Point of Care Ultrasound Utilization for the Evaluation of Ectopic Pregnancy in the Emergency Department

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The Advanced Practice Registered Nurse (APRN) who practices in the emergency department must understand how to rapidly diagnose and rule out life-threatening conditions. In women presenting to the emergency department within the first trimester of pregnancy, an ectopic pregnancy is a potentially life-threatening condition that must be explored. An ectopic pregnancy is the presence of a fertilized embryo that implants outside of the uterus, with almost 70% occurring in the fallopian tube.[1,2] Implantation of the fertilized embryo outside the uterus, especially in the fallopian tube, can have devastating consequences. Fallopian tube rupture secondary to an ectopic pregnancy is the most lethal consequence of an ectopic pregnancy and is one of the leading causes of hemorrhage-related mortality in the pregnant population.[2] While a thorough history and physical examination are key for identifying high-risk patients, point of care ultrasound (POCUS) is a vital tool that can be used by the APRN in the emergency department as part of the management of these patients. POCUS has gained utilization in emergency departments during the past few years and can aid the trained APRN in answering clinical questions to help guide their patient management.[3]

The APRN in the emergency department must understand the common presenting signs and symptoms that should alert them about a possible ectopic pregnancy—typically, women who present within their first trimester of pregnancy with abdominal pain and/or vaginal bleeding. These patients must be identified as high risk for possible ectopic pregnancy, especially if the patient has not previously had an ultrasound to confirm the presence of an intrauterine pregnancy (IUP).[3] In patients without a previous confirmed pregnancy, it is vital for the APRN to identify women of child-bearing age with amenorrhea and severe abdominal pain to be as equally at risk for an ectopic pregnancy as those previously stated.[3,4] Risk factors for an ectopic pregnancy include a history of pelvic inflammatory disease, previous ectopic pregnancy, previous fallopian tube surgery, and use of assisted reproductive technology.[1] The American College of Obstetricians and Gynecologists recommends that patients who are at risk for an ectopic pregnancy have visualization of an IUP by ultrasonography upon hospital presentation; typically a transvaginal ultrasound (TVUS) and a serum beta–human chorionic gonadotropin level are used to confirm the existence of a pregnancy.[2] Once an IUP is visualized on ultrasonography, the presence of ectopic pregnancy can almost fully be excluded, unless in the presence of a heterotrophic pregnancy, which would require further obstetrics/gynecology consultation.[5] A heterotrophic pregnancy can occur when an ectopic pregnancy and IUP are present at the same time, with an increased incidence in women undergoing assisted reproductive therapy.[1,5]

A trained APRN can use the bedside POCUS to help identify the presence of an IUP in patients who present with symptoms of an ectopic pregnancy. A transabdominal pelvic ultrasound (TAUS) can detect the presence of an IUP rapidly, which can help the APRN answer the clinical question of whether an IUP is present or rule out an ectopic pregnancy in a patient with abdominal pain and/or vaginal bleeding in the first trimester of pregnancy.[3] It is estimated that visualization of an IUP on the transabdominal pelvic POCUS examination carries a 99.3% specificity and 99.9% negative predictive value for the presence of an ectopic pregnancy.[5] For the APRN to note the presence

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of an IUP, she or he must visualize the gestational sac, fetal pole, and depending on gestational age, the presence of a fetal heartbeat, noting that identification of the yolk sac inside a gestational sac is typically the first sign of an IUP.[1,4,5] This examination can greatly reduce boarding times in the emergency department because visualization can rule out the presence of an ectopic pregnancy. If the APRN cannot visualize the previously mentioned structures for IUP, a TVUS must be ordered in attempt to improve visualization of the pelvic components. This step is warranted because the TVUS can identify the presence of a yolk sac and fetal heart beat as early as 4.5 to 5 weeks after the last menstrual period, whereas a TAUS only visualizes these structures at 6 to 7 weeks.[6,7] Therefore, it is important for the emergency APRN to understand that whereas the transabdominal POCUS examination can be used to help identify the presence of an IUP to exclude an ectopic pregnancy, the formal TVUS may be needed if they are unable to identify an IUP and their clinical suspicion is high.

The point-of-care TAUS can be completed by the APRN quickly when attempting to visualize an IUP in the first trimester of pregnancy. Formal education regarding POCUS techniques is vital for the APRN to successfully complete this examination. The following examination instructions should not replace formal education but help reinforce technique.

