

**American College of Radiology  
ACR Appropriateness Criteria®**

**Clinical Condition:**

**First Trimester Bleeding**

**Variant 1:**

**+  $\beta$ -hCG 5 weeks gestational age by history. No sac seen in uterus.**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><u>RRL*</u></b>
$\beta$ -hCG every 2 days	8		None
US pregnant uterus transvaginal first with or without transabdominal	8		None
US pregnant uterus follow-up scan in 7-10 days	8		None
US pregnant uterus follow-up scan in 2 or 3 days	6		None
US adnexa Doppler (pregnant patient)	4		None
US pregnant uterus transvaginal	4		None
$\beta$ -hCG every 7 days	4		None
US pregnant uterus endometrium Doppler	4		None
US pregnant uterus transabdominal	2		None
US pregnant uterus transabdominal first with or without transvaginal	2		None
Laparoscopy	2		None
D and C	2		None
<b>Rating Scale: 1=Least appropriate, 9=Most appropriate</b>			<b>*Relative Radiation Level</b>

**Variant 2:**

**5 weeks gestational age. Fetal Heart Rate = 85.**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><u>RRL*</u></b>
US pregnant uterus follow-up scan in 7-10 days	8		None
US pregnant uterus measure MSD - CR length	8		None
US pregnant uterus transvaginal first with or without transabdominal	8		None
US pregnant uterus transvaginal	6		None
US pregnant uterus uteroplacental circ. Doppler	4		None
US pregnant uterus follow-up scan in 2 or 3 days	4		None
US pregnant uterus transabdominal first with or without transvaginal	2		None
US pregnant uterus transabdominal	2		None
$\beta$ -hCG every 7 days	2		None
$\beta$ -hCG every 2 days	2		None
D and C	2		None
<b>Rating Scale: 1=Least appropriate, 9=Most appropriate</b>			<b>*Relative Radiation Level</b>

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**Clinical Condition:****First Trimester Bleeding****Variant 3:****5 weeks gestational age. Fetal heart rate = 110.**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><a href="#">RRL*</a></b>
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
US pregnant uterus measure MSD - CR length	8		None
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus follow-up scan in 2nd trimester	4		None
US pregnant uterus follow-up scan in 7 days	2		None
US pregnant uterus transabdominal first with or without transvaginal	2		None
US pregnant uterus follow-up scan in 3rd trimester	2		None
US pregnant uterus uteroplacental circ. Doppler	2		None
US pregnant uterus transabdominal	2		None
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

**Variant 4:****5 weeks gestational age. Fetal heart rate = 110. Moderate subchorionic hemorrhage.**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><a href="#">RRL*</a></b>
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
US pregnant uterus measure MSD - CR length	8		None
US pregnant uterus follow-up scan in 7 days	6		None
US pregnant uterus transabdominal first with or without transvaginal	4		None
US pregnant uterus follow-up scan in 2nd trimester	4		None
US pregnant uterus follow-up scan in 3rd trimester	4		None
US pregnant uterus uteroplacental circ. Doppler	2		None
US pregnant uterus transabdominal	2		None
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

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**Clinical Condition:****First Trimester Bleeding****Variant 5:****+  $\beta$ -hCG 7 weeks gestational age by history. No sac seen in uterus.**

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
US pregnant uterus follow-up scan in 2 days	8		None
$\beta$ -hCG every 2 days	8		None
US pregnant uterus transvaginal first with or without transabdominal	8		None
US adnexa Doppler (pregnant patient)	6		None
US pregnant uterus follow-up scan in 7 days	4		None
US pregnant uterus endometrium Doppler	4		None
US pregnant uterus transvaginal	4		None
US pregnant uterus transabdominal first with or without transvaginal	4		None
Laparoscopy	4		None
$\beta$ -hCG every 7 days	4		None
US pregnant uterus transabdominal	2		None
D and C	2		None
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

