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*Original Article*

# Clinicopathological characteristics of patients with uterine sarcoma: clinical presentation, treatment, and survival outcomes

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**Abstract:** This study aimed to analyze the common clinical features, imaging findings, treatment and prognosis of sarcoma of the uterus in order to provide evidence for management of this disease and improve the preoperative diagnostic rate of uterine sarcoma. We collected data on 72 patients with uterine sarcoma diagnosed by pathology after surgery. The clinicopathological features and prognosis were analyzed. The patients' mean age was 48.12 ± 7.36 years. The most common clinical manifestation was irregular vaginal bleeding. The cancer antigen 125 level was assessed in 37 patients and was elevated in only 6. The most common ultrasonic manifestations of uterine sarcoma were rich blood flow, no clear margin, and mass degeneration. Fifty patients underwent diagnostic curettage, and only 18 had malignant results. All patients initially underwent surgery in our hospital. Fifty patients underwent p53 measurement, 54 underwent Ki-67 measurement, and 34 underwent estrogen and progesterone receptor measurement. The 3-year survival rate was significantly higher in patients with stage I than stage II and III cancer as well as in patients without with vascular tumor thrombosis. Age, estrogen and progesterone receptor positivity, pathological type, and treatment did not significantly affect the 3-year survival rate. Preoperative diagnostic curettage or hysteroscopic examination can improve the preoperative diagnostic rate of uterine sarcoma. The clinical stage and presence of vascular thrombosis are prognostic factors.

**Keywords:** Uterine sarcoma, clinicopathological characteristics, treatment, survival outcomes

## Introduction

Uterine sarcoma is a rare malignant tumor found in women. The incidence is only 0.5% to 3.3% of all malignant tumors in the female genital tract and 3% to 9% of all tumors in the uterine body [1]. According to the 2016 National Comprehensive Cancer Network (NCCN) guidelines, uterine sarcomas are classified as uterine leiomyosarcoma (LMS), endometrial stromal sarcoma (ESS), undifferentiated uterine sarcoma, and other rare mesenchymal sarcomas (adenosarcoma, rhabdomyosarcoma, perivascular epithelioid cell tumors, and liposarcoma), whereas carcinosarcoma, which was previously classified as a type of uterine sarcoma, is now classified as type II endometrial carcinoma [2]. The most common clinical manifestations are irregular vaginal bleeding, an abdominal mass, dysmenorrhea, irregular lower abdominal pain, and tumor-induced compression symptoms (e.g., abdominal distension or frequent urination); however, many patients are asymptomatic [3]. Before surgery, ultrasonography, computed tomography, magnetic resonance imaging (MRI), and cancer antigen 125 (CA125) level are useful for diagnosis. However, the preoperative diagnosis of uterine sarcoma is challenging because of its nonspecific clinical manifestations and symptoms, which are similar to those of uterine leiomyoma. Most patients rely on intraoperative freezing or postoperative pathological diagnosis of incidental findings [4]. Uterine LMS is the most common pathological type, followed by ESS, undifferentiated uterine sarcoma, and other types. Most patients are in the early clinical stage at the time of diagnosis, and more than half of uterine sarcomas develop before menopause. The clinical data of uterine sarcomas are statistically different among different tissue types.

Because of the rarity of uterine sarcoma, information on optimal treatment and poor prognostic factors are still lacking. The therapeutic approach of uterine sarcomas is similar to the rest of soft tissue sarcomas [5, 6]. Surgery remains the mainstay of therapy for uterine sarcoma [7]. The basic surgical methods are total hysterectomy and lymph node resection, which differs among different tissue types, and the surgeon must consider whether young patients can retain their ovaries and whether fertility function can be preserved in infertile patients. According to the pathological type, chemotherapy, radiotherapy, or hormone therapy can be used after the operation. Some scholars believe that the main prognostic factors are age, clinical stage, depth of myometrial invasion, lymphatic thrombi within vessels, expression of estrogen receptor (ER) or progesterone receptor (PR) in lymph node metastasis, and treatment methods. Staging is currently considered the most important prognostic factor.

The present study was performed to review the available clinicopathological data, treatment data, survival outcomes, and prognostic factors of patients with uterine sarcoma treated in our hospital.

## Materials and methods

### *Patients and methods*

Inclusion criteria: 1. Those who were initially treated in our hospital and were diagnosed with uterine sarcoma by pathology after surgery; 2. Patients from an external hospital who had a diagnosis of uterine sarcoma, and were referred to our hospital Consultation was performed by a pathologist in our hospital, or in some cases patients were diagnosed with uterine sarcoma by routine pathology after reoperation.

Exclusion criteria: 1. Also accompanied by malignant tumors of other systems (excluding uterine sarcoma metastasis); 2. No confirmed postoperative routine pathology; 3. Those without complete medical records.

