

Obstetrics and Gynecology Ultrasound Topics in Emergency Medicine Resident Training

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ABSTRACT

The evaluation of abdominal or pelvic pain and/or vaginal bleeding using pelvic ultrasound is a common practice of the emergency physician. In fact, the American College of Emergency Physicians (ACEP) in 2008 published guidelines listing evaluation of pregnancy as a core application and evaluation of the adnexa as a secondary application for emergency bedside pelvic ultrasound. In 2012 the Accreditation Council of Graduate Medical Education (ACGME) along with the American Board of Emergency Medicine (ABEM) introduced milestones into residency programs to provide a framework of cognitive and behavioral performance standards, including procedure-based skills. The milestones are the knowledge, skills, attitudes and other attributes for each of the ACGME competencies that monitor resident performance throughout the residency and range from less to more advanced levels. Goal-directed focused ultrasound is one of twenty-three specific milestones that will be measured during emergency medicine training. Discussion will focus on how to teach focused goal-directed pelvic ultrasound based on the five levels within this milestone.

Keywords: Goal-directed focused pelvic ultrasound, Pelvic pain, Vaginal bleeding, First trimester images, Ultrasound milestones, Emergency medicine residency program.

How to cite this article: Greer VL, Brosseit MW. Obstetrics and Gynecology Ultrasound Topics in Emergency Medicine Resident Training. Donald School J Ultrasound Obstet Gynecol 2014;8(1):35-43.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Pelvic and lower abdominal pain with and without vaginal bleeding is a common complaint seen in female patients

of all ages in the emergency room. Focused point-of-care bedside pelvic ultrasound is a powerful diagnostic tool for the emergency physician, enabling early and efficient assessment plus detection of life-threatening emergencies in both pregnant and nonpregnant patients. There are various obstetrical and gynecologic reasons to utilize pelvic ultrasound in the emergency department; however, the published core indication for focused pelvic ultrasound by emergency physicians is to evaluate for an intrauterine pregnancy.¹⁻³ Emergency medicine residents can be trained to use bedside ultrasound to assess patients with pregnancies of all gestational ages, to include patients who may be presenting with pain and/or bleeding in pregnancy less than 20 weeks or patients in the last trimester involved with trauma. Bedside pelvic ultrasound is integral to assessment of obstetrical and gynecologic complaints as an extension of the pelvic examination. Moreover, with the aid of the beta subunit of human chorionic gonadotropin levels (hCG), it is equally important to teach sonographic evaluation of the differential diagnoses of pain and bleeding in early gestations as seen with ectopic pregnancy, molar pregnancy and abortions. Evaluation of pain in gynecologic emergencies by ultrasound would also include teaching scanning and interpretation of images for ovarian torsion or ruptured ovarian cysts and assessment of the hemodynamically unstable bleeding female patient. While assessment of the adnexa for pathology is considered a secondary application more suited to the emergency physician already in practice, it would not seem unusual for the resident to develop some degree of proficiency for detecting adnexal masses, like a dermoid cyst or endometrioma (Fig. 1) or tubo-ovarian abscess.¹

There have been many curricular models proposed since the 1990s by American College of Emergency Physicians (ACEP), the Society of Academic Emergency Medicine (SAEM) and the Accreditation Council of Graduate Medical Education (ACGME), mandating assessment and competency in emergency ultrasound as part of residency training.^{1,3,4}

The emergency medicine milestones, developed as a collaborative effort by multiple educational committees involved in emergency medicine education is the latest template to educate, do bedside teaching and assess residents for proficiency in emergency medicine ultrasound.^{4,5} The

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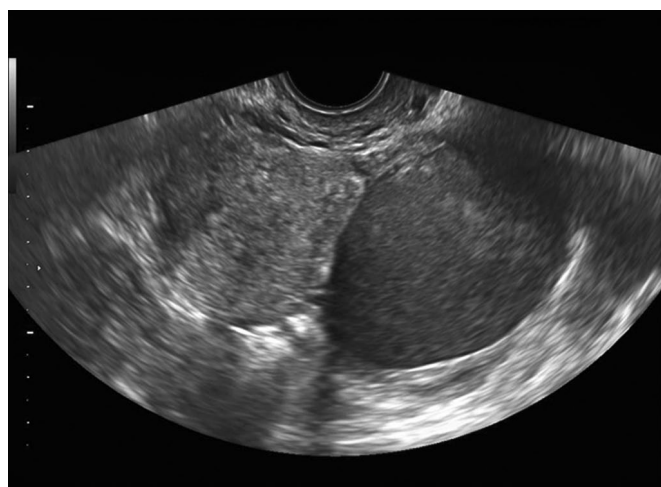


