



Pregnancy loss (miscarriage): Ultrasound diagnosis

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INTRODUCTION

Pregnancy loss, also referred to as miscarriage or spontaneous abortion, is generally defined as a nonviable intrauterine pregnancy up to 20 weeks of gestation. Early pregnancy loss, which occurs in the first trimester (ie, up to 12+6 weeks gestation), is the most common type. The diagnosis of pregnancy loss is generally confirmed with transvaginal ultrasound evaluation.

This topic will review the clinical criteria and when they may be applied for making an ultrasound diagnosis of pregnancy loss. Related content on risk factors and etiology, clinical presentation, treatment options, and management protocols is presented separately.

- (See "Pregnancy loss (miscarriage): Terminology, risk factors, and etiology".)
- (See "Pregnancy loss (miscarriage): Clinical presentations, diagnosis, and initial evaluation".)
- (See "Pregnancy loss (miscarriage): Counseling and comparison of treatment options and discussion of related care".)
- (See "Pregnancy loss (miscarriage): Description of management techniques".)

Content specific to individuals with recurrent pregnancy loss is discussed elsewhere.

- (See "Recurrent pregnancy loss: Definition and etiology".)
- (See "Recurrent pregnancy loss: Evaluation".)
- (See "Recurrent pregnancy loss: Management".)

In this topic, we will use the term "patient" to describe genetic females and use "woman/en" as used in the included studies. We encourage the reader to consider the specific counseling needs of transgender and gender-expansive individuals.

ROLE OF ULTRASOUND

When available, ultrasound, particularly transvaginal ultrasound, is generally performed in all pregnant individuals with signs or symptoms suggestive of pregnancy loss to confirm the presence or absence of normal, or abnormal, intrauterine gestation and exclude findings suggestive of ectopic pregnancy.

- (See "Pregnancy loss (miscarriage): Clinical presentations, diagnosis, and initial evaluation".)
- (See "Ectopic pregnancy: Clinical manifestations and diagnosis".)

Choice of imaging route — In general, pelvic ultrasound starts with transabdominal evaluation for a general overview and then includes transvaginal imaging as needed. For early pregnancy, transvaginal imaging is performed if transabdominal evaluation is technically inadequate or inconclusive ( image 1A-C) [1].

Transabdominal ultrasound can only be used in instances where the gestational sac is high above the cervix (for example, in fibroid uterus), and transperineal ultrasound may also be utilized, albeit infrequently [1]. The choice of transducer route and frequency is based on the clinical scenario, patient habitus, likely gestational duration of pregnancy (if known), and availability of equipment. (See "Ultrasonography of pregnancy of unknown location", section on 'Transabdominal versus transvaginal'.)

Ultrasound findings in first trimester — When using transvaginal ultrasound, gestational landmarks include identification of a gestational sac (4.5 to 5 weeks) ( image 1B), yolk sac (5 weeks) ( image 1C), cardiac activity (5.5 to 6 weeks) ( movie 1), and crown-rump length (CRL; 6 weeks) ( image 2 and  table 1). Measurement of the CRL provides the most accurate assessment of gestational duration, but mean sac diameter can also be used ( table 1 and  table 2) [2]. (See "Prenatal assessment of gestational age, date of delivery, and fetal weight", section on 'First-trimester gestational age assessment'.)

- **Crown-rump length** – An international standard for ultrasound dating of pregnancy based on CRL measurement was developed by the International Fetal and Newborn Growth Consortium for the 21st Century and is available online at  INTERGROWTH-21 [2]. (See "Prenatal assessment of gestational age, date of delivery, and fetal weight", section on 'First-trimester gestational age assessment'.)

- **Ultrasound findings by trimester** – The specific components of late first- versus second- and third-trimester examinations are described in detail in the American Institute of Ultrasound in Medicine-American College of Radiology-American College of Obstetricians and Gynecologists-Society for Maternal-Fetal Medicine-Society of Radiologists in Ultrasound (AIUM-ACR-ACOG-SMFM-SRU) Practice Parameter for the Performance of Standard Diagnostic Obstetric Ultrasound Examinations, which is beyond the scope of this topic [3]. (See "Prenatal assessment of gestational age, date of delivery, and fetal weight", section on 'Second- and third-trimester gestational age assessment'.)

Timing of ultrasound from last menstrual period — The timing of initial ultrasound in asymptomatic pregnant individuals varies. We advise that a pelvic ultrasound be deferred until seven weeks of gestation from the last menstrual period to avoid unnecessary evaluations for pregnancy of unknown location or embryos with slow or absent cardiac activity. An initial ultrasound for a patient at seven to eight weeks of gestation is more likely to identify the presence of embryonic cardiac activity and thus avoid the need for a follow-up ultrasound. Individuals with risk factors for pregnancy loss may undergo ultrasound at the initial prenatal visit, while for others the first ultrasound may occur at the time of first-trimester aneuploidy screening or at the time of second-trimester fetal anatomy assessment. (See "Ultrasonography of pregnancy of unknown location".)

ULTRASOUND DIAGNOSIS OF PREGNANCY LOSS

Pregnancy loss can be diagnosed with both serial and single ultrasound studies; the selection depends on the imaging findings (table 3) and the patient's preferences, including tolerance for a false-positive diagnosis (algorithm 1).

Serial ultrasound studies — Once an intrauterine pregnancy is identified on ultrasound, pregnancy loss is diagnosed if any subsequent ultrasound (performed routinely or for symptoms) shows no or abnormal intrauterine pregnancy or loss of previously seen cardiac activity [4]. Ultrasound is further used to confirm appropriate intrauterine location of pregnancy (to exclude cesarean scar, cervical, or interstitial implantation), absence of cardiac activity, and approximate gestational duration at which development stopped. The gestational duration of the pregnancy by ultrasound criteria may differ from the gestational duration by last menstrual period. (See 'Additional diagnostic challenges' below.)

Single ultrasound diagnostic criteria

Our approach — Evidence-based guidelines exist for the sonographic diagnosis of pregnancy loss (table 3) [4-9]. In our practice, we use this information in combination with other clinical information (eg, beta hCG trends) and further consider the preferences of the patient in applying the diagnostic criteria (algorithm 1):

- **Highest diagnostic certainty** – For patients who desire more time to confirm the diagnosis and/or desire the highest diagnostic certainty, we apply the Society of Radiologists in Ultrasound (SRU) criteria for early pregnancy loss (table 3 and algorithm 1) [5]. Criteria include a mean gestational sac diameter ≥ 25 mm (without a yolk sac or embryo (image 3A-B)) or an embryo with crown-rump length (CRL) ≥ 7 mm and without cardiac activity (image 4) as visualized with transvaginal ultrasound [4,5]. This approach is endorsed by the SRU as well as several academic societies and government agencies globally (table 3) [4-9]. (See 'Available diagnostic criteria' below.)

