distinguishing features of the different abdominal wall hernias (AWH).

- Review the imagiological findings of AWH and its pre- and post-surgical complications.

- Establish the advantages of calculating the volumes of abdominal cavity and hernial sac, when loss of domain is suspected.

Background

- AWH are a common finding in abdominal CT, that most often requires surgical treatment, which can be emergent if a complication is present.

- Post-surgical complications occur in 20-50%.
  → 50% of them require reintervention, which results in a heavy burden in health care costs.

- Incisional hernias are a frequent subtype of AWH, being especially prone to become giant, and thus to loss of domain, a condition that is associated with high rates of post-surgical complications
  → May be prevented by preoperative progressive pneumoperitoneum (PPP).

Imaging findings

Abdominal hernias – Imagiological findings:

- Abdominal wall defect with:
  - Neck
  - Hernial sac with intraabdominal contents
- May respond to provocative maneuvers
- Characterized primarily according to its location → Predict the risk of complications

Fig. 1 – CT evaluation of incisional hernia (A) that becames more evident with Valsalva maneuver (B).

Background

The radiologist is able to **identify the abdominal hernia**, but also **other pathological processes that can mimic it** clinically.

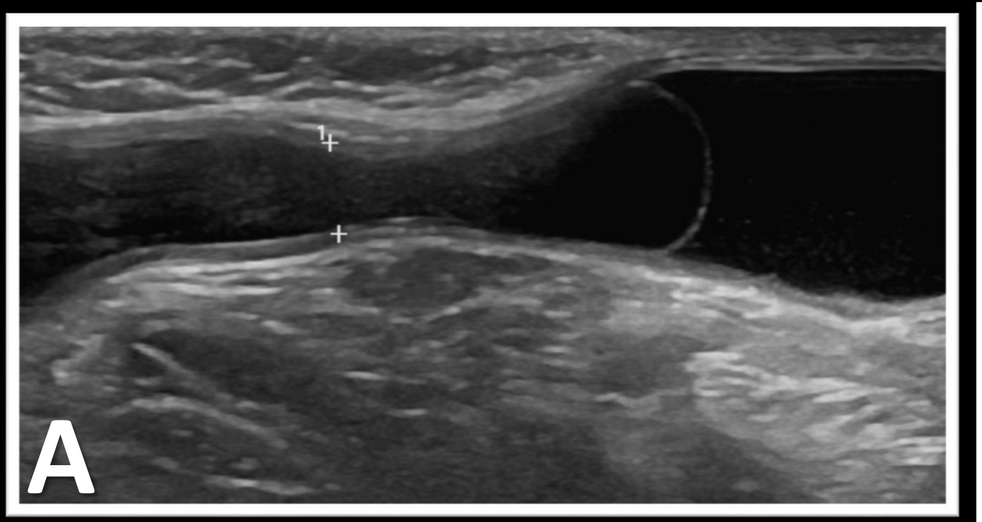


Fig. 2 – Pathologies that clinically mimic inguinal hernias, but are promptly identified radiologically.
Patent peritoneovaginal duct (A.); Testicular immature teratoma (B.);
B-cell Non-Hodgkin lymphoma (C.) with retroperitoneal and mesenteric mass (arrow), extending along the spermatic cord (arrowhead).

Imaging findings

Types of AWH:

- Groin hernias
  - Inguinal – the most common of AWH
    - Direct
    - Indirect
  - Femoral
- Ventral hernias – anterior and lateral abdominal wall
  - Midline hernias (+++) – Linea Alba
    - Umbilical (+++)
    - Paraumbilical
    - Epigastric
    - Hypogastric
  - Paramedian/lateral defects
- Lumbar hernias
- Incisional Hernias
  - Parastomal hernias

Strangulation and Incarceration are common

Imaging findings

Inguinal Hernias → ++ males

- Indirect – laterally to inferior epigastric vessels

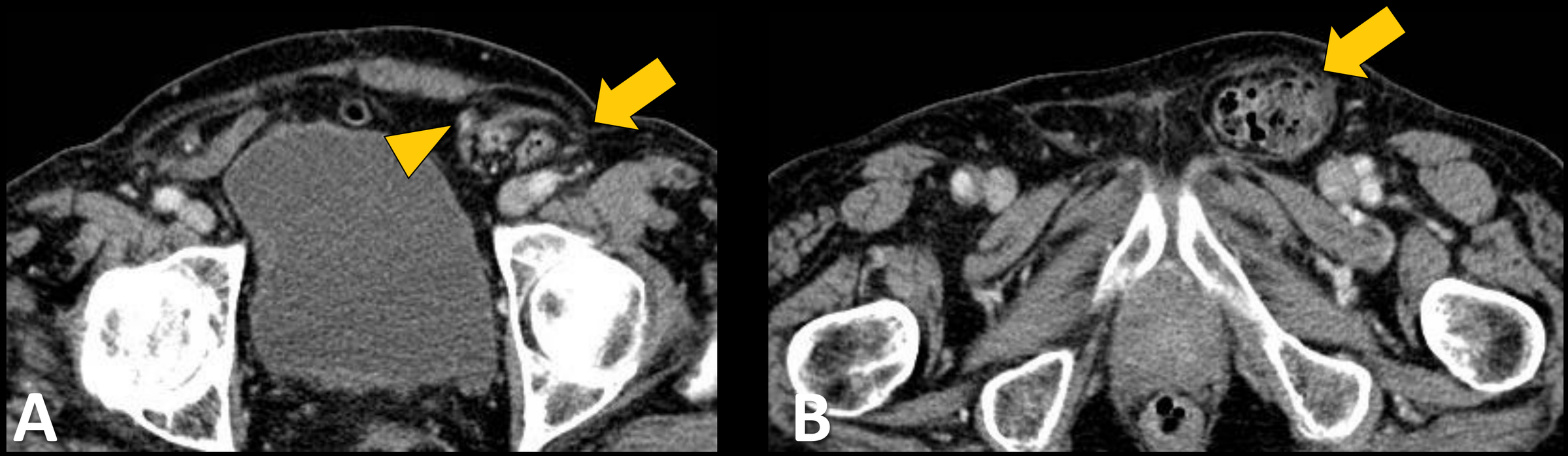


Fig. 3 – Contrast-enhanced CT (CECT) in the axial plane, in two different levels (A. and B.), showing indirect inguinal hernia, which contains bowel loops and originates laterally to the epigastric vessels.

- ✓ Childs → ++ indirect hernia – failure in the obliteration of the peritoneal extension accompanying the testis

Imaging findings

Inguinal Hernias → ++ males

- Indirect – laterally to inferior epigastric vessels
- Direct – medially to the inferior epigastric vessels

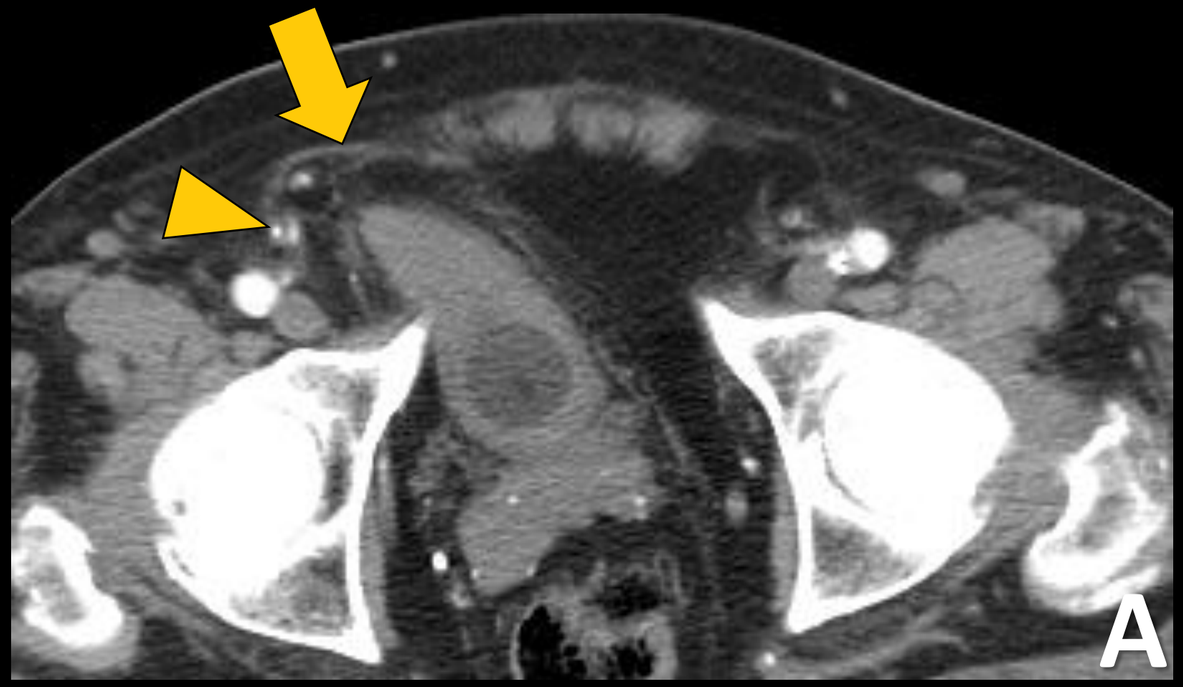


Fig. 4 – CECT in the axial plane (A.) and sagittal plane (B.), showing inguinal direct hernia (arrow), which contains bladder, and originates laterally to the epigastric vessels (arrowhead).

✓ Adults → both types – acquired weakness of the internal inguinal ring

Imaging findings

Inguinal Hernias → ++ males

- Indirect – laterally to inferior epigastric vessels
- Direct – medially to the inferior epigastric vessels

Amyand Hernia – inguinal hernia containing the cecal appendix.

Fig. 5 – CT in the axial plane, in two different levels showing direct inguinal hernia, which contains bladder, displacing the inguinal canal laterally, which acquires the form of a semicircle → Lateral Crescent Sign.

