Sonography of Inguinal Region Hernias

David A. Jamadar[1]
Jon A. Jacobson[1]
Yoav Morag[1]
Gandikota Girish[1]
Farhad Ebrahim[1]
Thomas Gest[2]
Michael Franz[3]

OBJECTIVE. The purpose of this article is to describe the anatomy of the inguinal region in a way that is useful for sonographic diagnosis of inguinal region hernias, and to illustrate the sonographic appearance of this anatomy. We show sonographic techniques for evaluating inguinal, femoral, and spigelian hernias and include surgically proven examples.

CONCLUSION. Understanding healthy inguinal anatomy is essential for diagnosing inguinal region hernias. Sonography can diagnose and differentiate between various inguinal region hernias.

A hernia is "the protrusion of a part or structure through the tissues normally containing it" [1], either through an opening in the tissues or via stretching of the tissue wall. External abdominal hernias are usually found in the inguinal region, where most are direct and indirect inguinal hernias and femoral hernias [2, 3]. Hernias may be associated with significant morbidity and even mortality [2, 4]. Although traditionally diagnosed clinically, hernias may be difficult to identify [4] and even more difficult to classify. Sonography is used to evaluate and differentiate inguinal hernias [5]. In this pictorial essay, we review anatomy, describe sonographic technique, and illustrate the common inguinal region hernias.

Anatomy

The inguinal region is composed of muscle and fascial layers (Fig. 1), and structures that traverse these layers are potential weak points. In the extreme lower abdominal region, the three lateral muscle layers (external oblique, internal oblique, and transversus abdominis) form an aponeurosis that extends toward midline over the rectus abdominis muscle. The lateral margin of the rectus abdominis muscle is marked by a fascial condensation, the linea semilunaris. The transversalis fascia is located deep in relation to these structures. The inguinal canal traverses these muscle and fascial layers, containing vascular and neural structures, and the spermatic cord (in men) or round ligament (in women).

The inguinal ligament, the folded and thickened lower border of the external oblique aponeurosis, attaches at the anterior superior iliac spine and pubic tubercle and medially forms the inferior floor of the inguinal canal. The posterior opening of the inguinal canal or deep inguinal ring (Fig. 2) is an anatomic defect in the transversalis fascia. The anterior opening of the inguinal canal or superficial inguinal ring is a triangle-shaped anatomic defect in the external oblique aponeurosis immediately superior and lateral to the pubic tubercle, where the contents of the inguinal canal can escape. Condensation of the internal oblique and transversus abdominis aponeuroses forms the conjoint tendon, and a reflection of the inguinal ligament forms the lacunar ligament (Fig. 2). The inferior epigastric artery originates from the external iliac artery proximal to the inguinal ligament, initially passing along the medial boundary of the deep inguinal ring, and ascends obliquely and medially to the rectus abdominis muscle.

When the posterior abdominal wall is viewed from within (Fig. 2), the inguinal ligament and the inferior epigastric artery divide the inguinal region into three primary anatomic areas. One area, called the inguinal or Hesselbach's triangle, is bounded inferiorly by the inguinal ligament, medially by the lateral margin of the rectus abdominis, and superiorly by the inferior epigastric artery. A second area, the femoral region, is inferior in relation to the medial aspect of the inguinal ligament, and a third area is lateral to the inferior epigastric artery and just above the inguinal ligament.

Keywords: abdominal imaging, gastrointestinal radiology, inguinal hernia, sonography

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[1]Department of Radiology, University of Michigan Hospitals, 1500 E Medical Center Dr., TC2910, Ann Arbor, MI 48109. Address correspondence to D. A. Jamadar (djamadar@umich.edu).

[2]Division of Anatomical Sciences, University of Michigan Medical School, Ann Arbor, MI.

[3]Department of Surgery, University of Michigan Hospitals, Ann Arbor, MI.