With this approach, the specificity and positive predictive values are essentially 100 percent [5] and both intra- and interobserver variability has been considered, which is important given the wide range of transvaginal ultrasound training and skill [10]. These criteria may be particularly helpful for individuals who wish to wait longer to confirm pregnancy loss and/or wish the lowest risk of false diagnosis, but this may result in treatment delay for some individuals if applied universally.

- **Reasonable diagnostic certainty** – For clinicians who are highly skilled at transvaginal sonography **and** patients who desire expedited treatment for pregnancy loss, it is reasonable to apply the criteria that include a mean gestational sac diameter ≥ 21 mm or a CRL of ≥ 6 mm without cardiac activity (as visualized with transvaginal ultrasound) to confirm pregnancy loss (algorithm 1) [11]. These criteria are based on data from an observational study, are not endorsed in society guidelines, and are not to be used by clinicians unexperienced in performing transvaginal ultrasonography (table 4) [5,11]. (See 'Available diagnostic criteria' below.)

In a setting of high-quality transvaginal ultrasonography, this approach allows the patient to efficiently proceed with treatment with high diagnostic certainty (0 percent false-positive rate in some studies). However, as imaging studies can be limited both by the quality of the machine used and the clinician's interpretation, these variables should be considered when managing patients whose pregnancies are at the threshold of the measurement cut points and placed into the context of the patient's needs. Patients should understand that there may be a slight risk of interrupting normal progress.

- **Rationale**

- **Rationale for highest diagnostic certainty criteria** – The higher ultrasound thresholds for diagnosing early pregnancy loss address the following issues:
 - **Variable quality of sonography** – Much of the research in diagnosis of early pregnancy loss relies on data from expert sonographers and radiologists [5]. Variations in ultrasound equipment and skill or training of the provider will affect measurements.

- **Impact of patient factors** – Patient factors such as obesity, uterine fibroids, and uterine position can make visualization of the pregnancy more difficult.
- **Rationale for reasonable diagnostic certainty** – The authors' concern with only using the criteria set forth by the SRU is that interobserver reliability was already accounted for in the prior studies, which resulted in less conservative criteria [4,5] (see 'Available diagnostic criteria' below).
- **Importance of patient preferences and other clinical data** – While clinicians never want to falsely diagnose a live pregnancy as a pregnancy loss, we similarly would never want a patient to have delayed management of a pregnancy loss due to not meeting conservative ultrasonographic criteria. Additionally, sonographic imaging is only one element of diagnosing a miscarriage, and the overall clinical picture includes other data that might suggest a benefit from applying less conservative ultrasonographic criteria (eg, plateau or fall in human chorionic gonadotropin levels). (See "Clinical manifestations and diagnosis of early pregnancy", section on 'Diagnosis'.)
- **Authors' interpretation of the data** – Based on the observational data, mean gestational sac diameter ≥ 21 mm **or** CRL ≥ 6 mm could be reasonably used as cutoffs for diagnosing pregnancy loss with a single ultrasound and without the need for a follow-up study or evaluation (table 4). The rationale for rounding up from 5.3 to 6 mm is the limited submillimeter precision of ultrasound measurements in this setting, coupled with the known false-positive rate at 5 mm with absent cardiac activity [10]. While the authors of the study advise a mean gestational sac diameter cutoff of ≥ 25 mm and a CRL cutoff of ≥ 7 to conservatively allow for interobserver variability and minimize the risk of a false-positive diagnosis of miscarriage, we believe these cutoffs are overly cautious given the false-positive rates of 0 and use mean gestational sac diameter ≥ 21 mm and CRL ≥ 6 mm in our practices.

Points of debate — Criteria for diagnosing pregnancy loss with a single ultrasound examination are a matter of debate and interpretation of available data because the criteria are influenced by the dataset used, clinical context, expertise of the sonographer, quality of the ultrasound machine, and the patient's need for diagnostic certainty.

- **Concern for false-positive test result** – One concern is that a false-positive test result (ie, a live pregnancy is incorrectly diagnosed as a pregnancy loss) could inadvertently result in termination of a desired, healthy pregnancy.
- **Clinical context and patient-centered care** – The entire clinical context must be taken into consideration when implementing the available guidelines. Clinical issues for consideration include the individual's "desire to continue the pregnancy, willingness to

postpone intervention to achieve 100 percent certainty of pregnancy loss, and the potential consequences of waiting for intervention, including unwanted spontaneous passage of pregnancy tissue, the need for an unscheduled visit or procedure, and patient anxiety" [4]. Depending on a patient's desires and preferences, it is appropriate to diagnose and manage early pregnancy loss when the clinical context is highly suggestive of loss but does not meet the strictest diagnostic criteria.

- **Impact of sonographer, anatomic approach, and equipment** – When using single ultrasound criteria to evaluate for pregnancy loss, baseline considerations include use of transvaginal or transabdominal approach, skill of sonographer, and quality of equipment. Additionally, M-mode is advised for evaluation of embryonic cardiac activity rather than pulsed or color Doppler to minimize any theoretical risks of thermal damage to the embryo.

In cases where the sac or embryonic pole measurement is at the diagnostic boundary, the experience and skill of the sonographer become extremely important because interobserver variability has been described [10]. In settings of diagnostic uncertainty, repeat imaging may be warranted if the patient desires additional confirmatory data.

Available diagnostic criteria — The suggested ultrasound criteria below for diagnosing nonviable pregnancy are based on studies performed starting in the early 1990s through the early 2000s (table 4). As these studies were performed, ultrasound technology and experience continued to evolve, which may account, in part, for their differences.

