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MRI appearance of mesenchymal tumors of the uterus

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ABSTRACT

Purpose: Uterine leiomyomas are the most common uterine neoplasms. Statistically, a uterine mass with unusual imaging features is more likely to represent a leiomyoma than other uncommon uterine mesenchymal neoplasms such as leiomyosarcoma or endometrial stromal tumors. Several prior studies have attempted to identify objective imaging characteristics that differentiate these entities. The purpose of this study was to test these criteria on our patient population.
Methods and materials: This retrospective study was approved by the institutional Human Investigations Committee and was performed in compliance with HIPAA regulations. Four patients with uterine leiomyosarcoma, two with stromal tumors of uncertain malignant potential (STUMP), one with endometrial stromal sarcoma, and two with mixed endometrial stromal and smooth muscle tumors were included in the study. Seventeen additional control cases of leiomyomas were selected as controls. Cases were blindly evaluated by two experienced readers. Objective criteria included T1 and T2 signal characteristics, enhancement pattern, the presence of cystic changes, and ill defined margins. Subjective criteria included individual reader gestalt. All cases had pathologic correlation.
Results: None of the objective criteria were associated with the presence or absence of uterine mesenchymal neoplasm. Ill defined margins came closest to having statistical significance ($p = 0.06$). Reader gestalt was statistically associated with the presence of mesenchymal neoplasm for one of our readers ($p = 0.02$) but not for the other ($p = 0.07$).
Conclusion: We found poor accuracy for objective imaging criteria in distinguishing leiomyomas with atypical imaging features from more clinically significant uterine mesenchymal neoplasms.

1. Introduction

Leiomyoma is the most common tumor of the female reproductive tract. Typical leiomyomas are easy to characterize as well defined, low T1 and T2 signal, enhancing masses. The typical appearances of degenerated fibroids have also been well described and the ability of MRI to distinguish them has been previously demonstrated [1–8]. Thus, recognizing the typical appearance of a degenerating fibroid is usually not a problem. However, distinguishing a degenerating fibroid with an atypical appearance from a potentially malignant uterine neoplasm is clinically challenging. In the past, symptomatic fibroids were treated with surgery so that the need for definitive characterization was less critical. However, hysterectomy and myomectomy are a decreased option today because of newer conservative management schemes such as hormonal therapy and uterine fibroid embolization. Therefore, the ability to differentiate benign fibroids from other potentially malignant myometrial tumors has become much more important.

The clinical diagnosis of a malignant myometrial mass is not straightforward. Rapid enlargement of a uterine mass in a postmenopausal woman is not as useful a finding for malignant change as once purported [9]. Unfortunately, there are no large series in this area due to the rarity of such neoplasms. For example, uterine sarcomas account for only 1% of gynecologic malignancies, and only 2–5% of uterine malignancies [10].

In this paper, we retrospectively reviewed our experience with differentiating leiomyomas with atypical imaging features from uncommon uterine mesenchymal neoplasms at MR imaging.

2. Materials and methods

This retrospective review was approved by our institution's Human Investigations Committee and performed in accordance

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with Health Insurance Portability and Accountability Act (HIPAA) guidelines. A waiver of informed consent was obtained.

2.1. Patient selection

We used IDX software (GE Healthcare, Burlington, VT) to search the reports of pelvic MRI exams performed at our institution between January 2000 and June 2006 for the following key terms: "atypical," "aggressive," "cellular," "degeneration," and "sarcoma." Eighty reports were identified. Review of our hospital's electronic medical record produced pathologic correlation for 20 of these cases: 1 leiomyosarcoma, 1 stromal tumor of uncertain malignant potential (STUMP), 1 combined smooth muscle and stromal tumor, 8 leiomyomas, 3 leiomyomas with hemorrhagic degeneration, 2 leiomyomas with hyaline degeneration, 1 leiomyoma with hydropic degeneration, 1 leiomyoma with myxoid degeneration, 1 leiomyoma with degeneration type not specified, and 1 cellular leiomyoma.

Subsequently, we performed a search of our hospital's pathology database using the terms "leiomyosarcoma," "STUMP," "endometrial stromal sarcoma" (ESS), "cellular leiomyoma," "leiomyoma with hydropic changes," "leiomyoma with hemorrhagic degeneration," and "leiomyoma with myxoid stromal changes." Thirty-nine cases were identified. A search of our hospital's picture archiving and communications system (PACS, Fuji Medical Systems) yielded images for 9 of these cases: 4 leiomyosarcomas, 2 STUMP, 2 ESS, and 1 combined smooth muscle and stromal tumors. Three of these cases (one leiomyosarcoma, one STUMP, and one combined smooth muscle and stromal tumor) had been identified via the search of exam reports described above.

