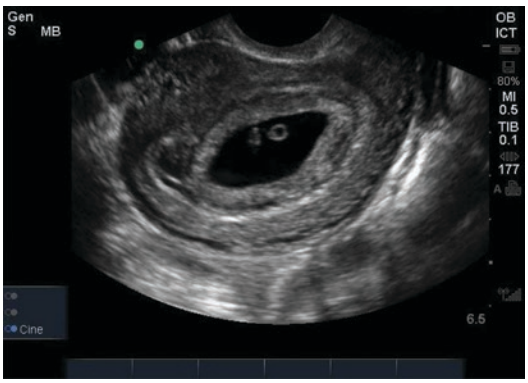
Emergency Obstetric Ultrasound

22

Christine Butts

Question 1

A 14-year-old girl presents to the Emergency Department with her mother, complaining of a syncopal episode today during school. She states that she became light headed when she stood up from sitting. She denies any other symptoms prior to the syncope and states she feels fine now. She has no past medical history and takes no medications. Vital signs obtained at triage are as follows: temperature 99.6 °F, heart rate 115 beats/minute, respiratory rate 20 breaths/minute, and blood pressure 98/60 mm Hg. She is well appearing and in no distress. Her physical examination is otherwise unremarkable with the exception of mild tachycardia and mild abdominal tenderness but no rebound tenderness. A urine pregnancy test is positive and a qualitative serum beta-human chorionic gonadotropin (beta-hCG) returns at 3000 mIU/mL. An endovaginal ultrasound is performed at the bedside and is shown below.



Which of the following is correct?

A. Transabdominal ultrasound is preferred to endovaginal ultrasound in early pregnancy evaluation due to its superior resolution.
B. A transabdominal ultrasound should be performed with an empty bladder to avoid artifact that may obscure the adnexa.
C. An endovaginal ultrasound should be performed with a full bladder to provide an acoustic window for visualization of the adnexa.
D. The ovaries can usually be identified with sonography lateral and posterior to the uterus, typically adjacent to the internal iliac artery and vein.
E. The posterior cul-de-sac should be evaluated for the presence of free fluid and can be found anterior to the uterus.

Correct Answer: D

C. Butts (✉)
Emergency Medicine, Louisiana State University, New Orleans, LA, USA
e-mail: cbutts@lsuhsc.edu

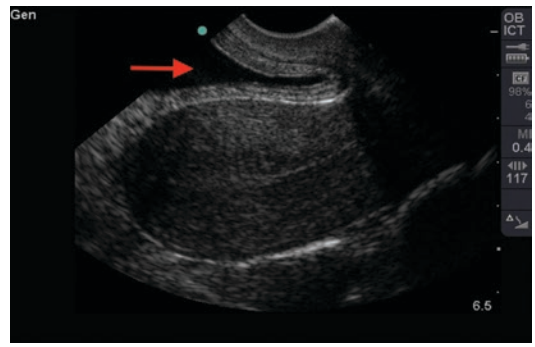
© Springer Nature Switzerland AG 2020
M. Waseem et al. (eds.), *Prepare for the Pediatric Emergency Medicine Board Examination*,
https://doi.org/10.1007/978-3-030-28372-8_22

Bedside ultrasound is a valuable tool in the evaluation of patients for ectopic pregnancy. Endovaginal ultrasound is performed with a high frequency endocavitary transducer and yields increased resolution over the lower frequency transabdominal ultrasound. For this reason, endovaginal ultrasound is typically more sensitive for detecting the findings of normal early pregnancy versus ectopic pregnancy. Due to its increased resolution, endovaginal ultrasound is capable of identifying signs of early pregnancy at roughly 5 weeks gestation, whereas transabdominal ultrasound will identify signs of early pregnancy at around 7 weeks gestation. Transabdominal ultrasound can be a helpful adjunct to endovaginal ultrasound, particularly to evaluate for the presence of intraperitoneal free fluid. This is due to its increased depth of penetration, and thus, broader image.

