

**American College of Radiology
ACR Appropriateness Criteria®
First Trimester Vaginal Bleeding**

Variant 1: First trimester vaginal bleeding. Positive urine or serum pregnancy test.

Procedure	Appropriateness Category	Relative Radiation Level
US pelvis transvaginal	Usually Appropriate	○
US pelvis transabdominal	Usually Appropriate	○
US duplex Doppler uterus	May Be Appropriate	○
MRI pelvis without IV contrast	May Be Appropriate	○
MRI pelvis without and with IV contrast	Usually Not Appropriate	○
CT pelvis without IV contrast	Usually Not Appropriate	☢ ☢ ☢
CT pelvis with IV contrast	Usually Not Appropriate	☢ ☢ ☢
CT pelvis without and with IV contrast	Usually Not Appropriate	☢ ☢ ☢ ☢

FIRST TRIMESTER VAGINAL BLEEDING

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Summary of Literature Review

Introduction/Background

Ultrasound (US) is the primary imaging modality in the evaluation of patients presenting with vaginal bleeding in the first trimester of pregnancy. Magnetic resonance imaging (MRI) and computed tomography (CT) play a minor role in problem-solving the causes of bleeding but may be useful when US is severely limited, for an unusual ectopic pregnancy, or when uncommon diagnoses are suspected. US correlated with serum human chorionic gonadotrophin (hCG) levels and clinical presentation can usually differentiate causes of first-trimester bleeding. These include normal intrauterine pregnancy (IUP) with or without a subchorionic hematoma, nonviable IUP, gestational trophoblastic disease (GTD), and ectopic pregnancy, which can all present with vaginal bleeding. Bleeding in the first trimester occurs in 7% to 27% of pregnancies, with an overall risk of miscarriage of approximately 12% [1]. US can usually differentiate an intrauterine from an ectopic pregnancy and a viable from a nonviable IUP. An overview of relevant US findings follows. Although it is important to diagnose ectopic pregnancies and nonviable IUPs, one should also guard against injury to normal pregnancies. Potential harm to a normal pregnancy can occur because of overinterpretation of a single US, misunderstanding the usefulness of the discriminatory level or serial values of hCG, and inappropriate treatment with methotrexate or dilation and curettage [2].

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US Transvaginal

Intrauterine fluid collection

The first visible US evidence of an IUP is a small spherical fluid collection with a hyperechoic rim, representing the gestational sac, located within the endometrium. Using high-frequency transvaginal transducers (generally about 7 MHz or higher), gestational sacs as small as 2 to 3 mm in mean sac diameter (MSD) may be visualized, corresponding to 4.5 to 5 weeks of gestation [3]. Prior to the identification of a yolk sac or embryo in the gestational sac, the intradecidual sign may be helpful to confirm an IUP. The intradecidual sign consists of an intrauterine fluid collection with a hyperechoic rim located in the endometrium separate from the central echogenic line that represents the collapsed endometrial cavity [4,5]. This sign, which can be visualized as early as 4.5 weeks, increases the probability of an IUP but is not reliable for diagnosing an IUP [6,7]. It can be difficult to apply the intradecidual sign in some patients, as the central echogenic line is not always evident. The double decidual sac sign, typically defined as two echogenic rings around the intrauterine fluid collection, is another finding that seems to increase the likelihood of an IUP but is not a reliable sign and is of limited usefulness for confirming an IUP [7-9]. The intradecidual sign and the double decidual sac sign both have poor interobserver agreement and neither is required for the diagnosis of an IUP [7].

Before a yolk sac or embryo is seen, there has been concern that fluid in the endometrial cavity, sometimes termed a pseudogestational sac, might be confused for a gestational sac. However, pseudogestational sacs can usually be recognized based on their shape (acute angle at the edge), contents (internal echoes), or location (in the endometrial cavity) [10]. If a nonspecific fluid collection in the uterus does not have the features of a pseudogestational sac, it should be interpreted as likely representing a gestational sac, and one should generally

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not undertake a treatment that could cause unintended harm to an IUP [7,10]. Rarely, a decidual cyst [11] could be mistaken for a gestational sac but usually does not have an echogenic rim and is usually not adjacent to the central echogenic line of the collapsed endometrial cavity.