All cases with both pathology and MR imaging were included in the analysis. The cases were divided into two groups. One group was designated as "leiomyoma" and consisted of 17 cases of leiomyoma with an atypical appearance on imaging. The other group consisted of 9 cases and was designated as "other mesenchymal neoplasms" and totaled 4 leiomyosarcomas, 2 STUMP, 2 ESS, and 1 mixed endometrial stromal and smooth muscle tumor. The histopathological diagnoses were confirmed by review of the hematoxylin–eosin stained slides.

2.2. MR imaging protocol

Imaging was performed over a period of 6 years on multiple GE 1.5 T superconducting scanners (Signa, GE Medical Systems, Milwaukee, WI). One more recent case was performed on a 3 T system (Signa HDx, GE Medical Systems, Milwaukee, WI). Sagittal fast spin echo (FSE) T2, FSE T2 with fat suppression, or FSE short tau inversion recovery (STIR); coronal FSE T2; axial FSE T2; and axial FSE T1 or gradient recalled echo (GRE) T1W images were obtained in all cases. Pre and post contrast T1W fat suppressed images were obtained in 16 of 26 cases following IV injection of 20 ml of either gadopentetate dimeglumine (Magnevist; Schering, Berlin, Germany) or gadodiamide (Omiscan; Amersham, Princeton, NJ) IV contrast. Post contrast images were obtained 2–5 min following the injection of contrast. Older protocols at our institution did not routinely use contrast to evaluate the uterus for leiomyomas. No anti-peristaltic agents were administered.

Scan parameters varied because the study was performed retrospectively over a period of 6 years. The T2 images were scanned with a FOV of 24–34; a slice thickness of 5 mm with an interslice gap of 1–2 mm; and an imaging matrix of 256–320 frequency by 224–256 phase. TR varied from 3200–9000 ms and TE varied from 104 to 130 ms. Signal averages varied from 2 to 4. T1 images were obtained with either a non-breath hold FSE sequence (flip 90°, TR 400–700 ms, TR 14–18 ms, slice thickness 5 mm with 1–2 mm interslice gap) or a breath hold fast gradient echo (flip 65–75°, TR 160–300 ms, TE in phase, slice thickness 5 mm with 1–2 mm interslice gap) technique. Pre- and post-contrast imaging was obtained with a breath-hold 3D fast spoiled gradient echo sequence with fat suppression. TR and TE varied based on scanner gradient speed.

Sixteen of 26 patients received IV contrast. Six of the nine (67%) other mesenchymal neoplasms were imaged with IV contrast. Ten of 17 (59%) leiomyomas were imaged with IV contrast.

Table 1
Criteria for evaluating the uterine masses.

(1) T1 brightness (defined as any foci brighter than the fat in the pubis at the symphysis)
(2) T2 bright (defined as >50% of the lesion being brighter than the myometrium)
(3) Well defined cystic areas (defined as internal foci of T2 signal as bright as fluid in the bladder)
(4) Heterogeneous enhancement (defined as well demarcated unenhanced areas on T1 post contrast images)
(5) Areas of increased T2 signal (defined as brighter than the myometrium) that also enhanced
(6) Poorly defined margins
(7) Pelvic adenopathy
(8) Evidence of peritoneal metastases
(9) Invasion of the mass into the bladder, rectum, pelvic side walls, or other structures.

2.3. Image interpretation

Images were evaluated in consensus by two readers blinded to the report and pathology. Reader #1 (GI) has 10 years of experience reading pelvic MRI. Reader #2 (JW) has 20 years of experience reading pelvic MRI. In the event that there were several masses within the uterus, the lesion to be analyzed was identified for the readers by a third radiologist who was not blinded to the initial report or to the pathology. For each mass the readers evaluated size, location, and the presence or absence of the characteristics listed in Table 1.

Additionally, each reader separately provided their impression as to whether the mass was a leiomyoma or other mesenchymal neoplasm (reader gestalt).

2.4. Analysis

We analyzed the following combination of criteria listed in Table 1 for predicting if a uterine mass was a leiomyoma or other mesenchymal neoplasm: (a) T1 bright, T2 bright, and focal areas of non-enhancement (in cases where IV contrast was administered), (b) T1 bright and T2 bright, (c) areas with increased T2 signal that also enhanced, (d) well defined cystic areas, (e) poorly defined margins, (f) T2 bright with poorly defined margins, and (g) reader gestalt. Criteria (a), (b), and (e) are criteria previously evaluated by retrospective studies in the literature [11,8]. Criteria (c), (d), and (f) were included based on anectodal experience.

2.5. Statistics

Differences in size, patient age, and interval from imaging to surgery between the leiomyomas and other mesenchymal neoplasms were analyzed using a two-tailed unpaired *t*-test. A Fischer exact test was used to determine if the proportion of leiomyomas and other mesenchymal neoplasms with each criteria were significantly different. Sensitivity and specificity were calculated for each combination of diagnostic criteria discussed above. Positive and negative predictive values were not computed because this is a non-consecutive selected patient population. Inter-reader variability for reader gestalt was assessed with the Kappa statistic.