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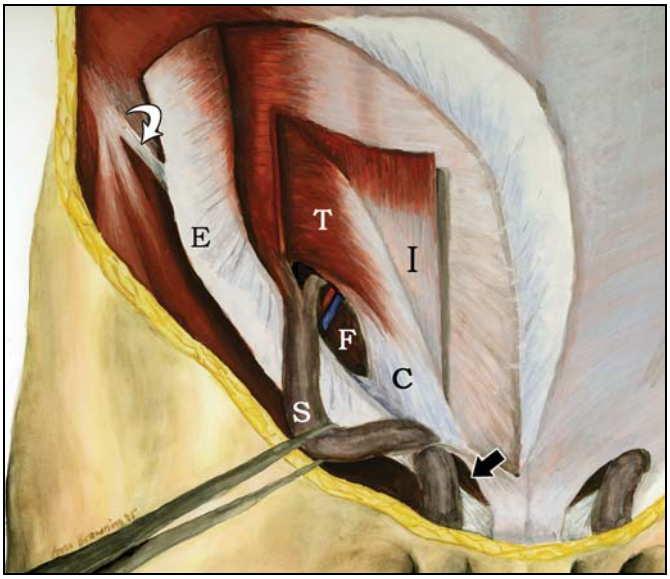

Fig. 1—Illustration of man's dissected right inguinal region from anterior view shows reflected external oblique aponeurosis (E), reflected internal oblique aponeurosis (I), and transversus abdominis muscle (T). Conjoint tendon (C) is medial to deep ring through which passes vas deferens and accompanying artery and vein to form spermatic cord (S). Note superficial ring (*straight arrow*), inguinal ligament (*curved arrow*), and transversalis fascia and extraperitoneal fat (F).

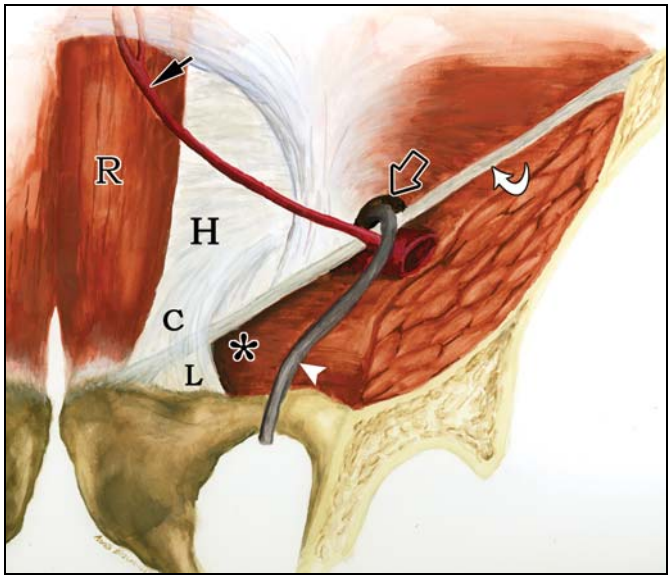

Fig. 2—Illustration of man's right inguinal region as viewed from within abdomen. Inferior epigastric artery (*solid straight arrow*), rectus abdominis muscle (R), and inguinal ligament (*curved arrow*) define boundaries of Hesselbach's triangle (H), location of direct hernia. Indirect inguinal hernia passes through deep ring (*open arrow*), which is lateral to inferior epigastric artery and above inguinal ligament. Location of femoral hernia (*asterisk*) is usually lateral to lacunar ligament (L) and inferior in relation to medial inguinal ligament. Note conjoint tendon (C) and vas deferens (*arrowhead*).

