**Dijlah Journal of Medical Sciences (DJMS)** Vol. 3, No. 2, May, 2026, pp. 164-172
P-ISSN: 3078-3178, E-ISSN: 3078-8625, paper ID: 19

ORIGINAL ARTICLE

# Comparing Leiomyoma and Leiomyosarcoma with Non-Invasive Medical Imaging Methods

**Mustafa Suhail Najm*, Hasanain Rashid Khaleel, Muntasser Farooq Ahmed and Hala Fouad Mohammed**
Bald General Hospital, Salah Al-Din Health Directorate Iraq Ministry of Health, Salah Al-Din, Iraq

**Article Info**

***Article history:***

Received December, 17, 2026
Revised January, 14, 2026
Accepted January, 31, 2026

***Keywords:***

Uterine Leiomyoma,
Uterine Leiomyosarcoma,
Preoperative Diagnosis,
Ultrasound,
CT,
MRI

**ABSTRACT**

Background: Preoperative diagnosis might be challenging when trying to differentiate between uterine leiomyoma and leiomyosarcoma due to their shared imaging and clinical features. Accurate distinction is a key to avoiding unnecessary delays in cancer diagnosis or aggressive therapy. In order to distinguish between leiomyoma and leiomyosarcoma, this study investigated the diagnostic role of non-invasive imaging modalities without diffusion-weighted imaging (DWI). Methods: From 2012 through 2024, researchers at Iraq's Al-Amal Oncology Teaching Hospital tracked patients' vitals in a retrospective case-control study. Using size-matched criteria, the researchers identified 23 individuals with preoperative imaging showing histopathologically proven uterine leiomyosarcoma (n = 8, CT n = 9, and MRI n = 6). They compared these patients to 34 patients who had their tumors removed. Six blinded radiologists, three of whom were consultants and three of whom were residents, independently evaluated tumor margins, necrosis, bleeding, vascularity, calcifications, heterogeneity, and overall probability of malignancy using a standardized 5-point grading system. The results of the logistic regression and receiver operating characteristic (ROC) analyses were used to ascertain the diagnostic performance. Results: The mean malignancy suspicion ratings (2.4 +- 1.1 for leiomyoma and 2.8 +- 1.3 for leiomyosarcoma, respectively) did not differ significantly between the benign and malignant groups. Ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) did not differ significantly in terms of diagnostic accuracy (P =.29-.93), and the ROC curve areas were 0.35 to 0.68. Reading proficiency had no effect on diagnosis accuracy, and no morphologic trait was a reliable predictor of cancer (P =.12-.95). Conclusions: Differentiating between uterine leiomyoma and leiomyosarcoma is not reliably achieved by conventional ultrasonography, CT, and MRI due to the absence of diffusion-weighted imaging. These findings support the idea that diffusion-weighted MRI and advanced functional imaging should be used together to improve pre-operative diagnostics and guide optimal therapeutic treatment.

***Corresponding Author:***

* Mustafa suhail najm
Bald General Hospital, Salah Al-Din Health Directorate Iraq Ministry of Health, Salah Al-Din, Iraq
Email: Mustafasuhei88888@gmail.com

## 1- INTRODUCTION

The neoplasm known as uterine leiomyosarcoma is cancerous. along the smooth muscle cells, and it accounts for around 1% of all uterine cancers [1, 2]. Despite a 5-year survival rate announcement from the National Cancer Institute, the prognosis is still not good. At 63% on people, it varies according on the severity of the ailment. patients with localized illness to 36% for patients with far-off diseases, up to 14% [3]. Leiomyomas, uterine leiomyomas, and leiomyosarcomas can all present with symptoms that are difficult to distinguish, making a clinical diagnosis challenging. Only after surgery can they be accessed by pathologists for treatment. likely leiomyomas [4].