Transabdominal ultrasound should be performed when the patient has a full bladder, so that the bladder may serve as an "acoustic window" to enhance the physician's view of the pelvis. Ultrasound waves are well transmitted through fluid filled structures and give an enhanced view of the adnexa. Conversely, endovaginal ultrasound should be performed when the patient has an empty bladder, so that the uterus is not pushed away from the field of view by the distended bladder.

To perform an endovaginal ultrasound, the transducer is typically inserted initially in a sagittal plane, with the indicator pointing up toward the ceiling. The transducer is inserted into the vagina slowly, until the uterus is visualized. The transducer should be angled slightly up and down until the entire uterus, from fundus to cervix is visualized. Slight retraction of the transducer within the vagina may be necessary to visualize the cervix. The cul-de-sac can usually be visualized in this orientation posterior or deep to the uterus. The transducer should then be angled slowly from right to left to fully visualize the cornual areas of the uterus and to locate the ovaries. The ovaries are seen as rounded, hypoechoic (gray) objects, typically with anechoic (black) rounded follicles within. They are typically described as having a "chocolate chip cookie" appearance. They will usually be found lateral and slightly posterior to the uterus. Identifying the pulsatile internal iliac artery with its accompanying vein can be helpful, as the ovaries are typically found adjacent to these structures.

Once the uterus and adnexa are evaluated in the sagittal plane, the transducer should be rotated toward the patient's right so that the pelvis can be evaluated in the transverse plane. The uterus should be identified and again scanned from fundus to cervix by angling the transducer up and down. Slightly pointing the transducer toward the right and left will allow the sonographer to scan the adnexa.



Transvaginal ultrasound of a normal uterus in the sagittal plane. The bladder can be seen at the upper left of the image (arrow), anterior to the uterine fundus

Take-Home Message

Both transabdominal and transvaginal ultrasound area useful in evaluation of patients with suspected pregnancy but transvaginal ultrasound is more sensitive for early pregnancy.

ABP Ultrasound Evaluation of Potential Ectopic Pregnancy

- Know the anatomy and pathophysiology relevant to ultrasound evaluation of potential ectopic pregnancy.
- Plan the key steps and know the potential pitfalls in performing ultrasound evaluation of potential ectopic pregnancy.

Question 2

Which is correct regarding the above ultrasound image in this patient?

A. A finding of a gestational sac is a definitive sign of an intrauterine pregnancy.
B. The double decidual sign is an indicator of an early ectopic pregnancy.
C. Visualization of a fetal pole within the uterus in a patient who is not taking follicle stimulating medications virtually rules out an ectopic pregnancy.
D. A yolk sac will typically first be seen on endovaginal ultrasound at approximately 9 weeks gestation.
E. The discriminatory zone should be strictly used to rule in or out the diagnosis of ectopic pregnancy.

Correct Answer: C

The goal of a bedside ultrasound is to identify findings consistent with an intra-uterine pregnancy (IUP). The presence of a yolk sac or fetal pole within the uterus is considered a definitive sign of early IUP. Although it is helpful to directly visualize an ectopic pregnancy, visualizing signs of an intrauterine pregnancy virtually rules out ectopic pregnancy in almost all patients. Patients who are taking follicle stimulating medications should be considered for the presence of a heterotopic pregnancy, or simultaneous intrauterine and ectopic pregnancy.

Knowledge of a patient's last menstrual period and qualitative beta-hCG level can be helpful in determining the expected sonographic findings. See the chart below for an approximate correlation of gestational age, beta-hCG level, and sonographic findings.

