

Pathology Proven Benign Metastasizing Leiomyoma: A Case Report

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Authors' contributions

Ana Teresa Teixeira – Responsible for general data acquisition, writing the manuscript and collecting the images.

Raquel Dias – Performed the head CT scan and brain MRI and made the neurocysticercosis diagnosis. Collected and described the corresponding images.

Joana Ferreira – Processed the pathology specimens, captured and described the images, and wrote the corresponding sections in the manuscript.

Lúcia Correia – Responsible for the surgical approach.

Teresa Margarida Cunha – Responsible for the original conception of the article, data acquisition, supervision of the drafting and revision of the manuscript.

Consent

Written informed consent was obtained from the patient for publication of this case report.

Ethical Statement and Human and Animal Rights

The case report does not involve experiments on humans or animals. Hence not applicable.

Conflict of Interest

The authors declare no conflicts of interest or relevant financial associations related to this study.

ABSTRACT

Benign metastasizing leiomyoma is a rare entity characterized by well-differentiated leiomyomas found outside the uterus, typically the lungs. It primarily affects middle-aged women who have undergone surgical treatment for leiomyomas.

We describe a case of a 44-year-old African woman with a previous myomectomy, who was found to have multiple lung nodules, initially suspected for leiomyosarcoma. Histological examination following lung thoracoscopic resection and total hysterectomy with adnexectomy confirmed the diagnosis of benign metastasizing leiomyoma.

After surgery the patient experienced a seizure, and multiple cerebral nodules were detected, initially thought to represent extrapulmonary benign metastasizing leiomyomas, but later confirmed as neurocysticercosis, endemic in Africa.

Benign metastasizing leiomyoma diagnosis can be challenging and misinterpreted as malignancy. However, in the appropriate clinical setting, its inclusion among the differential diagnoses is essential.

CASE REPORT

CASE REPORT

A 44-year-old African woman was referred to our hospital for investigation of multiple lung nodules first identified on an external cervical computed tomography (CT) done for cervicalgia (Figure 1).

She complained of diffuse abdominal cramps and chest pain with deep inspiration. The patient was not a smoker and didn't have any family or occupational related history that contributed to her condition.

Regarding her obstetric and gynecological background, she had four pregnancies, with one successful vaginal birth, a preterm birth resulting in stillbirth, alongside with an ectopic pregnancy and a spontaneous abortion. Additionally, she underwent a myomectomy in Africa, four years earlier, of which it was not possible to obtain the surgical specimen.

Upon first examination, she was eupneic on room air, with no additional relevant findings.

While still at the previous hospital, a lung nodule biopsy was conducted and the findings were described as compatible with either leiomyoma or primary or secondary leiomyosarcoma.

IMAGING FINDINGS

A positron emission tomography (PET) scan from the previous hospital (Figure 2) confirmed the presence of countless pulmonary nodules, with overall weak/not significantly intense 18-fluorodeoxyglucose (FDG) uptake (max Standardized Uptake Value <2.5).

A thoracic, abdominal and pelvic CT scan was then performed (Figure 3) which showed, in addition to multiple pulmonary nodules already known, a globose uterus, with heterogeneous myometrium due to probable adenomyosis, which was associated with several hypodense and hypoenhancing nodules, possible leiomyomas, the largest posterior on the right, measuring 28 x 27 x 25 mm in larger diameters. There was no lymphadenopathy neither lytic or blastic bone lesions.

Given these findings, the study was complemented with a pelvic magnetic resonance imaging (MRI) which confirmed a globose uterus with diffuse adenomyosis and multiple leiomyomas, predominantly intramural and infracentimetric, in relation to diffuse uterine leiomyomatosis. Additionally, there was a bigger leiomyoma, anterior intramural, moderately T2-hyperintense, measuring 34 x 28 x 40 mm, with restricted diffusion, corresponding to a cellular leiomyoma (Figure 4).

MANAGEMENT AND FOLLOW-UP

The imaging findings along with the past clinical history and the previous lung nodule biopsy, which did not provide a definite diagnosis, suggested a differential diagnosis of primary or lung metastases from leiomyosarcoma versus benign metastasizing leiomyoma. Discussion of the case in a multidisciplinary

meeting resulted in a recommendation to obtain a larger lung sample and thus enable a final diagnosis. The patient underwent video-assisted thoracic surgery (VATS) with atypical resection of the left upper lobe.

A 4 x 2.5 x 2 cm specimen containing multiple white nodules ranging from 0.2 to 0.8 cm was obtained. Microscopically, short fascicles of eosinophilic spindle cells with cigar-shaped nuclei could be observed (Figure 5A). No atypia, mitosis or necrosis were seen. Smooth muscle marker expression (smooth muscle actin and desmin) was detected (Figures 5B-C), estrogen receptors were present and no immunoexpression of HMB-45, CD34, STAT6 or S100 was seen. A diagnosis of benign metastasizing leiomyoma was suggested.

A total hysterectomy with bilateral adnexectomy was performed. The uterus weighed 394 g. The myometrial wall was diffusely thickened (4.5 cm) due to multiple confluent small nodules with less than 1 cm and multiple white myometrial nodules could be observed, the largest measuring 3.7 cm with a hemorrhagic core (Figures 6 and 7). All the nodules were composed of short fascicles of eosinophilic bland spindle cells with cigar-shaped nuclei expressing smooth muscle markers. A diagnosis of leiomyomata and diffuse leiomyomatosis was rendered.

Curiously, 21 days after surgery, the patient develops a first episode of generalized seizure. A head CT scan (Figure 8) was performed and demonstrated multiple intraparenchymal punctate cystic lesions, some of these with surrounding vasogenic edema. Randomly distributed parenchymal grossly calcified micronodules were noted. The final report considered secondary lesions as the most likely diagnosis.

Brain MRI (Figure 9) later performed revealed multiple lesions in the grey-white matter junction involving both cerebral hemispheres, the basal ganglia and the posterior midbrain, without restricted diffusion, with ring-enhancement, some of these associated with vasogenic edema. Additionally, both on CT and MRI (in unenhanced T1-weighted images), almost all lesions contained a spontaneous hyperdense/intense nodule, the "cyst with dot sign", representing the scolex (larval head).

