# American College of Radiology
# ACR Appropriateness Criteria®

**Clinical Condition:** **Abnormal Vaginal Bleeding**

**Variant 1:** **Postmenopausal vaginal bleeding. First study. (Endometrial sampling may also be performed initially followed by imaging if results are inconclusive or symptoms persist despite negative findings.)**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US pelvis transvaginal | 9 | 3-D imaging may be a useful adjunct to 2-D imaging to better characterize an intracavitary abnormality. | O |
| US pelvis transabdominal | 8 | | O |
| US saline infusion sonohysterography | 6 | 3-D imaging may be a useful adjunct to standard 2-D imaging if intracavitary abnormality is suspected. | O |
| US duplex Doppler pelvis | 5 | This procedure may be useful to better characterize a focal or diffuse endometrial abnormality. | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| MRI pelvis without and with IV contrast | 2 | | O |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| MRI pelvis without IV contrast | 1 | | O |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Variant 2:** **Postmenopausal vaginal bleeding, endometrium ≤5 mm by transvaginal ultrasound. (Some centers may choose to use ≤4 mm rather than ≤5 mm. Please see narrative.) Follow-up study.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US pelvis transabdominal | 4 | | O |
| US duplex Doppler pelvis | 4 | Color-flow Doppler may be useful for interrogation of a heterogeneous endometrium in searching for a focal versus diffuse abnormality. | O |
| US saline infusion sonohysterography | 2 | | O |
| MRI pelvis without and with IV contrast | 2 | | O |
| CT pelvis with IV contrast | 1 | | ☢☢☢ |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| MRI pelvis without IV contrast | 1 | | O |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Clinical Condition:** **Abnormal Vaginal Bleeding**

**Variant 3:** **Postmenopausal vaginal bleeding, endometrium >5 mm by transvaginal ultrasound. (Endometrial sampling would also be warranted in this clinical setting to evaluate for malignancy.) (Some centers may choose to use >4 mm. Please see narrative.) Follow-up study.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US saline infusion sonohysterography | 8 | 3-D imaging may be a useful adjunct to standard 2-D imaging if intracavitary abnormality is suspected. | O |
| US duplex Doppler pelvis | 6 | This procedure may be useful to better characterize a focal or diffuse endometrial abnormality. | O |
| MRI pelvis without and with IV contrast | 5 | This procedure is appropriate when SIS is not feasible or there is the need define extent of disease with endometrial cancer. | O |
| US pelvis transabdominal | 4 | | O |
| MRI pelvis without IV contrast | 2 | | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Variant 4:** **Premenopausal vaginal bleeding. First study.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US pelvis transvaginal | 9 | 3-D imaging may be a useful adjunct to 2-D imaging to better characterize an intracavitary abnormality. | O |
| US pelvis transabdominal | 8 | | O |
| US duplex Doppler pelvis | 5 | This procedure may be useful to better characterize a focal or diffuse endometrial abnormality. | O |
| US saline infusion sonohysterography | 4 | 3-D imaging may be a useful adjunct to standard 2-D imaging if intracavitary abnormality is suspected. | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| MRI pelvis without and with IV contrast | 2 | | O |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| MRI pelvis without IV contrast | 1 | | O |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Clinical Condition:** **Abnormal Vaginal Bleeding**

**Variant 5:** **Premenopausal vaginal bleeding, endometrium <16 mm by transvaginal ultrasound. Follow-up study.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US saline infusion sonohysterography | 6 | 3-D imaging may be a useful adjunct to standard 2-D imaging if intracavitary abnormality is suspected. | O |
| US duplex Doppler pelvis | 6 | May be useful to better characterize a focal or diffuse endometrial abnormality. | O |
| US pelvis transabdominal | 4 | | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| MRI pelvis without and with IV contrast | 2 | | O |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| MRI pelvis without IV contrast | 1 | | O |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Variant 6:** **Premenopausal vaginal bleeding, endometrium ≥16 mm by transvaginal ultrasound. Follow-up study. (Endometrial sampling may also be warranted in this clinical setting depending on patient risk factors for malignancy.)**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US pelvis transvaginal | 8 | Follow-up study performed in the early proliferative phase of the menstrual cycle or following administration of progesterone. | O |
| US saline infusion sonohysterography | 7 | 3-D imaging may be a useful adjunct to standard 2-D imaging if intracavitary abnormality is suspected. | O |
| US duplex Doppler pelvis | 5 | May be useful to better characterize a focal or diffuse endometrial abnormality. | O |
| MRI pelvis without and with IV contrast | 5 | | O |
| US pelvis transabdominal | 4 | This procedure may be helpful if the uterus is in a neutral position or if uterine penetration by TVUS is poor. | O |
| MRI pelvis without IV contrast | 3 | | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Clinical Condition:** **Abnormal Vaginal Bleeding**

