Computed Tomography / Tomodensitométrie

Outside the Inside: A Review of Soft-Tissue Abnormalities Seen on Thoracoabdominal Computed Tomography

Susan J. Frank, MD, Shari Friedman, MD, Milana Flusberg, MD, Ellen L. Wolf, MD, Marjorie W. Stein, MD*

Department of Radiology, Montefiore Medical Center, Bronx, New York, USA

Abstract

In this review, we illustrate the computed tomographic features of thoracoabdominal soft-tissue abnormalities, which may be easily overlooked and often can provide important information regarding systemic processes. Examples include necrotizing fasciitis, heterotopic ossification, fat necrosis, benign and malignant neoplasms, endometriosis, and collagen vascular disease as well as systemic and congenital pathology.

Résumé

Cette revue permet d’illustrer les caractéristiques tomodensitométriques des anomalies des tissus mous, lesquelles peuvent facilement passer inaperçues et souvent s’avérer une source de renseignements importants sur les processus systématiques. Elle porte notamment sur la fascite nécrosante, l’ossification hétérotrope, la stéatonecrose, les tumeurs bénignes et malignes, l’endométriose, la collagénose avec manifestations vasculaires et les affections systémiques et congénitales.

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Computed tomography (CT) is routinely ordered for the evaluation of thoracic, abdominal, and pelvic pathology. Soft-tissue abnormalities, often incidental, are frequent and easily overlooked. It is important that the radiologist be familiar with the appearance and differential diagnosis of soft-tissue abnormalities on CT. This pictorial essay will review the CT features of common and uncommon soft-tissue infections; postoperative complications; benign and malignant neoplasms; endometriosis; and vascular, congenital, and systemic conditions.

Infections

Abdominal-wall infections include cellulitis, necrotizing fasciitis, and abscesses. Infections may be primary, postoperative, or posttraumatic, or associated with foreign bodies, or due to extension of intra-abdominal infection. CT findings in cellulitis include subcutaneous fat stranding and skin and fascial thickening. Necrotizing fasciitis is life threatening and may be difficult to distinguish from cellulitis, particularly in its early stages. Subcutaneous gas is diagnostic in the appropriate clinical setting but is only reported in 55% of cases [1]. CT is useful in determining the extent of involvement, particularly when the infection involves the deep subcutaneous tissues (Figure 1) or intra-abdominal space. Fournier gangrene is a subtype of severe necrotizing fasciitis that involves the perineum, frequently seen in male patients with diabetes [2]. Pilonidal sinus disease results from chronic hair follicle infection with subcutaneous abscess formation and discharge through a midline draining sinus (Figure 2). Imaging is helpful to differentiate pilonidal sinus disease, which originates subcutaneously, from perianal fistulas, which communicate with the anus or the rectum [3]. CT is helpful in demonstrating these abscesses and fistulas.

Postoperative Appearances

There are normal and abnormal postoperative appearances of the subcutaneous tissues. Mild skin thickening, subcutaneous oedema, seromas, small hematomas, and gas within the soft tissues may be seen in the immediate postoperative period. Infection in this setting is suggested when fever or
leukocytosis is present. Postsurgical heterotopic ossification is a form of myositis ossificans traumatica and occurs only in subxiphoid, midline, vertical abdominal incisions. It is more common in men and has been reported as early as 11 days after surgery [4,5]. It is hypothesized to be due to either excessive suture line tension, metaplasia of mesenchymal embryonal cells, or intraoperative seeding of perichondrial cells [5]. CT reveals ossification within an incision, between the anterior abdominal fascia and the peritoneum (Figure 3) [5]. Heterotopic ossification can contain cartilage, bone, and fatty marrow [5-7]. The ability of CT to differentiate ossification from calcification, which is due to dystrophic deposits of calcium phosphate salts, is important because the treatment for heterotopic ossification is often surgical. CT also allows differentiation of heterotopic ossification from other palpable soft-tissue masses, including a retained foreign body, wound infection, and tumour seeding [5].

Fat Necrosis

Subcutaneous fat necrosis may be due to trauma, collagen vascular disease, myeloproliferative disease, pancreatitis, pancreatic cancer, or, rarely, exposure to cold [8,9]. Fat necrosis, when due to trauma, may occur long after the inciting event. On CT, it typically appears as a well-defined subcutaneous fat-density mass with peripheral enhancement and calcification (Figure 4). Alternatively, it may be visualized as a globular soft-tissue density with central fat [8].

Soft-Tissue Neoplasms

Soft-tissue tumours may be benign or malignant, primary or metastatic. Although magnetic resonance imaging is the modality of choice for soft-tissue tumour assessment, CT is also helpful in assessing matrix mineralization, bony involvement, and vascularity.

