Non herniary pathology of the abdominal wall

Poster No.: C-2376
Congress: ECR 2014
Type: Educational Exhibit
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Keywords: Congenital, Cancer, Abscess, Computer Applications-General, Ultrasound, CT, Abdomen
DOI: 10.1594/ecr2014/C-2376

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Learning objectives

1. The aim of this exhibit is to present the more usually no herniary pathologies of the abdominal wall diagnosed in ours institutions.

2. To describe and illustrate the imaging findings of different abdominal wall pathologies.

Background

We revised all the cases of pathology of the abdominal wall seen in ours institutions.

Pathological processes affecting the abdominal wall can be grouped into congenital lesions, fluid collections (including hematoma, abscesses and inflammatory conditions and postsurgical collections) and neoplasms.

Multimodality imaging is often required to assess these pathologies. Ultrasound is a useful simple first line investigation but is limited by its inability to visualise the full extent of pathology and its relation to adjacent structures. CT is commonly used. Cross-sectional imaging provides an excellent, non-invasive means of evaluating these processes but MRI has superior soft tissue resolution, multi-planar capability and lack of radiation and is a particularly useful modality especially in younger patients and in cases of suspected primary neoplasm.

Findings and procedure details

Anatomy of the abdominal wall

The abdominal wall consists of skin, fat, muscles, transversalis fascia and the parietal peritoneum.

Three layers should be identified in the subcutaneous tissue of the abdomen: a superficial adipose layer (SAT), a membranous layer, and a deep adipose layer (DAT). Beneath these layers lies the deep fascia enveloping the abdominal wall muscles Fig. 1 on page 7. To know the superficial anatomy is essential to the laparoscopic surgeon.

The rectus muscle extends from the xiphoid process of the sternum and 5,6,7th costal cartilages to the pubic symphysis. Along its superior aspect, the rectus abdominis muscle is surrounded by the aponeurosis of the three flank muscles. Approximately halfway between the umbilicus and the symphysis pubis, the aponeurosis of the internal oblique
muscle and the transverses abdominis muscle no longer contribute to the posterior aspect of the rectus sheath. This transition, marked by the arcuate line, leaves the rectus invested posteriorly only by the thin transversalis fascia from the arcuate line to the pubic symphysis Fig. 2 on page 8. Along the length of this strap muscle there are three fibrous intersections separating the muscle into four segments. The fibrous intersections are attached to the anterior surface of the rectus sheath, but not to the posterior surface. This allows the superior and inferior epigastric vessels to pass along the posterior surface of the muscle without encountering a barrier.

The external oblique muscle arises from the lower 8 ribs posteriorly to interdigitate with both the serratus and latissimus muscles. After contributing to the anterior portion of the rectus abdominis sheath, the remaining fibers insert onto the linea alba, which is the dense white line formed by the medial termination of all the aponeuroses. Inferiorly the aponeurosis inserts into the anterior superior iliac spine and stretches over to the pubic tubercle, forming the inguinal ligament.

The internal oblique muscle arises from the lumbar fascia, the iliac crest and the lateral two thirds of the inguinal ligament and runs upwards and forwards to form an aponeurosis. Above the arcuate line the aponeurosis splits to enclose the rectus muscle. Below the arcuate line the aponeurosis passes anterior to the rectus muscle. The inferior part of the aponeurosis inserts into the symphysis pubis. At this insertion the aponeurosis fused with the aponeurosis of the transverses abdominis muscle to form the conjoint tendon.

The transverses abdominis muscle arises from the lower six costal cartilages, the lumbar fascia and the iliac crest.

Asymmetry of abdominal wall muscles is common and often results from congenital variation or postoperative atrophy. Sometimes, the presence of an asymmetry may indicate an intraabdominal inflammatory process Fig. 3 on page 9.

