

# Role of Ultrasound in the Assessment of Postmenopausal Bleeding

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## ABSTRACT

Uterine bleeding is a symptom seen by gynecologists in approximately 70% of their visits with women of peri and postmenopausal age. A common symptom, postmenopausal bleeding sometimes can be indicative of malignant pathology. While traditional diagnosis took place via endometrial biopsy, diagnosis is trending toward the use of ultrasound. Benefits of ultrasound include its noninvasive nature, decreased cost, and increased accuracy in diagnosis of postmenopausal bleeding. We present a case-based approach to the usage of various ultrasonography techniques including 2D and color Doppler ultrasound, saline infusion sonography (SIS), 3D and 3D power Doppler ultrasound, as complements to traditional diagnosis of endometrial biopsy. In each of the cases, ultrasonography reveals the diagnosis of postmenopausal pathologies, including atrophic endometrium, endometrial polyps, endometrial hyperplasia, and the malignant pathology, such as endometrial carcinoma, uterine leiomyosarcoma and cervical carcinoma. By the end of our case-based discussion, learners are encouraged to test their knowledge in self-assessment quiz.

**Keywords:** Postmenopausal bleeding, Ultrasonography, Color Doppler ultrasound, Saline infusion sonography, 3D ultrasound, 3D power Doppler ultrasound, Atrophic endometrium, Endometrial polyp, Endometrial hyperplasia, Endometrial carcinoma, Uterine leiomyosarcoma, Cervical carcinoma.

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## INTRODUCTION

The differential diagnosis of postmenopausal bleeding is wide, and includes atrophic endometrium, endometrial hyperplasia, endometrial polyp, endometrial carcinoma, cervical cancer and uterine leiomyosarcoma.

Approximately 70% of the peri- and postmenopausal patients that gynecologists see in their office are suffering from abnormal genital tract bleeding.<sup>1</sup> While patients may be alarmed by this symptom, physicians should be equally as alarmed as postmenopausal bleeding can be the presenting symptom of cancer.<sup>2</sup> Their focus should be on identifying and excluding such malignant pathologies as the cause.

Therefore, physicians should approach women presenting with postmenopausal bleeding as having endometrial cancer until proven otherwise.<sup>3</sup> It is estimated that 10 to 15% of patients who present with postmenopausal

bleeding end up having endometrial cancer, and that endometrial carcinoma is the most common gynecological cancer in the Western population.<sup>4</sup>

The American Cancer Society revealed in their cancer facts and figures for 2011, that in 2011 alone, there are estimated to be approximately 46,470 new cases of uterine corpus cancer and 8,120 deaths as well as 12,710 new cases of cervical cancer and 4,290 deaths.<sup>5</sup> Significant proportion of these patients were postmenopausal. Postmenopausal bleeding is oftentimes a symptom of a potentially lethal disease presentation.

Numerous investigational and diagnostic tools are available to evaluate patients with postmenopausal bleeding, including endometrial biopsy, transvaginal ultrasound, saline infusion sonography (SIS), color Doppler ultrasound and 3D ultrasound. Endometrial carcinoma is perceived as 'curable cancer', given that the pathology is met with prompt detection and intervention.<sup>2</sup> Knowing when it is appropriate to use each modality, considering economical, comfort, invasiveness and sensitivity factors are key to successfully evaluating patients.<sup>1,2</sup>

We present a case-based discussion of the most common differential diagnoses of postmenopausal bleeding, the findings of these pathologies on ultrasound, and the different modalities available for diagnosis of these presentations.

## CASE REPORTS

### Case 1

The patient is a 67-year-old G3P3003 female who presents to her obstetrics and gynecology physician with history of vaginal spotting. She has been experiencing these symptoms on and off for the past 6 months. She is also experiencing lack of vaginal lubrication and postcoital pain. She notices the bleeding is worsened postcoitally. The patient's last menstrual period was at age 50. Since then, this is the first time she is experiencing vaginal bleeding of any type. She has no history of gynecologic problems or diagnoses. Her menarche was at age 13, and coitarche was at age 19. Her three pregnancies were uncomplicated and occurred at ages 24, 27 and 31. She denies history of sexually transmitted infections. Her last Pap smear was 8 months prior and was unremarkable.

Her medical history is significant for appendicitis and appendectomy at age 29. She denies nausea, vomiting, diarrhea, constipation and any other symptoms. The patient lives with her husband. She is a retired nurse.



