Learning objectives

1. To understand the anatomy of abdominal wall for differential diagnosis of abdominal wall masses.

2. To review the spectrum of imaging findings of high resolution ultrasonography (US) and multi-detector CT of various palpable or non-palpable abdominal masses.

Background

In many clinical practice, abdominal wall masses can be detected by patient's symptoms or physical examination. However unless the typical clinical manifestation, it is difficult to detect or characterize various abdominal masses. Ultrasonography is easy and convenient method to determine the presence or absence of abdominal wall lesions and it is useful for differential diagnosis with its characteristic imaging findings. Recent development of multi-detector CT technology allowed high resolution body imaging, it can detect more small masses of abdominal wall and it can also evaluate peritoneal pathology.

In this exhibit, we'll illustrate the CT and US imaging findings of various pathologic conditions of abdominal wall such as hernia, variable solid and cystic tumors, hematoma, infectious diseases, endometriosis, and vascular diseases. The clinical history, location of the lesion and characteristic imaging features are key points to reach the correct diagnosis. We also perform the radiologic-pathologic correlations, if they are surgically confirmed cases.

Imaging findings OR Procedure details

Anatomy of abdominal wall

The anterior abdominal wall layers include skin, subcutaneous fat, superficial fascia, external and internal abdominal oblique muscles, transversus abdominis muscle, transversalis fascia, properitoneal fat and peritoneum.

Transverse ultrasonographic scans of the anterior abdominal wall shows detailed anatomy (Fig.a). on page

With regard to location, abdominal masses can be devided into (Fig.b) on page 28

1. lesions that arise in association with skin (cutaneous lesions)
2. lesions that arise within the subcutaneous adipose tissue,

3. lesions that arise in intimate association with the fascia overlying the muscle.

**The causes of anterior abdominal wall masses can be summarized**

1. Fluid collections; hematomas, seromas, urinomas, cysts

2. Neoplasms; benign and malignant mesenchymal tumors, metastasis

3. Miscellaneous conditions including skin appendage lesions, vascular or infectious lesions

4. Hernias

**Fluid collections**

**Hematomas** can occur in subcutaneous fat layer (Fig.1) on page and the rectus sheath (Fig.2) on page 29. Rectus sheath hematomas may occur as a result of trauma to the abdominal wall or secondary to disorders of coagulation, blood dyscrasia, or degenerative vascular diseases. US and CT can demonstrate that the hematoma is confined to the abdominal wall.

A **seroma** (Fig.3) on page is a pocket of clear serous fluid that sometimes develops in the body after surgery. Most seromas resolve without manipulation within 30 days, however, aspiration may be indicated if the collection persists for more than 6 weeks.

At CT postoperative fluid collections can have a globular, tubular, or multilobular appearance.

**Urinomas** (Fig.4) on page of abdominal wall are occasionally encountered by penetrating and iatrogenic injuries to the bladder. Extraperitoneal bladder rupture can be confined solely to the paravesical space or can extend into the perivesical space of Retzius or into the scrotum, thigh, penis, or retroperitoneum.

**Epidermal inclusion cyst** (Fig.5) on page result from the proliferation of epidermal cells within a circumscribed space of the dermis. Most cysts appear as spherical or ovoid hypoechoic masses containing variable echogenic foci and lacking color Doppler signals. Contrast enhanced CT shows well defined hypoattenuated cystic mass in subcutaneous fat layer abutting the skin.

**Neoplasms**

**Lipomas** (Fig.6) on page are the commonest abdominal wall neoplasm.

They are well-defined, ovoid or pad-like masses.

Ultrasonography reveals an iso- to slightly hyperechoic texture as compared to the muscles, along with a thin echogenic capsule.
Hemangioma (Fig.7) on page 26 is the most frequently encountered vascular soft-tissue abnormality. It is estimated that hemangiomas comprise 7% of all benign soft-tissue tumors.

Hemangiopericytomas (Fig.8) on page 26 are uncommon tumors that arise from the cells of Zimmerman that are located around vessels. They are tumors of intermediate aggressiveness that have both benign and malignant forms. Hemangiopericytomas commonly involve the lower extremities, pelvis, and retroperitoneum. The presence of intratumoral necrosis indicates malignancy.

Dermal (cutaneous) neurofibromas (Fig.9) on page 30 usually appear during adolescence in patients with NF1. Nodular and pedunculated dermal neurofibromas most often affect the trunk and may become numerous, large, and disfiguring for some patients. Dermal neurofibromas are benign and do not undergo malignant transformation.

