

Transvaginal/transrectal ultrasound-guided aspiration biopsy for diagnosis of pelvic/pelvic floor tumors in females: A retrospective analysis

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Abstract. Ultrasound guidance for histological diagnosis is in real-time, convenient, and economical. The aim of this study was to determine whether transvaginal ultrasound (TVUS)- and transrectal ultrasound (TRUS)-guided aspiration biopsy allows detection of a malignant pathology of pelvic/pelvic masses. Data of 40 patients with pelvic and pelvic mass lesions by computed tomography or magnetic resonance imaging underwent TVUS- or TRUS-guided biopsy. Tissue samples obtained were assessed on suitability for histopathologic evaluation. The post-biopsy complication was monitored. All the specimens in the pelvic floor, vaginal stump, vaginal fornix, cervix, and posterior wall of the anal canal were adequate for histologic diagnosis. There were no post-biopsy complications. Transvaginal/transrectal ultrasound-guided aspiration biopsy is safe and simple. It can be used for the diagnosis and differential diagnosis of pelvic and pelvic floor lesions in women. Prospective studies are needed to test diagnostic performance across clinical scenarios.

Introduction

Ultrasound-guided intervention has many benefits. The visually clear real-time pathway guarantees negligible radiation hazard, secures procedural safety for aspiration, biopsy, and ablation in the treatment of multiple organ diseases, enhances multi-dimensional capability, provides convenience, decreases procedure time, and minimizes cost (1,2). Also, the pre-operative sampling of tumor mass is suggested to confirm the presence of cancer and ascertain morphological subtype before neo-adjuvant chemotherapy may lead to the potential

diagnostic misinterpretation of tumor cells and difficulties in detecting residual tumor after neoadjuvant chemotherapy of bulky malignant tissues (3).

Ultrasound-guided intervention has technically evolved with clinical procedures conducted at the abdomen, thorax and urogenital system (4). Transvaginal ultrasound (TVUS)-guided biopsy is safe and effective in the diagnosis of pelvic lesions (5-15).

TVUS-guided gun biopsy of the uterus and ovaries in the office setting histologically confirmed 19 of the 22 (86.4%) preliminary equivocal ultrasound diagnosis of adenomyosis, leiomyoma and benign ovarian mass (5). The diagnostic accuracy of TVUS using histopathology as a gold standard in identifying endometrial hyperplasia among 263 perimenopausal women presenting with abnormal uterine bleeding was found to be 75.6% (6).

TVUS has a high negative predictive value (99.1%) for an endometrial thickness of 10.8 mm in the evaluation of 100 women with post-menopausal bleeding (7). The TVUS biopsy diagnosis of peritoneal carcinomatosis and recurrent pelvic malignancy was validated in a cohort of 50/54 (93%) women by comparison with the histopathologic specimen or clinical course and outcome (8). TVUS-guided core needle biopsy adequately obtained tumor samples from 200 women with abdominopelvic or pelvic masses with 190 of 200 (95.0%) verified before treatment (9). Of the 200, 97 (48.5%) were inoperable tumors, 13 (6.5%) were metastatic, 45 (22.5%) were recurrent and 45 (22.5%) were rare tumors (9). In 55 women with pelvic masses detected on computed tomography (CT) or magnetic resonance imaging (MRI) before the biopsy, 46 (84%) of the pelvic samples from TVUS core biopsy were confirmed to be either malignant or benign, and 5 (9%) were inflammatory lesions showing an overall diagnostic accuracy of 51/55 (93%) (10). Of the 48 women diagnosed by ultrasound alone as having adenomyosis, 37 (77%) were histologically confirmed as having adenomyosis after TVUS-guided biopsy (11). Samples obtained by TVUS guided uterine core biopsy from 80 cases of pre-menopausal women scheduled for hysterectomy proved to be useful in the investigation of early pathogenesis of adenomyosis (12).

Transrectal ultrasound (TRUS)-guided core biopsy confirmed recurrent carcinoma of the uterine cervix in

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16/17 (94%) of women with non-diagnostic vaginal cytology and transvaginal punch biopsy (13). TRUS-guided biopsy revealed recurrent pelvic malignancy in 5/8 (62%) in women presenting with abdomino-pelvic and back pain (14). TRUS examination was assessed to have high diagnostic power for polycystic ovary syndrome among 183 Korean women aged 21-32 years (15).

