

Usual and unusual contents of inguinal hernia sac: A spectrum of radiologic findings

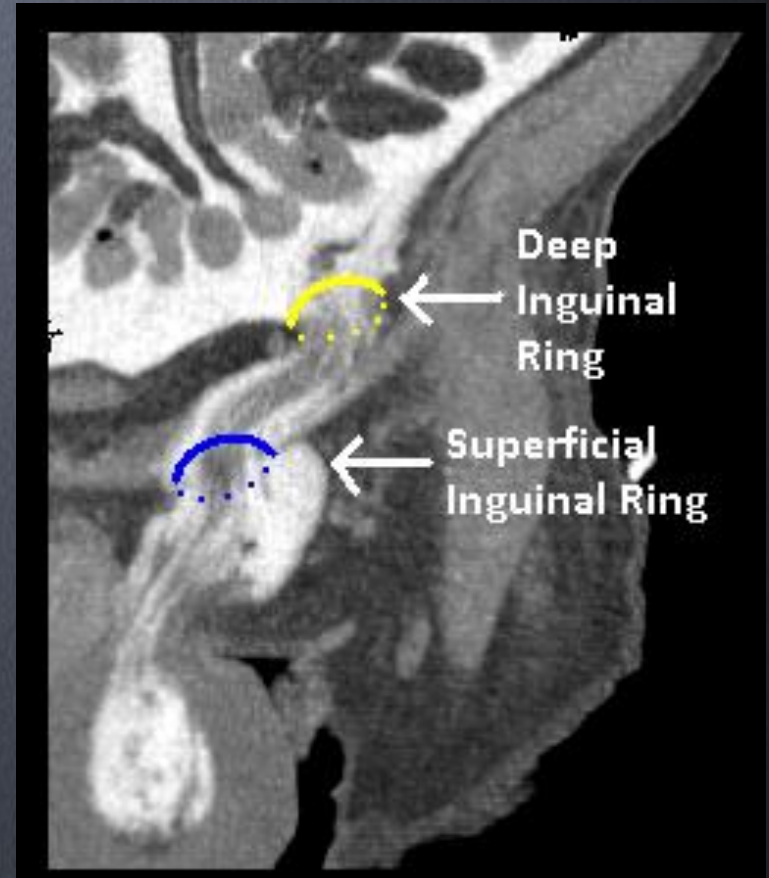
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Objectives

- Brief review of the radiologic anatomy of the inguinal canal and inguinal hernias
- Case-based discussion of imaging findings, pitfalls, and differential diagnosis of usual and unusual contents of the inguinal canal

Anatomy of the Inguinal Canal

- Lined by the aponeuroses of the abdominal oblique musculature
- Runs from the deep (internal) inguinal ring to the superficial (external) inguinal ring
- The **deep inguinal ring** is formed by an opening in the transversalis fascia
- The **superficial inguinal ring** is formed by a gap in the external oblique aponeurosis



Coronal image following the injection of intravenous contrast through a peritoneal dialysis catheter reveals contrast entering the left inguinal canal via a patent processus vaginalis.

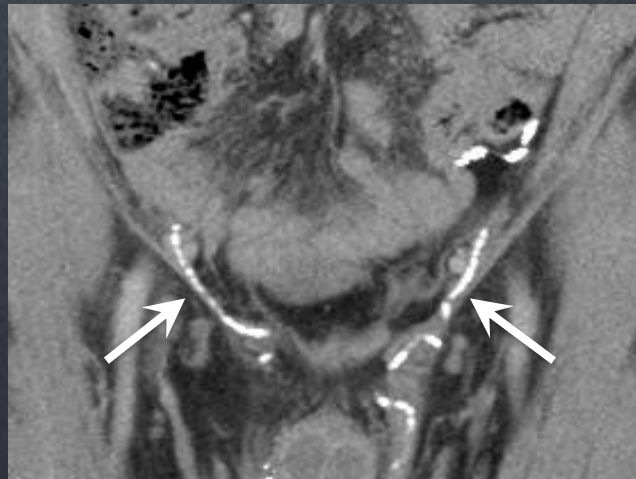
Normal Inguinal Canal Contents

■ Male

- **Spermatic cord**
 - Ductus (vas) deferens
 - Testicular artery
 - Testicular veins (pampiniform plexus)
 - Genital branch of the genitofemoral nerve
- Ilioinguinal nerve

■ Female

- **Round ligament**
- Ilioinguinal nerve to the labia majora

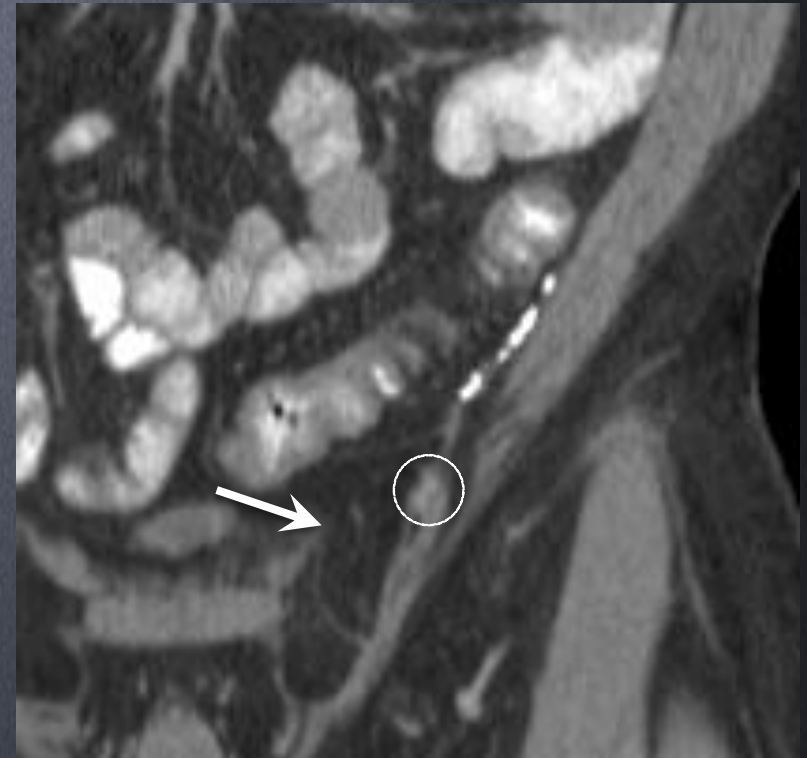
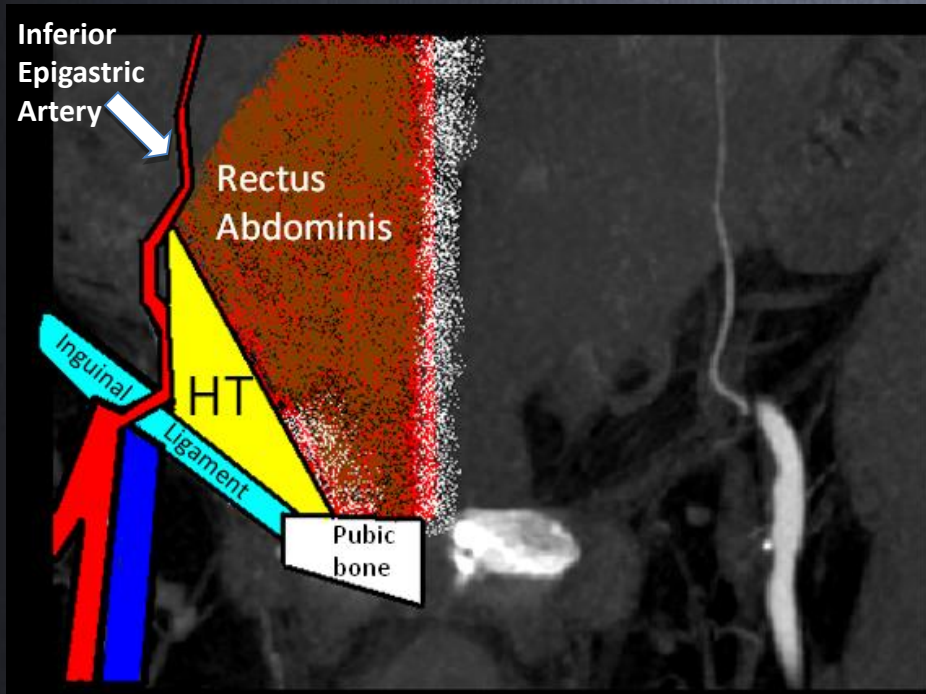


Axial and coronal images demonstrate the course of the calcified vas deferens (arrows) bilaterally.