- **Observational study data** – A 2011 observational cross-sectional study attempted to define the false-positive rates (FPRs) for different CRLs and mean gestational sac diameters by ultrasound assessment [11]. Data were collected prospectively for 1060 patients with a diagnosis of intrauterine pregnancy of uncertain viability. For the 585 individuals with nonviable pregnancies, the authors reported the following:
 - In the setting of an embryo with absent heartbeat, the FPR was 8.3 percent with CRLs of 4 and 5 mm, but 0 for a CRL ≥ 5.3 mm.
 - For mean gestational sac diameter, in the absence of both embryo and yolk sac, the FPRs for correctly diagnosing nonviable pregnancy were 4.4, 0.5, and 0 percent for cutoffs of 16, 20, and ≥ 21 mm, respectively.
 - For mean gestational sac diameter with a visible yolk sack but absent embryo, FPRs of 2.6, 0.4, and 0 percent were reported for mean gestational sac diameter cutoffs of 16, 20, and ≥ 21 mm, respectively.
- **SRU criteria** – In 2013, the SRU reviewed the available data and proposed even more stringent criteria than that which resulted in a 0 percent FPR in the prior studies

(table 4) [5,11]. Their stated goal was to achieve 100 percent specificity and positive predictive value (ie, no chance of incorrectly diagnosing a live pregnancy as nonviable), citing concerns about the potential for intra- and interobserver variability and/or differing levels of provider skill or ultrasound precision and their potential to lead to a false-positive diagnosis of pregnancy loss in the setting of a pregnancy that was actually alive [4,5].

The 2012 SRU Multispecialty Panel on Early First Trimester Diagnosis of Miscarriage and Exclusion of a Viable Intrauterine Pregnancy guidelines proposed the following ultrasound criteria to diagnose pregnancy loss [5]:

- A gestational sac ≥ 25 mm in mean diameter that does not contain a yolk sac or embryo (image 3A-B).
- An embryo with a CRL ≥ 7 mm that does not have cardiac activity.
- Absence of an embryo with a heartbeat in ≥ 2 weeks from a prior ultrasound demonstrating a gestational sac without a yolk sac.
- After a pelvic ultrasound showed a gestational sac with a yolk sac, absence of an embryo with a heartbeat in ≥ 11 days.
- **Historical data** – Initial studies published in the early 1990s attempted to determine the embryonic size at which cardiac activity was always present in normal pregnancy. After evaluating 398 transvaginal ultrasound studies performed in early pregnancy, the authors concluded that absence of cardiac activity in a visualized embryo usually signified embryonic demise [12]. However, in the absence of cardiac activity, definitive diagnosis of pregnancy demise was to be avoided if the CRL was less than 5 mm because two embryos (2 and 4 mm) initially had absent cardiac activity but progressed to normal outcome. The second study prospectively evaluated 309 consecutive early pregnancies, of which 175 were normal, with vaginal and abdominal ultrasound [13]. Using vaginal ultrasound, one-third of embryos with CRL < 5 mm did not have visualized cardiac activity compared with 100 percent of embryos ≥ 5 mm. Additionally, an empty gestational sac of < 12 mm average diameter was not able to predict nonviable pregnancy.

Based on these studies, initial criteria for nonviable early pregnancy included (table 4):

- CRL of 5 mm without cardiac activity.
- Empty gestational sac measuring 16 mm in mean gestational sac diameter.

Additional diagnostic challenges — Scenarios that can make the assessment of early pregnancy more challenging include discrepancy in the gestational duration based on last menstrual period or date of conception versus ultrasound, presence of multiple gestations, and inability to identify an intrauterine pregnancy with the resultant diagnosis of pregnancy of unknown location.

- **Gestational duration discrepancy** – In patients for whom the gestational duration of the pregnancy measured on ultrasound is substantially smaller than the expected gestational duration based on last menstrual period or conception date, providers must discuss the possibility that ovulation occurred later than expected and discuss the diagnostic criteria needed to confirm pregnancy loss. The gestational duration can be determined using mean sac diameter (table 2). (See "Prenatal assessment of gestational age, date of delivery, and fetal weight".)
- **Multiple gestation** – Occasionally, ultrasound will visualize a multiple gestation with one gestational sac showing reduced growth or lack of yolk sac or embryonic pole. In these cases, pregnancy loss is not diagnosed unless both gestational sacs meet the above criteria. (See "Twin pregnancy: Overview".)
- **Pregnancy of unknown location** – Individuals with a positive pregnancy test but no intrauterine pregnancy seen on ultrasound are assessed as having a pregnancy of unknown location and followed carefully with repeat imaging and possibly serial serum human chorionic gonadotropin levels until the location can be determined. Alternatively, diagnostic uterine aspiration can be performed to expedite the location diagnosis when preserving a possible intrauterine or extrauterine pregnancy is not the priority [14]. Differential diagnosis includes an early intrauterine pregnancy, an ectopic pregnancy, a miscarriage, or a molar pregnancy. (See "Ultrasonography of pregnancy of unknown location".)

Other ultrasound findings in early pregnancy — Separate from the criteria above, additional ultrasound findings may be suggestive of pregnancy outcome.

- **Suggestive of non-viable pregnancy**
 - **Expanded or empty amnion** – The presence of an expanded amnion greater than expected for the size of the embryo or an empty amnion can confirm pregnancy loss (image 5 and image 6). With appropriate ultrasound training and experience, these signs are very helpful since they allow for earlier diagnosis of a nonviable pregnancy [15,16]. The amnion is not typically seen as a separate structure, and is larger than the embryo until about eight to nine weeks; an amnion without an embryo or a small embryo with an amnion greater than anticipated size by gestational duration is consistent with pregnancy loss.

- **Findings suggestive of poor outcome** – While the findings below have been associated with poor pregnancy outcome, live pregnancy is not excluded with these findings and a follow-up ultrasound is indicated to further evaluate pregnancy viability.
 - Irregularly shaped gestational sac [17,18].
 - Moderate or large subchorionic hematoma, although supporting data are mixed [19,20].
 - **Chorionic bump** – A chorionic bump is a bulge or protrusion from the choriodecidua surface into the gestational sac [21]. This finding likely represents trapped blood as serial ultrasounds in one study showed changes similar to that of a hematoma [22]. A chorionic bump occurs in less than 1 percent of pregnancies, is not diagnostic of pregnancy loss, but can be associated with increased risk of loss (although studies vary) [22-25].
- **Findings consistent with live pregnancy**
 - **Gestational sac with yolk sac only** – A gestational sac with a yolk sac does not have an embryonic pole early in development (☒ image 7). In the presence of symptoms (vaginal bleeding, pain), a repeat ultrasound may be warranted in 7 to 10 days to confirm viability.
 - **Normal pregnancy with amnion** – In early pregnancy with normal development, the amnion expands well beyond the limits of the embryo itself after approximately eight weeks (☒ image 8).