Of the 11 studies that reported safety and efficacy, only one study reported vaginal bleeding, 10/55 (18%) and gross hematuria, 2/55 (4%) as TVUS procedure-related complications (10). There was no reported complication with TRUS-guided biopsy in any of the reports.

This study aimed to determine the accuracy and safety of transvaginal and transrectal core needle biopsy of pelvic cavity masses under ultrasound guidance. The authors undertook this study since there is scant literature on the histological findings from biopsies taken directly from the pelvic cavity and from pelvic floor lesions.

Materials and methods

Subjects. We randomly obtained medical records of female patients. A consecutive series of 40 patients with the diagnosis of pelvic or pelvic floor masses between July 2015 and August 2017 at the Department of Ultrasound of the First Affiliated Hospital of Medical University of Anhui (Hefei, China) were considered eligible and chosen for satisfying the inclusion criteria. Inclusion criteria were as follows: i) Mass was detected by MRI or positron emission tomography (PET)/CT one month prior to biopsy, ii) primary origin was undetermined; iii) mass was visible by either transvaginal or transrectal ultrasound technique, iv) mass was in proximity, v) accessible to either TVUS- or TRUS-guided biopsy for tissue sampling, and vi) histological confirmation is needed for further patient management. Exclusion criteria were as follows: i) No ultrasound-guided needle path, ii) poor coagulation function, iii) severe infection, and iv) severe heart and lung insufficiency.

Clinical laboratory indicators of patient status and risk of complication were evaluated. The laboratory indicators were complete blood count, prothrombin time, international normalized ratio, activated partial thromboplastin time. We retrospectively analyzed extracted clinicopathologic data.

Informed consent and ethics approval. Before the procedure, patients were informed of the risk of complications and potential damage to adjacent structures along the path of the needle. Consent to proceed with the biopsy was obtained before the procedure.

Before inclusion into the retrospective study, patients or legally authorized representatives of subjects were contacted. All the participants gave their informed consent for inclusion and use of patient information. The protocol of the study was approved by the Medical University of Anhui Institutional Review Board. The IRB approval project identification code is AF/SC-08/02.0. The study was conducted as per the Declaration of Helsinki.

Instrument and biopsy procedure. None of the included patients had contraindications for biopsy. Every biopsy was performed by one of two experienced physicians (CG, LW) who

had worked at least five years at the interventional ultrasound department using US instrument (Logiq E9; GE Healthcare, Chicago, IL, USA). TVUS- and TRUS-guided biopsies were performed in the lithotomy position with empty bladder after sterilization of the vagina and anus (16). The procedure utilized a reusable automatic biopsy gun (Bard Biopsy, Tempe, AZ, USA) compatible with an 18 gauge 15 cm tru-cut needle. The needle was inserted parallel to the transvaginal US probe and was directed to the lesion with an attached needle guide.

Local anesthesia and conscious sedation were not used. The biopsy needle with ultrasonic dynamic monitoring led the passage avoiding bowel, blood vessels, and bladder. The morphological characteristics of the mass, size, location, relationship with the adjacent tissues, and proximity to the vagina or rectum were observed before puncture. Upon reaching the lesion edge and gaining a penetration depth of >2.0 cm with strong echo lesions, biopsy specimens were drawn from different directions (17). All the specimens obtained were immediately placed on a sterile filter paper and fixed in 10% formaldehyde solution (Sigma-Aldrich; Merck KGaA, Darmstadt, Germany). Sections and slides from paraffin-embedded tissue blocks as samples were stained with hematoxylin-eosin.

After the transvaginal procedures, three sterilized cotton balls were immediately tucked into the biopsy sites for hemostasis. Bleeding and other possible complications were checked after the cotton balls were taken out after 30 min. Patients were observed around 30 min to 1 h with frequent vital signs monitoring in a dedicated area. Safety of the procedure was concluded if there were no or minor complications. If without discomfort or complications, patients were returned to the ward or sent home. The procedure and diagnostic criteria of TRUS-guided biopsy were similar to that of TVUS (18).

Radiologic, pathologic, and clinical data analyses. All archived CT, MRI, and ultrasonography (US) images from the picture archiving and communication system (PathSpeed, GE Healthcare, Milwaukee, WI, USA) were re-evaluated. Radiologists were aware of the history of the patient illness but blinded to all other clinical information. Two radiologists independently evaluated the pelvic lesions based on the: i) lesion size, ii) lesion nature (e.g., solid or cystic) (19), and iii) lesion site. The biopsy core number was counted from images, and the biopsy distance was determined from the standard reports. The biopsy distance was defined by the measured mean length of the biopsy needle seen on US images. Disagreements of the evaluation of two radiologists were resolved by consensus. If no agreement was reached, a third evaluator was consulted for final consensus.