Given that leiomyosarcoma tumors are often the result of morcellation, this could further complicate treatment. A patient may become untreatable if they become infected [5, 6]. Additionally, embolization of the uterine artery might cause leiomyosarcoma infarction. allows for the delay of diagnosis and treatment. The imaging of uterine leiomyosarcomas using computed tomography (CT), magnetic resonance imaging (MRI), or ultrasound scanning Magnetic resonance imaging (MRI) is often distorted by a heterogeneous bulk. Uterine architecture [7], which could mean cellular leiomyomas or degeneration. Prospective aid in differentiating "markers" to be photographed has been the subject of some research. Leiomyosarcomas undergo necrosis and bleeding [9]. Calcification [8] edges that are not clearly defined [10] margins that contain nodules, for example, diffusion-weighted imaging (DWI) impaired diffusion on MRI [15, 18], early/heterogeneous postcontrast enhancement [10, 11, 13]. However, imaging characteristics that are highly predictive of a pathologic cancer diagnosis are still available. shed light on. It has been pointed out that speedy development of a. Leiomyosarcoma should be considered when a uterine mass is present, however this is still up for debate [14]. There have been few studies in the literature that specifically examine this question, despite these attempts to clarify the imaging look that is predictive of cancer.
Precision with which radiologist identifys leiomyosarcomas, leiomyomas, and uterine masses, as well as the vast majority of prior cases [15].

Imaging investigations have utilized small cohorts [17-20]. The purpose of our research was to determine this in retrospect. How well radiologists in a size-matched, modality-matched group could differentiate between leiomyoma and leiomyosarcoma in US, CT, or MRI scans, unaided by mimics. an initial presentation's clinical reality.

## 2- MATERIALS AND METHODS

### 2.1 Subjects

At Al-Amal Oncology Teaching Hospital in Baghdad, Iraq, from January 1, 2012, through December 31, 2024, all adult female patients with a histopathologic diagnosis of uterine leiomyosarcoma after surgical resection were identified by querying the hospital's electronic pathology database. Participating patients were aged 18 years and above. The leiomyosarcoma group (n = 23) consisted of patients who had preoperative imaging completed using ultrasonography, CT, and/or MRI. To maintain consistency in the subject's time series, the imaging study that was selected was the one that was most recent relative to the operation date.

After that, a group of patients who had undergone a similar procedure the excision of a uterine leiomyoma and had its histology confirmed served as a control. The leiomyosarcoma patients and controls are matched one to one based on tumor size (within the population -1 cm on final pathology) and imaging modality (US, CT, or MRI). Review of imaging results not conducted. When multiple potential controls fulfilled the same criteria, a control was selected at random. To avoid any clustering bias, each patient was solely included in a single MRI study. Whenever possible, MRI tests were prioritized above CT and ultrasound to ensure a fair distribution of modalities.

Due to non-matching tumor sizes, two instances of leiomyosarcoma with tumor sizes above 30 cm were excluded. The sample for the overall analysis consisted of 23 cases of leiomyosarcoma with an average age of 49 years and a range of 29382 years, as well as 23 matched controls with an average age of 46 years and a range of 3271 years. The imaging characteristics of the sample were as follows: US (n = 14), CT (n = 18), and MRI (n = 14). Data from the study's population are summarized in Table 1.

**Table (1): Study Population Characteristics**

| Characteristic | Leiomyomas (n = 23) | Leiomyosarcomas (n = 23) |
|---|---|---|
| **Mean age** | 46 ± 12 years | 49 ± 11 years |
| **Ethnicity (n)** | | |
| **Arab Iraqi** | 21 (91%) | 20 (87%) |
| **Kurdish** | 1 (4%) | 2 (9%) |
| **Other / Unknown** | 1 (4%) | 1 (4%) |
| **Mean gravidity** | 2.3 ± 1.4 | 2.6 ± 1.7 |
| **Mean parity** | 1.9 ± 1.3 | 2.1 ± 1.5 |
| **Prior uterine artery embolization** | 0% (0/23) | 0% (0/23) |
| **Prior hormone therapy** | 35% (8/23) | 17% (4/23) |
| **Imaging modality (n)** | | |
| **CT** | 8 (35%) | 10 (43%) |
| **MRI (without DWI)** | 7 (30%) | 7 (30%) |
| **Ultrasound** | 8 (35%) | 6 (26%) |
| **Mean mass size** | 10 ± 4 cm | 11 ± 5 cm |

**CT= computed tomography, MRI= magnetic resonance imaging, DWI= diffusion-weighted imaging**

The surgical resection of all the study cases and controls was performed, and the diagnosis was made with the help of the standard histopathological examination.

### 2.2 Imaging details

Imaging protocols were mixed as a result of the relative infrequency of uterine leiomyosarcoma (as well as 12-year study period):

• Ultrasound (US): Grayscale and color Doppler assessment of the uterus and adnexa were a part of all pelvic ultrasound investigations. Cine and still images were available both in long and short-axis. A research was conducted in GE Logiq E9, Philips Affiniti, and Hitachi Aloka ultrasound units.