Inguinal Hernia

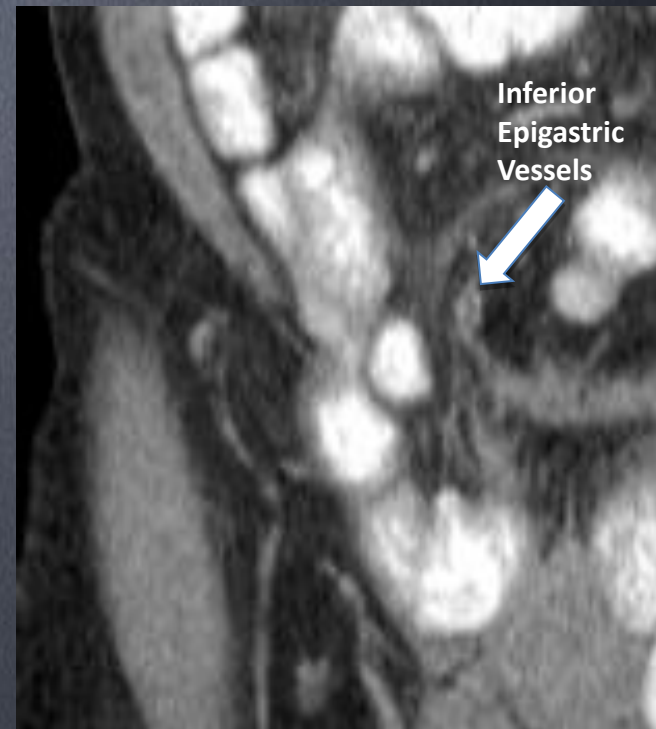
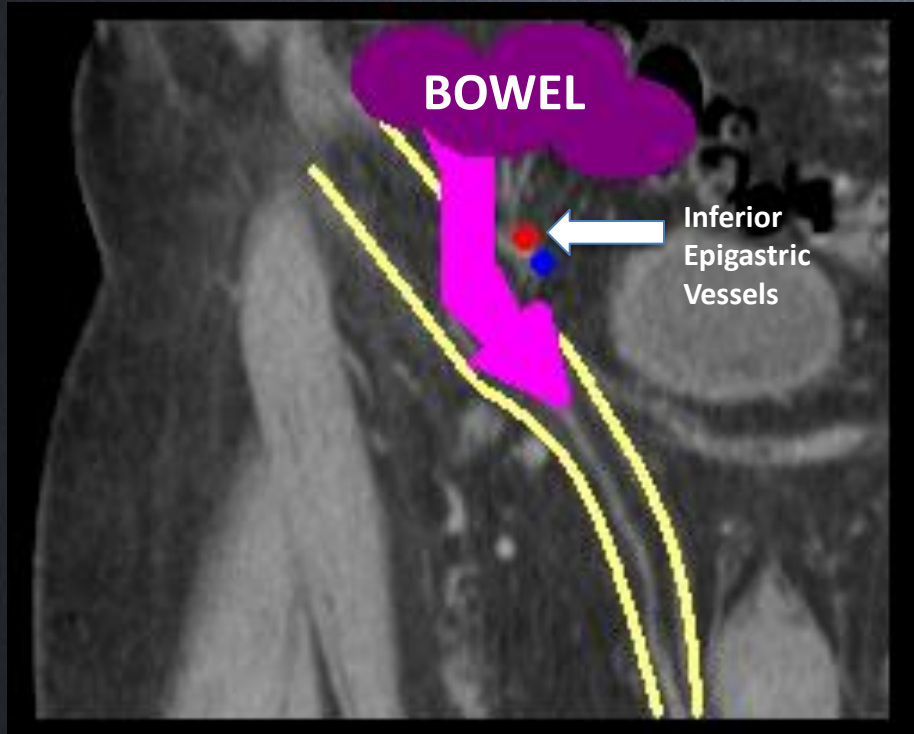
- The prevalence of groin hernia in the US is between 5-10%^{1,2}
 - 96% inguinal, 4% femoral
- Usually a **clinical diagnosis**
 - Physical examination performed by surgeons is 75% sensitive and 96% specific for inguinal hernia³

Direct Inguinal Hernia



Hernia (arrow) protrudes through a weakness in the transversalis fascia (Hesselbach's triangle), lateral to rectus abdominis, medial to the inferior epigastric vessels (circle), and above the inguinal ligament.

Indirect Inguinal Hernia



The hernia protrudes through the deep inguinal ring, lateral to the inferior epigastric vessels and anteromedial to the spermatic cord.

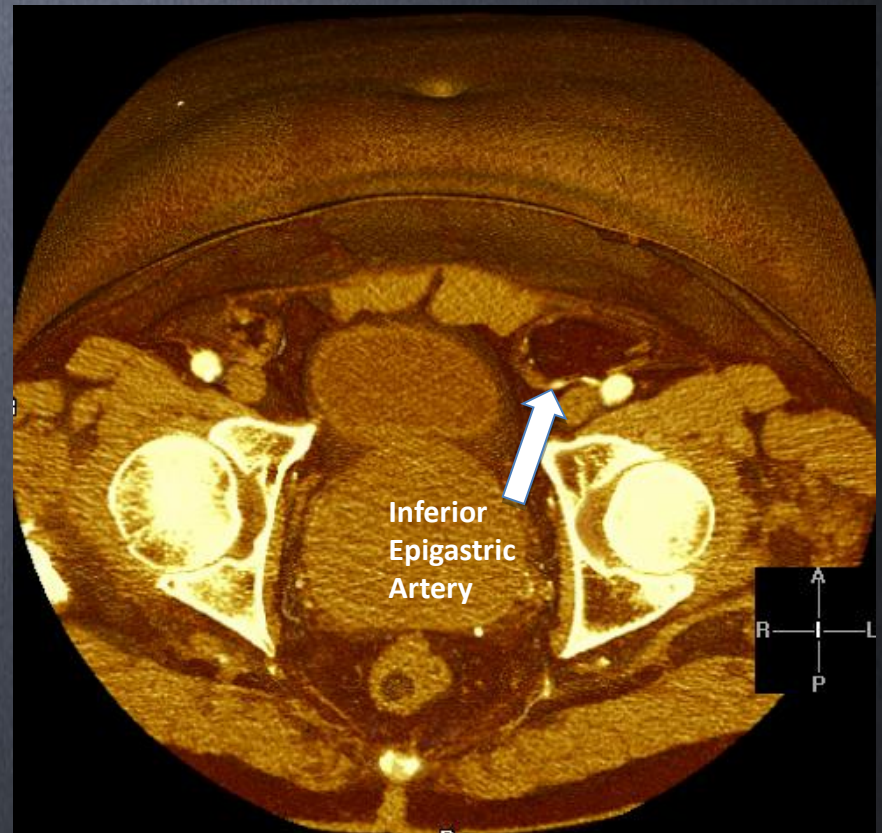
Role of Imaging

- Difficult to distinguish direct from indirect inguinal hernia with physical exam
- Physical diagnosis may be even more difficult in obese patients and patients with chronic pain⁴
- **CT and ultrasound** have been increasingly used at our institution for diagnosis in clinically uncertain cases, preoperative evaluation of incarcerated hernia, and evaluation of postoperative complication
- **Inguinal canal abnormalities are commonly found incidentally on CT**
- MRI generally reserved for problem solving