**Fig. 1:** Transvaginal ultrasound scan of postmenopausal patient. The endometrium is visualized as thin and hyperechogenic line measuring 1.8 mm

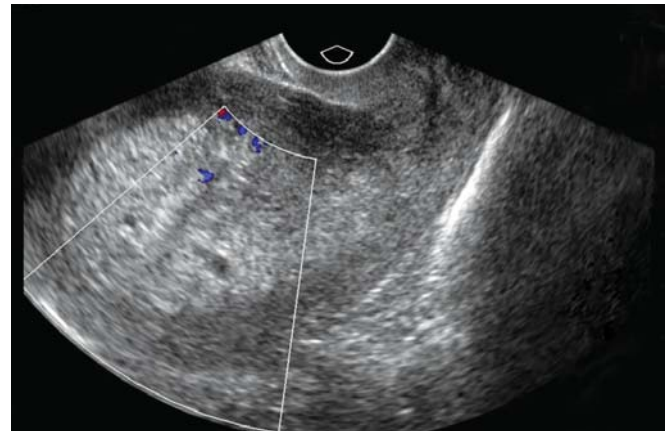
On physical examination, patient is healthy appearing, in no acute distress. Vital signs are unremarkable. Upon speculum examination, vaginal wall is thinned and reddened. Ultrasound is scheduled, and her image is shown in Figure 1. Biopsy of endometrium is taken, and results in mucus, blood and little tissue.<sup>6,7</sup> The patient was diagnosed with atrophic changes.

### Case 2

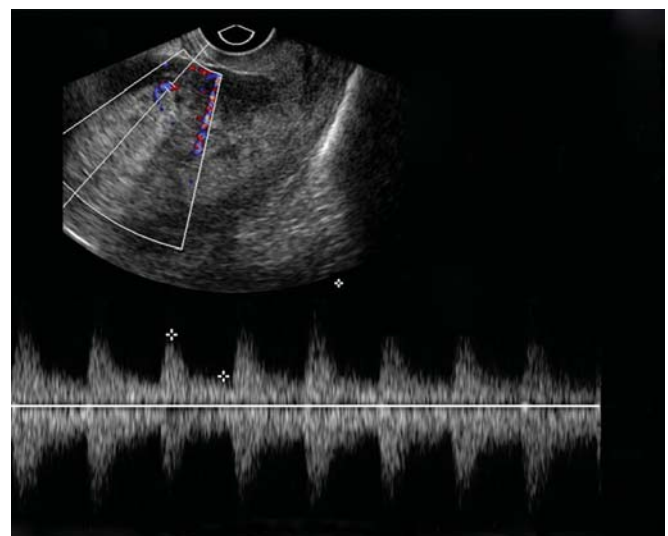
The patient is a 54-year-old Caucasian G1P1001 female who presents to her obstetrics and gynecology physician with complaints of abnormal and sporadic bleeding. She has had these symptoms for the past 3 months. She is very concerned that she is starting to 'have her periods' again, as she has already completed menopause. She denies other associated symptoms, such as pelvic pain. The patient's last menstrual period was 5 years prior. She has significant history of irregular and sporadic menstruation. She had one pregnancy, with one live birth at age 35, after years of difficulty getting pregnant due to PCOS. Her menarche was at age 12, and her coitarche was at age 20. She has no history of sexually transmitted infections, and her last Pap smear was 1 year prior and was negative for pathology.

She has significant medical history. Besides her polycystic ovary syndrome (PCOS), she is morbidly obese, and was diagnosed with diabetes 15 years prior. Her blood sugars are relatively uncontrolled. She has a significant history of hypertension. Series of medications used to control the hypertension have been unsuccessful. The patient lives with her husband, and works with him in a family owned shop. She denies weight loss, pelvic pain and any other symptoms.

Upon physical examination, the patient is an obese Caucasian female. Her body mass index (BMI) is 42. She does not appear weak, and she is in no acute apparent



**Fig. 2A:** Diffusely thickened hyperechogenic endometrium in a postmenopausal patient presenting with abnormal uterine bleeding



**Fig. 2B:** Color Doppler is superimposed for visualization of endometrial angiogenesis. Pulsed Doppler waveform analysis demonstrates moderate to high vascular impedance blood flow signals with resistive index of 0.58, suggestive of a benign lesion. Histology revealed endometrial hyperplasia

distress. Abdominal examination is unremarkable. She does not experience tenderness upon palpation of her abdomen. Speculum examination reveals dried blood in the vaginal vault.

Transvaginal ultrasound reveals diffusely thickened endometrium measuring 17 mm (Fig. 2A). Color Doppler depicts regularly separated peripheral vessels with moderate to high vascular impedance (Fig. 2B). Endometrial biopsy results reveal histology consistent with endometrial hyperplasia.<sup>8,9</sup>

### Case 3

The patient is a 61-year-old Caucasian G3P1112 female who presents with complaint of abnormal bleeding. The patient began experiencing these symptoms on and off for about 3 weeks. She says that the bleeding is relatively light.