Considering the MRI and CT findings, along with the clinical presentation of seizures, a diagnosis of neurocysticercosis in the vesicular/colloidal vesicular phase was made.

The patient was prescribed levetiracetam therapy, which she continued upon discharge from our institution, with no recurrence of seizures. She was referred to an infectious disease consultation for further therapeutic adjustments.

DISCUSSION

Etiology & demographics

Since it was first described by Steiner in 1939, fewer than 200 cases of benign metastasizing leiomyoma (BML) have been reported [1,2].

This uncommon condition primarily affects middle-aged women, typically during the premenopausal period, who have undergone surgical management for leiomyomas. The average time between the primary surgery and the diagnosis of BML can extend up to 16 years [3-7]. As previously stated, our patient had a myomectomy in Africa, four years prior to the BML diagnosis.

Cases are also reported in women who have not undergone uterine surgery, as well as in men and children [8].

The pathogenesis of leiomyoma dissemination, however, remains unclear with several hypotheses proposed. The most commonly accepted refers to hematogenous spread of benign uterine leiomyoma cells following surgery, but the long interval between surgery and the diagnosis contradicts this notion.

Iatrogenic peritoneal seeding from ruptured leiomyoma during myomectomy or hysterectomy, although more reasonable to explain the incidence of pelvic BML, does not explain its onset in patients who have never had uterine surgery.

Another hypothesis states that BML develops in any site with coelomic epithelium in response to hormonal exposure, with differentiation and focal proliferation of myofibroblasts [7-10].

Other mechanisms to be considered include lymphovascular embolization and metastases from misdiagnosed low-grade uterine leiomyosarcomas [11].

Clinical & imaging findings

In BML, well-differentiated leiomyomas are found in sites remote from the uterus, presenting a rare histological variant of a benign tumor with metastatic potential.

Patients are frequently asymptomatic and the nodules are usually an incidental finding, following imaging tests performed for another reason [12]. The rest of the patients may have mild to moderate symptoms from lung involvement, such as cough, dyspnea, or chest pain, as was the case of our patient. In fact, the lung is the most frequent site of metastases (in 80% of cases), often presenting as multiple and bilateral nodules, which can be misinterpreted as metastatic lesions. Extrapulmonary lesions have also been documented in the heart, bones, lymph nodes, skin, peritoneum and central nervous system [11].

Imaging features of BML are non-specific [13]. On thoracic x-ray and CT, the lung nodules can range from solitary and small to large and multiple, and may cavitate, leading to thin-walled or thick-walled cysts [14,15]. Endobronchial and pleural sparing is characteristic.

An 18-FDG PET/CT scan may be useful in distinguishing between malignant leiomyosarcoma and benign leiomyoma. Several studies have shown a notable absence of 18-FDG uptake in BML. As in our case, the pulmonary lesions lacked

significant FDG uptake. Additionally, the Standardized Uptake Value (SUV) of leiomyosarcomas is consistently higher than that of leiomyomas. However, the diagnostic accuracy in this regard is challenged by numerous reports of 18-FDG avid leiomyomas [16].

Given these limitations, imaging-guided biopsy is often required to make a definitive diagnosis.

The immunohistochemical profile of BML is positive for actin, desmin, and smooth muscle actin and has low Ki-67 expression [12]. The presence of estrogen and progesterone receptors indicates that BML originates from the female reproductive system, supporting the justification for hormonal therapy as a therapeutic option [17].

After surgery, our patient experienced a seizure episode followed by the detection of multiple brain nodules on contrast-enhanced CT. This raised initial suspicion that these lesions could represent metastases from BML.

Although it represents a rare site of metastatic spread, brain parenchymal involvement has been reported in BML [18].

However, the brain MRI findings were consistent with neurocysticercosis, a neurologic disorder caused by the encysted larva of the pork tape-worm, *Taenia solium*. It is the leading cause of acquired epilepsy in endemic regions, such as Africa, where our patient was from [19].

Treatment & prognosis

Due to its rarity, there are currently no established treatment guidelines for BML. Clinical management varies from patient monitoring to surgical resection with oophorectomy or hormonal therapies including estrogen receptor modulators, aromatase inhibitors and gonadotropin-releasing hormone analogues. The choice of hormonal therapy is supported by the usual presence of estrogen and progesterone receptors in these lesions, further reinforcing the hypothesis of coelomic mesenchymal tissue differentiating into muscle tissue under hormonal exposure [12].

The prognosis of BML is usually favorable as the growth rate of these tumors is slow. However, progression and the appearance of new lesions may occur, and so surveillance and careful follow-up are recommended.

Differential diagnoses

As BML typically presents through solitary or multiple lung nodules, its spectrum of differential diagnoses must encompass lung metastases, including metastases from uterine leiomyosarcoma, which are characterized by the presence of atypia, necrosis, nuclear pleomorphism and high mitotic activity, all of which were features that were absent in the specimens obtained from our patient. On CT, they may appear as a pulmonary mass or exhibit a 'cannonball' pattern, involving multiple sites due to the hematogenous spread characteristic of sarcoma tumors [10,20].

Primary pulmonary leiomyosarcomas are extremely rare and clinically aggressive tumors, likely originating from the smooth muscle cells found within the lung interstitium, bronchial tree or blood vessel walls. Primary lung leiomyosarcoma presents as a solitary well-circumscribed, heterogeneous nodule with smooth margins or large necrotic masses, in a non-smoker. Our patient presented countless solid pulmonary nodules, making this diagnosis less likely [21].

BML lesions may cavitate and therefore mimic lymphangiomyomatosis. They distinguish themselves from lymphangioliomyomatosis by their peripheral location within the lung parenchyma and the lack of airway and lymphovascular involvement. Additionally, on immunohistochemical staining, these cells exhibit positivity for estrogen/ progesterone receptors but do not express HMB-45 antibody, which favors lymphangioliomyomatosis [17].

