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Ultrasound of the Abdominal Wall and Groin

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High-resolution sonography is widely accepted as the method of choice for screening and diagnosis of abdominal wall and groin pathology. It provides a detailed view of the abdominal wall muscular layers and of the inguinal canal and its content. The major advantages of sonography include wide availability, low cost, speed, and lack of radiation. This pictorial essay presents a comprehensive and illustrative review of the use of high-resolution sonography in abdominal wall and groin diseases.

Technique

Abdominal wall and groin sonography usually requires a high-resolution ultrasound probe (10-12 MHz). A supplementary low-frequency probe (5-7 MHz) is occasionally necessary to delineate the deeper extent of the lesion, such as the origin of the hernia and tumour extent. Sometimes additional maneuvers may be required, such as intermittent increased intra-abdominal pressure (the dynamic Valsalva maneuver), compression, and imaging in a standing position, to characterize the lesion [1−4]. Extended and/or panoramic views are useful to better delineate the relationship of the lesion to the adjacent normal structures. Colour and power-Doppler sonography are essential to assess the vascularity of the lesion and to help trace relevant adjacent vessels.

Sonographic Anatomy and Pathology of the Groin and the Abdominal Wall

Groin Hernia

The anatomy of the groin includes the inguinal canal (superficial and deep inguinal ring), inguinal ligament, and femoral triangle. The inguinal ligament lies caudal to the inguinal canal and cranial to the inguinal skin crease. It extends from the anterior superior iliac spine laterally to the pubic tubercle medially (Figures 1 and 2). The inguinal ligament is composed of tightly packed fibrillar echogenic fibers seen on ultrasound (Figure 2). The inguinal canal is located cranial to

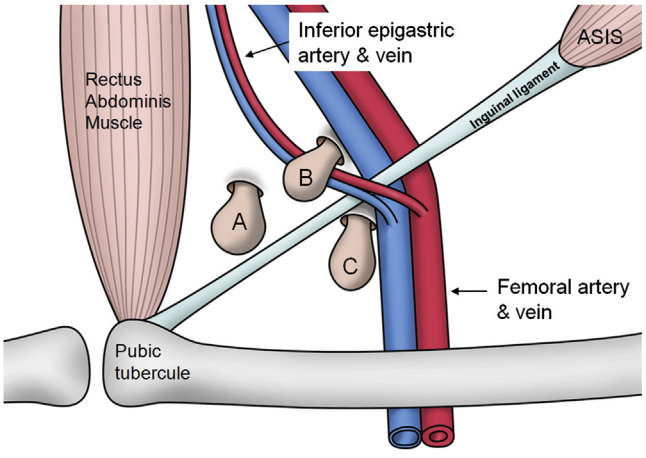

Figure 1. A diagram, showing the typical locations of different types of groin hernia and its relationship to the adjacent structure. (A) Direct inguinal hernia. (B) Indirect inguinal hernia. (C) Femoral hernia. This figure is available in colour online at http://carjonline.org/.

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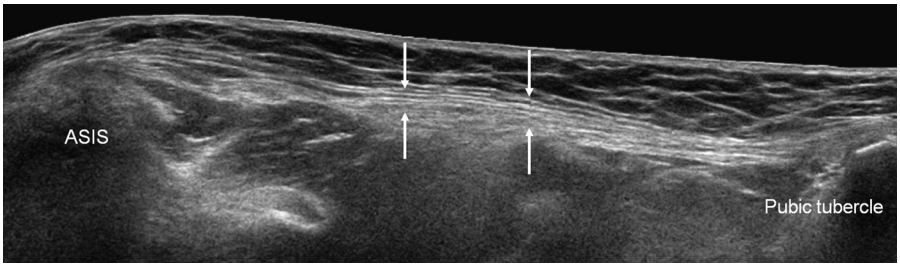

Figure 2. Inguinal ligament. Extended field-of-view oblique longitudinal ultrasound image, showing the inguinal ligament (arrows) extending from the pubic tubercle to the anterior superior iliac spine (ASIS). The normal inguinal ligament comprises parallel strands of echogenic fibers and is approximately 5-mm thick.

the inguinal ligament and extends from the deep inguinal ring laterally to the superficial inguinal ring medially. The deep inguinal ring, which is the opening in the transversalis aponeurosis, lies just superior to the middle of inguinal ligament and anterior to the femoral vessels (Figure 3A). The superficial inguinal ring is located just superior and lateral to the pubic tubercle (Figure 3B) and is the result of an opening in the external oblique muscle aponeurosis.

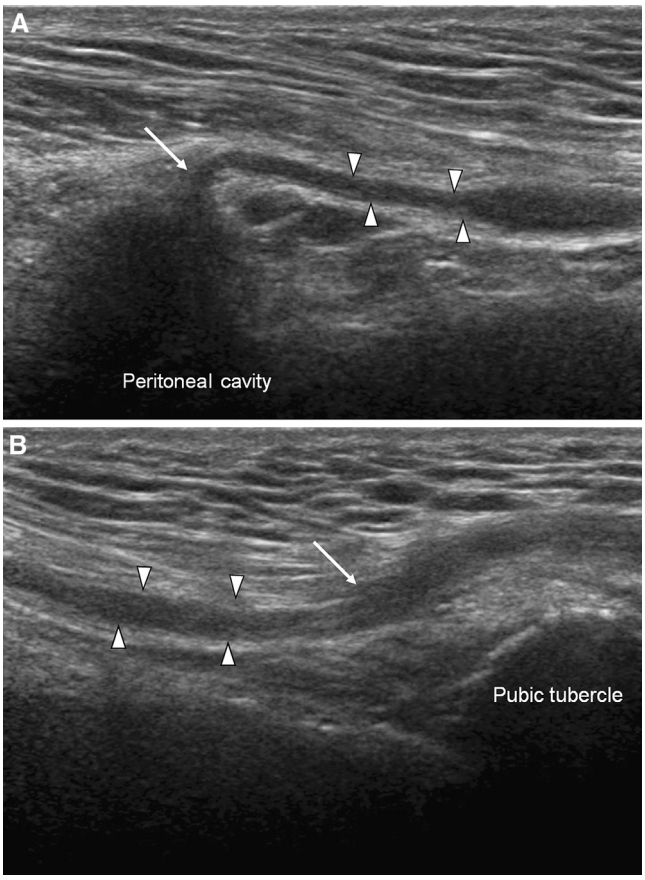

Figure 3. (A) Deep inguinal ring; oblique longitudinal sonogram along the inguinal canal, showing spermatic cord (arrowheads) within the proximal inguinal canal, which lies superior to the inguinal ligament; the spermatic cord passes through the deep inguinal ring (arrow), lateral to the inferior epigastric vessels to reach the peritoneum. (B) Superficial inguinal ring; oblique longitudinal sonogram, showing the spermatic cord (arrowheads) within the inguinal canal, extending through the superficial inguinal ring (arrow) to reach the high scrotal area (not shown here).

The inferior epigastric vessels (artery and vein) are a useful landmark to differentiate direct and indirect inguinal hernia. The inferior epigastric vessels can first be identified posterior to the lateral border of the inferior rectus muscles. The inferior epigastric vessels can be traced distally to their origins. The Hesselbach triangle is another landmark that is defined medially by the lateral border of the rectus abdominis, inferiorly by the inguinal ligament, and laterally by the inferior epigastric artery. The direct inguinal hernia typically originates within the triangle, whereas the indirect inguinal hernia originates from the deep inguinal ring, which lies lateral to the Hesselbach triangle.