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Pregnancy loss (spontaneous abortion)".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th

grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Pregnancy loss (The Basics)" and "Patient education: Bleeding in early pregnancy (The Basics)")
 - Beyond the Basics topics (see "Patient education: Pregnancy loss (Beyond the Basics)")
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PATIENT PERSPECTIVE TOPIC

Patient perspectives are provided for selected disorders to help clinicians better understand the patient experience and patient concerns. These narratives may offer insights into patient values and preferences not included in other UpToDate topics. (See "Patient perspective: Pregnancy loss".)

SUMMARY AND RECOMMENDATIONS

- **Role of ultrasound** – When available, transabdominal and transvaginal ultrasound are generally performed in all pregnant individuals with signs or symptoms suggestive of pregnancy loss to confirm the presence or absence of normal, or abnormal, intrauterine gestation and exclude findings suggestive of ectopic pregnancy. (See 'Role of ultrasound' above.)
- **Imaging approach** – Transabdominal, transvaginal, and transperineal ultrasound may all be used to assess pregnancy; the approach is determined by patient factors and available equipment. (See 'Choice of imaging route' above.)
- **Pregnancy landmarks by gestational duration** – When using transvaginal ultrasound, gestational landmarks include identification of a gestational sac (4.5 to 5 weeks) (image 1B), yolk sac (5 weeks) (image 1C), cardiac activity (5.5 to 6 weeks) (movie 1), and crown-rump length (6 weeks) (image 2 and table 1). Measurement of the crown-rump length (CRL) provides the most accurate assessment of gestational duration, but mean sac diameter can also be used (table 1 and table 2) [2]. (See 'Ultrasound findings in first trimester' above.)
- **Serial ultrasound criteria** – Once an intrauterine pregnancy is identified on ultrasound, pregnancy loss is diagnosed if any subsequent ultrasound (performed routinely or for

symptoms) shows no or abnormal intrauterine pregnancy or loss of previously seen cardiac activity. (See 'Serial ultrasound studies' above.)

- **Single ultrasound criteria** – Criteria for diagnosing pregnancy loss with a single ultrasound examination are a matter of debate and interpretation of available data because the criteria are influenced by the dataset used, clinical context, and the patient's need for diagnostic certainty. (See 'Points of debate' above and 'Available diagnostic criteria' above.)
 - **Highest diagnostic certainty** – For patients who desire the highest diagnostic certainty and/or more time to confirm the diagnosis , we apply the Society of Radiologists in Ultrasound (SRU) criteria that include a mean gestational sac diameter ≥ 25 mm (without a yolk sac or embryo) or an embryo with CRL ≥ 7 mm (without cardiac activity) as visualized with transvaginal ultrasound (algorithm 1). (See 'Our approach' above.)
 - **Reasonable diagnostic certainty for expedited diagnosis** – For patients who desire expedited treatment for pregnancy loss, it is reasonable to apply the criteria that include a mean gestational sac diameter ≥ 21 mm or a CRL ≥ 6 mm without cardiac activity, demonstrated with transvaginal ultrasound, to confirm pregnancy loss (algorithm 1). These criteria are for highly skilled sonographers only. This approach modifies the measurement thresholds given the context of the patient's needs. Patients should understand that there may be a slight risk of interrupting a normal pregnancy. (See 'Our approach' above.)
- **Additional challenges** – Scenarios that can make the diagnosis of pregnancy loss more challenging include discrepancy in the gestational duration based on last menstrual period or date of conception versus ultrasound, presence of multiple gestations, and pregnancy of unknown location. (See 'Additional diagnostic challenges' above.)

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GRAPHICS

Yolk sac



Image of an early gestational sac containing a yolk sac and early embryo. The yolk sac is the circular hyperechoic structure adjacent to the embryo.

YS: yolk sac; EM: embryo.

Courtesy of Thomas Shipp, MD.

Graphic 65928 Version 5.0

Gestational sac (transabdominal ultrasound)



Transabdominal sagittal image shows an intrauterine gestational sac (G) with an echogenic rim.

Courtesy of Tejas S Mehta, MD, MPH.

Graphic 56290 Version 3.0

Yolk sac (transvaginal ultrasound)



Transvaginal sagittal image shows a clear yolk sac (arrow) within the sac, diagnostic of an intrauterine pregnancy.

Courtesy of Tejas S Mehta, MD, MPH.

Graphic 65128 Version 4.0

Crown rump length



CRL: crown rump length; w: weeks of gestation; d: days; GA: gestational age.

Courtesy of Courtney D Stephenson, DO.

Graphic 94938 Version 2.0

Timing of first appearance of gestational landmarks on transvaginal ultrasound examination

Landmark	First appearance on transvaginal ultrasound examination
Gestational sac	4.5 to 5 weeks
Yolk sac	5 weeks
Cardiac activity	5.5 to 6 weeks
Measurable crown-rump length	6 weeks

The yolk sac is visible when the mean gestational sac diameter (MSD) is 8 mm and fetal cardiac activity can be observed when MSD is 16 mm. For transabdominal sonograms, the corresponding MSDs are larger than 20 and 25 mm, respectively. $MSD = (\text{length} + \text{height} + \text{width of the gestational sac})/3$. In addition, $MSD(\text{mm})+30 = \text{gestational age(days)}$.

Graphic 83304 Version 6.0

Determination of gestational age based on mean sac diameter

Mean sac diameter (mm)	Mean gestational age (weeks)	Gestational age (days)		
		Mean	95% confidence interval	95% prediction interval
2	5	34.5	34.2-35.5	31.6-38.2
3	5.1	35.8	35.2-36.3	32.5-39.1
4	5.2	36.6	36.1-37.2	33.3-39.9
5	5.4	37.5	37-38	34.2-40.8
6	5.5	38.4	37.9-38.9	35.1-41.7
7	5.6	39.3	38.9-39.7	36-42.6
8	5.7	40.2	39.8-40.6	36.9-43.5
9	5.9	41.1	40.7-41.4	37.8-44.3
10	6	41.9	41.6-42.3	38.7-45.2
11	6.1	42.8	42.5-43.2	39.5-46.1
12	6.2	43.7	43.4-44	40.4-47
13	6.4	44.6	44.3-44.9	41.3-47.9
14	6.5	45.5	45.2-45.8	42.2-48.7
15	6.6	46.3	46-46.6	43.1-49.6
16	6.7	47.2	46.9-47.5	44-50.5
17	6.9	48.1	47.8-48.4	44.8-51.4
18	7	49	48.6-49.4	45.7-52.3
19	7.1	49.9	49.5-50.3	46.6-53.2
20	7.3	50.8	50.3-51.2	47.5-54
21	7.4	51.6	51.2-52.1	48.3-54.9
22	7.5	52.5	52-53	49.2-55.8
23	7.6	53.4	52.9-53.9	50.1-56.7
24	7.8	54.3	53.7-54.8	51-57.6
25	7.9	55.2	54.6-55.7	51.9-58.5
26	8	56	55.4-56.7	52.7-59.4
27	8.1	56.9	56.3-57.6	53.6-60.3
28	8.3	57.8	57.1-58.5	54.5-61.1
29	8.4	58.7	58-59.4	55.4-62
30	8.5	59.6	58.8-60.4	56.2-62.9

Mean diameter of gestational sac and corresponding estimates of gestational age.

