Approach to ultrasound evaluation of common abdominal wall pathology

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Learning objectives

This poster provides an overview to sonographic appearance of common abdominal wall pathology and practical approach to analyze and suggest possible diagnosis.

Background

Abdominal wall lesions are not uncommon presentation to clinician. With the advantages of dynamic scan and good knowledge in abdominal wall pathology, ultrasound can provide possible diagnosis and guide subsequent clinical management.

Imaging findings OR Procedure Details

The abdominal wall pathology can mainly be classified into 4 categories - presence of bowel, solid lesion, fluid collection/cystic lesion and vascular lesion.

Presence of bowel

Hernia is one of the most common abdominal wall lesions. It is the protrusion of abdominal content through abdominal wall weakness or defect, of which the defect can sometime be visualized.

The most common herniated contents are omentum, fat and bowel loops. Ultrasound can provide real time assessment upon Valsalva maneuver and standing position to demonstrate induction and reducibility of hernia contents. The bowel loops in the herniated sac may become strangulated, especially for the irreducible hernia. Ischemic or strangulated bowel loops can show bowel wall thickening and absence of peristalsis in ultrasound.

There are several types of hernia. Inguinal hernia is the most common type, which is located superior to inguinal ligament. There are two subtypes - direct and indirect inguinal hernia.

The direct type is the protrusion of content through a defect in external oblique aponeurosis (superficial inguinal ring). It is located medial to the inferior epigastric artery and within the Hesselbach triangle (Fig. 1 on page 6).
The indirect type is more common than direct type. It is the protrusion of content through a defect in transversalis fascia (internal inguinal ring) into the inguinal canal. As internal inguinal ring is located lateral to the inferior epigastric artery, this can be discriminated from direct type. (Fig. 2 on page 6 and Fig. 3 on page 7) Scrotal extension can be demonstrated in indirect inguinal hernia (Fig. 4 on page 8), whereas it is very uncommon in direct type.

Femoral hernia is less common and has a female predilection. It is protrusion of hernia content into the femoral sac, which is the empty sac located medial to ipsilateral femoral vein and inferior to ipsilateral inguinal ligament. (Fig. 5 on page 9 and Fig. 6 on page 10)

Other common types of hernia include incisional hernia at previous operative site (Fig. 7 on page 11 and Fig. 8 on page 12) and ventral hernia in midline epigastrium due to defect in linea alba (Fig. 9 on page 13).

**Solid lesion**

Solid lipomatous lesions are commonly non-aggressive in nature, such as lipoma, subcutaneous panniculitis and herniated fat.

Abdominal wall lipoma is usually encapsulated and situated in subcutaneous region. Its sonographic appearance can be hypoechoic, isoechoic or mildly hyperechoic in comparison with surrounding fat (Fig. 10 on page 14). It is similar to the lipoma in the rest of the body.

Subcutaneous panniculitis is inflammation of subcutaneous fat. It can be localized and presented as a painful nodule with focal increase in echogenicity of subcutaneous fat at corresponding area (Fig. 11 on page 15).

For non-lipomatous solid lesion, benign lesions such as neurofibroma (Fig. 12 on page 16 and Fig. 13 on page 17) and aggressive lesions such as metastatic deposits in abdominal wall (Fig. 14 on page 18) could sometimes demonstrate similar sonographic appearance. Well defined border, homogeneous echogenicity and absence of vascularity cannot completely exclude malignancy. Interval follow up scan for monitoring lesion size can be considered. Histological examination may be required if high suspicious of malignancy.
However, in some scenario, possible diagnosis should be suggested.

1. Umbilical nodule with history of malignancy in particular gastrointestinal and gynecological origins, Sister Mary Joseph nodule (metastatic deposit) has to be considered.

2. Scar endometriosis as an ill-defined hypoechoic lesion at previous operation scar (in particular gynecological operation) in female patients. Cyclical nature of symptoms and variable sizes supports the diagnosis (Fig. 15 on page 19).