**Fig. 3:** Saline infusion sonography delineates a hyperechogenic focal endometrial lesion protruding into the uterine cavity. Endometrial polyp was removed by hysteroscopy

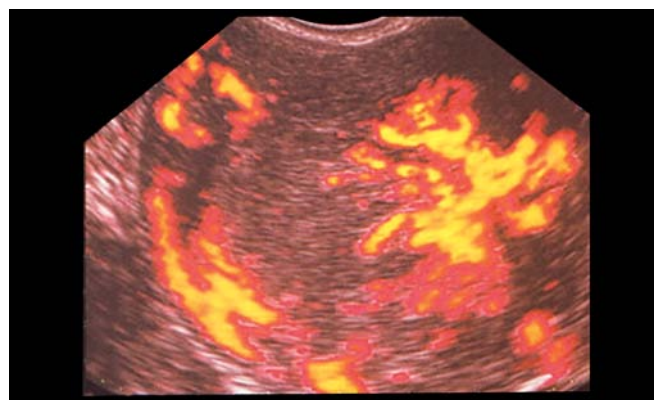
She had her last menstrual period at age 48. She had her two children at ages 22 and 23, and miscarried in her 30s. Her menarche was at age 11, and coitarche was at age 21. She has had one sexual partner in her lifetime, and has never been diagnosed with sexually transmitted infection or other gynecologic pathology. She is currently sexually active with her husband. Her last Pap smear was last year and was normal.

The patient is currently being treated for breast cancer with tamoxifen for approximately 8 months. She had a cholecystectomy at age 39, and a C-section for her second pregnancy at age 23. She has medically controlled hypertension for the past 15 years. She is married to her husband of 39 years, and works as a marketing executive for a local firm. The patient is not experiencing other symptoms besides the vaginal bleeding.

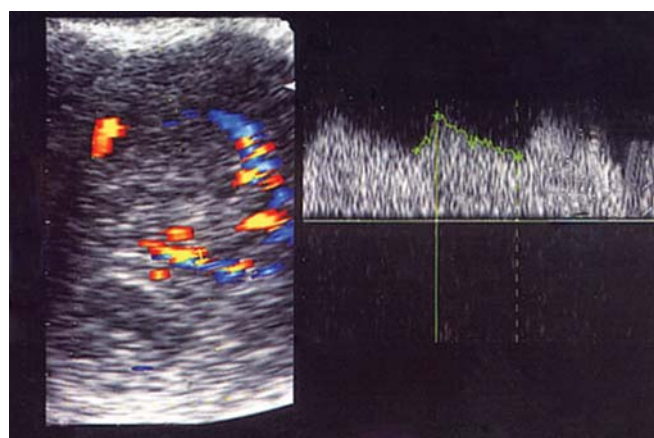
On physical examination, the patient is an overweight Caucasian female, with a BMI of 29. She is in no acute apparent distress. Vital signs are unremarkable. Speculum examination reveals blood in the vaginal canal. Bimanual examination is unremarkable. Focal endometrial thickening was detected with saline infusion sonography (SIS) (Fig. 3), and ultrasound diagnosis of endometrial polyp was confirmed by hysteroscopy.<sup>10-13</sup>

#### Case 4

The patient is a 65-year-old Caucasian G0P0 who presents to the gynecology clinic with history of vaginal discharge and abnormal vaginal bleeding. The patient started experiencing vaginal bleeding around 2 months ago. She is also experiencing a heavy white discharge, on and off, during the course of the last month.



**Fig. 4A:** Power Doppler imaging demonstrates ill-defined endometrium with irregular vessels within the myometrial portion of the uterus. Sonographic and Doppler findings are suggestive of deep myometrial invasion by endometrial carcinoma



**Fig. 4B:** Low vascular impedance with resistive index of 0.32 and high velocity of the myometrial blood flow suggest neovascularization within the deep myometrial layer. Histopathology confirmed an invasive endometrial carcinoma with deep myometrial invasion

She had her LMP at age 54. She has never been pregnant. Her menarche was at age 12, and coitarche was at age 23. She has had two sexual partners in her lifetime. She is not currently sexually active. Her last Pap smear was 3 years ago and was normal. The patient has significant medical history for type 2 diabetes mellitus and hypertension. She had breast cancer, first diagnosed at age 42. She was diagnosed with a recurrence of breast cancer at age 64 and has since been on tamoxifen. She is currently on medications to treat her diabetes and hypertension.

The patient is not married, and was widowed by her second husband at age 62. She lives by herself and is a retired elementary school teacher. She denies any other symptoms, and review of systems is negative.