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Graphic 94449 Version 3.0

Guidelines for transvaginal ultrasonographic diagnosis of pregnancy failure in a woman with an intrauterine pregnancy of uncertain viability*

Findings diagnostic of pregnancy failure	Findings suspicious for, but not diagnostic of, pregnancy failure¶
<ul style="list-style-type: none"> ■ Crown-rump length of ≥ 7 mm and no heartbeat ■ Mean sac diameter of ≥ 25 mm and no embryo ■ Absence of embryo with heartbeat ≥ 2 wk after a scan that showed a gestational sac without a yolk sac ■ Absence of embryo with heartbeat ≥ 11 days after a scan that showed a gestational sac with a yolk sac 	<ul style="list-style-type: none"> ■ Crown-rump length of <7 mm and no heartbeat ■ Mean sac diameter of 16 to 24 mm and no embryo ■ Absence of embryo with heartbeat 7 to 13 day after a scan that showed a gestational sac without a yolk sac ■ Absence of embryo with heartbeat 7 to 10 day after a scan that showed a gestational sac with a yolk sac ■ Absence of embryo ≥ 6 wk after last menstrual period ■ Empty amnion (amnion seen adjacent to yolk sac, with no visible embryo) ■ Enlarged yolk sac (>7 mm) ■ Small gestational sac in relation to the size of the embryo (<5 mm difference between mean sac diameter and crown-rump length)

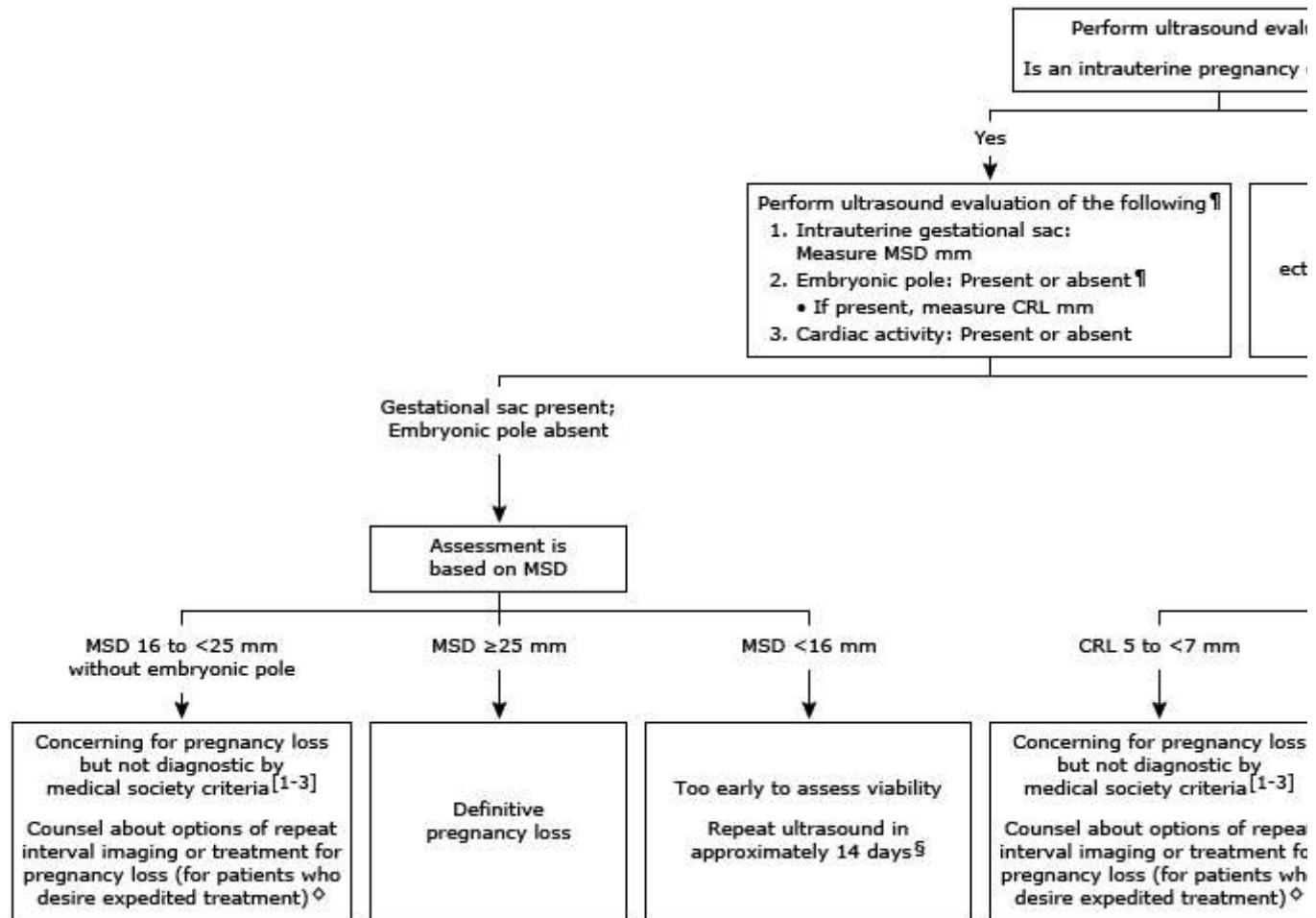
* Criteria are from the Society of Radiologists in Ultrasound Multispecialty Consensus Conference on Early First Trimester Diagnosis of Miscarriage and Exclusion of a Viable Intrauterine Pregnancy, October 2012.

¶ When there are findings suspicious for pregnancy failure, follow-up ultrasonography at 7 to 10 days to assess the pregnancy for viability is generally appropriate.