Our ultrasound approach to the diagnosis of inguinal hernia in men is to first identify the spermatic cord in the high scrotal area. The spermatic cord is then followed laterally until it enters the peritoneal cavity through the deep inguinal ring. If no hernia has been identified, then the Valsalva or a similar movement can be performed at this site and just medial to it to test for laxity in the region of the deep inguinal ring. If a hernia is present, then establish the relationship to the inferior epigastric vessels to determine whether it is indirect or direct. As expected, an indirect hernia lies lateral to the inferior epigastric vessels. A similar technique can be used in women by identifying the round ligament close to the labia majora and following it proximally. Colour-Doppler imaging is helpful in both sexes because the spermatic cord and round ligament can be more readily appreciated by identifying the vessels that accompany these structures. The femoral triangle is bounded proximally by the inguinal ligament, medially by the adductor longus, and laterally by the sartorius. It contains the femoral canal, vein, artery, and nerve from medial to lateral.

Hernia is the most common abdominal wall and groin lesion seen in clinical practice [2]. A hernia is an abnormal protrusion of an organ or part of an organ out of the cavity in which it is normally contained. The hernia sac usually contains mesenteric fat and occasionally bowel and fluid. The bowel loops appear as target lesions, with strong reflective central echoes that represent air in the lumen; the fluid is hypoechoic; and fat is hyperechoic. Movement of the hernia contents during real-time scanning or a change in size

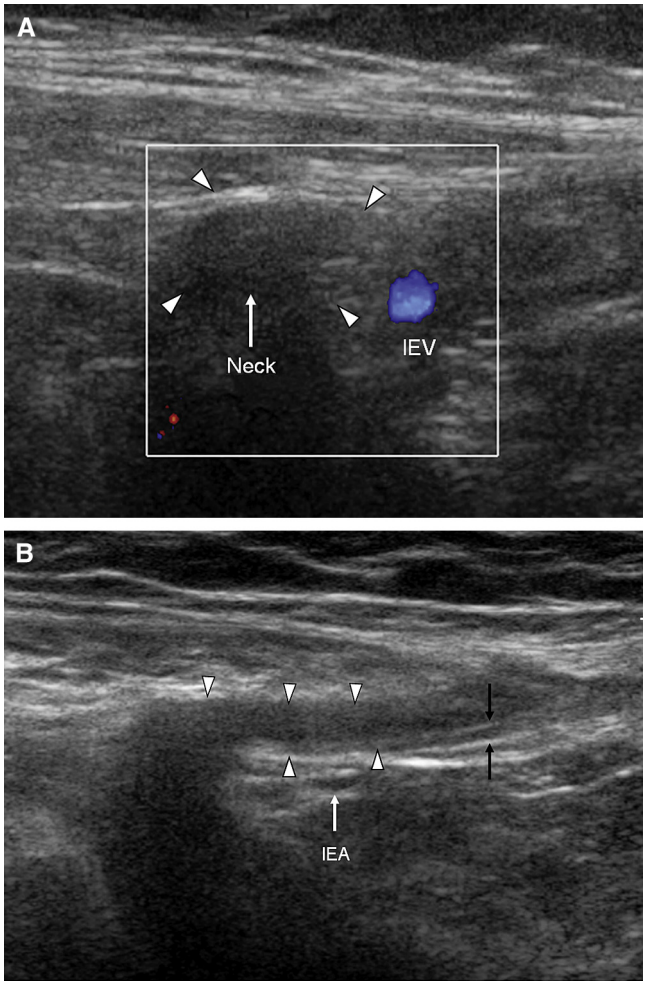

Figure 4. (A) Right indirect inguinal hernia; transverse sonogram of the right inguinal region, showing the neck (arrow) of the hernia (arrowheads) lying lateral to the inferior epigastric vessels (IEV) compatible with an indirect inguinal hernia. (B) Indirect inguinal hernia; oblique sonogram of the same patient in Figure 4A delineates the hernia sac (white arrowheads) of the indirect inguinal hernia inside the inguinal canal; the hernia originates from the deep inguinal ring lateral to the inferior epigastric artery (IEA, white arrow) and crosses superficial to it and extends along the inguinal canal; the hernia sac passes anterior to the spermatic cord (black arrows). The sac mainly contains fluid. This figure is available in colour online at http://carjonline.org/.

with the Valsalva maneuver are recognizable features of hernia.

Inguinal hernia is the most common type of hernia (75%) and is classified as direct or indirect [3,5]. Men are affected more than women. Indirect inguinal hernia is more common than the direct type [5]. The indirect inguinal hernia originates from the weakness of deep inguinal ring (lateral to the inferior epigastric vessels and the Hesselbach triangle). If large enough, the hernia extends along the inguinal canal and passes through the superficial inguinal ring before reaching the scrotum (Figures 1, 4A and 4B). The direct inguinal hernia protrudes medial to the inferior epigastric vessels in the Hesselbach triangle. It is due to the weakening of inguinal canal floor (transversalis fascia) (Figures 1 and 5). Thereafter, it also passes along the inguinal canal to the superficial inguinal ring.

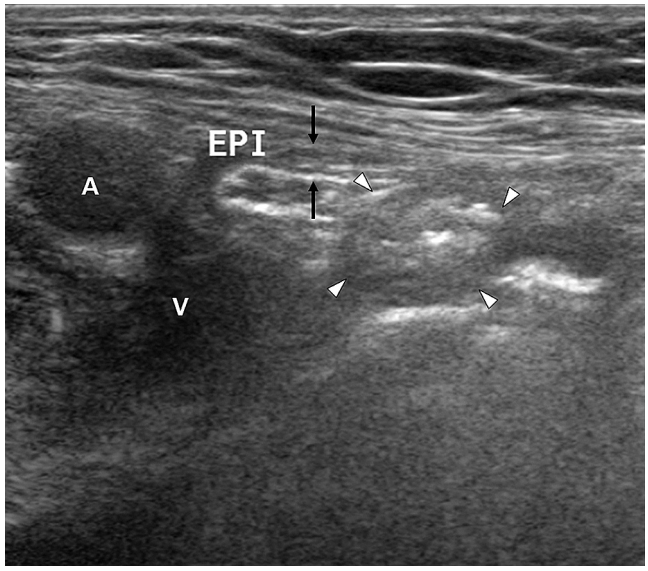

Figure 5. Direct inguinal hernia. Transverse sonogram, showing a large hernia sac with the neck (black arrows) medial to the inferior epigastric artery and paired vein. The hernia sac contains bowel (white arrowheads) with bowel gas. A = femoral artery; EPI = inferior epigastric artery and paired vein; V = femoral vein.

In adults, femoral hernia accounts for 2%-8% of groin hernias [6]. Women are affected more than men. The typical patient is an elderly overweight woman who presents with abdominal or groin pain, with or without a palpable mass. The femoral hernia protrudes through the femoral canal (Figure 6) and lies posterior to the inguinal ligament. The hernia is deep and easily missed clinically but is detectable on ultrasound. The neck is usually narrow, which increases the risk of strangulation.

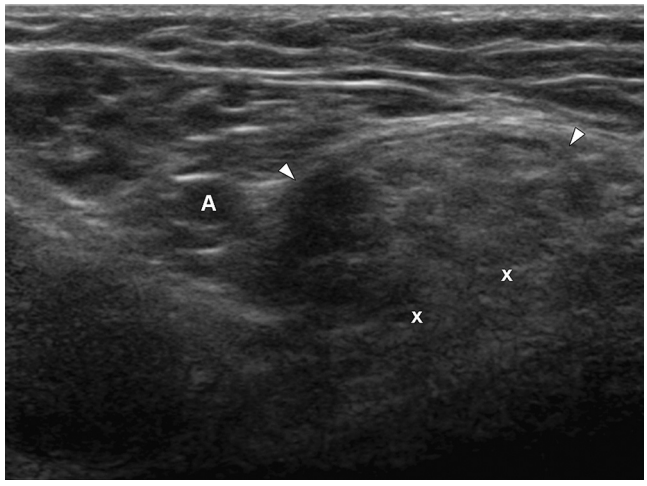

Figure 6. Femoral hernia. Transverse sonogram of the right groin below the inguinal ligament, showing a femoral hernia (arrowheads). The neck of the femoral hernia passes through the defect of femoral canal (marked by ×). The femoral canal lies medial to the femoral artery, vein, and nerve. The hernia contains mesenteric fat. A = femoral artery.