The medical records and pathological reports of 72 patients treated for uterine sarcoma at the Tianjin Central Hospital of Gynecology and Obstetrics (Tianjin, China) from 2010 to 2015 were reviewed. The pathological specimens were reviewed and diagnosed by two gynecological pathologists. All patients were followed up for at least 12 months. Clinical data including age; menopausal status; reproductive history; tumor size; clinical staging; tumor markers; expression of p53, ER, PR, and Ki-67 in immunohistochemical examination; preoperative curettage; imaging findings; and prognosis were collected.

The study was approved by the ethics committee of Tianjin Central Hospital of Gynecology and Obstetrics (Tianjin, China). Written informed consent was obtained from all patients.

### *Statistical analysis*

SPSS version 19.0 (IBM Corp., Armonk, NY, USA) was used for all data analyses. The clinical features (age, menopausal status, reproductive history, tumor size, clinical stage, tumor markers, and expression of PR and Ki-67), imaging findings, and prognosis of patients with various histological types of uterine sarcoma were analyzed and compared. All count data were analyzed with the chi-square test, and statistically significant differences were analyzed with the t test ($P<0.05$). The survival curve was plotted by the Kaplan-Meier product limit method.

## Results

### *Age of patients*

The patients ranged in age from 24 to 69 years, with a mean age of 48.12 ± 7.36 years. The median age of the 72 patients at the time of diagnosis was 48 years (range, 24-69 years); 3 patients were aged <40 years, and 10 patients were aged <50 years. The mean age; in the LMS group was 51.06 ± 7.41 years, that in the ESS group was 44.62 ± 7.13 years, and that in the adenosarcoma group was 46.71 ± 9.35 years.

### *Menopausal status and reproductive history*

Of the 72 patients, 30 were menopausal and 42 were premenopausal. More than half of the patients developed premenopausal disease (58.3%). Of the 30 menopausal patients, 17 had LMS, 8 had ESS, and 5 had adenosarcoma. Of the 42 premenopausal patients, 13 had LMS, 19 had ESS, and 10 had adenosarcoma. Among all 72 patients, 63 were fertile and 9

**Table 1.** Clinical characteristics

| Clinical findings | All sarcoma n = 72 (%) | LMS n = 30 (%) | ESS n = 27 (%) | Adenosarcoma n = 15 (%) |
|---|---|---|---|---|
| Age at diagnosis | | | | |
| mean ± SD | 48.12 ± 7.36 | 51.06 ± 7.41 | 44.62 ± 7.13 | 46.17 ± 9.35 |
| Menopause status | | | | |
| Pre-menopause | 42 (58.3) | 13 (43.3) | 19 (70.4) | 10 (66.7) |
| Post-menopause | 30 (41.7) | 17 (56.7) | 8 (29.6) | 5 (33.3) |
| Parity | | | | |
| 0 | 9 (12.5) | 4 (13.3) | 2 (7.4) | 3 (20) |
| ≥1 | 63 (87.5) | 26 (86.7) | 25 (92.6) | 12 (80.0) |
| Presenting symptom | | | | |
| Irregular bleeding | 36 (50.0) | 15 (50.0) | 14 (51.9) | 7 (46.7) |
| Vaginal discharge | | | | |
| Pelvic mass | 12 (16.7) | 6 (20.0) | 4 (14.8) | 2 (13.3) |
| Abdominal pain | 9 (12.5) | 6 (20.0) | 2 (7.4) | 1 (6.7) |
| Urinary symptom | 6 (8.3) | 1 (3.3) | 3 (11.1) | 2 (13.3) |
| None | 3 (4.2) | 1 (3.3) | 1 (3.7) | 1 (6.7) |
| Case history | | | | |
| ≤3 years | 6 (8.3) | 1 (3.3) | 3 (11.1) | 2 (13.3) |
| >3 years | 38 (52.8) | 12 (40.0) | 16 (59.3) | 10 (66.7) |
| SerumCA125 (U/L) | | | | |
| ≥35 | 34 (47.2) | 18 (60.0) | 11 (40.7) | 5 (33.3) |
| <35 | 6 (16.2) | 2 (20.0) | 2 (13.3) | 2 (16.7) |
| Ultrasound findings | 31 (83.8) | 8 (80.0) | 13 (86.7) | 10 (83.3) |
| Rich blood flow | 24 (33.4) | 8 (26.8) | 11 (40.8) | 5 (33.3) |
| No clear margin | 15 (20.8) | 5 (16.7) | 8 (29.6) | 2 (13.3) |
| Mass degeneration | 23 (31.9) | 11 (36.7) | 7 (25.9) | 5 (33.3) |
| No | 10 (13.9) | 6 (20.0) | 1 (3.7) | 3 (20.0) |
| MRI findings | | | | |
| Malignant | 18 (62.1) | 4 (44.4) | 9 (75.0) | 5 (62.5) |
| Benign | 11 (37.9) | 5 (55.6) | 3(25.0) | 3 (37.5) |
| D and C before operation | | | | |
| Malignant | 18 (36.0) | 2 (9.1) | 8 (57.1) | 8 (57.1) |
| Benign | 32 (64.0) | 20 (90.9) | 6 (32.9) | 6 (32.9) |