Three major arterial branches supply blood to either side of the anterior abdominal wall, which includes two branches of the external iliac artery and a branch of the internal thoracic artery. The inferior epigastric artery travels within the transversalis fascia until it reaches the arcuate line where it pierces the rectus sheath. The second branch of the external iliac, the deep circumflex iliac, runs parallel to the inguinal ligament between the transverses abdominis and internal oblique muscles. The superior epigastric, the terminal branch of the internal thoracic artery, enters the rectus sheath superiorly.

Congenital lesions

Urachal Abnormalities
Congenital

The urachus is an extraperitoneal tubular structure that courses from the umbilicus to the bladder dome. It is the obliterated remnant of at least two embryonic structures: the cloaca and the allantois. The tubular urachus normally involutes before birth, remaining as a fibrous band with no known function. Four congenital lesions of the urachus are known: patent urachus, urachal sinus, vesicourachal diverticulum and urachal cyst. The majority of patients with urachal abnormalities (except those with a patent urachus) are asymptomatic. However, they may become symptomatic if these abnormalities are associated with infection.

**Urachal sinus** consists of blind dilatation of the urachus at the umbilical end. In **vesicourachal diverticulum**, the urachus communicates only with the bladder dome.

A **urachal cyst** develops if the urachus closes at both the umbilicus and the bladder but remains patent between these two endpoints. It occurs primarily in the lower one-third of the urachus. CT or US shows a fluid-filled cavity in the midline lower abdominal wall. Superinfected urachal cyst manifests as wall thickening and demonstrates an attenuation higher than that of water at CT and soft-tissue components and mixed echogenicity at US. Fig. 4 on page 10

**Acquired urachal remnant diseases**

**Malignant urachal neoplasms** are rare. Although the normal urachus is most commonly lined by transitional epithelium, urachal carcinoma predominantly manifests as adenocarcinoma. These tumors are most commonly seen in men 40-70 years of age, and typically silent because of their extraperitoneal location; consequently, the majority of patients exhibit local invasion or metastatic disease at presentation. Ninety percent of urachal carcinomas arise in the juxtavesical portion of the urachus and extend superiorly toward the umbilicus and inferiorly through the bladder wall. At CT, urachal carcinoma may be solid, cystic, or a combination of the two. As with some other mucinous adenocarcinomas, urachal carcinomas may produce typical psammomatous calcifications that are well depicted at CT Fig. 5 on page 11. Calcifications in a midline supravesical mass are considered nearly diagnostic for urachal carcinoma.

**Omphalocele**

Omphalocele is an anterior abdominal wall defect at the base of the umbilical cord, with herniations of the abdominal contents. The herniated organs are covered by the parietal peritoneum. Omphalocele are associated with other anomalies in more than 70% of the cases, and the severity of the associated anomalies determines the prognosis Fig. 6 on page 12.
Fluid Collections

Hematoma

Hematomas of the anterior abdominal wall frequently involve the rectus sheath. There are various causes resulting in rectus sheath hematomas as abdominal trauma, previous surgery, coughing, stretching, hypertension, intraabdominal injections, iatrogenic causes during laparoscopy and anticoagulation therapy. Acute hematomas are hyperdense because of clot formation, and attenuation values decrease with time as breakdown of blood products occurs. Contrast-enhanced CT can provide information about signs of active bleeding. Active bleeding can be seen as a jet of contrast material within the hematoma on images obtained in the arterial phase and as layering of contrast material inside the hematoma in the delayed phase.

Rectus sheath hematomas above the arcuate line are usually ovoid transversely and biconcave in the long axis. They don’t extend across the midline due to the linea alba. Fig. 7 on page 13

In the abdominal wall below the arcuate line there’s only transversalis fascia between peritoneum and posterior rectus sheath, therefore, these collections extend into the prevesical space, and displace and compress the pelvic viscera Fig. 8 on page 14.