✓ Adults → both types – acquired weakness of the internal inguinal ring

Imaging findings

Femoral Hernias → ++ females

- Medially to the femoral vein and posteriorly to the inguinal ligament
- ++ Right side

<u>De Garengeot Hernia</u> – femoral hernia containing the cecal appendix

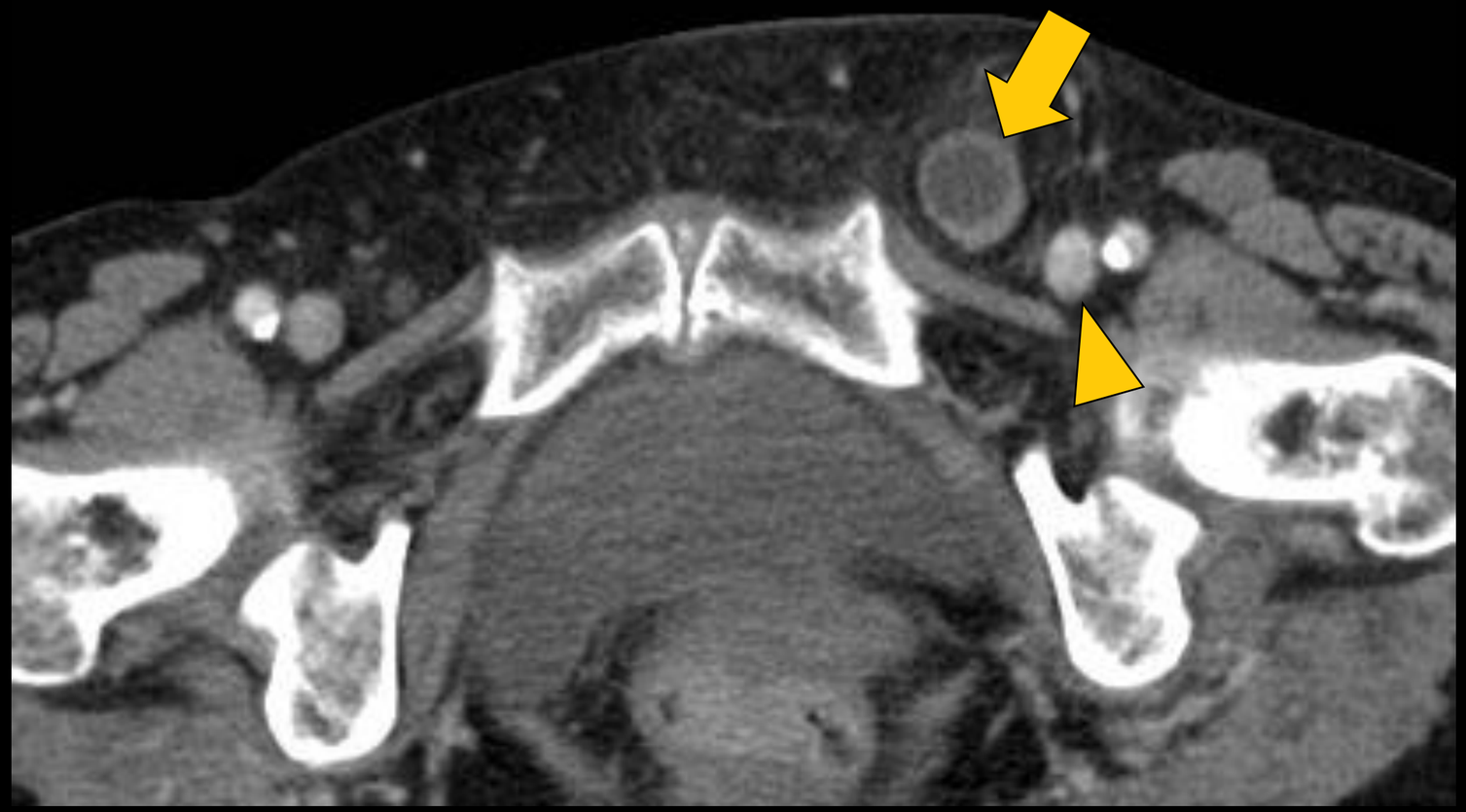


Fig. 6 – CECT in the axial plane showing femoral hernia (arrow), which contains bowel loop, originating posterior and inferior to the inguinal ligament, and located medial to the femoral vein (arrowhead).

Imaging findings

Umbilical Hernias → ++ females

- ++ small size

Paraumbilical Hernias

- ++ large defects → ++ diastasis of the rectus abdominis muscles

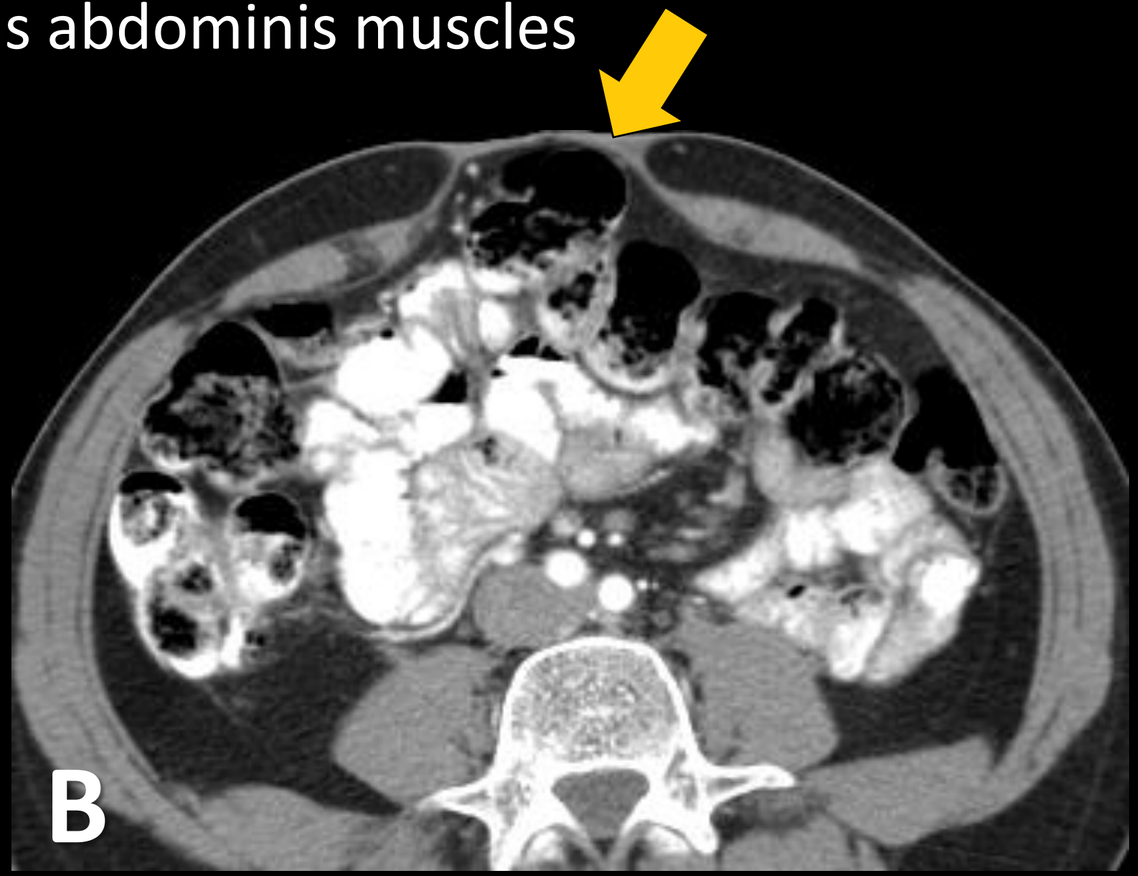


Fig. 7 – CECT in the axial plane showing umbilical hernia (A.) and paraumbilical hernia (B.) (arrows) in two different patients. Both contain bowel loops. Paraumbilical hernia is seen as a diastasis of the rectus abdominis muscles.

Imaging findings

Epigastric hernias

- Above the umbilicus

Hypogastric hernias

- Below the umbilicus

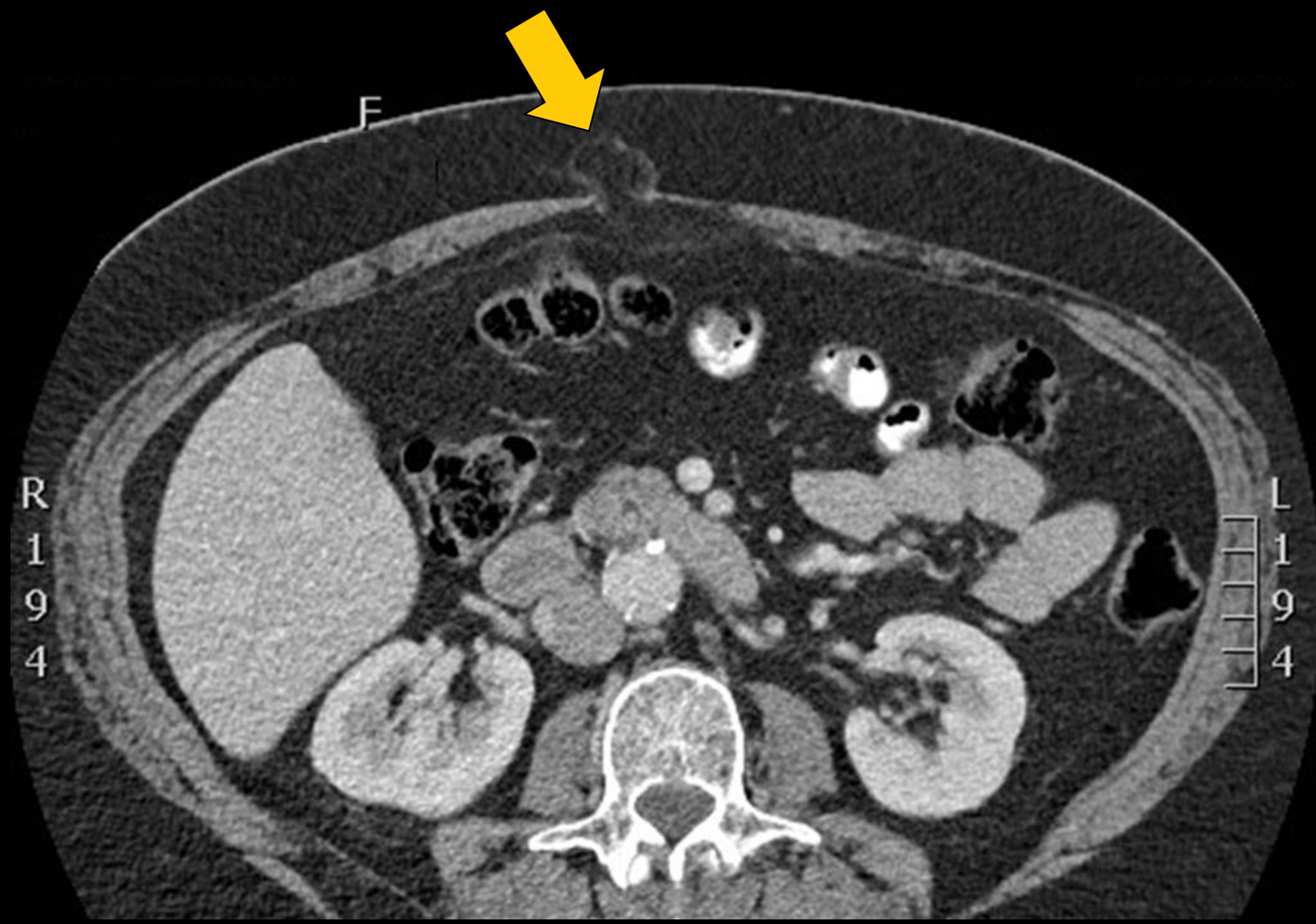


Fig. 8 – CECT in the axial plane showing epigastric hernia (arrow) containing only fat.

