Skim the Surface: Subcutaneous Abdominal Masses
A Quiz-Based Review

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Subcutaneous abdominal masses are encountered during routine imaging, either as incidental findings or in the evaluation of a palpable abnormality. Subcutaneous masses arise from multiple disease processes, including neoplastic and iatrogenic etiologies. Understanding and recognizing these entities will assist in the interpretation of these masses.

After reviewing this quiz-based presentation, participants will be able to:

• Understand the anatomy of the abdominal wall.

• Identify common and uncommon abdominal wall masses and mass-like conditions.

• Provide clinical management or follow up considerations where appropriate.

Residents, fellows, general radiologists, abdominal radiologists
OVERVIEW

ABDOMINAL WALL ANATOMY

BENIGN NEOPLASM
Fibromatosis (abdominal wall desmoid); Endometriosis; Varices; Neurofibroma; Rosai-Dorfman; Benign lipomatous tumor (lipoma)

MALIGNANT NEOPLASM
Liposarcoma; Cutaneous lymphoma; Metastases

IATROGENIC/TRAUMA
Liposuction/Abdominoplasty; Injection granuloma; Foreign body

CONGENITAL
Undescended testis; Urachal remnant
ABDOMINAL WALL ANATOMY

- Abdominal wall is composed of multiple muscle and fascial layers:

  (A) Above the umbilicus, the muscular fascia/aponeuroses surround the rectus abdominus to form the linea alba.

  (B) Below the umbilicus, the muscular fascia remains anterior to the rectus abdominus; only the transversalis fascia and peritoneum are posterior to the rectus muscles.

Fascial planes outlined as follows: external oblique muscle; internal oblique muscle; transversus abdominus muscle; transversalis fascia; peritoneum; linea alba.
QUESTION

Which of the following is true regarding abdominal wall fibromatosis:

A. Does not enhance
B. Extends along the orientation of the involved muscle aponeurosis
C. Rarely recurs after surgical resection
D. The “fascial tail sign” refers to malignant transformation
FIBROMATOSIS (DESMOID)

**Answer:** B. Extends along the orientation of the involved muscle aponeurosis

- Abdominal wall desmoids arise from proliferating fibroblastic cells in the fascia along the fascial plane of the involved aponeurosis
- Benign, though can be *locally aggressive and recur* following resection
- Risk factors: female, post-partum, prior abdominal surgery

**IMAGING CHARACTERISTICS**

**CT:** variable attenuation, post-contrast enhancement  
**US:** hypoechoic mass without vascularity  
**MRI:** heterogeneity reflects cellular and fibrous components  
- Generally **T1 isointense** to muscle; post-contrast enhancement  
- **T2W:** Cellular components hyperintense, fibrous components hypointense  
- “Fascial tail” sign describes linear extension of the mass along fascial plane

(A) Axial T2W, (B) T1W, and (C) T1W contrast-enhanced MRI demonstrate a **T2 heterogeneous, T1 isointense mass** in the right rectus abdominus muscle with **post-contrast enhancement.**
The major risk factor for abdominal wall endometriosis is:

A. Cesarean section  
B. Total abdominal hysterectomy  
C. Laparoscopic hysterectomy  
D. Laparoscopic myomectomy

Sagittal contrast-enhanced CT (CECT) demonstrates enhancing ill-defined soft tissue in the abdominal wall.
ABDOMINAL WALL ENDOMETRIOMA

Answer: A. Cesarean section
The risk of abdominal wall scar endometriosis is highest following Cesarean section, though prevalence remains <1%. No increased risk in patients with history of intra-pelvic endometriosis has been reported. The abdominal wall is the most common site of extra-pelvic endometriosis.

- Endometriosis: functioning endometrial tissue outside the uterine cavity
- Most commonly within the pelvis
- Endometrial tissue can seed the abdominal wall following Cesarean section delivery even in patients without pelvic endometriosis
- Clinical symptoms: cyclic or non-cyclic pain associated with a mass
- Differential diagnosis: desmoid, metastasis, sarcoma, granuloma

IMAGING CHARACTERISTICS
CT: nodules isodense to muscle, mild post-contrast enhancement
US: hypoechoic mass with mild peripheral vascularity
MRI: T1 isointense to muscle; post-contrast enhancement; T2 hyperintense (unlike ovarian endometriomias, which show T2 shading)