On physical examination, the patient is an obese female, BMI of 33, in no acute apparent distress. Vital signs show blood pressure 145/94. She is short of breath postambulation around the clinic. On speculum examination, dark blood is



seen in the vagina. Bimanual examination is positive for a slightly enlarged uterus. Ultrasound imaging is scheduled, and results are shown on Figures 4A and B. Ultrasound diagnosis of invasive endometrial carcinoma was confirmed at the time of surgery.<sup>14-16</sup>

**Case 5**

The patient is a 52-year-old G4P2113 French-speaking recent immigrant from East Africa, who presents to the walk-in clinic with history of vaginal spotting, postcoital bleeding and pelvic pain. She has been experiencing these symptoms for 3 months. She says that the bleeding is light. She uses pantyliners and says the bleeding unpredictable and burdensome. She describes the pelvic pain as stabbing, and radiating to both of her legs. Her last menstrual period was 3 years ago. She has had four pregnancies, and one miscarriage at age 27. Her last pregnancy was at age 32. Menarche was at age 11, and coitarche at age 13. The patient has had 12 sexual partners in her lifetime. She is currently sexually active with her husband, but also admits to having sexual relations outside of her marriage. She has never had a Pap smear.

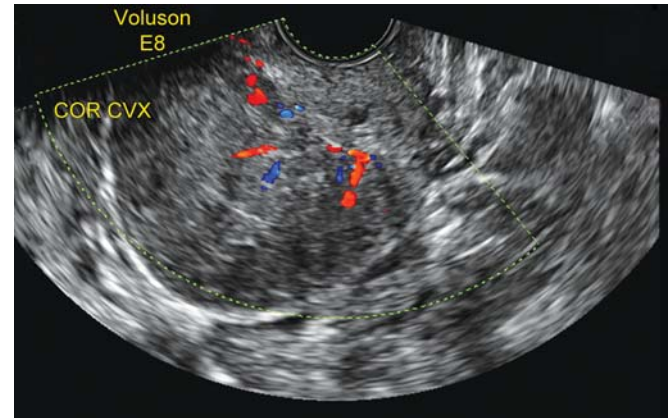
She has a history of vaginal infection with HSV2 that was diagnosed 15 years prior in a small East African hospital. The patient has no significant medical history. She has never had surgery. She is not currently taking any medications and has no known allergies. She denies family history of significant illness or disease.

The patient immigrated from East Africa 3 years ago, and is working on obtaining her citizenship. She is uninsured, as both she and her husband are unemployed. She has no history of receiving medical care in the United States. She lives with her husband of 16 years, and denies

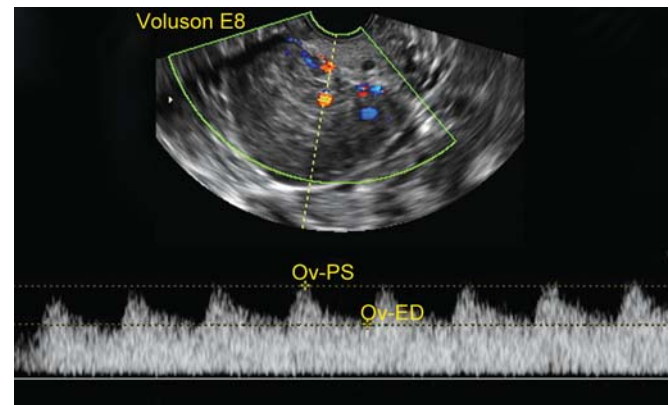
domestic violence or abuse. She smokes one pack per day of cigarettes but denies alcohol or use of illicit substances.

She denies headache, nausea and vomiting, but admits frequent dysuria. She has had some recent bowel disturbances, and has been experiencing discomfort with bowel movements.

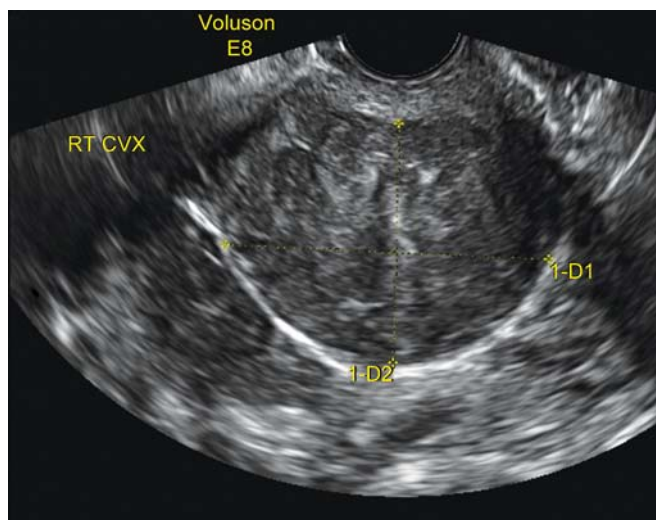
The patient is in no apparent distress. Vital signs are unremarkable. Upon pelvic examination, the patient has



**Fig. 5B:** Color Doppler depicts randomly dispersed penetrating vessels, suggestive of cervical carcinoma



**Fig. 5C:** Pulsed Doppler waveform analysis demonstrates low vascular impedance blood flow signals (RI = 0.43) obtained from the intratumoral vessels. Cervical carcinoma was confirmed by histology