CA-125, Carbohydrate antigen-125; MRI, Magnetic Resonance Imaging; D and C, dilatation and curettage.

were nulliparous. Most patients were fertile at the time of onset (87.5%). Among the 63 fertile patients, 26 had LMS, 25 had ESS, and 12 had adenosarcoma. Among the nine nulliparous patients, four had LMS, two had ESS, and three had adenosarcoma. These data are shown in **Table 1**.

*Symptoms of patients*

The most common presenting symptoms were irregular bleeding (36/72, 50.0%), vaginal discharge (12/72, 16.7%), and a pelvic mass (9/72, 12.5%); only three patients exhibited urinary symptoms (3/72, 4.2%), six had abdominal pain (6/72, 8.3%), and six had no symptoms (6/72, 8.3%). These data are shown in **Table 1**.

*Case history*

A total of 38 (52.8%) patients had a case history of <3 years and 34 (47.2%) had a case history of >3 years. In the LMS group, 18 (60.0%) patients had a case history of >3 years; in the ESS group, 16 (59.3%) patients had a case history of <3 years; and in the adenosarcoma group, 10 (66.7%) patients had a case history of <3 years. These data are shown in **Table 1**.

*CA125 level*

The CA125 level was assessed in 37 patients, only 6 of whom had an elevated CA125 level (16.2%). Of these six patients, two each had LMS, ESS, and adenosarcoma (**Table 1**).

*Imaging manifestations*

Ultrasonography is the most commonly performed radiographic test to evaluate pelvic masses and intrauterine masses. The most common ultrasonic manifestations of uterine sarcoma are rich blood flow, no clear margin, and mass degeneration. All patients underwent pelvic ultrasound examination, which revealed that 24 (33.4%) patients had rich blood flow, 15 (20.8%) patients had no clear margin, 23 (31.9%) patients had mass degeneration, and 10 (13.9%) patients had none of the above manifestations. Pelvic MRI is very important for the diagnosis of pelvic masses. In the present study, 29 patients underwent pelvic MRI, and 18 (62.1%) patients had positive findings. These data are shown in **Table 1**.

*Result of diagnostic curettage*

Pathological specimens were obtained from 50 patients by diagnostic curettage, and of these, only 18 (36.0%) patients had malignant results, while 32 (64.0%) had benign results (**Table 1**).

*Tumor size and surgery therapy*

Among all patients in our study, the tumor size was ≤5 cm in 42 (58.3%) patients and >5 cm in 30 (41.7%) patients. All patients initially underwent the surgery in our hospital. Of the 72 patients, 6 (8.3%) underwent myomectomy, 28 (38.9%) underwent hysterectomy and bilateral salpingo-oophorectomy, and 38 (52.8%) underwent hysterectomy, bilateral salpingo-oophorectomy, pelvic lymph node resection, and omental resection. Among the patients with LMS, 3 underwent myomectomy, 12 underwent hysterectomy and bilateral salpingo-oophorectomy, and 15 underwent hysterectomy, bilateral salpingo-oophorectomy, pelvic lymph node resection, and omental resection. In the ESS group, no patients underwent myomectomy, 12 underwent hysterectomy and bilateral salpingo-oophorectomy, and 15 underwent hysterectomy, bilateral salpingo-oophorectomy, and pelvic lymph node resection. In the adenosarcoma group, three patients underwent myomectomy, four underwent hysterectomy and bilateral salpingo-oophorectomy, and eight underwent hysterectomy, bilateral salpingo-oophorectomy, and pelvic lymph node resection. A second surgical re-exploration was performed in 14 patients (6 patients each in the LMS group and ESS group, and 2 patients in the adenosarcoma group). These data are shown in **Table 2**.

*Clinical stage*

Most patients were diagnosed with early-stage cancer (stage I). According to the FIGO stage, 52 patients had stage I cancer (78.8%), 6 had stage II (9.1%), 8 had stage III (12.1%), and none had stage IV. In the LMS group, 24 patients had stage I cancer, 2 had stage II, and only 1 had stage III. In the ESS group, 18 patients had stage I, 3 had stage II, and 6 had stage III. In the adenosarcoma group, 10 patients had stage I and only 1 each had stage II and stage III. Data are shown in **Table 2**.