• Computed Tomography (CT): CT all examinations were contrast-enhanced CT of the pelvis. All cases had axial images and most of them had coronal and sagittal reformats. Thyckness of slices was between 3 and 7 mm. Scans were made in GE Revolution 64-slice and Siemens Somatom 128-slice.

• Magnetic Resonance Imaging (MRI): Each of the MRIs was allocated a specific pelvic imaging study comprising of T1- and T2-weighted imaging in the axial, sagittal, and coronal planes. The majority of the studies also involved post-contrast T1-weighted imaging, and dynamic contrast sequences were also available in some studies. In no case diffusion-weighted imaging (DWI) was done. MRI was done with 1.5T GE Signa and 3.0T Philips Ingenia scanners.

### 2.3 Image review

All radiology tests were anonymized, randomized, and looked at on the hospital PACS workstation. Each case was independently evaluated by six radiologists (three final year radiology residents and three consultant radiologists) who were blinded to clinical and histopathological data. The reviewers were given the information that there was 1:1 proportion of leiomyoma to leiomyosarcoma and that cases were matched based on the size and mode of imaging.

Each case was reviewed by assigning 5-point Likert scores of:

1. Margins
2. Necrosis
3. Hemorrhage
4. Vascularity
5. Calcifications
6. Internal heterogeneity

Increased scores reflected increased feature presence, with the exception of margins, in which increased scores reflected increased ill-defined boundaries. The primary diagnostic endpoint was the recording of an overall malignancy likelihood score (Likert: 1 = definitely benign, 5 = definitely malignant).

### 2.4 Clinical data

The electronic medical record was used to gain patient demographic and clinical data such as age, parity, uterine artery embolization history, and hormonal therapy (Table 1).

### 2.5 Data analysis

The major diagnostic performance measure was the distinction between leiomyoma and leiomyosarcoma according to the overall score of the malignancy likelihood. The Student t -test was applied to compare mean scores. ROC curves were produced to compare diagnostic accuracy between imaging modalities in general and receiver operating characteristic curves. Univariate binary logistic regression was used to assess the relationship between mean morphologic feature scores and malignancy. The SPSS statistics version 26 (IBM Corp.) and Microsoft Excel were used to perform the analyses. A P-value of less than 0.05 was taken to be statistically significant.

The approval of the institutional Review Board was secured and informed consent requirements were not undertaken because the study is retrospective and de-identified. External funding was not received.

## 3- RESULTS AND DISCUSSION

The leiomyoma and leiomyosarcoma groups did not differ in terms of gravidity and parity significantly (Table 1). None of the patients in both groups had a history of uterine artery embolization before. The endocrine treatment was reported in 8/23 (35) of the leiomyoma controls and 4/23 [17] of the leiomyosarcoma cases (P =.21). Leiomyomas were given a mean of 2.4 1.1 (consultant radiologists) and 2.3 1.2 (resident radiologists) as the malignancy suspicion scores. The mean suspicion scores of the leiomyosarcomas were 2.8 + 1.2 (consultants) and 2.7 + 1.3 (residents). No significant difference in the scores of suspiciousness between consultant and resident groups existed, neither in case of leiomyas (P =.48) nor in case of leiomyosarcoma (P =.91).

ROC curve analysis showed that the relative ability to distinguish leiomyosarcoma versus leiomyoma was not secretly different than chance; combined with all modalities of imaging (P = .34.86) and individually by modality (US, CT, or MRI; P =.27.94) (Table 2; Figures 1-5).

**Table (2): Reader and Imaging Modality Areas Under the ROC Curves**

| Reader | All Examinations (n = 46) | P | Ultrasound (n = 14) | P | CT (n = 18) | P | MRI (n = 14) | P |
|---|---|---|---|---|---|---|---|---|
| **Attending** | | | | | | | | |
| **A** | 0.548 | .69 | 0.432 | .63 | 0.612 | .41 | 0.557 | .79 |
| **B** | 0.491 | .82 | 0.504 | .89 | 0.526 | .77 | 0.344 | .48 |
| **C** | 0.572 | .50 | 0.648 | .27 | 0.538 | .74 | 0.601 | .66 |
| **Resident** | | | | | | | | |
| **D** | 0.515 | .84 | 0.588 | .58 | 0.549 | .63 | 0.472 | .72 |
| **E** | 0.560 | .62 | 0.455 | .70 | 0.601 | .44 | 0.645 | .52 |
| **F** | 0.597 | .39 | 0.630 | .54 | 0.673 | .31 | 0.521 | .88 |