**Variant 6:****7 weeks gestational age. CRL = 9 mm – FHM.**

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
D and C	8		None
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
US pregnant uterus measure MSD - CR length	2		None
$\beta$ -hCG every 2 days	2		None
US pregnant uterus measure yolk sac diameter	2		None
US pregnant uterus follow-up scan in 2 days	2		None
$\beta$ -hCG every 7 days	2		None
US pregnant uterus follow-up scan in 7 days	2		None
US pregnant uterus uteroplacental circ. Doppler	2		None
US pregnant uterus transabdominal first with or without transvaginal	2		None
US pregnant uterus transabdominal	2		None
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

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**Clinical Condition:****First Trimester Bleeding****Variant 7:****7 weeks gestational age. Fetal heart rate = 90.**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><a href="#">RRL*</a></b>
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus follow-up scan in 7-10 days	8		None
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
US pregnant uterus measure yolk sac diameter	6		None
US pregnant uterus measure MSD - CR length	6		None
US pregnant uterus uteroplacental circ. Doppler	4		None
US pregnant uterus follow-up scan in 2 or 3 days	4		None
β-hCG every 7 days	4		None
β-hCG every 2 days	2		None
D and C	2		None
US pregnant uterus transabdominal first with or without transvaginal	2		None
US pregnant uterus transabdominal	2		None
<b>Rating Scale: 1=Least appropriate, 9=Most appropriate</b>			<b>*Relative Radiation Level</b>

**Variant 8:****7 weeks gestational age. Fetal heart rate = 130.**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><a href="#">RRL*</a></b>
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
US pregnant uterus transabdominal first with or without transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus measure MSD - CR length	6		None
US pregnant uterus follow-up scan in 3rd trimester	4		None
US pregnant uterus follow-up scan in 7 days	2		None
US pregnant uterus transabdominal	2		None
US pregnant uterus uteroplacental circ. Doppler	2		None
US pregnant uterus follow-up scan in 2nd trimester	No Consensus		None
<b>Rating Scale: 1=Least appropriate, 9=Most appropriate</b>			<b>*Relative Radiation Level</b>

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**Clinical Condition:****First Trimester Bleeding****Variant 9:****+  $\beta$ -hCG 9 weeks gestational age by history. No sac seen in uterus.**

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
$\beta$ -hCG every 2 days	8		None
US pregnant uterus transvaginal	8		None
US pregnant uterus transvaginal first with or without transabdominal	8		None
US pregnant uterus follow-up scan in 7-10 days	8		None
US adnexa Doppler (pregnant patient)	6		None
US pregnant uterus endometrium Doppler	4		None
Laparoscopy	4		None
US pregnant uterus follow-up scan in 2 or 3 days	4		None
$\beta$ -hCG every 7 days	4		None
US pregnant uterus transabdominal first with or without transvaginal	4		None
D and C	4		None
US pregnant uterus transabdominal	2		None
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

**Variant 10:****9 weeks gestational age. CRL = 23 mm – FHM.**

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
D and C	8		None
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus uteroplacental circ. Doppler	2		None
US pregnant uterus transabdominal	2		None
US pregnant uterus follow-up scan in 7 days	2		None
US pregnant uterus measure yolk sac diameter	2		None
US pregnant uterus measure MSD - CR length	2		None
$\beta$ -hCG every 7 days	2		None
US pregnant uterus follow-up scan in 2 days	2		None
$\beta$ -hCG every 2 days	2		None
US pregnant uterus transabdominal first with or without transvaginal	2		None
<b>Rating Scale:</b> 1=Least appropriate, 9=Most appropriate			<b>*Relative Radiation Level</b>

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**Clinical Condition:****First Trimester Bleeding****Variant 11:****9 weeks gestational. Fetal heart rate = 90.**