**Fig. 5A:** Cervical mass 4 × 3 × 4.5 cm assessed by B-mode ultrasound



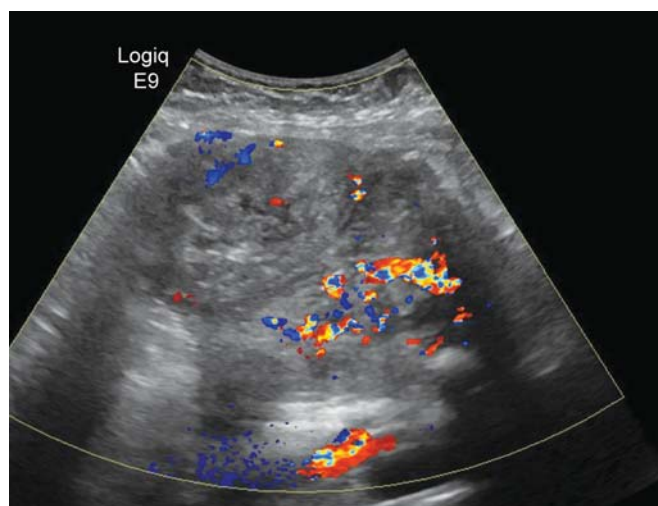
**Fig. 5D:** Transvaginal ultrasound of a distended uterine cavity filled with echogenic fluid in a patient following pelvic radiation. Sonographic finding is typical for mucohematometra

blood in the vaginal canal. Upon speculum insertion, friable and necrotic lesion is visible on the cervix. Transvaginal sonography revealed a cervical mass with randomly dispersed penetrating vessels (Figs 5A to C). Colposcopy was performed, and histology was consistent with cervical carcinoma.<sup>17-20</sup>

### Case 6

The patient is a 74-year-old G2P2002, African-American female, who presents to her obstetrics and gynecologist physician with abnormal vaginal bleeding, discharge and pelvic pain. She claims that these symptoms have been worsening significantly for the past 3 months. She experiences the pain constantly, and describes it as dull and aching.

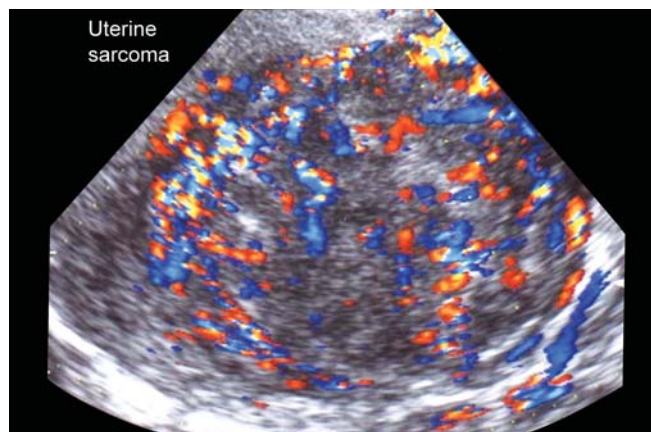
The patient had two children at ages 45 and 47. Her menarche was at age 11. Her coitarche was at age 17. Her last menstrual period was 32 years prior. Her menopause



**Fig. 6A:** Heterogeneous uterine tumors demonstrated sudden growth. Color Doppler shows prominent blood flow signals with irregular branching pattern



**Fig. 6B:** Regular vessels at the periphery of the uterine tumor, outlined by color Doppler ultrasound may aid in delineation of the uterine leiomyoma



**Fig. 6C:** Transvaginal color Doppler image of a fast growing uterine tumor in a postmenopausal patient presenting with abnormal uterine bleeding. Highly vascularized areas and randomly dispersed vessels with irregular course are suggestive of uterine malignancy. Histology revealed uterine leiomyosarcoma

was unremarkable. She has had four sexual partners in her lifetime. She has never been diagnosed with any sexually transmitted infections. She was diagnosed with a leiomyoma at age 46. At the time, she was prescribed with Depo-Lupron, and the leiomyoma resolved. She presented for her annual well-woman examination in her office 12 months prior. At the time of her examination, all physical findings were unremarkable. Pap smear at that time was normal. Her medical history, except for the leiomyomas, is unremarkable. She has no surgical history. Five years ago she performed pelvic ultrasound, which revealed two small fibroids measuring 2.0 and 1.5 cm. The patient denies nausea, vomiting, diarrhea and constipation. She has been experiencing headaches, but no overall decrease in appetite. She denies shortness of breath, respiratory difficulty, chest pain and/or palpitations.