To complete the TAUS examination for IUP identification, the APRN will use the curvilinear transducer, which is a low frequency transducer; approximately 2 to 5 MHz.[5] This low-frequency transducer allows for deeper penetration of the ultrasound waves, giving the APRN a better depiction of the deeper pelvic organs. With any POCUS, practitioners should place themselves on the patient's right side with the ultrasound machine within reach to their left. The patient should be encouraged to have a full bladder during this examination, because it will enhance the view of the uterus and other pelvic structures; however, in the emergency setting having a full bladder often is not feasible.[5,8]

The examination will start with the patient in the supine position. The APRN will complete this POCUS examination in both the axial and sagittal viewing planes to properly visualize the pelvic structures. The practitioner will need to place the ultrasound machine in either the abdominal or obstetric examination mode. The TAUS examination will begin in the axial viewing plane by placing the curvilinear transducer slightly above the patient's symphysis pubis with the transducer indicator aimed toward the patient's right shoulder.[5] With the probe in this position, the provider will visualize the bladder, uterus, adnexa, and ovaries. The provider will need to adjust the depth and gain on the ultrasound machine while exercising the movements of tilting, rocking, fanning, or sliding the ultrasound transducer to accurately visualize the needed structures. After investigation in the axial viewing plane, the APRN will need to view the same pelvic structures in the sagittal view. To obtain the sagittal view, the practitioner will simply rotate the transducer 90 degrees rightward from the axial viewing position so that the transducer indicator is now positioned cephalad. During both views, the APRN is attempting to visualize an IUP, which is present when she or he can identify a gestational sac, yolk sac, and fetal pole[8,9] (Figure 1).

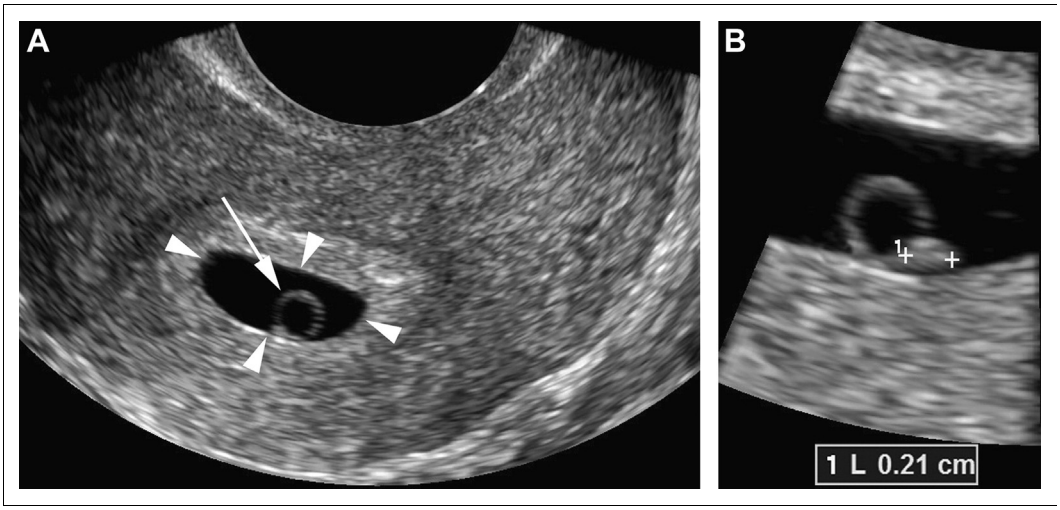

FIGURE 1

(A) Presence of yolk sac (single arrow) within the gestational sac (multiple arrows), within the uterus. (B) Presence of fetal pole and yolk sac within the gestational sac.[4]

One of the first structures that can be visualized on POCUS during the first trimester of pregnancy is the gestational sac. The gestational sac will appear as a hypoechoic oval structure within the uterus, which is surrounded by an echogenic ring.[5] Next the yolk sac will need to be visualized but will depend on the gestational age of the pregnancy. The yolk sac will appear as a round fluid-filled echogenic structure within the gestation sac, within the uterus.[8] Identification of the yolk sac inside the gestational sac is the first evidence of an IUP.[5,8] Adjacent to the yolk sac, the provider may be able to visualize the fetal pole, also known as the embryo; this structure may not be visible until approximately 6.5 weeks on the TAUS and may require a TVUS. Additionally, depending on the gestation age of the pregnancy, the practitioner may be able to visualize a fetal heartbeat, which may be seen as early as 6 weeks.[5] Once the APRN is able to visualize the gestational sac, yolk sac, and fetal pole within the uterus she or he can conclude that there is an IUP and exclude an ectopic pregnancy[5,8,10] (Figure 2).