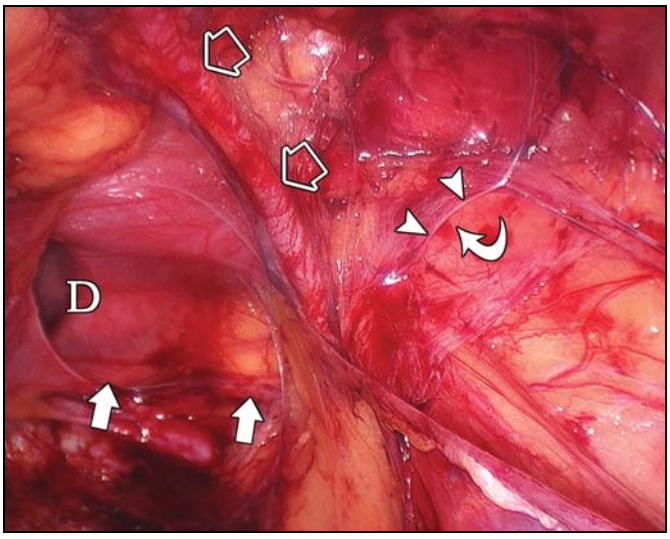

Fig. 3—57-year-old man with intraoperative laparoscopic view of right direct inguinal hernia. Open arrows show inferior epigastric artery and solid arrows show inguinal ligament, which define lateral and inferior boundaries of Hesselbach's triangle through which direct hernia defect (D) is distended by gas used during laparoscopy. Deep inguinal ring (*curved arrow*) is closed by gas pressure, but medial boundary (*arrowheads*) can be seen. Note that extraperitoneal fat obscures vas deferens, external iliac artery, and other anatomic details.

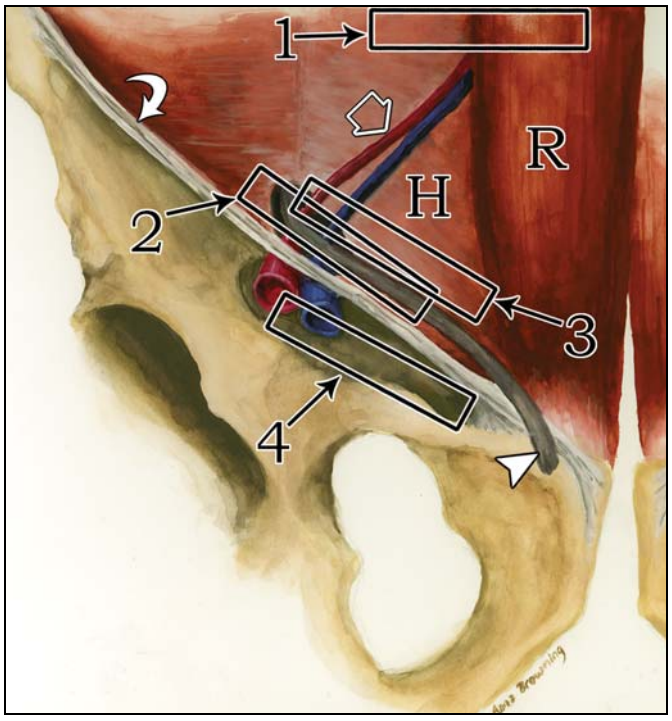

Fig. 4—Illustration of man's right inguinal region from anterior view shows transducer position to evaluate for spigelian hernia (1), indirect inguinal hernia (2), direct inguinal hernia (3), and femoral hernia (4). Note locations of inguinal ligament (*curved arrow*), rectus abdominis muscle (R), lateral boundary of Hesselbach's triangle (H) defined by inferior epigastric artery (*open arrow*), and spermatic cord (*arrowhead*).