Lymphangioliomyomatosis is a slowly progressive lung disease associated with mutations in the tuberous sclerosis genes complex that mainly affects young women of reproductive age, resulting in cystic remodeling of the lung parenchyma [22].

More rarely, rheumatoid nodules, sarcoidosis and amyloidosis may also be considered. Depending on the location of the metastases, additional differential diagnoses may be included.

TEACHING POINT

Benign metastasizing leiomyoma is a rare entity characterized by well-differentiated leiomyomas found outside the uterus, usually in middle-aged women with previous surgery for leiomyomas, and typically in the lungs, presenting with nodules that can range from solitary and small to large and multiple, and may cavitate, characteristically with endobronchial and pleural sparing.

Therefore, it should be considered in the differential diagnosis for women presenting with multiple pulmonary nodules, especially those with a history of uterine leiomyomas.

QUESTIONS

Question 1

Which of the following is false regarding benign metastasizing leiomyoma (BML)?

1. Generally impacts middle-aged women before menopause
2. Previous surgery for leiomyomas is a known risk factor
3. The median duration between the initial surgery and the diagnosis may span up to 5 years (applies)
4. Its pathogenesis is still not established
5. It is defined by the presence of well-differentiated leiomyomas outside the uterus

Explanation:

1. BML is commonly diagnosed in premenopausal middle-aged women [This uncommon condition primarily

affects middle-aged women, typically during the premenopausal period, who have undergone surgical management for leiomyomas].

2. A history of previous surgical management for leiomyomas (myomectomy or hysterectomy) is an established risk factor [This uncommon condition primarily affects middle-aged women, typically during the premenopausal period, who have undergone surgical management for leiomyomas].

3. The average time elapsed between the initial surgery for leiomyomas and the diagnosis of BML varies, but can extend up to 16 years [The average time between the primary surgery and the diagnosis of BML can extend up to 16 years].

4. BML pathogenesis remains unknown [The pathogenesis of leiomyoma dissemination remains unclear with several hypotheses proposed].

5. In BML, leiomyomas can be found in sites remote from the uterus, for example in the lungs, heart or bones [In BML, well-differentiated leiomyomas are found in sites remote from the uterus, presenting a rare histological variant of a benign tumor with metastatic potential], [Extrapulmonary lesions have also been documented in the heart, bones, lymph nodes, skin, peritoneum and central nervous system].

Question 2

In benign metastasizing leiomyoma (BML), which of the following is the most common location where leiomyomas are found outside the uterus?

1. Bones
2. Lung (applies)
3. Brain parenchyma
4. Skin
5. Lymph nodes

Explanation:

1. Although there are published cases of BML with bone metastases, these are extremely rare [Extrapulmonary lesions have also been documented in the heart, bones, lymph nodes, skin, peritoneum and central nervous system].

2. Lung is the most common site for leiomyomas to be found outside the uterus in BML [In fact, the lung is the most frequent site of metastases (in 80% of cases), often presenting as multiple and bilateral nodules, which can be misinterpreted as metastatic lesions].

3. Although there is at least one published case regarding brain parenchyma involvement in BML, this is an extremely rare location for metastatic spread [Although it represents a rare site of metastatic spread, brain parenchymal involvement has been reported in BML].

4. Although cases of cutaneous metastases in BML have been reported, they are extremely rare [Extrapulmonary lesions have also been documented in the heart, bones, lymph nodes, skin, peritoneum and central nervous system].

5. Lymph node involvement in BML although possible is rare [Extrapulmonary lesions have also been documented in the heart, bones, lymph nodes, skin, peritoneum and central nervous system].

Question 3

A 44-year-old woman presents with multiple bilateral incidentally found, well circumscribed, lung nodules on CT scan. She had a previous myomectomy at age 35. A lung biopsy is performed and on immunohistochemical staining, the lesion is positive for actin, smooth muscle actin, and estrogen and progesterone receptors, but do not express HMB-45 antibody. The Ki-67 expression is low. What is the most likely diagnosis?

1. Lymphangioliomyomatosis
2. Lung metastases from uterine leiomyosarcoma
3. Primary pulmonary leiomyosarcoma
4. Sarcoidosis
5. Benign metastasizing leiomyoma (BML) (applies)

Explanation:

1. The differential diagnosis with lymphangioliomyomatosis is considered mainly when the lung nodules are cavitated. The different radiological pattern on CT and the absence of HMB-45 antibody helps the diagnosis [BML lesions may cavitate and therefore mimic lymphangioliomyomatosis. They distinguish themselves from lymphangioliomyomatosis by their peripheral location within the lung parenchyma and the lack of airway and lymphovascular involvement. Additionally, on immunohistochemical staining, these cells exhibit positivity for estrogen/ progesterone receptors but do not express HMB-45 antibody, which favors lymphangioliomyomatosis].

2. In the appropriate clinical setting they may be suspected. Like BML they can be multiple but typically exhibit a 'cannonball' pattern and more aggressive features on histopathology [As BML typically presents through solitary or multiple lung nodules, its spectrum of differential diagnoses must encompass lung metastases, including metastases from uterine leiomyosarcoma, which are characterized by the presence of atypia, necrosis, nuclear pleomorphism and high mitotic activity, all of which were features that were absent in the specimens obtained from our patient. On CT, they may appear as a pulmonary mass or exhibit a 'cannonball' pattern, involving multiple sites due to the hematogenous spread characteristic of sarcoma tumors].

3. Unlike BML, typically presents as a solitary nodule/ mass [Primary pulmonary leiomyosarcomas are extremely rare and clinically aggressive tumors, likely originating from the smooth muscle cells found within the lung interstitium, bronchial tree or blood vessel walls. Primary lung leiomyosarcoma presents as a solitary well-circumscribed, heterogeneous nodule with smooth margins or large necrotic masses, in a non-smoker].