**Variant 7:** **Heterogeneous endometrium or suspected focal abnormality at transvaginal ultrasound. Follow-up study.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US saline infusion sonohysterography | 8 | 3-D imaging may be a useful adjunct to standard 2-D imaging if intracavitary abnormality is suspected. | O |
| US duplex Doppler pelvis | 7 | This procedure may be useful to better characterize a focal or diffuse endometrial abnormality and to evaluate for vascular pedicle flow or irregular vessels in endometrial cavity. | O |
| MRI pelvis without and with IV contrast | 5 | Consider this procedure if SIS is not feasible. | O |
| MRI pelvis without IV contrast | 4 | | O |
| US pelvis transabdominal | 4 | This procedure may be helpful if the uterus is in a neutral position or if uterine penetration by TVUS is poor. | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

**Variant 8:** **Endometrium not adequately visualized at transvaginal ultrasound. Follow-up study.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US saline infusion sonohysterography | 8 | | O |
| US pelvis transabdominal | 6 | | O |
| MRI pelvis without and with IV contrast | 6 | Consider this procedure if SIS is not feasible. This procedure would be preferred if underlying malignancy is suspected. | O |
| MRI pelvis without IV contrast | 4 | | O |
| US duplex Doppler pelvis | 3 | | O |
| CT pelvis with IV contrast | 2 | | ☢☢☢ |
| CT pelvis without IV contrast | 1 | | ☢☢☢ |
| CT pelvis without and with IV contrast | 1 | | ☢☢☢☢ |
| **Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

# ABNORMAL VAGINAL BLEEDING

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## Summary of Literature Review

### Introduction/Background

Virtually every woman will, at some point in her lifetime, experience episodes of vaginal bleeding that will be perceived as abnormal. From menarche to menopause, the average menstrual cycle is 29 days long, with a range of 23–39 days [1]. Overall, the length of the menstrual cycle remains relatively constant throughout the reproductive years, but as a woman approaches menopause the cycle gradually shortens. Although blood loss is difficult to quantify, most loss occurs in the first few days of menses, and bleeding generally lasts from 2 to 7 days. The cycle length and the volume and duration of bleeding remain fairly constant for a woman throughout her reproductive years. After menopause, bleeding ceases completely. Abnormal vaginal bleeding may include noncyclic, excessive, or prolonged bleeding in the premenopausal patient or any vaginal bleeding in the postmenopausal patient. Differential considerations vary with patient age, hormonal status, and risk factors for endometrial carcinoma [2]. The perimenopausal patient with abnormal bleeding is a special clinical challenge since menstrual bleeding is less predictable in this age group. Vaginal bleeding may occasionally be misinterpreted as hematuria. The latter should be excluded by clinical history, catheterized urine specimen, and/or physical examination.

Endometrial carcinoma is the most common gynecologic cancer in the United States, with a mean age of 60 years at diagnosis [3]. Although 20% of cases are diagnosed in premenopausal women [2], most patients are postmenopausal. The most common presentation is abnormal vaginal bleeding, a finding that is seen in over 90% of postmenopausal women with endometrial carcinoma [4]. However, even in the postmenopausal patient, endometrial cancer accounts for only up to 10% of uterine bleeding, with endometrial atrophy being the most common etiology in 50% of the cases [5]. Only about 15% of cancers occur in women without bleeding [6,7]. The early diagnosis of endometrial carcinoma allows for the best opportunity for cure. Therefore, endometrial carcinoma should be rigorously sought and excluded in any postmenopausal or perimenopausal patient with abnormal bleeding, and in younger patients with significant risk factors, such as obesity and anovulation. Anovulatory bleeding is the most common etiology of abnormal bleeding in the premenopausal patient [8]. However, anatomic abnormalities such as endometrial and cervical polyps and submucosal fibroids may also be a cause and are found in up to 40% of premenopausal patients evaluated for this symptom [9]. Other abnormalities that may cause abnormal bleeding include endometrial hyperplasia, fibroids, adenomyosis, cervical and vaginal neoplasia, and other less common uterine tumors and coagulopathies (most commonly Von Willebrand disease). Pregnancy-related complications should always be excluded in any woman of reproductive age with abnormal bleeding.