(A) Axial CECT demonstrates ill-defined mildly enhancing soft tissue at Cesarean scar. (B) Ultrasound shows a hypoechoic mass with mild peripheral vascularity.
QUESTION

Vulvoperineal varicosities are most often seen in the presence of:

A. Portal hypertension
B. Lower extremity deep venous thrombosis
C. Congestive heart failure
D. Pelvic congestion syndrome
Abdominal wall varices serve as a porto-systemic collateral pathway in portal hypertension

Vulvoperineal varicosities are generally NOT seen in portal hypertension; they are associated with pelvic congestion syndrome and may be related to ovarian venous incompetence
  - First presentation is usually during pregnancy

Best visualized on CT venography, ultrasound, or MRI

Treatment for symptomatic lesions involves removing retrograde flow from ovarian veins: coil embolization, sclerotherapy, surgical ligation

Answer: D. Pelvic congestion syndrome
Regarding neurofibromatosis:

A. Plexiform neurofibroma is sensitive but not specific for neurofibromatosis type 1 (NF1)

B. Neurofibromas are hypervascular and avidly enhancing

C. Neurofibromatosis is the second most common neurocutaneous syndrome

D. Neurofibromas are generally hypoattenuating on CT
NEUROFIBROMA

Answer: D. Neurofibromas are generally hypoattenuating on CT

- Neurofibroma: a benign nerve sheath tumor which is inseparable from the parent nerve; associated with neurofibromatosis type 1 (NF1), the most common neurocutaneous syndrome (phakomatosis)
- NF1 is characterized by abnormal tumor suppression and multiple benign and malignant neoplasms throughout the body
- Clinical manifestations also include skin pigmentation abnormalities (café au lait spots, axillary/groin freckles), Lisch nodules (benign hamartomas of the iris), neurofibromas (cutaneous and intra-abdominal), optic gliomas
- Cutaneous neurofibromas usually appear during adolescence
- Plexiform neurofibromas extend throughout a nerve plexus; these are pathognomonic for NF1
- Malignant neoplasms include malignant peripheral nerve sheath tumor (MPNST), neuroendocrine tumors, sarcoma

IMAGING CHARACTERISTICS
Neurofibroma = fusiform, tapering mass
CT: nodules mildly hypodense to muscle, mild post-contrast enhancement
US: echogenic mass
MRI: T1 hypointense; T2 “target sign” of central low intensity (fibrous stroma) and peripheral hyperintensity (myxoid matrix)

(A) Axial CECT demonstrates a low density nodule within the skin of the right thigh in this patient with NF1. (B) Axial CECT shows a much larger, heterogeneous mass distally within the right thigh musculature is a malignant peripheral nerve sheath tumor. The heterogeneity reflects internal necrosis.
Rosai-Dorfman disease can be included in the differential diagnosis of which finding?

A. Cystic retroperitoneal mass
B. Retroperitoneal lymphadenopathy
C. Fat-containing subcutaneous mass
D. Perineural soft tissue mass

Axial CECT demonstrates ill-defined confluent soft tissue density within the subcutaneous fat and skin thickening in this patient with biopsy-proven Rosai-Dorfman disease.
Rosai-Dorfman disease describes the clinical entity of sinus histiocytosis with massive lymphadenopathy (SHML).

Benign progressive histiocytic proliferative disorder characterized by lymphadenopathy, usually cervical, though cases of massive retroperitoneal lymphadenopathy have been reported.

Extra-nodal manifestations (soft tissue thickening and nodules) are present in up to 43% patients.

Most common extra-nodal site: skin - usually head/neck, though can develop throughout the body.

Extra-nodal manifestations can also include the gastrointestinal and genitourinary tracts.

Age of presentation usually < 20 years.

Etiology unknown, may represent autoimmune/inflammatory or post-infectious process.

Answer: B. Retroperitoneal lymphadenopathy

Axial contrast-enhanced CT demonstrates soft tissue density nodules within the subcutaneous fat and skin in this patient with biopsy-proven Rosai-Dorfman disease.
BENIGN LIPOMATOUS TUMOR

- Lipoma = most common benign soft tissue tumor
  - Represents up to 50% soft tissue neoplasms
- Common cause of palpable mass & referral for imaging
- Multiple lesions in 5-15% patients
- Superficial lipoma: subcutaneous, more common
- Deep lipoma: retroperitoneal, intramuscular
  - Difficult to distinguish from well-differentiated liposarcoma