On pelvic examination with a speculum, there is evidence of dark blood in the vagina. Bimanual examination reveals significantly enlarged bulky uterus. Ultrasound is scheduled, and imaging shows heterogeneous uterus. Uterine tumors are significantly larger than 5 years ago (Figs 6A and B).<sup>21,22</sup> Color Doppler demonstrates highly vascularized uterine tumors with irregular vessels and low vascular impedance blood flow signals.<sup>23</sup> Sonographic and Doppler findings are suggestive of uterine malignancy.

### DISCUSSION

Several ultrasound imaging modalities are available for the assessment of postmenopausal bleeding. While the initial evaluation of a patient with postmenopausal bleeding traditionally took place in the inpatient setting with dilatation and curettage (D and C) and endometrial biopsy (EMB),<sup>2</sup> evaluation is trending toward outpatient imaging with



ultrasound. Outpatient evaluation of the woman with postmenopausal bleeding is not only better tolerated by the patient, but is effective and cost efficient. The development of ultrasound techniques has led to transvaginal ultrasound as the initial diagnostic tool for postmenopausal bleeding.<sup>24</sup> This noninvasive, painless method has the crucial purpose of ruling out malignancy in a patient with postmenopausal bleeding.<sup>24,25</sup> Endometrial biopsy is an effective means for initial diagnosis, but has limitations beyond causing patient discomfort. It is estimated that approximately two-third of the samples taken via endometrial biopsy are inaccurate, as the samples did not hold enough tissue.<sup>2</sup> Due to the possible inaccuracy and misleading results of EMB, ultrasound is a useful tool to complement the diagnosis of endometrial pathology.

Both EMB as well as D and C remove the endometrial tissue. Therefore, it is important to stress that ultrasound assessment of the endometrium should always be performed prior to invasive procedures. Using ultrasound and/or color Doppler prior to biopsy allows for a more accurate measurement of endometrial thickness and assessment of tissue composition and blood flow.

When using the transvaginal ultrasound, it is imperative to visualize the entire uterine area, include both layers of the endometrium, and exclude, if present, intracavitary fluid. Using the cut-off of endometrial stripe thickness of 5 mm, it became possible to differentiate between the patients who are low- and high-risk of endometrial cancer. If the stripe is >5 mm and Pap smear is within the normal limits, the patient may be sent home with reassurance. If the bleeding and symptoms continue, additional diagnostic methods should be applied.<sup>2</sup>

In a patient with several risk factors for malignant endometrial pathology, such as tamoxifen use and obesity, hysteroscopy is suggested as the initial diagnostic tool, because transvaginal ultrasound may oftentimes miss focal pathology, such as an endometrial polyp.

A diffusely thickened endometrial stripe with distinct boundaries is indicative for hyperplasia. A thinned stripe is suggestive of atrophic endometritis, or endometrial atrophy. A polyp is shown as a focally thickened endometrium, usually with a feeding vessel detected by color and/or power Doppler ultrasound. Endometrial carcinoma shows up as a thick endometrial stripe with irregular endometrial/myometrial borders.<sup>26</sup>

Other visualization techniques for postmenopausal bleeding include saline infusion sonography, color Doppler ultrasound, 3D ultrasound, hysteroscopy, and CT and MRI if and when clinically indicated.

## Hysteroscopy-Guided Endometrial Biopsy

Hysteroscopy-guided endometrial biopsy has been shown to more accurately diagnose pathology than traditional D and C.<sup>27</sup> Hysteroscopy allows for visualization of the entire uterine cavity, and can aid in identification and removal of focal pathology as well as biopsy of diffuse pathology.<sup>28</sup> As the hysteroscope enters the uterine cavity, the tissue can overlap, and diminish the appearance of focal pathology, such as endometrial polyp.<sup>28</sup> Therefore, studies suggest that SIS can complement the use of hysteroscope in the biopsy and diagnosis of focal pathology.<sup>2</sup>

## Saline Infusion Sonography

Injection of isotonic saline into the uterine cavity, called saline infusion sonography or hysterosonography allows for thorough visualization of the endometrial lining and assessment of the endometrial pathology. Using this method, diffuse endometrial thickening can be differentiated from focal endometrial pathology, such as a polyp.<sup>24,26</sup> SIS can aid in making the decision whether the clinician should perform hysteroscopy, D and C or EMB.<sup>29</sup> More recent studies illustrated the benefits of SIS with 3D multiplanar imaging.<sup>29</sup>

## Color Doppler Ultrasound

Color Doppler is a useful tool for identifying the presence of uterine cancer, as it determines the type of angiogenesis by measuring the vascular resistance. High resistance in the sub- and intraendometrial vessels measured by resistive and/or pulsatility indices indicates benign pathology, while low resistance demonstrates possible malignant pathology.<sup>28</sup>

## 3D Power Doppler Ultrasound

3D power Doppler ultrasound enables assessment of the virtually reconstructed vascularity within a volume of the endometrium. Using the specially designed VOCAL™ software, endometrial vascularity can be objectively determined by calculating the vascularity index (VI), flow index (FI) and vascularity flow index (VFI). Tissue perfusion correlates positively with microvessel density count as assessed by immunohistochemical techniques.<sup>4</sup> In clinical practice oncologists and pathologists already use the mean vessel density to measure the intensity of tumor vascularization. Initial 3D power Doppler data indicate that 3D power Doppler ultrasound has a potential to study it noninvasively.