Fig. 1: Transverse scan of a left ovarian mass on pelvic ultrasound. Appearance is typical for 'chocolate cyst' or endometrioma

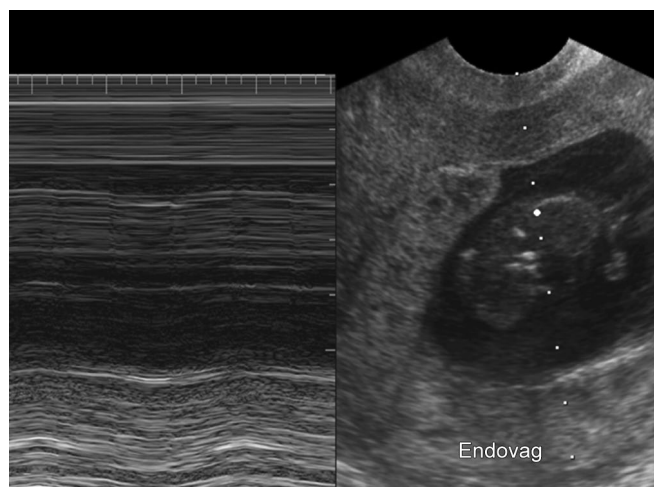


Fig. 2: Transvaginal ultrasound image of fetal demise. Note the irregular gestational sac (right). M-mode reveals absence of fetal heart beat (left)

discussion will now focus on how the Emergency Medicine Patient Care (EMPC) 12 milestone can be taught throughout residency training programs based on four of the five levels:

- Level 1 describes indications for pelvic ultrasound
- Level 2 explains how to optimize images and identify proper probes
- Level 3 will discuss performance of the goal-directed focused ultrasound exams and give interpretation of the images
- Level 4 will require each training program to set the minimum number of focused examinations each resident will need to do for proficiency and competency (and therefore not be covered in this discussion)
- Although Level 5 is considered beyond postgraduate training, residents may still be able to learn the application of focused ultrasound examinations for adnexal pathology during their residency.^{2,4}

Indications for Goal-directed Focused Pelvic Ultrasound (Level 1 EM Milestone)

The primary indication, especially in the first trimester, for the use of emergency bedside pelvic ultrasound is to answer the question, 'is there evidence of a definitive intrauterine pregnancy?'¹ During assessment of patients to answer this question, the emergency physician can find an intrauterine pregnancy approximately 70% of the time. The remainder of pelvic scans may be indeterminate (cannot determine pregnancy type or location) or include diagnoses such as a molar pregnancy, an ectopic or other abnormal pregnancies (e.g. fetal demise (Fig. 2), blighted ovum, missed abortion). Emergency Medicine Level 1 Milestone—Indications for Focused Emergency Medicine Bedside Pelvic Ultrasound are listed in Table 1.

Identification of Probes used for Pelvic Ultrasound and How to Obtain Optimal Ultrasound Images (Level 2 EM Milestone)

Focused ultrasound of the pelvis requires, in most instances, both the longitudinal and transverse scans using both the transabdominal and transvaginal ultrasound probes.^{6,7} The essential images to obtain include vaginal canal and cervix, uterus, pouch of Douglas (posterior *cul-de-sac*) and ovaries; if there is concern for rupture or free fluid, consideration of Morison's Pouch (to assess for intra-abdominal free fluid) and the vesicouterine segment (anterior *cul-de-sac*) may occur.¹

Transabdominal (TA) ultrasound protocol would include both the longitudinal and transverse images of the uterus, vaginal canal, cervix and adnexa. Curvilinear phased array abdominal 3.5-5.0 MHz probes are most frequently used for TA scanning with the patient in a supine position. A full bladder will optimize the views by displacing the bowel and providing an acoustic window. Indications for TA scans include easier and faster scans (even the most novice resident is familiar with using this probe), allows for deeper penetration to see the lower abdomen and entire pelvis, may be the safer method to detect causes of vaginal bleeding in late pregnancy, and can detect free fluid in the abdomen in patients with significant rupture from pelvic causes. Limitations for this approach include less resolution, abdominal gas may make imaging the lower abdomen less than optimal and the pelvis may be difficult to visualize in obese patients.