*Expression of p53, Ki-67 and ER/PR*

Some of the patients underwent an immunohistochemical examination. Of the 50 patients who underwent p53 assessment, 21 (42.0%) had a p53 + result. Of the 54 patients who underwent Ki-67 assessment, 51 (94.4%) had a Ki-67 + result. Of the 34 patients who underwent ER/PR assessment, 19 (55.9%) had a ER/PR + result. In the LMS group, 25 patients underwent p53 examination and 8 exhibited p53 expression, 24 patients underwent Ki-67 examination and 21 exhibited Ki-67 expression, and 15 patients underwent ER and PR examination and 5 exhibited ER and PR expression. In the ESS group, 12 patients underwent p53 examination and only 2 exhibited p53 expression, 17 patients underwent Ki-67 examination and all exhibited Ki-67 expression, and 11 patients underwent ER and PR examination and all exhibited ER and PR expression. In the adenosarcoma group, 13 patients underwent p53 and Ki-67 examination; of these, 6 exhibited p53 expression and all 13 exhibited Ki-67 expression. Additionally, in the adenosarcoma group, 8 patients underwent ER and PR examination; of these, 3 exhibited ER and PR expression. These data are shown in **Table 2**.

*Follow-up*

Among the 72 patients, 66 were followed up by telephone or by the outpatient department or

**Table 2.** Surgery pathological characteristics

| Surgery pathological findings | All sarcoma n = 72 (%) | LMS n = 30 (%) | EMSS n = 27 (%) | Adenosarcoma n = 15 (%) |
|---|---|---|---|---|
| Tumor size | | | | |
| ≤5 cm | 42 (58.3) | 13 (43.3) | 18 (66.7) | 11 (73.3) |
| >5 cm | 30 (41.7) | 17 (56.7) | 9 (33.3) | 4 (26.7) |
| Primary surgery | | | | |
| myoectomy | 6 (8.3) | 3 (10.0) | 0 (0) | 3 (20.0) |
| Hsyterectomy+BSO | 28 (38.9) | 12 (40.0) | 12 (44.4) | 4 (26.7) |
| Hsyterectomy+BSO+LNR | 38 (52.8) | 15 (50.0) | 15 (55.6) | 8 (53.3) |
| Figo stage | | | | |
| I | 52 (78.8) | 24 (88.9) | 18 (66.7) | 10 (83.4) |
| II | 6 (9.1) | 2 (7.4) | 3 (11.1) | 1 (8.3) |
| III | 8 (12.1) | 1 (3.7) | 6 (22.2) | 1 (8.3) |
| IV | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Immunohistochemical result | | | | |
| P53+ | 21 (42.0) | 13 (86.7) | 2 (16.7) | 6 (46.2) |
| P53- | 29 (58.0) | 12 (13.3) | 10 (83.3) | 7 (53.8) |
| Ki-67+ | 51 (94.4) | 21 (87.5) | 17 (100) | 13 (100) |
| Ki-67- | 3 (5.6) | 3 (12.5) | 0 (0) | 0 (0) |
| ER/PR+ | 19 (59.9) | 5 (33.3) | 11 (100) | 3 (37.5) |
| ER/PR+ | 15 (44.1) | 10 (66.7) | 0 (0) | 5 (62.5) |

BSO, bilateral salping-oophenrectomy; PLE, Pelvic lymphadenectomy.

other departments; 61 patients survived for more than 1 year, 55 patients survived for more than 2 years, 34 patients survived for 3 years, and 23 patients survived for more than 5 years. The patients' 1-, 2-, 3-, and 5-year survival rates were 92.4%, 83.3%, 51.5%, and 34.8%, respectively. Using a follow-up of 3 years as the study object, analysis of the factors affecting survival is shown in **Table 3**. The Kaplan-Meier product limit method was used to draw the survival curve of patients (survival function 1, 2). There were no significant differences in age, menopausal status, expression of ER/PR, histological type, or treatment between the patients and the prognosis.

The Kaplan-Meier product limit method was also used to draw the survival curve of patients with different clinical stages by log rank analysis. The survival rate of patients with stage I cancer was significantly higher than that of patients with stage II and stage III cancer (P = 0.027), as shown in **Figure 1**. The survival rate of patients without vascular thrombus was significantly higher than that of patients with vascular thrombus (P = 0.02), as shown in **Figure 2**.

## Discussion

Uterine sarcoma is a rare gynecological malignant tumor that represents 1% of all gynecological tumors and accounts for 3% to 7% of all uterine corpus malignancy [8]. According to the 2016 NCCN classification, uterine sarcoma can be classified into uterine LMS, ESS, undifferentiated endometrial/uterine sarcoma, and other rare uterine mesenchymal sarcoma subtypes (adenosarcoma, rhabdomyosarcoma, and perivascular epithelioid cell tumor). Carcinosarcoma was previously categorized as a type of sarcoma but is now considered and treated as high-grade endometrial carcinoma. ESS is subdivided into low-grade and high-grade ESS.