Imaging findings

Paramedian/lateral defects → Less common than median defects

- ++ omentum and short segments of bowel
- Incarceration is common

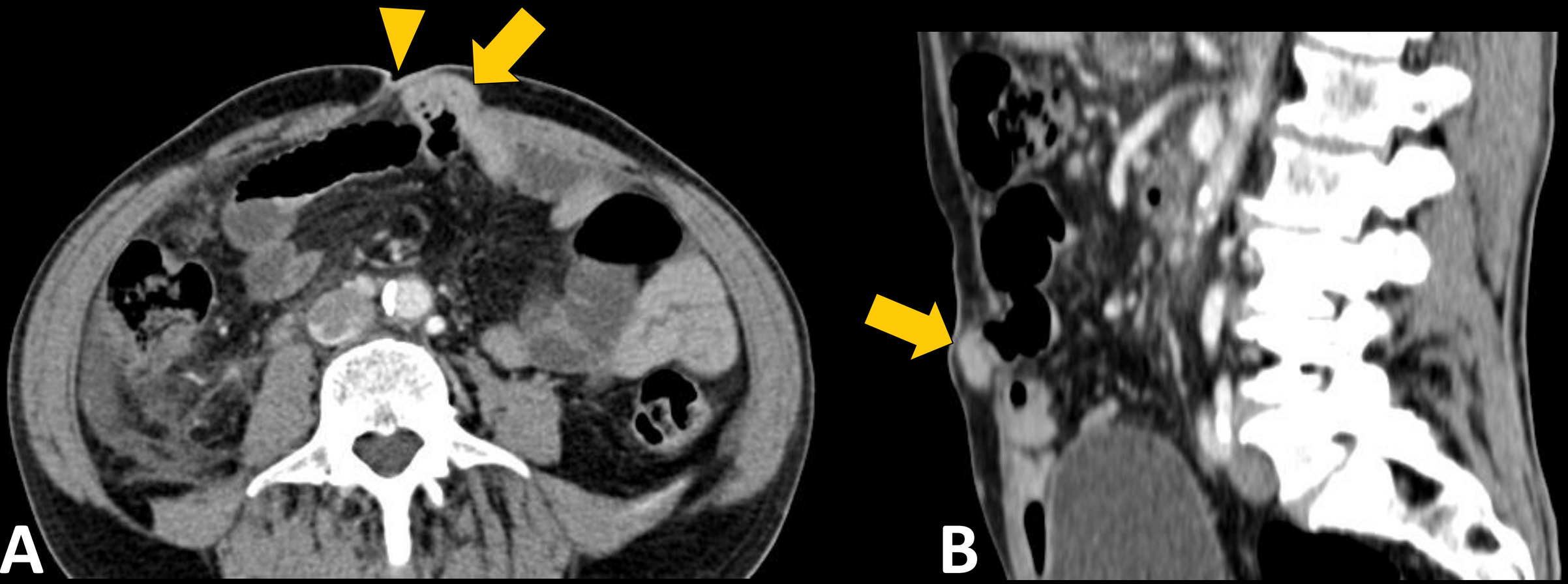


Fig. 9 – CECT in the axial (A.) and sagittal (B.) plane, showing paraumbilical hernia (arrow) containing bowel loop, just lateral to the umbilicus (arrowhead).

Imaging findings

Lumbar hernias

- Below the rib cage and above the iliac crests

  - ✓ Diffuse (+++) → after surgery (++ kidney surgery) or trauma
    - May contain bowel loops, retroperitoneal fat, kidneys and other viscera.

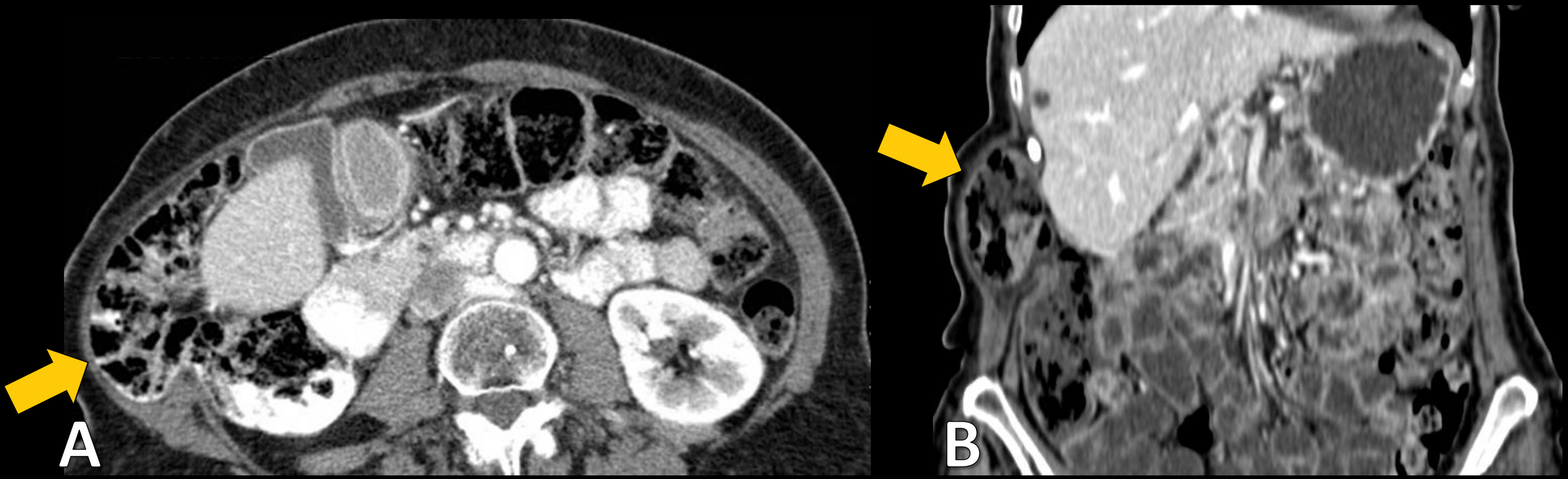


Fig. 10 – CECT in the axial (A.) and coronal (B.) plane showing lumbar hernia (arrow), containing bowel loops, which appeared after kidney surgery.

Imaging findings

Lumbar hernias

- Below the rib cage and above the iliac crests

  - ✓ Diffuse (+++) → after surgery (++ kidney surgery) or trauma
    - May contain bowel loops, retroperitoneal fat, kidneys and other viscera.

  - ✓ Herniation through the superior or inferior lumbar triangle
    - Superior – Internal oblique muscle (anteriorly), 12th rib (superiorly), erector spinal muscle (posteriorly)
    - Inferior – External oblique muscle (anteriorly), iliac crest (inferiorly), latissimus dorsi muscle (posteriorly)

Imaging findings

Incisional hernias → 2-15% of patients who undergo abdominal surgery

- Anywhere in the abdominal wall
- ++ in the first few months after surgery
- Difficult to detect at physical examination
- Recurrence after treatment may affect 46% patients

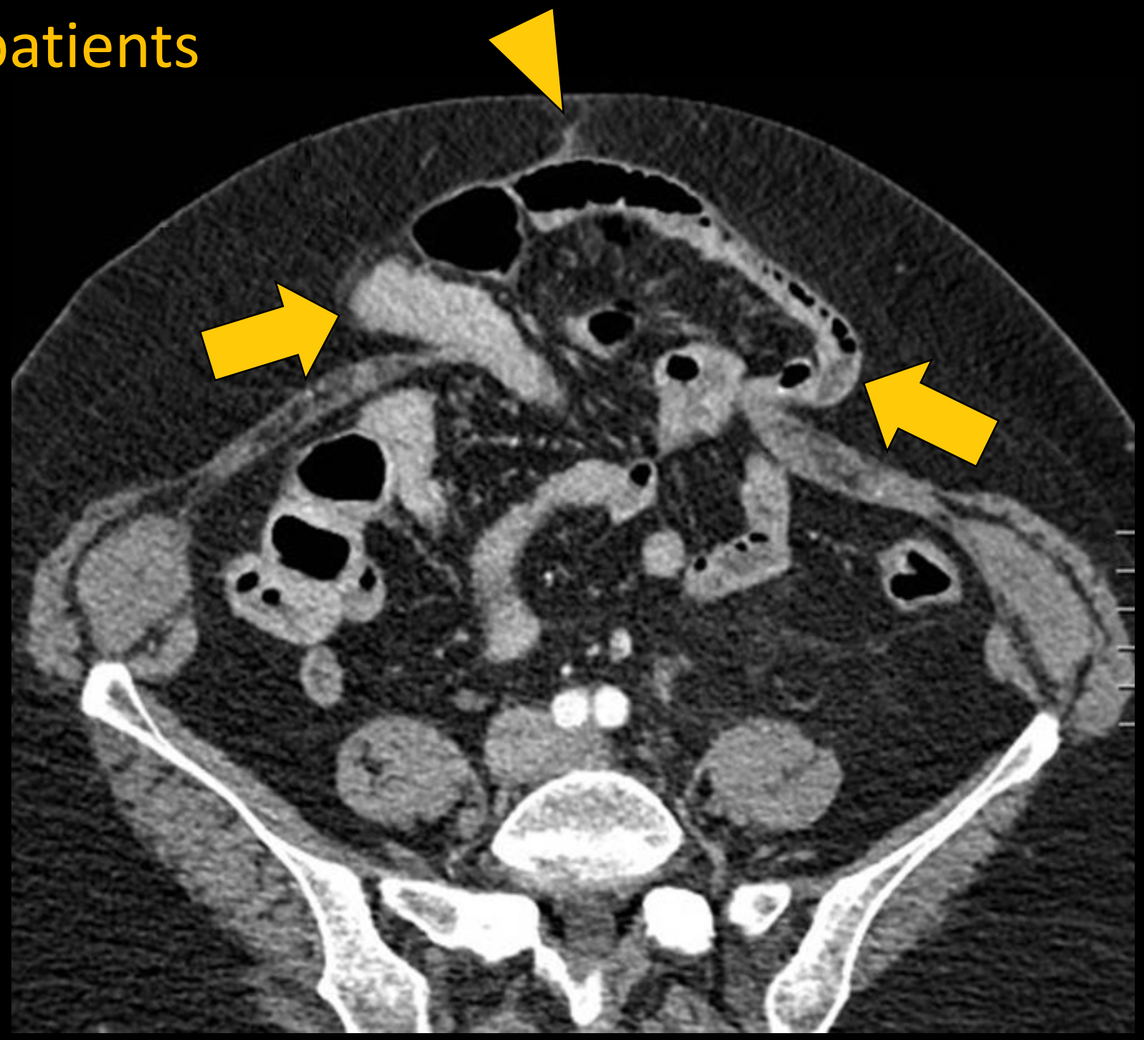


Fig. 11 – CECT in the axial plane showing incisional hernia (arrows) containing bowel loops. Subcutaneous scar also seen (arrowhead).

