

INTRODUCTION

Ectopic pregnancy is the leading cause of pregnancy-related deaths during the first trimester (1). The incidence of ectopic pregnancy has been on the increase over the past several decades (2) and it continues to contribute significantly to maternal morbidity and mortality, especially in the developing world (3).

RISK FACTORS

Several risk factors for ectopic pregnancy exist (4) and are listed in **Table 13.1**. History of tubal surgery such as prior tubal sterilization or prior tubal surgery for ectopic pregnancy are amongst the most common risk factors and thus should heighten alertness for the presence of an ectopic pregnancy in symptomatic patients. Other risk factors include pelvic inflammatory disease, female infertility and use of an intra-uterine device.

TABLE 13.1 Risk Factors for Ectopic Pregnancy

- History of tubal surgery
- History of prior ectopic pregnancy
- Use of Intrauterine Device
- History of infertility

CLINICAL SYMPTOMS

Ectopic pregnancy should be considered when a patient presents with pain and/or vaginal bleeding in the setting of a positive pregnancy test. The presence of an adnexal mass on physical examination should also initiate an ectopic pregnancy work-up, when a positive pregnancy test is present. Clinical symptoms are not specific for ectopic pregnancy and should not be used solely for diagnosis. The location of the pain may vary (5) and the clinical triad of pain, bleeding and adnexal mass is present in less than half of patients with ectopic pregnancy (6).

ANATOMIC LOCATION OF ECTOPIC PREGNANCY

Most ectopic pregnancies are located along the course of the fallopian tube, with the ampullary and isthmic sections of the tube accounting for the largest proportions of ectopic pregnancies (**Figure 13.1**). Other rare tubal locations include the fimbrial end of the tube or the interstitial (cornual) end of the tube (**Figure 13.1**). The interstitial or cornual ectopic pregnancy deserves special mention, as ectopic pregnancies in this location typically present at a more advanced stage in gestation and are commonly associated with severe hemorrhage and maternal shock at the time of presentation. Cornual ectopic pregnancies are also more difficult to diagnose by ultrasound as they mimic a normal intrauterine gestation, especially when they present at an advanced stage. **Figure 13.2** and **13.3** show cornual ectopic pregnancies in the early part of the first trimester and **Figures 13.4** and **13.5** show cornual ectopic pregnancies at more advanced gestations. Cervical ectopic pregnancies occur in less than 1 % of all ectopic pregnancies and are typically diagnosed by transvaginal ultrasound (**Figure 13.6**). Cervical ectopic pregnancies are best treated with either intramuscular or direct injection, into the gestational sac, of methotrexate or potassium chloride (into gestational sac) under ultrasound guidance, especially when preservation of fertility is desired. Conservative management, following injection of methotrexate or potassium chloride into the gestational sac, is desired, as long as the patient is not bleeding excessively, as most injected cervical ectopic pregnancies will spontaneously resolve. In low-resource settings where treatment options are limited, cervical ectopic pregnancy with heavy vaginal bleeding can be temporarily managed (tamponade) with placement of a cervical cerclage when technically feasible or by inserting compression (30 cc) Foley balloon-catheter(s) into the cervical canal.

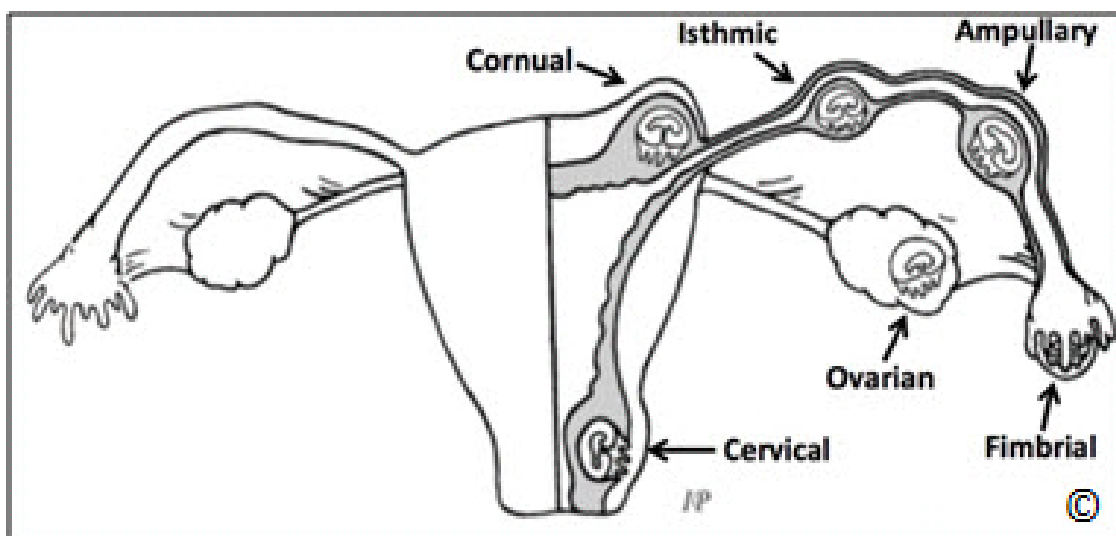


Figure 13.1: Locations of ectopic pregnancies in the pelvis. Most ectopic pregnancies are located along the course of the fallopian tube, with the ampullary and isthmic sections accounting for the largest proportions. Abdominal pregnancy is not depicted in this sketch. Sketch is courtesy of Dr. Igor Palahnuk.

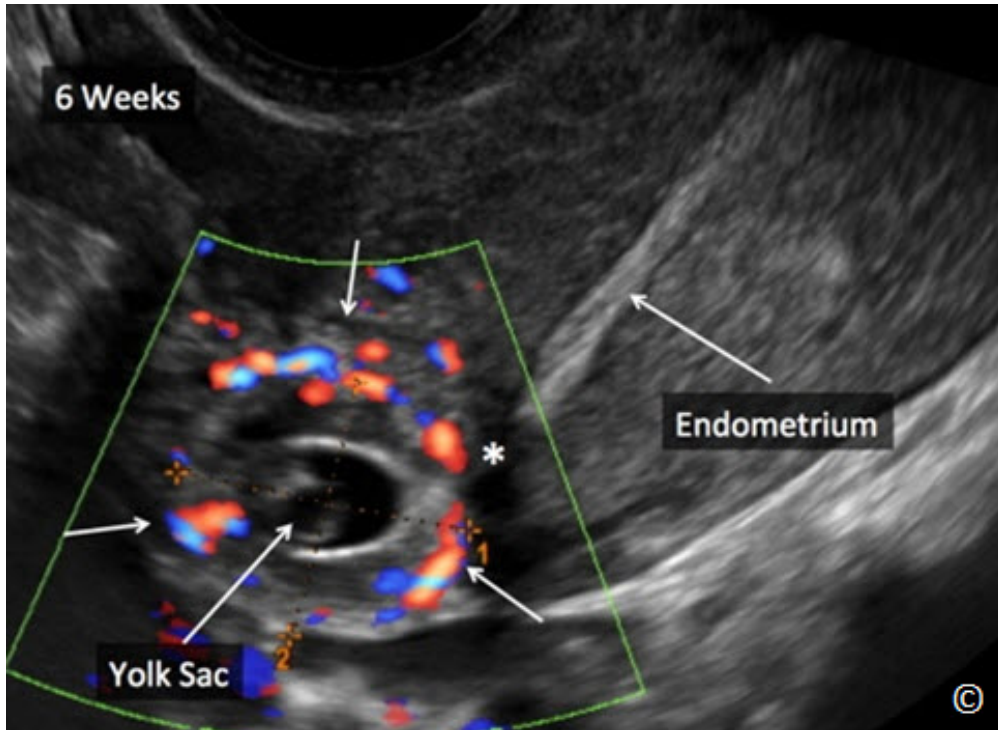


Figure 13.2: Grey scale and color Doppler ultrasound of a cornual ectopic pregnancy at 6 weeks' gestation (arrows). Note that the endometrial echo (labeled as endometrium) is distinctly separate from the cornual ectopic pregnancy (asterisk). Note the yolk sac within the ectopic pregnancy (labeled).