Benign Neoplasms

Lipomas are very common benign soft-tissue tumours, frequently seen incidentally, more often in women, and are multiple in 5%. Typical locations include the back, shoulders, abdomen, and extremities. Lipomas are usually superficial but...
may be intramuscular. On CT, lipomas measure fat density, often contain fibrous septations, and may contain calcifications or induce cortical thickening in adjacent bone (Figure 5). Septations are usually thin, smooth, and nonenhancing compared with their malignant counterparts, but imaging overlap exists with well-differentiated liposarcomas [7,10].

A hibernoma, a variant of a lipoma, is a benign tumour composed of brown fat, often located in the thigh or near the scapula. On CT, it exhibits fatty, or slightly higher, attenuation, and may demonstrate serpentine vasculature and mild capsular enhancement (Figure 6). Although fluorodeoxyglucose avid on positron emission tomography—CT, it may be distinguished from malignancy by its characteristic location and CT attenuation [10].

Elastofibroma is a rare benign tumour composed of fibrous tissue and fat, most frequently found in elderly women. Sixty percent are bilateral and are characteristically located in the infrascapular region, deep to the serratus anterior and latissimus dorsi muscles. On CT, the mass is typically soft-tissue attenuation, with dense striations and fatty streaks (Figure 7) [11].

Neurofibromas may be plexiform, localized, or diffuse. They may be associated with neurofibromatosis when multiple or plexiform. On CT, a neurofibroma appears as a fusiform soft-tissue mass in close proximity to a nerve and may erode bone (Figure 8). It is typically isodense to muscle on noncontrast CT, with a variable enhancement pattern after intravenous contrast [10].

Desmoid tumour is a deep fibromatosis, which is benign but notorious for local recurrence. It commonly occurs between 25 and 35 years of age, and may be seen with familial adenomatous polyposis. Although 70% occur in the extremities, women taking oral contraceptives or who are recently postpartum have an increased incidence of desmoids in the rectus abdominis and internal oblique muscles. On CT, desmoids are ill defined or spiculated, iso- or hyperdense, and enhance after intravenous contrast [12].

Malignant Neoplasms

Liposarcoma is seen in middle-aged and elderly patients, typically in the thigh, gluteal region, retroperitoneum, or lower extremity. Features of fatty lesions that increase suspicion for
malignancy include large size, thick septa, nodular solid components, and contrast enhancement. Poorly differentiated liposarcomas may not have visualized fat [7,10]. Malignant fibrous histiocytoma, also referred to as pleomorphic undifferentiated sarcoma, occurs most often in the lower extremities, especially the thigh. It appears as a heterogeneously enhancing soft-tissue mass frequently causing adjacent bone destruction. The mass may occasionally contain bone, cartilage, fibrous tissue, hemorrhage, or necrosis [10]. Granulocytic sarcoma (chloroma) predominately occurs in a subcutaneous or intramuscular location, in patients younger than 15 years who have acute or chronic myelogenous leukaemia or other myeloproliferative disorders. Chloromas characteristically appear as slightly hypodense masses compared with muscle and with homogeneous contrast enhancement (Figure 9) [13]. Kaposi sarcoma, often an AIDS-defining illness, is linked to herpes virus type 8 infection. It most commonly presents as hyperenhancing subcutaneous nodules (Figure 10) [14].

Soft-tissue metastases are most often identified in the abdominal and chest wall, back, thigh, and shoulder (Figure 11). Lung cancer is the most common primary tumour to metastasize to soft tissues followed by kidney, colon, and melanoma. Soft-tissue metastases may be the first sign of malignancy [15].

**Endometriosis**

Endometriosis is a common gynaecologic condition that occurs in 15% of menstruating women, almost exclusively in the pelvis. It may also form in a surgical scar after caesarean section, hysterotomy, hysterectomy, or laparotomy. The incidence of abdominal-wall endometriomas after a caesarean section varies from 0.03%—1% [16,17]. Endometrial deposits have been reported in the dermal and subcutaneous tissues, and, infrequently, in the rectus abdominis muscle and rectus sheath [18]. Scar endometriosis typically presents as a cyclically enlarging palpable abdominal-wall...
mass with increased tenderness during menses. CT typically reveals an enhancing solid mass in the abdominal wall, often with adjacent inflammatory stranding (Figure 12). The appearance varies, depending on the phase of the menstrual cycle, relative proportion of stroma, and the amount of hemorrhage and fibrosis. Magnetic resonance imaging may be useful to confirm the presence of blood products [16–18]. Medical management with progestational agents is often unsuccessful, and endometriomas may recur when hormonal treatment is terminated. Thus, surgery is the treatment of choice, and CT is useful in presurgical planning [16–18].