Transvaginal (TV) ultrasound protocol includes coronal and longitudinal planes of the uterus, cervix and vaginal canal, and longitudinal and transverse planes of the ovaries. This examination can be done in conjunction with the pelvic examination with the patient supine before or after

Table 1: Emergency medicine level 1 milestone: indications for focused emergency medicine bedside pelvic ultrasound^{1,2,4,5}

Pregnancy indications (Level 1 EM milestones)		Gynecology indications	Adnexal pathology indications (Level 5 EM milestone)
First trimester ultrasound evaluation	Second and third trimester ultrasound evaluation	<ul style="list-style-type: none"> • Evaluation for ovarian torsion • Detection of IUD • Detection of causes of vaginal bleeding and/or pelvic pain • Fibroids • Ovarian cysts • Evaluation for PID or tubo-ovarian abscess 	<ul style="list-style-type: none"> • Detection of adnexal pathology • Differentiation of adnexal masses
<ul style="list-style-type: none"> • Detect definitive intrauterine pregnancy • Detection of other causes of vaginal bleeding and/or pain • Ectopic pregnancy • Molar pregnancy • Spontaneous abortions • Pregnancy failures • Detection of fetal heart tones • Determination of gestational age • Evaluation of multiple gestations 	<ul style="list-style-type: none"> • Detection of vaginal bleeding • Placenta previa • Abruptio placenta* • Evaluation of post-partum hemorrhage • Uterine rupture* 		

*Best diagnosed with history and physical exam; US assists with indirect findings such as free fluid in the abdomen

Table 2: Emergency medicine level 2 milestone: Probes used for pelvic ultrasound and how to obtain optimal images

Probes used in goal-directed focused pelvic ultrasound and how to obtain optimal images				
Type of pelvic scanning	Type of probe and frequency	Proper positioning of patient	Pros	Cons
Transabdominal pelvic ultrasound	<ul style="list-style-type: none"> • 3.5-5 MHz transabdominal probe • Curvilinear phased array • Requires both sagittal and transverse orientation of probe for optimal scans 	<ul style="list-style-type: none"> • Supine • Full bladder optimal 	<ul style="list-style-type: none"> • Can see entire pelvis and lower abdomen • Allows for deeper penetration • Can detect free fluid in the abdomen in patients with significant rupture from pelvic causes 	<ul style="list-style-type: none"> • Although can penetrate deeper, less resolution • Abdominal gas may make imaging in lower abdomen less than optimal • Cannot be used on less than optimal body habitus
Transvaginal pelvic ultrasound	<ul style="list-style-type: none"> • 5-10 MHz endovaginal probe • Small footprint phased array • Requires both sagittal and transverse (coronal) orientation of probe for optimal scans 	<ul style="list-style-type: none"> • Supine • Lithotomy position after or before pelvic examination • May place towels underneath buttocks to lift pelvis if do not have pelvic bed • Empty bladder optimal 	<ul style="list-style-type: none"> • Better resolution for pelvic pathology • Able to visualize early gestational landmarks earlier • Able to see pelvis in patients with less than optimal body habitus 	<ul style="list-style-type: none"> • Obtaining and interpreting images slightly more difficult for novice learner • Must avoid air in probe cover prior to scanning to minimize artifacts during scanning

the pelvic examination. An endocavitary 5.0-10.0 MHz small footprint phased transducer probe is disinfected and covered with a probe cover that contains coupling gel. Sterile vaginal lubricant is placed on the transducer sheath and the transducer is inserted into the vagina in the presence of a chaperone. An empty bladder facilitates scanning as a full bladder makes visibility of scanning difficult. The patient is supine and the lithotomy position is utilized (a towel placed under the pelvis may mimic this if a gynecologic table is not readily available). Indications for TV scanning include ability to visualize gestational landmarks earlier, better resolution of pelvic pathology, improved visualization of

the pelvis in patients who are obese and ability to use the cornual flare to help visualize the ovaries. Limitations of TV scanning are that obtaining and interpreting images may be slightly more difficult for the novice learner and one must avoid air in the probe cover prior to scanning in order to minimize artifacts seen while scanning. An emergency resident may make an exception and only do a transabdominal scan if determination of the gestational age or fetal heart tones are warranted in emergent situations (i.e. trauma or medical resuscitations).⁶

The first trimester scan protocol includes both longitudinal and transverse scans of the uterus and gestational sac,



Fig. 3: Biparietal diameter measurement (BPD) of 3.26 cm indicates gestational age of 16 weeks 2 days

longitudinal assessment of the cervix, assessment of the crown rump length (CRL) by measuring the long axis of the fetal pole or embryo, M-mode to measure cardiac activity and ovary transverse scans. For accurate dating of the gestational age later in pregnancy, do the biparietal diameter (BPD) (Fig. 3) and femur length between 13 and 26 weeks, and abdominal circumference to determine the gestational age in the last trimester. Emergency medicine level 2 milestone—probes used for pelvic ultrasound scanning and how to obtain optimal images are presented in Table 2.

