Imaging of Uterine Leiomyomas

Stephen Karasick,1 Anna S. Lev-Toaff,1 and Michael E. Toaff2

Advances in the medical and surgical treatment of uterine leiomyomas have stimulated interest in the imaging of these common tumors. The purpose of this essay is to illustrate the appearance of leiomyomas on images obtained with various techniques. The advantages of each technique in particular clinical circumstances are discussed.

Uterine leiomyomas (also called myomas and fibroids) are the most common solid uterine neoplasm, occurring in 20–40% of all women during their reproductive years [1]. They are well-circumscribed benign lesions composed primarily of smooth muscle with various amounts of fibrous connective
tissue. A pseudocapsule of areolar tissue containing one or two feeding vessels surrounds the tumor. As fibroids enlarge, they may outgrow their blood supply, resulting in ischemia and degeneration characterized as hyaline, cystic, myxomatous, fatty, or carneous. These tumors are estrogen dependent and usually regress after menopause. They are usually multiple. Leiomyomas occur most commonly in the myometrium of the uterine corpus, occasionally in the lower uterine segment, and rarely (3%) in the cervical region. According to their location with respect to the layers of the uterus, myomas are classified as submucous (under the endometrium), mural (within the myometrial wall of the uterus), or subserosal (projecting out of the uterine wall and covered by serosa). Many lesions are in a combined location (e.g., having both submucous and mural components). This classification is useful for both imaging and clinical purposes, because the signs and symptoms and the treatment options vary according to the location. From an imaging standpoint, location is also important in the differential diagnosis; for example, a subserosal pedunculated fibroid may mimic an adnexal mass. Also, a submucous fundal myoma may deform the uterine cavity so that it mimics a bicornuate uterus on hysterosalpingography.

**Plain Radiography**

Plain radiography of the abdomen and pelvis often does not show the uterine leiomyoma unless the tumor has undergone calcific degeneration. This type of degenerative change is more common with subserosal lesions, especially tumors with pedicles, and in leiomyomas in postmenopausal women. Occasionally, a large, nonspecific soft-tissue mass will be seen indenting the dome of the bladder or compressing the ureters at the pelvic brim, sometimes with dilatation of the

---

**Fig. 4**—Transvaginal sonogram shows large hypoechoic mass in endometrial cavity (arrows).

**Fig. 5**—Transvaginal sagittal sonogram shows endometrial echo ( cursors) draped over submucous fibroid (M). Posterior margin of mass is delineated (arrows).

**Fig. 6**—Transverse sonogram through fundal subserous myoma during third trimester of pregnancy shows signs of degeneration. Echo texture is heterogeneous, and several cystic spaces are present (arrows).

**Fig. 7**—Sagittal sonogram at 31 weeks' gestation shows large fibroid (black arrows) in lower uterine segment posteriorly. Note heterogeneous echo texture and cystic spaces (white arrow). Persistent transverse fetal lie necessitated cesarean section. Lower uterine segment and cervical fibroids are associated with increased use of cesarean delivery due to malpresentation and obstructed labor. B = bladder, F = fetus.

**Fig. 8**—Transverse transabdominal sonogram shows lobulated hypoechoic mass (arrows) inseparable from left side of uterine body (u). At surgery, a subserosal myoma extending into left broad ligament was found.
upper urinary tract. Irregular coarse calcifications in the pelvis are most often caused by uterine leiomyomas. Occasionally, circumferential calcification of the lesion may occur (Fig. 1).

Sonography

Sonography is ideal to confirm clinically suggested uterine fibroids. The most common sonographic appearance is of a hypoechoic (Fig. 2) or heterogeneous uterine mass. When multiple small leiomyomas are present, sonography may merely show globular uterine enlargement. Submucous or small mural leiomyomas may distort the normally linear central endometrial echo (Fig. 3). Occasionally, a large submucous myoma will be seen as a mass within the endometrial cavity (Fig. 4), with the endometrial echoes draped over the mass (Fig. 5). The sonographic texture of leiomyomas depends on the relative ratio of fibrous tissue to smooth muscle and on the presence and type of degeneration. Hence, leiomyomas may be minimally echogenic; irregular anechoic areas are seen if cystic degeneration is present. Clusters of high-level echoes with distal acoustic shadowing are quite common with calcific degeneration. Carneous degeneration during pregnancy may cause severe pain and appear sonographically as a heterogeneous pattern with cystic spaces within the fibroid [1] (Fig. 6). Fibroids located in the lower uterine segment and cervix are associated with a higher frequency of cesarean sections and retained placentas [2] (Fig. 7). Pedunculated subserosal leiomyomas extend laterally outward between the folds of the broad ligament (intraligamentary), simulating an adnexal mass (Fig. 8).

Transvaginal sonography provides detail that surpasses that of transabdominal sonography. Transvaginal imaging can detect very small lesions and provides better differentiation of a submucous from a mural lesion, as both may produce distortion of the endometrial echo. However, because of a limited field of view, subserosal or pedunculated fibroids may be missed, and the transvaginal approach should be used in conjunction with transabdominal sonography.

Hysterosalpingography

Hysterosalpingography is considered the gold standard for identification of a submucous leiomyoma. Submucous lesions can be seen as smooth (Fig. 9) or irregular (Fig. 10), single or multiple (Fig. 11) filling defects with or without gross distortion
Fig. 12.—Importance of early radiograph of uterine cavity in hysterosalpingography.  
A, Early filling radiograph shows large submucous fibroid in left corpus with lobulated margins (arrows).  
B, On later radiograph, mass is nearly obscured by dense contrast material.

