Radiologic Evaluation of Inguinal Masses: From Hernias to Canal of Nuck Hydroceles

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Objectives

• To provide an overview of groin hernias and how they can be differentiated on imaging.

• To provide a review of the differential diagnosis of inguinal pathology simulating groin hernias for which the radiologist should be aware.

Disclosures

• Nothing to disclose.
Inguinal Anatomy Basics

• The inguinal canal is a diagonally oriented tunnel lined by the aponeuroses of the abdominal wall musculature.

• It begins at the internal/deep inguinal ring, a gap in the transversalis fascia above the inguinal ligament and posterolateral to the inferior epigastric vessels.

• It terminates at the superficial inguinal ring, an opening in the external oblique aponeurosis, superolateral to the pubic tubercle.

• The canal serves as the passageway of the spermatic cord in males and the round ligament of the uterus in females, in addition to lymphatics, sympathetic nerve fibres and connective tissue.
Inferior epigastric artery (yellow) arises from external iliac artery (red). Fat encircles the spermatic cord (green) as it transits the internal inguinal ring.

Spermatic cord (green) within the inguinal canal. Adjacent inguinal ligament (blue) and external iliac artery (red).

Spermatic cord (green) at the level of the superficial inguinal ring. The femoral vessels (red) are lateral within the femoral canal, along with the node of Cloquet (brown).
Groin Hernias

- By far, the most common type of abdominal hernia is the inguinal hernia, representing 80% of cases (1).
- Hernias: Inguinal (direct, indirect), femoral, obturator.
- Femoral hernias account for only 5% of abdominal hernias, however prompt clinical and radiological diagnosis is necessary as 40% manifest with strangulation (1).
- Hernia contents range from intra-abdominal fat and bowel loops, to bladder and reproductive organs.

Differential Diagnosis of an Inguinal Mass

- Congenital/Reproductive: cysts, cryptorchidism, retractile testes, endometriosis.
- Neoplasia: Primary vs metastatic.
  - Femoral hernias account for only 5% of abdominal hernias, however prompt clinical and radiological diagnosis is necessary as 40% manifest with strangulation (1).
- Infectious or Inflammatory.
  - Hernia contents range from intra-abdominal fat and bowel loops, to bladder and reproductive organs.
Inguinal Hernias - **Direct**

- Direct inguinal hernias occur via a defect in the transversalis fascia within the Hesselbach triangle.

  - The Hesselbach triangle is bordered by the rectus abdominis muscle medially, the inferior epigastric vessels superolaterally, and the inguinal ligament inferiorly.

- Therefore, direct inguinal hernias occur **inferomedial** to the inferior epigastric vessels.

- More common in men, with lowest incidence of strangulation amongst groin hernias (4).

Right direct inguinal hernia containing bowel and mesenteric fat. The hernia sac is **medial** to the inferior epigastric vessels (red arrow). A fat-containing left inguinal hernia is also present.
Inguinal Hernias - *Indirect*

- Indirect inguinal hernias enter the deep/internal inguinal ring and extend through the inguinal canal.

- Therefore, they occur *lateral* to the inferior epigastric vessels and Hesselbach triangle.

- In men, the contents can extend through the superficial ring into the scrotum, while in women, they can follow the round ligament into the labia majora (2).

- Indirect hernias are five times more common than direct hernias, with a moderate risk of strangulation (1,2).

(Burkhardt, Arshanskiy, Munson, & Scholz, 2011)
CT C+ from two patients with inguinal hernias. The image on the left shows an *indirect* hernia containing bowel. On the right, ascites is seen pooling within a *direct* hernia. Note the relative position of the inferior epigastric artery (red arrows).
Femoral Hernias

• The femoral sheath is a fascial layer encircling the femoral artery and vein laterally, and femoral canal medially.
• The femoral ring is the widest part of the femoral canal.
• Femoral hernias extend through the femoral ring, below the inguinal ligament.
• They occur medial to the common femoral vein, often compressing it (2).
• Account for only 5% of abdominal hernias, however 40% manifest with strangulation (1).
• F:M ratio of 4:1, thought to be secondary to dilatation of the femoral ring due to the hormonal and physical changes of pregnancy (5).

(Burkhardt, Arshanskiy, Munson, & Scholz, 2011)
- The images on the right depict ascites within a right femoral hernia (white arrows).

- Note the position of the hernia inferolateral to the inguinal canal (green arrow) and anterior to the pectineus muscle (brown arrow).

- The hernia compresses the right common femoral vein, which appears slit-like relative to the contralateral side (blue arrows).

- For reasons unknown, femoral hernias are twice as common on the right (5).
Obturator Hernias

- Occur as a result of laxity in obturator canal, formed by the obturator fascia and membrane.

- The canal harbors the obturator artery, vein and nerve, and traverses the obturator foramen.

- More common in elderly women and patients with chronically elevated intra-abdominal pressure, e.g. COPD (6).