**CT= computed tomography; MRI= magnetic resonance imaging; ROC= receiver operating characteristic**

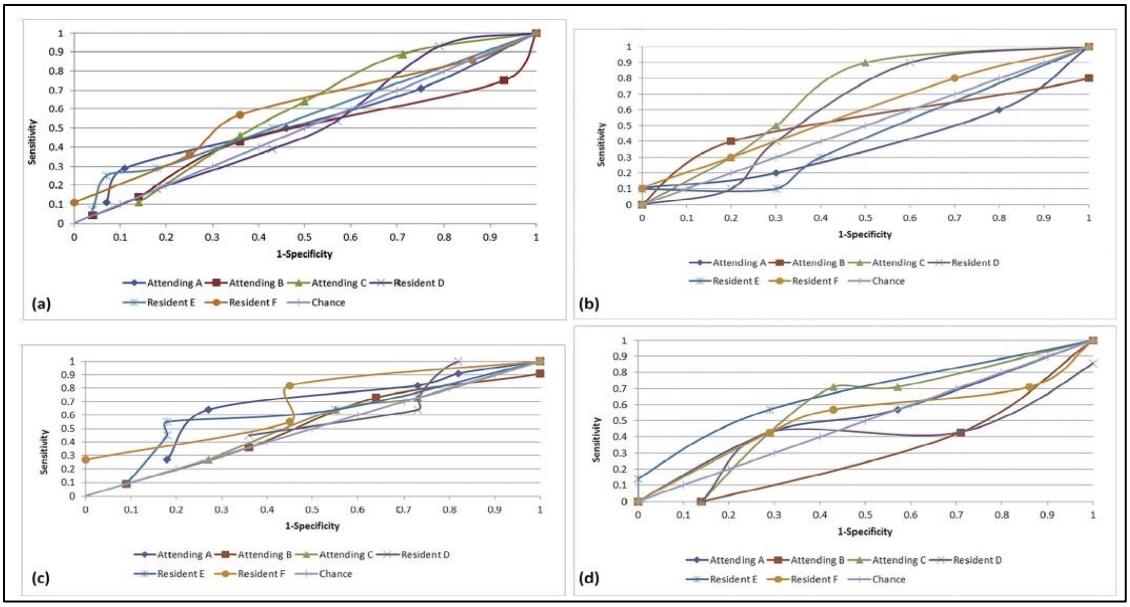


**Fig (1): Radiologists on staff and in training will have a) Curves representing receiver operating characteristic (ROC) tests. One way to show that you can discriminate is with ROC curves**

In the group of ultrasound-diagnosed leiomyomas and leiomyosarcomas, there were 22 cases of computed tomography (CT) and MRI, Group MRI scans conducted in a combined fashion, b) Resident radiologists' and attending radiologists' ROC curves. The ROC curves shown here show the ability of the ultrasonic examination group to discriminate between leiomyoma and leiomyosarcoma, c) Received-on-chip (ROC) curves for both practicing and resident radiologists. The ability to distinguish between the leiomyoma and leiomyosarcoma CT examination groups is shown by the ROC curves, d) Resident and attending ROC curves in a nutshell. Radiologists: The ROC curves show that the MRI group can distinguish between leiomyoma and leiomyosarcoma.

Similarly, no particular morphologic visual feature, including margins, necrosis, hemorrhage, vascularity, calcifications, or internal heterogeneity, was shown to be a statistically significant predictor of malignancy (P =.1195) (Table 3).