Discuss Performance of Goal-directed Focused Ultrasound Exams and Interpret the Images (Level 3 EM Milestones)

It is imperative that the emergency medicine physician be able to determine when a definitive intrauterine pregnancy is present.^{1,3,8} Residents must learn not only very early sonographic signs of a potentially normal pregnancy; they also need to recognize sonographic findings of pregnancy failure and abnormal pregnancies such as the rare presentation of an interstitial or cervical ectopic pregnancy.^{1,3,4} In order to recognize early normal pregnancy findings, the resident must be comfortable with endovaginal ultrasound imaging.

First Trimester Normal Pregnancy Ultrasound Imaging

The earliest sonographic imaging of a normal pregnancy is the ‘intradecidual sign’ seen as early as 3.5 weeks with varying degrees of sensitivity and specificity. This is a small focal, eccentric, anechoic area in the endometrium caused by the embedded blastocysts.⁹ Other important sonographic milestones that should be seen include the following: (1) a gestational sac (GS) can be seen by transvaginal US at 5 weeks of gestational age (measures 5 mm and will typically

not be seen at this point by TA US); (2) the yolk sac should always be present on TV US when the GS measures greater than 10 mm and by TA US when the mean sac diameter (MSD) is greater than 20 mm, and (3) cardiac activity in the embryo should be seen when the GS measures more than 18 mm by TV US and should be more than 25 mm with TA US scanning.⁹ The gestational sac on US appears as a well-defined fluid-filled cavity with a surrounding hyperechoic rim, embedded eccentrically in the endometrial lining of the fundus or midbody of the uterus (Fig. 4). The double decidual sac sign, formed by the inner echogenic decidua capsularis and the outer ring the decidua parietalis is typically seen between 4 and 6 weeks of gestation. Since the pseudogestational sac of an ectopic pregnancy can be confused with this sign, do not use it to determine evidence an intrauterine pregnancy (IUP). The yolk sac is the first sign of a true intrauterine pregnancy, with a positive predictive value of 100% (Fig. 5). On TV US it appears as a round, thin-walled cystic structure that measures less than 6 mm seen within the gestational sac (resembles a Cheerio®) at 5 weeks gestation and is virtually always seen by 5.5 weeks.⁹ An embryo should be seen with TV US when the GS measures 18 mm and with TA US scanning when the GS measures 25 mm. It appears as a focal echogenic area of 1 to 2 mm thickness adjacent to the yolk sac between 5 and 6 weeks of gestational age.⁹ Embryonic cardiac activity should always be seen when the embryo measures greater than 5 mm. Use M mode to measure cardiac activity—in general, the fetal heart rate should be between 100 and 115 beats per minute (BPM) between 5 and 6 weeks of gestation and should be about 140 BPM by 9 weeks of age (Fig. 6). It is important to not use Doppler in the evaluation of normal intrauterine pregnancy as this poses certain risk to the developing fetus. It is best used during a formal ultrasound to confirm fetal demise.

In the first trimester, the measurement of the crown rump length (CRL) between 7 and 13 weeks provides a very accurate estimate of the gestational age (Fig. 7). The resident should not include the yolk sac in this measurement and should try to get the embryo as extended as possible in order to provide the most accurate measurement.

First Trimester Abnormal Ultrasound Imaging

If the focused goal directed ultrasound does not reveal a normal intrauterine pregnancy, then the other diagnoses that must be considered in women with vaginal bleeding and pelvic pain include ectopic pregnancy, spontaneous abortion, failed pregnancy and molar pregnancy.^{10,11} Focused goal-directed pelvic ultrasound should not wait on serum hCG levels, especially in a true emergency. It should be noted however, that it is important for the resident to be aware