- Female predominance may be due to more oblique course of the canal and/or laxity of pelvic muscles during pregnancy (6).

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101F evaluated for DVT demonstrates a R obturator hernia containing fluid (green). Obturator hernias lie deep to the pectineus (brown) and anterior to the obturator externus (yellow).
Hernia complications

- Groin hernias can contain nearly any structure in the lower pelvis.
  - Most feared complications include bowel incarceration and obstruction, or strangulation.
  - Rarer cases include an incarcerated appendix (Amyand) or Meckel’s diverticulum (Littré).

CT C+ from a 57y with known abdominal hernias. Axial slices demonstrate herniation of the right ovary (yellow arrow) within an indirect inguinal hernia. The left obturator hernia utero-ovarian ligament (blue arrow) can be followed along the course of the hernia. A fat-containing inguinal hernia is also present on the left.

Strangulated bowel within an indirect left inguinal hernia (green). The bowel wall is edematous with adjacent fluid in the hernia sac.
Embryologically, the gubernaculum testis and processus vaginalis are two key structures in normal gonadal development.

- The gubernaculum (white open) is a fibrous ligament extending from the gonads (black closed) in the lower pelvis to the fetal groin, assisting in gonadal descent.

- The processus vaginalis refers to a peritoneal fold extending through the inguinal canal and into the scrotum. It forms the tunica vaginalis testis in males and is obliterated in females.

- Failure of obliteration of the processus vaginalis can lead to fluid accumulation within this potential space, referred to as a Canal of Nuck hydrocele.

- Failure of testis migration results in Cryptorchidism (image to the right).

Neoplasia: Primary vs metastatic.

Vascular: Pseudoaneurysm/aneurysm, hematoma, varicocele, fistula.

Infections or Inflammatory.
Canal of Nuck Hydrocele

Axial T1 (upper left), T2 (upper right) and T1 Fat-sat Post-Gadolinum (bottom left) MRI in a young female patient referred for evaluation of an inguinal mass. The study demonstrates a cystic, non-enhancing lesion in the right inguinal canal, which does not communicate with the peritoneal cavity (not shown). Findings are consistent with a Canal of Nuck hydrocele.
Testis Migration

- Testis can be located at any point along path of embryologic descent, defined as either intraabdominal or cannilar (outside abdominal cavity).
- They can also be ectopic in location, outside normal embryologic pathway (perineum, femoral canal...)
- Testicular retraction refers to transient proximal migration along the inguinal canal.
- Abnormal positioning of the testis results in increased risk of torsion and malignancy.

3M presenting with severe left inguinal pain with palpable mass. Doppler US shows a necrotic, avascular testis within the left inguinal canal. Some flow is seen in the epididymis.

CT C+ from the same patient shows bilateral cannilar location of the testes within the inguinal canals. The left testis (yellow) is enlarged and necrotic compared to the right (green).
Inguinal Endometriosis

- Although endometriosis commonly affects the pelvis, inguinal disease is rare (8).

- They occur within the extraperitoneal portion of the round ligament, as well as along inguinal nodes and within hernias (8).

- Associated with malignant transformation to clear cell carcinoma (9), highlighting importance in prompt diagnosis.

Grayscale US image from a young female patient with cyclical abdominal pain, demonstrates a 3.3x2.8cm lesion in the right ovary, with diffuse internal echoes.

CT C+ from the same patient demonstrates an isodense, slightly ill-defined lesion (yellow arrow) in the left inguinal canal. Excisional biopsy confirmed endometriosis.
Neoplasia

Differential Diagnosis of an Inguinal Mass

- Groin neoplasms are subdivided into benign and malignant pathologies.
- Hernias: Inguinal (direct, indirect), femoral, obturator.
- Congenital/Reproductive: Cysts, cryptorchidism, retrograde testes, endometriosis.
- The most common benign tumor of the groin is a lipoma of the spermatic cord (7).
- Vascular: Pseudoaneurysm, aneurysm, hematoma, varicocele, fistula.
- Infections or Inflammatory

- Additional benign tumors of the groin include neurofibromas of the ilioinguinal or genitofemoral nerves (3) and desmoid tumors.

Axial CT C+ shows a fat density lesion lateral to the right spermatic cord (blue arrow), compatible with a lipoma.

Axial CT C+ shows a fat-containing L inguinal hernia, anterior to the spermatic cord (yellow arrow).
Desmoid Tumor

- Rare tumors representing 3.5% of all fibrous tumors (11).
- Associated with Gardner syndrome, FAP, and surgical scars (12).
- When occurring in the groin region, they commonly manifest as a painful mass, +/- lower extremity edema (13).
- MR signal characteristics are low T1, heterogenous T2, and enhancement post-gadolinium (14).