An experienced pathologist evaluated the histology of the specimen. The pathologist was aware of the history of the patient illness but blinded to all other clinical information including the imaging results (20). The step detects the presence or absence of malignancy thereby detecting or excluding the diagnosis (21). Possible complications based on the patients' medical records were evaluated using the Clavien-Dindo classification (22).

Results

Of the 40 female patients included in the study, 39 had TVUS, and 1 had TRUS-guided biopsy. The mean age was 54 years

Table I. Normal values of coagulation in patients undergoing TVUS- and TRUS-guided aspiration biopsy.

Hematologic test	Normal range of values (reference)	Cut-off
Activated partial thromboplastin time	28.0-42.0	45
INR	0.85-1.15	1.6
Platelets, 10 ⁹ /l	125-350	50
Prothrombin time	11.0-16.0	18

INR, international normalized ratio; TVUS, transvaginal ultrasound; TRUS, transrectal ultrasound.

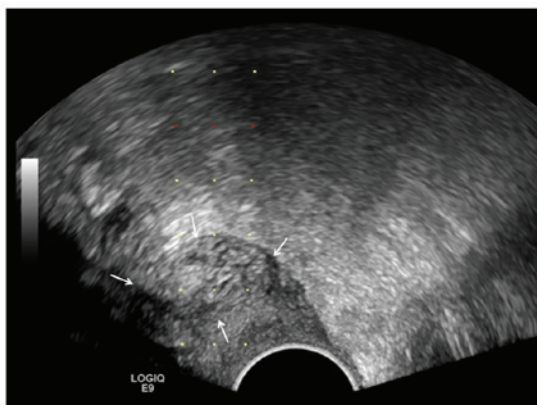


Figure 1. TVUS of a 67/F patient with endometrial cancer. Biopsy was taken at the vaginal stump, with a mass of 3.0x1.7 cm, indicated by the white arrows. TVUS, transvaginal ultrasound.

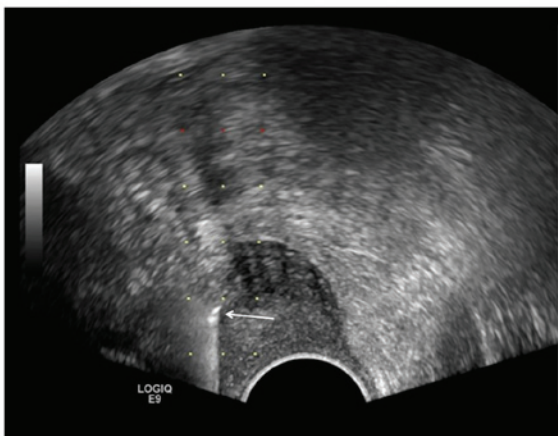


Figure 2. The puncture needle enters the lesion of the vaginal stump as shown by the white arrow.

(range, 46-69 years). All laboratory results were within the acceptable normal range of coagulation parameters (Table I). There were no complications identified.

The median lesion size was 5.5 cm (range, 1-15 cm). Thirty-four of the lesions were solid while six were cystic. The mean distance of the biopsy was 2.4 cm (range, 1.4-5.6 cm). The median number of biopsy cores obtained from each



Figure 3. TVUS of a 62/F patient with cervical cancer. Biopsy was taken at the cervix. A 2.8x2.3 cm mass is indicated by the white arrows. TVUS, transvaginal ultrasound.

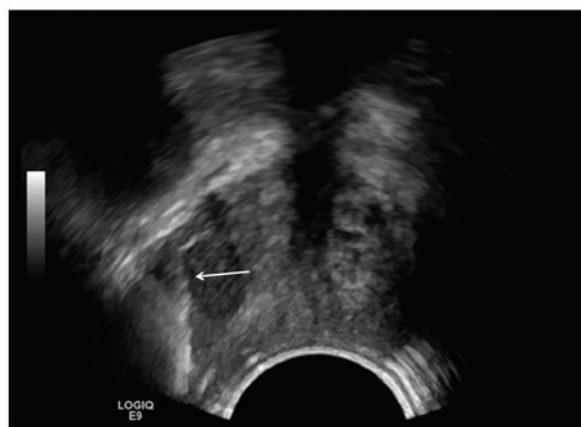


Figure 4. The puncture needle enters the cervical lesion as shown by the white arrow.

patient was 4.0 (range, 2-7 cores). The specimens (Table II) were obtained from pelvic cavity and pelvic floor in 18 cases (45%), the vaginal stump in 6 cases (15%), the cervix in 2 cases (5%) and the vaginal fornix in 13 cases (32.5%). Representative cases are shown in Figs. 1-4.