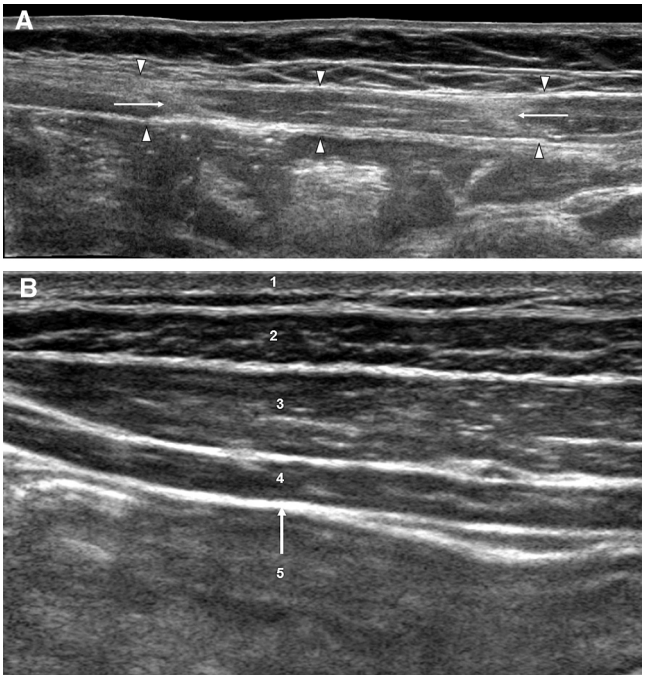

Figure 7. (A) Normal anatomy of anterior abdominal wall; extended field-of-view image; normal rectus muscle (arrowheads) is hypoechoic, with strands of internal echogenicity that extend from the pubic symphysis–crest inferiorly to the xiphisternum and adjacent costal margin superiorly; the compartment is divided by tendinous intersections, which appear as linear echogenic lines on ultrasound (arrows). (B) Normal anatomy of the abdominal wall laterally; transverse sonogram on the lateral abdominal wall; the peritoneum is marked by the arrow. 1 = skin and subcutaneous layer; 2 = external oblique muscle; 3 = internal oblique muscle; 4 = transversus abdominis muscle; 5 = peritoneal cavity.

Midline Hernia

The abdominal wall is divided into anterior, anterolateral, and posterior parts. The anterior abdominal wall contains 2 paramedian vertically oriented rectus abdominis muscles (Figure 7A), whereas, in the anterolateral part, one can appreciate the 3 abdominal wall muscles (external oblique, internal oblique, and transversus abdominis) (Figure 7B). The linea alba is a fibrous structure formed by fusion of the aponeuroses of the abdominal wall muscles. It connects the left and right rectus abdominis muscles. Divarication of rectus abdominis muscles is defined as a congenital defect of linea alba, which can be demonstrated as a defect of the linear alba in the ultrasound (Figure 8). If there is protrusion of the abdominal content (commonly fat) through the defect, it is defined as linea alba hernia (Figure 9). It is more commonly epigastric (above the umbilicus) than hypogastric (below the umbilicus).

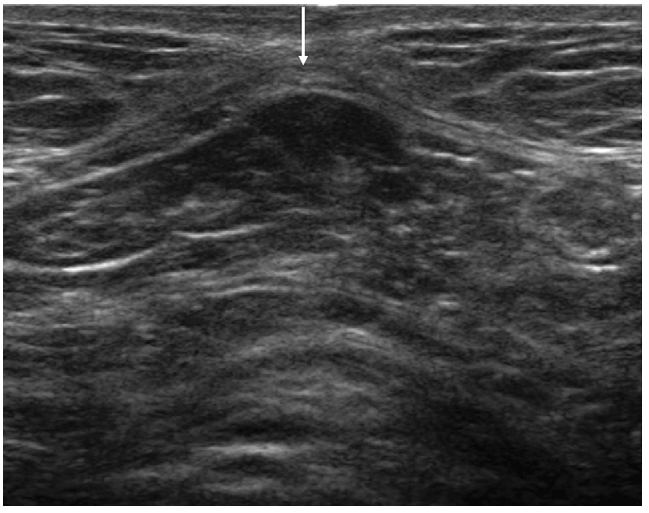

Figure 8. Divarication of rectus abdominis muscles. The midline transverse sonography, showing a defect of the linear alba (arrow), which resulted in separation of the rectus muscles (divaricate) and anterior bulging of the underlying peritoneal cavity.

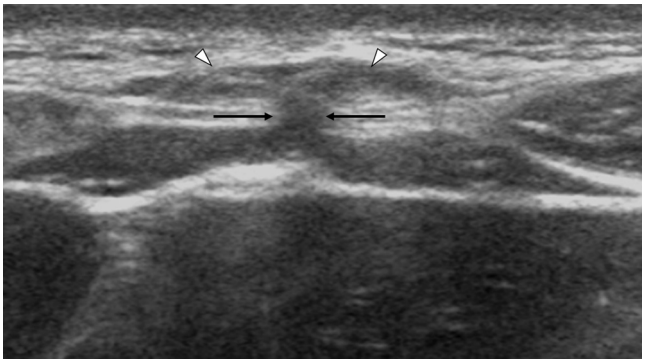

Figure 9. Linea alba defect hernia. Transverse sonogram of the epigastrium. There is herniation of the preperitoneal fat (arrowheads) through a defect in the linea alba (arrows) into the deep subcutaneous tissues.

Umbilical hernia is the most common congenital ventral hernia. This can be diagnosed by its typical location at the umbilicus (Figure 10), and it usually has a narrow neck. It

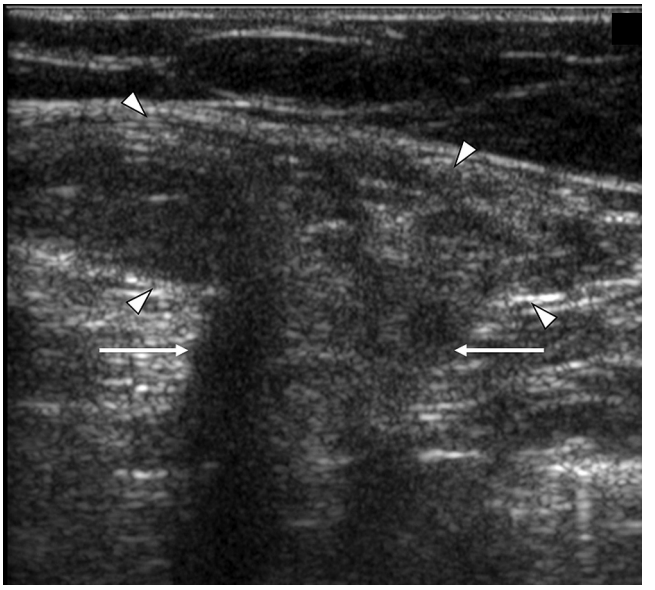

Figure 10. Umbilical hernia. Transverse sonogram of the umbilicus, showing a hernia (arrowheads) that contains mesentery passing through a defect in the umbilicus (arrows) to lie deep to the subcutaneous tissues.