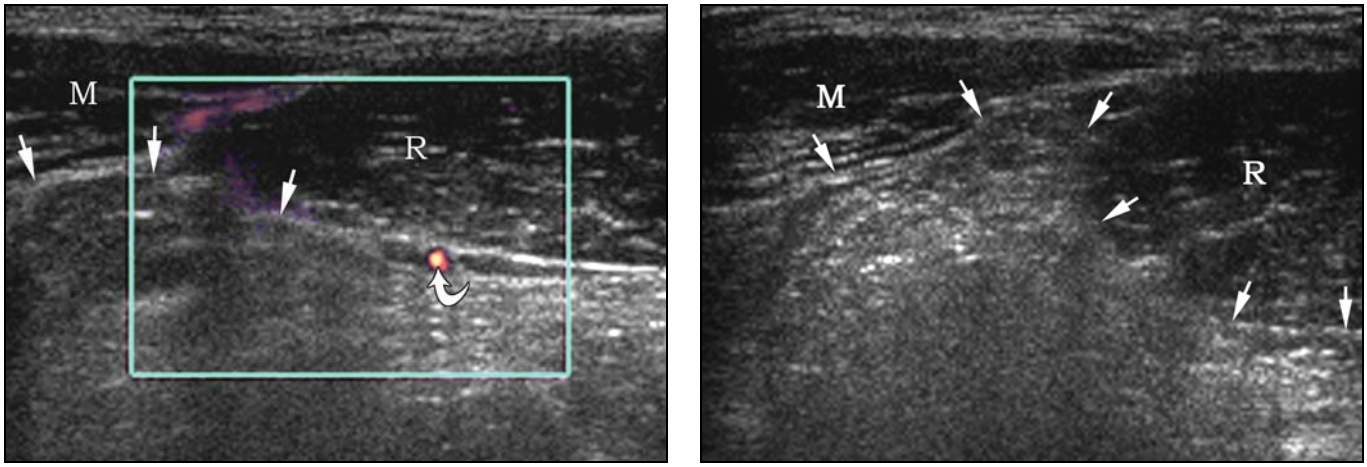

Fig. 5—25-year-old man with right spigelian hernia.
A, Pre-Valsalva maneuver sonogram over linea semilunaris in axial plane corresponding to transducer position 1 in Figure 4 (hernia not visible) showing right rectus abdominis muscle (R), inferior epigastric artery (*curved arrow*), peritoneal fat stripe (*straight arrows*), and lateral abdominal muscles (M).
B, Post-Valsalva maneuver sonogram in same location showing peritoneal fat stripe distorted by fat-containing spigelian hernia (*arrows*) at linea semilunaris. Note rectus abdominis muscle (R) and lateral abdominal muscles (M).

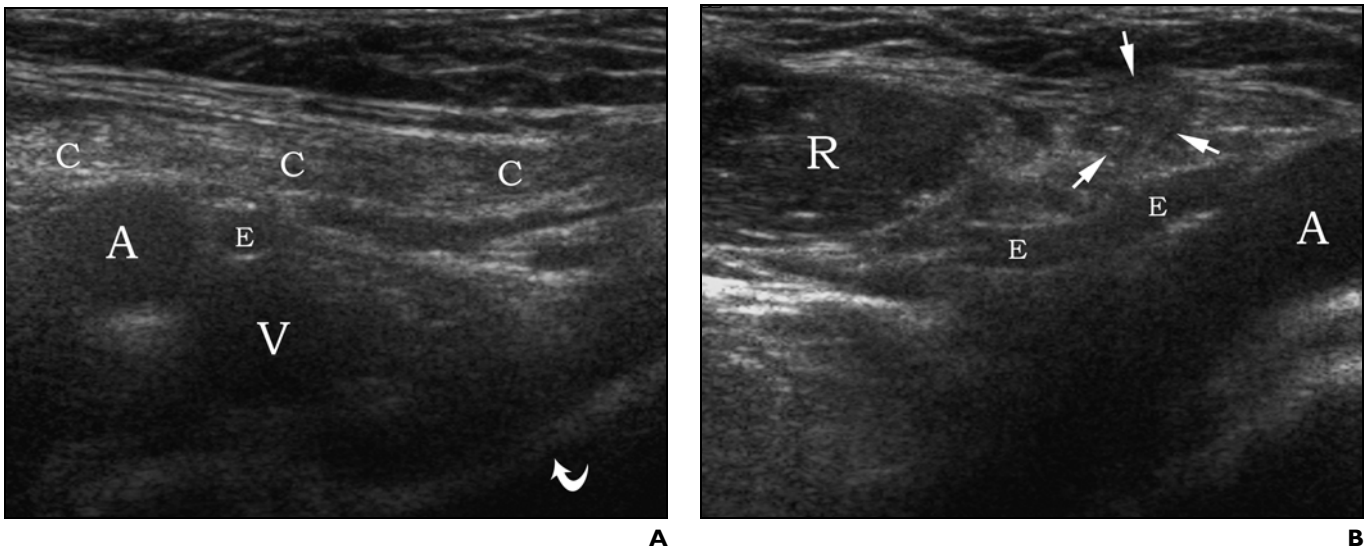

Fig. 6—40-year-old man with healthy right inguinal anatomy.
A, Sonogram of inguinal region parallel and cranial to inguinal ligament corresponding to transducer position 2 in Figure 4 shows spermatic cord (C), external iliac artery (A), inferior epigastric artery (E), femoral vein (V), and superior pubic ramus (*curved arrow*).
B, Sonogram of inguinal region (transducer position not illustrated in Fig. 4) directly over and parallel to inferior epigastric artery (E), spermatic cord short axis (*arrows*), external iliac artery (A), and rectus abdominis (R).