Radiologic Procedure	Rating	Comments	RRL*
US pregnant uterus measure MSD - CR length	8		None
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus transabdominal first with or without transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus measure yolk sac diameter	8		None
US pregnant uterus follow-up scan in 7-10 days	8		None
US pregnant uterus transvaginal first with or without transabdominal	8	Either TV or TA can be used.	None
US pregnant uterus follow-up scan in 2 or 3 days	6		None
US pregnant uterus uteroplacental circ. Doppler	4		None
β-hCG every 7 days	2		None
US pregnant uterus transabdominal	2		None
D and C	2		None
β-hCG every 2 days	2		None
<b>Rating Scale: 1=Least appropriate, 9=Most appropriate</b>			<b>*Relative Radiation Level</b>

**Variant 12:****9 weeks gestational. Fetal heart rate = 130.**

Radiologic Procedure	Rating	Comments	RRL*
US pregnant uterus transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus transabdominal first with or without transvaginal	8	Either TV or TA can be used.	None
US pregnant uterus transabdominal	6		None
US pregnant uterus follow-up scan in 2nd trimester	5		None
US pregnant uterus follow-up scan in 3rd trimester	4		None
US pregnant uterus transvaginal first with or without transabdominal	4		None
US pregnant uterus uteroplacental circ. Doppler	2		None
US pregnant uterus measure MSD - CR length	2		None
US pregnant uterus follow-up scan in 7 days	2		None
<b>Rating Scale: 1=Least appropriate, 9=Most appropriate</b>			<b>*Relative Radiation Level</b>

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## FIRST TRIMESTER BLEEDING

Expert Panel on Women's Imaging: Arthur C. Fleischer, MD<sup>1</sup>; Rochelle F. Andreotti, MD<sup>2</sup>; Marcela Böhm-Vélez, MD<sup>3</sup>; Elliot K. Fishman, MD<sup>4</sup>; Mindy M. Horrow, MD<sup>5</sup>; Hedvig Hricak, MD, PhD<sup>6</sup>; Amy Thurmond, MD<sup>7</sup>; Carolyn Zelop, MD.<sup>8</sup>

### **Summary of Literature Review**

First trimester vaginal bleeding is very common, occurring in approximately 25% of patients who are known to be pregnant. In many patients the bleeding is self-limited and is probably due to implantation of the conceptus into the decidualized endometrium.

If the bleeding is not self-limited and is accompanied by severe pain, uterine contractions, and a dilated cervix, the clinical changes are irreversible and the pregnancy is doomed to failure. Because these clinical changes are irreversible, ultrasound has little to offer.

If bleeding and cramping are relatively mild and the cervix is long and closed, the diagnosis is threatened abortion. Analysis of this group reveals that 50% have an abnormal outcome [1], with the differential diagnosis encompassing a broad spectrum of conditions including a normal intrauterine pregnancy (IUP) (50% of patients), an abnormal living intrauterine pregnancy, a missed abortion, a blighted ovum, retained products of conception, ectopic pregnancy, and gestational trophoblastic disease. Ultrasound examination is especially important in these patients, because the findings may be pivotal not only for determining the precise cause of the bleeding but also for suggesting appropriate therapy.

In comparison to abdominal imaging, the literature emphasizes that in patients with threatened abortion, vaginal sonography is more effective not only for making the specific diagnosis of ectopic pregnancy but also for clarifying indeterminate findings noted on transabdominal scans [2-5]. In general, if the gestational age is less than 8 or 9 weeks, the sonographic examination should begin using a vaginal approach. If the study is incomplete or inconclusive, an abdominal approach may offer complementary information. A transabdominal approach is often satisfactory in the late first trimester of 9 weeks or more. Nonetheless, in difficult, abnormal, or inconclusive cases, a vaginal examination should also be done in an effort to clarify the findings.

When evaluating a patient with threatened abortion, it is most important to determine if an intrauterine gestational sac is visible and whether or not it has a normal appearance [6]. Using transabdominal ultrasound, an intrauterine sac should normally be visible when the  $\beta$  hCG is  $\geq 1800$  mIU/ml (2nd IS) or  $\geq 3240$  mIU/ml (IRP) [7], and a yolk sac and embryo should be detected when their mean sac diameters (MSD) are 20 and 25 mm, respectively [6]. Using a vaginal transducer, the discriminatory  $\beta$  hCG level for sac detection is 1000 mIU/ml (2nd IS) or 1800 mIU/ml (IRP) [8]; and a yolk sac and embryo should be detected when their MSDs are 8 and 16mm, respectively [9]. In questionably abnormal cases, a follow-up ultrasound should be considered. Knowing that the MSD normally increases by 1 mm/day allows the sonologist to recommend an appropriate time interval between the initial and follow-up examination(s) [10]. Although not universally accepted, many sonologists also recommend a second trimester sonographic examination to screen for abnormalities that were unsuspected during the first trimester.