From: Doubilet PM, Benson CB, Bourne T, et al. Diagnostic criteria for nonviable pregnancy early in the first trimester. *N Engl J Med* 2013; 369:1443. Copyright © 2013 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society.

Graphic 139961 Version 1.0

Diagnosis of early pregnancy loss with transvaginal ultrasound*



In early pregnancy, imaging with transvaginal ultrasound is typically needed to optimize visualization of the embryo, and if present, cardiac activity.

IUP: intrauterine pregnancy; CRL: crown-rump length; MSD: mean gestational sac diameter.

* Early pregnancy loss generally applies to pregnancy in the first trimester (ie, up to 12 6/7 weeks' gestation).

¶ The sequential development of pregnancy structures visible with ultrasound imaging in normal early pregnancy include gestational sac (in gestational week 4), yolk sac (in week 5), and embryonic pole (5 6/7 weeks), with cardiac activity (in week 6). Crown-rump length is a longitudinal measurement of the embryonic pole. Gestational age based on last menstrual period may be inaccurate; a detailed discussion of determining gestational age with ultrasound findings is presented in related UpToDate content.

Δ Discussion of the evaluation and management of ectopic pregnancy, including heterotopic pregnancy, and pregnancy of unknown location are presented in related UpToDate content.

◊ For patients who desire expedited treatment of pregnancy loss and who accept a small chance of interrupting a potentially viable pregnancy, definitive treatment for pregnancy loss can be considered with the following caveats:

- The ultrasound was performed and interpreted by a highly skilled sonographer/sonologist.
and
- The patient has a clear understanding of a possible false-positive result.

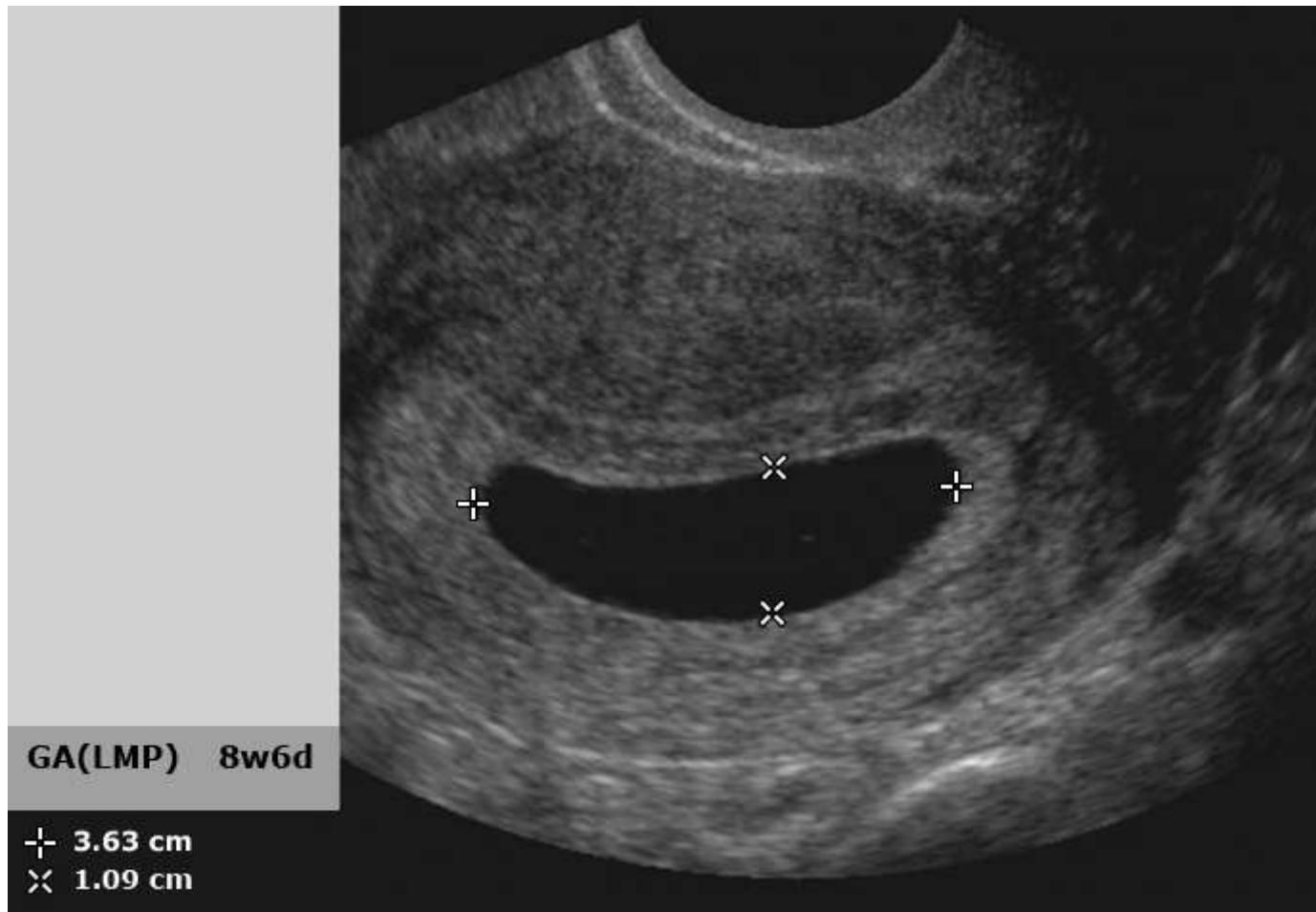
§ Patients with CRL <5 mm are advised to repeat imaging in 7 to 10 days to assess for embryonic growth and cardiac activity. Patients with MSD <16 mm are advised to repeat imaging closer to 14 days (rather than 7 to 10 days) to increase the chance of visualizing a live pregnancy.

References:

1. ACOG Practice Bulletin No. 200 Summary: Early Pregnancy Loss. *Obstet Gynecol* 2018; 132:1311.
 2. Doubilet PM, Benson CB, Bourne T, et al. Diagnostic criteria for nonviable pregnancy early in the first trimester. *N Engl J Med* 2013; 369:1443.
 3. Abdallah Y, Daemen A, Kirk E, et al. Limitations of current definitions of miscarriage using mean gestational sac diameter and crown-rump length measurements: a multicenter observational study. *Ultrasound Obstet Gynecol* 2011; 38:497.
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Graphic 140173 Version 1.0

Sagittal view of an empty gestational sac



Sagittal view of an empty gestational sac as indicated by the caliper markers (+ and x). Mean sac diameter is 25 mm without an embryonic pole or yolk sac. These findings are consistent with nonviable pregnancy.