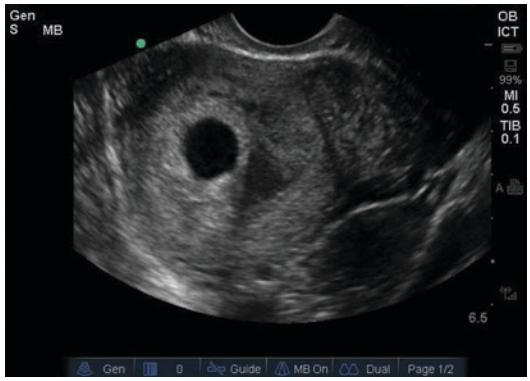
An empty gestational sac alone should not be considered to be an indicator of early intrauterine pregnancy, as distinguishing the gestational sac of a normal early pregnancy and the pseudogestational sac of ectopic pregnancy can be difficult for even an experienced sonographer. Similarly, although a double decidual sign is considered to be the earliest sign of an intrauterine pregnancy, it can be difficult to distinguish from a pseudogestational sac; it should therefore not be relied upon by the emergency physician at the bedside to rule in an intrauterine pregnancy. A double decidual sign is defined by a concentric ring surrounding the gestational sac.

The findings of a yolk sac, fetal pole, or fetus with cardiac activity within the uterus are considered definitive findings of an intrauterine pregnancy and should be sought in evaluating patients with suspected ectopic pregnancy. Identifying one of these findings rules out an ectopic pregnancy in patients who are not taking follicle-stimulating medications.

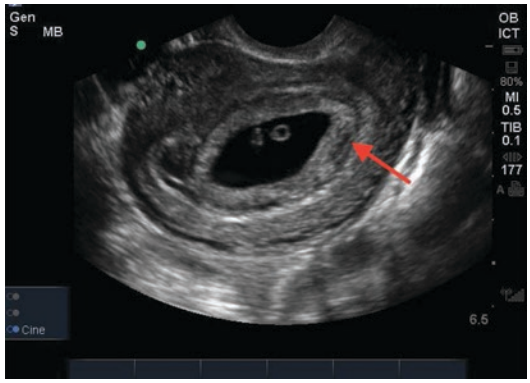
Although a correlation with beta-hCG is useful in evaluating the sonographic findings, recent literature has raised questions on the traditional concept of a "discriminatory zone" to rule in or out an ectopic pregnancy. The concept of the discriminatory zone utilizes the idea that once the serum beta-hCG level reaches a certain point, evidence of a pregnancy should be visible. If it is not, then an ectopic pregnancy or nonviable pregnancy is assumed. The level at which this assumption can be made has fluctuated and has not been consistent across the literature, but values around 1500 mIU/mL are often used. Current recommendations state that when the adnexa appear normal and there is no significant free fluid, a single beta-hCG should not be used to make decisions regarding the viability of a pregnancy. Rather, a single beta-hCG level should be interpreted in context of the clinical presentation. In most cases, this level should be repeated in 48 hours to determine whether it is rising appropriately.

Gestational age	Beta-hCG (mIU/mL)	TV ultrasound	TA ultrasound
5 weeks	1000-2000	Gestational sac	N/A
5–6 weeks	>2000	Yolk sac	Gestational sac
6 weeks	10,000–20,000	Embryo with heartbeat	Yolk sac
7 weeks	>20,000	Embryo with head and torso	Embryo with heartbeat

John MA, Mateer J, Blaivas M. *Emergency ultrasound*. New York: McGraw Hill; 2008.



Transvaginal ultrasound demonstrating an empty gestational sac



Transvaginal ultrasound demonstrating an intrauterine gestational sac containing a fetal pole. This finding is consistent with an intrauterine pregnancy. Also demonstrated in this image is the double decidual sign (arrow)

Take-Home Message

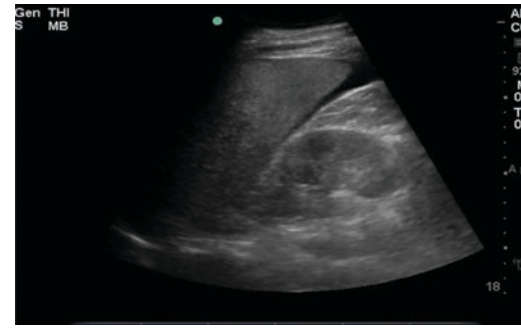
The finding of a gestational sac or double decidual sign in the uterus is not definitive signs of an intrauterine pregnancy. The finding of a yolk sac or fetal pole within the endometrium of the uterus is definitive signs of an intrauterine pregnancy and reassuring for ruling out an ectopic pregnancy.