Once an embryo is detected, cardiac activity is normally visible by transabdominal imaging when the crown rump length (CRL) is 9 mm [11]; the corresponding CRL on a vaginal scan is 4-5 mm [12-14]. Despite cardiac activity, sonography may reveal findings that suggest a poor outcome; these include bradycardia (abnormal at  $\leq 6.2$  weeks is  $\leq 100$  BPM; abnormal between 6.3-7 weeks is  $\leq 120$  BPM [15,16], an oligohydramniotic sac (abnormal = MSD – CRL  $\leq 5$ mm) [17], or an abnormal appearing yolk sac (diameter  $>5$ mm) [18], and/or amnion (abnormally large amniotic cavity, or an "empty" amniotic cavity) [19,20]. Whether or not a subchorionic hemorrhage is associated with an abnormal outcome (either at the time of initial bleeding) [21-23], or perinatally [22-24], is unclear. However, one study showed a correlation of size of subchorionic hemorrhage, age of patient, and time of bleeding with the likelihood of spontaneous abortion. Women who were over 35 years of age, and had large bleeds before 8 weeks were most likely to spontaneously abort [25].

Ectopic pregnancy must be considered if a gestational sac is absent when the  $\beta$  hCG level exceeds the discriminatory level for detecting a sac (especially if significant vaginal bleeding has not occurred), or historically, by 4 to 5 weeks gestational age. At least one investigator concludes that in patients with suspected ectopic pregnancy, vaginal sonography can and should be used alone for these examinations [26].

The role of Doppler ultrasound for evaluating patients with first trimester bleeding remains unclear. In the experience of some investigators, measuring the Resistive Index (RI) to evaluate uteroplacental blood flow has

<sup>1</sup>Principal Author and Panel Chair, Vanderbilt University Medical Center, Nashville, Tenn; <sup>2</sup>Vanderbilt University Medical Center, Nashville, Tenn; <sup>3</sup>Weinstein Imaging Associates, Pittsburgh, Pa; <sup>4</sup>The Johns Hopkins Hospital, Baltimore, Md; <sup>5</sup>Albert Einstein Medical Center, Philadelphia, Pa; <sup>6</sup>Memorial Sloan-Kettering Cancer Center, New York, NY; <sup>7</sup>Legacy Meridian Park Hospital, Tualatin, Ore; <sup>8</sup>St. Francis Hospital and Medical Center, Hartford, Conn, American College of Obstetrics and Gynecology.

Reprint requests to: Department of Quality & Safety, American College of Radiology, 1891 Preston White Drive, Reston, VA 20191-4397.

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proven effective for differentiating normal from abnormal intrauterine pregnancies [27]; the findings of other investigators, however, have not been similar [28]. Color and pulsed Doppler have also been advocated by some investigators to improve the sensitivity for diagnosing ectopic pregnancy [29-31]; this too, is not universally accepted [32-33]. Some clinical and sonographic predictors of ectopic pregnancy outcome include longer times from last menstrual period (LMP), lower  $\beta$  hCG, absence of gestational sac, and higher resistive indexes [34]. In women with possible gestational trophoblastic disease, Doppler of trophoblastic tissue reveals a low impedance, high-flow state that differs from the lower-flow, higher impedance pattern seen in women with nonviable gestations or degenerating fibroids [35,36]. Doppler may prove to be especially useful to evaluate myometrial invasion and during follow-up examinations for women receiving chemotherapy.

### 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. 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	Effective Dose Estimate Range
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

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