Courtesy of Deborah Levine, MD.

Graphic 130909 Version 1.0

Gestational sac without yolk sac or embryo



Transverse view of the uterus shows an abnormally shaped intrauterine gestational sac with mean sac diameter of 31 mm. At this sac size, a yolk sac and embryo should be seen but were not. Arrows indicate the empty amnion, which is consistent with an early pregnancy loss.

Courtesy of Tejas S Mehta, MD, MPH.

Graphic 77246 Version 3.0

Embryo without cardiac activity consistent with embryonic demise



Image of a 13 mm embryo without cardiac activity consistent with embryonic demise. The calipers indicate a size of 1.29 cm which corresponds to a gestation of 7 weeks, 4 days.

Courtesy of Deborah Levine, MD.

Graphic 130903 Version 2.0

Comparison of ultrasound criteria used to diagnose pregnancy loss

Measurement	Number of participants	Crown-rump length (without cardiac activity)	FPR	Mean gestational sac diameter	FPR
Initial studies ^[1,2]	707 consecutive pregnancies	5 mm	Not available	16 mm	Not available
2011 prospective cross-sectional study ^[3] (less stringent)	1060 total consecutive patients	6 mm	0	≥21 mm	0
2013 Society of Radiologists in Ultrasound ^[4] (more stringent)	Combination of the previous studies	7 mm	0	≥25 mm	0

FPR: false-positive rate.

References:

1. Brown DL, Emerson DS, Felker RE, et al. Diagnosis of early embryonic demise by endovaginal sonography. *J Ultrasound Med* 1990; 9:631.
2. Pennell RG, Needleman L, Pajak T, et al. Prospective comparison of vaginal and abdominal sonography in normal early pregnancy. *J Ultrasound Med* 1991; 10:63.
3. Abdallah Y, Daemen A, Kirk E, et al. Limitations of current definitions of miscarriage using mean gestational sac diameter and crown-rump length measurements: a multicenter observational study. *Ultrasound Obstet Gynecol* 2011; 38:497.
4. Doubilet PM, Benson CB, Bourne T, et al. Diagnostic criteria for nonviable pregnancy early in the first trimester. *N Engl J Med* 2013; 369:1443.

Graphic 130912 Version 1.0

Ultrasound image of expanded amnion without embryo consistent with early pregnancy loss

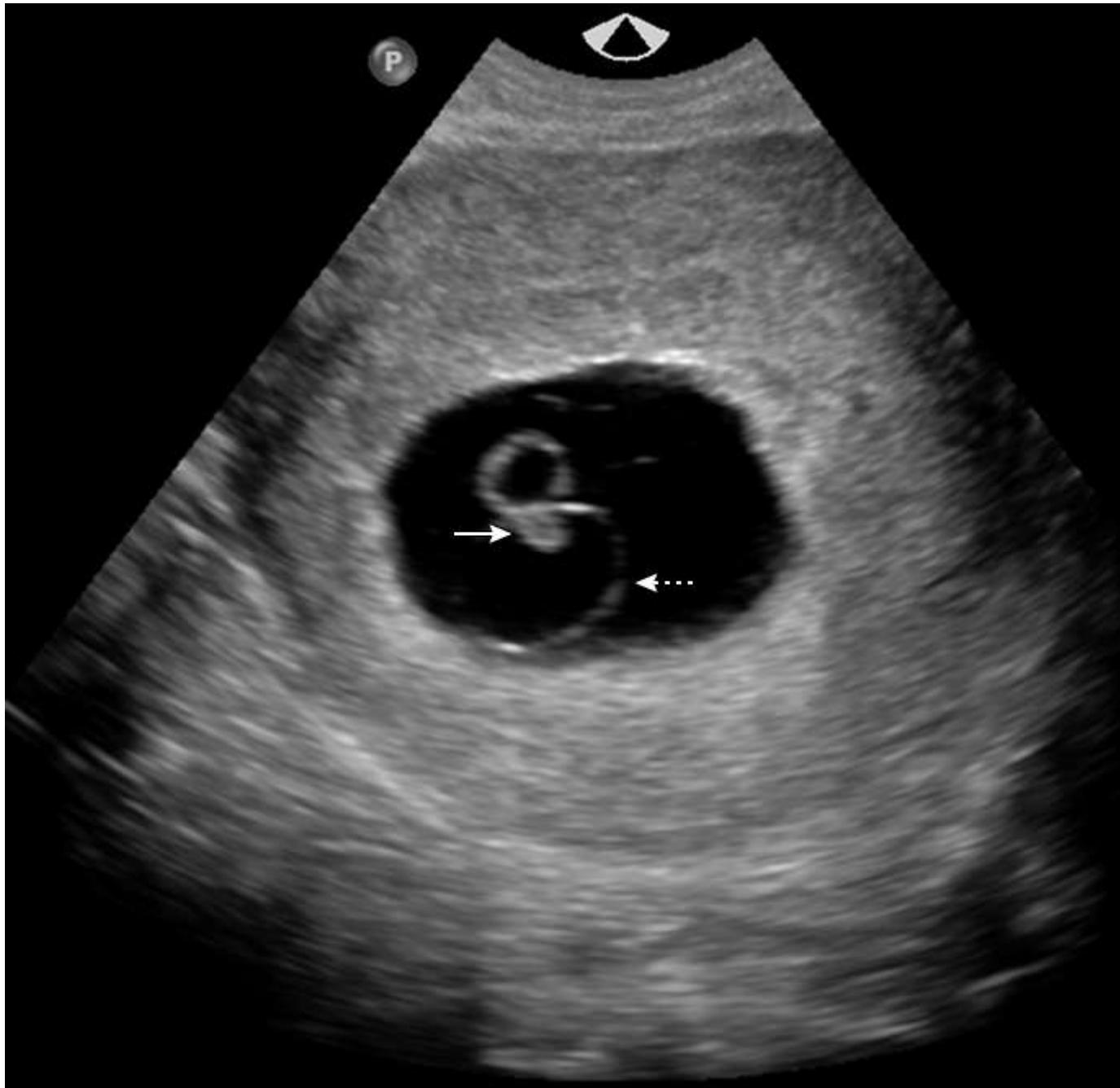


The arrow indicates the amnion. No embryo is present.

Courtesy of Deborah Levine, MD.