All the specimens were adequate for histologic evaluation and diagnosis with 72% (28/39) being identified as primary and 13% (5/39) as metastatic malignancy. There was one diagnosed case of rectal cancer with a post-operative specimen from the posterior wall of the anal canal obtained by TRUS-guided biopsy (2.5%).

Discussion

A retrospective analysis was performed in our center to determine whether TVUS- and TRUS-guided aspiration biopsy allows the detection of a malignant pathology in the pelvic/pelvic floor. The study shows detection in almost all suspicious clinical cases by MRI or PET/CT consistent with a more than 90% adequacy and accuracy of other studies (8-10). An experienced pathologist provided the expertise that has optimized the use of aspiration biopsy.

TVUS- or TRUS-guided aspiration biopsy has several advantages. The biopsy is technically easy and does need

Table II. Malignancy proven lesions from transvaginal ultrasound-guided aspiration biopsies.

Patient	Age (years)	MRI and PET/CT findings at sites	Pathomorphological findings	Diagnosis
1	84	Pelvic cystic, solid mass	Grayish white, poorly differentiated cancer	Ovarian cancer
2	67	Vaginal stump hypoechoic	Low-grade adenocarcinoma	Ovarian cancer
3	60	Bottom of the pelvic floor	Grayish white, poorly differentiated adenocarcinoma	Ovarian cancer
4	52	Low echo above the vaginal stump	Grayish white, poorly differentiated squamous cell carcinoma	Cervical cancer
5	46	Cervical anterior lip hypoechoic	Medium-differentiated adenocarcinoma, metastatic carcinoma of the upper digestive source may be large	Metastatic adenocarcinoma, upper gastrointestinal
6	68	Pelvic floor cervix	Gray-white, poorly differentiated urothelial carcinoma may be large	Cervical cancer
7	46	Low echo above the vaginal stump	Gray-white, poorly differentiated cancer, combined with a history of breast cancer metastasis may be large	Metastatic poorly differentiated, breast
8	54	Right ovarian solid lesion	Grayish white, spindle cell lesion, no excluding sex stromal tumor	Ovarian cancer
9	47	Low echo of the left uterus	3 grayish white, high-grade serous carcinoma, source of female reproductive system	Ovarian cancer
10	62	Hypoechoic lesion on the left side of the posterior vagina	3 grayish white, ovarian serous carcinoma metastasis	Ovarian cancer
11	46	Cervical anterior and posterior lip hypoechoic, cervix 1, cervix 2, anterior vaginal wall	High-grade squamous intraepithelial neoplasia CIN3, suspicious microinvasive, chronic inflammation of vaginal lesions	Cervical cancer
12 ^a	47	Cervical, ovary	1 anterior lip of the cervix, smooth muscle; 1 posterior lip of the cervix, adenocarcinoma; 2 ovarian cancer, adenocarcinoma;	Straight B junction tumor ovarian metastasis
14	50	Hypoepitic lesions above the vagina	Grayish white 3, leiomyoma	Uterine fibroids
15	67	Vaginal stump cystic, solid mass	Poorly differentiated cancer	Ovarian cancer
16	60	Right ovarian giant cystic	Medium differentiated adenocarcinoma	Metastatic non-small cell lung cancer, adenocarcinoma
17	47	Vaginal stump	Poorly differentiated cancer	Ovarian cancer
18	52	Pelvic mass	Poorly differentiated cancer	Ovarian cancer
19	62	Cervical hypoechoic	Squamous cell carcinoma	Cervical cancer
20	61	Double ovarian solid mass	Metastatic poorly differentiated adenocarcinoma	Metastatic non-small cell lung cancer, adenocarcinoma
21	56	Vaginal stump	Poorly differentiated cancer	Cervical cancer
22	61	Vaginal wall stump	Poorly differentiated cancer	Cervical cancer
23	48	Left attachment pocket solid mass	Serous carcinoma	Ovarian cancer
24	71	Vaginal stump	Endometriosis	Endometriosis
25	45	Left ovary hypoechoic	Spindle cell tumor	Sex cord stromal tumor
26	52	Low echo of the anterior wall of the vagina	Leiomyoma	Vaginal leiomyoma
27	43	Pelvic cystic mixed echo	Serous carcinoma	Ovarian cancer
28 ^a	54	Left genital hypoechoic lesion	Adenoid cystic carcinoma	Ovarian cancer
29	67	Vaginal stump	Adenocarcinoma	Endometrial cancer
30	56	Left ovarian solid part and posterior lip lesion	Poorly differentiated cancer	Ovarian cancer