IMAGING CHARACTERISTICS
May have thin capsule; should NOT enhance
CT: fat attenuation, may have thin septations
US: echogenic
MRI: fat signal on all sequences

(A) Axial and (B) coronal CECT show a small non-enhancing fat-density lesion within the left external oblique muscle consistent with a superficial lipoma.
A fluid-signal intensity mass with fat-containing septations and post-contrast enhancement is incidentally noted in the paraspinal musculature on an abdominal MRI. This finding should prompt consideration of which primary tumor:

A. Well-differentiated liposarcoma
B. De-differentiated liposarcoma
C. Myxoid/round cell liposarcoma
D. Pleomorphic liposarcoma
## LIPOSARCOMA

**Liposarcoma (LPS) type** | **Demographics** | **Imaging**
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**Atypical lipomatous tumor (ALT), well-differentiated LPS, de-differentiated LPS** | **Most common LPS type (50%)** - Sites: Extremities (ALT); Inguinal/paratesticular; retroperitoneum - Metastases: lung, liver | - Mostly fat - **Septations > 2 mm** - **Nodules/masses:** - < 1 cm well-differentiated; - > 1 cm de-differentiated

**Myxoid/round cell LPS** | **Young adults** - Sites: lower extremities - intramuscular - Metastases: paraspinal, bone, contralateral extremity, retroperitoneum | - **Multi-loculated fluid-containing mass** - Fat-containing septations; overall <25% fat - Diffuse **enhancement**

**Pleomorphic LPS** | **Older adults (mean age 65)** - Sites: extremities – deep soft tissues - Metastases: lung, liver | - Solid mass with **minimal fat** - May have internal hemorrhage/necrosis

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**Answer:** C. Myxoid/round cell liposarcoma

May appear cystic on MRI - contrast is essential to differentiate from a cyst.

*Sagittal CECT demonstrating a fat-containing mass with enhancing septations and nodules in the left inguinal region. Biopsy confirmed well-differentiated liposarcoma.*
Regarding cutaneous T-cell lymphoma:

A. Imaging is nonspecific in differentiating from other cutaneous entities
B. Patients typically have no clinical skin findings
C. Skin lesions usually show no FDG avidity
D. Visceral and nodal involvement has >75% 5 year survival rate
CUTANEOUS T-CELL LYMPHOMA

Answer: A. Imaging is nonspecific in differentiating from other cutaneous entities

Cutaneous T-cell lymphoma findings are best appreciated clinically as dermatitis or panniculitis; CT findings are nonspecific. CT is utilized primarily to determine extent of visceral involvement, which may be as subtle as hepatosplenomegaly. Visceral involvement portends a poor prognosis (<5% 5 year survival).

- Also known as mycosis fungoides/Sézary syndrome
- Subtype of peripheral T-cell lymphoma (PTCL)
- PTCL classification includes both predominantly nodal disease and primary extranodal disease
- Other subcutaneous manifestations of PTCL include subcutaneous panniculitis-like TCL and anaplastic large cell lymphoma

IMAGING CHARACTERISTICS

Role of imaging is primarily to evaluate for visceral involvement

CT: nodules hyperdense to muscle, mild post-contrast enhancement
PET/CT: +FDG avidity
US: solid, hypoechoic, vascular mass
METASTASES

- Primary epithelial tumors are the most common skin malignancies (basal cell carcinoma, squamous cell carcinoma, melanoma)
- Cutaneous metastases from internal/visceral malignancies are rare, occurring in less than 10% cases
  - Spread is from direct invasion (including at surgical sites), hematogenous, and/or lymphatic spread
- Breast and colon cancer are the most common cutaneous metastases in women; lung and colon cancer are the most common in men


(B) Axial CECT demonstrates hyperenhancing subcutaneous nodules in the lateral anterior wall. Biopsy confirmed metastatic cervical squamous cell carcinoma.

(C) Axial CECT demonstrating isodense subcutaneous nodules in the left rectus and left gluteal regions. Biopsy confirmed lymphoma.
QUESTION

What complication of abdominoplasty is shown?

A. Seroma
B. Hematoma
C. Bunched rectus abdominus musculature
D. Flap necrosis
LIPOSUCTION/ABDOMINOPLASTY

Answer: B. Hematoma
Active contrast extravasation is present in the left gluteal soft tissues. Management included embolization of the bleeding vessel (pre-embolization angiogram shown). Seroma is the most common early post-operative complication, though is not seen in this case.