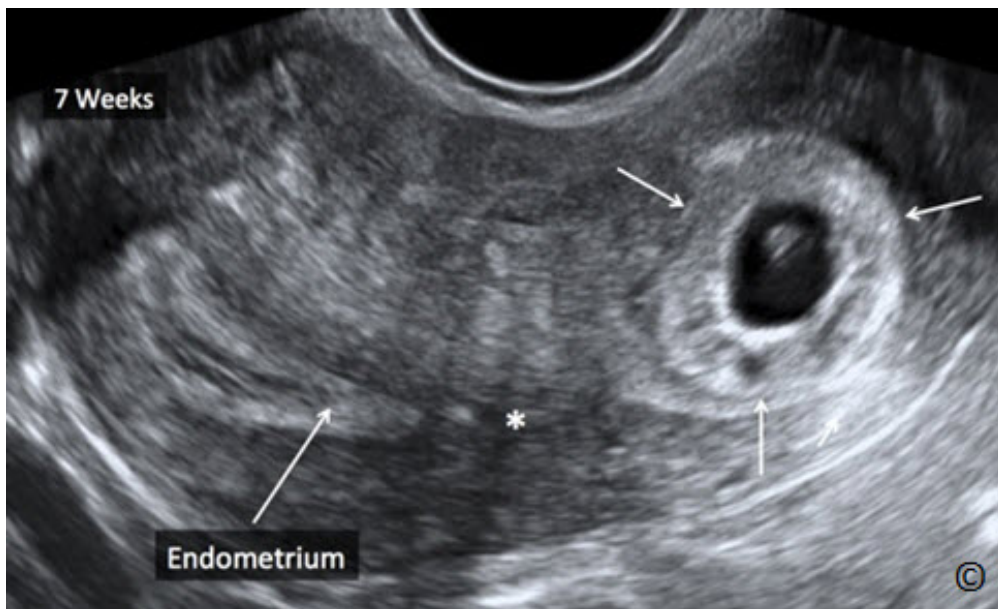


Figure 13.3: Grey scale ultrasound of a cornual ectopic pregnancy at 7 weeks' gestation (arrows). Note that the endometrial echo (labeled endometrium) is distinctly separate from the cornual ectopic pregnancy (asterisk).

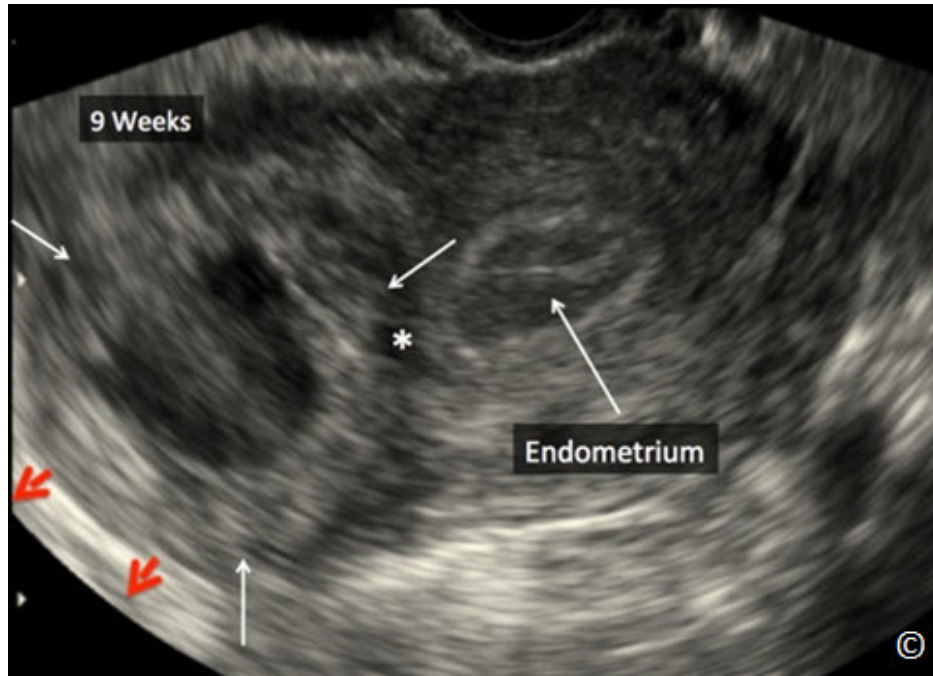


Figure 13.4: Transvaginal ultrasound of a transverse plane of the upper uterus showing a cornual ectopic pregnancy (white arrows) at 9 weeks' gestation. Note that the endometrial echo (labeled as endometrium) is distinctly separate from the cornual ectopic pregnancy (asterisk). The ectopic sac is bulging on the serosal aspect of the uterus (red arrow heads).

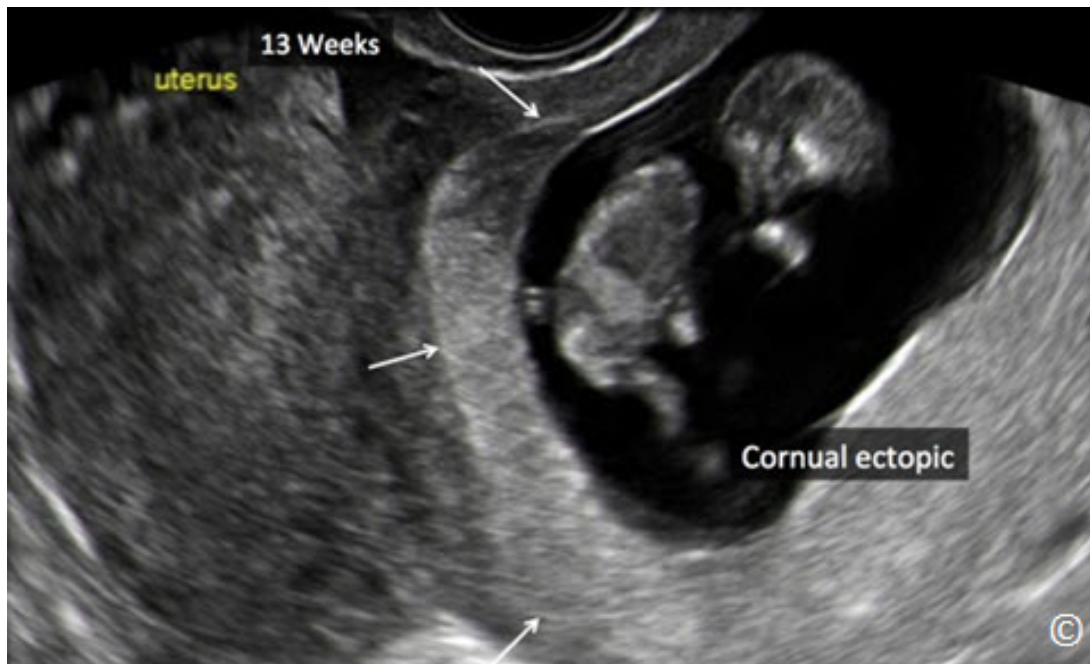


Figure 13.5: Transvaginal ultrasound of an oblique plane of the upper uterus showing a cornual ectopic pregnancy (arrows) at 13 weeks' gestation. Note the size of the cornual pregnancy (labeled) that may be mistaken for an intrauterine gestation. The uterus is labeled in yellow.

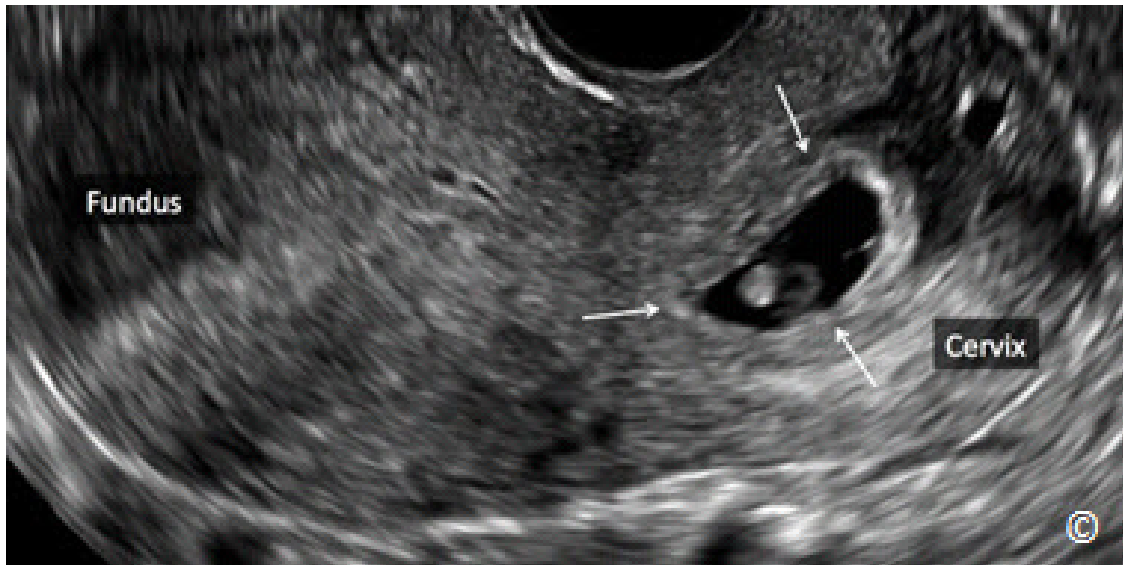


Figure 13.6: Transvaginal ultrasound of a sagittal plane of the uterus showing a cervical ectopic pregnancy (arrows). The uterine fundus and cervix are labeled for image orientation.