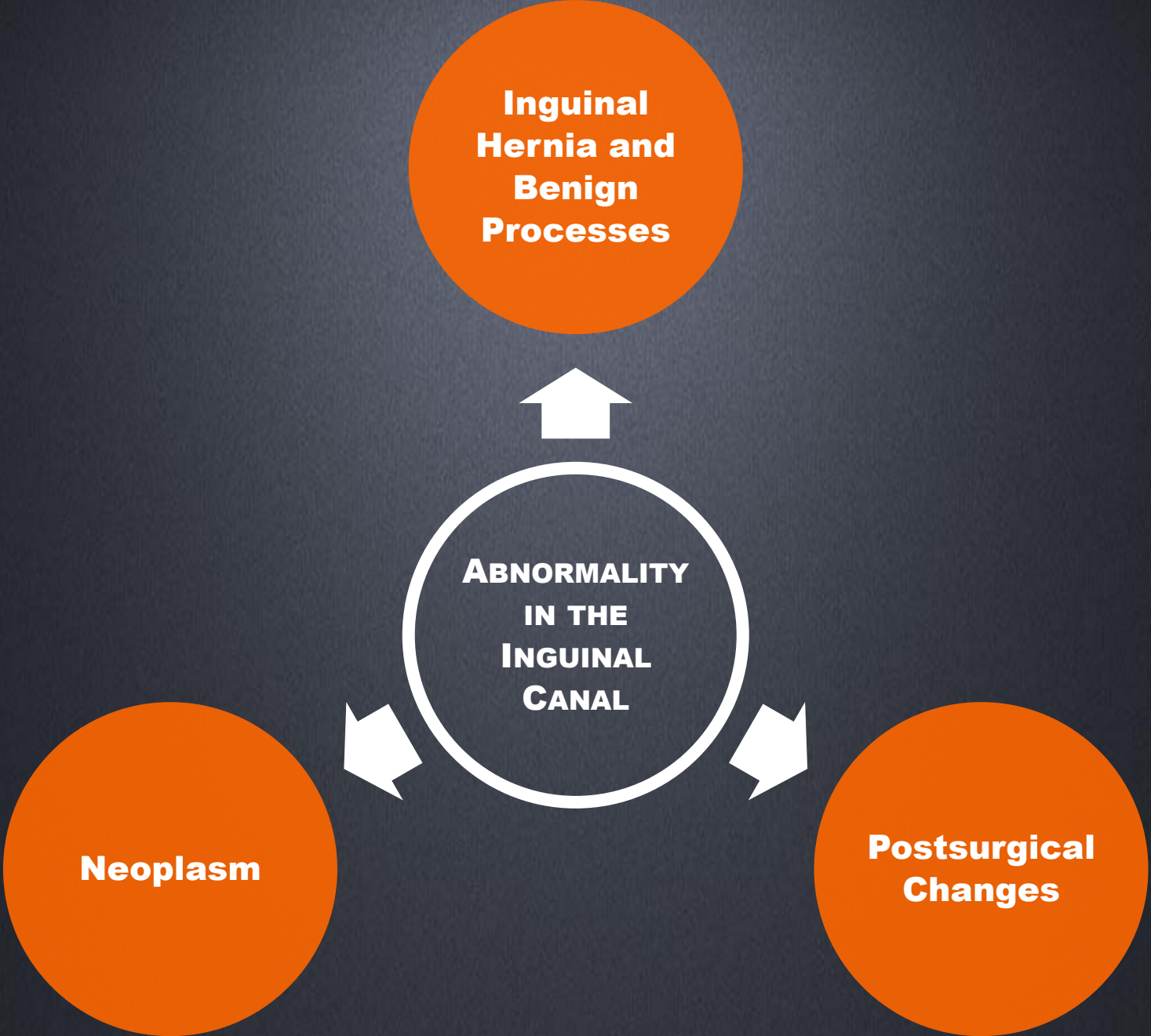
Role of Imaging



Inguinal hernias may be clinically occult in obese patients, even in cases of large hernia.



3D reconstruction demonstrates an indirect left inguinal hernia, which may be difficult to palpate, deep to the subcutaneous adipose tissue.



**Inguinal
Hernia and
Benign
Processes**

**ABNORMALITY
IN THE
INGUINAL
CANAL**

Neoplasm

**Postsurgical
Changes**

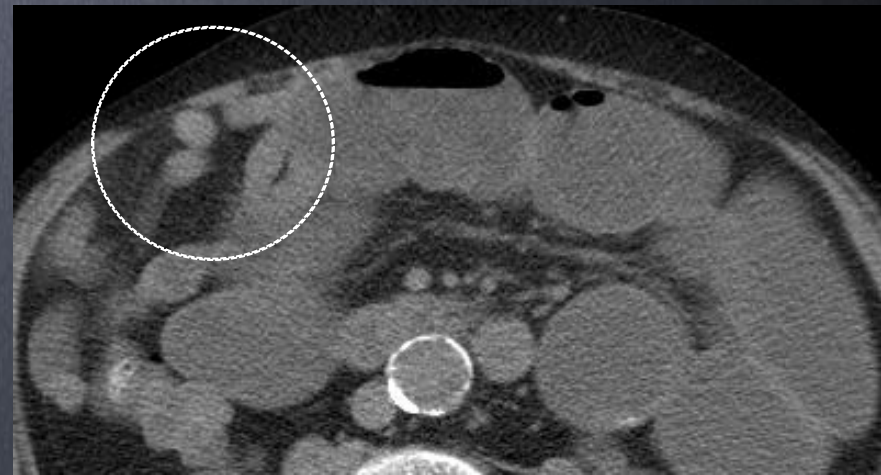
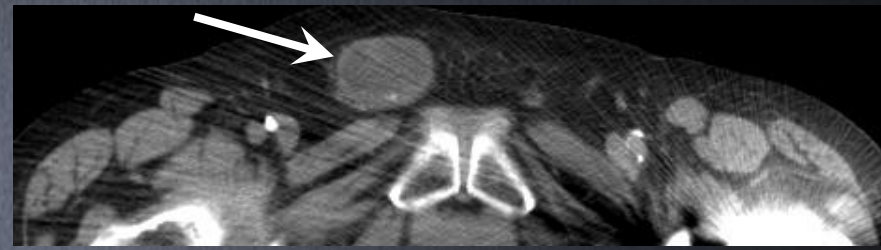
**Inguinal
Hernia and
Benign
Processes**

The diagram consists of two circles and an arrow. The top circle is solid orange and contains the text 'Inguinal Hernia and Benign Processes'. The bottom circle is white with a white outline and contains the text 'ABNORMALITY IN THE INGUINAL CANAL'. A white arrow points upwards from the bottom circle to the top circle, indicating a causal or diagnostic relationship.