Imaging findings

Incisional hernias → 2-15% of patients who undergo abdominal surgery

- Anywhere in the abdominal wall
- ++ in the first few months after surgery

Fig. 12 – CECT in the axial plane showing parastomal hernia containing dilated small bowel loops (thick arrow) and free fluid (thin arrow).

✓ Parastomal Hernias → a subtype of incisional hernias

Imaging findings

Other less common hernias

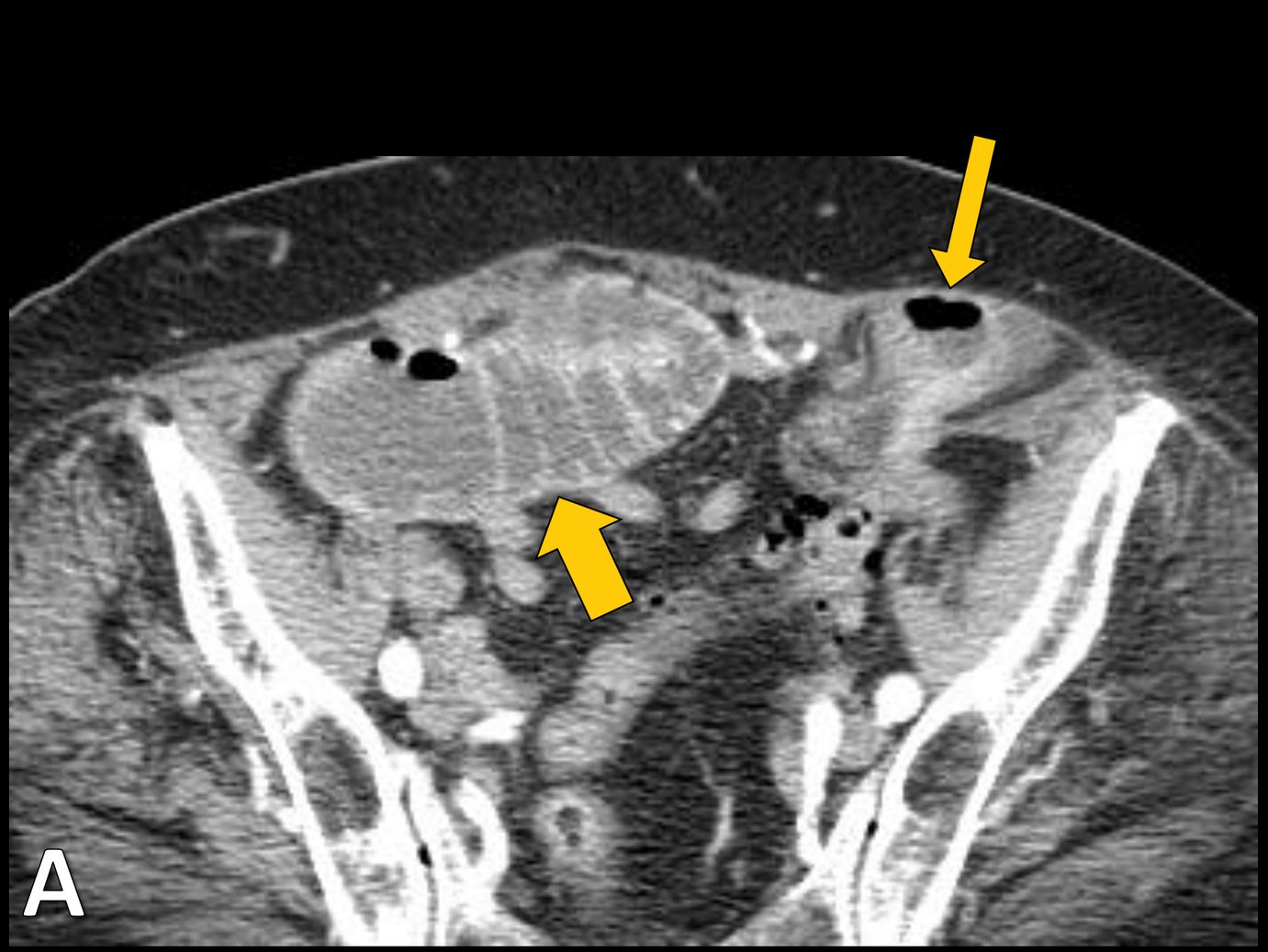
- Abdominal wall → particular tendency to incarceration and strangulation

  - ✓ Spigelian – herniation along the semilunar line → ++ interparietal
  - ✓ Interparietal – hernia sac in the fascial planes between the abdominal wall muscles → ++ inguinal region
  - ✓ Richter → herniation of antimesenteric wall of the bowel that does not compromise the entire wall circumference → ++ femoral
  - ✓ Littre → inguinal hernia that contains Meckel diverticulum

- Pelvis → ++ elderly woman → acquired weakness of the pelvic floor

  - ✓ Sciatic → herniation through sciatic foramen (++ bowel loops or ureter)
  - ✓ Obturador → herniation through obturador foramen (++ bowel loops or ureter)
  - ✓ Perineal (++) - adjacent to the anus or labia majora or in the gluteal region

Other less common hernias – Spigelian hernia



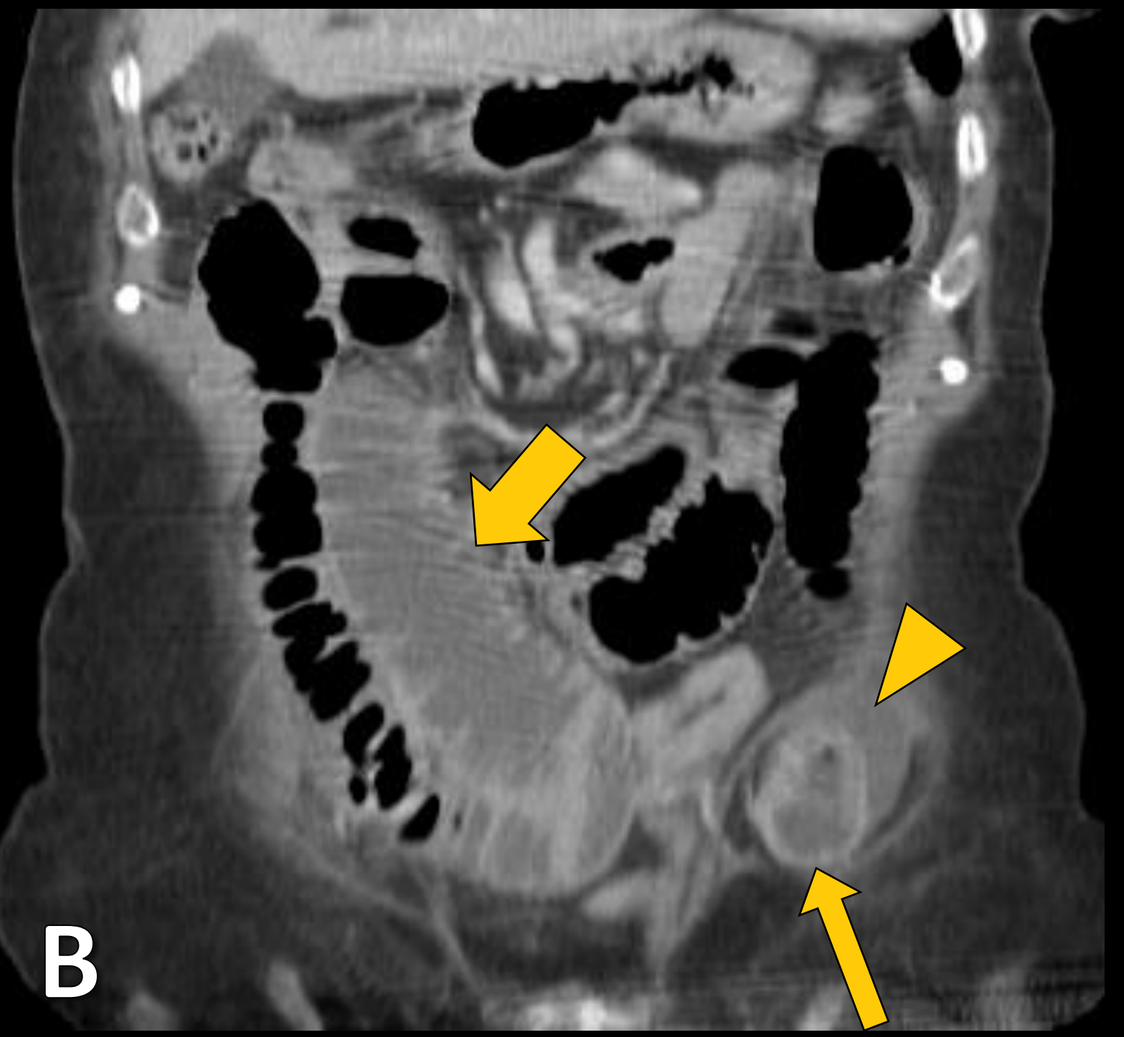


Fig. 13 – CECT in the axial (A.) and coronal (B.) plane showing Spigelian hernia (thin arrow) causing small bowel obstruction (dilated small bowel loops – thick arrow). Free fluid in the hernia sac is also seen (arrowhead).