Implantation of a gestational sac in a cesarean section scar is referred to as cesarean scar implantation and is technically not an ectopic pregnancy as the gestational sac is within the uterine cavity. Cesarean scar implantation can lead, later in gestation, to severe placental abnormalities, such as placenta accreta, or rupture of the gestational sac (7, 8). The diagnosis of a cesarean section scar implantation is performed when a gestational sac is noted by ultrasound to be located in the lower uterine segment, in or near, a cesarean section scar, in a patient with a prior cesarean section. Magnification of the ultrasound image may help confirm the diagnosis (**Figure 13.7** and **13.8**). Similar to cervical ectopic pregnancy, treatment of cesarean section scar implantation is best achieved by direct injection of methotrexate or potassium chloride into the gestational sac, under ultrasound guidance (**Figure 13.9 A and B**).



Figure 13.7: Transvaginal ultrasound in grey scale of a sagittal plane of the uterus showing a cesarean scar implantation of a gestational sac (arrows). The cervix is labeled for image orientation.

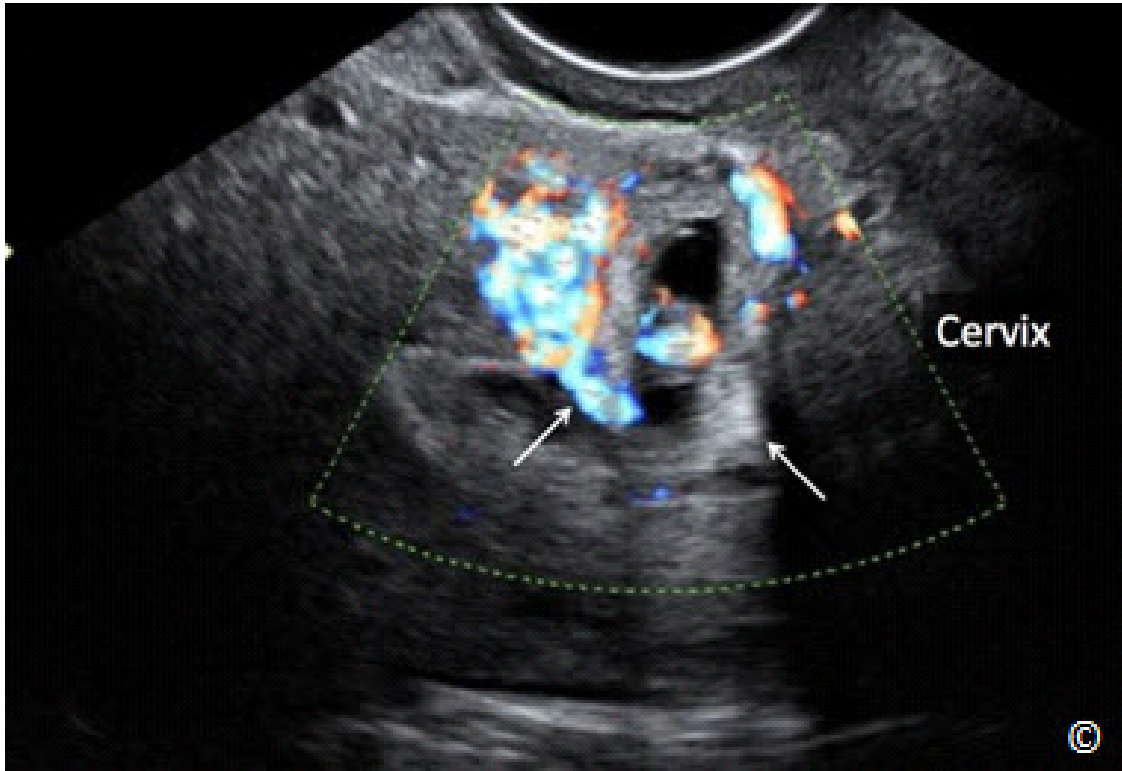


Figure 13.8: Transvaginal ultrasound in color Doppler of a sagittal plane of the uterus showing a cesarean scar implantation of a gestational sac (arrows – same as in figure 13.7). Note the increased vascularity on color Doppler of the gestational sac. The cervix is labeled for image orientation.

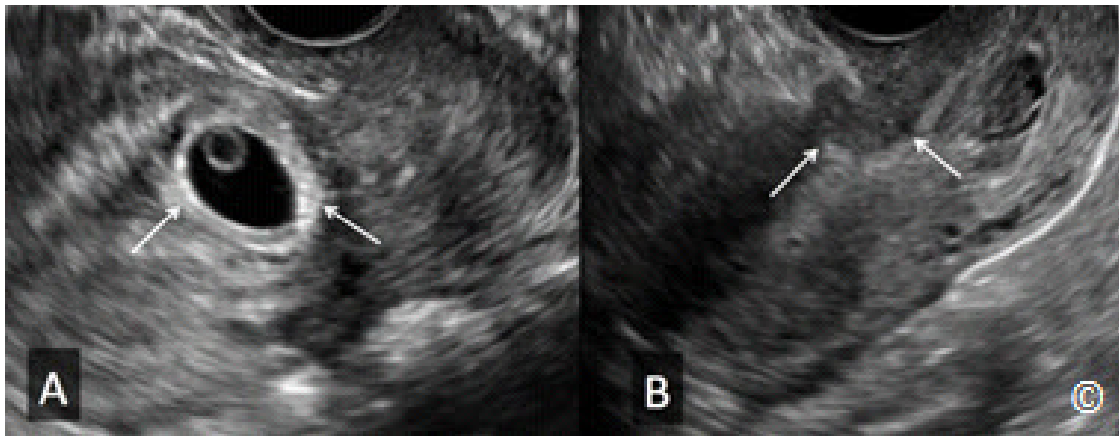


Figure 13.9 A and B: Transvaginal ultrasound of a sagittal plane of the uterus showing in (A) a cesarean scar implantation (arrows). The figure B shows the same cesarean scar implantation (arrows) two weeks after direct methotrexate injection. Note the significant resolution.

STEP-WISE ULTRASOUND APPROACH TO THE DIAGNOSIS OF ECTOPIC PREGNANCY

This section describes the step-wise approach to the work-up of a woman presenting with clinical symptoms suggestive of the presence of an ectopic pregnancy. Before this stepwise approach is initiated, it is important to note that taking a detailed history and performing a physical examination are essential components of the care of the woman and thus should be part of the initial evaluation. A differential diagnosis should then be formulated as new information and diagnostic tests are being gathered. **Table 13.2** lists a typical differential diagnosis for a woman presenting with lower abdominal pain and vaginal bleeding.

TABLE 13.2	Differential Diagnosis of a Woman Presenting in the Reproductive Age Group with Lower Abdominal Pain and Vaginal Bleeding
<ul style="list-style-type: none"> - Normal pregnancy - Threatened or impending miscarriage - Ectopic pregnancy - Symptomatic ovarian mass (hemorrhagic cyst, dermoid, torsion) - Pelvic inflammatory disease - Dysfunctional uterine bleeding - Gastrointestinal origin - Urinary origin 	

Obtaining a pregnancy test should be one of the first diagnostic tests to be performed. A negative pregnancy test practically rules out a live ectopic pregnancy, assuming that the pregnancy test that is available has sufficient sensitivity to detect human chorionic gonadotropin (HCG) levels commensurate with early pregnancy. A positive pregnancy test establishes pregnancy but does not indicate the location of the gestational sac, or the viability of the pregnancy. Please note that chronic ectopic pregnancies may coexist with low HCG levels and are typically associated with chronic pelvic pain. **Figures 13.10** and **13.11** show a chronic ectopic pregnancy with an HCG level of 22 IU / ml. The patient presented with a pelvic mass and chronic right pelvic pain.

