A wide spectrum of radiological findings of uterine leiomyoma and the gynecologic disorders mimicking leiomyoma.

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Learning objectives

To illustrate typical and atypical imaging features of leiomyomas. To demonstrate some gynecologic disorders which mimick uterine leiomyomas. Finally we present a rare case with multiple pulmonary metastases which changes in wax and wane synchronized with a menstrual cycle.

Background

Uterine leiomyoma is the most common gynecologic neoplasm and its diagnosis is usually easy and definitive in most cases. However, some type of leiomyomas show atypical features as to location, CT and MRI findings and clinical course. We present various degenerated myomas such as hyaline, cystic ,red(hemorrhagic), myxoid, and lipoleiomyoma. Uterine leiomyomas are also classified into intramural, submucosal and subserosal. We especially focus on subserosal type with pedunculated leiomyomas as they have to be distinguished from ovarian tumors.

Submucosal myoma can be seen as prolapsed myoma in cervical canal or vagina.

We also show CT and MRI findings correlating with histopathological features. We will describe and illustrate a wide variety spectrum of radiological features of uterine leiomyoma particularly focusing on atypical cases.

Imaging findings OR Procedure details

Hyaline degeneration

Leiomyomas typically appear as distinct mass of low signal intensity relative to myometrium on T2-weighted images and of intermediate signal intensity on T1-weighted images. Most leiomyomas undergo some degree of degeneration, which contribute to various appearance on MR imaging. Hyaline degeneration occurs in more that 60% of uterine leiomyomas(Fig1). We present some types of degeneration as below.

Red generation(Fig2)
Red degeneration manifests typically in a pregnant woman. This is due to leiomyomas with hemorrhagic infarction and necrosis by intravenous obstruction, causing acute pain. This characteristic change reflects no enhancement midmost.

**Cystic degeneration**

Cystic degeneration is considered to be extremely sequel of edema which manifests as round, well-circumscribed area with fluid. MR findings are high signal intensity on T2-weighted images and low signal intensity on T1-weighted images with no enhancement (Fig 3).

**Myxoid degeneration**

Myxoid degeneration means soft mucoid areas, sometimes with cystic change (Fig 4). This type of degeneration may also be seen in leiomyosarcoma and other malignant tumors. It is estimated this is one of the reasons that give difficulties in distinguish degenerated leiomyomas from leiomyosarcomas.

**Lipoleiomyoma**

Lipoleiomyoma is an unusual leiomyoma with fat tissue (Fig 5). It is reported that the incidence of lipomatous tumors was 0.28% of all leiomyomas. The pathogenesis is obscure, but half of the cases had concomitant metabolic disease.

**Cellular leiomyoma**

Cellular leiomyoma is different from usual leiomyomas in high cellularity of smooth muscle cells. Cellular leiomyomas are composed of more smooth muscle cells and less intervening collagen tissue contrary to usual leiomyomas. This leads to higher signal intensity on T2-weighted images (Fig 6). In addition, various degenerated leiomyomas are also depicted as high signal intensity on T2-weighted images.

Although such various appearance of degenerated leiomyomas are benign tumors, their appearance is similar to malignant tumors including leiomyosarcoma (Fig 8).

**Leiomyosarcoma**

Leiomyosarcoma is a disease that has to be distinguished all the time (Fig 7).

It is often difficult to distinguish leiomyomas that show high intensity on T2-weighted image from malignant tumors on the basis of routine MR examination including diffusion-weighted imaging (DWI). However, apparent diffusion coefficient (ADC) measurement
may be helpful to distinguish malignant tumors, cellular leiomyomas and degenerated leiomyomas. But owing to various limitations, further studies are required.

**Appearance of leiomyomas depending on location**

Uterine leiomyomas are classified into intramural, submucosal and subserosal as to location. We especially focus on subserosal leiomyomas. As cellular leiomyoma and other degenerated leiomyomas, they show high signal intensity on T2-weighted images. In the case such leiomyomas are situated outer uterus with pedicle. It is important to distinguish pedunculated leiomyomas and ovarian tumors. We display some examples here.

Figure 9 shows similar findings to subserosal leiomyoma, but it is not necessary certain because ovaries are not detected and lack of bridging vascular sign. It is important to judge whether extrauterine mass is derived from ovaries or not for making precise diagnosis. MRI is the most useful modality for detecting ovaries and other anatomic location (Fig 10).

**Prolapsed leiomyoma** (submucosal leiomyoma)

Submucosal leiomyomas account for 5% in uterine leiomyomas. and prolapsed leiomyomas account for 2.5% in cases undergoing hysterectomy for uterine leiomyomas (Fig 11).

**Cervix leiomyoma**

Cervix leiomyoma is a term explains leiomyoma that is situated in cervix of the uterus (Fig 12).

It accounts for 8% of all leiomyomas. This condition matters in pregnancy (Fig 13).

**Torsion of a uterine leiomyoma**

Usual subserosal leiomyomas are usually non symptomatic, but can cause acute pain due to complete rotation of vascular pedicle of subserosal leiomyoma, which prevent venous outflow and arterial inflow. MRI is useful in detecting the relationship between ovaries and uterine pedicle.