Imaging findings

Complications

- Bowel Obstruction

- Strangulation – ischemia due to compromised blood supply

- Incarceration – irreducible sac

- Extension of intraabdominal conditions into the hernia → exacerbation of symptomatology

Imaging findings

Complications

❑ Bowel Obstruction

➢ **CT features:**

- ✓ Dilated bowel proximal to the hernia (green arrows)
- ✓ Normal caliber or collapsed bowel distal to the obstruction (blue arrow)
- ✓ Transition point at the level of the hernia (red arrow)
- ✓ Dilatation of the herniated bowel loops (yellow arrow)
- ✓ Fecalization of the small bowel contents proximal to the obstruction
- ✓ Concomitant signs of strangulation

Second most frequent cause of **small bowel obstruction**. (colonic obstruction is uncommon)

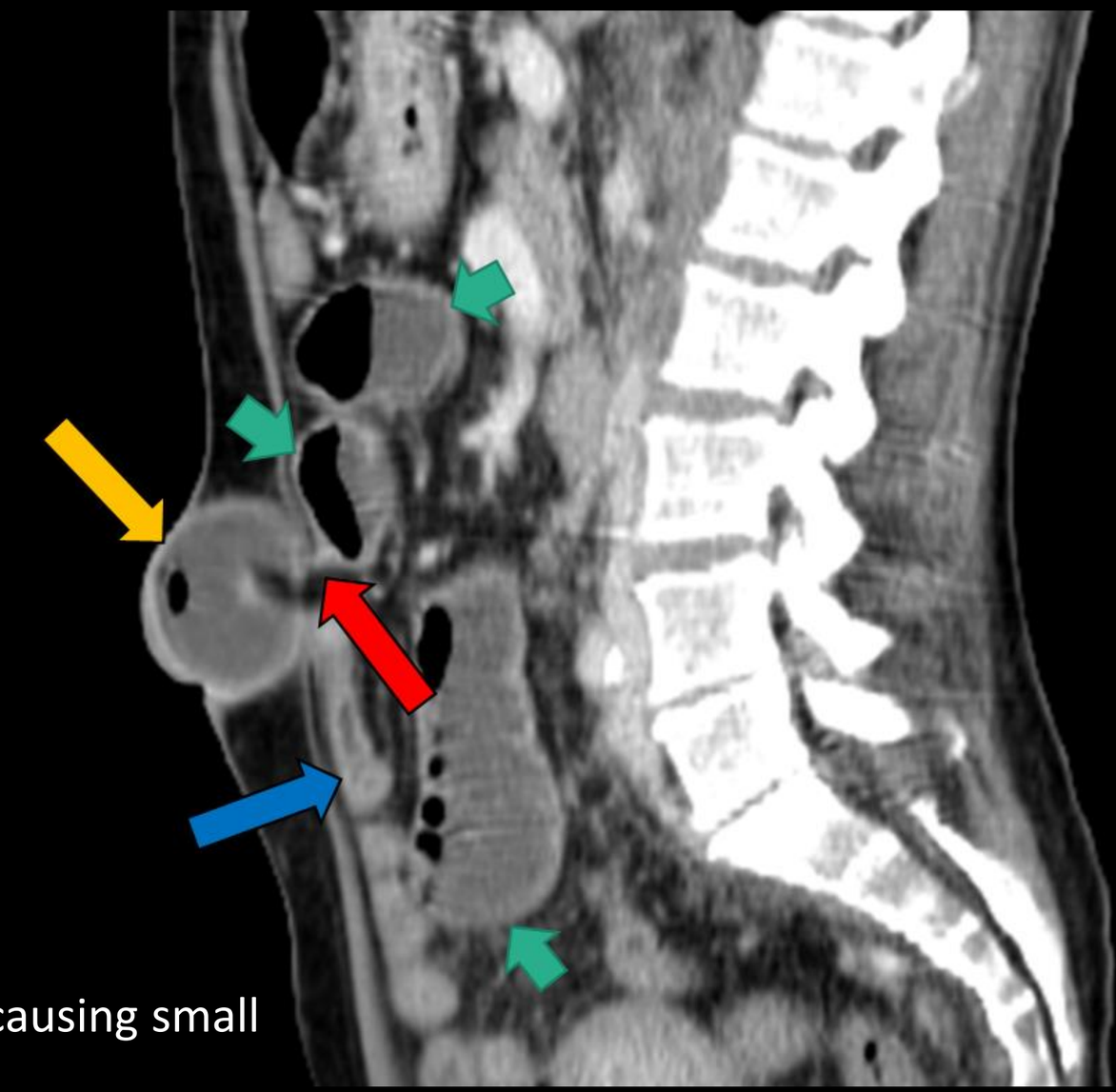


Fig. 14 – CECT in the sagittal plane showing umbilical hernia causing small bowel obstruction.

Imaging findings

Complications

Predisposes to other complications:
- Obstruction
- Ischemia

❑ Incarceration

- **Clinical diagnosis** (not radiological!)
  - ✓ CT can predict it → hernia sac has a narrow neck

- Suspect of impending strangulation if:
  - ✓ Free fluid within the hernia sac
  - ✓ Bowel wall thickening
  - ✓ Luminal dilatation

Fig. 15 – CECT in the axial plane showing paraostomal hernia containing dilated small bowel loops (thick arrow) and free fluid (thin arrow), which suggests impending incarceration. Note that the colonic loop forming the stoma has normal caliber (arrowhead).

Imaging findings

Complications

❑ Strangulation

High surgical mortality rate!

- ++ when obstruction of the afferent and efferent bowel loops → closed loop in the hernial sac

- **CT features:**

✓Dilated, fluid-filled U- or C-shaped loops within the hernial sac (yellow arrow) and proximal obstruction → May have a “serrated beak” appearance at the transition point (blue arrow)
✓Wall thickening
✓Parietal hypo or hyperattenuation and enhancement (yellow arrow)
✓Mesenteric vessel engorgement (red arrow)
✓Mesenteric haziness (red arrow)
✓Fat obliteration (green arrow)
✓Ascites

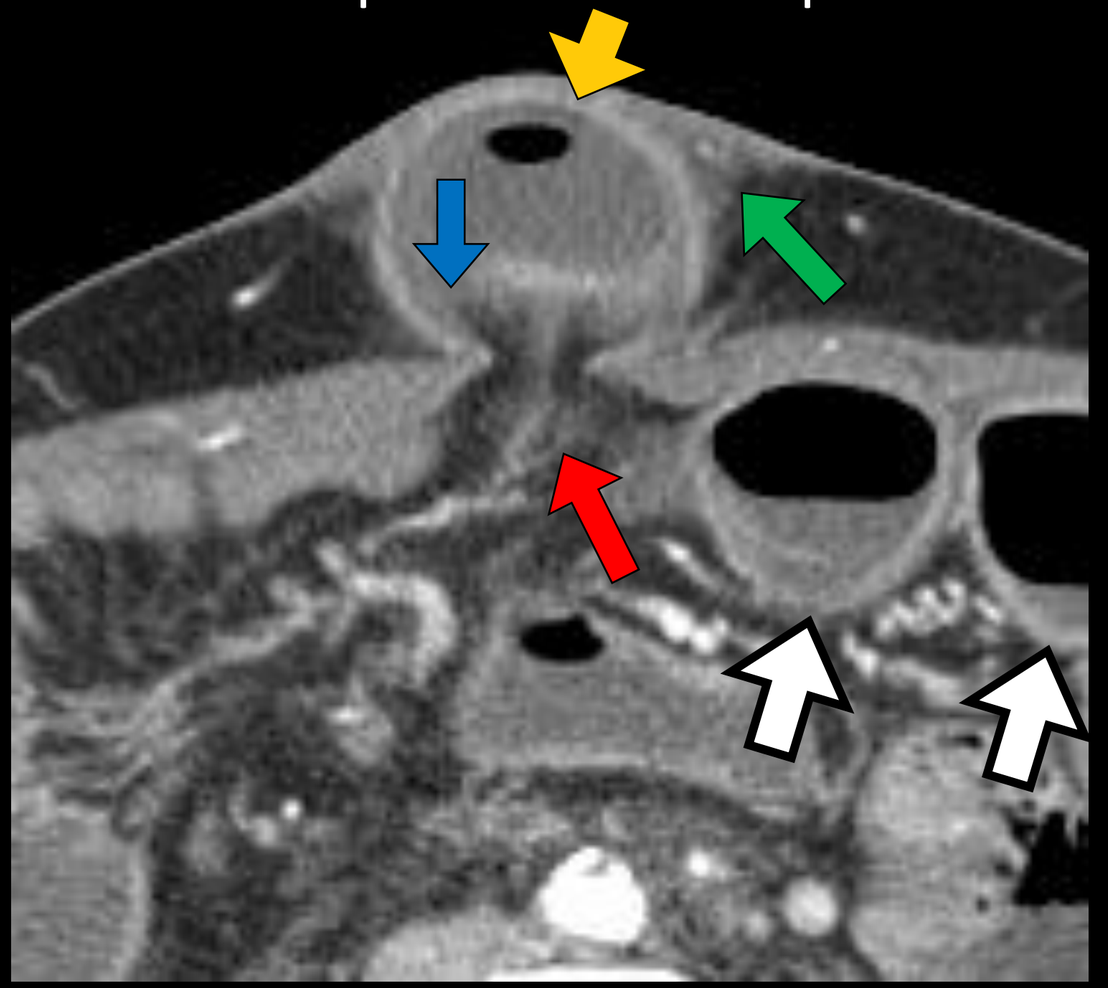


Fig. 16 – CECT in the axial plane showing umbilical hernia causing small bowel obstruction (dilated bowel loops – white arrows).

Imaging findings

Complications

❑ Loss of domain

++ Incisional hernias
++ Overweight patients

➢ When herniated viscera of the abdomen inhabit the hernia sac in a permanent way.

Restoring the hernia sac contents to the abdominal cavity
↓
Intra-abdominal hypertension
↓
Abdominal compartment syndrome and **respiratory and circulatory disturbances**
↓
Possibly fatal

Fig. 17 – CECT in the axial plane showing giant incisional hernia.

Imaging findings

Complications

❑ Loss of domain

Desired volume of gas **=** Calculated **volume of the hernia sac**

➢ **Progressive preoperative pneumoperitoneum (PPP)** → used to achieve adequate abdominal space to the reintegration of the hernia sac contents.

✓ Performed if **giant hernia** → ++ if hernia sac volume (HSV) is **≥ 20-25%** of abdominal cavity volume (ACV) → Volume Ratio (VR) ≥ 20-25%

Defined commonly as **hernia sac > 10 cm i**n length or width

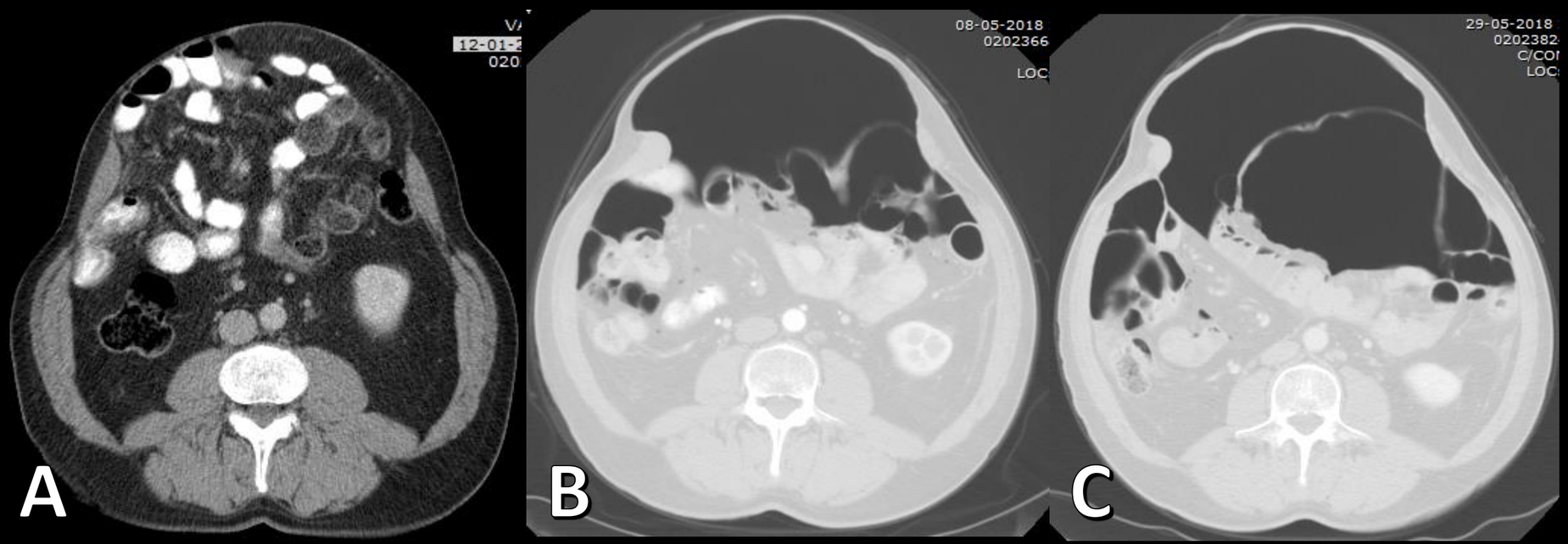


Fig. 18 – CECT in the axial plane showing giant incisional hernia before (A.) and after PPP (B. and C.), in two different timings.