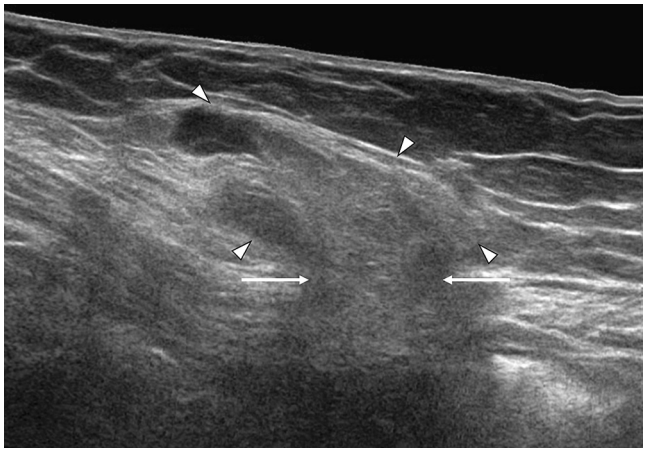

Figure 11. Spigelian hernia. Transverse sonogram right loin region. Hernia sac (arrowheads) that contains both fluid and mesentery, extending through a defect in the abdominal wall (arrows) just lateral to the rectus abdominis muscle (not shown).

should be differentiated from Sister Mary Joseph nodule (metastatic umbilical nodule), which is mostly solid in nature.

Spigelian hernia is a rare hernia and constitutes approximately 0.12% of all abdominal hernias [7]. It is due to a defect in the transverse abdominis muscle aponeurosis at the linea semilunaris located between the lateral border of rectus abdominis and the medial edge of the internal oblique muscle (Figure 11). The hernia most commonly occurs at the junction of the arcuate lines of the rectus sheath and the linea semilunaris. It has a high risk of strangulation because of its narrow neck.

Incisional hernia is located at the scar from previous surgery (Figure 12) as a delayed complication of abdominal surgery. This type of hernia occurs in 0.5%-14% of patients, and the recurrent rate is 4% [8]. Obesity and wound infection are the predisposing factors [8].

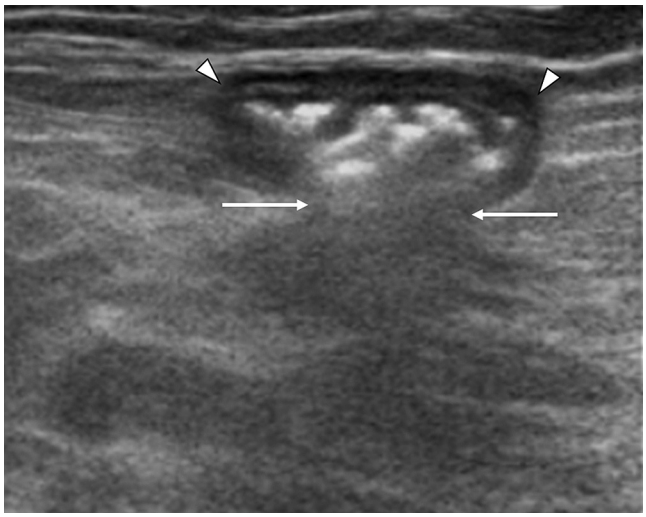

Figure 12. Incisional hernia. Transverse sonogram upper abdominal wall. The incisional hernia sac (arrowheads) that contains small bowel with gas, extending through a defect in the abdominal wall (arrows) at the site of previous surgery.

Pseudoaneurysm and Arteriovenous Fistula

Pseudoaneurysm and arteriovenous fistula (AVF) commonly occur after catheterization of the femoral artery for interventional vascular procedures and in intravenous drug abusers. The incidence of femoral artery pseudoaneurysm after catheterization is 0.1%, whereas AVF is much less common [8]. Pseudoaneurysm is an encapsulated pulsatile hematoma, so-called because it does not contain the normal intima, media, and adventitia of a standard aneurysm. On ultrasound, there is persistent communication of the pseudoaneurysm lumen and the true lumen. Colour-Doppler imaging shows the typical to-and-fro pattern in the neck region, with a swirling pattern within the sac (Figures 13A and B). AVF usually shows mixed arterial and venous flow within the femoral vein (Figure 14A), with a mosaic colour pattern due to vibration artifacts in the perivascular soft tissues (Figure 14B).

Undescended Testis

Undescended testis (or cryptorchidism) is the most common congenital anomaly of the male reproductive system. The prevalence is 9%-30% in premature infants and 3%-6% in full-term infants [1]. There is increased risk of malignancy, ranging from 3%-18% (mean, 11%) [9]. The diagnosis of cryptorchidism in adults is uncommon, and the undescended testis is usually found atrophic, lying along the course of its fetal descent pathway, that is, between the hilum of the ipsilateral kidney to the high scrotal region. On ultrasound, the undescended testis is seen as an oval, homogeneous, hypoechoic mass with its long axis parallel to the inguinal canal (Figure 15). The absence of the testis in the scrotum will confirm the diagnosis.

Groin Lymph Nodes

Enlarged reactive lymph nodes are usually oval in shape. They have a preserved fatty hilum, smooth border, and thin cortex (Figure 16A). Colour-Doppler imaging shows normal hilar vascularity. Malignant lymph nodes are more roundish in appearance and hypoechoic or heterogenous in echogenicity, with loss of normal fatty hilum (Figure 16B). Colour-Doppler imaging shows peripheral or mixed hilar and peripheral vascularity.

Spermatic Cord and Cyst of the Canal of Nuck

A spermatic cord cyst presents as a cystic mass in the groin along the spermatic cord. It is differentiated from inguinal hernia by its absence of communication to the abdominal cavity (Figure 17). The female equivalent is a cyst of the canal of Nuck, which lies along the round ligament in the inguinal canal (Figure 18). The canal of Nuck in the female anatomy corresponds to the processus vaginalis of the male anatomy [10]. During embryologic development, the processes vaginalis is a peritoneal evagination into the inguinal canal, and it accompanies the round ligament [10]. The varicocele of the

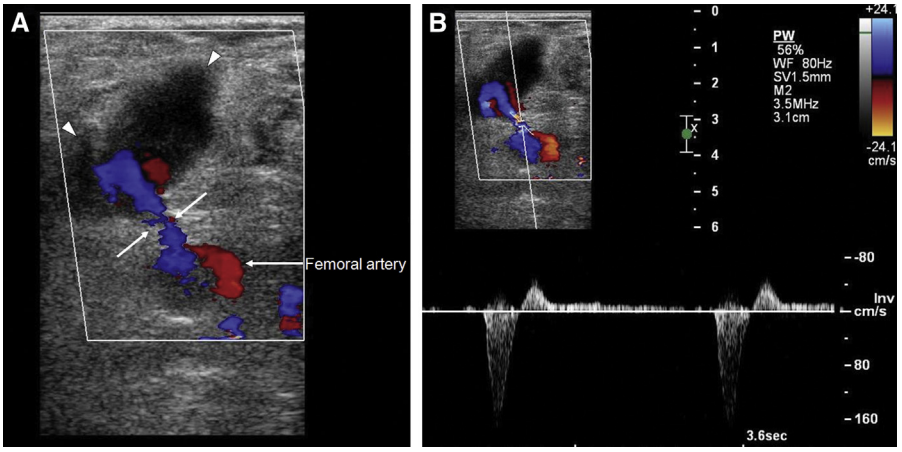

Figure 13. (A) Femoral artery pseudoaneurysm; transverse sonogram, showing a pseudoaneurysm (arrowheads) arising from femoral artery; the neck of the pseudoaneurysm (thin white arrows) and the sac demonstrated typical to-and-fro blood flow. Femoral artery is indicated by the (thick white arrow). (B) Femoral artery pseudoaneurysm; spectral colour-Doppler imaging, showing typical to-and-fro blood flow pattern via the neck. This figure is available in colour online at http://carjonline.org/.

round ligament in a pregnant woman may be large in size and mimic a cyst of the canal of Nuck. However, the presence of colour flow within the varicocele can be easily differentiated from the cyst of the canal of Nuck.