Abscesses and inflammatory collections

Subcutaneous tissue inflammation (cellulitis) shows a nonspecific CT findings (can be found in other entities such as heart failure or in edematous patients). These findings include the presence of linear densities in the subcutaneous tissue, the loss of differentiation of the muscular layers and increasing the size of the muscles of the wall Fig. 9 on page 15 Fig. 10 on page 16. Abscesses are often secondary to surgery or injury, or spontaneous (diabetic or immunocompromised patients). Also, they may be secondary to intra-abdominal inflammatory changes (mainly Crohn's disease or diverticulitis). Abscesses are showed as collections of low attenuation coefficient with peripheral uptake of contrast material. Occasionally they may contain gas. Fig. 11 on page 17 Fig. 12 on page 18

Necrotizing fasciitis is a life-threatening soft tissue infection involving the superficial fascia and subcutaneous fat. The clinical findings often overlap with those of relatively benign conditions such a cellulitis. CT tends to shows soft-tissue gas associated with fluid collections. Fig. 13 on page 19

Postsurgical Collections

These collections are located in the vicinity of laparotomy. Usually, they show some uptake of contrast material in its peripheral part. Air inside the collection may significate
infection, although it may be secondary to air communication with the outside (through the skin suture) or with intrabdominal cavity (through an intestinal fistula). Fig. 14 on page 20

**Neoplasms**

**Benign**

**Desmoid** is the most common primary neoplasm of abdominal wall. Desmoids are histologically benign but locally aggressive fibrous tumors, with invasion of contiguous structures. Usually, they are well-defined, relatively homogeneous masses isodense with soft tissue. Most desmoids will demonstrate enhancement following administration of intravenous contrast. On MRI, they present a signal intensity less than or equal to that of muscle on T1, and a variable signal intensity on T2 (often low signal intensity because of the high collagen content). Fig. 15 on page 21

**Lipoma** is the most common soft tissue tumor. On ultrasound, lipomas usually appear as hyperechoic masses. CT and MRI reveal a mass of homogenous adipose tissue similar to the surrounding normal fat. They can have thin internal septa and do not enhance after intravenous contrast administration. Although the appearance of well-differentiated liposarcomas may overlap with lipoma, characteristics that increase the likelihood of malignancy include increased patient age, large lesion size (> 10 cm), thick septations (> 2 mm), nodular or globular nonadipose mass-like areas, and decreased percentage of fat. Fig. 16 on page 22

Abdominal wall **endometrioma** is usually associated with operations in which the uterus is opened, and most patients present a palpable mass in the region of the surgical scar. Sonography shows a solid, hypoechoic lesions in the abdominal wall, with internal vascularity on Doppler examination. The imaging appearance might be expected to be more heterogeneous, with frequent cystic changes due to intralesional bleeding associated with menstruation. These sonographic findings are nonspecific, and a wide spectrum of disorders presenting as a mass in the abdominal wall should be considered in the imaging differential diagnosis. The CT and MR characteristics of abdominal wall endometriosis are nonspecific also, both showing a solid enhancing mass in the abdominal wall. Fig. 17 on page 23

**Malignant tumors and metastasis**

**Metastases** are the most common malignant tumor of the abdominal wall (melanoma, kidney, pancreas, ovary and lung are the most common sites of the primary tumor) Fig. 18 on page 24 Fig. 19 on page 25. Sister Mary Joseph`s nodule is referred to as the metastasis of visceral malignancy to umbilicus, commonly from the gastrointestinal or genitourinary tract. Intraabdominal tumors also can infiltrate directly into muscle layers of
the abdominal wall. Implants can also be found in the abdominal wall after laparoscopic surgery. In these cases, the implants are located at the entry point of the trocar. Fig. 20 on page 26

Soft tissue sarcomas are mesenchymal neoplasms. They have a high incidence of local recurrence and have a propensity for distant metastases. Less than 5% of sarcomas appear as primary abdominal wall tumors. Malignant fibrous histiocytomas, liposarcoma, fibrosarcomas and synovial sarcomas are the most common histologic variants. Fig. 21 on page 27