Previous research has shown that most patients with uterine sarcoma are 40 to 55 years of age, more than half are premenopausal, and a few are nulliparous [4]. In the present study, uterine LMS was the most common histological type of uterine sarcoma, ESS was the second most common, and adenosarcoma was the third. No patients in our study had undifferentiated endometrial/uterine sarcoma; this may have been associated with its rare inci-

**Table 3.** Prognosis factors of 3 years survival rate

| | Classification | Number | 3 years survival rate | | *P* value |
|---|---|---|---|---|---|
| | | | N | % | |
| Age | ≤49 years | 19 | 13 | 68.4 | 0.610 |
| | >49 years | 15 | 9 | 60.0 | |
| Menopausal state | Pre-menopause | 23 | 13 | 56.5 | 0.149 |
| | Post-menopause | 11 | 9 | 81.8 | |
| FIGO stage | I stage | 26 | 20 | 76.9 | 0.027 |
| | II stage | 4 | 1 | 25.0 | |
| | III stage | 4 | 1 | 25.0 | |
| Histological type | LMS | 15 | 11 | 73.1 | 0.414 |
| | ESS | 12 | 6 | 50.0 | |
| | AS | 7 | 5 | 71.4 | |
| Vascular invasion | Positive | 11 | 3 | 27.3 | 0.002 |
| | Negative | 23 | 19 | 82.6 | |
| ER/PR | Positive | 16 | 10 | 62.5 | 0.134 |
| | Negative | 7 | 2 | 28.6 | |
| Therapy | Myoectomy | 2 | 0 | | |
| | Basic operation | 17 | 10 | 58.8 | 0.065 |
| | Basic operation + other therapy | 15 | 12 | 80.0 | |

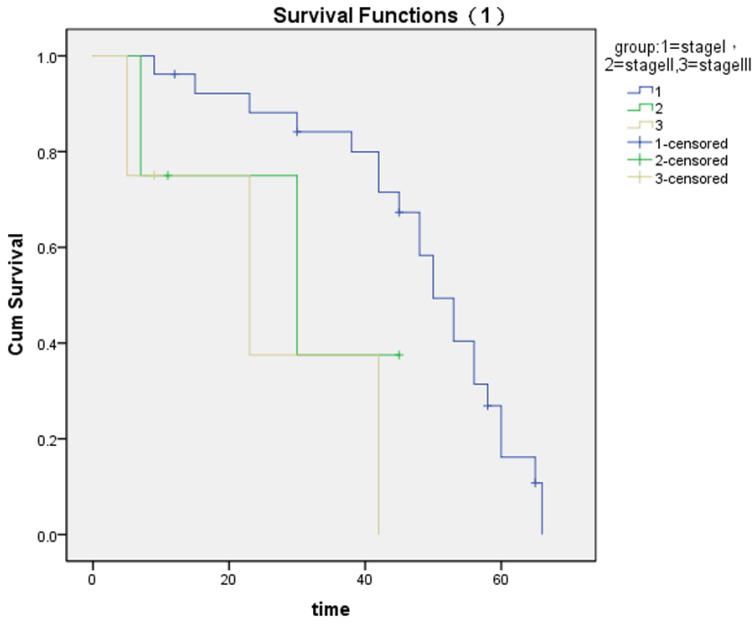


**Figure 1.** Progression-free survival of patients with sarcoma stratified by clinical stage (stage I vs stage II vs stage III). The survival rate of stage I patients was significantly higher than that of patients with stage II and stage III (P = 0.027).

dence. The patients were 24 to 69 years old, and the median age of all 72 patients at the time of diagnosis was 49 years (mean, 48.12 ± 7.36 years). Of the 72 patients, 49 (68.1%) were 40 to 55 years old at diagnosis, 42 (58.3%) were premenopausal, and 9 (12.5%) were nulliparous. The mean age of the patients in the LMS, ESS, and adenosarcoma groups was 51.06 ± 7.41, 44.62 ± 7.13, and 46.17 ± 9.35 years, respectively. There were statistically significant differences in the mean ages of patients with different histological types. Patients with uterine LMS were older than those with ESS, which is in accordance with previous reports in the literature [4].

*Clinical manifestations of uterine sarcoma*

There is no typical clinical manifestation of uterine sarcoma. The most common symptoms are irregular bleeding, vaginal discharge, a pelvic mass, and abdominal pain; however, many patients have no symptoms [9].