4. Sarcoidosis, as other systemic diseases affecting the lungs through multiple nodules must be considered in the differential [More rarely, rheumatoid nodules, sarcoidosis and amyloidosis may also be considered.].

5. Typically presents though multiple lung nodules that show benign features on histopathology analysis, in a middle-aged woman with a previous surgery for leiomyoma [The immunohistochemical profile of BML is positive for actin, desmin, and smooth muscle actin and has low Ki-67 expression].

Question 4

Which of the following should not be considered in the therapeutic approach of patients with benign metastasizing leiomyoma (BML)?

1. Estrogen stimulation therapy (applies)
2. Estrogen receptor modulators
3. Surgery with bilateral oophorectomy
4. Clinical monitoring
5. Aromatase inhibitors

Explanation:

1. Although the pathogenesis of BML remains unclear, coelomic epithelium response to hormonal exposure with differentiation and proliferation of myofibroblasts is a considered hypothesis, reinforcing the importance of low hormone levels, not the opposite [The choice of hormonal therapy is supported by the usual presence of estrogen and progesterone receptors in these lesions, further reinforcing the hypothesis of coelomic mesenchymal tissue differentiating into muscle tissue under hormonal exposure].

2. Function as an estrogen receptor antagonist in some tissues [Clinical management varies from patient monitoring to surgical resection with oophorectomy or hormonal therapies including estrogen receptor modulators, aromatase inhibitors and gonadotropin-releasing hormone analogues].

3. Bilateral oophorectomy, particularly in these premenopausal women contributes to lower hormonal environment [Clinical management varies from patient monitoring to surgical resection with oophorectomy or hormonal therapies including estrogen receptor modulators, aromatase inhibitors and gonadotropin-releasing hormone analogues].

4. Close clinical monitoring is also a possibility [Clinical management varies from patient monitoring to surgical resection with oophorectomy or hormonal therapies including estrogen receptor modulators, aromatase inhibitors and gonadotropin-releasing hormone analogues].

5. Aromatase is involved in estrogen biosynthesis. Its inhibition lowers the hormonal stimulation [Clinical management varies from patient monitoring to surgical resection with oophorectomy or hormonal therapies including estrogen receptor modulators, aromatase inhibitors and gonadotropin-releasing hormone analogues].

Question 5

Which of the following shouldn't be found on histopathology analysis from a lung nodule biopsy in a patient with benign metastasizing leiomyoma (BML)?

1. Positivity for desmin
2. Positivity for smooth muscle actin
3. Low Ki-67 expression
4. Presence of estrogen/ progesterone receptors
5. Positivity for human melanoma black (HMB-45) antibody (applies)

Explanation:

1. In relation to the smooth muscle differentiation of leiomyomas [The immunohistochemical profile of BML is

positive for actin, desmin, and smooth muscle actin and has low Ki-67 expression].

2. In relation to the smooth muscle differentiation of leiomyomas [The immunohistochemical profile of BML is positive for actin, desmin, and smooth muscle actin and has low Ki-67 expression].

3. Describing the lack of aggressiveness in these tumors [The immunohistochemical profile of BML is positive for actin, desmin, and smooth muscle actin and has low Ki-67 expression].

4. Favors its gynecologic origin [The presence of estrogen and progesterone receptors indicates that BML originates from the female reproductive system, supporting the justification for hormonal therapy as a therapeutic option].

5. Human melanoma black (HMB-45) antibody is not expressed in BML [Additionally, on immunohistochemical staining, these cells exhibit positivity for estrogen/ progesterone receptors but do not express HMB-45 antibody, which favors lymphangioliomyomatosis].

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FIGURES

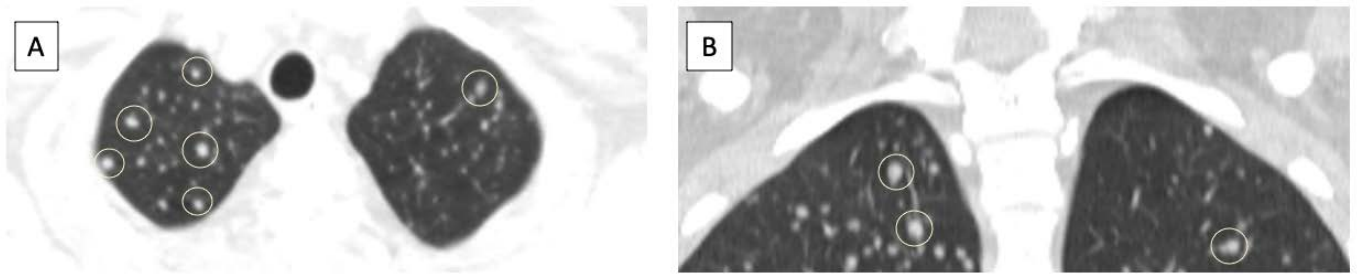


Figure 1: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Unenhanced cervical CT scan performed with 120kV, 339mAs, slice thickness 2mm in axial acquisition (A), then reformatted into coronal (B).
Findings: Axial (A) and coronal (B) images show multiple incidentally found lung nodules (some pointed with circles), bilateral, solid and infracentimetric, only partially intercepted in this study.