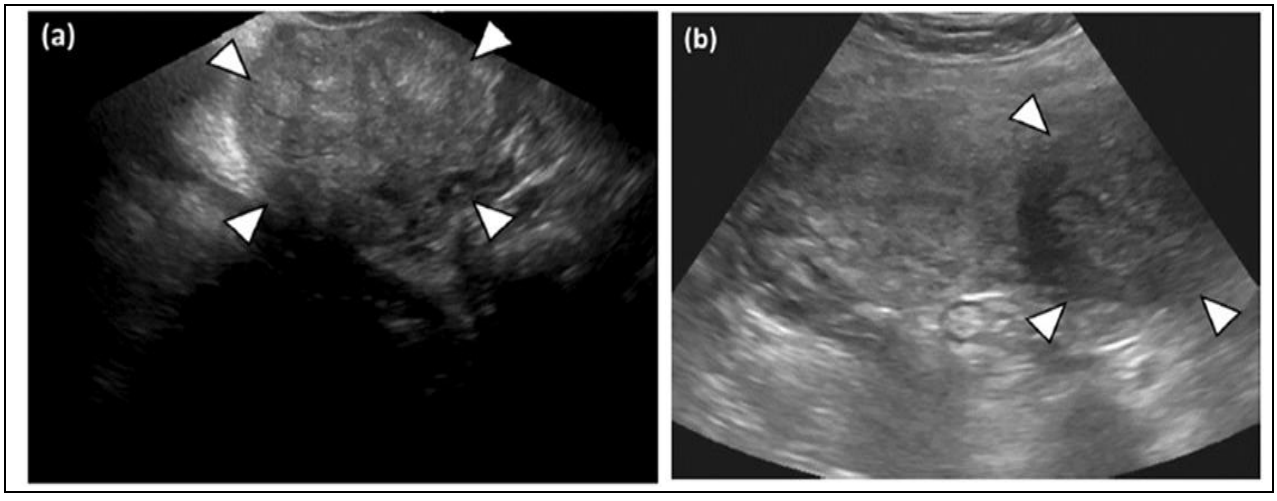


**Fig (2): The patient was a woman with leiomyoma, aged 36. a) side-by-side, b) all-around**

The leiomyosarcoma is the term most readers choose to describe it, which indicates a moderate level of suspicion. grade: 2.8. Sonographic pictures (a, side-by-side; b, all-around). display a mixed-type uterine mass that is diversified (arrowheads). echogenicity-related terms.

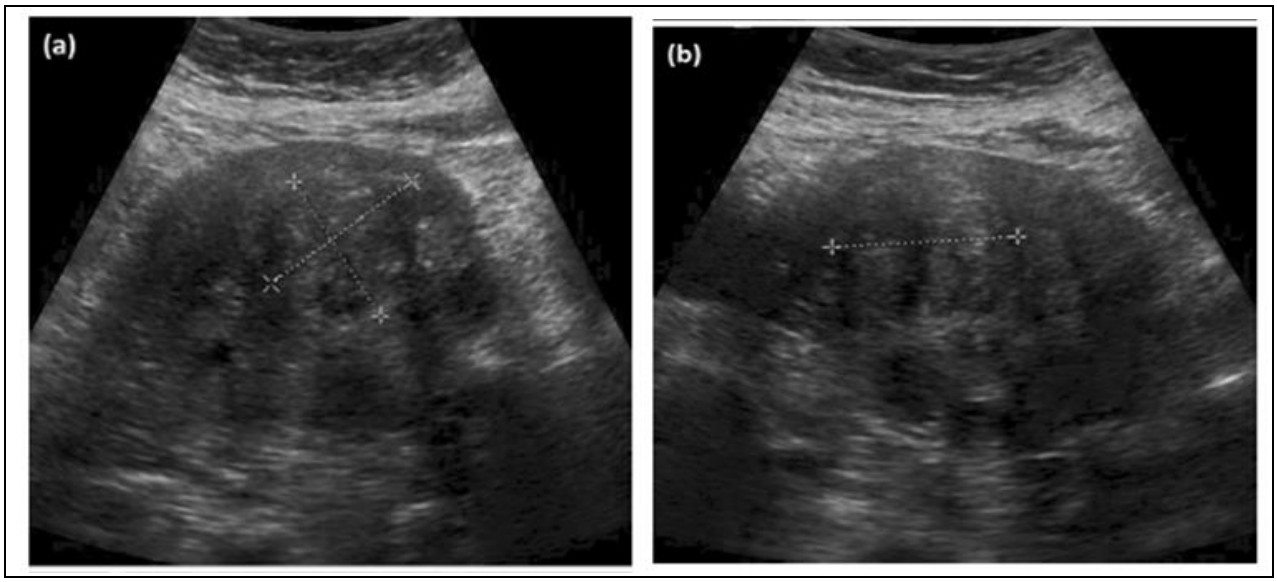


**Fig (3): A 45-year-old lady diagnosed with leiomyosarcoma. a) horizontal, b) vertical**

A leiomyoma, meaning "mean suspicion," was the wrongly assumed interpretation by most readers. Results: 1.7. Ultrasound pictures (a, horizontal; b, vertical). Display a heterogeneous mass with varying degrees of echogenicity using measuring calipers superimposed on top of one another.