Pathology

By viewing the posterior wall of the inguinal region from within (Figs. 2 and 3), one can appreciate several sites prone to herniation. The first site is the deep inguinal ring, where an indirect inguinal hernia occurs. Here, herniated structures enter the inguinal canal lateral to the inferior epigastric artery and superior to the inguinal ligament, and extend for a variable distance through the inguinal canal. A second site of herniation is at the inferior aspect of the Hesselbach's triangle, where a direct inguinal hernia usually occurs. This weakened area is just lateral to the conjoint tendon and medial to the inferior epigastric artery, in contrast to the indirect inguinal hernia that originates lateral to the inferior epigastric artery. A third weakened area is inferior in relation to the inguinal ligament and lateral to the lacunar ligament, where a femoral hernia occurs, typically medial and adjacent to the femoral vessels. The fourth area is at the lateral margin of the rectus abdominis muscle, superior to the inferior epigastric artery as it crosses the linea semilunaris, where a spigelian hernia occurs. Indirect inguinal hernias are most common regardless of sex; femoral hernias are more common in women.

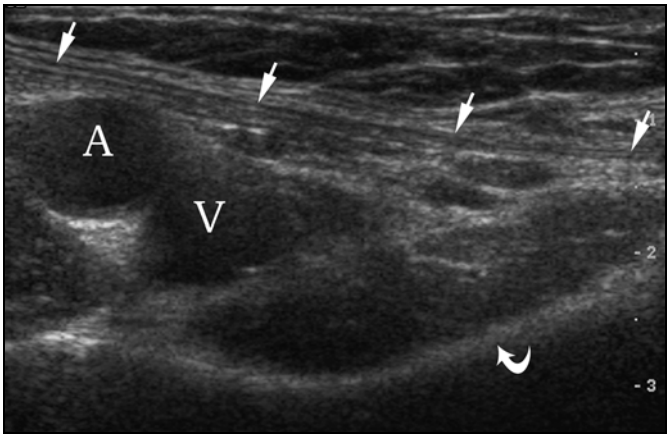

Fig. 7—40-year-old man showing healthy right inguinal anatomy. Sonogram of inguinal region parallel to and directly over inguinal ligament, distal to origin of inferior epigastric artery (transducer position not illustrated in Fig. 4). Note femoral artery (A), femoral vein (V), inguinal ligament (*straight arrows*), and superior pubic ramus (*curved arrow*).