In the nonpregnant premenopausal patient without risk factors for endometrial carcinoma, a trial of medical therapy may initially be undertaken if anovulatory cycles are suspected [2]. In the postmenopausal patient or for persistent bleeding despite medical therapy in the premenopausal patient, endometrial sampling or imaging is warranted. Although imaging procedures cannot replace definitive histologic diagnosis, they play an important

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role in screening, further characterizing anatomic abnormalities as focal or diffuse, and directing appropriate patient care, often preventing unnecessary diagnostic procedures. For further evaluation of the patient with inconclusive biopsy results or persistent bleeding despite negative biopsy findings, imaging can be essential.

In the setting of abnormal vaginal bleeding, office endometrial sampling now has largely replaced dilatation and curettage (D&C); however, issues of access to the endometrial cavity and sampling error limit the clinical value of a negative result. Furthermore, only about 60% of the endometrial cavity is curetted with D&C, and many focal lesions may be missed, making the detection of focal structural causes for bleeding a vital role of imaging in this clinical setting [10]. In their prospective study, Epstein et al [10] evaluated 105 postmenopausal women presenting with vaginal bleeding. Patients underwent D&C followed by hysteroscopic examination. Ninety eight percent of women were found to have a focal growth pattern at hysteroscopy and of those D&C failed to diagnose 58% of polyps, 50% of hyperplasia, 60% of atypical hyperplasia, and 11% of endometrial cancers. In a retrospective study evaluating 311 women with abnormal vaginal bleeding, D&C failed to detect intrauterine disorders in 52.7% of patients who were subsequently diagnosed at hysterectomy [11].

**Transvaginal Ultrasound**

Transvaginal ultrasound (TVUS) is generally the initial imaging procedure of choice for evaluating abnormal vaginal bleeding due to its high sensitivity for depiction of endometrial pathology, its widespread availability, and its excellent safety profile and cost-effectiveness [12-16]. In the postmenopausal patient, endometrial thickness is a well-established predictor of endometrial disease, and TVUS is the mainstay in detecting and characterizing abnormal endometrial thickening with highly reproducible measurements [17-19]. Endometrial thickness refers to the double thickness measurement (sum of the thickness of the 2 endometrial layers excluding any intracavitary fluid). In order to obtain accurate endometrial measurements, it is crucial to perform the TVUS on days 4–10 of the menstrual cycle after the endometrium is sloughed in premenopausal women. For postmenopausal women on hormone replacement therapy (HRT), imaging is time-sensitive and will depend on the type of hormonal regimen (continuous combined vs cyclic hormones). If an abnormally thickened endometrium is identified, nonfocal endometrial biopsy is generally advocated as the next diagnostic step to exclude diffuse endometrial pathology, including carcinoma and hyperplasia [20,21]. Alternatively, saline infusion sonohysterography (SIS) may be obtained to differentiate between focal and diffuse abnormalities and to guide hysteroscopic biopsy.

In a meta-analysis of 35 studies including 5,892 postmenopausal women, using 5 mm as the upper threshold for normal endometrial thickness, the sensitivity of TVUS for detecting endometrial cancer was 96% [16]. An endometrial thickness ≤5 mm was associated with a less than 1% probability of endometrial cancer. Sensitivity for the detection of cancer did not differ for women taking HRT compared to those not taking HRT. Many additional studies have further demonstrated that with an endometrial thickness <5 mm, the risk of endometrial cancer is very low [19,22,23]. An expert panel for the evaluation of postmenopausal bleeding concluded that if US shows a normal-appearing endometrium with a double thickness measurement of ≤5 mm, the test can be considered negative for endometrial carcinoma [24]. A similar criterion can be used for women taking HRT, tamoxifen, or other selective estrogen receptor modulator therapy. Recent guidelines from the American College of Obstetrics and Gynecology advocate using 4 mm as the endometrial thickness cutoff that reasonably excludes endometrial carcinoma [25]. However, this threshold may be associated with lower specificity and more false-positive US examinations [16].

In the asymptomatic postmenopausal patient without bleeding, the use of TVUS for screening is controversial. There is lack of consensus regarding what endometrial thickness best separates those with from those without endometrial pathology, and further validation is necessary. Upper threshold values ranging from 4 mm to 11 mm have been suggested [7,26]. In addition to endometrial thickness, individual patient parameters such as age, hormonal therapy, and other risk factors for endometrial carcinoma must also be considered in patient management decisions.