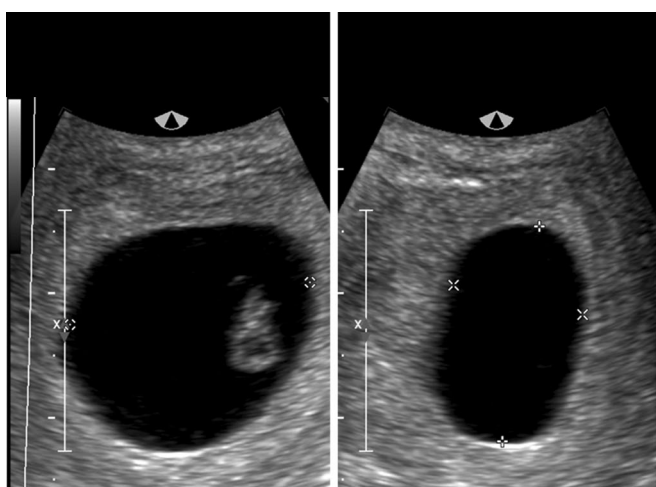


Fig. 4: Gestational sac visualized by transabdominal ultrasound. Fetal pole is clearly seen on the left. The double decidual sac sign consists of two concentric echogenic rings encasing a central anechoic focus that impress on the endometrial stripe



Fig. 7: CRL is a very accurate measurement in the first trimester for determination of gestational age between 5 and 12 weeks. Note that the yolk sac is excluded from the measurement



Fig. 5: Transvaginal scan of a gestational sac. A yolk sac measuring 4.6 mm is clearly seen within the gestational sac. Yolk sac visualization is the first indication by ultrasound of a definitive intrauterine pregnancy

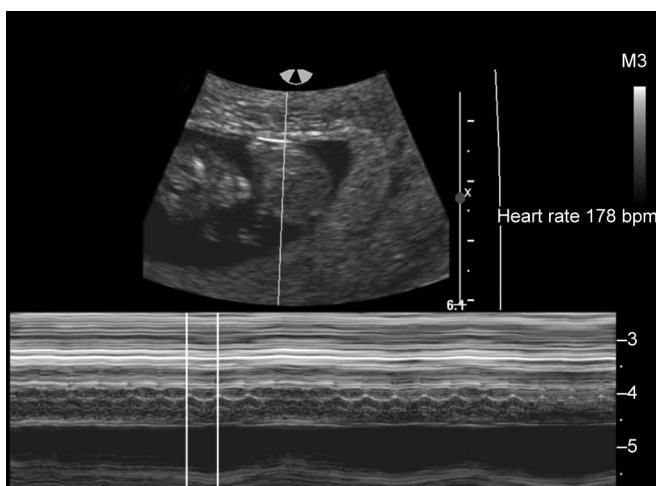


Fig. 6: M-mode demonstration of regular fetal heart rate (178 BPM). Normal is between 120 and 140 beats per minute

of the discriminatory level of the beta subunit of human chorionic gonadotropin (β -hCG). This is the range of the serum β -hCG level at which an intrauterine gestational sac should be visualized (i.e. the discriminatory zone is typically 1000 to 2000 mIU/ml international reference preparation (IRP) for TV US and 2400 to 3600 mIU/ml (IRP) for TA US. Also, another generally accepted concept is that in a normal pregnancy, the β -hCG will double or increase by at least 66% in 48 hours. This knowledge will help the resident with expectant follow-up and management of the indeterminate or abnormal pregnancy with serial sonographic images and repeat serum β -hCG levels. An inappropriate rise or fall of the β -hCG plus ultrasound findings of an abnormal pregnancy requires immediate obstetrical consultation and/or clinic follow-up.^{7,9-11} In patients presenting with bleeding, the type and Rh of the patient should be determined; if a patient is Rh negative, Rhogam should be given.¹¹

Ectopic pregnancy: Ectopic pregnancy (EP) accounts for approximately 2 out of every 100 diagnosed pregnancies.^{12,13} Despite the fact that the mortality rate for EP has fallen in recent years, it remains the highest cause of first trimester pregnancy-related death.¹⁴ As such, EP remains a critical diagnosis that should be considered in any patient with a positive β -hCG and vaginal bleeding or acute pelvic pain. Ectopic pregnancy is defined as a pregnancy in which the embryo implants in any location outside of the endometrium of the uterus.¹⁵ The location of implantation varies, with the most common location being in the ampullary segment of the fallopian tube. Ectopics may also locate to the isthmic and fimbrial portions of the fallopian tube.¹⁴ Other types of ectopics include cervical, cornual, ovarian, interstitial, intra-abdominal, scar and heterotopic.¹⁵