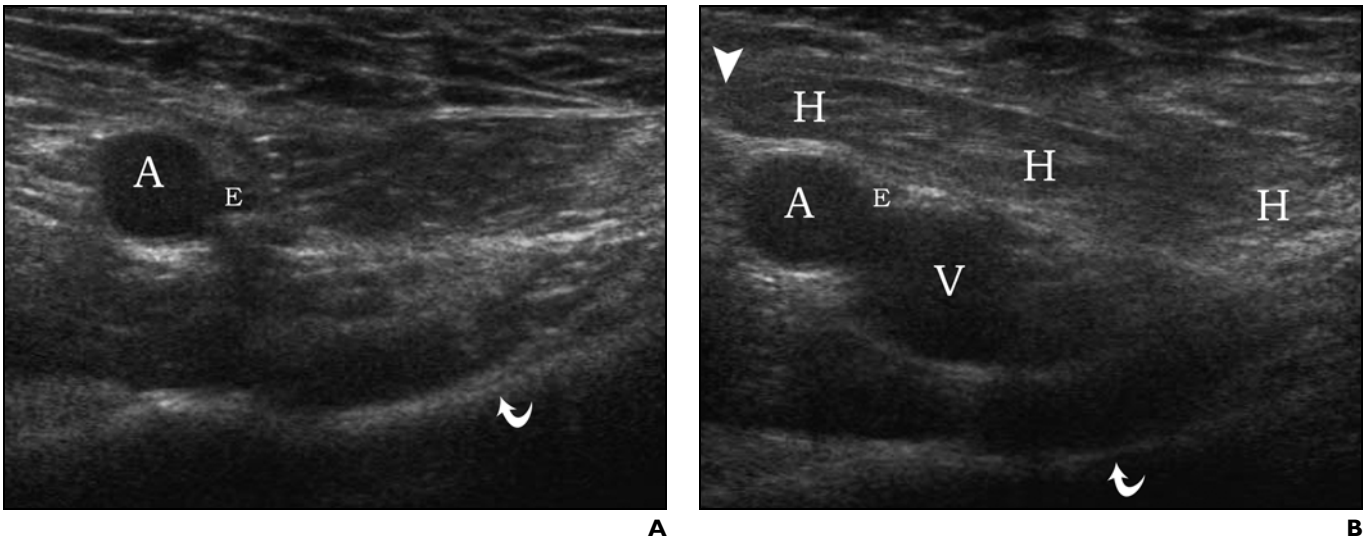

Fig. 8—30-year-old man with sonogram of right indirect inguinal hernia with transducer positioned parallel to and cranial to inguinal ligament corresponding to transducer position 2 in Figure 4.
A, Pre-Valsalva maneuver sonogram (hernia not visible) shows external iliac artery (A), inferior epigastric artery (E), and superior pubic ramus (*curved arrow*).
B, Post-Valsalva maneuver sonogram shows external iliac artery (A), inferior epigastric artery (E), dilated external iliac vein (V), superior pubic ramus (*curved arrow*), and indirect inguinal hernia (H) originating from lateral to external iliac artery (*arrowhead*) and traversing inguinal canal from lateral to medial. (Left = lateral)

Sonographic Technique and Appearances

Because the inguinal region structures are superficial, a linear transducer of 10 MHz or greater is effective, although in some patients with a larger body habitus a transducer of 7 MHz may be needed. In the obese, distortion of anatomy, the presence of pannus, and the sound-attenuating properties of adipose tissue may make indentifying the anatomy more difficult. Initially, examination of the inguinal region is done with the patient supine. It is essential to ask the patient to increase abdominal pressure (Valsalva maneuver) at each of the sonographic steps to identify transient hernias. The Valsalva maneuver is a critical component of the examination, because in many patients the hernia may be completely reduced at rest. In addition, the characteristic movement of the herniating tissues often clinches the diagnosis. This dynamic capability of sonography is an advantage when compared with other cross-sectional imaging techniques. Reexamination with the patient standing is also recommended if supine evaluation does not reveal herniation. Herniated bowel contents may show peristalsis, and herniated fat will appear hyperechoic. It is also important to evaluate for reducibility and bowel viability identified by peristalsis or mucosal blood flow.

Spigelian Hernia

The sonography examination for a spigelian hernia should begin at the lateral margin of the rectus abdominis (the linea semilunaris) in the transverse plane from the level of the umbilicus (Fig. 4). As the transducer is moved inferiorly, the inferior epigastric artery can be identified as it passes deep in relation to the lateral border of the rectus abdominis muscle. Just superior to this location, along the linea semilunaris, is the site where a spigelian hernia may occur (Fig. 5). The inferior epigastric artery is then followed inferiorly to the external iliac artery, defining the lateral boundary of Hesselbach's triangle (Fig. 4).