The value of endometrial thickness as an indicator for endometrial pathology in the premenopausal patient is unreliable, as it may vary widely depending on the phase of the menstrual cycle. The optimum threshold level of endometrial thickness that should prompt further evaluation in this age group remains the subject of debate. The examination should ideally be performed during the early proliferative phase of the menstrual cycle when the endometrium is at its thinnest. A thickness >16 mm in a symptomatic premenopausal patient may be considered abnormal but with suboptimal sensitivity (67%) and specificity (75%) [14]. A recent study suggests that an endometrial thickness of 8 mm yields a higher sensitivity of 83.6% but with a lower specificity of 56.4% [27].

Focal heterogeneity or eccentric thickening of the endometrium detected at TVUS always should be further investigated regardless of endometrial thickness to exclude endometrial pathology [24]. TVUS can help to identify focal lesions within the endometrium such as polyps and submucosal fibroids, which may lead to sampling error and a negative biopsy result.

Abnormalities within the myometrium such as fibroids and adenomyosis also may be a cause of abnormal vaginal bleeding. Fibroids are readily demonstrated at sonography and can be characterized as submucosal, intramural, subserosal, or cervical in location [28]. In a meta-analysis of 14 studies including 1,898 women who had US for uterine pathology, the pooled sensitivity and specificity for TVUS for the diagnosis of adenomyosis were 82.5% and 84.6%, respectively [29]. However, detection of adenomyosis at TVUS may be limited if there is coexisting uterine pathology, such as fibroids. In one study, the sensitivity and specificity of TVUS for diagnosing adenomyosis in patients with and without fibroids were 33.3% and 78% and 97.8% and 97.1%, respectively [30].

**Saline Infusion Sonohysterography**

SIS (also referred to as sonohysterography or hysterosonography) consists of the instillation of sterile saline into the uterine cavity via a small catheter under TVUS guidance. This allows for better delineation of the endometrial lining when it is not clearly delineated on TVUS, which may occur in 5%–10% of patients [31]. This technique also allows for differentiation of focal lesions such as polyps from diffuse abnormalities such as endometrial hyperplasia. More recently, the use of gel instead of saline to fill the uterine cavity (gel-instillation sonography [GIS]) has shown some promising results, with sensitivity of 77.8% and 85% and specificity of 80.7% and 85% for SIS and GIS, respectively, for detecting intracavitary lesions [32]. Because of its higher viscosity, a smaller amount of gel is required to adequately distend the uterine cavity, resulting is less patient discomfort/pain and better technical results. As an advantage, this technique does not affect power Doppler signal in women with endometrial polyps, a phenomenon that had been reported previously when using saline [33].

Conventional 2-D SIS and hysteroscopy show similar performance characteristics, with sensitivity of 95%–96% and specificity of 88%–90% for detecting/characterizing focal endometrial abnormalities [34,35]. However, hysteroscopy allows for directed tissue sampling. SIS before hysteroscopy permits identification of a focal mass, prompting triage to a hysteroscopically directed biopsy procedure. SIS may also be used to further evaluate the endometrium in patients with negative TVUS and biopsy with persistent bleeding, allowing for detection of small intracavitary abnormalities, such as polyps or focal hyperplasia, not detectable by TVUS [9,36]. In a study by Erdem et al [37] the sensitivity and specificity of SIS were 97.7% and 82.4%, respectively, versus 83.0% and 70.6%, respectively, for TVUS for detection of endometrial abnormalities such as polyps, submucosal fibroids, and endometrial hyperplasia in patients with abnormal vaginal bleeding. Differentiation of endometrial from subendometrial abnormalities, particularly in patients treated with tamoxifen, is also an important role for this technique with significant implications for patient management [38,39]. Some investigators have compared the diagnostic accuracy of 3-D SIS and that of conventional SIS. Although the 2 methods may show comparable or slightly higher sensitivity and specificity in diagnosing intrauterine lesions, 3-D SIS correlates better with hysteroscopy findings in premenopausal and postmenopausal patients with abnormal vaginal bleeding [40,41].