**ABNORMALITY
IN THE
INGUINAL
CANAL**

75M with abdominal pain

- Inguinal hernia can contain any abdominal organ, including small and/or large bowel
- Incarcerated bowel containing hernias are a leading cause for mechanical bowel obstruction¹¹
- Prompt surgical intervention is indicated due to the high likelihood of strangulation

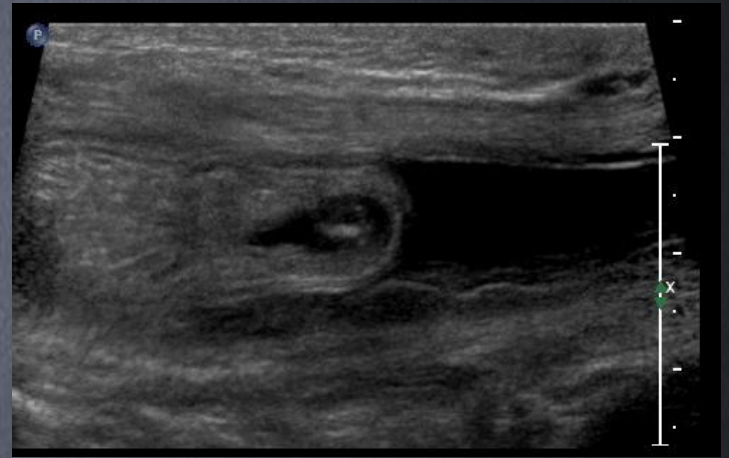


Direct right inguinal hernia containing small bowel (arrows), complicated by strangulation and proximal small bowel obstruction. Distally decompressed loops of small bowel (circle) can be seen in the right lower quadrant.

Incarcerated small bowel

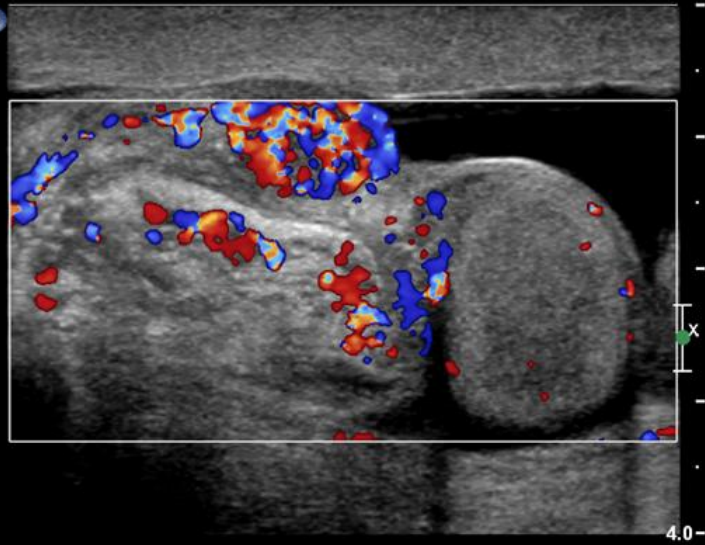
Companion 1: Bowel Hernia

35M with abdominal pain



Ultrasound shows a tubular structure that has peristalsis on real-time imaging, and slides with valsalva.

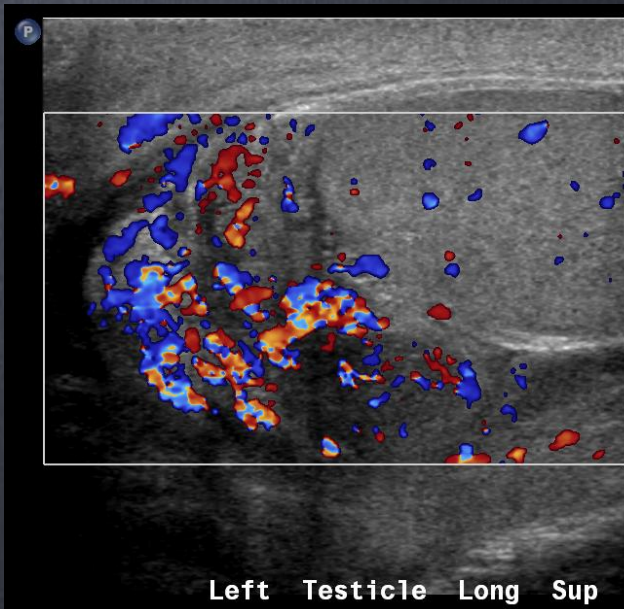
Companion 2: Epididymitis



Long Sup T0 Left Testicle

Scrotal ultrasound shows a complex tubular hypervascular mass extending from the inguinal canal to the left scrotum. Lack of peristalsis or sliding with valsalva argues against bowel hernia. Epididymitis was suspected.

Vasitis

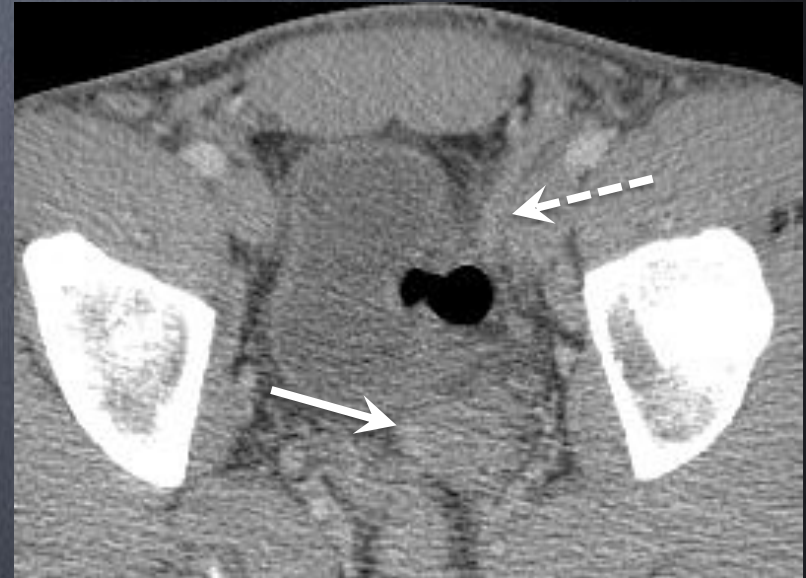


Left Testicle Long Sup

Ultrasound shows an enlarged, heterogeneous epididymis with markedly increased vascularity. Testicular vascularity is normal.

Vasitis

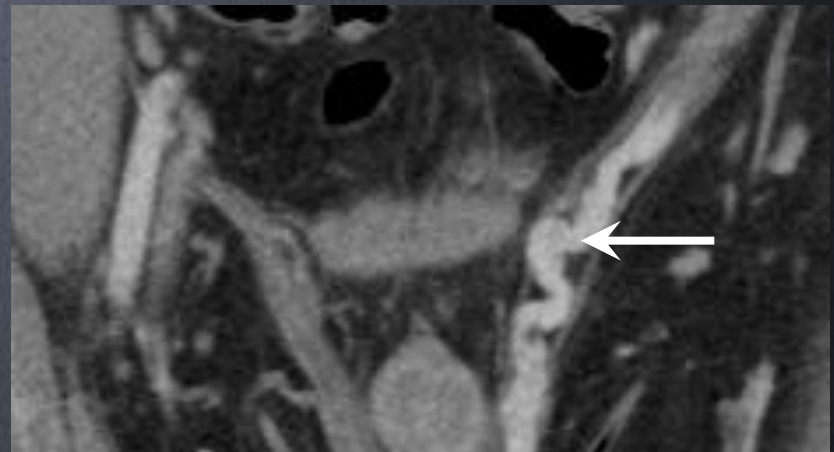
- Inflammation of the vas deferens
- Vasitis nodosa is a complication of vasectomy and may be asymptomatic
- Acute pain and swelling in infectious vasitis⁵
- Result of retrograde spread of pathogens from the urinary tract, prostate, or seminal vesicle⁶
- Ultrasound used to evaluate for epididymitis, orchitis, and testicular torsion
- CT is more definitive in differentiating vasitis from inguinal hernia⁵



Subsequent CT in the same patient shows prominent prostate gland (not pictured), left seminal vesicle (white arrow) and left vas deferens (dashed arrow) with surrounding stranding. Urine positive for *N. gonorrhoea*.