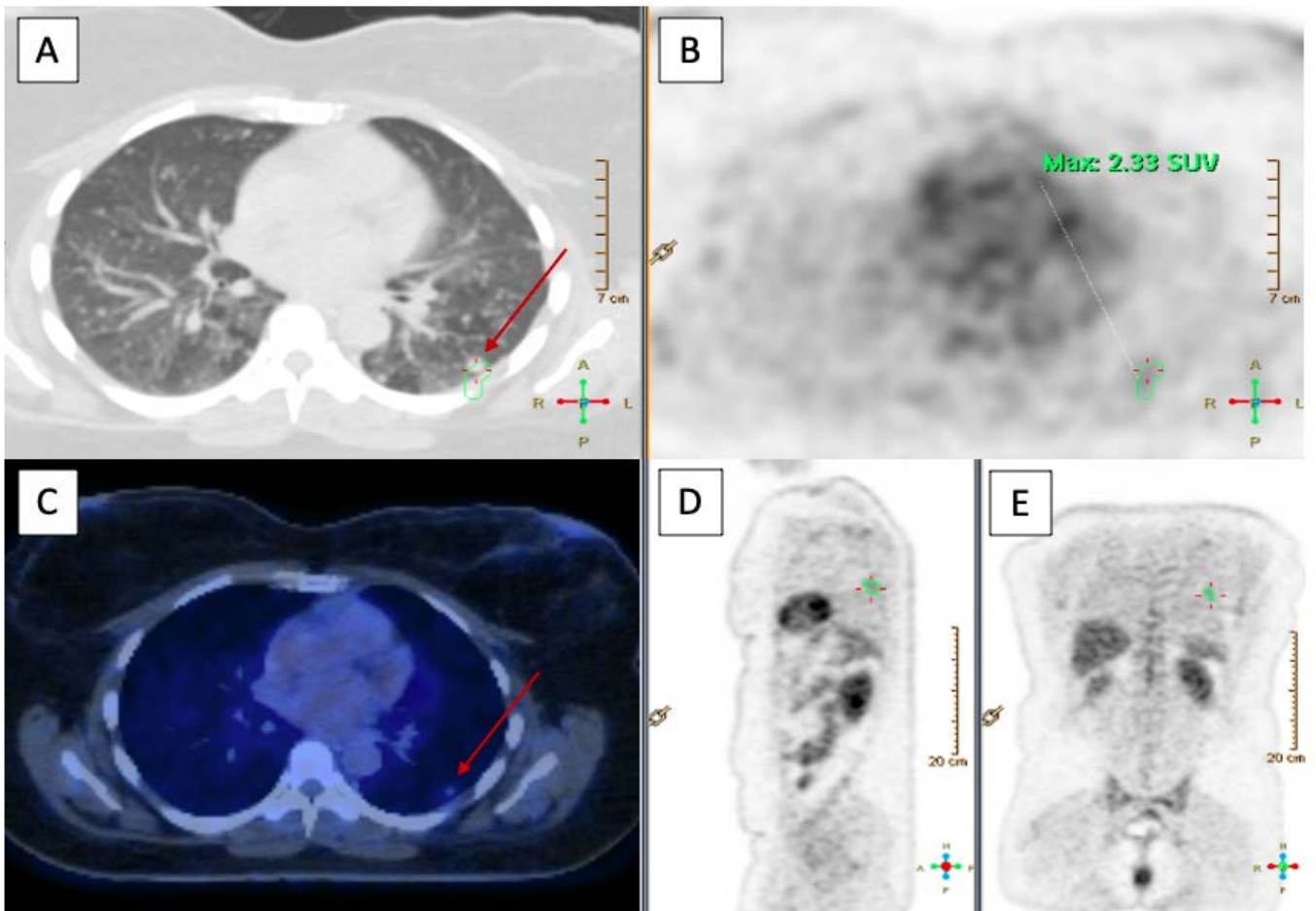


Figure 2: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Low dose CT scan performed with 120kV, 892mAs, slice thickness 4mm in axial acquisition (A) and total-body PET scan performed with 18-fluorodeoxyglucose with an activity of 321MBq, acquired in axial (B), fused axial (C), sagittal (D) and coronal (E).
Findings: The multiple lung nodules evident on the low-energy CT scan, including the biggest in the superior segment of the left lower lobe (arrow in A and C) lacked significantly intense FDG uptake on PET (analyzed area marked in A, B, D, E).

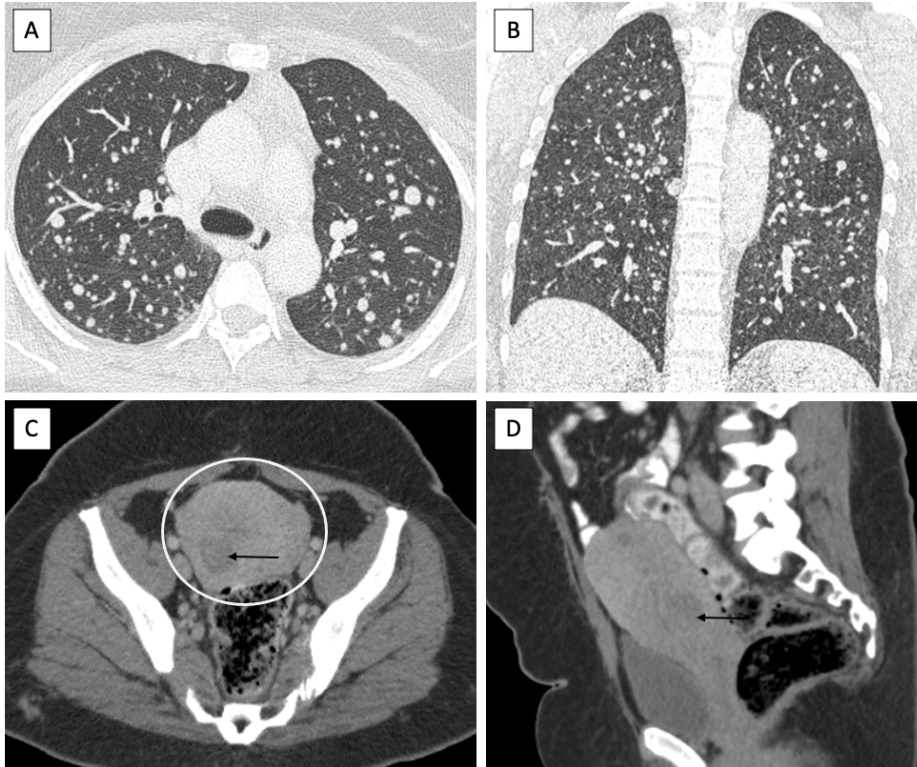


Figure 3: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Enhanced thoracic, abdominal and pelvic CT scan, acquired in portal phase, and performed with 120 kV, 347mAs, slice thickness 1mm for lung-window (A-B) and 3mm for small parts (C-D), in axial acquisition then reformatted into coronal and sagittal.
Findings: Axial (A) and coronal (B) lung images confirm the presence of innumerable soft tissue lung nodules, with smooth margins. Additionally, a globose uterus, with heterogeneous myometrium and several hypodense and hypoenhancing nodules, possible leiomyomas were seen, the largest posterior on the right (arrow in C and D). No lymphadenopathy, pleural effusion, or bone lesions were noted.