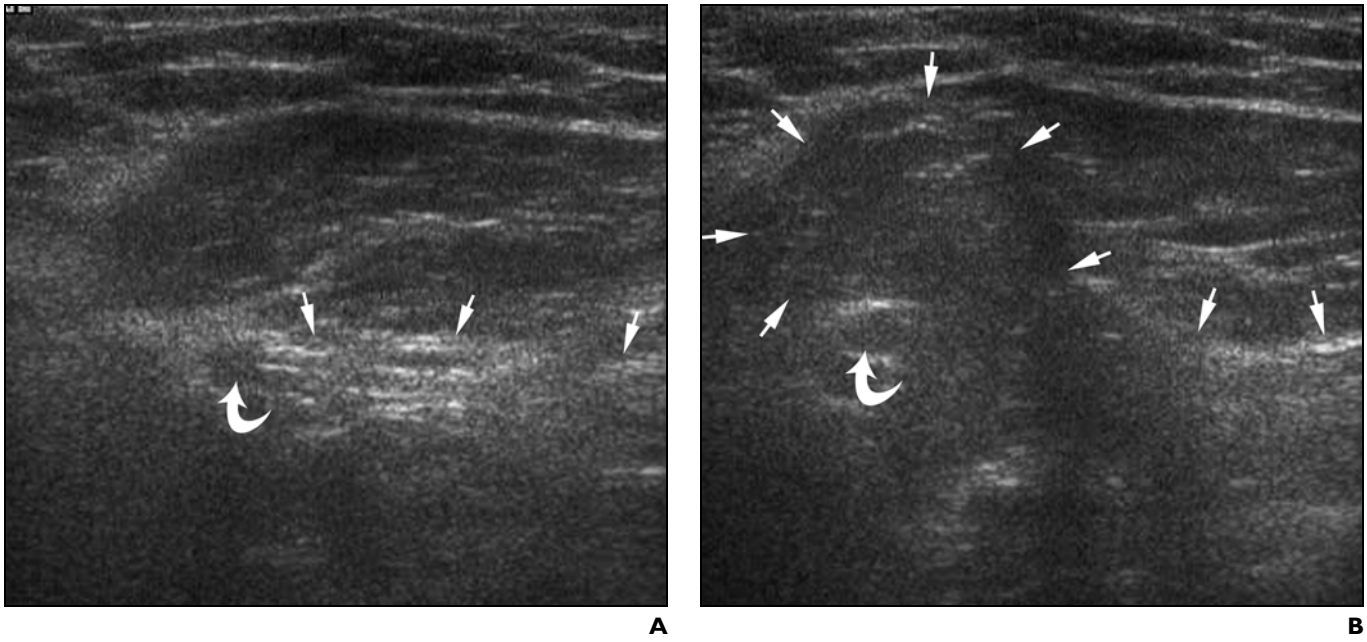

Fig. 9—39-year-old man with direct inguinal hernia. Sonogram of right inguinal region parallel to and cranial to inguinal ligament corresponding to transducer position 3 in Figure 4.
A, Pre-Valsalva maneuver sonogram shows (hernia not visible) peritoneal fat stripe (*straight arrows*) medial to inferior epigastric artery (*curved arrow*).
B, Post-Valsalva maneuver sonogram shows direct inguinal hernia deforming peritoneal reflection (*straight arrows*) medial to inferior epigastric artery (*curved arrow*). (Left is lateral, right is medial.)