POCUS can be used by the emergency APRN to quickly and accurately diagnose intraabdominal free fluid resulting from a ruptured ectopic pregnancy. In women with severe abdominal pain who present to the emergency department in their first trimester of pregnancy, the APRN can utilize the POCUS focused abdominal sonogram in trauma (FAST) examination. The FAST examination is conducted to visualize specific areas of the peritoneal cavity where fluid can accumulate after a ruptured ectopic tubal pregnancy. Specifically, the APRN should attempt to visualize any fluid located in Morrison's pouch (located between the superior hepatic boarder and the inferior boarder of the right kidney) or the pouch of Douglas (located between the rectum and posterior wall of the uterus) during this examination, because these 2 spaces are the most common sites for fluid accumulation after a ruptured tubal pregnancy.[3,7,8] If free fluid or hemoperitoneum is identified on the FAST examination, the APRN must initiate an immediate obstetrics/gynecology consultation because this poses a life-threatening risk. Furthermore, in a hemodynamically unstable patient with positive free-fluid findings on the FAST examination and without an identifiable IUP, the APRN should suspected an ectopic pregnancy.[3] These patients typically will need timely surgical consultation and possible intervention, necessitating quick identification and management by the APRN. A prompt obstetrics/gynecology consultation will expedite the patient's care and potentially produce better outcomes for these patients.

FIGURE 2

Presence of yolk sac (large arrow), fetal pole (small arrow), within the gestational sac, confirming presence of an intrauterine pregnancy (IUP).[10]

The point of care FAST examination, when performed correctly, is a quick and efficient examination to visualize free fluid in the abdominal cavity. Free fluid on the FAST examination will appear as an anechoic (black) area in a space that should not have fluid accumulation. The FAST examination typically includes 4 basic views: right upper quadrant, left upper quadrant, pelvic, and sub-xiphoid. Persons typically are taught to start with the right upper quadrant view and progress to the left upper quadrant view and then the pelvic view, finishing with the sub-xiphoid view.

The emergency APRN will use the low-frequency curvilinear transducer and place the ultrasound machine in abdominal mode. Starting with the right upper quadrant or perihepatic view, the provider will place the probe on the midaxillary line at approximately the ninth intercostal space with the probe indicator pointed cephalad.[5] The APRN will need to visualize the diaphragm, depicted by a hyperechoic line located under the pleural space. Next the provider will evaluate the liver, located underneath the diaphragm, looking for fluid accumulation between these 2 structures. The practitioner will then visualize the space between the liver and the right kidney, which is known as the hepatorenal recess or Morrison's pouch. This potential space most commonly accumulates fluid after a ruptured tubal ectopic pregnancy and must be investigated thoroughly[11] (Figure 3). Moving the probe caudally, the inferior pole of the right kidney and right paracolic gutter can be examined.[5,12]

The next view is the left upper quadrant view, also known as the perisplenic view. Because of the posterior displacement of the organs in the left upper quadrant, the APRN will place the curvilinear probe slightly posterior to the mid axillary line between the sixth and ninth intercostal

space, with the probe indicator pointed cephalad.[5] The left upper quadrant view includes 3 spaces that are important to visualize because they may accumulate free fluid during a ruptured ectopic tubal pregnancy: the perisplenic space (between the diaphragm and the spleen), the splenorenal recess (between the spleen and the left kidney), and the left paracolic gutter (under the inferior pole of the left kidney)[5,11,12] (Figure 4).

The next view is the pelvic view, which is similar to the transabdominal ultrasound previously mentioned. A full bladder will optimize visualization of the pelvic structures. When viewing the pelvis, the APRN will complete views in the axial and sagittal planes and place the probe slightly above the symphysis pubis. In women, fluid from a ruptured tubal ectopic pregnancy typically will accumulate in the recto-uterine space, also referred to as the pouch of Douglas, which is located between posterior wall of the uterus and the rectum[11,12] (Figure 5). It is important to scan the bladder in its entirety, ensuring that all walls of the bladder are viewed and visualizing any free fluid behind it.

The final view is the sub-xiphoid view, which analyzes the pericardial sac for fluid. The curvilinear probe is placed in the sub-xiphoid position with the probe pointed to the patient's right shoulder.[5,12] The APRN can complete all 4 views within a matter of minutes with proper technique and education. Throughout all views, the practitioner may need to rock, tilt, slide, and fan while manipulating the depth and gain of the ultrasound machine to produce the needed images on the screen. Additionally, placing the patient in a slight Trendelenburg position will help increase the sensitivity of this examination by allowing the provider to visualize dependent fluid.[12]