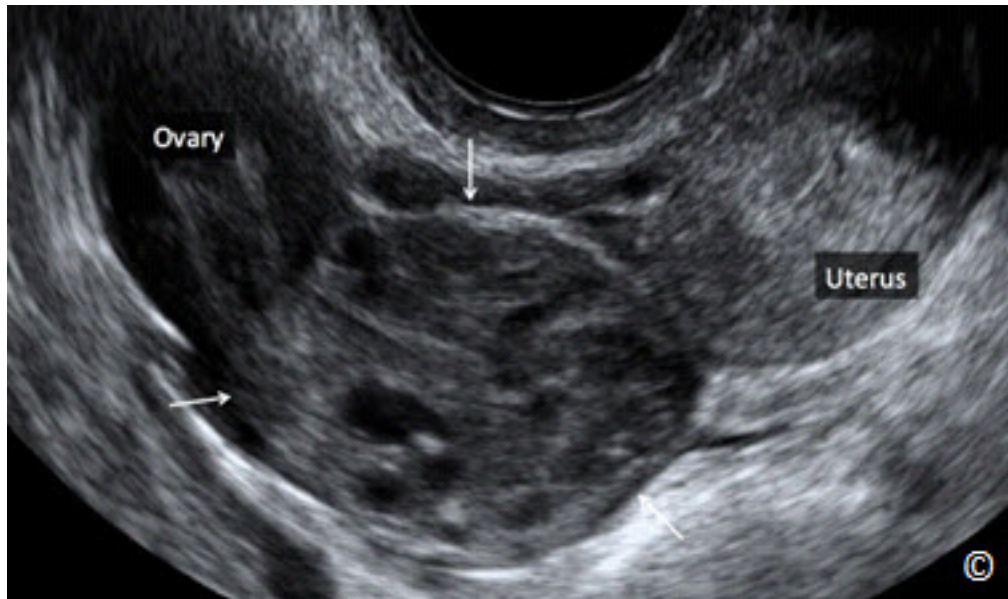


Figure 13.10: Transvaginal ultrasound showing a chronic ectopic pregnancy (arrows-confirmed on pathology) in a woman who presented with chronic pelvic pain. HCG levels were 22 IU/ml. A separate ovary was noted (labeled). The uterus (labeled) is seen adjacent to the chronic ectopic.

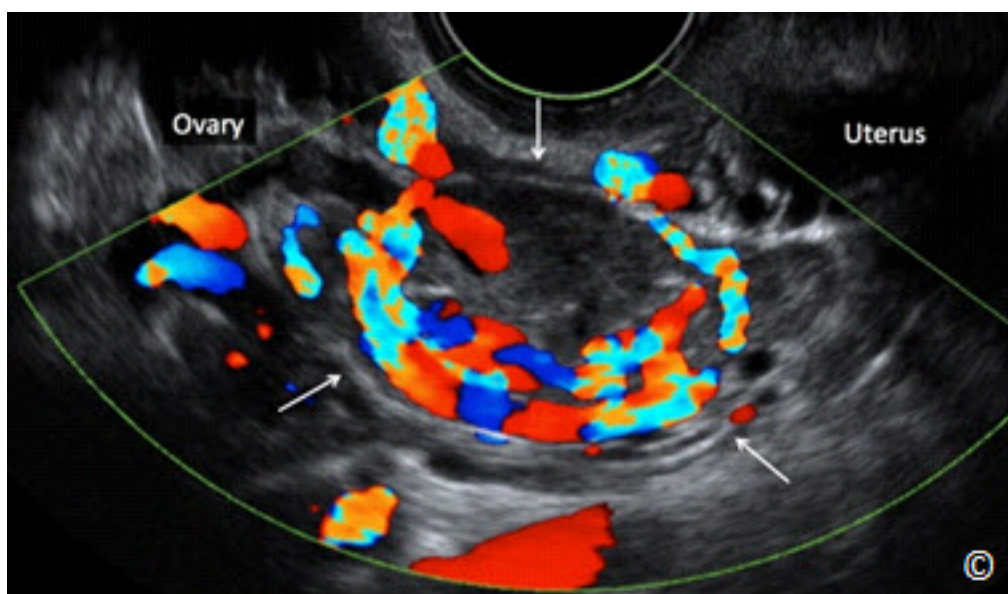


Figure 13.11: Transvaginal ultrasound with color Doppler in the same woman as in figure 13.10 showing significant vascularity of the chronic ectopic pregnancy (arrows)

Given that this textbook represents a basic approach to the use of ultrasound in obstetrics and gynecology, we will not expand on the relationship of the serum HCG level with the sonographic appearance of the gestational sac in the uterus. Suffice it to say that there is a relationship between rising HCG levels and normal intrauterine pregnancies. In general, normal pregnancies will show a doubling of the HCG level every 2-3 days (9). This rule however is not exclusive as 1 in 5 ectopic pregnancies will show this rise in HCG levels (9) and thus HCG levels should not be used alone in excluding an ectopic pregnancy.

The stepwise ultrasound approach hereby described should be initiated if the pregnancy test is positive.

This stepwise approach is performed by the transvaginal ultrasound:

Step one:

Assess the endometrial cavity for the presence of a gestational sac:

The presence of a gestational sac in the endometrial cavity (**Figure 13.12**) practically rules out an ectopic pregnancy. Note that on very rare occasions, a heterotopic pregnancy can occur (a concurrent intrauterine and an extrauterine pregnancy) (**Figure 13.13**) – (**Clip 13.1**). The incidence of a heterotopic pregnancy in a natural pregnancy is around 1 in 7000 pregnancies. Heterotopic pregnancies are more common in pregnancies of assisted reproduction (**Figure 13.14**).

The gestational sac of a normal pregnancy on ultrasound, which appears between the 4th and the 5th menstrual week, corresponds to the chorionic cavity of the embryo (**Figure 13.12**). The yolk sac is the first structure to appear on ultrasound within the gestational sac and is typically first seen at the 5th menstrual week (**Figure 13.15**), followed by the amnion between the 5th and the 6th week and the embryo by the 6th menstrual week (**Figure 13.16**). The normal intrauterine gestational sac has a distinctive ultrasound appearance, with a thick rim of echogenic tissue (**Figure 13.17**). This echogenic rim differentiates the gestational sac from blood or fluid collection within the endometrial cavity. Blood or fluid collection within the endometrial cavity is commonly called pseudosac (**Figure 13-18 A and B**). The term pseudosac is used in relation to the presence of an ectopic pregnancy. For more discussion on the first trimester, please refer to chapter 4.

If a gestational sac is seen within the endometrial cavity, complete the ultrasound examination by evaluating the adnexal regions and the cul-de-sac. Go to step 2, if no gestational sac is seen in the endometrial cavity.

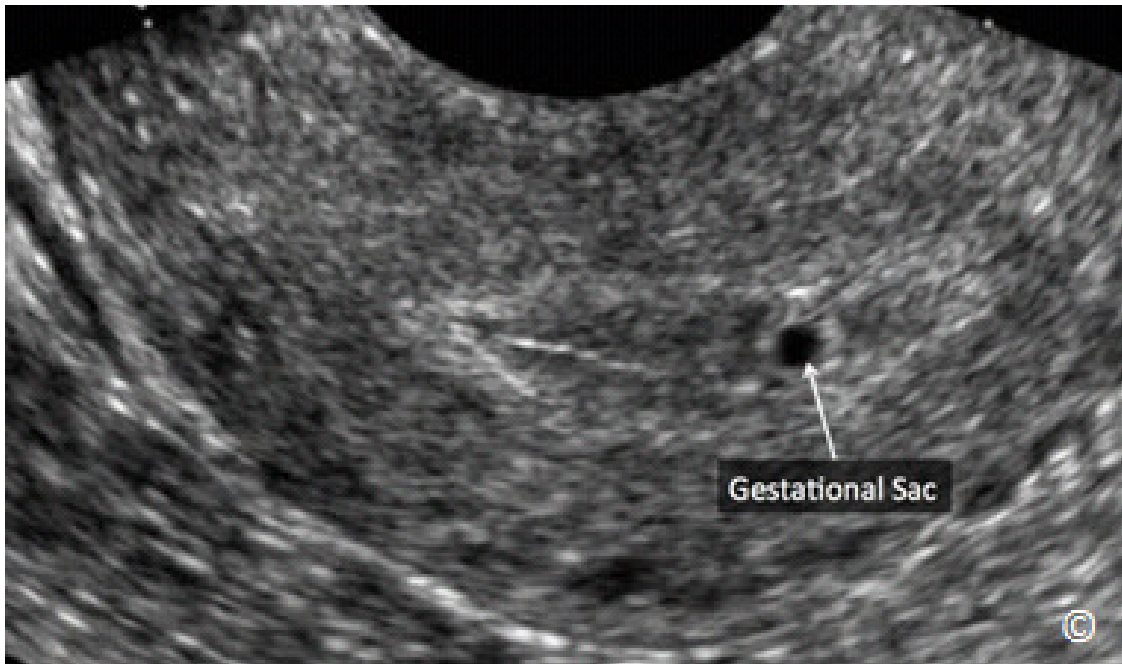


Figure 13.12: Transvaginal ultrasound of a sagittal plane of the uterus showing a gestational sac (labeled) at about 5 weeks' gestation. The presence of an intrauterine gestational sac practically rules out an ectopic pregnancy with some exceptions. See text for details.