❑ Loss of domain

- Calculating HSV and ACV → the abdominal cavity and the hernia sac can be considered to be ellipsoid structures → Three diameters:
  - ✓ Longitudinal/cranio-caudal (a)
  - ✓ Transverse (b)
  - ✓ Anterior-posterior (c)

The largest measure of all slices of the entire CT scan, even if the measures were obtained from different slices

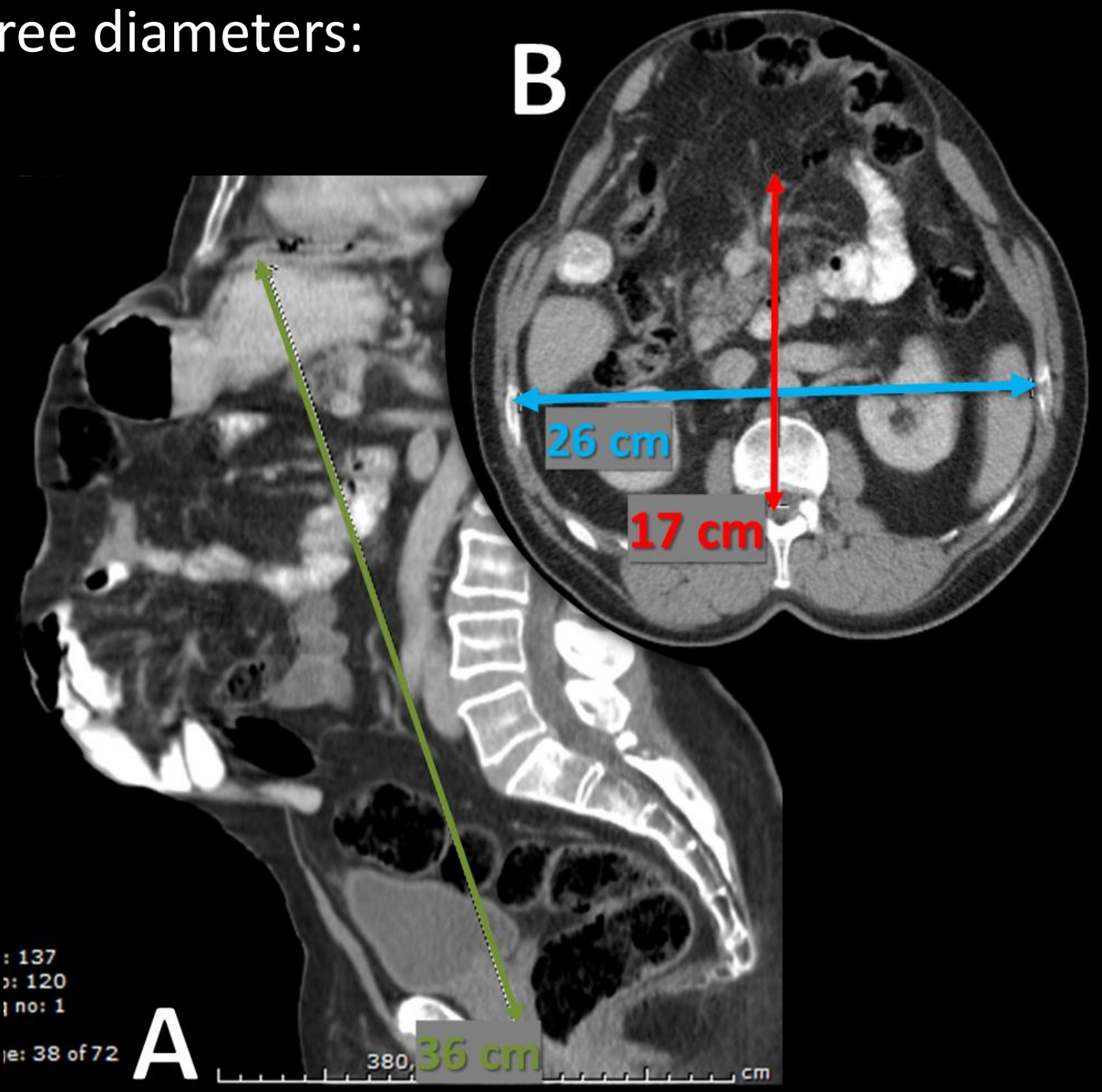


Fig. 19 – CECT in the sagittal reconstructed plane and axial plane showing how to measure the three diameters of the abdominal cavity.

❑ Loss of domain

- Calculating HSV and ACV → the abdominal cavity and the hernia sac can be considered to be ellipsoid structures → Three diameters:
  - ✓ Longitudinal/cranio-caudal (a)
  - ✓ Transverse (b)
  - ✓ Anterior-posterior (c)

Formula for the volume of an ellipsoid:

$V = 4/3 \times \prod \times r1 \times r2 \times r3$

~

$V = 0.52 \times a \times b \times c$

VR = HSV/ACV

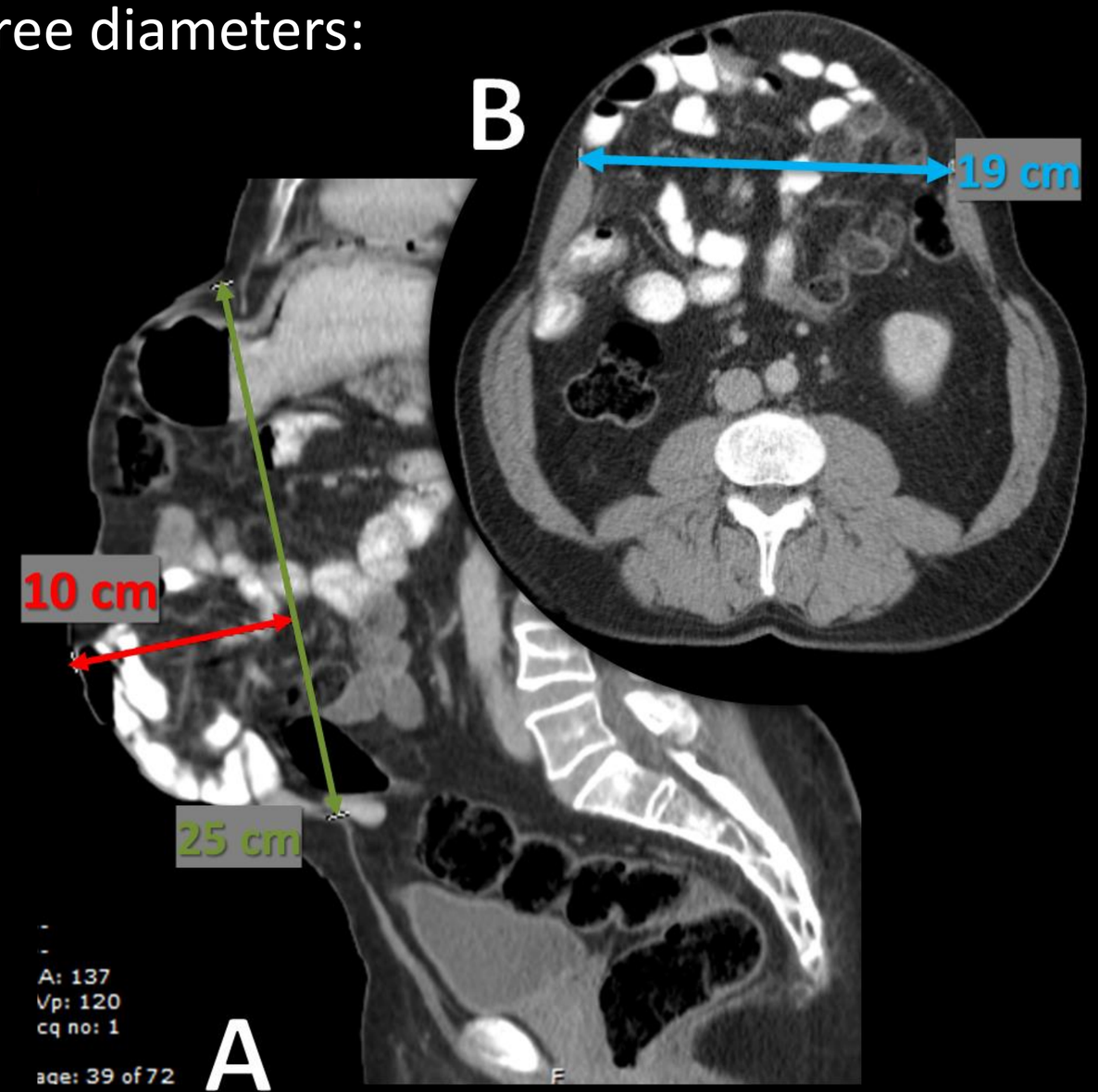


Fig. 20 – CECT in the sagittal reconstructed plane and axial plane showing how to measure the three diameters of the hernia sac.