## Atrophic Endometrium

As discussed in the case 1, atrophic endometrium can be identified on ultrasound. The endometrium is visualized as

a thin and hyperechogenic line. In order to diagnose the atrophic changes, it is imperative that one considers the entire clinical picture. Postmenopausal patients with lower BMI, abnormal uterine bleeding and/or spotting, and endometrial thickness  $\leq 4$  mm on ultrasound are likely to have atrophic endometrium.<sup>31</sup>

### Endometrial Hyperplasia

In the presented case 2, endometrial hyperplasia was presented as a diffusely thickened hyperechogenic endometrium. Color Doppler was used to visualize the vascularity of the endometrium. Vessels were identified along the endometrial periphery, but it was noted that they did not penetrate the periphery of the endometrial lining. Pulsed Doppler waveform demonstrated moderate to high vascular impedance, typical for benign lesions.<sup>30</sup> One study published in 2010 indicated that 2D ultrasound determination of thickness ( $>5$  mm being benign, and  $>5$  mm having potential for malignancy) has equivalent diagnostic capability to observing the characteristics of blood flow in the lesion by color Doppler.<sup>32</sup>

In the past, D and C was a mainstay for obtaining endometrial histology, while now pipelle biopsy is used as a standard office procedure following ultrasound assessment for postmenopausal bleeding.

### Endometrial Polyp

Saline infusion sonography or hysterosonography is a useful means for identifying endometrial polyps. Injecting liquid into the uterine cavity allows for visualization of any projections into the uterine cavity. As seen in SIS image performed on case 3, polyp is typically hyperechogenic focal irregularity of the endometrial stripe. When superimposed, color Doppler may demonstrate a single feeding vessel.<sup>26</sup>

### Endometrial Carcinoma

As seen in case 4, power Doppler ultrasound can be used for detection and staging of endometrial carcinoma. Doppler assessment is particularly useful for evaluation of isoechoic endometrial thickening and ill-defined endometrial lining. Important prognostic factors in endometrial carcinoma are myometrial invasion, histologic grading of the carcinoma and presence of lymph node metastases. The depth of myometrial invasion is classified as none (stage 1A), superficial (invasion of less than half of the myometrium, stage 1B), or deep (invasion of deep myometrial mantle, stage 1C). The incidence of lymph node involvement is tightly linked to the degree of myometrial invasion. Therefore, estimation of the invasion depth is

crucial in preoperative evaluation of the patients with positive endometrial biopsy. Seen on power Doppler are irregular vessels within the deep myometrial layer of the uterus (Figs 4A and B). As discussed earlier, low vascular impedance indicated a malignant lesion, which was confirmed by histology.<sup>26,30</sup>

### Cervical Carcinoma

Ultrasound is not especially useful in the diagnosis of cervical lesions, including cervical carcinoma. Widespread screening by Pap smear has significantly increased detection rates of cervical dysplasia and carcinoma *in situ*, and has reciprocally decreased the incidence of invasive cervical carcinoma. Great majority of cervical carcinoma originate from squamous cells in the ectocervix, while less than 10% of arise from the endocervix, and may not be visible on speculum examination.<sup>33,34</sup> Recent studies suggest that 3D ultrasound is a more accurate presurgical assessment than MRI for cervical cancer.<sup>33</sup> Case 5 presented with postcoital spotting, abnormal genital tract bleeding and pelvic pain. Transvaginal ultrasound revealed a solid heterogeneous cervical lesion with randomly dispersed penetrating vessels with low vascular impedance on spectral Doppler analysis, typical for cervical carcinoma. Endoluminal or rectal 3D ultrasound techniques can aid in viewing the regions where the cancer has invaded, such as to the rectum, bladder, or other pelvic structures.<sup>33</sup> Sonography may also be used to detect the complications of advanced cervical cancer. For example, Figure 5D demonstrates cervical stenosis and hematometra secondary to pelvic radiation.