Trauma

Hematomas occur in patients with a bleeding tendency, such as those patients on anticoagulant therapy or with a history of trauma, sometimes it occurs in the absence of indifiable trauma, particularly in the rectus sheath (where the inferior epigastric vessels can be constricted by normal exertions). On ultrasound, the sonographic appearance is variable (Figure 19). The internal echogenicity of the hematoma depends on the age of the blood, echo-free and/or anechoic in the acute stage then becomes more organized with mixed echogenicity in a subacute or chronic phase. Hematomas should not show internal vascularity in the acute phase. Muscular tear of the abdominal wall muscles can also be easily diagnosed by ultrasound. The discontinuity of the normal muscle fibers is usually filled by the hematoma in the acute state (Figure 20).

Seroma

A seroma occurs after surgery or trauma. On ultrasound, a seroma appears cystic in echogenicity, with strong posterior acoustic enhancement. A seroma is usually echo-free because of its sterile fluid content. No solid component can be demonstrated unless complicated by hemorrhage.

Abscess

Abscesses are sometimes difficult to be differentiated from hematomas or seromas. As mentioned above, seromas are usually echo-free, whereas abscesses typically have more irregular walls, low-level internal echoes, and adjacent inflammatory change (Figure 21). Sometimes, the abscess

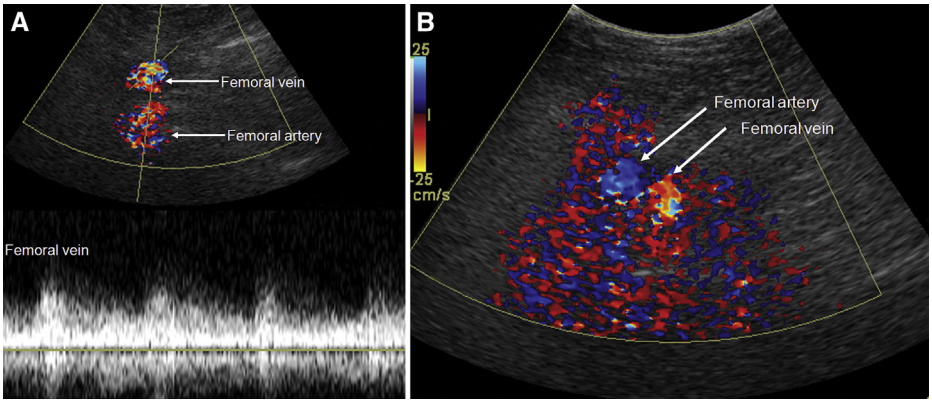

Figure 14. (A) Femoral arteriovenous fistula (AVF); spectral colour-Doppler imaging of the femoral vein, showing mixed high (arterial) and low vascular flows (venous) compatible with AVF. (B) AVF; colour-Doppler imaging of the same patient, showing the typical appearance of mosaic colour pattern, that is, vibration artifacts in the perivascular soft tissue, which indicates the presence of AVF. This figure is available in colour online at http://carjonline.org/.

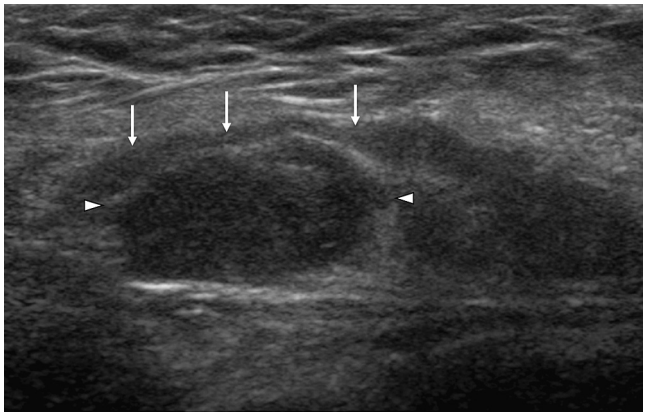

Figure 15. An undescended testis in the inguinal canal. A longitudinal sonogram of the groin region, showing an oval-shaped hypoechoic structure (white arrowheads) within the inguinal canal consistent with an undescended testis. The testis is slightly smaller than the normal testis (not shown) due to expected atrophy. There was only a single testis in the scrotum. Epididymis and spermatic cord (white arrows).

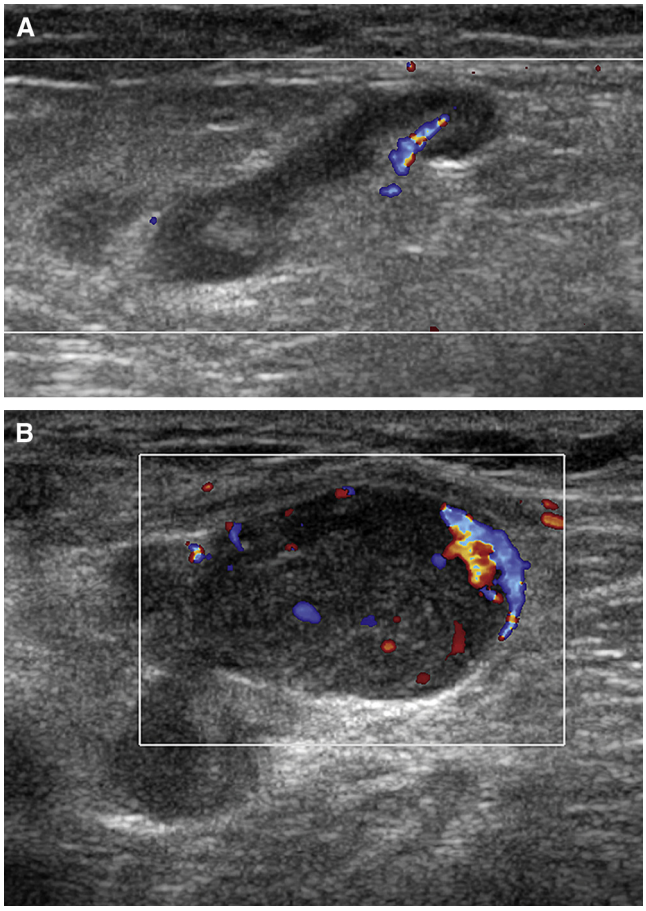

Figure 16. (A) Reactive inguinal lymph nodes; transverse sonogram with colour-Doppler imaging, showing an oval-shaped hypoechoic nodule with fatty hilum and vascularity; the cortex is smooth and thin; the features are compatible with a reactive lymph node. (B) Malignant inguinal lymph node; transverse sonogram with colour-Doppler imaging, demonstrating an abnormally enlarged rounded lymph node with loss of the normal fatty hilum; peripheral vascularity with a chaotic pattern is seen in the lymph node; percutaneous biopsy yielded material consistent with a lymphoma. This figure is available in colour online at http://carjonline.org/.

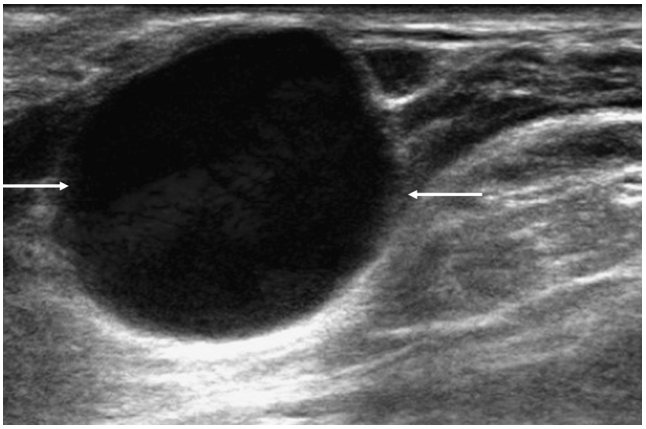

Figure 17. A spermatic cord cyst. The sonography of the right groin, revealing a discrete anechoic cyst (arrows) along the spermatic cord in the inguinal canal.

originated from the abdominal cavity via a fistula, which could be elicited by the ultrasound (Figure 22). Clinical history and, if necessary, ultrasound-guided aspiration, is helpful in differentiating abscess from seroma or liquefied hematoma.