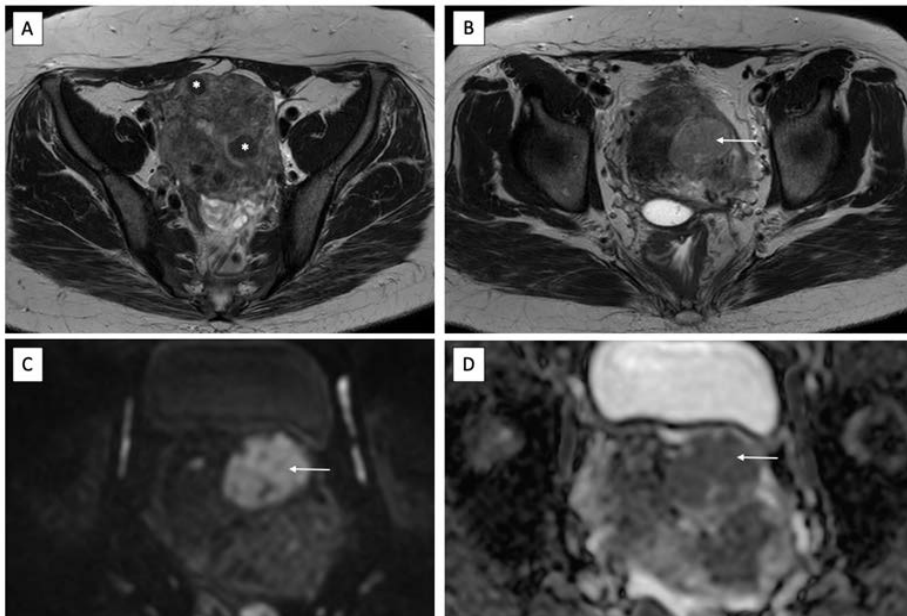


Figure 4: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Philips Ingenia 3T machine. A-B) Axial unenhanced T2-weighted image with TR-5798ms and TE-100ms. C) Axial diffusion weighted imaging (DWI) with $b = 1000$. D) Axial corresponding apparent diffusion coefficient (ADC). All sequences were acquired with slice thickness of 4mm.
Findings: Globose uterus with signs of diffuse adenomyosis and multiple leiomyomas, predominantly intramural and infracentimetric (*). A cellular leiomyoma (arrow) was also seen, anterior intramural, showing moderate hyperintensity on T2 (B) and restricted diffusion (C) with corresponding low ADC value (D).

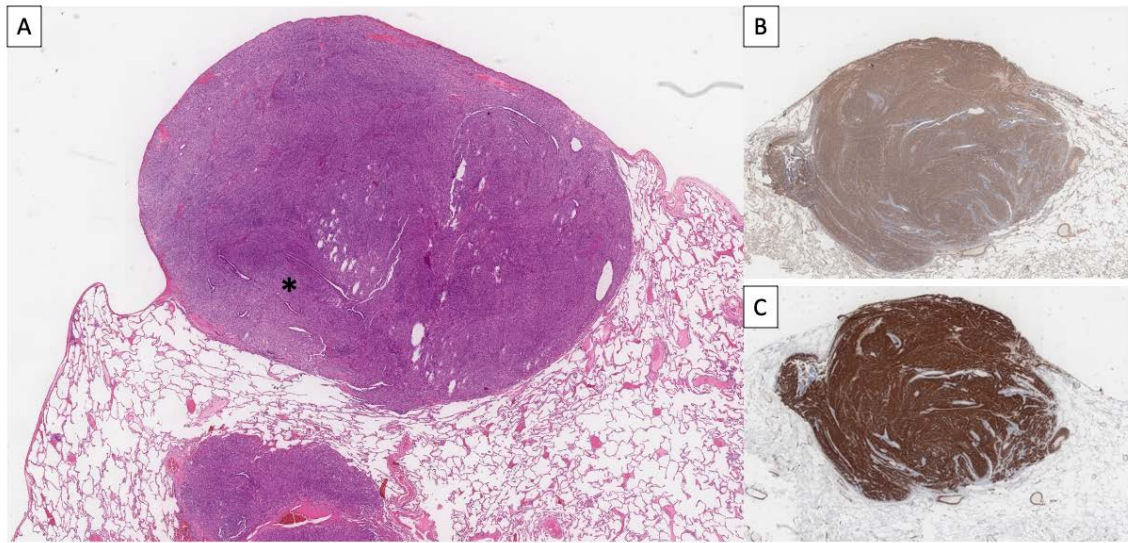


Figure 5: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Photomicrographs of the specimen obtained from atypical resection of the left upper lung lobe. A) Hematoxylin and eosin stain. B) Smooth muscle actin stain. C) Desmin stain.
Findings: Multiple well-defined nodules can be observed. They are composed of fascicles of bland spindle cells (*) that entrap normal respiratory mucosa. These cells express smooth muscle actin (B) and desmin (C) and do not express HMB-45, CD34, STAT6 or S100.