Graphic 130904 Version 1.0

Ultrasound image of embryonic pole with expanded amnion

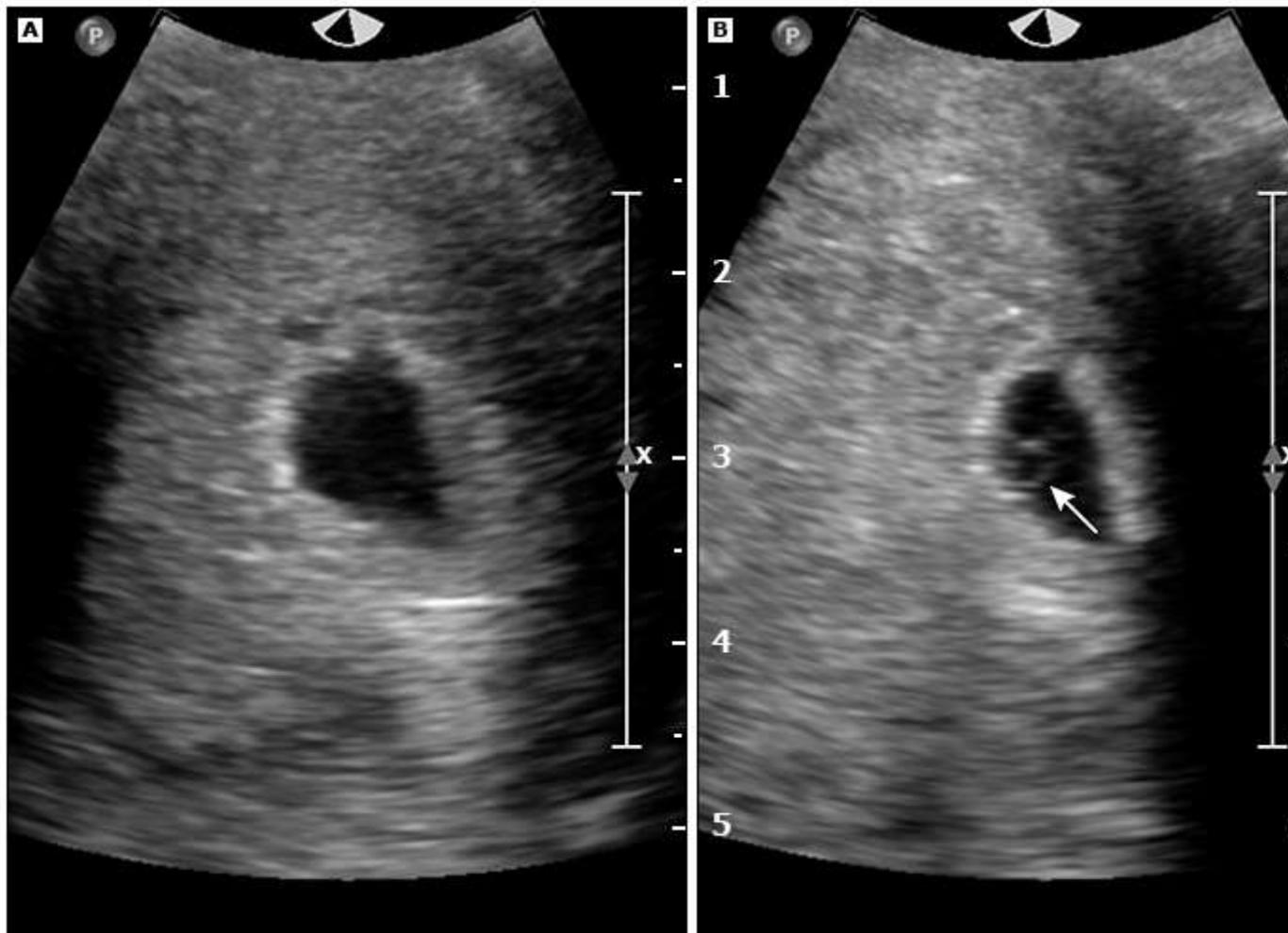


A 3 mm embryonic pole is visible that lacks cardiac activity. While the small embryo without cardiac activity is not diagnostic for pregnancy loss, the diagnosis of pregnancy loss is confirmed by the presence of the expanded amnion seen in this image. The solid arrow is the embryonic pole. The dotted arrow is the expanded amnion.

Courtesy of Deborah Levine, MD.

Graphic 130906 Version 1.0

Ultrasound image of gestational sac with yolk sac but no embryo



(A) The image shows a mean gestational sac of 7 mm.

(B) The image shows the yolk sac within the gestational sac (arrow). It is too early in pregnancy to see an embryo. Repeat ultrasound in 7 to 10 days is reasonable to confirm pregnancy viability.

Courtesy of Deborah Levine, MD.

Graphic 130910 Version 1.0

Ultrasound image of a live 8 week gestation embryo with cardiac activity and amnion



This ultrasound image shows a viable 8 week embryo (marked with calipers) with amnion visible (arrow). A fetal heart beat was detected.

Courtesy of Deborah Levine, MD.

Graphic 130911 Version 1.0

Contributor Disclosures

Sarah Prager, MD, MAS No relevant financial relationship(s) with ineligible companies to disclose. **Elizabeth Micks, MD, MPH** No relevant financial relationship(s) with ineligible companies to disclose. **Vanessa K Dalton, MD, MPH** Grant/Research/Clinical Trial Support: HHS Office of Population Affairs [Reproductive health]; Michigan Department of Health and Human Services [Perinatal health]; National Institutes for Health [Perinatal depression]. Consultant/Advisory Boards: Merck [HPV vaccination]. Other Financial Interest: Medical Letter Contributing Editor [Women's health]; Society of Family Planning [Women's health]. All of the relevant financial relationships listed have been mitigated. **Robert L Barbieri, MD** No relevant financial relationship(s) with ineligible companies to disclose. **Courtney A Schreiber, MD, MPH** Patent Holder: Penn, Saul [Medical management of nonviable pregnancy]. Consultant/Advisory Boards: Exeltis [Advisory board, contraceptive technology R&D]. Other Financial Interest: American Board of Obstetrics and Gynecology [Member of Board of Directors, Chair of Division of Complex Family Planning]; Athenium Pharmaceuticals [Early pregnancy loss]. All of the relevant financial relationships listed have been mitigated. **Liina Poder, MD** No relevant financial relationship(s) with ineligible companies to disclose. **Kristen Eckler, MD, FACOG** No relevant financial relationship(s) with ineligible companies to disclose.

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