Urachal and Umbilical Vascular Anomaly

Strictly speaking, urachal and umbilical vessel anomalies can be defined as the abdominal wall abnormalities because they usually lie between the abdominal wall muscle and the parietal peritoneum, and present as abdominal pain or a mass. An urachal cyst or allantois, which appears approximately day 16 after birth and regresses after

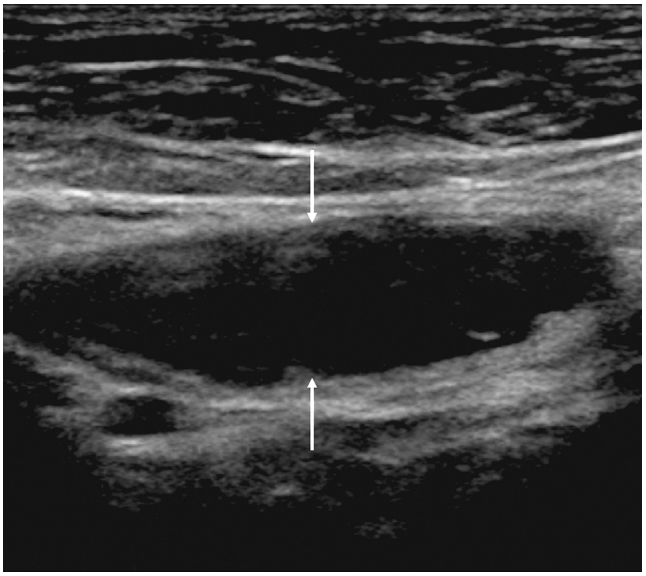

Figure 18. A cyst of the canal of Nuck. Oblique sonography of the left groin, demonstrating a discrete cyst (arrows) along the inguinal ligament of a female patient. This is along the course of round ligament and suggestive of a cyst of the canal of Nuck.

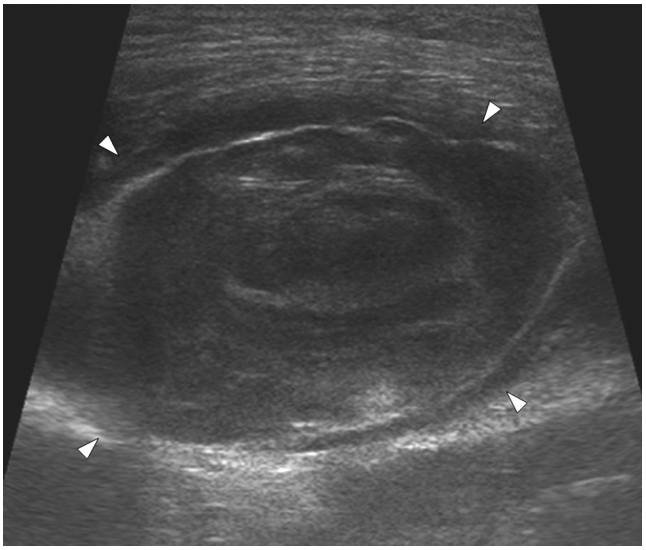

Figure 19. Rectus sheath hematoma. There is a large oval-shaped heterogenous hypoechoic lesion (white arrowheads) within the rectus sheath that is displacing the rectus muscle peripherally. The features are compatible with rectus sheath hematoma. No colour flow was present on colour-Doppler imaging. Clinical and ultrasound appearances were compatible with a rectus sheath hematoma.

approximately 5 months, is due to a thick fibrous cord of urachus, which extends from the tip of the urinary bladder to the umbilicus [11]. Failure of obliteration of urachus will result in congenital urachal anomalies, that is, an urachal cyst (approximately 30% of cases), vesicourachal diverticulum (approximately 3%-5%), umbilical-urachal sinus (approximately 15%), and alternating sinus and patent urachus (50% of cases). Congenital urachal anomalies are twice as common in men than women [11]. Urachal cysts are occasionally diagnosed during ultrasound of the anterior abdominal wall and typically are located at the bladder end

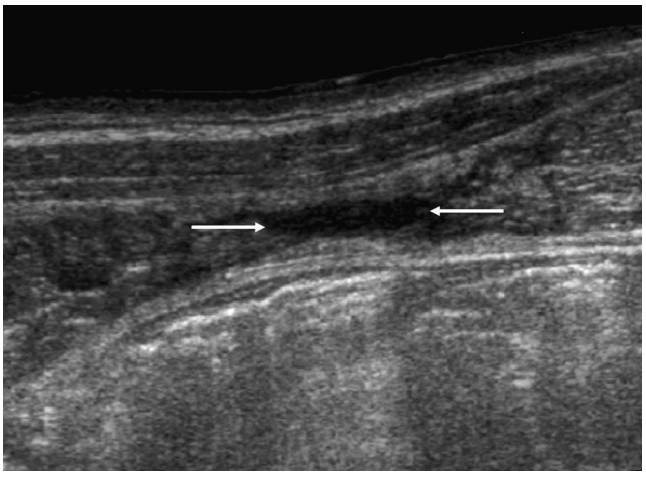

Figure 20. Abdominal wall muscle tear. The patient had an acute history of trauma to the right lateral abdominal wall. An oblique sonography, showing discontinuity of the internal and external oblique abdominal wall muscle fibers with hematoma filling up the gap (arrows). The features are compatible with muscle tear.

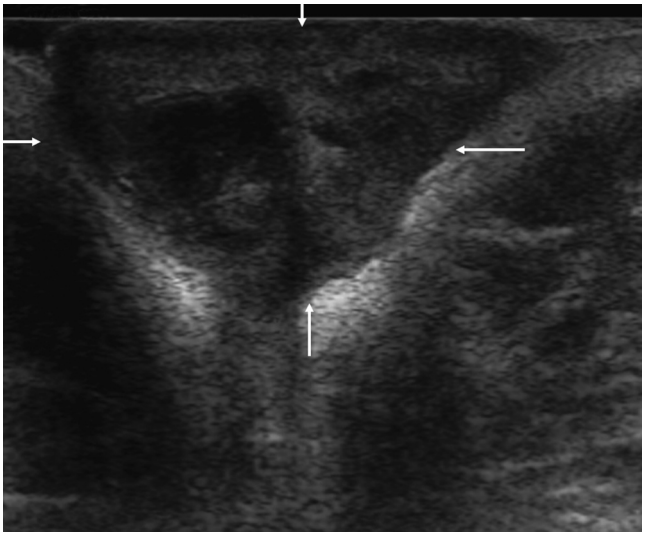

Figure 21. Abdominal wall abscess. Transverse sonogram of the umbilicus in a middle-aged patient with fever and increased white blood cell count. There is a mixed hypo- and anechoic mass (arrows) in the umbilicus, with low-level echoes, consistent with abscess formation in the umbilicus.

of the urachus (Figure 23A). It is commonly complicated by infection or hemorrhage (Figure 23B). The sonographic features of infection and hemorrhage include septation, layering, and low-level echoes (blood cells or debris). The typical location helps to differentiate it from other diagnoses. The umbilical vein acts as collateral communicating the systemic and portal venous system, especially in patients with liver cirrhosis and portal hypertension. Its recanalization can be demonstrated in the ultrasound scan (Figure 24).