**Table (3): Scale 1–5 Mean Attending Radiologist Imaging Characteristic Scores Stratified by Pathology**

| Characteristic | Leiomyoma (n = 23) | Leiomyosarcoma (n = 23) | P value |
|---|---|---|---|
| **Margins** | 2.3 ± 0.7 | 2.6 ± 0.8 | .24 |
| **Necrosis** | 2.0 ± 1.0 | 2.3 ± 1.1 | .71 |
| **Hemorrhage** | 1.7 ± 1.0 | 1.3 ± 0.6 | .12 |
| **Vascularity** | 2.8 ± 0.8 | 2.9 ± 0.7 | .68 |
| **Calcifications** | 1.4 ± 0.7 | 1.3 ± 0.6 | .91 |
| **Heterogeneity** | 3.3 ± 0.8 | 3.4 ± 0.9 | .94 |

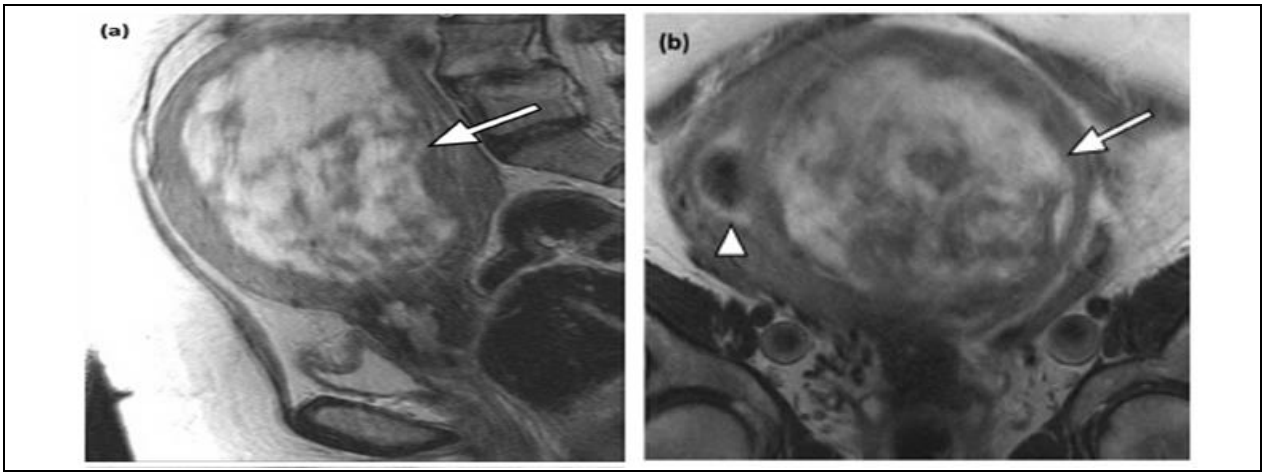


**Fig (4): A leiomyoma is mischaracterized in a 47-year-old female patient. A leiomyosarcoma was suspected by the majority of readers (mean suspicion score: 3.3). a) A sagittal T2-weighted fast spin echo MR image of a leiomyoma; the arrow points to a dense mass that forms behind the heterogeneous inner uterine wall, b) On the coronal plane, there is a small submucosal leiomyoma with low signal intensity adjacent to a high signal intensity mass that is pressing down on the endometrial cavity (arrowhead)**