Sebaceous Cyst

The term "sebaceous cyst" includes epidermal inclusion cysts that occur in relatively hairless parts of the body, and pilar cysts, which are associated with hair follicles. Sebaceous cysts contain keratin but do not contain sebum. They occur due to blocked sebaceous glands or hair follicles, or excessive testosterone production. Common locations include the scalp, face, neck, trunk, back, and scrotum. They exhibit variable CT attenuation, depending on their content, and are characteristically located in the subcutaneous tissues just beneath the skin surface. Steatocystoma multiplex is a rare autosomal dominant disorder of the pilosebaceous unit. Patients with steatocystoma multiplex present with numerous sebum and keratin-containing intradermal cysts, often on the chest (Figure 13) [10,19].

Eagle-Barret Syndrome

Eagle-Barret or prune belly syndrome occurs exclusively in male patients and is characterized by congenital absence or hypoplasia of the abdominal-wall muscles in association with genitourinary abnormalities (Figure 14). Cryptorchidism is always present. Varying degrees of urinary tract obstruction are seen, including urinary bladder enlargement.

Acquired Muscle Atrophy

Acquired muscle atrophy of the abdominal-wall musculature may result from disuse or denervation. On CT, muscular atrophy is seen as fatty replacement of muscle (Figure 15). The atrophy is typically diffuse when secondary to muscular dystrophy, cerebral palsy, or quadriplegia, and is unilateral or asymmetric when due to cerebral vascular accident, poliomyelitis, trauma, or surgery [10].
Figure 15. Muscle atrophy. (A) An 80-year-old man after a hip fracture with unilateral gluteal muscle atrophy (arrow) due to disuse seen on noncontrast computed tomography. (B) A 43-year-old man with muscular dystrophy with diffuse muscle atrophy.

Collagen Vascular Disease

Autoimmune connective tissue disorders such as polymyositis and dermatomyositis can demonstrate a sheet-like pattern of calcification in the skin, subcutaneous tissues, and fascial planes termed calcinosis universalis [7]. Calcinosis circumscripta refers to dermal papules, plaques, and subcutaneous nodules seen in the early stages of polymyositis, dermatomyositis, lupus, and scleroderma, which may contain calcifications [22]. Interstitial lung disease may be visualized (Figure 16).

Renal Disease

Patients with chronic renal failure commonly develop periarticular calcium deposits. Metastatic calcification refers to the deposition of calcium in normal soft tissues secondary to elevated serum calcium from an abnormality of calcium metabolism [7]. These deposits can be mass-like with fluid-calcium levels that render them indistinguishable from idiopathic tumoural calcinosis (Figure 17) [22].

Vascular Pathology

Vascular lesions are typically low density, with areas of heterogeneity secondary to vascular, fibrous, and fatty
tissue. Low-flow lesions, such as venous malformations, are visualized as soft-tissue masses with phleboliths and vessels that enhance after contrast. Arteriovenous fistulas or malformations are high-flow lesions that typically demonstrate large feeding arteries and draining veins. CT angiography can aid in preoperative planning by delineating the anatomy and venous drainage patterns [7]. Hemangiomatosis is a common benign vascular neoplasm, frequently seen in children. On CT, it appears as a soft-tissue mass, often with calcified phleboliths and enhancing tortuous vessels (Figure 18). Cavernous intramuscular forms may have large fatty components. Patients with portal venous hypertension or central venous obstruction can demonstrate collateral veins in the chest and abdominal wall (Figure 19). This is often seen in association with subcutaneous oedema, characterized by stranding within the subcutaneous fat, more prominent in the dependent tissues [21].

**Rectus Sheath Hematoma**

Rectus sheath hematoma (RSH) often presents with sudden onset of abdominal pain and a palpable abdominal mass. RSH is more frequent in women and may occur after minimal trauma, such as coughing, or with exercise. RSH may be due to damaged inferior or superior epigastric arteries or tears of the muscle. Anticoagulation is a predisposing factor [23]. On CT, RSH appears as a lenticular-shaped mass when above the arcuate line and as a spherical mass when below the line. This difference in shape is due to the different anatomic composition of the posterior rectus sheath below the arcuate line. The density varies with the age of the hematoma, which is generally hyperdense acutely, may develop a hematocrit level, and becomes iso- or hypodense over time (Figure 20).

**Conclusions**

Soft-tissue abnormalities are common and easily overlooked on routine thoracoabdominal CT. Radiologists must carefully evaluate the soft tissues, which can reveal unsuspected abnormalities and provide information about systemic processes. Familiarity with CT features of soft-tissue lesions, including location, the relationship to adjacent structures, attenuation and enhancement patterns, can aid in establishing the correct diagnosis and in guiding optimal patient management.

**References**