Imaging findings

Complications

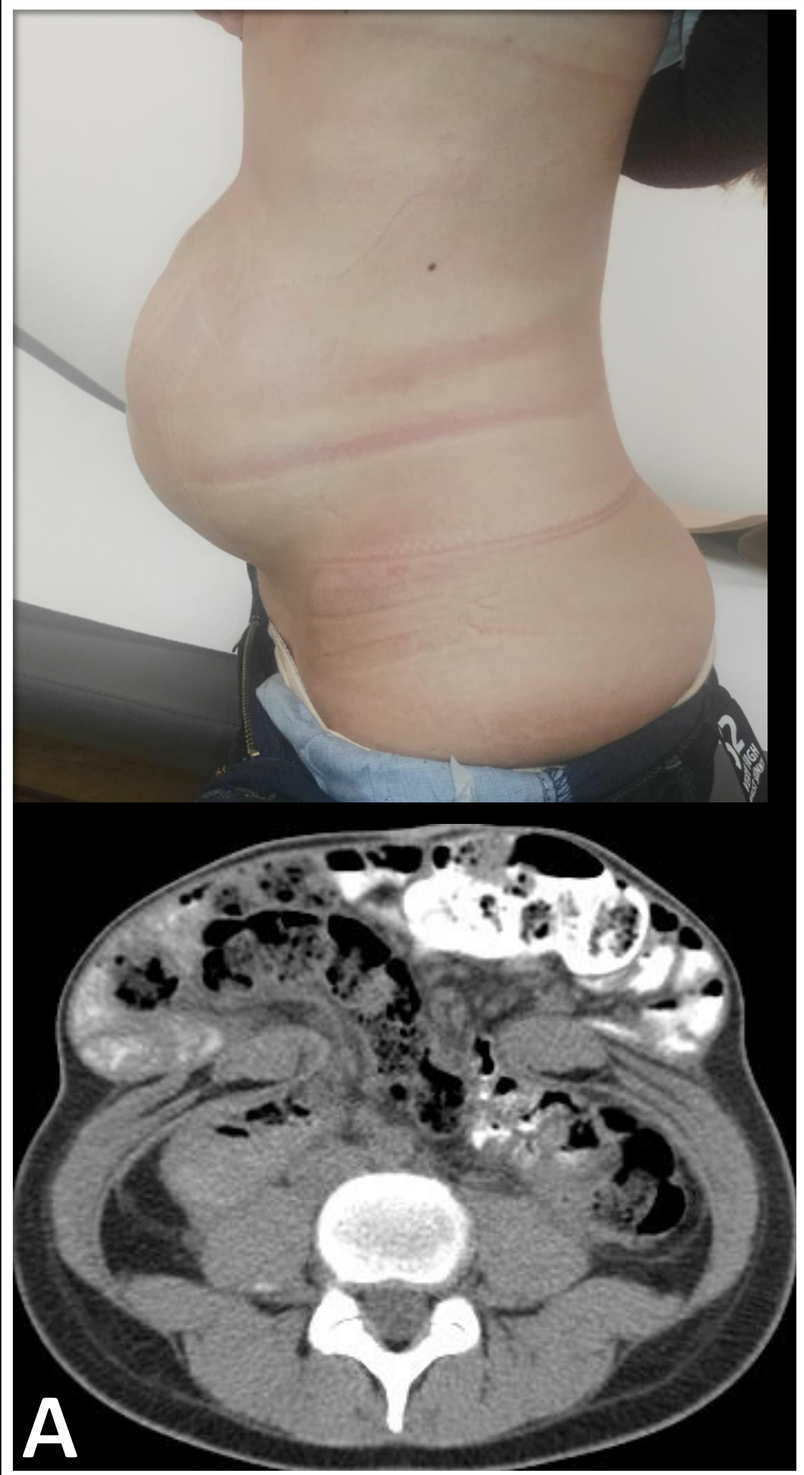


Fig. 21 – Giant hernia with loss of domain before treatment (A. – patient's photograph and axial CT), during PPP (B. patient's photograph and axial CT; arrow – extremity of the intrabdominal catheter) and after repair (C. – patient's photograph).

Courtesy of Dr. Fernando Ferreira

❑ Extension of intra-abdominal conditions

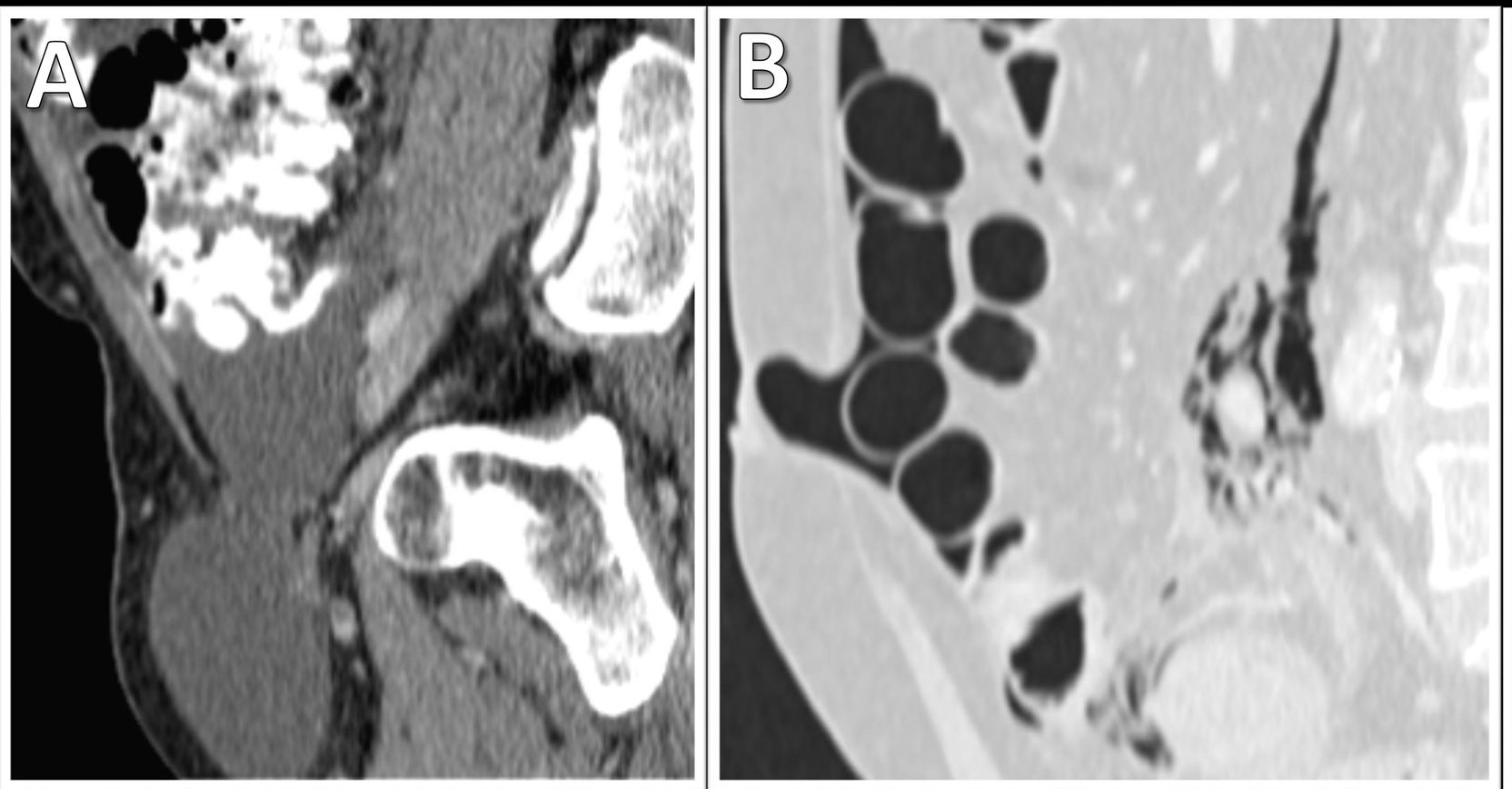


Fig. 22 – CECT in the sagittal reconstructed plane (A. and B.) and axial plane in two different levels (C.), showing intra-abdominal conditions extending to hernia sac in three different patients – **A.** Inguinal hernia containing ascitic fluid in patient with peritoneal carcinomatosis;
B. Umbilical hernia containing gas in a patient with bowel perforation;
C. Pseudomyxoma peritonei extending to inguinal hernia secondary to mucocele of the appendix.

Imaging findings

Post-Surgical Complications

❖ Fluid collections (infected or not)

- ++ immediate postoperative period
- ++ seromas or hematomas

- **CT features:**
  - ✓ Globular, tubular, or multilobular appearance
  - ✓ Loculated, with enhancing rims
  - ✓ May have airfluid levels

++ spontaneous resolution

→ Consider aspiration if:

- ✓ > 6 weeks
- ✓ Growth
- ✓ Symptoms
- ✓ Suspicious for infection

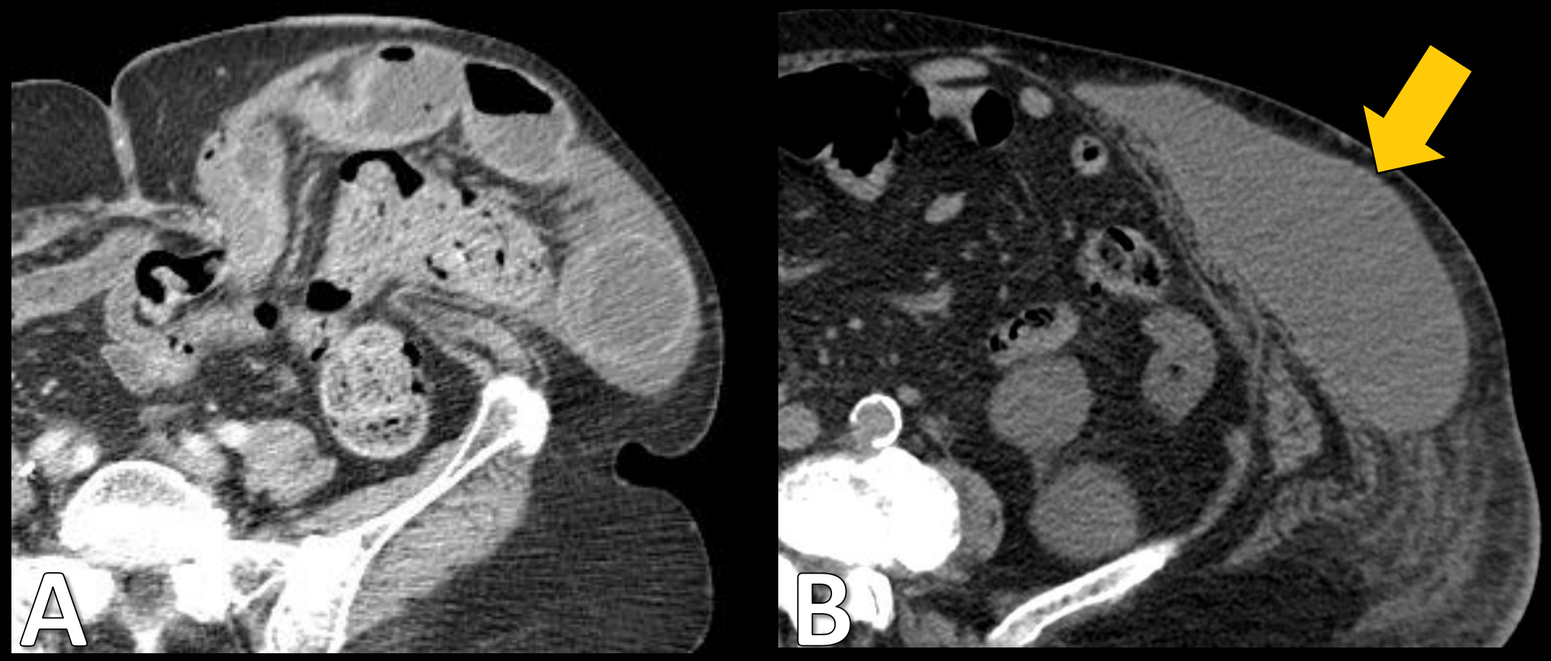


Fig. 23 – CECT (A.) and non-enhanced CT (B.) in the axial plane in the same patient, before and after parastomal hernia repair. A fluid collection (arrow) is seen in the immediate postoperative period.