3. In male patient with absence of testis, isolated small hypoechoic ovoid lesion in the ipsilateral groin (~75-80% in inguinal canal) without echogenic hilum supports the diagnosis of undescended testis. Testicular parenchyma evaluation is crucial due to potential risk of malignant transformation (Fig. 16 on page 20).

4. Hypoechoic inguinal lymph nodes with distorted architecture are suspicious of malignant involvement. They are commonly seen in lymphoma and malignancy with expected lymphatic drainage pathways across inguinal nodes such as lower limb malignant tumor (Fig. 17 on page 21).

5. Everted xiphisternum can be mistaken as an epigastric mass and presented as a painless hard lesion, which can be confirmed with ultrasound (Fig. 18 on page 22).

**Fluid collection/cystic lesion**

Anechoic fluid collection in the abdominal wall can be sterile such as seroma or inflammatory in nature such as abscess.

Seroma can be seen adjacent to post-operative wound, in particular after hernia mesh repair (Fig. 21 on page 25). Abscess can be due to haematogenous spread or contagious infection such as severe cellulitis (Fig. 19 on page 23 and Fig. 20 on page 24). Inflammatory fluid collection or abscess along the Tenckhoff catheter exit site in peritoneal dialysis patients is one of the common examples in daily practice (Fig. 22 on page 26).

Rectus sheath haematoma is clinically important. It is usually due to inferior epigastric artery injury. Patients with bleeding tendency such as leukemia, coagulopathy or taking anti-platelet / anti-coagulation medication are at risk. Subtle trauma or injury such
as severe coughing can result in this condition. Early identification may alter patient management such as reversal of deranged clotting profile or possible interventional embolization if ongoing bleeding (Fig. 23 on page 27).

The sonographic echogenicity depends on the chronicity of the haematoma. It is likely mixed hyper-/isoechoic and hypoechoic in acute stage and becomes more hypoechoic when lesion ages. The haematoma is commonly ovoid within the rectus sheath, which is confined to ipsilateral sheath above the arcuate line and may spread across midline below this line.

Urachus is a congenital urachal remnant between umbilicus and urinary bladder. It is usually diagnosed in pediatric patients. Urachus can be presented in form of cyst, sinus or fistula. It usually remains asymptomatic unless infection or bleeding complication occurs.

Urachal cyst appears anechoic and sometimes faint internal echoes can be seen (Fig. 24 on page 28). Urachal sinus or fistula is commonly presented as a thickened tubular structure along the midline below the umbilicus. Differentiation between two can sometimes be difficult as the opening may be subtle and not well visualized in ultrasound scan (Fig. 25 on page 29).

Hydrocele of spermatic cord is occasionally presented as an inguinal mass in male patient. It is shown as a well-demarcated anechoic lesion along the spermatic cord, superior and separated from ipsilateral testis and epididymis (Fig. 26 on page 30).

Vascular lesion

Vascular lesion is a relatively uncommon entity in abdominal wall. Subcutaneous haemangioma can be presented as an area with multiple tiny ill-defined hypoechoic lesions in an echogenic hypervascular background (Fig. 27 on page 31 and Fig. 28 on page 32).

Pseudoaneurysm in the groin region is not uncommon, usually in needle drug addicts or iatrogenic from arterial puncture. There is extravasation from femoral artery into the surrounding tissues. It forms a potential space and communicates with the injured portion of femoral artery. Pulsation and possible swirling of echogenic blood can sometimes be seen in the potential space during real time scan, with classical yin-yang sign in Doppler examination due to turbulent flow (Fig. 29 on page 33, Fig. 30 on page 34 and Fig. 31 on page 35).
Saphenous varix is serpentine dilatation of saphenous vein draining into the saphenofemoral junction. It is anechoic in gray scale ultrasound and may demonstrate size change upon Valsalva maneuver, mimicking femoral hernia due to similar anatomical location. However, it can easily be distinguished from femoral hernia with presence of venous flow signal in Doppler study (Fig. 32 on page 36 and Fig. 33 on page 37).