In the present study, irregular vaginal bleeding was the most common clinical presenting

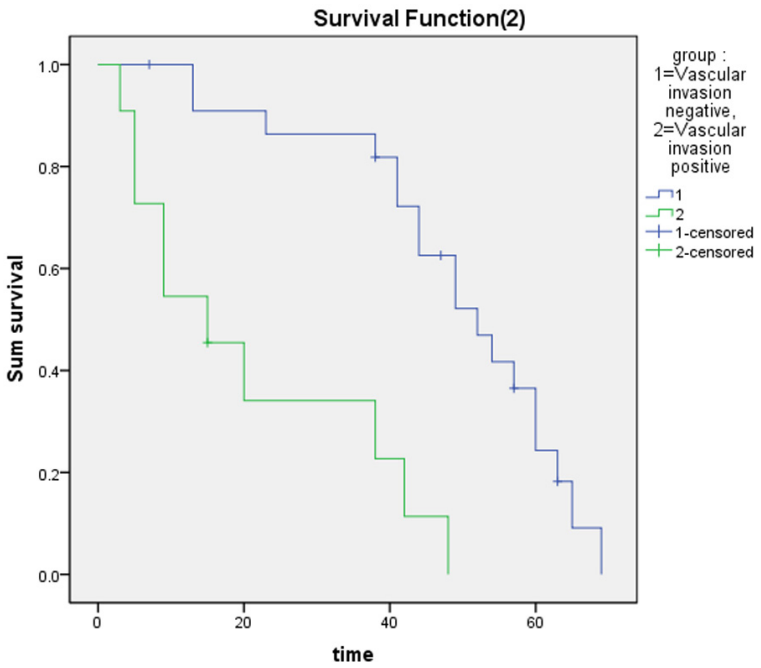


**Figure 2.** Progression-free survival of patients with sarcoma stratified by vascular ivast (without vascular thrombus vs positive vascular thrombus). The survival rate of patients without vascular thrombus was significantly higher than that of patients with positive vascular thrombus (P = 0.02).

symptom in the patients with uterine sarcoma. This type of bleeding included dripping bleeding, massive hemorrhage, and menopausal bleeding; the color of the bleeding was yellowish or brown, and it had no odor. Some patients had irregular or prolonged menstruation, which was a risk factor for anemia and weakness.

Some patients with uterine sarcoma had vaginal discharge resembling rice water; it was a white or bleeding vaginal secretion in some cases and always had an odor. Some patients with later-stage uterine sarcoma had large amounts of vaginal discharge resembling rice water, and the discharge had a strong odor caused by tissue necrosis or infection. Small pelvic masses could not be palpated; they could only be felt when they had grown larger than the size of a uterus at 3 months of pregnancy. Some patients had dysmenorrhea or abdominal pain, and the dysmenorrhea was always secondary. Abdominal pain was usually caused by rapid mass growth and tissue necrosis or infection. Symptoms caused by mass compression included abdominal distension, frequent micturition, and dysuria. The most common cause of compression-related symptoms was the mass pressing the bladder or gut. Some patients had no typical clinical signs. They presented to the hospital mostly because of a mass in the uterine cavity or cervical vegetation.

Among the 72 patients in our study, the most common symptom was irregular vaginal bleeding (present in half of the patients). The second most common symptom was vaginal discharge. A few patients had a pelvic mass, abdominal pain, or no symptoms. There were no significant differences in the clinical manifestations of patients with different histological types.

*Diagnosis of uterine sarcoma*

The preoperative diagnosis of uterine sarcoma is difficult because its nonspecific clinical manifestations and symptoms are similar to those of uterine fibroids, adenomyosis, endometrial carcinoma, and cervical cancer. In addition, because of the lack of special tumor markers and effective diagnostic measures in the early stage, the missed diagnosis rate may reach 50%. In the present study, only 21 of patients were diagnosed with uterine sarcoma preoperatively, and 45 patients had a missed diagnosis of fibroids; these findings are in accordance with previous reports.

*Preoperative diagnosis*

As the first-choice imaging examination for gynecological disease, color Doppler ultrasonography plays an important role in early diagnosis of uterine sarcoma. Uterine sarcoma has several typical characteristics on color Doppler ultrasonography. On gray-scale sonography, the tumor is mostly myometrial or an intrauterine single lesion with a large volume (>8 cm). The shape is irregular or lobular, the multiple boundaries of the tumor are blurred, and part of the tumor can exhibit invasive growth. The internal structure of the lesion most commonly exhibits honeycomb/mixed echogenicity. Additionally, most tumors are characterized by abundant peripheral blood flow, irregular blood

flow, distributions of peripheral and central blood flow, or a disordered shape and irregular direction of blood flow, which can be seen as mosaic blood flow [10]. In the present study, all patients underwent color Doppler ultrasound examination, which most commonly showed rich blood flow rich tumor degeneration; there were no significant differences among the different tissue types.