The discriminatory level of hCG refers to the level at which a gestational sac should always be seen on transvaginal US in a normal singleton IUP and has historically been suggested as 1,000 to 2,000 mIU/mL [12,13]. However, even a level of 2,000 mIU/mL has been found to be too low to exclude a normal IUP [14-16]. If there is no transvaginal US evidence of a gestational sac when a single serum hCG is 3,000 mIU/mL or higher, it is unlikely there will be a viable IUP [17]. For a hemodynamically stable patient with no sonographic evidence of an IUP or ectopic pregnancy, management decisions should generally not be made based on a single hCG level [16,17]. Follow-up hCG assay and US are usually appropriate in such a scenario.

Definite intrauterine gestation

The yolk sac, a thin-walled, spherical structure with an anechoic center, is the first sonographic feature that confirms an IUP [8]. It is usually visualized by transvaginal US in a gestational sac >8 mm in MSD [18]; however, in some normal pregnancies the gestational sac will be larger before a yolk sac is seen [19]. The embryo will initially appear as a thickened, linear echogenic structure at the edge of the yolk sac. With transvaginal US, the embryo is usually seen by about 6 weeks gestational age and by the time the gestational sac grows to a MSD of 16 mm; however, in some normal pregnancies the gestational sac will be larger before an embryo is seen [20].

Although the absence of a yolk sac in a gestational sac >8 mm MSD or the absence of an embryo in a gestational sac >16 mm MSD is worrisome for a nonviable IUP, these cutoffs are not sufficient to make a definitive diagnosis of a nonviable IUP [19]. Because of measurement variability and the desire to maximize diagnostic certainty and avoid inadvertent harm to a viable embryo, the MSD at which the absence of an embryo is diagnostic of a nonviable IUP is ≥ 25 mm with a technically adequate transvaginal US [17,19,21]. However, only a minority of nonviable pregnancies will have a MSD of ≥ 25 mm. Thus, for smaller gestational sacs, time-based criteria for follow-up US may be useful. If the initial transvaginal US shows a MSD of <25 mm and a yolk sac without an embryo, a nonviable IUP can be diagnosed if there is no embryonic cardiac activity 11 or more days later [17,22]. If the initial transvaginal US did not show a yolk sac in a gestational sac with a MSD of <25 mm, a nonviable IUP can be diagnosed if there is no embryonic cardiac activity 14 or more days later [17,22]. It has been suggested that these time-based criteria to confirm nonviable pregnancies might be shortened in some patients, depending on gestational age and MSD at time of the initial US [21].

With transvaginal US, cardiac activity is normally evident in an embryo of any crown-rump length (CRL). Absence of cardiac activity in an embryo measuring ≥ 5 mm in CRL had previously been considered as diagnostic of embryonic demise. However, because of measurement variability and the desire to maximize diagnostic certainty and avoid inadvertent harm to a viable embryo, that CRL threshold has increased slightly to 7 mm. On transvaginal US, lack of embryonic cardiac activity in an embryo ≥ 7 mm in CRL confirms embryonic demise [17,19,21]. Absence of cardiac activity in embryos <7 mm is still worrisome for embryonic demise, but the patient should generally be re-evaluated with a follow-up US in 7 to 10 days [17]. Continued absence of embryonic cardiac activity on transvaginal US at least 7 days later confirms embryonic demise [21].

Once an IUP is definitely established by US, various US findings may be seen that are associated with a nonviable IUP. These include bradycardia [23,24], small gestational sac compared to embryo [25], enlarged amniotic cavity [26], empty amniotic cavity [27], absence of cardiac activity with visualization of the amnion [28], and abnormal size or shape of the yolk sac [29]. However, these findings are not definitive for a nonviable IUP, and in these situations, follow-up US in correlation with serial quantitative serum beta hCG measurements is often useful. Subchorionic hematomas are not an infrequent finding during the first trimester. They are usually small and not thought to substantially increase the risk of a nonviable pregnancy. Large (two-thirds or more of the gestational sac circumference) subchorionic hematomas may be associated with an increased risk of nonviable pregnancy [30].