28M with LLQ pain

- Varicocele can be primary or secondary
- Primary type caused by impaired drainage of the testicular vein, usually due to incompetent valves
- Secondary type results from increased extrinsic pressure on the testicular vein⁷
- Symptoms include pain, palpable mass, or infertility

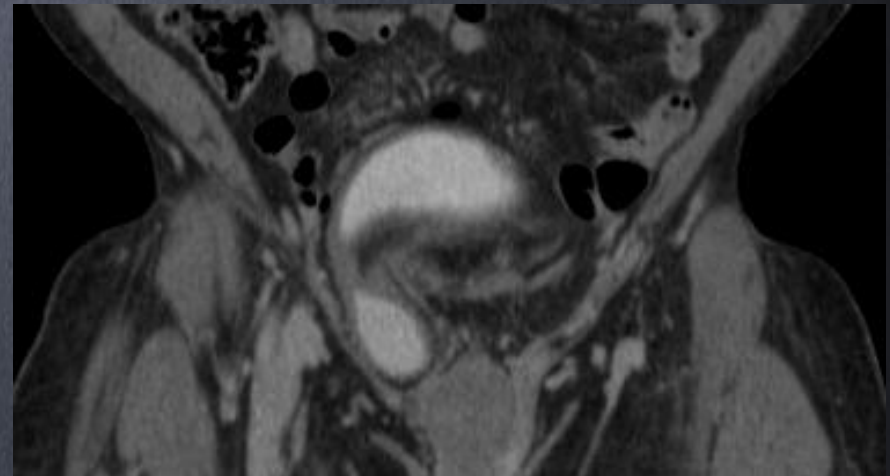


Axial and coronal CT images demonstrate dilated (>3 mm) serpiginous tubules (arrows) in the left inguinal canal.

Varicocele

59M with hematuria

- On physical exam, bladder herniation is inseparable from other hernias⁸
- Chronic distension causes thinning of the bladder wall, making it indistinguishable from hernia sac lining at surgery
- Important to diagnose preoperatively
- Unrecognized bladder injury during herniorrhaphy may result in significant morbidity

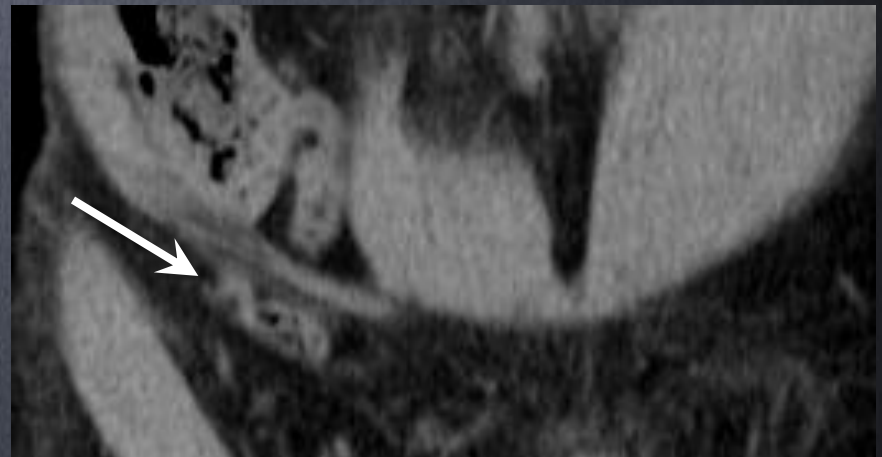
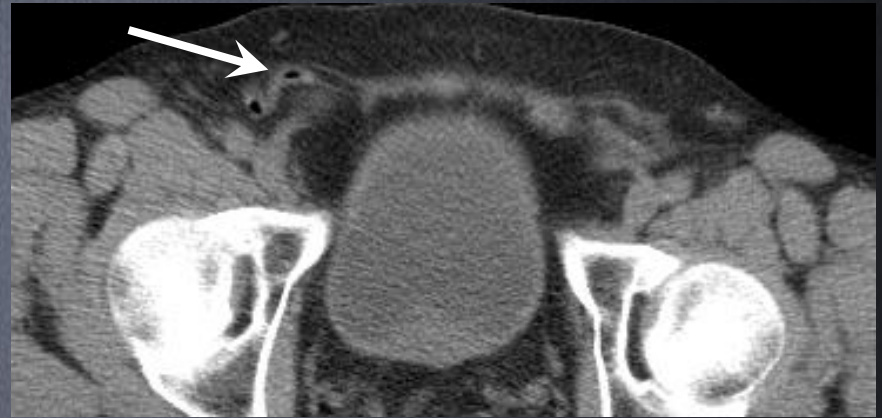


Delayed CT urogram images reveal a direct right inguinal hernia containing urinary bladder (arrow) filled with contrast.

Bladder hernia

61M with flank pain

- Amyand's hernia: appendix within inguinal hernia sac
- Incidence of appendicitis within the inguinal canal is 0.07-0.13% of all cases of appendicitis⁹
- Lack of specific signs and symptoms makes clinical diagnosis difficult
- Imaging diagnosis made with CT when evaluating for other pathology
- Treatment is appendectomy with primary hernia repair



Axial and coronal images reveal a normal appendix (arrows) in the right inguinal canal.

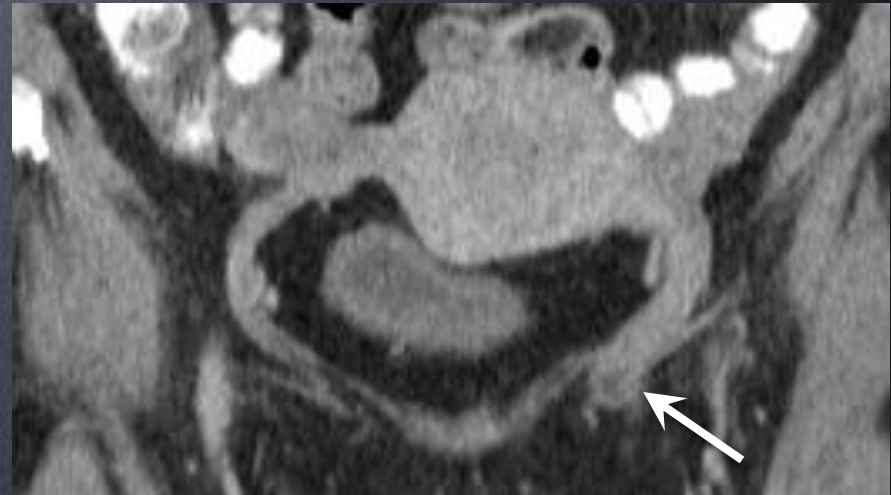
Amyand's hernia

46F breast carcinoma staging

- Herniation of the ovary is rare (<3% of hernia in women)¹⁰
- Generally seen in pediatric patients and often associated with congenital genitourinary tract anomalies
- Complications include ovarian torsion, incarceration or salpingitis
- At imaging, follow gonadal veins to identify each ovary to avoid misinterpretation



Axial image reveals an ovoid soft tissue density (arrow) in the left inguinal canal.