### Uterine Leiomyosarcoma

Uterine leiomyosarcomas are extremely rare tumors. They can be visualized as solid or heterogeneous myometrial lesions, similar to that of benign uterine tumors.<sup>30,35</sup> The most useful diagnostic clue of myometrial malignancy is rapid uterine growth in a postmenopausal patient. When clinically suspecting a malignant myometrial tumor, color Doppler is a useful diagnostic tool used alongside clinical reasoning. When visualized with color Doppler ultrasound, prominent blood flow signals and irregular branching patterns are visualized. Uterine leiomyomas, are seen to have regular peripheral vascularity (Fig. 6B), while uterine leiomyosarcomas, have markedly irregular peripheral and central vascularity (Fig. 6C). In this respect, color Doppler has been suggested to be superior to grey scale ultrasound in differentiation between benign and malignant myometrial lesions.<sup>35</sup> Also, leiomyosarcomas show high blood flow velocity, and low impedance to blood flow, suggestive of a malignant nature.<sup>30</sup>

## CONCLUSION

After evaluating patients with postmenopausal bleeding for significant risk factors, identifying their medical history, and performing physical examination, the physician should employ outpatient ultrasound imaging for the diagnosis of abnormal genital tract bleeding. Color and pulsed Doppler ultrasound improves diagnostic accuracy because the endometrial and cervical carcinoma, and myometrial malignancy shows abnormal blood flow pattern due to tumor neovascularization. Contrast agents are another possibility for enhancing ultrasound examination by increasing the detection rate of small vessels. Technological advances and further improvement of 3D ultrasound will contribute to a more objective evaluation of uterine tumor morphology and vascularity, which may result in improved differential diagnosis of postmenopausal vaginal bleeding.

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## SELF-ASSESSMENT QUIZ

- A 62-year-old female patient presents with abnormal vaginal bleeding for approximately 4 months. Upon transvaginal ultrasound, the endometrial stripe thickness is approximately 3.2 mm. The patient is sent home with reassurance. However, 1 month later, she returns complaining of the same symptoms. What is the most appropriate next step?**
  - Reassure the patient, and schedule follow-up in 6 months
  - Perform MRI on the patient to evaluate for abdominal pathology
  - Perform endometrial biopsy
  - Reevaluate on transvaginal ultrasound, and perform hysteroscopy-guided endometrial biopsy
- A 59-year-old female patient presents with postmenopausal bleeding for 5 months. What is the diagnosis that must be excluded before evaluating for other pathology?**
  - Endometrial polyp
  - Endometrial cancer
  - Cervical cancer
  - A and B and C
- Which of the following ultrasound modalities evaluates the uterus with vascularity index (VI), flow index (FI) and vascularity flow index (VFI)?**
  - Transvaginal ultrasound
  - 3D power Doppler ultrasound
  - Color Doppler
  - Saline infused sonohysterography
- On color Doppler ultrasound, the uterus of a 67-year-old female with postmenopausal bleeding is visualized. Focal pathology is identified, and using Doppler ultrasound a single vessel is seen feeding into the growth. The vessel has high vascular resistance. What is the most likely diagnosis?**
  - Endometrial polyp
  - Atrophic endometritis
  - Uterine leiomyosarcoma
  - Endometrial leiomyoma

5. A 53-year-old postmenopausal patient is evaluated for postmenopausal bleeding. After transvaginal ultrasound, and a visualized thickened endometrial stripe, hysteroscopy is performed. What is the problem with performing hysteroscopy alone?
  - A. It can cause irritation to the uterine walls
  - B. There is no problem
  - C. Hysteroscopy is not indicated
  - D. The walls of the uterus can collapse and hide the endometrial pathology
6. A 63-year-old postmenopausal patient, G5 P4014, who has recently immigrated from India, presents to your clinic. She has never been evaluated by pap smear. You perform transvaginal ultrasound with color Doppler, and findings show a cervical mass with random penetrating vessels. What is the most likely diagnosis?
  - A. Cervical carcinoma
  - B. Uterine leiomyosarcoma
  - C. Endometrial polyp
  - D. Endometrial hyperplasia
7. Ultrasound of a uterus reveals diffuse endometrial thickening with regular borders and moderate to high vessel resistance on Doppler ultrasound. What is the most likely diagnosis for this imaging?
  - A. Endometrial carcinoma
  - B. Atrophic endometritis
  - C. Endometrial hyperplasia
  - D. Uterine leiomyosarcoma
8. Endometrial biopsy is performed on a patient with postmenopausal bleeding. Result shows mucus and blood and not much tissue. What is the likely ultrasound finding?
  - A. Endometrial stripe 2.5 mm
  - B. Endometrial stripe 6.7 mm
  - C. Focal mass with single penetrating vessel
  - D. None of the above
9. How does endometrial polyp appear on transvaginal ultrasound?
  - A. Hyperechogenic focal lesion
  - B. Highly vascularized anechoic lesion
  - C. Hypoechoic avascular lesion
  - D. Diffuse endometrial thickening
10. What is the most appropriate imaging modality to rule out malignancy in a patient with postmenopausal bleeding, considering cost, comfort and efficacy?
  - A. MRI
  - B. CT scan
  - C. Hysteroscopy
  - D. Transvaginal ultrasound

### Answers

1 D 2 D 3 B 4 A 5 D 6 A 7 C 8 A 9 A 10 D