Desmoid tumors (Fig. 10) on page 30 are benign myofibroblastic neoplasia, they are originating from the muscle aponeurosis and classified as deep fibromatoses. They constitute 3% of all soft tissue tumors and 0.03% of all neoplasms. Despite their aggressive local infiltration, desmoid tumors lack a metastatic potential. However, because of this local infiltration and compression of surrounding structures, a high recurrence rate exists and in anatomic locations with restricted access to surgical resection.

Granular cell tumors (GCT) (Fig. 11) on page 31 are found in virtually any body site, including the tongue, skin, subcutaneous tissue, breast, rectum and vulva. They can be rarely seen in the abdominal wall.

Primary malignant mesenchymal tumors such as rhabdomyosarcoma fibrosarcoma, dermatofibrosarcoma protuberans, leiomyosarcoma, liposarcoma, synovial sarcoma, malignant schwannomas, malignant histiocytoma and poorly differentiated sarcoma can occur in abdominal wall.

Dermatofibrosarcoma protuberans (Fig.12) on page 27 is a low-grade malignant mesenchymal tumor that originates in the dermis. They are characterized by progressive, locally infiltrative behavior. If left untreated, these tumors continue to grow slowly, invading the surrounding tissue, including neurovascular bundles.

Metastatic diseases of abdominal wall are not uncommon (Fig13, Fig.14A,B, Fig.15 on page , Fig.16) on page 32. Primary lesions that cause subcutaneous metastases include melanoma and lung, breast renal, and ovarian cancer. Tumoral seeding seems to be higher with laparoscopic surgery than with conventional surgery.

Miscellaneous tumor like lesions

Endometriomas (Fig.17) on page 33 of abdominal wall is resulted from the proliferation of endometrial tissue, it may occur after surgical procedures that violate the uterine cavity, such as a cesarean section. Abdominal wall endometriosis frequently presents with noncyclic symptoms. Imaging findings of a solid mass near a cesarean section scar strongly suggest its diagnosis.

Varices (Fig.18) on page 33 of abdominal wall may occur in the systemic venous occlusion or portal hypertension. One specific collateral vessel, the recanalized umbilical or parauterine vein, is highly
specific for portal hypertension. This vessel drains the portal venous system from the left portal vein along the falciform ligament into the anterior abdominal wall, terminating in many paraumbilical system veins, causing caput medusae.

Thrombophlebitis of superficial vein (Fig. 19) on page 34 may be caused by trauma, or by systemic diseases, or it may occur repeatedly for no apparent reason. The superficial veins of the chest or abdominal wall rarely are involved.

Lobular panniculitis with fat necrosis (Fig. 20) on page 34 is a subcutaneous fat necrosis, one of the features of panniculitis, occurs after trauma and is described in association with a variety of medical conditions. Fat necrosis in nonbreast subcutaneous areas is not shown well on sonography, appearing as a hyperechoic focus within the more hypoechoic subcutaneous fat with loss of uniformity of the surrounding tissue.

Inflammatory pseudotumors (Fig. 21), also called Inflammatory myofibroblastic tumors are predominantly found in the lung and abdomen. In the pediatric population, they represent up to 20% of primary lung tumors overall, and 57% of benign lung tumors.

Less commonly, IMTs also arise in other areas of the body, including the trunk and pelvis, genitourinary system, extremities, and head and neck.

Chronic granulomatous inflammations with fibrosis (Fig. 22) on page, or calcifications (Fig. 23) on page can mimic abdominal wall tumors.

Prominent xiphoid process (Fig. 24) on page is another tumor mimicker, it is a long, jointed xiphoid process causing an apparent mass in the epigastric region is an important normal variant. Lack of appreciation of this entity can result in unnecessary surgery.

Infectious lesions

Cellulitis and Abscess (Fig. 25 and Fig. 26) on page are inflammatory diseases of the abdominal wall commonly result from postsurgical wound infection or extension of an intraabdominal abscess. Usually it involves the subcutaneous tissues or the muscular layer.

The pathogenesis of abdominopelvic actinomycosis (Fig. 27) on page 35 is not well understood. Patients often have a history of a perforated viscus, recent surgery, or use of intrauterine devices. The appendix is the most common intraabdominal organ involved and other reported sites include the colon, stomach, liver, gallbladder, pancreas, small bowel, anorectal region, pelvis, abdominal wall, and urinary tract.

Cysticercosis (Fig. 28) on page 35 in humans is infection by the larval form (cysticercus cellulosae) of the pork tapeworm Taenia solium. Encystment of larvae can occur in almost any tissue. The location of cysts in order of frequency is the central nervous system, subcutaneous tissue and striated muscle, vitreous humour of the eye and, rarely, other tissues.