Images for this section:

**Fig. 1:** Right direct inguinal hernia with herniation of fat. Direct inguinal hernia is located medial to the inferior epigastric artery (*) and within the Hesselbach triangle. The arrows indicate the extent of the hernia sac.
Fig. 2: Left indirect inguinal hernia. The neck of indirect inguinal hernia sac is located lateral to the inferior epigastric artery (*). The horizontal arrow indicates the hernia sac.
Fig. 3: Left indirect inguinal hernia (same patient as Fig 2) This is taken slightly inferior to the Fig2, showing the herniated bowel loops (white arrows). Tracing the neck of the hernia sac is necessary. This image can mimic direct type as bowel being located medial to the inferior epigastric artery.
Fig. 4: Left indirect inguinal hernia with bowel herniation into the scrotal sac. Classical ultrasound morphology for normal bowel loops with intraluminal air as bright echo. Peristalsis is another feature shown in real time scan.
Fig. 5: Right femoral hernia in femoral sac. A small bump of hernia is noted medial to the right common femoral vein (V). The right common femoral artery (A) is lateral to the right common femoral vein.
**Fig. 6:** Right femoral hernia. (same patient as Fig 5) This is the probe in same position during Valsalva maneuver. This can exaggerate the hernial content due to increase in intra-abdominal pressure. Compression of the common femoral vein by the hernia is also shown. (A - common femoral artery, V - common femoral vein)
**Fig. 7:** Left abdominal wall incisional hernia with herination of bowel. Patient with previous abdominal operation showing protrusion of bowel loops at site of operation. The abdominal wall defect (indicated between crosses) is visualized and measured.
Fig. 8: Computer Tomography (CT) for left abdominal wall incisional hernia. (same patient as Fig 7) The anatomy of hernial content and abdominal wall defect by CT can similarly be demonstrated by ultrasound. Ultrasound has additional advantages of dynamic maneuvers and ionizing radiation free.
**Fig. 9:** Ventral hernia in epigastric region with herniation of pre-peritoneal fat. Presence of defect in the linea alba (indicated between crosses) between bilateral rectus abdominis muscles (RA) in the epigastric region, with classical button mushroom like appearance.
Fig. 10: Lipoma in abdominal wall. It is likely encapsulated and situated at subcutaneous region. In this case, it is slightly hyperechoic compared with adjacent subcutaneous fat. The feature is similar to the lipoma in the rest of the body.
**Fig. 11:** Subcutaneous panniculitis. Patient with painful subcutaneous nodule. A focal hyperechoic lesion is noted at the corresponding area in the subcutaneous fat of abdominal wall.
**Fig. 12:** Localized neurofibroma in patient with Neurofibromatosis type 1 (NF1). There is a well defined hypoechoic nodule (between arrows) in the subcutaneous layer, usually multiple in NF1 patients.
Fig. 13: Diffuse type neurofibroma in patient with Neurofibromatosis type 1 (NF1). There are ill-defined plaque-like lesion with multiple hypoechoic tubular-like tortuous tracts or nodules and slightly hyperechoic stroma.
Fig. 14: Subcutaneous nodule in abdominal wall in patient with lung cancer. A mixed iso- and hypoechoic lesion in left upper abdominal wall. The border of the lesion is relatively well-defined. It is surgically removed and histology confirms subcutaneous metastatic deposit.
**Fig. 15:** Scar endometriosis in patient with previous cesarean session. An ill-defined hypoechoic lesion is adjacent to the surgical scar. Patient may not reveal history of endometrosis. Clinical history with cyclical nature of symptoms supports the diagnosis.
**Fig. 16:** Undescended testis in right inguinal region. In the absence of testis in the scrotal sac, meticulous search in the inguinal region has to be conducted. Isolated ovoid well-defined hypoechoic lesion without echogenic hilum supports the diagnosis of undescended testis. It is usually small and has risk of malignant transformation.
Fig. 17: Metastatic inguinal lymph node with big toe squamous cell carcinoma (SCC). Enlarged lobulated inguinal lymph node with distorted architecture, highly suspicious of metastatic in nature with given history. Subsequent fine needle aspiration confirms metastasis.