Cornual pregnancy occurs when the embryo implants within the cornua of a bicornuate uterus. Cornual pregnancies are the hardest to diagnose since they may initially appear to be within the uterine body on ultrasonography. In scar pregnancy implantation occurs within the myometrial scar of a previous C-section. Interstitial pregnancy refers to implantation in the myometrial segment of the fallopian tube. Interstitial pregnancies are especially hazardous, because the location allows for further development of the embryo (many times to 10 to 12 weeks gestation) prior to rupture. Further, the interstitium of the fallopian tube is in close proximity to the uterine artery. As an ectopic pregnancy enlarges, the risk for rupture increases. Ruptured ectopics can result in loss of fertility and maternal mortality. Early diagnosis and appropriate treatment and disposition therefore are essential in avoiding the significant morbidity and mortality that are associated with ectopic pregnancy.

The predominant risk factors for ectopic pregnancy are¹⁵:

- History of ectopic pregnancy
- History of pelvic inflammatory disease (PID)
- Tubal surgery (for tubal sterilization or ectopic pregnancy)
- Infertility treatment.

The classic presentation of ectopic pregnancy is missed menses preceding abdominal pain and vaginal bleeding. Unfortunately, these findings are neither sensitive nor specific for ectopic pregnancy. Many patients who present with ectopic pregnancy may actually be asymptomatic.

Human chorionic gonadotropin is a hormone produced by the syncytiotrophoblast of the embryo following conception. In normal pregnancies the average doubling time is 48 hours. As previously stated, the discriminatory zone, the zone in which a transvaginal US should reliably detect a gestational sac is institutionally dependent, but generally at levels of 1,000–2,000 mIU/ml.^{11,15} In ectopic pregnancies, serum β -hCG levels usually rise much more gradually.

The first step in US examination for possible ectopic is to evaluate for the presence of a viable intrauterine pregnancy (IUP). If an IUP is seen, an EP can be reasonably excluded as the chances of heterotopic pregnancy are roughly 1:7000¹⁶; although the rates are considerably higher (1:100) in women undergoing assisted reproductive therapy.¹⁷ It is important that the EM physician scan the intrauterine pregnancy in both planes and be confident that the pregnancy is indeed in the endometrium of the uterus vs a cornual, cervical and interstitial location as each carries a worse prognosis than tubal pregnancies.

In the patient with a β -hCG greater than the discriminatory zone (2,000 mIU/ml) and an empty uterus, the EM physician must maintain a high suspicion for EP. The next step is careful evaluation of both adnexa looking for any masses.

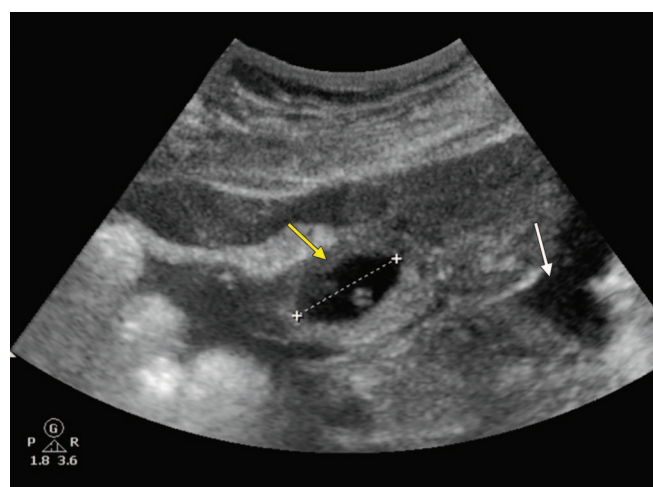


Fig. 8: Right adnexal mass (yellow arrow) with a gestational sac and fetal pole. Also note free fluid with complex echoes (white arrow)



Fig. 9: Ruptured ectopic: a significant amount of free fluid is seen in Morison's pouch

The ovary provides a useful landmark for the adnexa as it is usually located near the ampullary portion of the fallopian tube. The appearance of an ectopic pregnancy is highly variable, though the most common appearance is that of the tubal ring sign—a hyperechogenic ring surrounding an anechoic center (Fig. 8).¹⁶ It is possible to visualize a yolk sac and even a fetal pole within the ring with or without a heartbeat. This finding is the most specific, but least sensitive for EP. The last step that should be taken by the EM physician in the evaluation of possible EP is observation of the dependent portions of the pelvis as well as Morison's pouch to evaluate for free fluid indicating possible ruptured ectopic (Fig. 9). Definitive management once an ectopic is seen includes any resuscitation that may need to be done in the emergency department and emergent gynecology consultation.¹⁰