Anterior abdominal wall hernias
- Ventral hernias (Fig.29) on page 36

  - Epigastric hernias and hypogastric hernias occur in the linea alba above and below the umbilicus, respectively.

- Umbilical hernia

  - Umbilical hernias are by far the most common type of ventral hernia; they are usually small and are particularly common in women.

- Lumbar hernia (Fig.30) on page 36

- Spigelian hernia (Fig.31) on page 36

- Incisional hernias (Fig.32) on page 36

  - Incisional hernias are delayed complications of abdominal surgery.

  - They may manifest anywhere in the abdominal wall and are more commonly encountered in association with vertical than with transverse incision.

- Trocar site hernia

  - The risk of a trocar site hernia after laparoscopic surgery is significantly lower than for open surgery and the prevalence was reported as equal to 12 or even less than 1%.

- Traumatic hernia

  - Traumatic abdominal wall hernia is an uncommon injury despite the high prevalence of blunt abdominal trauma.
Images linked within the text of this section:

Anatomy of Abdominal Wall

- Skin
- Superficial fascia
- Camper’s fascia
- Scarpa’s fascia
- External abdominal oblique
- Internal abdominal oblique
- Transversus abdominis
- Transversalis fascia
- Extraperitoneal fat
- Peritoneum

Transverse scans of the anterior abdominal wall shows detailed anatomy. RA, rectus abdominis; EO, external oblique; IO, internal oblique; TA, transverse abdominis.

Fig.
Fig. 1. 71 year-old female patient who are on anticoagulant therapy due to cardiac disease. High resolution ultrasonography (A) shows multiple small round hypoechoic lesion without internal blood flow on color doppler exam. Precontrast CT scan (B) shows hyperdense fluid collection in subcutaneous fat layer and Rt psoas muscle.

Fig. 2. Rectus hematoma in a 72 year-old female with painful suprapubic mass. Precontrast CT shows a hyperdense hematoma in right rectus muscle.
Ultrasonography shows well defined heterogenous hypoechoic mass in rectus muscle without blood flow on color doppler exam.

86 year-old female patient with right upper quadrant mass. Large heterogenous high attenuated acute hematoma in right rectus muscle. Postcontrast CT shows contrast material extravasation.
Fig. 3. Seroma in a 75 year-old male patient. CT scan shows a thin walled fluid collection at incision site of anterior abdominal wall.

Fig. 4. Fluid collection in anterior abdominal wall due to extraperitoneal bladder rupture. Fluid can be confined solely to the paravesical space or can extend into the perivesical space of Retzius or into the scrotum, thigh, penis, or retroperitoneum.
Fig. 5. Epidermal inclusion cyst in 53 year-old man. CT shows a well defined low attenuated cystic mass in subcutaneous layer at left flank. Color doppler US shows a well demarkated slightly inhomogenous hypoechoic mass without internal blood flow.
Fig. 6. Subcutaneous lipoma. Ultrasonography reveals an iso- to slightly hyperechoic texture as compared to the muscles, along with a thin echogenic capsule. At CT lipoma usually shows well defined low attenuated mass in the subcutaneous fat layer or intermuscular fascial layers.
Hemangioma

Fig. 7. Hemangioma in a 10-year-old boy with left inguinal mass. Ultrasonography shows a lobulated hypoechoic mass with scanty tumor vascularity. Contrast enhanced CT shows a low attenuated mass at left inguinal area.

Hemangiopericytoma

Fig. 8. 42-year-old man with palpable abdominal mass. Ultrasonography shows a mass with clearly defined margins and a heterogeneous echo pattern that is highly vascularized on color Doppler exam. Contrast-enhanced CT shows a homogeneous, highly vascularized tumor.
Neurofibromas

Fig. 9. 38 year-old man with neurofibromatosis type 1. Contrast enhanced CT shows multiple small neurofibromas (arrows) in the skin and subcutaneous fat layer of abdominal wall.

Desmoid tumors

Fig. 10. 52 year old man with recurred desmoid tumor of abdominal wall. Ultrasonography shows heterogenous hypoechoic tumor in subcutaneous space of right flank and hypervascular infiltrative mass on contrast enhanced CT.
Granular cell tumors (GCT) are found in virtually any body site, including the tongue, skin, subcutaneous tissue, breast, rectum and vulva. They can be rarely seen in the abdominal wall.