In the present study, most patients with ESS had large solid or cystic masses in the muscle wall, and the masses invaded the tissues around the ligaments and blood vessels. Most of the lesions showed isointense signals on T1-weighted imaging (T1WI) and hyperintense signals on T2-weighted imaging (T2WI), indicating obvious hyperintense lesions on T2WI. Arc calcification was seen in a few patients, and the parenchymal and septal components were significantly enhanced after enhanced scanning [11]. In patients with uterine LMS, MRI showed a soft tissue mass that was unclear from the uterine boundary and contained a pseudocapsule. These patients can exhibit heterogeneous high-intensity lesions on T1WI with irregular boundaries and hemorrhagic or necrotic areas on T2WI. The main MRI finding of uterine adenosarcoma is usually an intrauterine polypoid soft tissue mass with an unclear cervical canal boundary. Lesions occurring in the cervical canal can penetrate the cervical canal on T1WI. Lesions on T1WI show the same or slightly lower signal intensity on T2WI and are mainly high-intensity mixed-signal lesions. Irregular cystic signals can be observed in the lesions. Enhanced scanning of the lesions shows obvious uneven enhancement in the parenchyma, continuous enhancement in the later stage, and non-enhancement in the cystic part. The literature contains no relevant descriptions of the MRI findings of undifferentiated uterine sarcoma. Skorstad studied 212 patients with uterine LMS for 10 years and found that MRI evaluation is the most sensitive imaging technique for preoperative identification of LMS [12]. In the present study, 22 patients underwent pelvic nuclear MRI, of whom 15 showed a malignant or suspicious malignant tumor (68.2%). The diagnostic accuracy was significantly better than that of color Doppler ultrasound before the operation. There was no significant difference in the positivity rate among different tissue types. However, because of its high examination cost, long examination time, and requirement for injection of special contrast agent, the clinical application of nuclear MRI is not as common as color Doppler ultrasound. It is often used when preoperative diagnostic curettage pathology suggests malignancy or rapid tumor growth. Some scholars believe that MRI of uterine sarcoma lacks obvious specificity, but MRI more clearly shows the size, shape, cystic/solid nature, and invasion of adjacent tissues than does color Doppler. Therefore, both plain and enhanced MRI scans can help in the differential diagnosis of tumor denaturation, unclear tumor boundaries, or invasion of surrounding tissue shown on color Doppler imaging [13].

No specific tumor marker is available for uterine sarcoma [14]. The CA125 level is increased in most gynecological malignancies, such as endometrial and ovarian malignancies. In the present study, the CA125 level was measured in 37 patients. Using a CA125 level of >35 U/ml as the limit, CA125 was increased in 6 patients of 8 (20.0%) with LMS, 2 of 13 (13.3%) with ESS, and 2 of 10 (16.7%) with adenosarcoma [2]. There was no significant difference in the prevalence of a high CA125 level among the different tissue types.

The tissue of origin varies among different types of uterine sarcomas. ESS and adenosarcoma originate from the interstitial components of the endometrium, and the tumor usually appears as a polypoid mass protruding into the uterine cavity; thus, preoperative curettage usually provides positive results. However, uterine LMS originates from the myometrium of the uterus, and most of these tumors are located in the serous layer between the walls of the uterus. In the present study, positive results were difficult to obtain from preoperative scraping before hysteroscopy. The positive rate of preoperative curettage in 22 patients with uterine LMS was 9.1% (2/22), that in 14 patients with ESS was 57.1% (8/14), and that in 14 patients with uterine adenosarcoma was 57.1% (8/14). There was a significant difference in the positive rate of preoperative curettage among patients with these different tissue types. The positive rate of preoperative curettage was higher in patients with ESS and uterine adenosarcoma. The highest positive rate of curettage in patients with ESS in this study may have

been due to the difference in the locations of the tumors or the fact that tumors of the stromal sarcoma were compressed into the uterine cavity, resulting in inadequate curettage for the diagnosis of ESS. Therefore, curettage or hysteroscopy should be performed before the operation in patients with suspected uterine sarcoma or those planning to undergo hysterectomy for treatment of hysteromyoma.

*Intraoperative diagnosis*

Grossly, a uterine sarcoma generally appears as a large mass with an unclear margin. The cut surface is soft, fishlike, grayish white, and yellow to brown and may be cystic, hemorrhagic, or necrotic. Some of the tumor tissue is brittle. There is obvious invasion of the myometrium and cystic degeneration in the center, and some cases show polyps or a submucous myomatous process with abundant peripheral blood vessels [15]. During the operation, masses with the above features should be excised to the greatest extent possible and completely removed to avoid spread of the mass to the pelvic cavity. The specimen should then be rapidly sent for frozen section pathology so that the surgeon can decide whether to expand the scope of the operation according to the frozen pathology results; a secondary operation should be avoided if possible. In the present study, 14 patients underwent intraoperative frozen section examination (11 patients were diagnosed with sarcoma by rapid pathology, 2 were diagnosed with atypical leiomyoma, without the exception of LMS, exact paraffin; and 1 was diagnosed with uterine leiomyoma, by severe heterosexual cells, and mitosis with necrotic and invasive growth). Rapid frozen examination of a suspected sarcoma is the last line of defense against a missed diagnosis of uterine sarcoma.