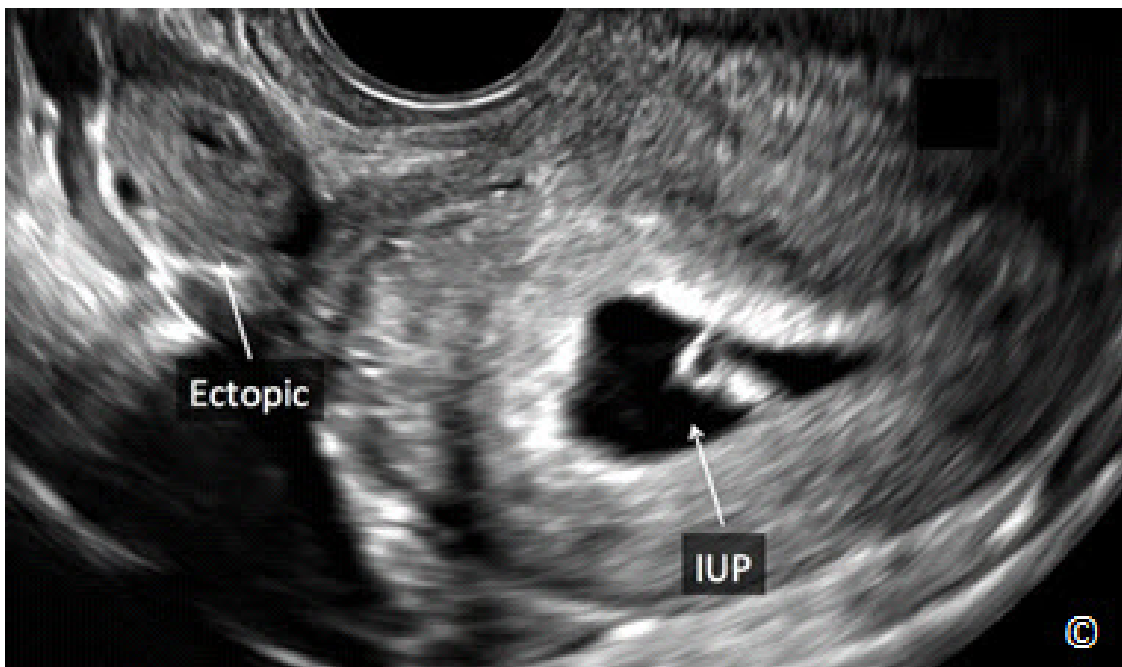


Figure 13.13: Transvaginal ultrasound of a heterotopic pregnancy at 6 weeks' gestation. Note the presence of an intrauterine pregnancy (IUP) and a tubal ectopic pregnancy (labeled) in the adnexa.

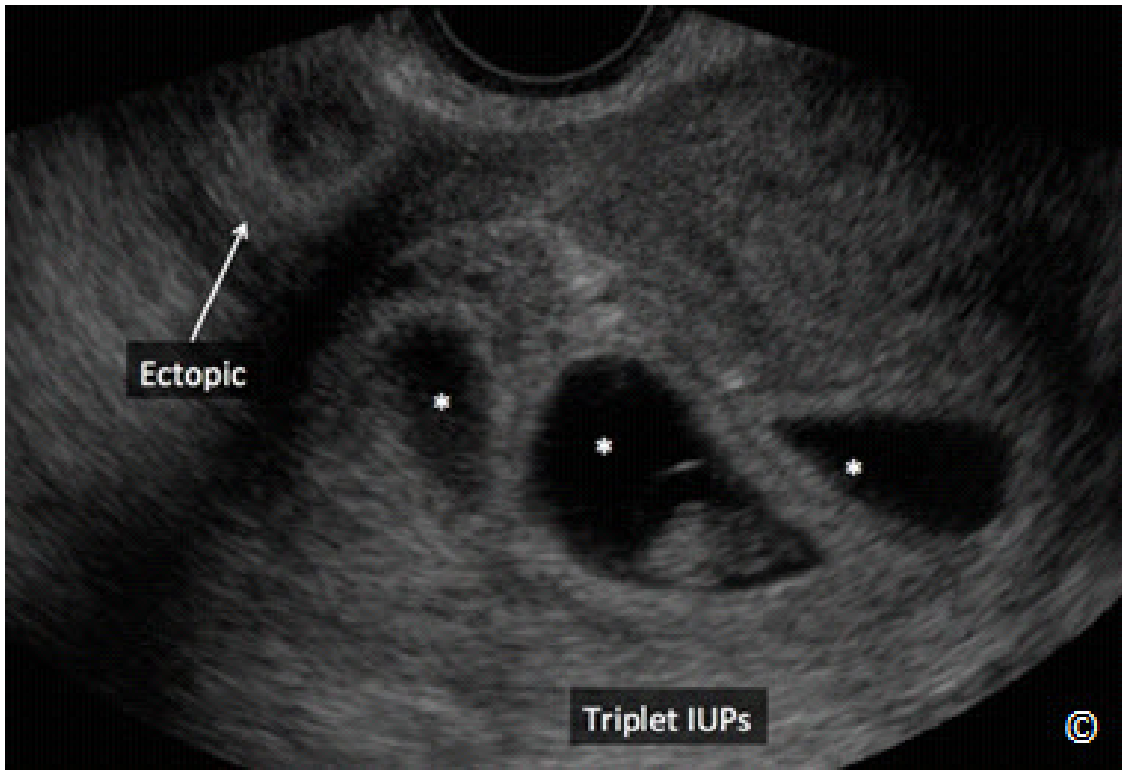


Figure 13.14: Transvaginal ultrasound of a heterotopic pregnancy at 7 week's gestation. Note the presence of a triplet intrauterine pregnancy (asterisks - Triplet IUPs) and a tubal ectopic pregnancy (labeled) in the adnexa. This pregnancy was conceived by assisted reproduction.



Figure 13.15: Transvaginal ultrasound of a sagittal plane of the uterus showing a gestational sac at 5 weeks' gestation with a yolk sac (labeled). Note that the yolk sac is the first structure to appear within the gestational sac and is typically first seen at the 5th menstrual week.

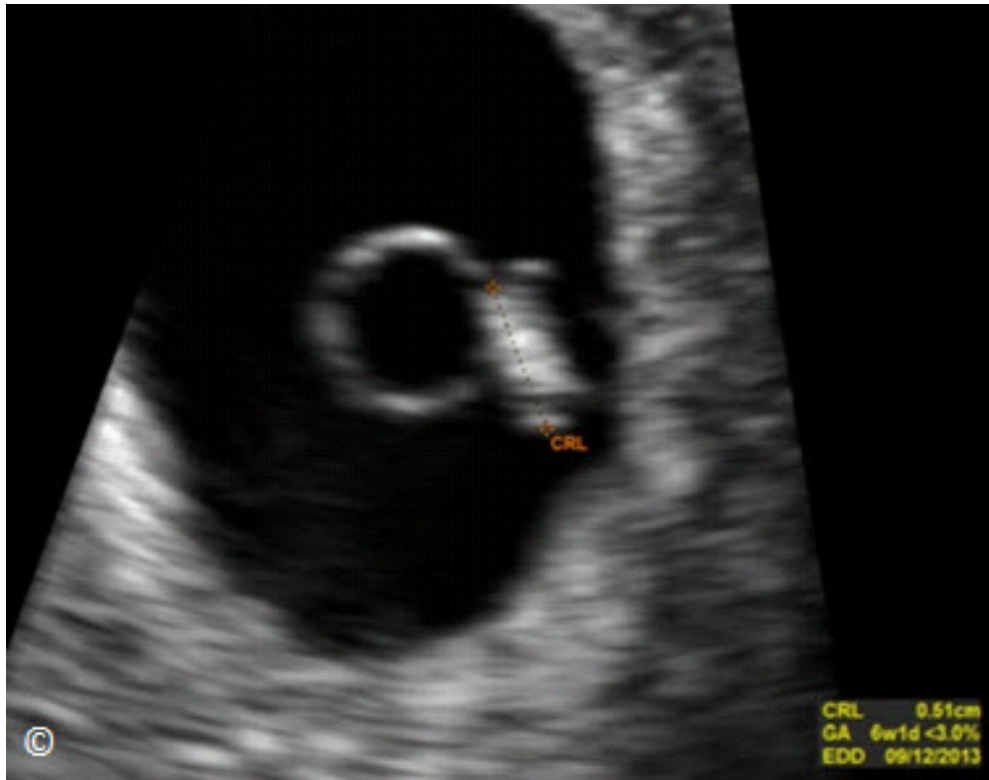


Figure 13.16: Transvaginal ultrasound of a gestational sac at 6 weeks' gestation showing an embryo (measured). The yolk sac (not labeled) is seen next to the embryo. CRL = crown rump length, GA = gestational age and EDD = estimated date of delivery.