**Miscellany**

Some types of pacemakers (cardiac, anal) and reservoirs, ventriculoperitoneal shunt catheters or vascular grafts can be found in the subcutaneous abdominal tissue. CT can also show certain types of prosthetic mesh used to repair hernias. In cases of portal hypertension, collateral circulation can be seen through veins of the anterior abdominal wall that drain blood from the left portal through recanalization of the umbilical and paraumbilical veins. The presence of gas in the abdominal wall (without associated collections) is usually secondary to prior surgery. In extensive subcutaneous emphysema by pneumothorax, gas may dissect into the abdomen. Fig. 22 on page 28 Fig. 23 on page 29 Fig. 24 on page 30

**Suture granuloma (Schloffer tumour):** it represents a benign tumour-like, granulomatous inflammatory lesion that occurs after a surgical intervention in which nonabsorbable sutures were used. It usually develops slowly, may remain asymptomatic for many years and can be accompanied by vague symptoms including moderate pain or discomfort. Sonographically the suture granuloma presents as a well-defined hypoechoic lesion that may include an echo-free or echo-poor liquefied center representing a chronic abscess and hyperechoic double (rail-like) or single lines inside it representing suture material. Due to its high spatial resolution sonography usually enables the correct diagnosis based on the detection of the typical appearance of sutures within the hypoechoic granuloma. Because of their small size, sutures are not easily detectable on CT or MRI images these modalities being able to only detect an unspecific fluid collection with enhancement due to inflammation. Fig. 25 on page 31

**Images for this section:**
Fig. 1
Fig. 2
ASYMMETRY OF ABDOMINAL WALL MUSCLES

Atrophy of the rectus in a patient without history of surgery (normal variant) Intrabdominal inflammatory changes with an asymmetry of abdominal wall muscles (appendicitis).

Fig. 3
Infected urachal cyst. Contrast material enhanced CT scan shows a thick-walled cystic lesions (with inflammatory changes in the posterior Wall), just beneath the abdominal wall in the midline (arrows)
Mucinous adenocarcinoma arising from the uracal remnant. Contrast enhanced CT shows a low-attenuation mass with thin, curvilinear calcifications peripherally, contiguous with the dome of the bladder. The lesion extends superiorly toward the umbilicus.
Fig. 6

**OMPHALOCELE**

Multiple bowel loops and liver herniate into a membrane-covered abdominal wall defect.
HEMATOMA

71 Years ols women with pain in the FID.
A. US shows and anechoic and multitabicated mass.
B-D. Axial, coronal and sagital scan, show a high attenuation mass at the right rectus muscle with hyperdense contents suggestive of active bleeding.
HEMATOMA (BELOW THE ARCULATE LINE)

Rectus sheath hematoma that shows active bleeding in the arterial phase (A-B) and an extension into the prevesical space (asterisk), displacing and compressing the bladder (arrows).

Fig. 8
82 years old men
Cellulitis. US (A) shows hyperechogenicity of the subcutaneous tissue, with small fluid collections. Axial CT scan (B) demonstrates subcutaneous inflammatory stranding, and skin thickening.
CELULITIS

81 years old diabetic women. A. Axial CT  B. Coronal CT  C. Sagittal CT demonstrating subcutaneous inflammatory stranding and skin thickening secondary to extensive cellulitis
Fig. 11

71 years old man who has a subcutaneous collection (postoperative of rectum neoplasia)

A. axial  B. coronal and  C-D sagital CT show the hipodense mass with gas and rim of enhancement, and its communication with the peritoneal cavity (arrow)
71 years-old woman with fever

A. US shows an heterogeneous mass in the abdominal wall

B. Axial contrast-enhanced CT scan shows an hypodense and ill defined mass with rim enhancement involving rectus muscles and subcutaneous fat of right abdominal wall.