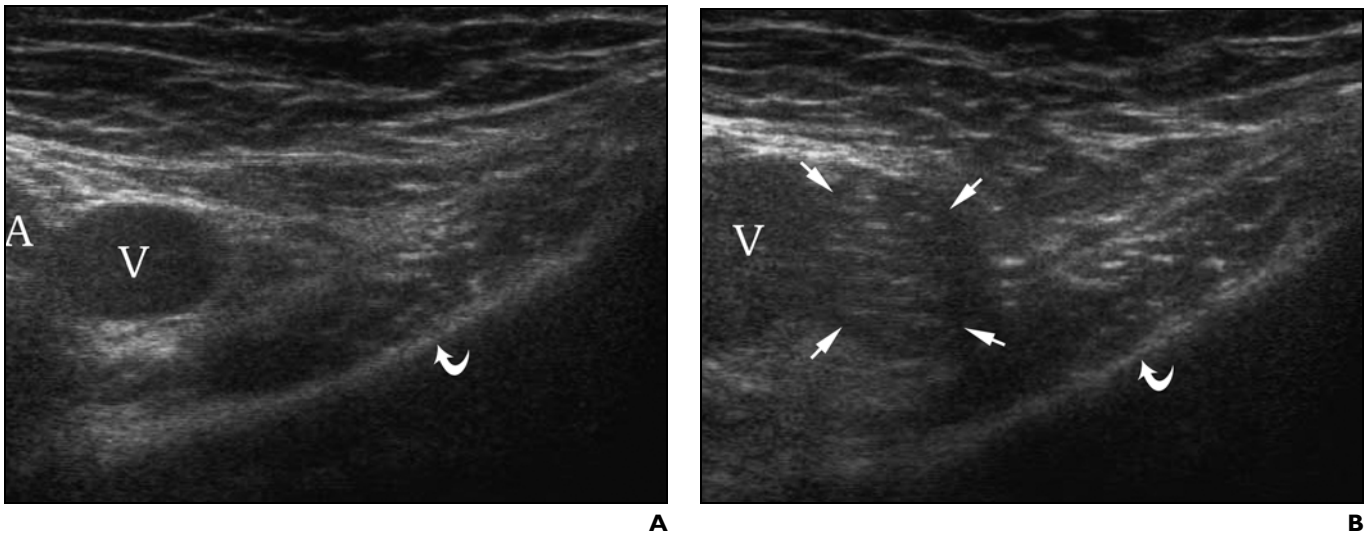

Fig. 10—31-year-old woman with femoral hernia. Sonogram of right inguinal region parallel to and caudad to inguinal ligament corresponding to transducer position 4 in Figure 4.
A, Pre-Valsalva maneuver sonogram shows (hernia not visible) femoral artery (A), femoral vein (V), and superior pubic ramus (*curved arrow*).
B, Post-Valsalva maneuver sonogram shows dilated femoral vein (V) lateral to femoral hernia (*arrows*). Superior pubic ramus (*curved arrow*) is also seen.

Indirect Inguinal Hernia

For an indirect inguinal hernia, once the transducer is positioned where the inferior epigastric artery originates from the external iliac artery, it is rotated obliquely so that the medial aspect is inferior, along the long axis of the inguinal ligament (Fig. 4). In men, the healthy spermatic cord can be seen in longitudinal and transverse planes as a heterogeneous hyperechoic structure with hypoechoic tubules and vascularity, originating from the internal inguinal ring (Fig. 6). This structure should be differentiated from the inguinal ligament (Fig. 7), which has a more compact fibrillar appearance, is taut extending from the ilium to the pubis, and is just inferior in relation to the internal

inguinal ring. With the transducer positioned longitudinal to the inguinal canal and visualizing the inferior epigastric artery at its origin, an indirect inguinal hernia can be seen protruding anteriorly toward the transducer from its origin lateral to the inferior epigastric artery. The herniated tissue then turns medially anterior to the inferior epigastric artery and extends inferomedially as it traverses and often distends the inguinal canal parallel to the skin surface (Fig. 8). An indirect inguinal hernia may reach the pubic tubercle and exit the superficial ring and may enter the scrotum in a man.

Direct Inguinal Hernia

Similar to indirect inguinal hernia evaluation, for a direct inguinal hernia the transducer is placed longitudinal to the inguinal canal and anterior to the inferior epigastric artery origin (Fig. 4). However, the transducer is moved medially because direct inguinal hernias originate medial to the inferior epigastric artery in Hesselbach's triangle. Imaging superior to the inguinal canal as well as in the orthogonal plane will ensure complete evaluation of Hesselbach's triangle. With the Valsalva maneuver, this hernia will protrude directly anteriorly toward the transducer (Fig. 9).

Femoral Hernia

Having evaluated the inguinal region superior to the inguinal ligament, the transducer is moved inferior to the inguinal ligament (Fig. 4), and the area medial to the femoral vein is evaluated for femoral hernia (Fig. 10). During the Valsalva maneuver, the femoral vein will normally dilate and should be differentiated from a femoral hernia.

Sports Hernia

The sports hernia has been inconsistently described in the literature. Proposed causes include a weak and dilated deep inguinal ring [6], a deficiency in the posterior wall of the inguinal canal [7], injury of the conjoint tendon or transversalis fascia [8], or another abnormality in the absence of a hernia [9]. It is possible that a sports hernia could represent several different pathologies common to a specific subset of patients.

Conclusion

The inferior epigastric artery at its origin is a critical anatomic landmark in differentiating indirect from direct inguinal hernias; a hernia originating lateral to the inferior epigastric artery is indirect, whereas one that is medial is direct. Femoral hernias characteristically occur medially to the femoral vein and inferiorly in relation to the inguinal ligament. Spigelian hernias occur at the lateral margin of the rectus abdominis superior to the inferior epigastric artery where it crosses the linea semilunaris. With an understanding of inguinal region anatomy and knowledge of the variety of hernias found in the inguinal region, sonographic diagnosis can assist the surgeon in managing this common clinical condition.

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