ABP Ultrasound Evaluation of Potential Ectopic Pregnancy

- Know the indications and contraindications for ultrasound evaluation of potential ectopic pregnancy.
- Plan the key steps and know the potential pitfalls in performing ultrasound evaluation of potential ectopic pregnancy.
- Recognize the complications associated with ultrasound evaluation of potential ectopic pregnancy.

Question 3

A 16-year-old female presents to the Emergency Department with severe lower abdominal pain. She reports the symptoms began abruptly this morning and were associated with lightheadedness. She denies any past medical history or medications. She is in significant distress, clutching her abdomen. Her vital signs are as follows: temperature 99.0 °F, heart rate 120 beats/minute, respiratory rate 20 breaths/minute, and blood pressure 80/50 mm Hg. Her physical examination is significant for diffuse abdominal tenderness and rebound tenderness. A bedside ultrasound is performed and is shown below.



Which of the following is correct regarding ultrasound in the evaluation of early pregnancy?

A. The most commonly seen finding in ectopic pregnancy is the presence of a "tubal ring."
B. The presence of free fluid in the hepatorenal space in a patient with positive pregnancy test and an empty uterus is highly suggestive of an ectopic pregnancy.
C. Free fluid within the cul-de-sac is never a normal finding.
D. The finding of a "tubal ring" confers a low likelihood of ectopic pregnancy.
E. Differentiation of a normal ovary from the complex mass of ectopic pregnancy is straightforward and can easily be performed by the bedside sonographer.

Correct Answer: B

In the absence of findings of an intrauterine pregnancy described above, the adnexa should be scanned for direct evidence of ectopic pregnancy. Specifically, the findings of pelvic and intra-abdominal free fluid, tubal ring, and complex adnexal mass should be sought.

The presence of greater than a physiologic amount of pelvic free fluid in the cul-de-sac should be considered very suspicious in a patient with a positive pregnancy test and lack of evidence of an intrauterine pregnancy. Free fluid is typically first seen in the cul-de-sac of the pelvis, posterior to the uterus, as an anechoic (black) or hypoechoic (dark gray) collection. A small amount, or physiologic amount, is usually described as being confined to the cul-de-sac and covering less than one-third of the inferior posterior uterus. The larger the collection of free fluid, the more abnormal the finding, and the more likely the diagnosis of ectopic pregnancy. When large amounts of free fluid are seen within the pelvis, the transabdominal transducer should be used to evaluate the hepatorenal space for the presence of free fluid within the peritoneum (see below). This finding is highly suggestive of an ectopic pregnancy when the pregnancy test is positive and no intrauterine pregnancy is seen.

A tubal ring is a subtle finding that is nearly diagnostic for ectopic pregnancy. It is described as a rounded, hyperechoic (light gray), thick-walled ring in the adnexa with a hypoechoic (light gray) or anechoic (black) center (see below). It can be a subtle finding and can be easily overlooked by an inexperienced sonographer.

A complex mass is the most commonly seen finding in ectopic pregnancy and is described as a mixture of solid and cystic components in the adnexa. Its appearance can vary depending on its makeup. This can also be a subtle finding and can easily be confused with normal adnexa or bowel contents.