Axial T1 (top left), T2 fat-sat (bottom left) and T1 fat-sat post-Gadolinium (top right) MRI in a 37F presenting with right groin pain and palpable lump. Study demonstrates an enhancing mixed signal intensity lesion in the right Sartorius muscle. Biopsy results were compatible with desmoid tumor.
Neoplasia - Malignant

- Malignant tumors commonly involve the inguinal region by direct extension, and can be either primary or metastatic (7).

- Primary neoplasms include sarcomas (liposarcoma, undifferentiated), Burkitt lymphoma and testicular/embryonic cancer along the spermatic cord (3).

- Metastatic disease can either be from a pelvic primary (prostate, vagina, penis, anorectal), lower extremities (melanoma), or systemic (lymphoma) (3,7), amongst others.

24M presenting with a left groin mass. Axial STIR (bottom) and T1 fat-sat post-Gadolinium (top) MRI shows a large heterogeneous, enhancing mass (green arrows) in the left pelvis extending through the femoral canal to the groin. Biopsy showed undifferentiated sarcoma.
Inguinal Lymphadenopathy

- The inguinal lymph nodes course along the greater saphenous vein and inguinal ligament.

- They drain the lower abdomen, external genitalia and lower third of vagina, anal canal, and lower extremities (15).

- Inguinal nodes can measure up to 2 cm in healthy individuals (16).

- More specific findings for adenopathy include loss of fatty hilum or evidence of necrosis.

- Etiologies include reactive nodes from local inflammation or infection, and malignancy (primary or metastatic).

CT C- from a 61M with a palpable mass in the right groin. There are numerous enlarged right inguinal nodes (blue arrow). Final diagnosis was B-cell lymphoma.

CT C- from a 46F with a history of melanoma. There is a large left inguinal lymph node (yellow arrow), confirmed to be metastatic melanoma.
Vascular Etiologies

• Most common vascular pathologies in the inguinal region are iatrogenic, sequelae of femoral artery manipulation.
  - Complications include hematomas and arterial pseudoaneurysm.

• True aneurysms are relatively rare, occurring in atherosclerotic vessels (7).

• Other vascular pathologies include varicoceles, and post-traumatic AV fistulas (7).

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54F presenting with a palpable groin mass post-femoral artery catheterization. CTA images show a saccular outpouching with a flap at the L CFA (red), compatible with pseudoaneurysm.

Doppler US in a different patient showing the characteristic “yin-yang” appearance, in a partially thrombosed pseudoaneurysm.
Inguinal Hematoma

- 37M with recent vasectomy, presented with RLQ and right groin pain. CT was requested to r/o appendicitis.

CT C- demonstrates a hyperdense collection (HU 35) within the right inguinal canal, tracking along the spermatic cord into the scrotum.

Doppler and Grayscale US confirm the presence of a largely hyperechoic collection tracking along the inguinal canal and scrotum. Findings are compatible with a post-operative hematoma.
Infectious/Inflammatory

Differential Diagnosis of an Inguinal Mass

- Groin abscess may either occur locally (sebaceous or sweat glands) or extend from distal sources, such as the retroperitoneum.
- As the hip joint forms the floor of the groin, an inflammatory hip process can simulate a groin mass (7).
  - Examples include iliopsoas bursitis, synovial osteochondromatosis and metal-on-metal pseudotumor.

CT C- in a 66M presenting with fever, leukocytosis, and flank pain. An iliopsoas abscess (yellow arrow) is seen extending along the entire course of the muscle, down to the tendinous insertion at the lesser trochanter.

CT C- from the same patient demonstrating a large, heterogeneous calcified mass within the left iliopsoas muscle (yellow arrows). An iliopsoas abscess (brown arrow) is seen, extending along the entire course of the muscle, down to the tendinous insertion at the lesser trochanter.

CT C- from a patient with chronic hip pain post left THA. There is dislocation of the prosthesis (blue arrow), with a partially calcified mass projecting over the left iliac fossa (yellow arrow). Courtesy of Dr. F. Discepola.

CT C- from a patient with right hip dysplasia, presenting with groin pain. There is fluid expansion of the iliopsoas bursa (brown arrow), suggestive of bursitis.

Hernias: Inguinal (direct, indirect), femoral, obturator.

Congenital/Reproductive: Cysts, cryptorchidism, retroperitoneal fibrosis.

Infectious/Inflammatory.

Neoplasia: Primary vs metastatic.

Differential Diagnosis of an Inguinal Mass

Hernias: Inguinal (direct, indirect), femoral, obturator.

Congenital/Reproductive: Cysts, cryptorchidism, retroperitoneal fibrosis.

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Examples include iliopsoas bursitis, synovial osteochondromatosis and metal-on-metal pseudotumor.
Conclusion

- The groin is complex in pathology, ranging from hernias to malignancy.
- Knowledge of the anatomy and embryology of the inguinal region is essential in characterizing lesions and providing an appropriate differential diagnosis.
- Collaboration between radiologists and clinicians is essential as the clinical course, in conjunction with the imaging findings, narrows the differential diagnosis and ultimately, improves patient care.
References