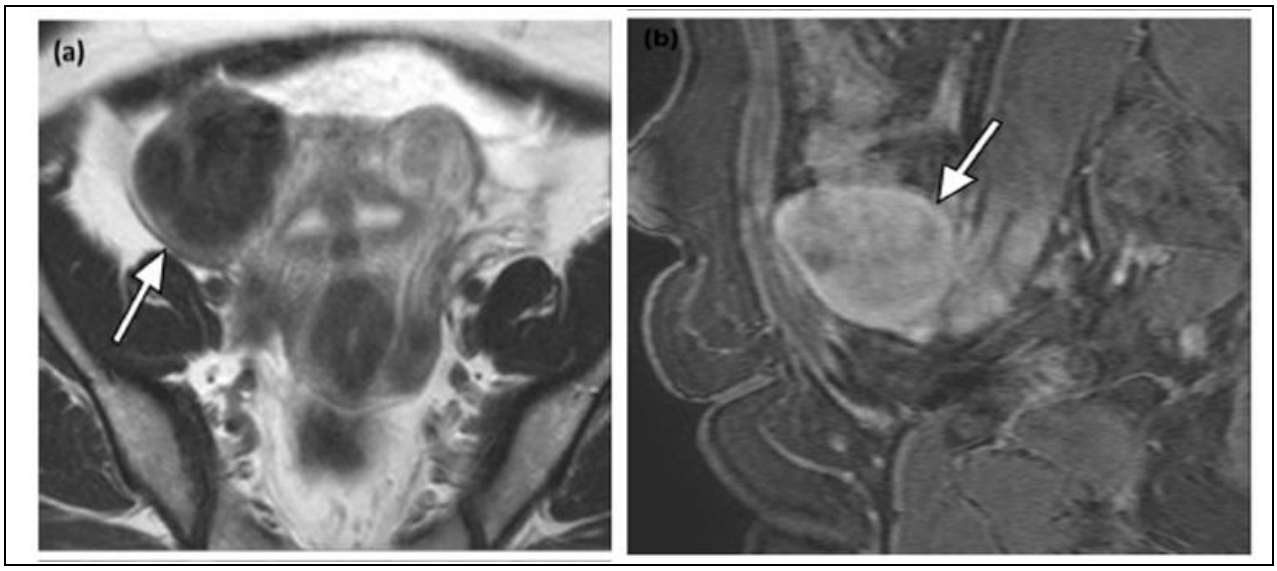


**Fig (5): leiomyosarcoma has been misdiagnosed in a 46-year-old lady. The majority of readers seem to think it's a leiomyoma (mean suspicion score: 1.5). a) The arrow in the magnetic resonance (MR) picture of the right uterine (T2-weighted short axis) shows a mass with low signal intensity and signal weakness. Fundus, and in, b) (sagittal, T1-weighted, fat-suppressed, postcontrast); the arrow that indicates the growing uterine size**

As part of this retrospective diagnostic accuracy study, we have established calculated results of the inability of radiologists to reliably differentiate between uterine leiomyoma and leiomyosarcoma on grayscale/color Doppler ultrasound, contrast-enhanced CT, or MRI, without diffusion-weighted imaging, matched based on lesion size and imaging modality, at Al-Amal Oncology Teaching hospital. Furthermore, none of the morphologic imaging features provided showed discriminatory power to malignancy. The results were the same in terms of experience, as consultant and resident radiologists did not differ in terms of their results. We have found that our findings are in agreement with the existing literature that showed a high degree of similarity between imaging appearances of benign and malignant myometrial tumors. Possible utility of hemorrhage, T2 signal intensity, or margin irregularity was proposed in previous MRI-based studies [8, 9, 11], but these results were determined with very small samples, lesion size was not equal, and interpretation by a single reader was done- all of which probably could overstate diagnostic accuracy. In our case, margin and hemorrhage were also not predictive of malignancy ($P > .10$).

Still more recent researchers have noted that diffusion-weighted imaging (DWI) and values of ADC show a potential to discriminate between leiomyosarcoma and benign leiomyoma [15, 17]. Nevertheless, due to the fact that MRI does not carry out DWI procedures at the time of the study, we could not direct our results to these findings. This underscores a significant practical drawback of most clinical organizations where DWI is not a regular part of preoperative MRI procedures in the pelvis.

Past ultrasound based research [19, 20] has also found comparable conclusions that features of grayscale and Doppler are very similar and our results support the same that US alone cannot be used to differentiate malignant lesions.

### 3.1 Study Limitations

This research has various limitations. Although the time span of the study was 12 years, the total number of cases of leiomyosarcoma was not large as the disease is not very common. Retrospective character of the study restricted standardized imaging protocols and did not allow evaluating the growth rate of the tumor but prior research recommends that rapid growth is not a dependant predictor of malignancy [21]. Also, improvements in technology of MRI during the period of the study such as the more recent use of DWI were not incorporated in the previous imaging protocols examined.

## 4- CONCLUSION

This paper shows that standard US, CT, and MRI without DWI are inadequate in the process of differentiating between uterine leiomyoma and leiomyosarcoma even at the hands of senior radiologists. The use of morphologic features of imaging is not advisable. Future studies would put a strong emphasis on standardized MRI protocols with DWI and ADC mapping, and a multicenter study is probably needed to have enough leiomyosarcoma cohorts to do a comprehensive study.

## REFERENCES

[1] Choi, J. H., & Ro, J. Y. (2021). The 2020 WHO classification of tumors of bone: An updated review. Advances in Anatomic Pathology, 28(3), 119–138.