56 years-old men with umbilical abscess

C. US: anechoic mass in the umbilical area

D. Axial contrast-enhanced CT scan shows an hypodense mass with rim enhancement

Fig. 12
NECROTIZATING FASCITIS

Abdominal Ct show gas in the abdominal wall, ischiorectal fossa and scrotum.

Fig. 13
A. 57 years old woman. Subcutaneous collection in the anterior abdominal wall after an eventration repair surgery. Ct scan shows a well-defined hypodense mass over the surgical mesh.

B. 61 years old men with great collections after colon surgery. Note the air bubbles inside.

Fig. 14
57-year-old men with upper abdominal wall mass. Axial contrast CT scan shows a great well-defined mass of low attenuation relative to muscle that protudes into the upper right abdominal wall. Histological findings confirmed the diagnosis of desmoid tumor.

35-year-old women. Axial contrast CT scan shows a ill-defined mass of low attenuation involving the left inferior rectus abdominis muscle, without intrabdominal component. Histological findings confirmed the diagnosis of desmoid tumor.
82-year-old man with painless palpable mass in left abdominal wall. US shows an hyperechogenic, well-defined mass (A). Axial contrast enhanced CT scan (B) shows well-defined mass with same attenuation as fat in left abdominal wall, consistent with lipoma.
ENDOMETRIOMA

42-year-old woman with a 3-year history of a palpable mass. The patient had a history of endometriosis and prior cesarean scar. CT shows a soft-tissue-attenuation mass with surrounding inflammatory changes. Histological findings confirmed the diagnosis of endometrioma.

37-years-old women with abdominal pain (previous cesarean). US shows a hipoehogenic solid mass of irregulars margins. Axial T1 and Fat Sat show the small lesion. Histological findings confirmed the diagnosis of endometrioma.

Fig. 17
Fig. 18

A. Adenocarcinoma of the bladder
B. Adenocarcinoma of the rectum
C. Adenocarcinoma of the endometrium
Fig. 19

A. Retroperitoneal adenopathies and a round mass in the posterior left abdominal wall (Lymphoma).
B. Solid ill-defined implant in the left abdominal wall (ovarian adenocarcinoma).
C. Implant in the right abdominal rectus (colon adenocarcinoma)
ABDOMINAL WALL INFILTRATION

A. Abscessified sigmoid tumor that infiltrates into the muscle layers of the abdominal wall, with abscess formation in the subcutaneous tissue.

IMPLANT AFTER LAPAROSCOPIC SURGERY

B. Tumor implant in port site after laparoscopic surgery of gallstones. Histological study of the gallbladder showed adenocarcinoma.

Fig. 20
CT-scan show a large non-homogeneous tumor, solid, ill-defined, with calcifications involving the right inferior rectus abdominis muscle.

Fig. 21
MISCELLANY

A. Anal pacemaker
B. Ventriculoperitoneal shunt

Fig. 22
Fig. 23

61 years old man with liver cirrhosis. Axial CT shows portosystemic collateral circulation via the umbilical vein: caput medusae.

Axial CT shows venous collaterals in the abdominal lateral wall muscles.
49-year-old men with traffic accident. Axial unenhanced CT scan shows free gas dissecting into the abdominal wall.

Small amount of air in the lateral abdominal wall secondary to thoracic trauma.

Fig. 24
32 years old woman with nodular mass in the subcutaneous tissue of the right iliac fossa (appendicectomy two years ago). US shows a well-defined hypoechoic lesion. We suggested the diagnosis of granuloma because its relationship with the appendicectomy scar.

Fig. 25
Conclusion

- The accurate diagnosis of the abdominal wall lesions represents a challenge for radiologists because of the large spectrum of these lesions. In most cases we need to make a biopsy.
- Cross sectional imaging provides the optimum way to diagnose and assess the full extent of these pathologies.

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