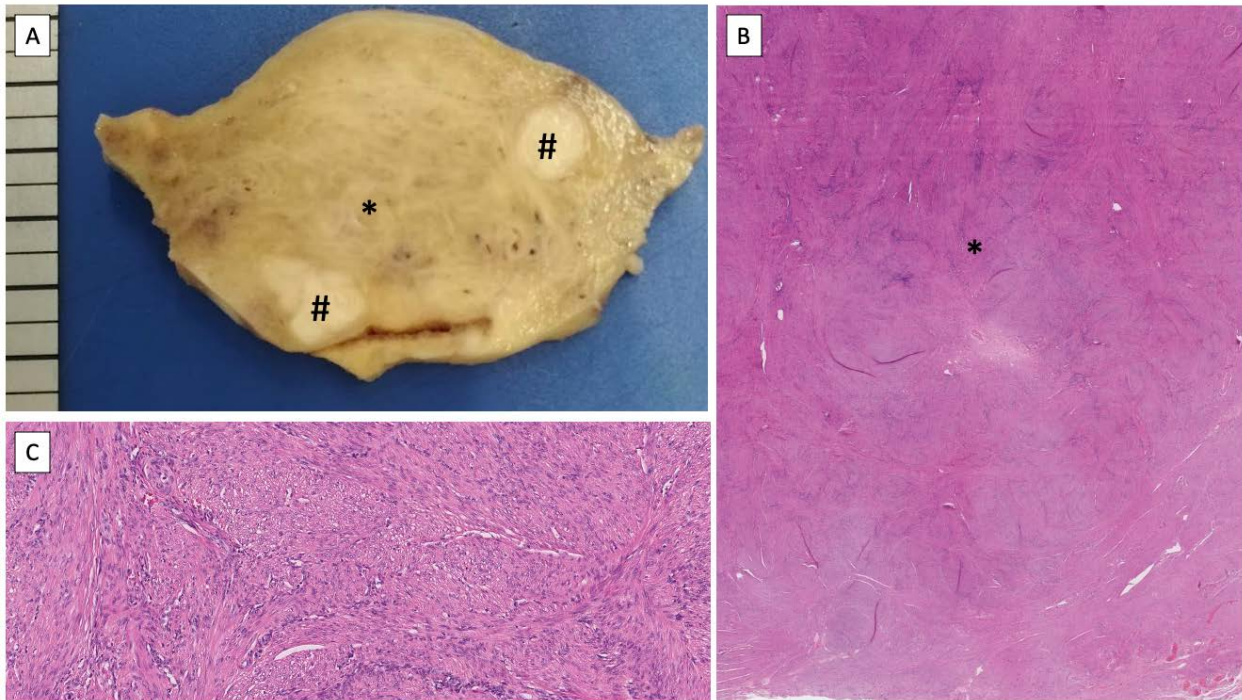


Figure 6: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: A) Photograph of part of the resected uterus. Gross findings of hysterectomy specimen. B-C) Hematoxylin and eosin stain.
Findings: On images A and B, myometrial thickening due to multiple confluent small nodules (*) and some larger white well-demarcated nodules (#) can be observed. On higher magnification, all these nodules were composed of bland spindle eosinophilic cells with cigar-shaped nuclei (C). No atypia, mitoses or necrosis were observed (C).

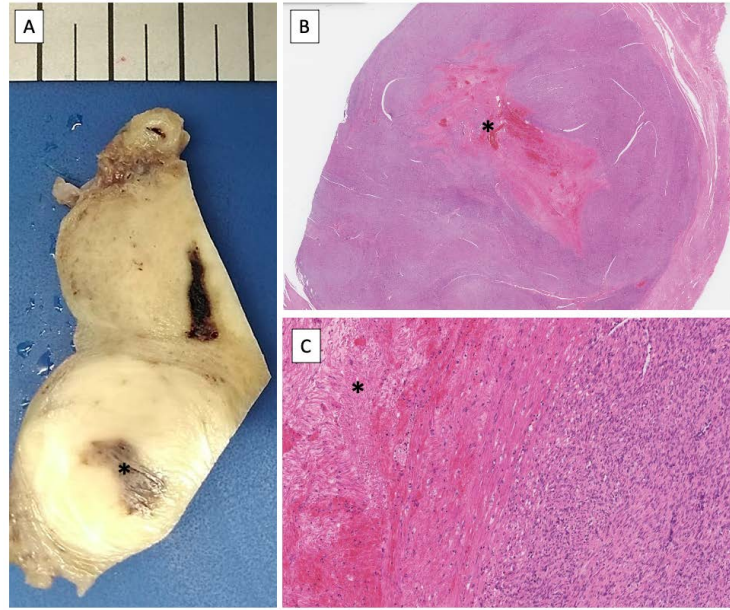


Figure 7: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: A) Photograph of part of the resected uterus. Gross findings of hysterectomy specimen. B-C) Hematoxylin and eosin stain.
Findings: The cellular leiomyoma previously seen on MRI, had a hemorrhagic center (* on images A, B and C). The cells surrounding the hemorrhage showed no significant atypia (C).

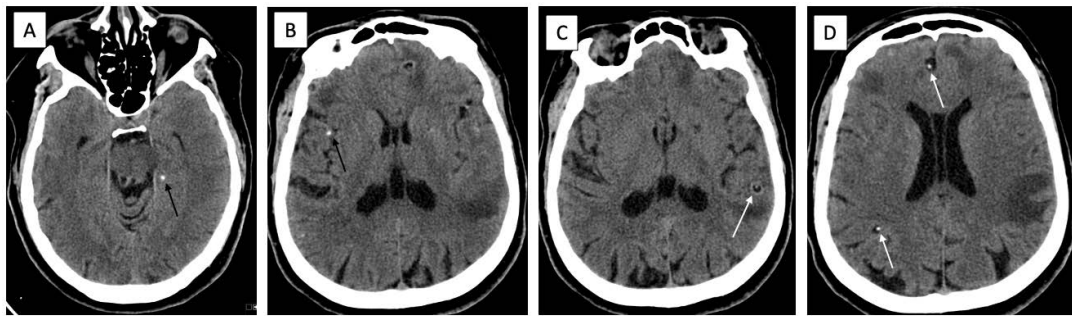


Figure 8: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Unenhanced skull CT scan performed with 120kV, 339mA, slice thickness 3mm, in axial acquisition.
Findings: Multiple punctate calcified parenchymal lesions (black arrows) randomly distributed across both brain hemispheres are seen (A-B). In addition, several cystic lesions with a spontaneous dense central dot (white arrows)- “cyst with dot sign”- are noted (C, D). Figure (C) depicts lesion-associated vasogenic edema.