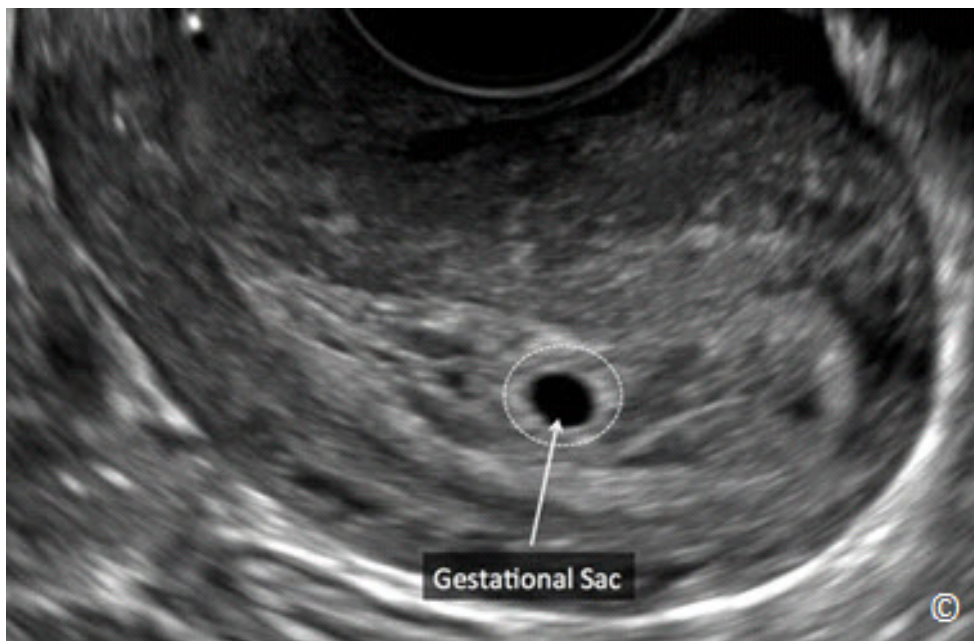


Figure 13.17: Transvaginal ultrasound of a sagittal plane of the uterus with a normal gestational sac (labeled) at 5 weeks' gestation. Note the echogenic rim surrounding the gestational sac (dashed circle).

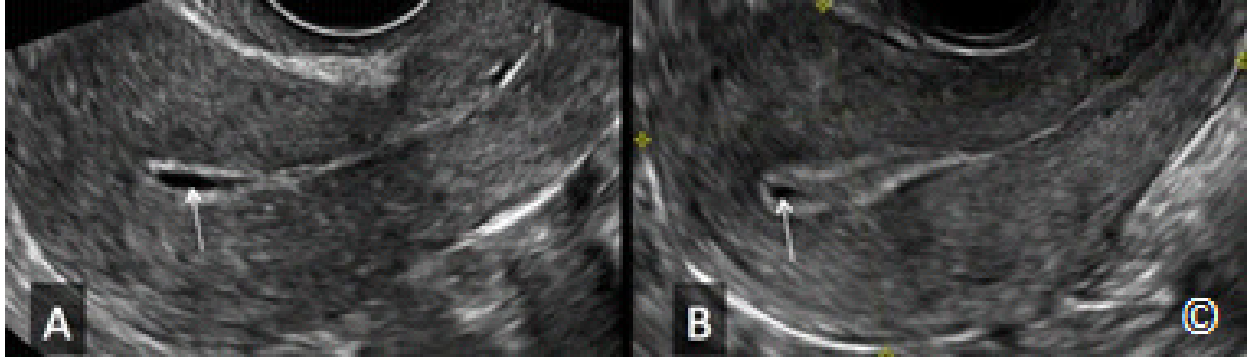


Figure 13.18 A and B: Transvaginal ultrasound of sagittal planes of two uteri (A) and (B) with endometrial fluid (arrows) in the setting of suspected ectopic pregnancies. The term pseudosac is used when endometrial fluid is noted in association with an ectopic pregnancy.

Step Two:

Assess the cul-de-sac for the presence of fluid:

The presence of fluid in the cul-de-sac is an important part of this evaluation as it may suggest the presence of blood from a ruptured ectopic pregnancy or a ruptured ovarian cyst. The cul-de-sac can be assessed for fluid or blood on ultrasound by imaging the space posterior to the cervix and the lower uterine segment in a sagittal plane of the uterus and cervix using the transvaginal approach (**Figure 13.19**). Low-velocity color Doppler, if available, can be used to confirm the absence of vascular flow within the blood clots. It is important to note that the mere presence of fluid in the cul-de-sac in a patient with a suspected ectopic pregnancy should be concerning for the possibility of intra-abdominal bleeding and this information should be considered in the overall management of the patient. If fluid is noted in the cul-de-sac region in significant quantity, assessing the regions in the upper gutters of the abdomen is important as the presence of fluid in those locations will confirm that a significant amount of free fluid is present in the abdomen and pelvis and will raise the suspicion for significant intra-peritoneal bleeding. It is also important to note that the presence of fluid in the cul-de-sac in small amount is a normal finding and is part of the normal physiologic changes of the menstrual cycle.



Figure 13.19: Transvaginal ultrasound of a sagittal plane of the uterus in a patient with a ruptured ectopic pregnancy. Note the presence of free fluid in the cul-de-sac and surrounding the uterus (asterisks). A blood clot (labeled) is also noted in the cul-de-sac. In this image, the endometrial thickness is also measured (yellow calipers).

Step 3:

Assess the Adnexal Region for the Ectopic Gestational Sac:

The third step in the ultrasound examination of the pelvis includes a thorough evaluation of both adnexal regions in transverse and sagittal scanning planes. This evaluation should include assessment of the ovaries and the surrounding anatomic regions, looking for fluid, blood and for the ectopic gestational sac. The ectopic gestational sac, when present in the adnexal region, is commonly in the fallopian tube. It is typically round in shape and has an echogenic ring and an anechoic center (**Figure 13.20 A and B**). Commonly, the patient's symptoms correlate with the location of the ectopic pregnancy in the pelvis but with noted exceptions. It is also important not to confuse an ectopic gestational sac with a corpus luteum (**Figure 13.21**), which is commonly located on the same side ovary. **Table 13.3** shows differentiating characteristics of the corpus luteum from the ectopic gestational sac. **Figures 13.22** and **13.23** show tubal ectopic pregnancies on ultrasound. Color Doppler is not helpful in the differential diagnosis given the overlap with corpus luteum flow and the varying degrees of blood flow patterns in ectopic pregnancies. **Figure 13.24 A-C** shows varying degrees of blood flow on color Doppler in three different ectopic pregnancies.

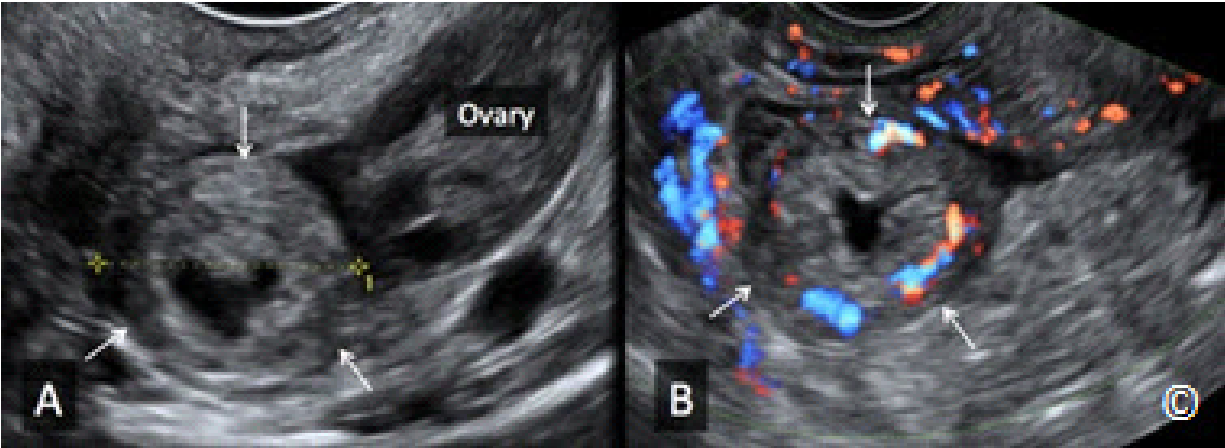


Figure 13.20 A and B: Tubal ectopic pregnancies in A and B (arrows) imaged on transvaginal ultrasound. Note the echogenic ring and the anechoic center (doughnut-like appearance) in both ectopic pregnancies. Color Doppler in B shows moderate ectopic sac vascularity. The ovary is seen (labeled) in A.