Spontaneous abortions: Spontaneous abortion is defined as pregnancy terminating before the 20th completed week of

gestation due to partial or complete expulsion. Approximately 80% of spontaneous abortions occur in the first trimester.¹⁸ The types of spontaneous abortions include threatened, inevitable, missed, incomplete and complete abortions. In inevitable abortion a patient presents with profuse vaginal bleeding and ongoing pelvic cramping (consistent with labor) which eventually results in dilatation of the cervix with expulsion of fetal tissue as the abortion will invariably occur. A patient with incomplete abortion presents with vaginal bleeding and pain of various degrees; ultrasound of incomplete abortion shows a thickened endometrial stripe due to some retained products of conception and the cervical OS may be open. A patient with missed abortion due to retention in the uterus of an abortus may have minimal pain or vaginal bleeding. The presence of a CRL of greater than 5 mm, an embryo or fetus with no fetal cardiac activity and a closed os is suggestive of a missed abortion. Patients presenting with vaginal bleeding that is less than that seen with inevitable abortion, and pain at various times in the pregnancy with a closed os plus the sonographic presence of a live fetus (depending on gestational age when presenting to the ED) is a threatened abortion. A complete abortion is one in which all of the products of conception are expelled from the uterus. To be clinically certain of this diagnosis, it is important to visualize the products of conception and determine whether the chorionic villi are present. Note that by ultrasound, an empty uterus as seen with a complete abortion is hard to distinguish from an early ectopic with an empty uterus.¹⁸

Sonographic markers of early IUP failure or poor prognostic markers include (1) an angulated, collapsed gestational sac with amorphous echoes, (2) anembryonic pregnancy defined as a gestational sac of greater than 25 mm and no yolk sac (Fig. 10); (3) retained products of conception (Fig. 11) which appears as ill-defined cystic and solid echogenic material within the endometrial cavity, (4) calcified yolk sac or a yolk sac of > 10 mm in diameter, (5) thin decidua (< 2 mm), (6) fetal heart tones < 90 beats per minute, and (7) a subchorionic hemorrhage that is two-thirds or greater the size of the chorionic sac involved.^{10,18}

Molar pregnancy: Included in the differential diagnosis of pelvic pain and/or vaginal bleeding in this trimester is the molar pregnancy. A hydatidiform mole, which occurs in 1 out of 1,000 pregnancies, is a trophoblastic neoplasm from the placenta of an abnormal pregnancy that produces high titers of β -hCG. The diagnosis should be considered when on physical examination uterine size is greater, the patient presents with hyperemesis gravidarum or symptoms similar to pre-eclampsia that occur in the first and early second trimester and when levels of the quantitative β -hCG exceeds

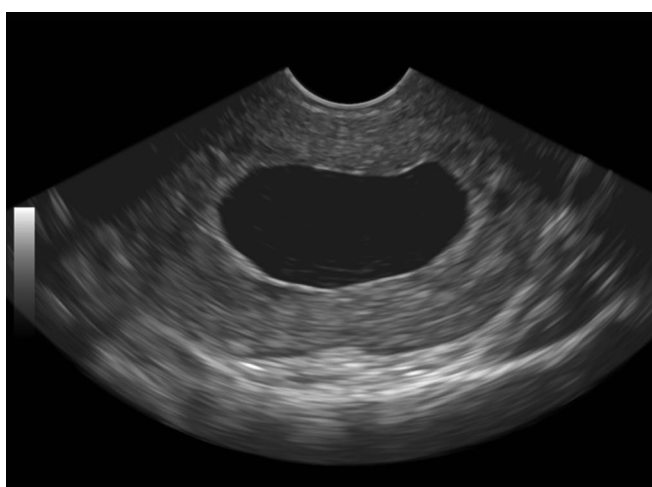


Fig. 10: Transvaginal ultrasound of an anembryonic pregnancy or blighted ovum. Transverse endovaginal scan demonstrating a lobulated and enlarged irregular gestation sac without an embryo and/or yolk sac. Note some low level internal echoes within the gestational sac



Fig. 11: Transvaginal sonogram of retained products of conception (RPOC). Note thick heterogenous echogenic material within the endometrial cavity of the lower uterine segment



Fig. 12: Transvaginal ultrasound of molar pregnancy. Note enlarged uterus with typical 'snow storm' appearance of trophoblastic disease (left). The endometrium is poorly visualized with multiple cystic cluster images within it indicative of the molar pregnancy. Doppler flow would show increased flow. Note the ovaries also have multiple cysts in a 'spoke wheel' appearance (right)

dates. On ultrasound, it has the appearance of a large and random collection of grape-like cell clusters resulting in the classic appearance described as a 'snowstorm' or 'grape-like cluster' (Fig. 12).