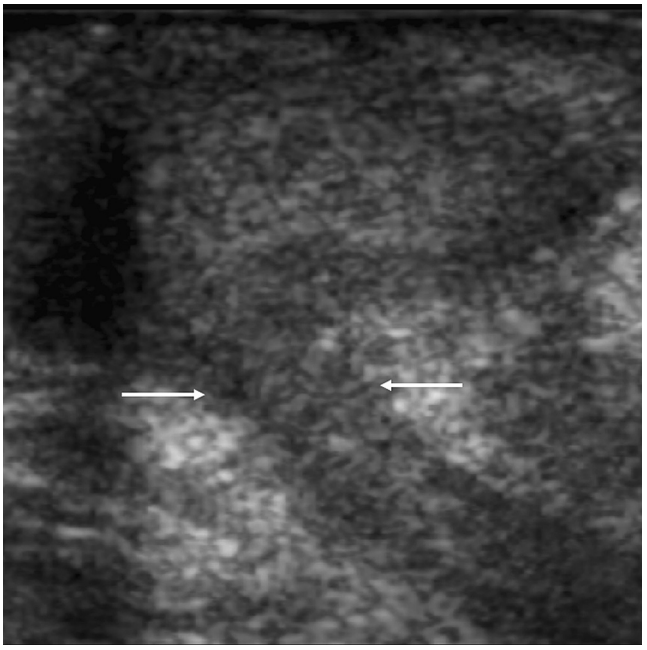

Figure 22. Fistulation to abdominal wall. This patient had longstanding Crohn disease that predominantly affected the small bowel. There is a fistula tract (arrows) that connects from the small bowel to the abscess (arrowheads) in the abdominal wall in this transverse sonography.

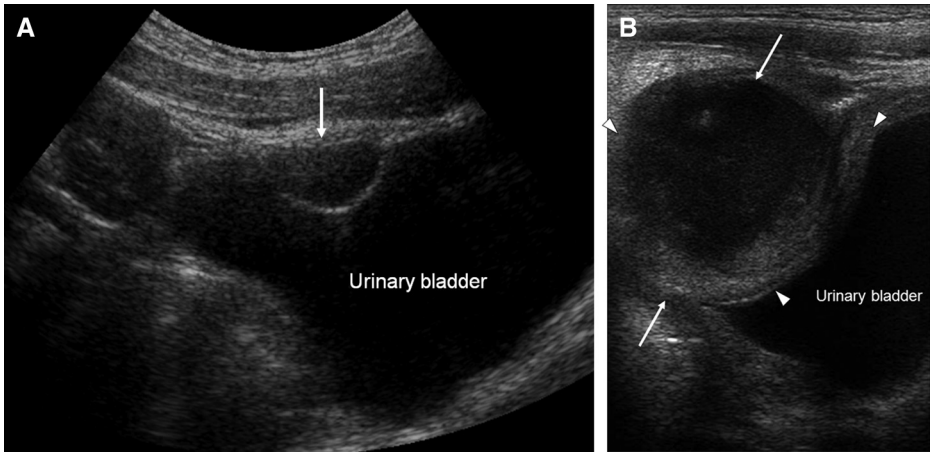

Figure 23. (A) An urachal cyst; longitudinal sonogram of suprapubic region; a small cystic lesion is present in the anterosuperior anterior aspect of the urinary bladder, suggestive of small urachal cyst (arrow). (B) Infected urachal cyst; longitudinal sonogram at the suprapubic region of another patient; a mixed hypo- and anechoic mass in the suprapubic region, with low-level echoes inside the lesion suggestive of pus formation; adjacent soft-tissue inflammatory change with urinary bladder wall thickening is also noted (arrowheads); with the typical position and appearance, the features are compatible with infected urachal cyst (arrows).

Endometriosis

A female patient with cyclic pain and or swelling of an abdominal mass that corresponds to the menstrual period should raise the suspicion of endometriosis. Those patients usually either have undergone previous uterine surgery via an abdominal incision (Figure 25) or have known endometriosis. On ultrasound, the mass usually displays an irregular border with heterogeneous echogenicity. The mass shows hypervascularity associated with inflammation of the soft tissue around the mass. The triad of cyclical pain, a mass, and a caesarean section scar are diagnostic of endometriosis.

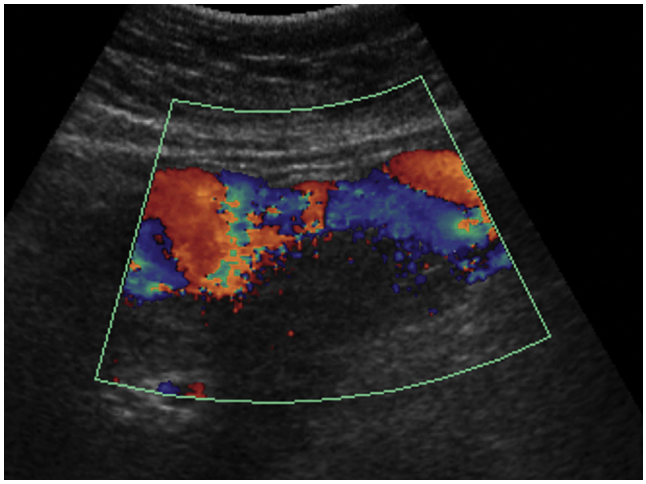

Figure 24. Varices from umbilical vein recanalization. The patient had a history of severe liver cirrhosis. There are dilated vessels just beneath the mid abdominal wall (along the course of umbilical vein) in this longitudinal sonography. The features are suggestive of umbilical vein recanalization with varices formation due to increased collateral flow. This figure is available in colour online at http://carjonline.org/.

Neoplasm

Abdominal wall tumours can be benign or malignant (primary or secondary). Lipoma is the most common benign tumour of the groin and the abdominal wall. On sonographic examination, it is well encapsulated, spindle shaped, and echogenic, with thin internal septations and good through-transmission (Figure 26). It is soft, mobile, and compressible on pressure. Omental fat within the hernia can mimic the lipoma, but the former often shows mesenteric vascularity on colour-Doppler imaging and other features of hernia.

Desmoid tumours are benign fibrous tissue neoplasms that originate from the musculoaponeurotic structures throughout the body. A desmoid tumour most commonly occurs in girls and women during their reproductive years [8,12]. Desmoid tumours are locally aggressive but benign fibrous tumours commonly arising from the abdominal wall at the site of previous surgery. On ultrasound, a desmoid

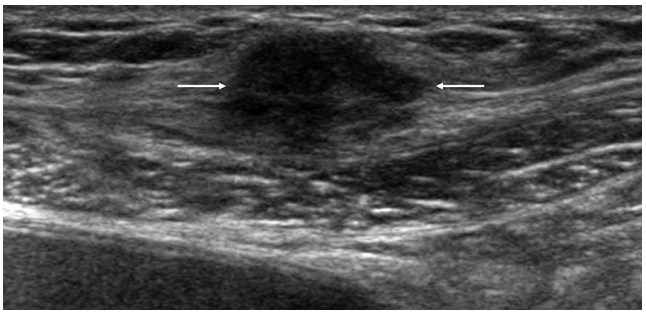

Figure 25. Abdominal wall endometriosis. Longitudinal sonogram at the suprapubic region of a 50-year-old woman who had cyclic pain over the hysterectomy scar. An irregular hypoechoic mass is present in the subcutaneous tissues deep to the cutaneous scar suggestive of endometriosis (arrows), which was confirmed by ultrasound-guided biopsy.