*Treatment of uterine sarcoma*

The main treatment principle of uterine sarcoma is surgery, which can be supplemented by hormone therapy, chemotherapy, or radiotherapy [16]. The basic surgical procedure for uterine sarcoma is total bilateral salpingo-oophorectomy. Tumor cell reduction should be performed for any extrauterine metastases found during the operation. Different scholars have different views on whether systematic pelvic lymphadenectomy should be performed depending on the tissue type, whether young patients can retain their ovaries, and whether infertile patients can retain fertility function. Although ERs are expressed in some cases of uterine LMS, several studies have shown that early premenopausal ovarian preservation does not affect the recurrence rate or overall survival rate of patients with LMS [11]. Sim and other scholars believe that uterine LMS should not be dissected systematically unless it is in contact with obviously enlarged lymph nodes [17]. Lin Zhongqiu and others reported that the rate of lymph node metastasis in uterine LMS ranges from 6.6% to 11.0% and recommended removal of the lymph nodes. Thus, for early uterine LMS, the ovary may be preserved, and lymphadenectomy is not routinely performed; if the lymph nodes do not show inflammatory swelling, suspicious positive or extrauterine metastasis can be excluded. Whether postoperative adjuvant therapy can improve the survival rate of patients remains unclear. Some scholars believe that radiotherapy can control local recurrence. In the late stage, patients with recurrence can be treated with chemotherapy. The most common used chemotherapeutic drugs are doxorubicin, docetaxel, and gemcitabine. Some targeted therapies such as trabectedin can be used to control advanced or metastatic leiomyomas [18]. ESS is an estrogen-sensitive tumor; thus, preservation of the ovary is not generally recommended. Beck found that retention of ovarian function increased the recurrence rate and difference in 28 cases of early low-grade ESS ($P = 0.046$) [19]. A follow-up study of 831 patients with ESS by Chan showed that in young patients with stage I and stage II ESS, the recurrence rate was higher than that of ovarian preservation, but there was no significant difference in the 5-year survival rate ($P = 0.06$) [14]. Manfei Si analyzed 3058 patients in 11 medical institutions and showed that the overall survival rate was not affected by lymphadenectomy [17]. He studied whether pelvic lymph node dissection and bilateral salpingo-oophorectomy should be integrated into a standardized procedure [20]. After the operation, the patient can be supplemented with progesterone, aromatase inhibitors, and other hormone therapy, but additional radiotherapy and hormone replacement therapy is generally not recommended. Pelvic lymphadenectomy is generally not recommended for these tumors. Undifferentiated endometrial

sarcoma can be treated with radiotherapy + chemotherapy, but adenosarcoma has low-degree malignant potential and should be closely followed up.

*Prognosis of uterine sarcoma*

The recurrence rate of uterine sarcoma is high and the prognosis is very poor. The 5-year survival rate is only 20% to 40% [21]. Data show that the prognosis of uterine sarcoma is closely related to the age at onset, clinical stage, depth of myometrial infiltration, presence of lymphatic thrombi in vessels, expression of ER/PR in lymph node metastasis, and treatment methods [9]. A higher age at onset and deeper myometrial infiltration are associated with a higher recurrence rate in patients with lymphatic thrombi and lymph node metastasis. ER/PR positivity is a protective factor against postoperative recurrence. The value of the histological type in prognostic evaluation remains controversial. Abeler considered that the tissue type of sarcoma is also a high risk factor for the prognosis of uterine sarcoma. Poorly differentiated ESS has a relatively good prognosis, while well-differentiated ESS and undifferentiated uterine sarcoma have a relatively poor prognosis. The present study showed that the clinical stage and presence of vascular tumor emboli were the main prognostic factors in 31 patients with uterine sarcoma, and the degree of malignancy was higher in patients with than without vascular tumor emboli. There was no significant correlation between the pathological type and the patients' prognosis; however, there was also no significant difference in the treatment methods. Notably, the number of patients followed up in this study was relatively small, and further pathologic examinations are necessary in larger study populations.

## Conclusion

Uterine sarcoma may occur in premenopausal women, and the most common clinical manifestation is irregular vaginal bleeding. Uterine sarcoma has no specific ultrasound imaging findings and lacks special tumor markers. Preoperative diagnostic curettage or hysteroscopic examination can improve the preoperative diagnosis rate of uterine sarcoma. The clinical stage and presence of vascular thrombosis are risk factors for a poor prognosis. Age at onset, ER/PR positive expression, pathological type, and treatment do not significantly affect the prognosis.

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## Disclosure of conflict of interest

None.

## Abbreviations

LMS, leiomyosarcoma sarcoma; ESS, endometrial stromal sarcoma; LGESS, low-grade endometrial stromal sarcoma; HGESS, high-grade endometrial stromal sarcoma; ER, estrogen receptor; PR, progesterone receptor; HRT, Hormone replacement therapy; NCCN, National Comprehensive Cancer Network.

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