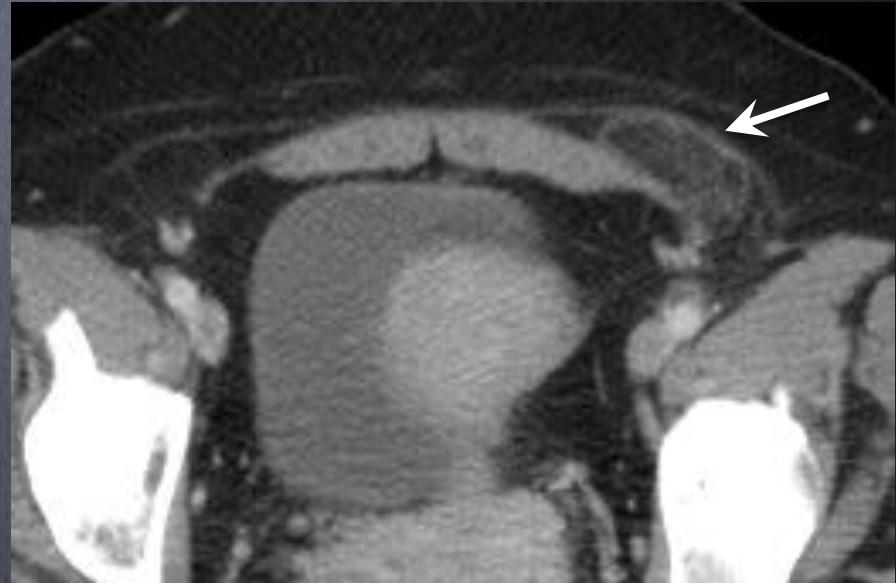


The left ovary (arrow) and fallopian tube extend into the inguinal canal on the coronal image.

Ovary herniation

47F with LLQ pain

- Important to recognize that incarcerated fat containing hernias can be a cause of severe pain¹²
- Unlike incarcerated hernias that contain bowel or other organs, this is not regarded as a surgical emergency
- Differentiate fat herniation from inguinal canal lipoma, which does not connect to the extraperitoneal cavity



Axial CT image demonstrates a fat-containing left inguinal hernia (arrow) with stranding of the fat, suggesting incarceration.

Incarcerated fat herniation

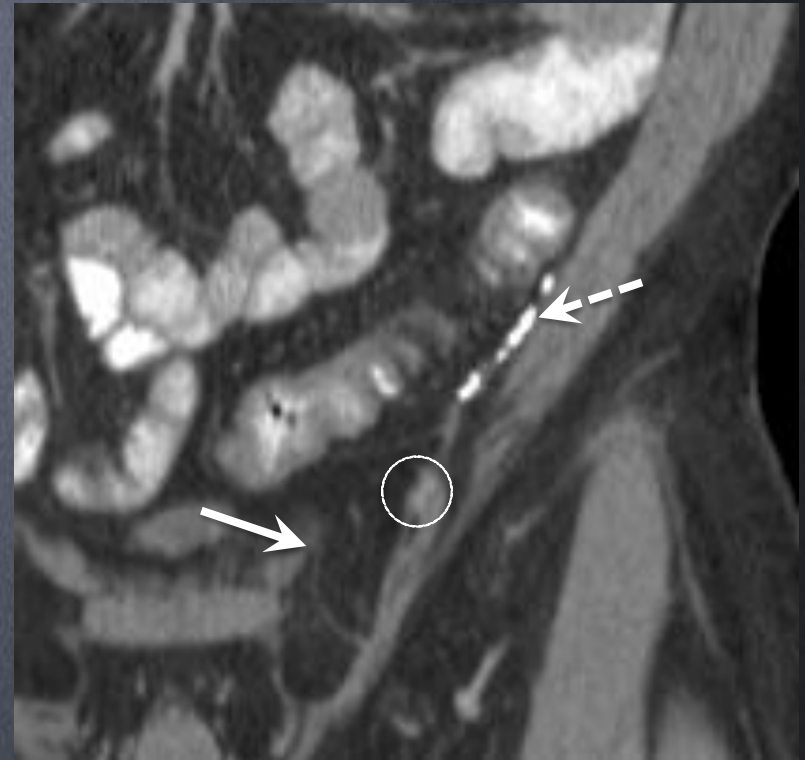
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graph LR; A[ABNORMALITY IN THE INGUINAL CANAL] --> B[Postsurgical Changes]
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**ABNORMALITY
IN THE
INGUINAL
CANAL**

**Postsurgical
Changes**

46M with prior hernia repair

- Mesh can be directly identified when radiopaque material used¹³, or indirectly by staples or suture calcifications
- Recurrence rates following mesh repair vary based on technique, with a range of 5-10% at two years¹⁴
- Most common long term complications include neuralgia, hematoma or seroma, orchitis and other testicular problems, and infection

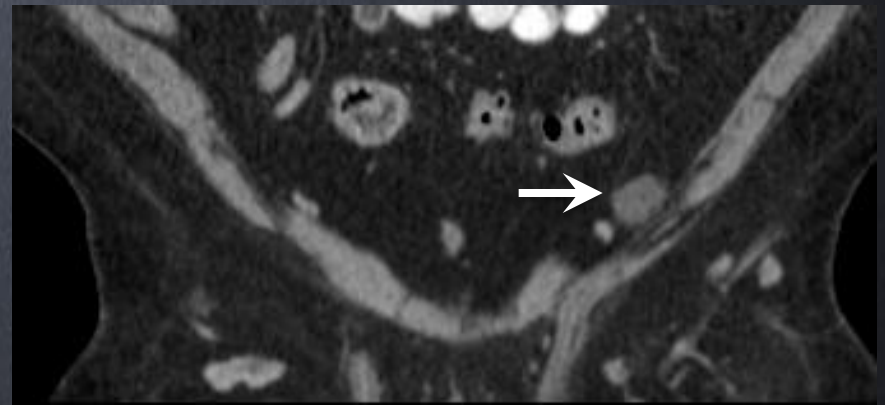


Direct left inguinal hernia (solid arrow) containing fat. The inferior epigastric vessels (circle) are identified lateral to the hernia sac. Prior hernia repair (dashed arrow) is evident.

Recurrent inguinal hernia

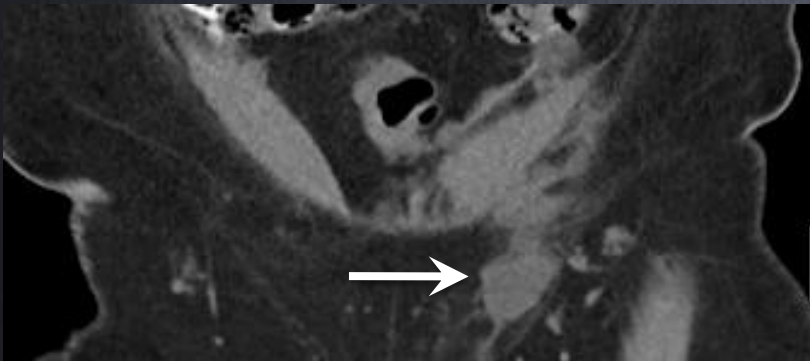
Polypropylene Plug Repair

- Prolene plugs have a soft tissue density on CT similar to surrounding muscle¹⁵
- Located anterior to the iliac vessels at the **deep inguinal ring**
- May be misinterpreted as lymphadenopathy, leading to unnecessary biopsy, erroneous diagnosis, or upstaging of disease
- MRI appearance not yet described in the literature
- **History is crucial**