Ectopic pregnancy

Whenever an IUP is not identified in a patient with a positive pregnancy test, extrauterine locations for the pregnancy should be carefully evaluated [31,32]. This involves identification of the ovaries and corpus luteum along with a careful search for any extraovarian mass that is not a paraovarian cyst or pedunculated fibroid because the vast majority of ectopic pregnancies are in the fallopian tube. Ectopic pregnancies are located ipsilateral to the corpus luteum in 70% to 80% of cases [33,34] and it is important to distinguish between the

corpus luteum and a tubal pregnancy in order to avoid misdiagnosis. The corpus luteum usually appears as a <3-cm cystic lesion with a thick wall (with or without internal echoes in the central cystic component, and with or without a crenulated appearance of the wall) or as a rounded hypoechoic lesion that may simulate a solid mass [35-38]. The most important feature to assess is whether an identified mass is inside the ovary or outside the ovary. Gentle pressure with the transvaginal transducer, and sometimes also with the examiner's hand on the lower anterior abdominal wall, may help demonstrate whether the mass and the ovary move together or separately, potentially distinguishing the intraovarian location of a corpus luteum from the extraovarian location of a tubal pregnancy.

Although visualization of an extrauterine gestational sac with a live embryo is 100% specific for an ectopic pregnancy, this situation is uncommon [39]. More common, though slightly less specific, is an extrauterine mass with a fluid center and hyperechoic periphery, which has been termed a tubal ring [40,41]. Additionally, the ectopic pregnancy may appear as a nonspecific heterogeneous mass with no identifiable gestational sac within it. This latter appearance has been reported as the most common sonographic finding of a tubal pregnancy [39]. Even with such a nonspecific-appearing mass, tubal pregnancy is likely when the mass is outside the ovary (with no other obvious cause, such as a pedunculated fibroid or paraovarian cyst) in a patient with a positive serum hCG and no sonographic evidence of an IUP [41]. Given the potential for inappropriate management with methotrexate or surgical intervention, the diagnosis of ectopic pregnancy should generally be based on positive findings and not solely on the absence of an IUP.

Assessment of any free intraperitoneal fluid is important in the evaluation for an ectopic pregnancy. In this setting, echoes within the free fluid are often due to blood. Trace anechoic free fluid in the pelvis is generally normal. The presence of more than a normal small amount of free fluid or echoes within the fluid, even without identification of an extraovarian mass, is concerning for an ectopic pregnancy [42-44]. However, this finding is not specific and can also occur for other reasons, such as rupture of a hemorrhagic ovarian cyst with an early, nonvisualized IUP.

A minority of ectopic pregnancies occur in locations other than the fallopian tube. The most common nontubal locations are interstitial, cervical, and within a Cesarean section scar. Three-dimensional US may be useful if an interstitial pregnancy is suspected but the diagnosis is uncertain based on 2-D US [45]. Rudimentary horn and abdominal pregnancies are less common, and ovarian ectopic pregnancy is rare. Coexisting intrauterine and extrauterine pregnancy (sometimes referred to as a heterotopic pregnancy) is rare, though is more likely to occur in women undergoing assisted reproduction techniques [46]. In general, for a woman with a spontaneously occurring pregnancy, identification of an IUP excludes a coexisting ectopic pregnancy with near complete certainty. However, the adnexa should still be routinely evaluated.