Imaging findings

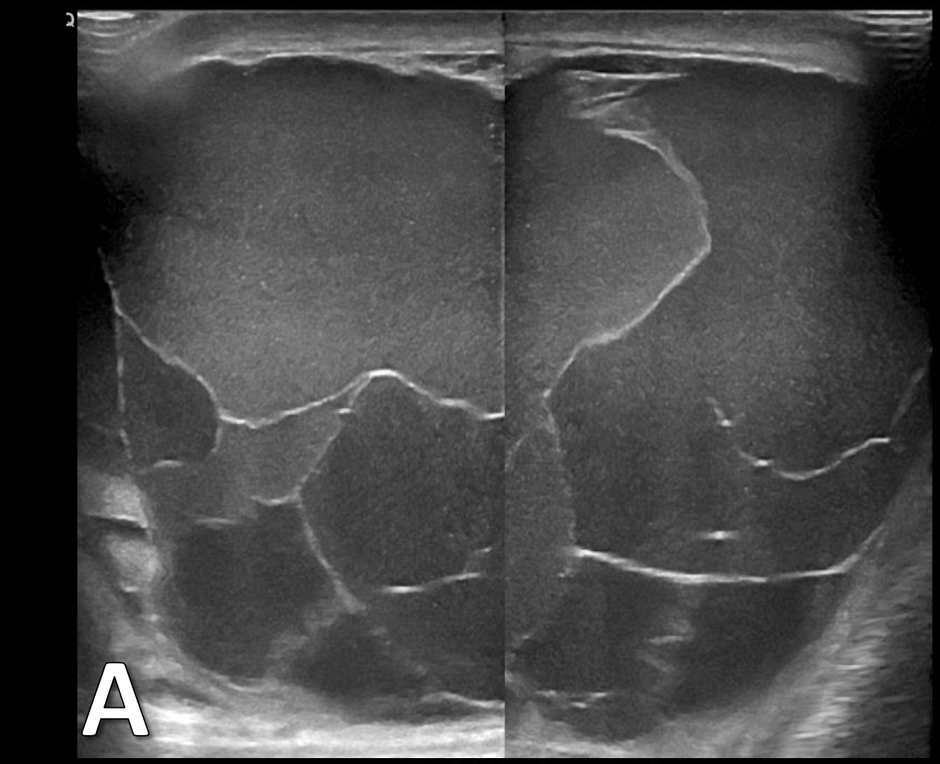
Post-Surgical Complications

Risk factor for hernia **recurrence**!

❖ Fluid collections (infected or not)

- ++ immediate postoperative period
- ++ seromas or hematomas

- **Suspicious findings of infected collection**
  - ✓ Clinical – Fever/leukocytosis
  - ✓ Imagiological:
    - Gas or thick septa in a previously "simple" collection
    - Enhancing rim
    - Adjacent fat stranding
    - "*De novo*" collection ≥ 1 week after surgical repair



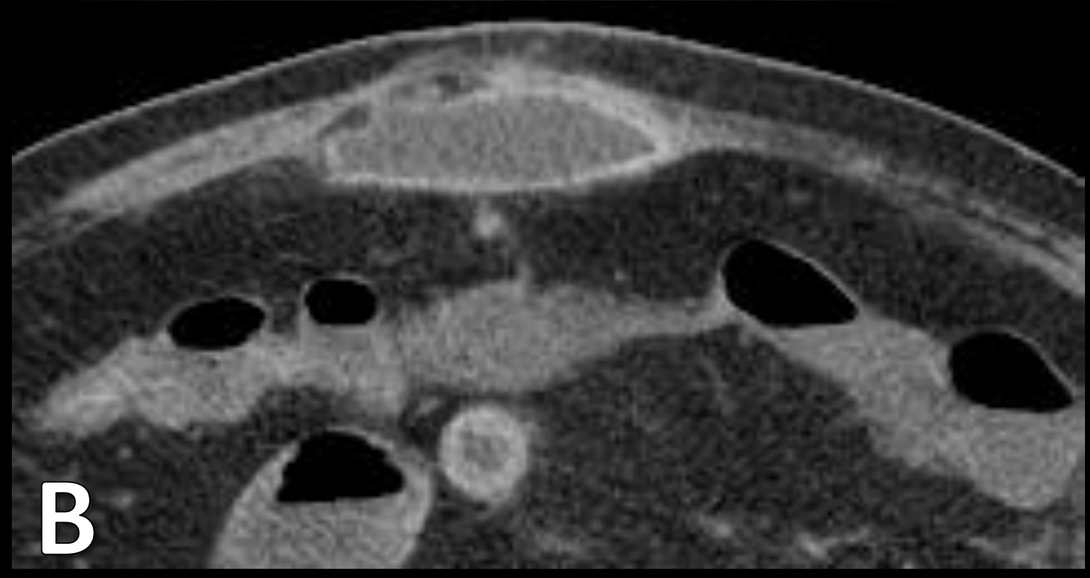


Fig. 24 – Scrotal ultrasound examination (A.) and CECT in the axial plane (B.) in two different patients, after surgical hernia repair. **A.** Low level echoes and septa "*de novo*" in a previously simple large hydrocele. **B.** Fluid collection with enhancing rim.

Post-Surgical Complications

❖ Hernia Recurrence

- The most common complication
- ++ 2-3 years after surgery

- Clinical evaluation of recurrent hernias is usually **limited** due to:
  - ✓ The existence of nonabsorbable mesh and accompanying fibrosis
  - ✓ Obesity
  - ✓ Abdominal distention
  - ✓ Spontaneous contraction of the abdominal wall

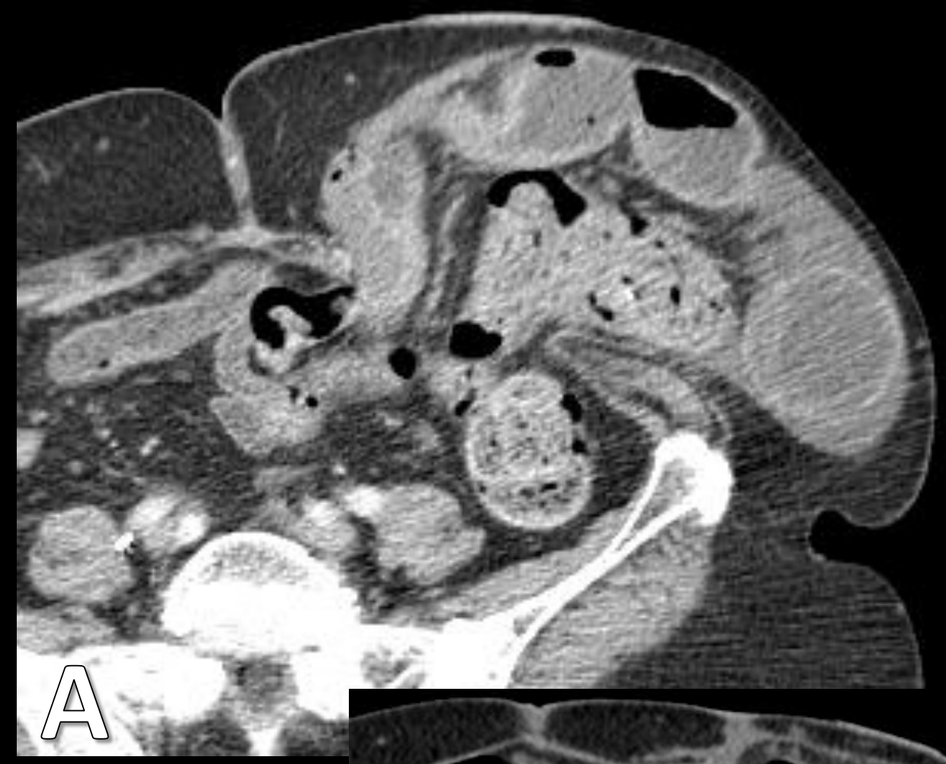


Fig. 25 – CECT (A.) and non-enhanced CT (B.) in the axial plane in the same patient, before and after parastomal hernia repair, showing hernia recurrence.

Post-Surgical Complications

❖ Mesh-related complications

- Fibrosis of the adjacent tissues (mesh with asymmetric or irregular shape at CT)
- Mesh shrinkage
- Intraperitoneal **adhesions** → risk of small bowel **obstruction**
- Mesh migrates within the abdominal wall

Fig. 26 – CECT in the sagittal reconstructed plane shows small bowel dilatation (thick arrow), with the transition point (arrowhead) next to the abdominal wall, few weeks after incisional hernia repair with surgical mesh, in keeping with small bowel obstruction secondary to adhesions, confirmed intraoperatively. Also shown, postoperative fluid collection with enhancing rim (thin arrow).

Conclusion

- Clinical evaluation of patients with AWH is often limited, mainly with incisional hernias, often associated with overweight.

- CT can accurately characterize the hernia location, size and contents, as well as the presence of pre- and post-surgical complications, allowing optimization of treatment approach.

- Calculating hernial sac and abdominal cavity volumes provides objective criteria to the selection of patients who'll benefit from PPP and the estimation of the amount of gas to insufflate.

Bibliography

- Aguirre, D., *et al.* Abdominal Wall Hernias: Imaging Features, Complications, and Diagnostic Pitfalls at Multi–Detector Row CT. RadioGraphics (2005) 25:1501–1520

- E.Y., Tanaka, *et al.* A computerized tomography scan method for calculating the hernia sac and abdominal cavity volume in complex large incisional hernia with loss of domain. Hernia (2010) 14:63–69

- Lassandro, F., *et al.* Abdominal hernias: Radiological features. World Journal Gastrointestinal Endoscopy (2011) 16; 3(6): 110-117

- Azar, F. K., *et al.* Ventral hernia repair in patients with abdominal loss of domain: an observational study of one institution's experience. Hernia (2017) 21(2):245-252