Fig. 13.—Hysterosalpingogram shows fundal submucous fibroid (open arrows) associated with venous myometrial intravasation of contrast medium (solid arrows). Later radiographs showed filling of pelvic veins; together with fundal mass effect, these findings suggest a fibroid rather than adenomyosis.

Fig. 14.—Hysterosalpingogram shows small submucous fibroid (arrow) simulating endometrial polyp in lower uterine segment of anteflexed uterus.

Fig. 15.—Hysterosalpingogram shows globular enlargement of uterine cavity due to mural fibroids.

Fig. 16.—Large mural/submucous fibroid. Hysterosalpingogram shows large soft-tissue mass displacing uterus (U) to left. Crescentic impression on uterine cavity suggests a submucous component. Note elevation and draping of right fallopian tube (arrows) over mass.

of the uterine cavity. Attention to technique is important in the evaluation of leiomyomas; early filling radiographs of the uterus along with oblique views should be used (Fig. 12). The endometrium overlying some submucosal tumors is often thin or necrotic causing mucosal irregularity and venous myometrial intravasation (Fig. 13). Early vascular intravasation can resemble adenomyosis, but later films may show opacification of pelvic veins. Small submucous leiomyomas may be difficult to differentiate from endometrial polyps (Figs. 11A and 14). Submucous myomas, however, usually alter the uterine contour and size, whereas polyps are usually seen as a filling defect in an otherwise normal uterine cavity. Mural leiomyomas often enlarge the uterine cavity in a globular fashion (Fig. 15), and when they have a submucous component, they may produce an elongated or crescentic configuration to the uterine cavity (Fig. 16). Fundal leiomyomas can cause an increase in the distance between the two uterine cornua, simulating a bicornuate uterus (Fig. 17). Subserosal leiomyomas usually have no definite signs on hysterography, but they can be large and be seen as soft-tissue masses that...
deform the uterine cavity as well as compress, displace, and occlude the fallopian tubes (Figs. 18 and 19).

CT

The most common CT findings of leiomyoma are a deformed uterine contour and an enlarged uterus (Fig. 20). Leiomyomas usually display uniformly solid consistency (Fig. 21), but they may be heterogeneous (Fig. 20) because of hyaline or cystic degeneration [3]. The presence of calcification, usually a coarse dystrophic type, is the most specific sign of leiomyoma (Fig. 22). A necrotic or degenerating leiomyoma may be seen as a low-attenuating mass in the uterus. Rarely, a leiomyoma may become infected and its central core filled with gas or purulent fluid.

MR Imaging

MR imaging provides excellent visualization and localization of uterine leiomyomas [4]. Usually the lesions are well circumscribed and have medium-intensity signal similar to that of adjacent myometrium on T1-weighted images; on T2-weighted images (e.g., 1500/40 [TR/TE]), they usually have a homogeneous low-intensity signal (Fig. 23). Degenerating leiomyomas have various nonspecific MR appearances ranging from medium to high signal on T1-weighted images to a heterogeneous, mostly high signal in the area of degeneration on T2-weighted images (Fig. 24). In patients with large or multiple myomas, MR, with its multiplanar capability, is often the best study to precisely delineate the location of each mass (Figs. 23 and 25–27). In particular, MR images are ideal to show the proximity of a myoma to the bright endometrial...
Fig. 23.—Sagittal MR image (1500/40) shows numerous mural myomas (m). Other images confirmed displaced but intact endometrial echo. (CT scan of this patient is shown in Fig. 20.)

Fig. 24.—Large submucous fibroid with cystic degeneration. Midsagittal MR image (1500/40) of uterus shows large submucous fibroid (arrows) bulging into high-signal-intensity endometrial cavity (e). High signal intensity (asterisk) in center of fibroid indicates cystic degeneration. Additional myomas of low signal intensity are seen in cervix (f) and posterior corpus (F).

Fig. 25.—A, Hysterosalpingogram shows large polypoid filling defect (arrows) in cervical region. Cervical fibroids may be difficult to visualize unless they protrude into cervical canal. B, Sagittal MR image (1500/40) clearly depicts myoma (asterisk) in anterior cervix of retroverted uterus (solid arrows). High-intensity rim (open arrow) most likely is due to vascular congestion.

Fig. 26.—A, Sagittal MR image (1500/40) shows multiple low-signal-intensity masses in submucous (asterisk), mural (m), and subserous (s) locations. Note that submucous myoma impinges on endometrial signal. Another submucous myoma found at surgery was seen on other MR images. B, Hysterosalpingogram shows only two submucous myomas (m).
cavity (Fig. 24). Some leiomyomas are surrounded by a high-intensity rim on T2-weighted images (Fig. 25B), most likely resulting from local vascular congestion [5].

**Summary**

There is no single correct approach to evaluating uterine leiomyomas. Accurate assessment of the number, size, and location of leiomyomas, especially when myomectomy is planned, is important because it often influences the type of surgical approach. CT is not a first-line imaging study; however, it often shows leiomyomas in asymptomatic patients. Hysterosalpingography and transvaginal sonography are particularly useful in the diagnosis of submucous leiomyomas. This is fundamentally important because these tumors are often missed on clinical examination, at dilatation and curettage, and on transabdominal sonography, especially if the leiomyoma is small and the patient obese. Transvaginal sonography enables follow-up study of growth or shrinkage of the leiomyoma in response to medical treatment with a gonadotropin releasing hormone agonist. MR imaging may be superior to sonography and hysterosalpingography for preoperative localization of leiomyomas, particularly in patients with multiple or large tumors.

**REFERENCES**