Pregnancy of unknown location

“Pregnancy of unknown location” (PUL) is a transient state that refers to patients with a positive pregnancy test and no evidence of an ectopic pregnancy or an IUP on transvaginal US [47]. Most patients with a PUL will have a nonviable IUP [48]. Clinical findings of cramping pain and passage of tissue vaginally help support this diagnosis. If a prior pelvic US had demonstrated an IUP, an empty uterus on a follow-up US is definitive proof of a nonviable IUP that is no longer present. Following the diagnosis of a nonviable IUP, continued bleeding or persistent elevation or rise of serum hCG may suggest retained products of conception (RPOC). Grayscale and Doppler US are often helpful in this scenario. An endometrial mass, focal endometrial thickening, or marked diffuse thickening is suggestive of RPOC, particularly when flow is detected within the endometrial abnormality by Doppler imaging [49,50].

Other causes of PUL include an early IUP (<4.5-5 weeks) or a nonvisualized ectopic pregnancy. A small minority of patients with PUL (probably about 7%-20% but likely more toward the lower end of that range), will later be diagnosed with an ectopic pregnancy [48]. Patients with a PUL can pose a diagnostic challenge. If the patient is hemodynamically stable, follow-up hCG and/or US should generally be performed before surgical or medical therapy is undertaken, regardless of the initial hCG level [15,16].

Gestational trophoblastic disease

When US does not show an intrauterine gestational sac, but rather a hyperechoic area in the endometrium with multiple cystic spaces [51], one should consider a complete molar pregnancy, the most common form of GTD. In the earlier part of the first trimester, this classic appearance may be absent and the sonographic findings more variable [52,53]. Complete molar pregnancy can sometimes appear similar to RPOC. Partial molar pregnancy can

be more difficult to diagnose sonographically than complete molar pregnancy [54,55] but should be considered if an embryo is present with cystic change in the early placenta. The US findings of partial molar pregnancy overlap those of a nonviable IUP with hydropic degeneration of the early placenta. The hCG is often, but not always, inappropriately elevated with GTD. Definitive diagnosis is based on histopathological evaluation of uterine contents.

US Transabdominal

Most research studies have used transvaginal US, and there is little evidence in regards to diagnosis of nonviable IUP with transabdominal US alone. Transabdominal US may be adequate in some patients if the diagnosis is clear, such as when a viable IUP and normal adnexa are demonstrated in a patient with no risk factors for heterotopic pregnancy. Transabdominal US is more likely to be adequate later in the first trimester as opposed to the early first trimester.

Ectopic pregnancy

If an abnormal amount of free intraperitoneal fluid is identified in the pelvis, transabdominal US should be used to evaluate the flanks and dependent locations in the right upper (Morison pouch) and left upper quadrants. It is difficult to reliably predict tubal rupture by US [39]. Larger amounts of free intraperitoneal fluid correlate with ruptured ectopic pregnancy, but in about one-third of cases with a large amount of free intraperitoneal fluid, the fallopian tubes are intact [56]. Clotted blood in the pelvis can sometimes be mistaken for mesentery or blend in with adjacent organs such as the uterus and be difficult to recognize.

US Duplex Doppler

When a normal or potentially normal IUP is present, pulsed Doppler US (whether spectral, color, or power Doppler) of the pregnancy should generally be avoided in the first trimester due to concerns about potential bioeffects in the developing embryo [57-59]. Documentation of embryonic cardiac activity is best done with M-mode US as the heart rate can be measured. Video clips can also be used to document embryonic cardiac activity.

Once a normal IUP has been excluded, Doppler US may be useful when other diagnoses such as RPOC are suspected. Doppler US is not generally needed to make a diagnosis of GTD, but may be helpful as an ancillary tool in the management of some patients with GTD [60,61]. Doppler US is rarely useful for diagnosing tubal pregnancies as both the corpus luteum and a tubal pregnancy often have flow detected peripherally. Although Doppler US could conceivably be useful in some nontubal ectopic pregnancies such as cervical, interstitial, or Cesarean section scar pregnancies, its diagnostic utility for these diagnoses has not been well established in the literature.