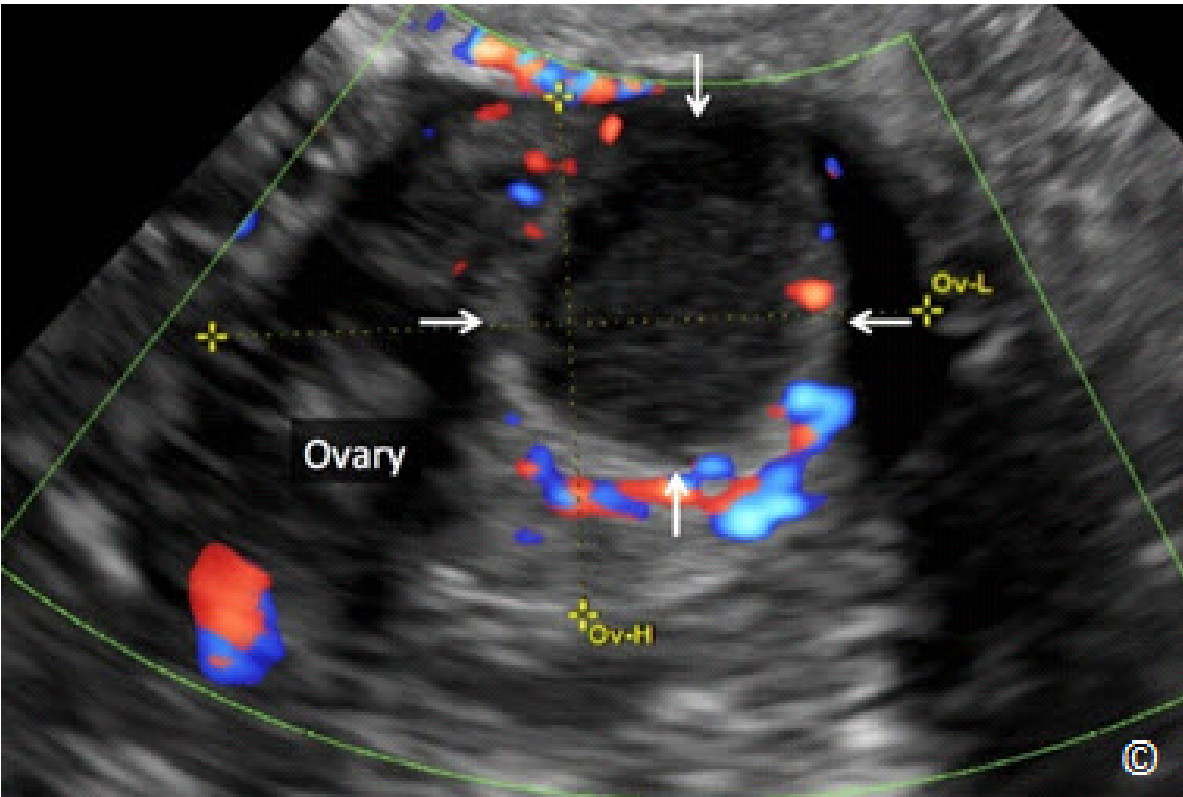


Figure 13.21: Transvaginal ultrasound in grey scale and color Doppler of a corpus luteum (arrows) within the ovary (labeled). See **Table 13.3** for differentiating features from an ectopic pregnancy.

TABLE 13.3**Differentiating Features of a Corpus Luteum From an Ectopic Pregnancy**

- Corpus luteum is located within the ovary
- Corpus luteum is surrounded by normal ovarian tissue
- Corpus luteum moves with the ovary with manipulation
- Corpus luteum typically does not have a thick echogenic ring
- Color Doppler and pulsed Doppler cannot differentiate between the two entities

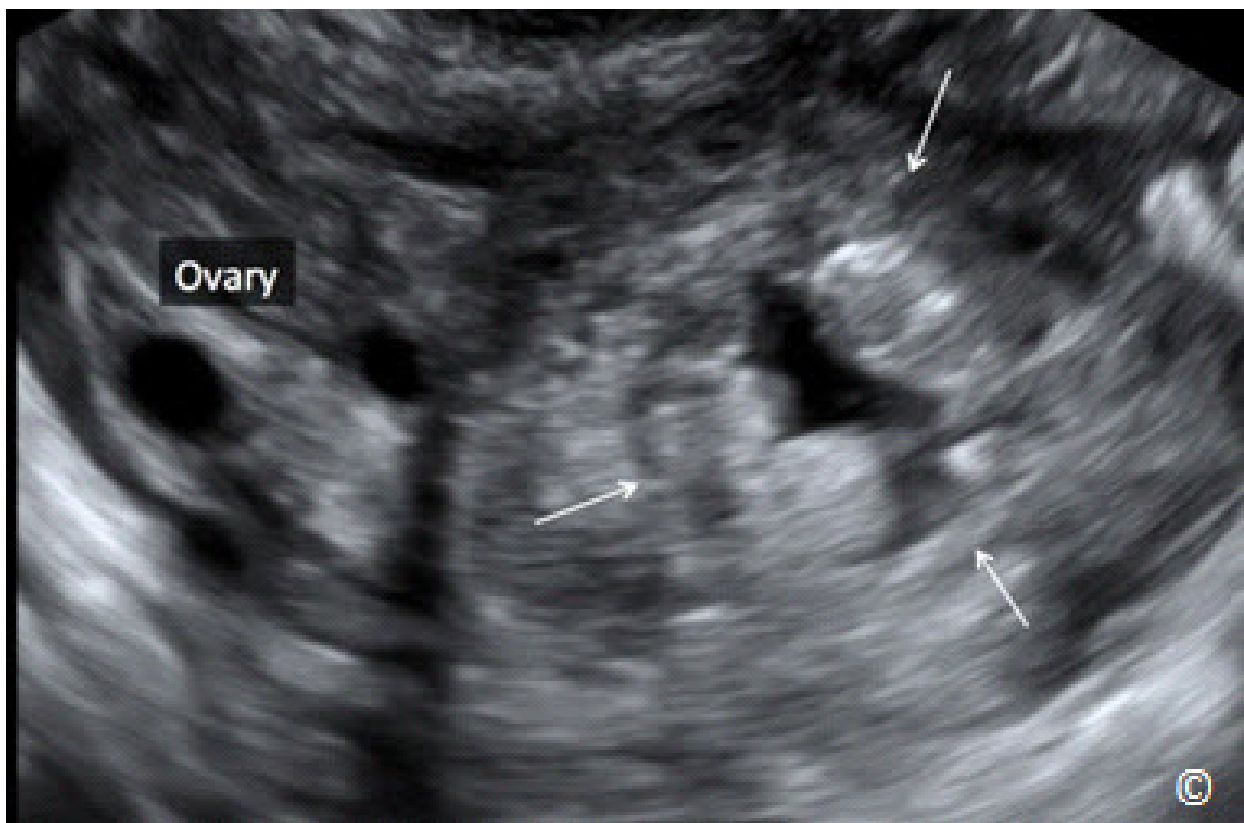


Figure 13.22: Transvaginal ultrasound showing a tubal ectopic pregnancy (arrows). Note the separation of the ectopic sac from the ovary (labeled). The ectopic sac has echogenic borders and an anechoic center (doughnut-like appearance).



Figure 13.23: Transvaginal ultrasound showing a tubal ectopic pregnancy (arrows). Note the echogenic thick borders and an anechoic center (doughnut-like appearance). The ovary is labeled and is typically lateral to the ectopic gestation.

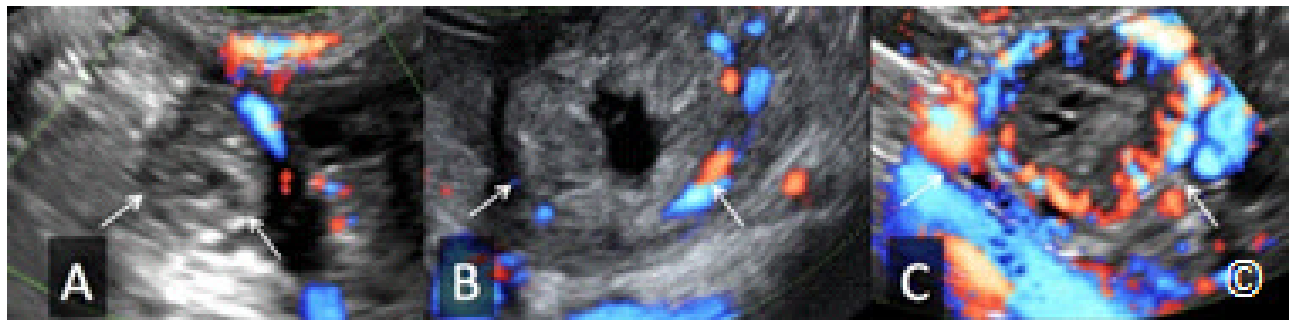


Figure 13.24 A, B, and C: Tubal ectopic pregnancies in A, B and C (arrows) imaged on transvaginal ultrasound with color Doppler at similar velocity scale and filter set-up. Note the varying degrees of vascularity between ectopic pregnancies with minimal to absent in A, moderate in B and excessive in C. Color Doppler is not a helpful differentiating feature of ectopic pregnancy.