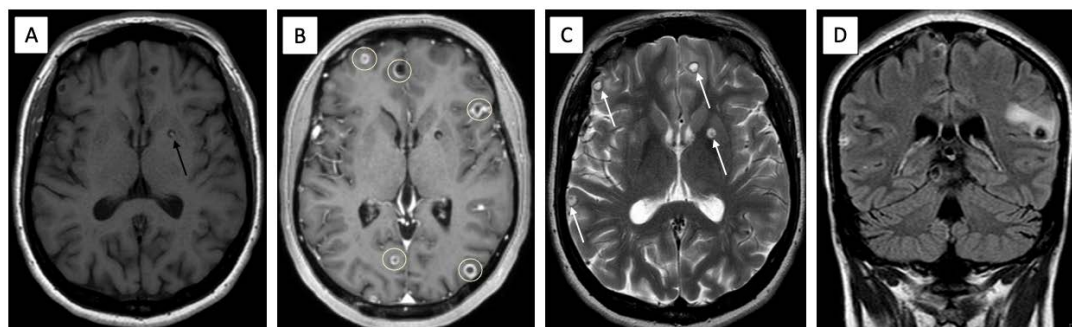


Figure 9: 44-year-old woman with benign metastasizing leiomyoma presenting with multiple lung nodules, and neurocysticercosis.
Technique: Philips Ingenia 3T machine. A) Axial unenhanced T1-weighted image with TR-543ms and TE-12ms. B) Axial post-gadolinium T1-weighted image with TR-8,21ms and TE-3,76ms. C) Axial T2-weighted image with TR-5334ms and TE-110ms. D) Coronal T2-weighted FLAIR with TR-11000ms and TE-140ms. All sequences were acquired with slice thickness of 4mm.
Findings: Inside some of the cystic lesions, an hyperintense central dot is seen (black arrow), representing the scolex (larval head). Most lesions show ring-enhancement (circles) following gadolinium administration (B) and high signal on T2-weighted imaging (white arrows in C). Some are associated with vasogenic edema, most conspicuous on FLAIR (D).

Table 1: Summary table of benign metastasizing leiomyoma

Definition	Well-differentiated leiomyomas found in sites remote from the uterus – a rare histological variant of a benign tumor with metastatic potential.
Etiology	Unknown. 3 main theories are accepted: Hematogenous spread of benign uterine leiomyoma cells following surgery; Iatrogenic peritoneal seeding during surgery; Coelomic epithelium response to hormonal exposure with differentiation and proliferation of myofibroblasts.
Incidence	Not clearly defined due to low incidence. Fewer than 200 cases have been reported.
Gender Ratio	Primarily affects middle-aged women, but cases are also reported in men.
Age predilection	Middle-aged women, typically during the premenopausal period. Cases are also reported in children.
Risk factors	Previous surgical management for leiomyomas (myomectomy or hysterectomy).
Treatment	No established guidelines, due to its rarity. Varies from patient monitoring to surgery with oophorectomy or hormonal therapies (estrogen receptor modulators, aromatase inhibitors and gonadotropin-releasing hormone analogues).
Prognosis	Usually favorable as the growth rate of these tumors is slow. However, progression and the appearance of new lesions may occur.
Findings on imaging	Non-specific. <ul style="list-style-type: none"> • X-ray and CT: From solitary and small to large and multiple lung nodules which may cavitate. Endobronchial and pleural sparing is characteristic. • 18-FDG PET/CT: Absence of significantly intense 18-FDG uptake.
Histopathology	Positive for actin, desmin, smooth muscle actin and estrogen / progesterone receptors.

Table 2: Differential diagnoses table for benign metastasizing leiomyoma

	Imaging Findings	Histopathology
Benign metastasizing leiomyoma	Non-specific. <ul style="list-style-type: none"> • X-ray and CT: From solitary and small to large and multiple lung nodules which may cavitate. Endobronchial and pleural sparing is characteristic. • 18-FDG PET/CT: Absence of significantly intense 18-FDG uptake. 	Positive for actin, desmin, smooth muscle actin and estrogen / progesterone receptors. Negative for human melanoma black (HMB-45) antibody.
Lung metastases from uterine leiomyosarcoma	<ul style="list-style-type: none"> • X-ray and CT: May appear as a pulmonary mass or exhibit a 'cannonball' pattern, involving multiple sites due to the hematogenous spread characteristic of sarcoma tumors. • 18-FDG PET/CT: Higher avidity for 18-FDG uptake than leiomyomas. 	Presence of atypia, necrosis, nuclear pleomorphism and high mitotic activity.
Primary pulmonary leiomyosarcoma	X-ray and CT: Presents as a solitary well-circumscribed, heterogeneous nodule with smooth margins or large necrotic masses.	Also stains positively to desmin and smooth muscle actin, confirming smooth muscle differentiation, but exhibits higher mitotic activity, nuclear atypia, multinucleation, prominent vascularity and zonal necrosis.
Lymphangioliomyomatosis	CT: Thin-walled rounded empty cysts, pneumothorax, reticular opacities and chylous pleural effusion.	Positive for smooth muscle actin and HMB-45 antibody.

KEYWORDS

Benign metastasizing leiomyoma; Leiomyosarcoma; Neurocysticercosis; MRI; Pathology anatomy

ABBREVIATIONS

ADC = APPARENT DIFFUSION COEFFICIENT
BML = BENIGN METASTASIZING LEIOMYOMA
CT = COMPUTED TOMOGRAPHY
DWI = DIFFUSION WEIGHTED IMAGING
FDG = FLUORODEOXYGLUCOSE
FLAIR = FLUID ATTENUATED INVERSION RECOVERY
HMB = HUMAN MELANOMA BLACK
MRI = MAGNETIC RESONANCE IMAGING
PET = POSITRON EMISSION TOMOGRAPHY
VATS = VIDEO-ASSISTED THORACIC SURGERY

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