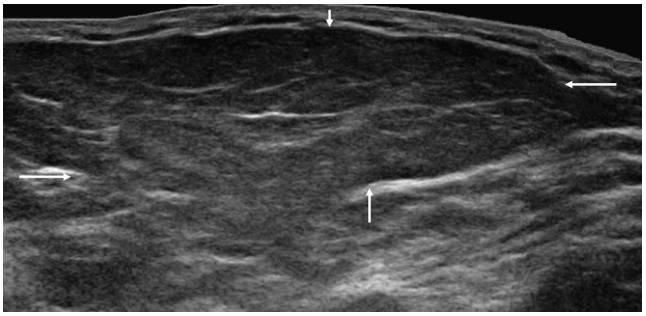

Figure 26. Inguinal subcutaneous lipoma. Extended field-of-view image, showing a mildly hyperechoic mass (arrows) with thin internal echogenic lines in the subcutaneous layer of the groin. The features are consistent with a lipoma.

tumour usually is relatively homogenous and hypoechoic, with good transmission in appearance (Figure 27). Other benign tumours include nerve sheath tumour (Figure 28) and sebaceous cyst. Primary sarcomas of the abdominal wall are very rare. Metastatic tumours are more common but still rare, usually from melanoma, lymphoma, or gastric carcinoma.

The ultrasound appearances of most solid masses are nonspecific and biopsy is usually required for definitive diagnosis. Sometimes, benign pathology such as fat necrosis (Figure 29) and calcified granuloma (Figure 30) can mimic neoplasm. Fat necrosis occurs after trauma and is described in association with a variety of medical conditions [13,14]. Fat necrosis has varied sonographic appearances, from well-defined isoechoic mass with a hypoechoic halo to a poorly defined hyperechoic region in the subcutaneous fat and usually resolved on follow-up imaging. The calcified granuloma usually presents after previous insult (trauma or infection) and gives a calcified lesion with strong acoustic shadowing. There usually is no significant interval change in size and appearance in follow-up scan.

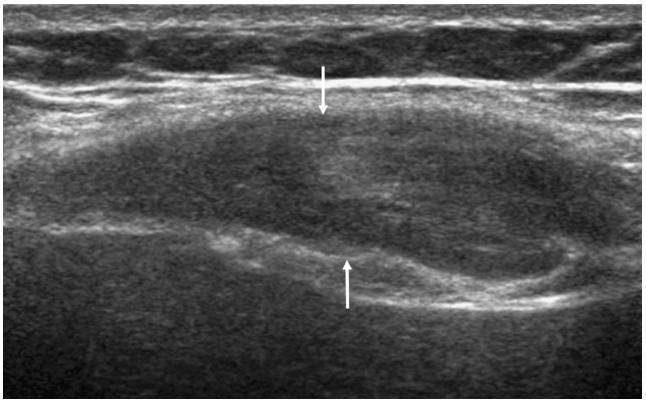

Figure 27. Abdominal wall fibromatosis (desmoid tumour). Transverse sonogram of the anterior abdominal wall, showing a well-defined hypoechoic lesion (arrows) with a smooth border in the muscle layer of the anterior abdominal wall. Ultrasound-guided biopsy yielded material diagnostic of fibromatosis.

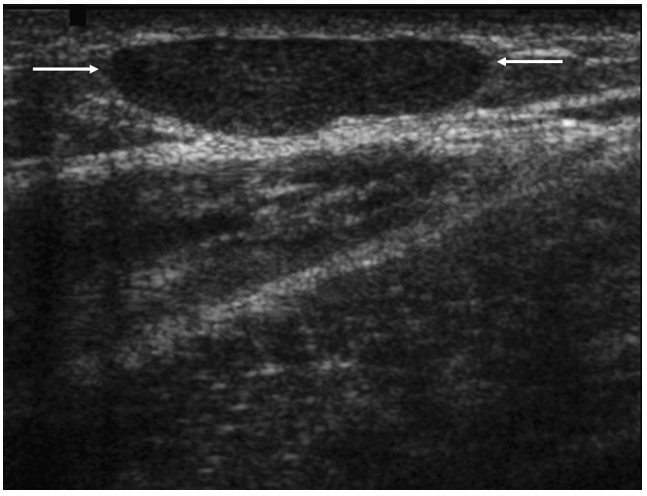

Figure 28. A neurofibroma in the abdominal wall. The patient had a history of neurofibromatosis type I. There is a well-defined hypoechoic lesion (arrows) in the anterior abdominal wall, compatible with neurofibroma.

Conclusion

High-resolution sonography is an accurate, noninvasive, and rapid technique for evaluating abdominal wall and groin pathology. The interactive real-time capability enables accurate correlation with clinical symptoms and signs. The majority of abdominal wall and groin pathology can be readily and accurately identified.

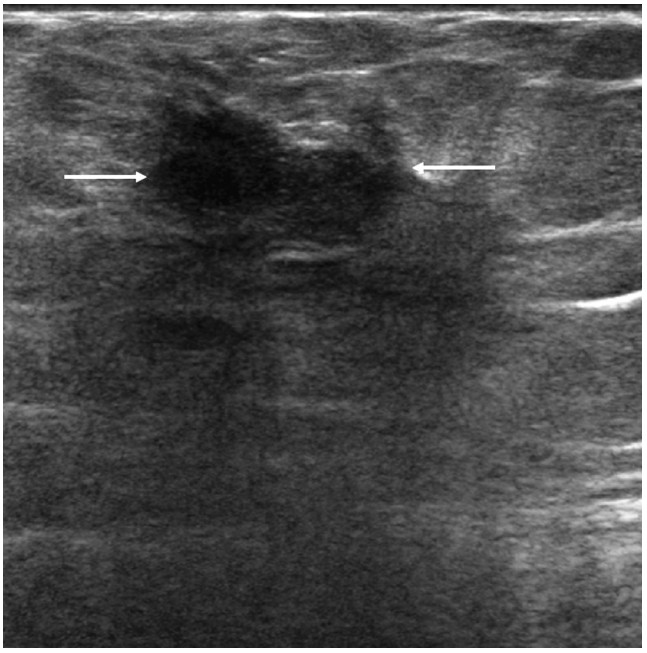

Figure 29. Fat necrosis of the abdominal wall. The patient presented with abdominal wall pain and a mass. Transverse sonography, showing an ill-defined hypoechoic lesion (arrows) with posterior shadowing at the anterior abdominal wall. A biopsy specimen revealed fat necrosis.

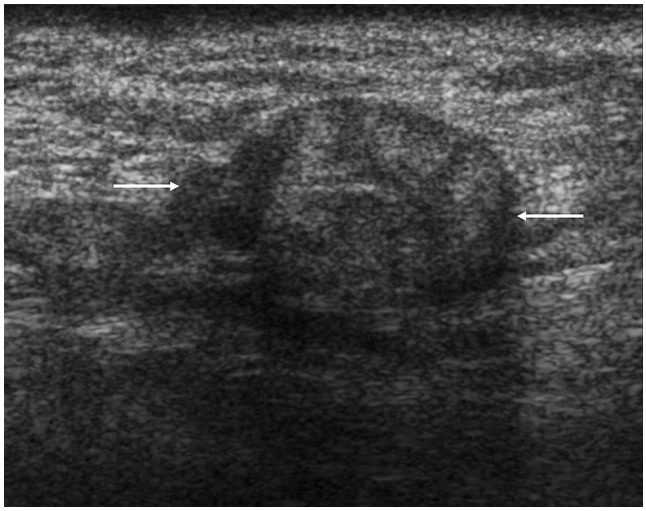

Figure 30. A scar granuloma. The patient had a history of a laparotomy for complicated cholecystitis and presented with an abdominal wall mass 6 months after the surgery. Transverse sonography, showing a well-defined hypoechoic lesion (arrows) with acoustic shadowing at the surgical scar suggestive of scar granuloma and confirmed with clinical follow-up, which showed no serial change in 5 years.

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