The presence of an ectopic gestational sac in the adnexa that is distinctly separate from the ovary in a woman presenting with symptoms suggestive of an ectopic pregnancy, especially in the absence of an intra-uterine gestational sac, establishes the diagnosis of an ectopic pregnancy. The additional presence of fluid in the cul-de-sac confirms the diagnosis. When ultrasound findings are not diagnostic of ectopic pregnancy, it is important to consider all findings and make a judgment based upon available information. Given that significant change in the normal gestation occurs in the first trimester in a short time-frame, a follow-up ultrasound within a short period of time such as in 3 to 4 days when the woman's medical condition is stable and compliance is adequate, may help clarify the diagnosis. If the woman's condition is unstable, intervention is warranted irrespective of the ultrasound findings.

A rare presentation of an ectopic pregnancy is the abdominal pregnancy. Abdominal pregnancy can be associated with significant morbidity, especially if the pregnancy is allowed to grow. Placental insertion on the bowels or pelvic vasculature can result in significant bleeding if removal is attempted. If an advanced abdominal pregnancy is encountered, it is prudent to remove the fetus but keep the placenta in situ to avoid massive bleeding. **Figures 13.25** and **13.26** show an abdominal pregnancy at 14 weeks gestation in the right adnexa. The patient presented with lower abdominal pain. This abdominal ectopic pregnancy was treated with direct injection of potassium chloride and methotrexate into the gestational sac under transvaginal ultrasound guidance. No further intervention was needed and the woman's symptoms improved immediately following this procedure.

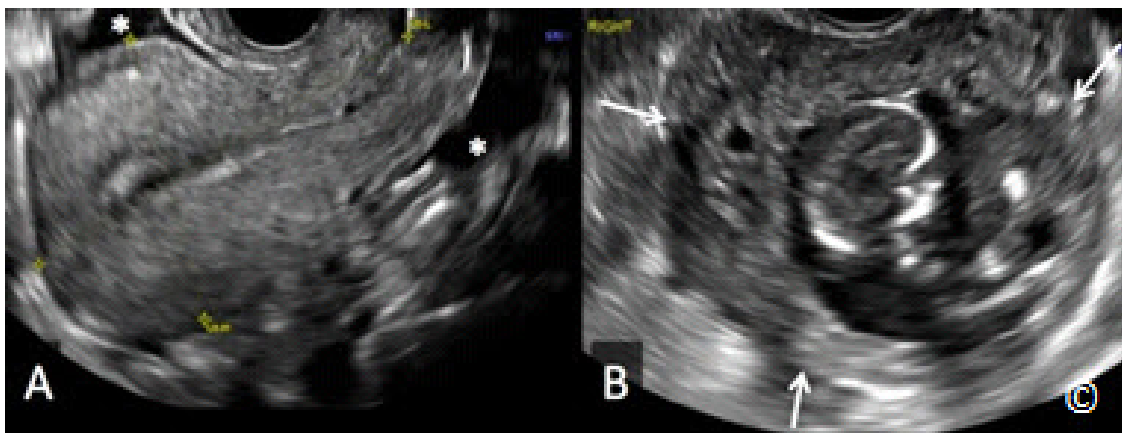


Figure 13.25 A and B: Transvaginal ultrasound of an abdominal ectopic pregnancy at 14 weeks gestation in the right pelvis. Figure 13.25-A shows a sagittal view of the uterus with pelvic free fluid (asterisks). Figure 13.25-B shows the abdominal pregnancy (arrows) in the right pelvis.

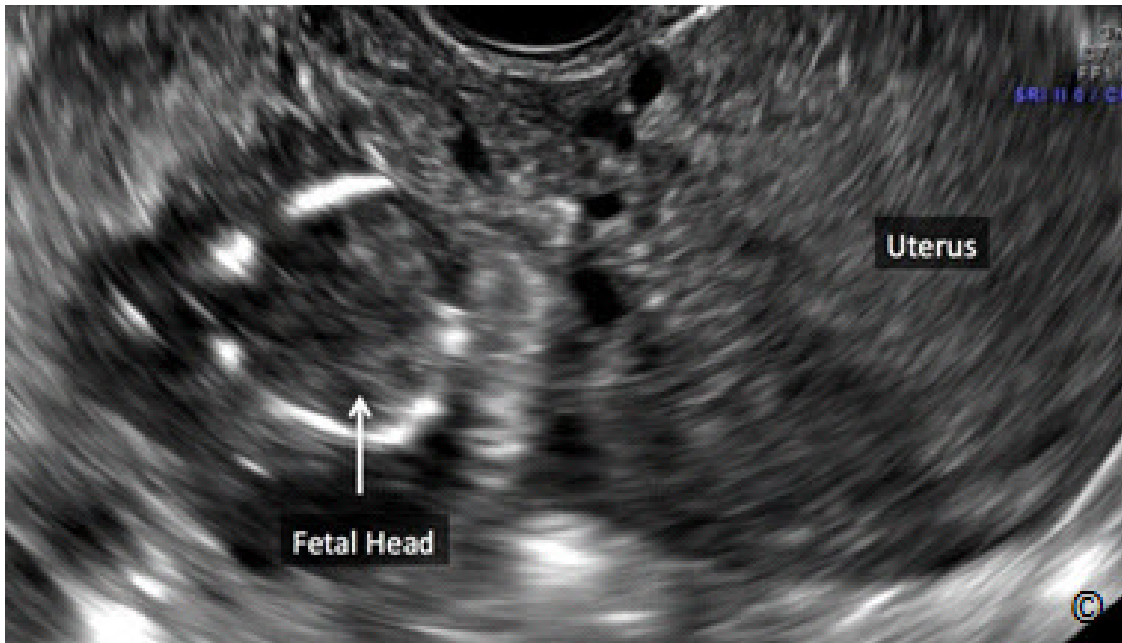
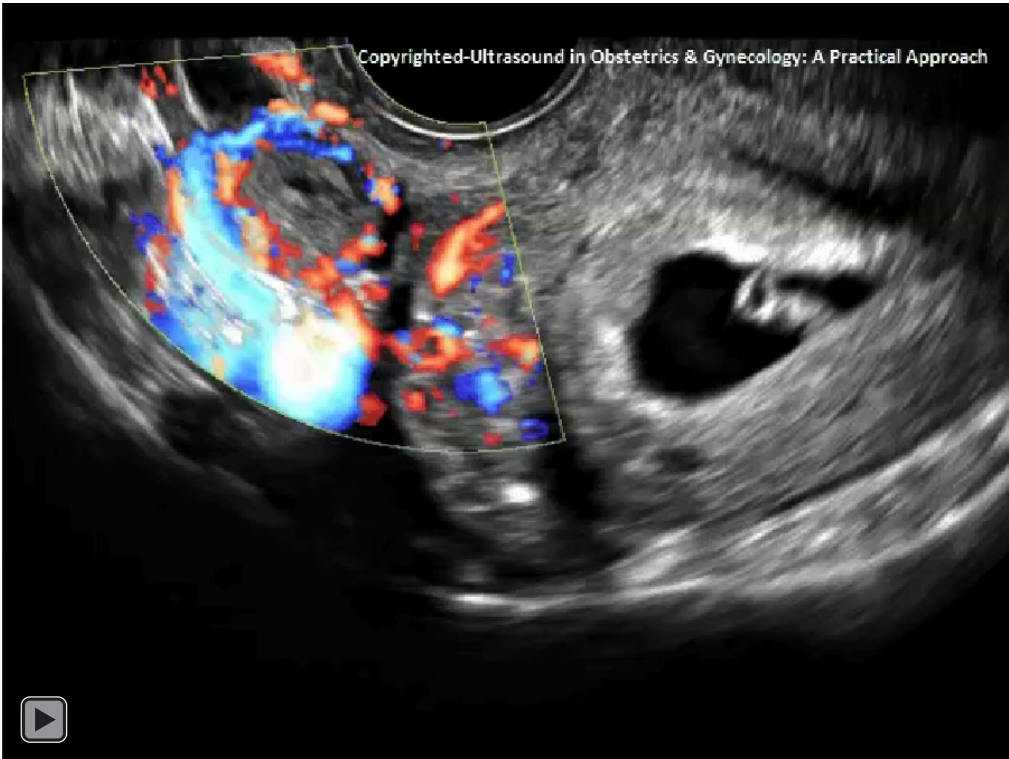


Figure 13.26: Transvaginal ultrasound of an abdominal ectopic pregnancy at 14 weeks gestation in the right pelvis (same as in figure 13.25) following direct injection of potassium chloride and methotrexate. The uterus (labeled) is seen separate from the ectopic pregnancy. The macerated fetal head is labeled.



CLIP 13.1



References:

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