Table II. Continued.

Patient	Age (years)	MRI and PET/CT findings at sites	Pathomorphological findings	Diagnosis
31	52	Posterior wall of the lower vagina	Leiomyoma	Uterine fibroids
32	64	Above the vaginal stump	Endometrial stromal sarcoma	Uterine cancer
33	70	Cervical hypoechoic	Inflammatory	Inflammatory cells, cervix
34	59	Uterine rectal fossa lesion	Serous carcinoma	Ovarian cancer
35	42	Left echo low echo nodule	Metastatic cancer	Endometrial cancer
36	53	Uterine rectal fossa lesion	Serous carcinoma	Ovarian cancer
37	46	Subcutaneous hypoechoic	Adenoid cystic carcinoma infiltration	Vaginal cancer
38	42	Pelvic mass	Low-grade adenocarcinoma	Cervical cancer
39	41	Vaginal stump	Squamous cell carcinoma	Cervical cancer
40	54	Uterine rectal fossa	Left ovarian granuloma	Ovarian cancer

^aLaparoscopy and transvaginal ultrasound-guided. CT, computed tomography; MRI, magnetic resonance imaging; PET, positron emission tomography.

anesthesia. Either of the two techniques can be used as a first-line investigation in the evaluation of women with pelvic or pelvic floor masses (6,9). The biopsy can be supplemented with procedures such as laparoscopy for lesions involving ovary and cervix as experienced in the hospital. In addition to the traditional benefits of ultrasound-guided biopsy (1,2), seeding by malignant cells seems low risk (9). Also, it is not known whether the risk of infection is high with the transrectal or transvaginal approaches. Antibiotic prophylaxis is well-established in transrectal biopsy of the prostate (23). However, whether infection and subsequent antibiotic prophylaxis are necessary for TVUS-guided biopsy remains to be observed.

The present study has several limitations. As a retrospective analysis using medical chart reviews, data inputted from medical records were not sufficient to determine diagnostic performance. Analysis to provide valid and reliable diagnostic performances (sensitivity, specificity, positive predictive value, negative predictive value, accuracy) requires the identification of a set of variables to provide the best prediction. Missing data precluded the detection of increasing diagnostic certainty from imaging to histopathology. Detection or exclusion of malignancy using test-result based sampling or case-referent sampling is ideal (21).

Second, the diagnostic test is almost always not applied in isolation but in combination (21). Interacting variables (relevant clinical variables, tumor markers, CT/MRI, clinical stage of cancer) increase sample size and may not be easy to be obtained. To conduct this kind of study, we may have to collaborate with other hospital centers. Finally, there were case scenarios in the management of cancer patients that were not encountered but are potentially significant: i) A previously diagnosed benign tumor turning out to be malignant, ii) distinguishing either a recurrence or post-treatment fibrosis, iii) whether TRUS complements TVUS, and iv) follow-up stage of cancer management.

Despite the limitations, the validity of the pathomorphologic findings and final diagnosis were not compromised because the pathologist was blinded to all other clinical information including the imaging results.

Ultrasound-guided transvaginal or transurethral biopsy seems to be a reliable and safe procedure for histopathological evaluation of the pelvic cavity and pelvic mass lesions. Prospective studies of adequate sample size are needed to evaluate the usefulness of the procedures across various clinical case scenarios.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

CG. participated in the analysis and interpretation of data, and drafted the manuscript. XL made substantial contributions to the conception and design of the study. CG, LW and CZ carried out the study and collected the data. XL contributed to revising the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This retrospective medical record review was approved by the Institutional Review Board/ Clinical Medical Research Ethics Committee of the First Affiliated Hospital of Anhui Medical University (Approval no: AF/SC-08/02.0)

Patient consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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