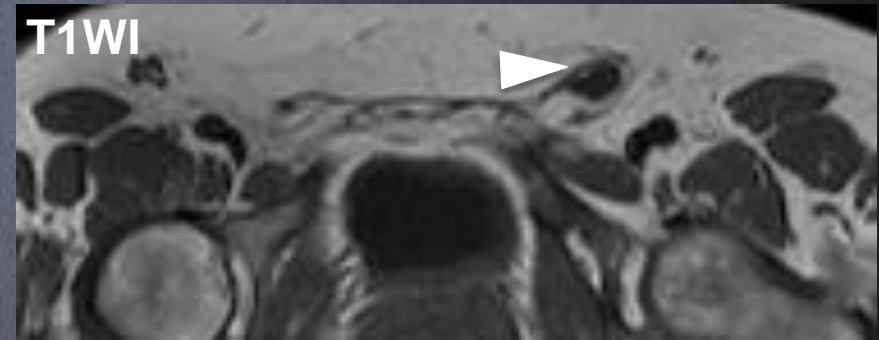


An ovoid nodular soft tissue density (white arrows) abuts the left internal inguinal ring.

45F with chronic groin pain



Axial and coronal CT images demonstrate a soft tissue density (arrows) in the left inguinal canal with surrounding stranding.

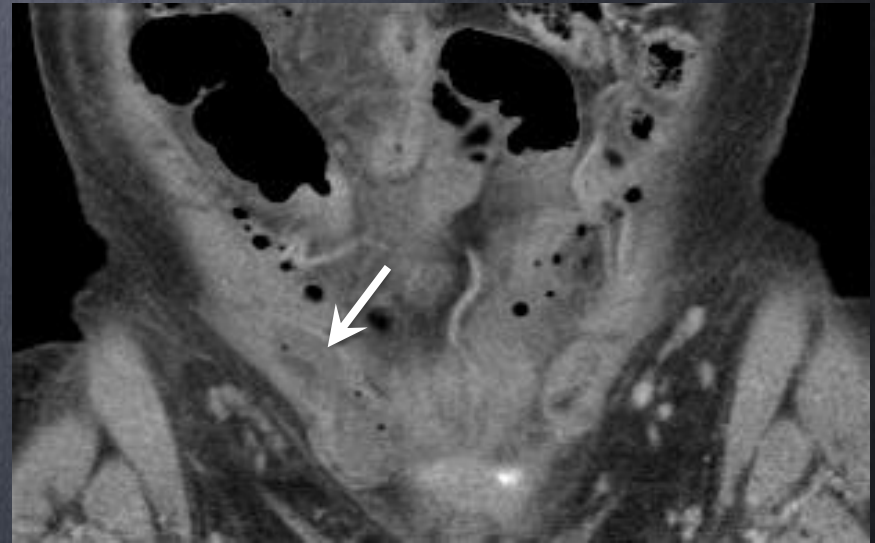


Axial MR images in the same patient show a corresponding structure (arrowheads) with low T1 and low T2 signal intensity. Findings correspond to fibrous tissue surrounding a migrated polypropylene plug.

Migrated prolene plug

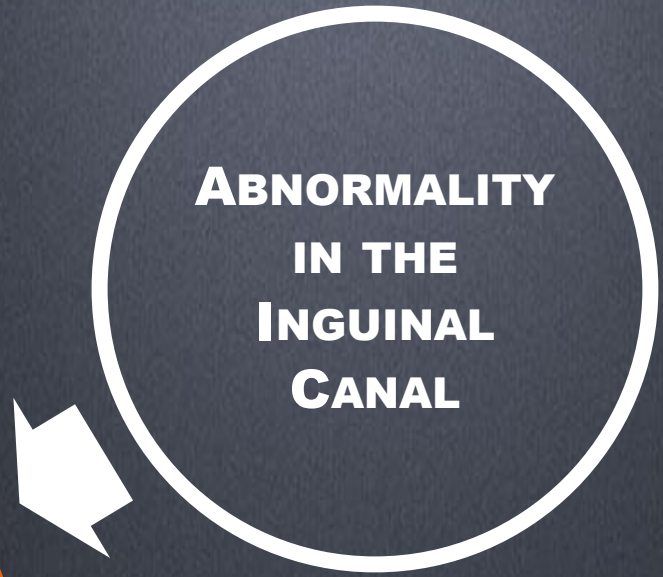
55F with RLQ pain 5d post inguinal hernia repair

- Most common immediate (<2 wks) postoperative complication is hematoma or seroma¹⁴
- Wound infection is much less common
- At imaging, gas within the collection suggests abscess
- Important to correlate with systemic signs and symptoms of infection to avoid contaminating a sterile collection

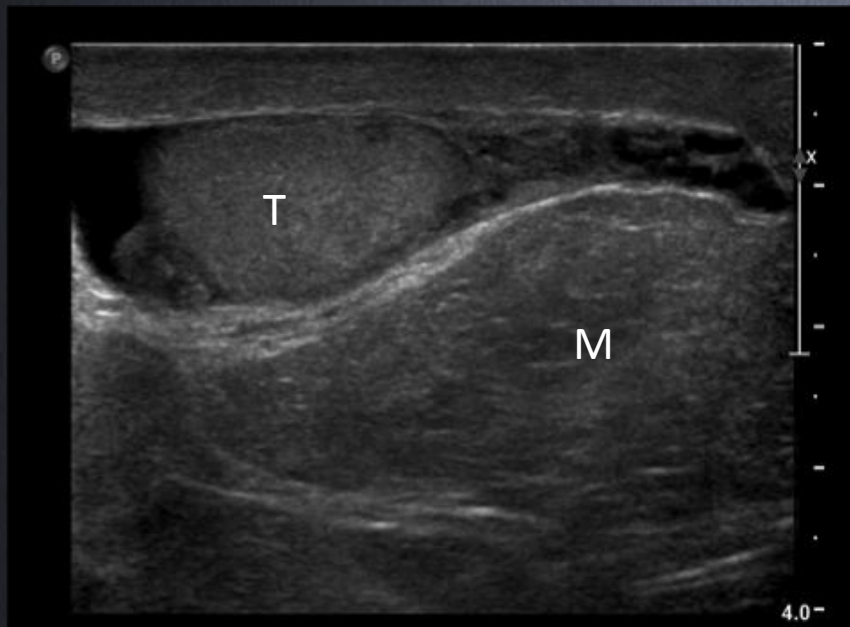


Axial and coronal images demonstrate air and fluid within the right inguinal canal (white arrows) suggesting abscess.