Second and Third Trimester Ultrasound Imaging

Ultrasound evaluation of pelvic pain and bleeding in the later gestations will include determination of a live fetus vs an abortion or fetal demise, determination of gestational age, and importantly evaluation for placenta previa (painless vaginal bleeding) or abruption (painful vaginal bleeding). In the third trimester, most focused goal-directed ultrasound evaluations will be done by transabdominal ultrasound (as opposed to the endovaginal exam) for evaluation of pain and bleeding. Placenta previa is an obstetrical complication due to the placental insertion in the lower uterine segment that is a major cause of antepartum hemorrhage. Evaluation of placenta previa involves visualizing the placenta for its fundal lie. Traditionally four grades are defined. The resident will need to identify patients that have risk factors for this clinical entity in the evaluation of third trimester bleeding and do a confirmatory ultrasound by transvaginal ultrasound by the radiology department after consultation with an obstetrics and gynecology. Abruptio placenta is a potentially life-threatening obstetrical emergency causing late trimester vaginal bleeding and pain. It occurs in approximately 1% of pregnancies worldwide. The diagnosis is usually made clinically based on history, especially if there are significant risk factors for this disease, and on the findings of an irritable uterus on the physical examination and by tocometry. Focused early goal-directed US is not diagnostic for abruption but it can aid in the diagnosis by exclusion of placenta previa and by the detection of free fluid in the abdomen.

Ultrasound Evaluation of the Nonpregnant Patient

Several clinical entities present as life-threatening pelvic emergencies: (1) ruptured hemorrhagic cyst, (2) a degenerating uterine fibroid that has outgrown its blood supply, (3) ruptured uterus due to trauma, and (4) ovarian torsion. Evaluation of the adnexa for an ovarian mass > 5 cm, the presence of free fluid in the posterior *cul-de-sac* and Morison's, and absence of venous and/or arterial blood flow make the diagnosis of ovarian torsion almost a certainty, prompting emergent gynecologic consultation. The focused goal-directed ultrasound of the uterus and/or adnexa of the patient presenting with pain and/or vaginal bleeding would help evaluate these emergencies. Other indications could include the evaluation for a tubo-ovarian abscess (a complication of pelvic inflammatory disease) or an ovarian or adnexal mass (Fig. 13).



Fig. 13: Right ovarian mass, 5 × 4 × 4 cm, causing pain. Size and complex echogenicity puts the adnexa at risk for torsion

CONCLUSION

Emergency medicine residency training requires evaluation of a resident's competency and proficiency to do focused goal-directed emergency ultrasound throughout the residency from less to more advanced levels, Level 1 defined as the skill level of a medical school graduate to what constitutes the skill of an attending physician, Level 5.² One of the primary goals of the Emergency Medicine Milestones and also the ACEP ultrasound Clinical Policy is to assess the competency of residents in performing and interpreting focused EM pelvic ultrasound.

By the end of their training the resident should be able to:¹⁻⁴

- Perform focused pelvic bedside ultrasound using the appropriate ultrasound probes
- Know the appropriate scanning protocols and patient positions to help obtain optimal ultrasound imaging
- Identify sonographic and anatomical landmarks to be able to recognize normal and abnormal pelvic pathology
- Recognize the limitations associated with transabdominal and transvaginal ultrasound scanning.

As EM residents and physicians become increasingly competent with the modality of ultrasound, there will likely be an increasing expectation that they master the technical and diagnostic aspects of pelvic ultrasound. In the past and still today, the US evaluation of ectopic pregnancy by the EM physician has focused on ensuring the presence of a viable IUP and the absence free fluid in the peritoneum.^{1,3} With the adoption of the new ACGME and ABEM milestones, level 5 ultrasound proficiency will now require the EM physician to be able to evaluate the adnexa for pathologic processes including adnexal masses and ectopic pregnancy. In addition, residency programs will need to determine what assessment methods (i.e. direct observation, simulators and web-based

discussions) they will use to evaluate each level of the pelvic ultrasound milestone.

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