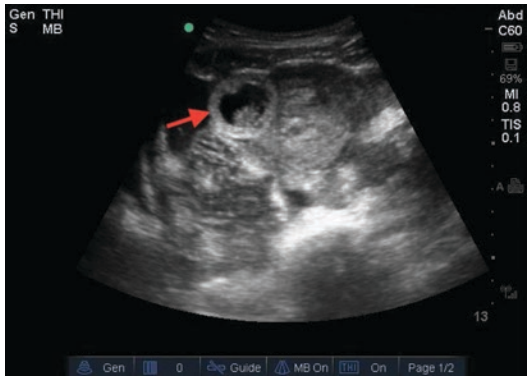
When evaluating for findings of ectopic pregnancy, the emergency physician should have a high degree of suspicion when the pregnancy test is positive and there is an empty uterus. The finding of either pelvic or intraperitoneal free fluid should raise this suspicion. At this point, if the stability of the patient allows, a formal radiologist interpreted ultrasound should be performed to evaluate for the more subtle findings of tubal ring and complex adnexal mass.

Take-Home Message

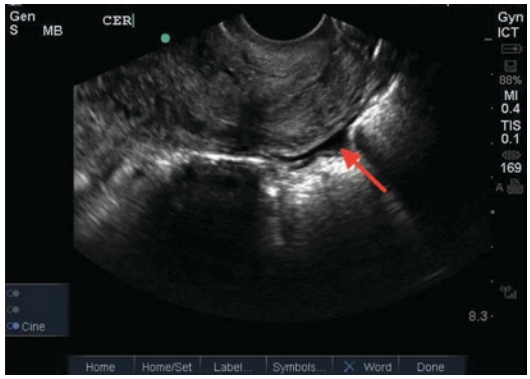
There are several findings suggestive of an ectopic pregnancy. However, a finding of a positive pregnancy test with either free fluid in the abdomen or an empty uterus is concerning for possible ectopic pregnancy.

ABP Ultrasound Evaluation of Potential Ectopic Pregnancy

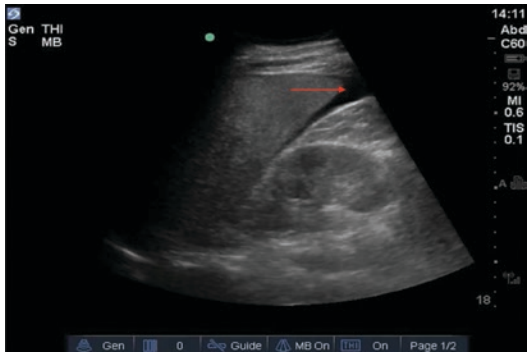
- Know the indications and contraindications for ultrasound evaluation of potential ectopic pregnancy.
- Plan the key steps and know the potential pitfalls in performing ultrasound evaluation of potential ectopic pregnancy.



Arrow indicates tubal ring seen adjacent to an empty uterus on transabdominal ultrasound of the pelvis. Free fluid is seen to the left of the tubal ring



Transvaginal ultrasound image of a small amount of free fluid within the cul-de-sac, posterior to the cervix. Free fluid is considered small, or physiologic, in this region when it extends to less than one-third of the height of the uterus



Transabdominal ultrasound of the right upper quadrant showing anechoic (black) free fluid (arrow) within the hepatorenal space

Suggested Reading

Question 1

Fox JC, Lambert MJ. Emergency ultrasound. New York: McGraw Hill; 2008. p. 353–72.
Matsuno WC. Pediatric emergency medicine. New York: McGraw Hill; 2009.
Reardon RF, Joing SA. Emergency ultrasound. New York: McGraw Hill; 2008. p. 279–318.
Rodriguez AM, Okada PJ, Sheffield JS. Pediatric emergency medicine. New York: McGraw Hill; 2009.

Question 2

Doubilet PM, et al. Criteria for diagnosing early pregnancy. NEJM. 2013;369:1443–51.
Matsuno WC. Pediatric emergency medicine. New York: McGraw Hill; 2009.
Reardon RF, Joing SA. Emergency ultrasound. New York: McGraw Hill; 2008. p. 279–318.
Rodriguez AM, Okada PJ, Sheffield JS. Pediatric emergency medicine. New York: McGraw Hill; 2009.

Question 3

Matsuno WC. Pediatric emergency medicine. New York: McGraw Hill; 2009.
Reardon RF, Joing SA. Emergency ultrasound. New York: McGraw Hill; 2008. p. 279–318.