Fig. 18: Everted xiphisternum. Patient claimed to have an epigastric "mass". Ultrasound demonstrates everted xiphisternum (X) at the corresponding site and absence of mass in the epigastric area.
Fig. 19: Cellulitis with adjacent subcutaneous abscess in abdominal wall. Increased echogenicity in subcutaneous fat represents edematous changes. In clinical context of cellulitis, adjacent hypoechoic fluid likely represents abscess.
Fig. 20: Cellulitis with subcutaneous abscess. (same patient as Fig 19) Increase in vascularity in subcutaneous fat confirms inflammatory changes, compatible with cellulitis.
Fig. 21: Seroma in recent inguinal hernia mesh repair. A predominantly anechoic lesion at site of operation, compatible with seroma. Faint internal septation can be due to hemorrhagic component, which is not uncommon.
Fig. 22: Peri-catheter abdominal wall collection. A well defined anechoic collection (indicated by crosses) follow the track of the Tenckhoff catheter (arrow). Subsequent aspiration of collection yields pustule fluid.
Fig. 23: Acute spontaneous rectus sheath haematoma in patient on warfarin. A heterogenous ovoid hypoechoic lesion along the right rectus sheath. Chronic lesion can appear more hypoechoic compared with acute stage.
Fig. 24: Urachal cyst. Well defined ovoid anechoic cyst between umbilicus and urinary bladder, showing no communication between these two structures.
**Fig. 25:** Urachal sinus in pediatric patient. Midline hypoechoic tubular structure (*) between urinary bladder (B) and umbilicus (U). Exact communication to the umbilicus is not well demonstrated in this ultrasound scan. Operative findings confirm a blind end at umbilical level (urachal sinus).
Fig. 26: Right hydrocele of cord. An well defined anechoic lesion in close relationship with right spermatic cord (arrow). It is not in connection with epididymis and testis.
**Fig. 27:** Abdominal wall haemangioma. Ill-defined echogenic area with multiple tiny ill-defined hypoechoic lesions in subcutaneous abdominal wall. Increase in background vascularity is demonstrated in accompanying Doppler study.
Fig. 28: Abdominal wall hemangioma. (same patient as Fig27) Dopple study reveals echogenic hypervascular background, compatible with subcutaneous hemangioma.
Fig. 29: Pseudoaneurysm of left common femoral artery (CFA) in a drug addict. An abnormal saccular hypoechoic outpouching (indicated within four crosses) is noted medial to the distal CFA (arrow), compatible with a pseudoaneurysm.
Fig. 30: Pseudoaneurysm (same patient as Fig29) The corresponding saccular pseudoaneurysm (big horizontal arrow) medial to common femoral artery (thin arrow) demonstrates classical yin-yang side due to presence of turbulent flow.
Fig. 31: Pseudoaneurysm (same patient as Fig29) Computer tomography demonstrates the saccular contrast outpouching (horizontal arrow) medial to common femoral artery. This is equivalent to the finding of pseudoaneurysm in ultrasound scan.
**Fig. 32:** Left saphenous varix. Dilation of the anechoic serpentine saphenous varix (white solid arrows) in the anterosuperior aspect of the femoral vein (V) drains into the left femoral vein (V) via saphenofemoral junction (horizontal white arrow).
Fig. 33: Left saphenous varix (same patient as Fig 32). Doppler study on the dilated serpentine saphenous varix confirms venous flow with retrograde flow upon coughing (indicated by arrows).
Conclusion

Ultrasound is an easily assessable tool in making diagnosis and guiding patient clinical management. It is important for radiologists, especially musculoskeletal radiologists, to familiarize common appearance of abdominal wall pathology and provide possible diagnosis.

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