**Transabdominal Ultrasound**

Transabdominal pelvic US is usually performed in conjunction with TVUS, and the 2 techniques are complementary. Transabdominal scanning offers a wider field of view, increased depth of penetration, and an ability to evaluate adjacent organs. A transabdominal approach is particularly helpful for evaluating a markedly enlarged fibroid uterus, especially if there is extension of subserosal or pedunculated fibroids out of the pelvis. However, optimum evaluation of the endometrium generally requires TVUS, which allows for higher-resolution imaging [18,42]. If the transvaginal probe cannot be tolerated, as is often the case in a prepubertal or virginal patient, transabdominal US using the urinary bladder as an acoustic window becomes essential.

**Doppler Ultrasound**

Color and duplex Doppler US allow for the assessment of uterine and endometrial vascularization and may be of added value in further characterizing an endometrial abnormality detected at TVUS. Demonstration of blood flow in an intracavitary lesion excludes the possibility of a retained blood clot. Endometrial polyps often demonstrate a feeding vessel, which can aid in detection at TVUS [43]. A recent study by Cil et al [44] compared the mapping characteristics of power Doppler for the diagnosis of endometrial polyps versus submucosal fibroids. They found that the single vessel pattern had a sensitivity and specificity of 81.2% and 88.2%, respectively, for the diagnosis of endometrial polyps, whereas the rim-like pattern had a sensitivity and specificity of 70.6% and 100%,

respectively, for the diagnosis of submucosal fibroids. However, the clinical usefulness of using intratumoral resistive indices and Doppler velocimetry of the uterine arteries in distinguishing benign from malignant processes remains under investigation [45,46].

**Three-Dimensional Sonography**

3-D sonography can be a useful adjunct to TVUS and SIS in the characterization of abnormalities within the endometrial cavity, including localization of focal abnormalities prior to directed biopsy. It allows the ability to reconstruct any plane of section in orientations that cannot be obtained directly using standard 2-D sonography and SIS [47,48]. In a study by Benacerraf et al [49] 3-D coronal view of the uterus was of added value to the standard 2-D pelvic sonogram in 24% of all patients referred for gynecologic sonography and in up to 39% of patients with an endometrial thickness ≥5 mm. Recently, 3-D power Doppler angiography combined with 3-D TVUS has become a new diagnostic tool to evaluate vascular patterns in the abnormal endometrium and endometrial volume. Although some advocate its potential usefulness in allowing for differentiation between benign and malignant causes of a thickened endometrium [50,51], others do not find it superior to the diagnostic capabilities of 2-D US [52].

**Magnetic Resonance Imaging**

Magnetic resonance imaging (MRI) of the pelvis may be a useful problem-solving tool when US findings are not definitive. Uterine anatomy is well-delineated at MRI secondary to inherent soft-tissue contrast of uterine tissues. Although not a first-line test, MRI may be considered for evaluating the endometrium when TVUS is not possible or when the endometrium cannot be well visualized due to uterine orientation or coexisting abnormalities such as adenomyosis or leiomyomas. MRI may provide additional important information regarding fibroid number, size, and location prior to intervention such as embolization or myomectomy. MRI may also help to confirm the diagnosis of adenomyosis, which may be difficult at TVUS when there are coexisting fibroids. In a recent study evaluating the diagnostic performance of MRI in the detection for adenomyosis and fibroids, MRI had a positive predictive value of 92.3% and 95.7%, respectively [53].

In a woman with an enlarging or an abnormally enlarged uterus where underlying malignancy is a concern and US does not delineate the endometrium, MRI may assist in identification of a thickened endometrial lining or of morphological lesions such as fibroids or adenomyosis. Although MRI-detected features of benign endometrial polyps overlap with those of carcinoma, most polyps are benign. The prevalence of malignancy in endometrial polyps increases with patient age but is generally less than 3% in postmenopausal patients and less than 1% in women of childbearing age [54]. Histologic confirmation remains necessary when an endometrial mass is identified at MRI [55]. However, evidence of an endometrial lesion invading the myometrium is suggestive of malignancy. In a recent study assessing the diagnostic accuracy of MRI in local staging of endometrial carcinoma, contrast-enhanced MRI showed a 90% sensitivity and 80% specificity for evaluating deep myometrial invasion [56]. Also, demonstration of enhancement of an intracavitary abnormality with gadolinium contrast agents confirms the presence of a mass and excludes the possibility of a retained blood clot or debris. Results of initial studies investigating the added value of diffusion-weighted imaging in differentiating benign from malignant endometrial lesions show promise, but further investigation is necessary before this technique can be applied to clinical practice [57,58]. A recent prospective study showed that apparent diffusion coefficient (ADC) values were significantly lower in endometrial cancers compared to those of normal endometrium and normal myometrium [59]. The investigators, however, concluded that there was no correlation between ADC values and depth of myometrial invasion, histologic tumor grading, and presence of metastatic lymphadenopathy.