MRI imaging of torsion are intermediate heterogenous signal on T2, high intensity on T1 and no enhancement after injection of gadolinium (Fig 14).
Benign metastasizing leiomyoma

Benign metastasizing leiomyoma is very rare disease that manifests unusual growth pattern of leiomyoma. Benign metastasizing leiomyoma is histologically explained as smooth muscle tumors in an organ other than the uterus. The lung is the most common affected organ and other sites include lymph nodes, peritoneum and retroperitoneum.

Leiomyoma is histologically benign, however it has potential to metastasize in a patient with a history of hysterectomy.

We present a case of benign metastasizing leiomyoma in 48 year old woman. Multiple bilateral well-defined pulmonary nodules were incidentally found on chest radiograph. She had a history of myomectomy 8 years before. On photomicrograph from uterine leiomyoma less than 4 mitoses per high power field are seen (Fig 16). After that the lung lesion was surgically enucleated for diagnosis. The immunohistochemical staining is consistent with smooth muscle cells (Fig 17). She was diagnosed as benign metastasizing leiomyoma.

Benign metastasizing leiomyoma is histologically highly differentiated with isolated mitoses, minimal atypical nuclei and absence of coagulative necrosis.

Images for this section:

Fig. 1: (a) Sagittal T2-weighted shows intramural leiomyoma of low density. (b) Photomicrograph (Hematoxylin-eosin stain) Stromal component separates the smooth
muscle cells and progress to extensive replacement of the smooth muscle cells by collagen.

**Fig. 2:** Leiomyoma with red degeneration in 39-year-old woman who consulted an internist because of acute lower abdominal pain. (a) Sagittal T2-weighted image shows high signal mass with low signal rim that is associated with hemorrhage. (b) T1-weighted axial shows high signal rim. Gadolinium-enhanced T1-weighted MR image shows midmost area of necrosis. (d) Photomicrograph (hematoxylin-eosin stain) shows hemorrhagic and necrotic area.
**Fig. 3:** Pedunculated leiomyoma with cystic degeneration. Cystic component are depicted high intensity on T2-weighted image with no enhancement (yellow arrow).

**Fig. 4:** Sagittal T2-weighted image shows well-circumbed mass in the myometrium with mixture of high and low intensity. Photomicrograph shows myxoid material is seen.
**Fig. 5:** Sagittal T2-weighted image shows distinct mass with high intensity. T1-weighted images show high intensity inside the leiomyoma. Photomicrograph (Hematoxylin-eosin stain) shows adipocytes in the leiomyoma.
Fig. 6: Sagittal T2-weighted image shows myometrial mass of heterogenous high signal intensity. The mass was pathologically proven as cellular leiomyoma.
**Fig. 7:** T2-weighted image shows heterogenous of iso signal intensity and high signal intensity. T1-weighted images show high signal intensity in the mass. Gadolinium T1-weighted images with fat suppression shows hemorrhage and necrotic changes.

![Fig. 7](image)

**Fig. 8:** (a) T2-weighted image shows distinct mass of high signal intensity within the posterior to the wall of the uterus. (b) After gadolinium injection, the mass is strongly enhanced contrary to the myometrium. MRI findings suggest the possibility of leiomyosarcoma, but the mass was histologically proven as cellular leiomyoma.

![Fig. 8](image)

**Fig. 9:** (a) Sagittal T2-weighted image shows well-circumscribed low intensity mass anterior to the uterus. (b) Gadolinium T1-weighted image with fat suppression shows weaker enhancement contrary to the myometrium.

![Fig. 9](image)
Fig. 10: Oblique T2-weighted image shows small multilocular cysts are around the mass. This finding is correspond to ovarian follicles, which means the mass is derived from the ovary.
**Fig. 11:** Sagital T2-weighted image shows pedunculated leiomyoma descended through orifice of uterus to diameter the vaginal canal.
**Fig. 12:** Sagittal T2-weighted image shows distinct leiomyoma which occupy cervix uterus.
Fig. 13: Intramural leiomyoma in the lower uterine segment in a 30-year-old-woman. MRI was performed for delivery planning. A cesarean section was performed because vaginal delivery was expected to be difficult.
Fig. 14: Sagittal T2-weighted images shows low density mass adjacent to the uterus. Axial T2-weighted images shows spiral signal between the mass and uterus. The mass is high signal on T1-weighted image and it is not enhanced on Gadolinium T1-weighted images with fat suppression. Yellow arrow shows spiral flow void that is correspond to twisted pedicle.
Fig. 15: CT shows well-circumscribed multiple nodules that vary in size according to a menstrual cycle. Some nodules became enlarged but the others decreased in size.
Fig. 16: Photomicrograph shows mitosis is seen indicated by black arrow in previously removed leiomyoma.
**Fig. 17:** Photomicrograph shows lung lesion enucleated surgically is composed of abundant smooth muscle cells. Immunoreactivity for smooth muscle actin and estrogen receptor express both positive.
Conclusion

Leiomyoma is the most common benign tumors in the uterus, however it shows various appearance that mimicks other uterine tumors and ovarian tumors including malignancy. We demonstrate uterine leiomyomas histopathologically proven particularly focusing on atypical imaging findings as to location, imaging feature and clinical course.

Personal Information

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