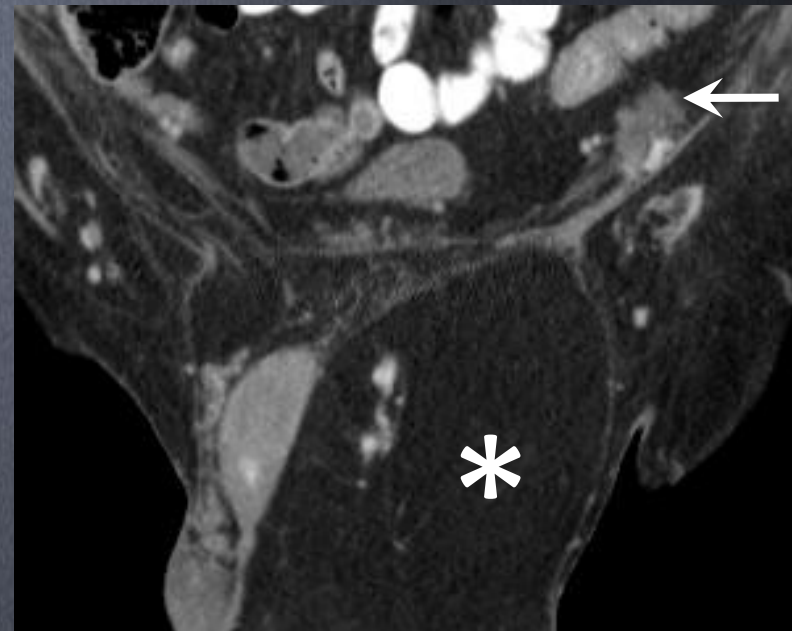
Postoperative abscess



85M with groin bulge on exam



Scrotal ultrasound reveals a large soft tissue mass (M) containing amorphous hyperechoic material posterior to the left testis (T). This was initially diagnosed as an inguinal hernia containing extraperitoneal fat.



Subsequent coronal CT image shows a large fat attenuation mass (*) within the left inguinal canal which does not communicate with the intraperitoneal cavity. Polypropylene mesh plug (arrow) is identified at the deep inguinal ring.

Liposarcoma

Inguinal Canal Liposarcoma

- Liposarcoma makes up 7% of all paratesticular sarcomas, of which 12% occur in the inguinal canal¹⁶
- Large fat attenuation mass on CT, which may have internal soft tissue nodules or septations
- Most common type is well-differentiated, with no malignant potential
- Treatment is surgical excision, with or without radiation and/or chemotherapy
- Other primary neoplasms of the inguinal canal include other soft tissue sarcomas, testicular carcinomas, and Burkitt lymphoma¹⁷

75M restaging penile squamous cell carcinoma post conservative resection

- Penile cancer rare in the US
- Nodal metastasis most important prognostic factor for 5-year survival¹⁸
- Inguinal nodes most commonly involved
- CT or MRI used for staging in patients with clinical adenopathy or obese patients
- Treatment more aggressive if nodal metastases identified

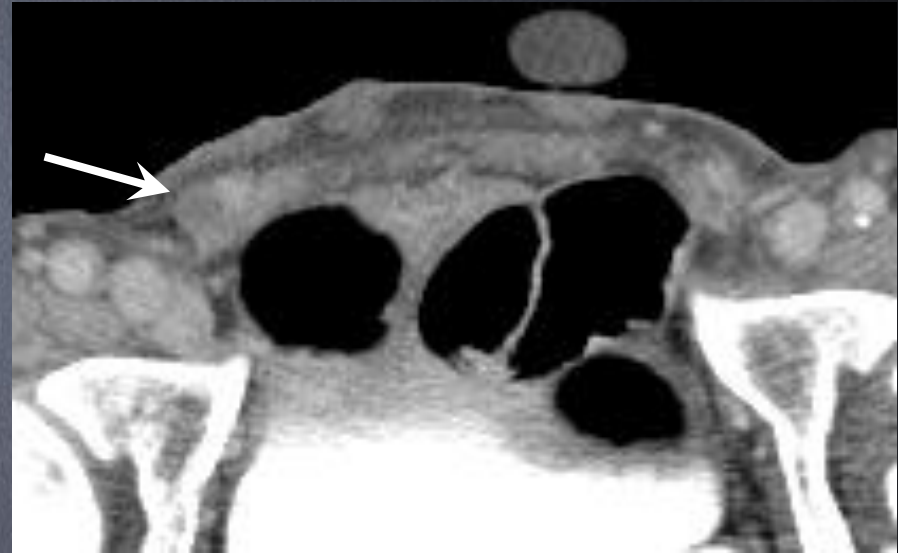


Axial CT image reveals a soft tissue lesion in the right inguinal canal, concerning for metastatic disease. The lesion resolved spontaneously on subsequent imaging and was therefore determined to be postoperative collection.

Granulation tissue mimics metastasis

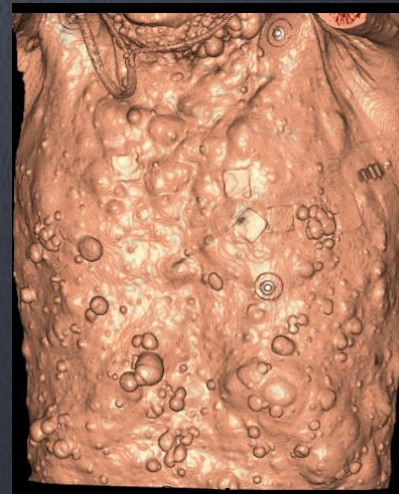
64M with neurofibromatosis 1

- Benign and malignant peripheral nerve sheath tumors (PNST) occur both sporadically and in association with NF1
- In the inguinal canal, PNST arise from the ilioinguinal or genitofemoral nerve
- CT: smoothly marginated mass, decreased attenuation in comparison to muscle, and varying patterns of enhancement¹⁹



Axial CT image reveals multiple cutaneous neurofibromas and a peripherally enhancing soft tissue lesion (arrow) in the right inguinal canal.

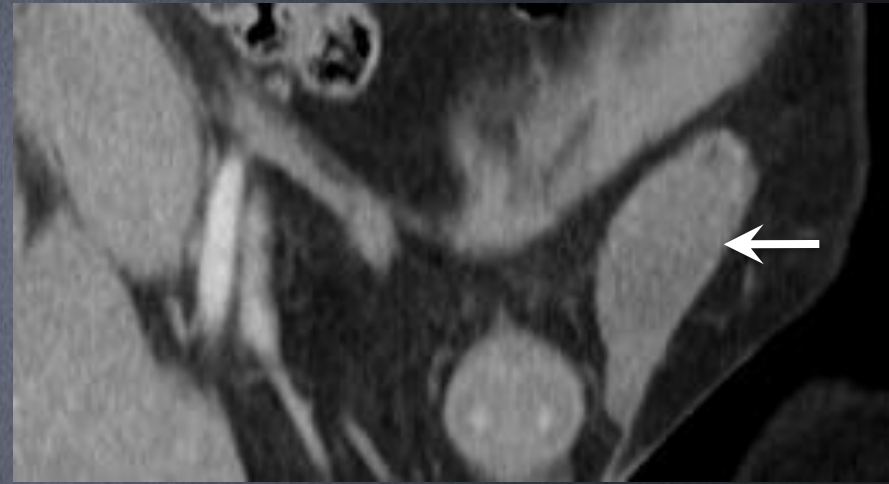
Peripheral nerve sheath tumor



3D reconstruction demonstrates innumerable cutaneous neurofibromas.

42M with abdominal pain

- Incomplete descent of the testis into the scrotum occurs in 2-8% of males at birth²⁰
- May be unilateral or bilateral
- Inguinal canal most common location of undescended testis²⁰
- Both the undescended testis and normally descended testis are at increased risk of developing testicular carcinoma²⁰
- Treatment is orchipexy



Coronal CT image incidentally reveals an oblong soft tissue structure (white arrow) within the left inguinal canal.



Ultrasound identifies the left testis (T) in the inguinal canal.

Undescended testis

Summary

- Most common abnormality in the inguinal canal is herniation of normal intra-abdominal organs
- Inguinal hernia can be direct or indirect
- Imaging performed in evaluation of uncertain cases, preoperative planning, and postoperative follow-up
- Inguinal canal abnormalities are most often seen incidentally
- Understanding of normal anatomy provides the foundation for creating a pertinent differential diagnosis

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