Fig. 11. 44-year-old woman presented with a non-tender, hard mass in the upper midline of abdominal wall. Ultrasonography shows marked hypoechoic mass with posterior acoustic shadowing, contrast enhanced CT shows homogenous enhancement of the mass. Microscopically, proliferation of polygonal to spindle shaped cells devided by fibrous septa, eccentrically located nuclei and eosinophilic granular cytoplasm (H & E; ×400)
Fig. 12. Dermatofibrosarcoma protuberans in 72 year-old woman. Contrast enhanced CT shows well defined slightly inhomogenous enhancing mass in subcutaneous layer abutting the skin. Gross specimen shows well defined pinkish solid mass in subcutaneous layer.
Fig. 13. 50-year old woman with hematogenous metastasis from breast cancer; Contrast enhanced CT shows multiple hematogenous metastatic nodules in subcutaneous fat layer.

Fig. 14. Incision site tumor seeding from urothelial cancer

Fig. 15. Incision site tumor seeding; Colon cancer

Fig. 16. Gastric GIST
Fig. 16. 43 year old female patient with HCC. Arterial phase of contrast enhanced CT scan and high resolution ultrasonography shows well defined tumor seeding along the needle track after percutaneous needle biopsy of a malignant lesion.
Endometriomas

Fig. 17. 37 year-old woman who underwent c-sec operation. US and CT show irregular margined mass at previous incision scar.

Varices

Fig. 18. Abdominal wall varix in 56 year old patient with cirrhosis of the liver. Contrast enhanced CT shows well enhancing tortuous variceal veins in anterior abdominal wall.
Thrombophlebitis of superficial vein

Fig. 19. 43 year old woman with palpable abdominal thread-like lesion in. Ultrasonography shows tubular hypoechoic lesion (arrows) in subcutaneous space. Pre- and postcontrast CT shows suspicious vascular structures in subcutaneous space of anterior abdominal wall with mild skin thickening.

Lobular panniculitis with fat necrosis

Fig. 20. 25 year-old woman who complained palpable abdominal wall mass. Ultrasonography shows heterogenous hyperechoic lesions in subcutaneous space of anterior abdominal wall.
**Inflammatory pseudotumor**

Fig. 21. 46-year old woman with palpable abdominal mass. Ultrasonography shows well defined heterogenous hypoechoic mass with internal low echoic cystic portion. Contrast enhanced CT shows heterogenous enhancing mass with thick wall in fascial layer of right lateral abdominal wall.

**Chronic granulomatous inflammation**

Fig. 22. Fibrosis  
Fig. 23. Calcification
Fig. 24. Prominent xiphoid process mimic abdominal wall mass. 34 year-old man with palpable mass at epigastric area. Ultrasonography and CT shows heterogenous hypoechoic and low attenuated structure extended from sternum.
**Cellulitis and Abscess**

Fig. 25. 66 year-old man with abdominal wall abscess. Contrast enhanced CT shows gas and fluid containing abscess cavity with enhancing wall in right anterior abdominal wall.

Fig. 26. 66-year old man with exophytic cholangiocarcinoma and invasion of anterior abdominal wall and abscess formation. Ultrasonography shows hypoechoic mass and fluid collection and Contrast enhanced CT shows abscess in abdominal wall with enhancing peripheral thick wall.
Actinomycosis

Fig. 27. 52 year-old man with chronic perihepatic abscess due to actinomycosis. Contrast enhanced CT shows well defined abscess (arrows) with enhancing thick wall in perihepatic peritoneal space and anterior abdominal wall.

Cysticercosis

Fig. 28. 45 year-old female patient with palpable abdominal mass. High resolution ultrasonography shows well defined anechoic cystic mass with internal daughter cyst (arrows) and septations in abdominal wall. Pre- and postcontrast CT shows heterogenous attenuated mass and well enhancing thick wall of cystic lesion in anterior abdominal wall.
Anterior abdominal wall hernias

Fig. 29. Ventral hernia

Fig. 30. Lumbar hernias

Fig. 31. Spigelian hernia

Fig. 32. Incisional hernia
Abdominal wall masses

With regard to locations, abdominal masses can be divided into:

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2. Lesions that arise within the subcutaneous adipose tissue,
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Additional images for this section:
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Fig. 3
Rectus sheath hematoma

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Fig. 30. Lumbar hernias

Fig. 31. Spigelian hernia

Fig. 32. Incisional hernia

Fig. 11
Conclusion

Abdominal wall masses are not uncommon diseases that manifestate with solitary or multiple, palpable or non-palpable lesions, can be associated intraperitoneal disease processes.

Imaging with CT and ultrasonography can play important roles to detect and characterize the various abdominal wall masses. Ultrasonography is easy and convenient to evaluate abdominal wall masses, even though very small sized mass. CT is useful to detect multiple abdominal wall lesions and to evaluate associated intraabdominal pathology.

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References