[2] Gadducci, A., Multinu, F., De Vitis, L. A., Cosio, S., Carinelli, S., & Aletti, G. D. (2023). Endometrial stromal tumors of the uterus: Epidemiology, pathological and biological features, treatment options and clinical outcomes. Gynecologic Oncology, 171, 95–105.

[3] Zapardiel, I., et al. (2023). Prognostic factors in patients with uterine sarcoma: The SARCUT study. International Journal of Gynecological Cancer, 33(6), 897–904.

[4] Bužinskienė, D., Mikėnas, S., Drąsutienė, G., & Mongirdas, M. (2018). Uterine sarcoma: A clinical case and a literature review. Acta Medica Lituanica, 25(4), 206.

[5] Ludovisi, M., et al. (2019). Imaging in gynecological disease (15): Clinical and ultrasound characteristics of uterine sarcoma. Ultrasound in Obstetrics & Gynecology, 54(5), 676–687.

[6] Giunchi, S., et al. (2022). Sonographic imaging in uterine sarcoma: A narrative review of literature. Gynecology and Pelvic Medicine, 5.

[7] Liu, J., & Wang, Z. (2022). Advances in the preoperative identification of uterine sarcoma. Cancers, 14(14), 3517.

[8] Sousa, F. A. E., Ferreira, J., & Cunha, T. M. (2021). MR imaging of uterine sarcomas: A comprehensive review with radiologic–pathologic correlation. Abdominal Radiology, 46(12), 5687–5706.

[9] Suzuki, A., et al. (2019). Differential diagnosis of uterine leiomyoma and uterine sarcoma using magnetic resonance images: A literature review. Healthcare, 7(4), 158.

[10] Sun, S., et al. (2019). How to differentiate uterine leiomyosarcoma from leiomyoma with imaging. Diagnostic and Interventional Imaging, 100(10), 619–634.

[11] Bužinskienė, D., Mikėnas, S., Drąsutienė, G., & Mongirdas, M. (2018). Uterine sarcoma: A clinical case and a literature review. Acta Medica Lituanica, 25(4), 206.

[12] Lebar, V., Čelebić, A., Calleja-Agius, J., Stefanovska, M. J., & Staric, K. D. (2025). Advancements in uterine sarcoma management: A review. European Journal of Surgical Oncology, 51(4), 109646.

[13] Raffone, A., et al. (2024). Diagnostic accuracy of MRI in the differential diagnosis between uterine leiomyomas and sarcomas: A systematic review and meta-analysis. International Journal of Gynecology & Obstetrics, 165(1), 22–33.

[14] Agarwal, D., et al. (2025). Imaging in uncommon uterine malignancies. Journal of Gastrointestinal and Abdominal Radiology.

[15] Kaganov, H., Ades, A., & Fraser, D. S. (2018). Preoperative magnetic resonance imaging diagnostic features of uterine leiomyosarcomas: A systematic review. International Journal of Technology Assessment in Health Care, 34(2), 172–179.

[16] Dueholm, M., & Hjorth, I. M. D. (2017). Structured imaging technique in the gynecologic office for the diagnosis of abnormal uterine bleeding. Best Practice & Research Clinical Obstetrics & Gynaecology, 40, 23–43.

[17] Stukan, M., Rutkowski, P., Smadja, J., & Bonvalot, S. (2022). Ultrasound-guided trans-uterine cavity core needle biopsy of uterine myometrial tumors to differentiate sarcoma from a benign lesion: Description of the method and review of the literature. Diagnostics, 12(6), 1348.

[18] Aminzadeh, P., Alibrahim, E., Dobrotwir, A., Paul, E., & Goergen, S. (2021). Multiparametric MR evaluation of uterine leiomyosarcoma and STUMP versus leiomyoma. British Journal of Radiology, 94(1119), 20200483.

[19] Camponovo, C., Neumann, S., Zosso, L., Mueller, M. D., & Raio, L. (2023). Sonographic and magnetic resonance characteristics of gynecological sarcoma. Diagnostics, 13(7), 1223.

[20] Valletta, R., et al. (2024). Leiomyoma or sarcoma? MRI performance in the differential diagnosis of sonographically suspicious uterine masses. European Journal of Radiology, 170, 111217.

[21] Hindman, N., et al. (2022). MRI evaluation of uterine masses for risk of leiomyosarcoma: A consensus statement. Radiology, 306(2), e211658.