The emergency APRN can utilize these 2 POCUS examinations, the TAUS and the FAST examinations, to help expedite care and answer clinical questions in patients who present with a possible ectopic pregnancy. The use of these examinations can help decrease length of stay in the emergency department by identifying either the presence or absence of an IUP and free fluid present in the hemodynamically unstable patient. These examinations help the APRN rule in or out their differential diagnoses sooner because the bedside POCUS typically is more readily available than formal ultrasonography completed in the radiology department.[4,13] If the APRN can rule in or rule out ectopic pregnancy faster, disposition can occur sooner, which can decrease boarding times in the emergency department.[13] In the midst of the hectic environment and rapid pace of emergency medicine, the APRN can use these POCUS examinations to help diagnose and manage patients with possible ectopic pregnancies more quickly and efficiently, ultimately reducing the risk of serious complications and improving patient outcomes.[6]

With any advanced skill, the APRN may need additional training to be proficient in using POCUS to help diagnose and manage patients with a possible ectopic pregnancy. Visualization of an IUP may be dependent on the skill and training level of the provider, and APRNs should know their scope of practice and limitations when performing the TAUS and FAST POCUS examinations.[5] Once proficiency is achieved, these POCUS examinations can be great tools for APRNs to use to help identify the presence or absence of an IUP, as well as identifying hemoperitoneum as a result from ruptured tubal pregnancy. These skills can help expedite decision making for the APRN when caring for patients who present with signs and symptoms that are consistent with an ectopic

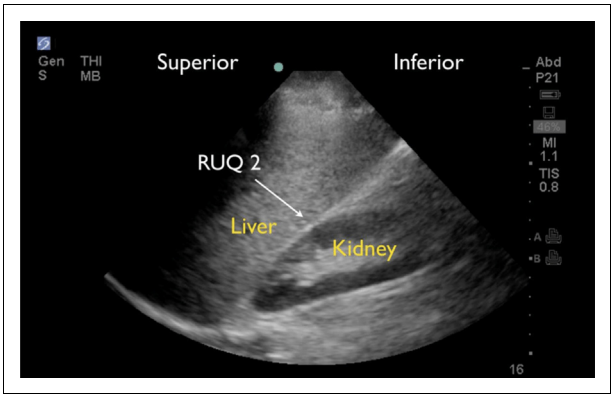

FIGURE 3

Normal right upper quadrant (RUQ) view showing Morrison's pouch (RUQ2). Image courtesy of Viveta Lobo, © 2017 Lobo et al.[11]

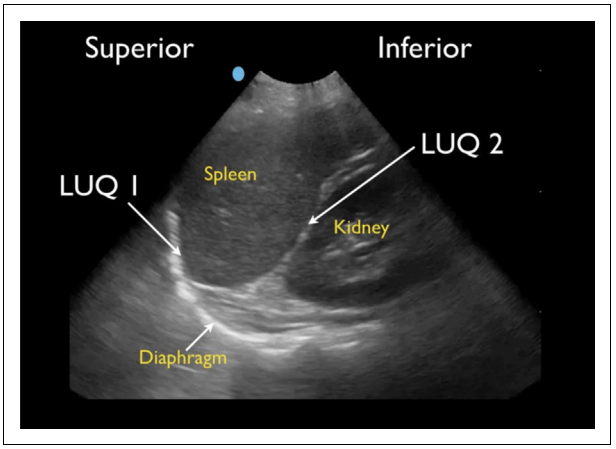

FIGURE 4

Normal left upper quadrant (LUQ) view depicting the spleno-diaphragmatic space (LUQ1) and the spleno-renal recess (LUQ2). Image courtesy of Viveta Lobo, © 2017 Lobo et al.[11]

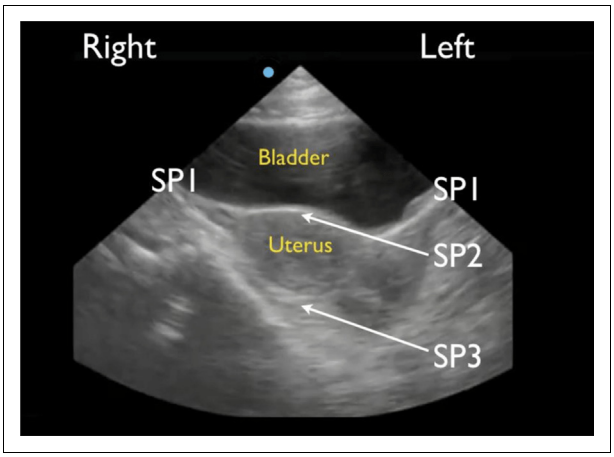

FIGURE 5

Normal pelvic view of a woman showing lateral spaces to the bladder (SP1), space 5 in between the bladder and uterus (SP2) and space posterior to the uterus (SP3). Image courtesy of Viveta Lobo, © 2017 Lobo et al.[11]

pregnancy. The APRN must understand that POCUS findings are used to help answer clinical questions and concerns about their patient's condition and should be supported with clinical suspicion, as well as other diagnostic findings.

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