IMAGING CHARACTERISTICS
Liposuction: (A) linear densities radiating from skin surface (cannula tracts); overlying skin thickening
Abdominoplasty: (B) bunching together of rectus abdominus muscles (due to surgical plication) is an expected post-operative appearance
INJECTION GRANULOMA

Silicone injection for aesthetic gluteal augmentation is not FDA-approved in the USA; presumably patients with this finding were treated outside the USA (or illegally).

Imaging appearance of injected silicone is varied, as demonstrated above.

- Silicone injection for aesthetic gluteal augmentation is not FDA-approved in the USA; presumably patients with this finding were treated outside the USA (or illegally).
- Imaging appearance of injected silicone is varied, as demonstrated above.

Not all gluteal injections are silicone. (A) Coronal T2W MRI shows intramuscular and subcutaneous hyperintense nodules. This patient acknowledged receiving steroid injections. (B) Axial T1W contrast-enhanced MRI in arterial phase and (C) portal venous phase show an arterially enhancing lesion with washout. Biopsy confirmed adenoma.
QUESTION

Subcutaneous foreign bodies are generally visible on radiographs except which of the following:

A. Plastic  
B. Glass  
C. Gold  
D. Wood

Ultrasound demonstrates a fragment of a palm frond in the subcutaneous tissues. The fragment is echogenic with surrounding hypoechoic “halo” of edema.
IATROGENIC/TRAUMA

FOREIGN BODY

Answer: **D. Wood**

Organic materials such as plants and wood are initially radio-lucent and may be difficult to visualize on radiographs if no overlying skin change or subcutaneous gas is present. ALL subcutaneous foreign bodies are echogenic on ultrasound.

(A) Axial CT and (B) associated topogram image show scattered areas of punctate metallic densities, reported to be buckshot following an assault. The topogram better demonstrates the overall distribution of involvement. (C) Coronal CT of a different patient performed for malignancy follow up demonstrates multiple linear hyperdensities representing tips of acupuncture needles from the practice of Hari acupuncture.

- Subcutaneous foreign objects may be known at the time of imaging or may be discovered incidentally
- Imaging must include evaluation for complications, including abscess formation, proximity to vital vascular structures/organs, and/or underlying osteomyelitis
The initial imaging modality to evaluate for unknown location of undescended testis is:

A. Laparoscopy
B. Ultrasound
C. CT
D. MRI
Answer: B. Ultrasound

Ultrasound remains the initial modality of choice to evaluate the scrotum and inguinal canal in the setting of non-palpable testis. MRI is more sensitive and specific for evaluating the position of intra-abdominal testes. Laparoscopy can be performed if the testis is not visualized on MRI.

- Undescended (cryptorchid) testes increase risk for infertility, torsion, inguinal hernia, and malignant degeneration
- Risk of malignancy is increased 5-10x regardless of whether early orchiopexy (recommended by age 6-12 months) is performed
- Malignancy risk is also increased in the contralateral testis
QUESTION

The most common malignancy to develop in a urachal remnant is:

A. Squamous cell carcinoma
B. Adenocarcinoma
C. Transitional cell carcinoma
D. Undifferentiated carcinoma
URACHAL REMNANT

Answer: B. Adenocarcinoma

Adenocarcinoma is the most common malignancy of the urachus, though it is a very rare primary bladder neoplasm (<2% primary bladder tumors). Up to 34% of bladder adenocarcinomas are urachal. Development of adenocarcinoma is thought to be secondary to epithelial metaplasia followed by malignant degeneration.

- Congenital abnormalities of the urachus are due to incomplete resorption of the allantois
- Spectrum of anomalies includes
  - Patent urachus (50%) – diagnosed neonatally
  - Urachal cyst (30%) – often infected at time of diagnosis
  - Urachal sinus (15%) – dilatation at umbilical aspect
  - Urachal diverticulum (5%) – dilatation at vesicular aspect
- Complications: infection, calculus formation, adenocarcinoma

(A) Axial CECT demonstrates midline rim-enhancing fluid collections involving the rectus musculature. (B) Sagittal CECT shows the collection contiguous with the dome of the bladder extending toward the umbilicus. The appearance is most suggestive of an infected urachal remnant, likely a urachal diverticulum.

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CONCLUSION

Familiarity with the spectrum of subcutaneous abdominal masses and mass-like pathology will enable the radiologist to provide more accurate interpretation of these lesions and direct further evaluation and management.

REFERENCES


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