Miscellaneous diagnoses

US can also depict some unusual causes of first-trimester bleeding, such as what traditionally has been termed a uterine arteriovenous malformation (AVM). The terminology of this entity is evolving as many of these are not true AVMs and will resolve spontaneously. Other terms such as “vascular lesions” and “enhanced myometrial vascularity” have been proposed [62]. Although suggestive findings may be seen on grayscale US, Doppler imaging is important for making the diagnosis of an AVM [62]. True AVMs are usually acquired and due to prior uterine instrumentation. One should be cautious when diagnosing an AVM/enhanced myometrial vascularity in the postpartum period, as similar US findings can occur with RPOC [63] and with GTD. Low-resistance arterial flow in the myometrium may also be due to subinvolution of the placental bed. Although usually seen in the postpartum period [64], subinvolution of the placental bed can also occur after a nonviable IUP in the first trimester and simulate an AVM. Many of these vascular lesions will respond to conservative management; velocity in the suspected vascular lesion may be helpful in guiding management [65,66]. In stable patients, follow-up US should be considered before diagnosing or treating a potential AVM.

MRI

While an early pregnancy may be recognized on MRI, it generally is due to unintentional imaging of the pregnancy [67]. MRI is rarely needed for evaluating an IUP or tubal pregnancy. However, one may occasionally recognize tubal pregnancies on MRI [68], and MRI may be helpful as a problem-solving tool for nontubal ectopic pregnancies or GTD [69-71]. MRI may also help in cases of unusual implantation sites or in women with uterine anomalies. In pregnancy, gadolinium should be used with caution and only when critical and the potential benefits are felt to be justified [72]. Gadolinium is not generally recommended in a normal first-trimester pregnancy. MRI without gadolinium is thought to be safe in the first trimester of pregnancy [73].

RPOC may be identified by MRI, but MRI has little role in making the diagnosis of RPOC. RPOC and GTD may both manifest as an enhancing endometrial mass but are usually distinguishable on clinical grounds [74]. Contrast-enhanced pelvic MRI may be helpful to evaluate the extent of myometrial invasion and local extrauterine spread of GTD [75]. Uterine AVM can also be diagnosed with MRI [76].

CT

An early IUP may be recognized on CT, but it is usually due to unintentional imaging of the pregnancy [67]. Because of its ionizing radiation, CT is generally not performed to evaluate vaginal bleeding in the first trimester of pregnancy. CT may identify an ectopic pregnancy [68], but reported cases of ectopic pregnancy diagnosed on CT were often performed for other reasons or in patients not known to be pregnant [77,78]. When a patient is clinically unstable, emergent care should generally not be delayed by additional imaging with CT or MRI. RPOC may be identified by CT, particularly when an enhancing mass is seen, but CT has little role in making the diagnosis of RPOC and the findings overlap those of GTD [74]. In patients with GTD, CT may be helpful in evaluating the extent of extrauterine spread [75].

Summary of Recommendations

- Transvaginal and transabdominal US are the most appropriate imaging modalities in patients with abnormal vaginal bleeding in the first trimester of pregnancy. Transvaginal US is generally the preferred modality. Transabdominal US is often complementary to transvaginal US and may sometimes be adequate alone.

Summary of Evidence

Of the 82 references cited in the *ACR Appropriateness Criteria® First Trimester Vaginal Bleeding* document, 1 is categorized as a therapeutic reference that may have design limitations. Additionally, 79 references are categorized as diagnostic references including 6 good-quality studies and 19 quality studies that may have design limitations. There are 54 references that may not be useful as primary evidence. There are 2 references that are meta-analysis studies.

The 82 references cited in the *ACR Appropriateness Criteria® First Trimester Vaginal Bleeding* document were published from 1975-2017.

Although there are references that report on studies with design limitations, 6 good-quality studies provide good evidence.

Safety Considerations in Pregnant Patients

Imaging of the pregnant patient can be challenging, particularly with respect to minimizing radiation exposure and risk. For further information and guidance, see the following ACR documents:

- [ACR Practice Guideline for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#) [79]
- [ACR-ACOG-AIUM Practice Guideline for the Performance of Obstetrical Ultrasound](#) [80]
- [ACR Guidance Document for Safe MR Practices](#) [81]
- [ACR Manual on Contrast Media](#) [72]

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

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 [82].

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
○	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.

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.