**Computed Tomography**

Computed tomography (CT) is generally not warranted for evaluating vaginal bleeding since uterine anatomy is not well characterized due to limited soft-tissue contrast resolution. For detection of endometrial thickening using TVUS as the reference standard, the sensitivity, specificity, and positive and negative predictive values of multidetector CT were 53.1%, 93.5%, 66.7%, and 89.1%, respectively, in one recent study [60]. Multiplanar reformation may be a helpful addition to standard axial images when evaluating the endometrium at multidetector CT [61], with reconstructed images in the sagittal plane being particularly useful in determining the degree of myometrial invasion in patients with endometrial carcinoma. However, an abnormal endometrium incidentally detected at CT should be referred to TVUS for further evaluation.

**Positron Emission Tomography/Computed Tomography**

Positron emission tomography (PET) with CT (PET/CT) is not warranted for evaluating vaginal bleeding. In premenopausal patients, normal endometrial uptake of fluorine-18-2-fluoro-2deoxy-D-glucose (FDG) changes cyclically, increasing during the ovulatory and menstrual phases. This variation requires that the evaluation of the endometrium be correlated with the menstrual history. In postmenopausal women, increased tracer uptake is considered abnormal [62]. Neither use of contraceptives nor hormonal therapy is associated with a significant increase in endometrial tracer uptake. Abnormal endometrial tracer uptake incidentally detected on PET should be referred for TVUS evaluation.

**Summary**

- Imaging can play an important role in screening, characterization of structural abnormalities, and directing appropriate patient care, often preventing inappropriate diagnostic procedures. However, imaging procedures cannot replace definitive histologic diagnosis.
- TVUS is generally the initial imaging procedure of choice for evaluating abnormal vaginal bleeding, and endometrial thickness is a well-established predictor of endometrial disease in postmenopausal women. Endometrial thickness measurements ≤5 mm [16,22,24] and ≤4 mm [19,23,25] have been advocated as appropriate threshold values to reasonably exclude endometrial carcinoma in the postmenopausal age group [22-25]. However, the most appropriate value for upper limits normal for the asymptomatic postmenopausal patient without bleeding remains the subject of debate. An upper threshold value of 16 mm has been suggested for the premenopausal patient with abnormal bleeding, although it remains controversial as endometrial thickness varies greatly in this patient age group [14,27].
- Transabdominal US is generally an adjunct to TVUS and is most helpful when TVUS cannot be performed or when there is poor visualization of the endometrium secondary to uterine position or poor penetration due to associated uterine pathology such as fibroids or adenomyosis.
- Tissue sampling may be the most appropriate initial step in the evaluation of abnormal vaginal bleeding.
- SIS after TVUS allows for identification of focal abnormalities within the endometrial cavity, which may then guide hysteroscopic biopsy or resection [34,35]. GIS may represent an adequate substitute to SIS in the future [32,33].
- Color and duplex Doppler allow for assessment of uterine and endometrial vascularization and may be of added value in further characterizing an endometrial abnormality detected at TVUS. Endometrial polyps will often have a feeding vessel, which aids in their detection [43,44].
- Pelvic MRI is an important problem-solving tool and adjunct to TVUS, particularly when SIS cannot be performed for technical reasons or to better define extent of disease if endometrial carcinoma is suspected. Adding diffusion-weighted sequences may improve preoperative assessment of patients with endometrial carcinoma.
- CT is generally not warranted for evaluating a patient with abnormal vaginal bleeding. An abnormal endometrium incidentally detected at CT should be referred to TVUS for further evaluation.

**Relative Radiation Level Information**

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

| Relative Radiation Level Designations | | |
|---|---|---|
| **Relative Radiation Level*** | **Adult Effective Dose Estimate Range** | **Pediatric Effective Dose Estimate Range** |
| O | 0 mSv | 0 mSv |
| ☢ | <0.1 mSv | <0.03 mSv |
| ☢☢ | 0.1-1 mSv | 0.03-0.3 mSv |
| ☢☢☢ | 1-10 mSv | 0.3-3 mSv |
| ☢☢☢☢ | 10-30 mSv | 3-10 mSv |
| ☢☢☢☢☢ | 30-100 mSv | 10-30 mSv |
| *RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies". | | |

**Supporting Documents**

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

## References


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