

# ULTRASOUND FINDINGS IN ECTOPIC PREGNANCIES: AN ICONOGRAPHIC ESSAY

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## ABSTRACT

*The objective of the present work is to identify the markers and sonographic aspects of an ectopic pregnancy and trace the main types of ectopic pregnancy found.*

*Ectopic pregnancy is a known complication of the pregnancy that can carry a high rate of morbidity and mortality if not recognized and treated promptly.*

*It is essential that healthcare providers maintain a high index of ectopic suspicion in their pregnant patients, as they may experience pain, vaginal bleeding or more vague complaints such as nausea and vomiting. Although the clinical triad of pain, vaginal bleeding and amenorrhea is considered very suggestive of an ectopic pregnancy, ultrasonography has become essential in the detection, confirmation and exact location and provides information for the treatment and its therapeutic options.*

*Therefore, it is essential for a sonographer to recognize all ultrasonographic markers.*

KEYWORDS: ECTOPIC PREGNANCY, ULTRASOUND, DIAGNOSIS

## INTRODUCTION

Ectopic pregnancy is a known pregnancy complication that can carry a high rate of morbidity and mortality if not recognized and treated promptly. It is essential that healthcare providers maintain a high index of ectopic suspicion in their pregnant patients, as they may experience pain, vaginal bleeding, or more vague complaints such as nausea and vomiting.

Fertilization and embryo implantation involve an interplay of chemical, hormonal, and anatomical interactions and conditions to allow for a viable intrauterine pregnancy. Ovaries are the female reproductive organs located on both sides of the uterus, in the lower pelvic region. The ovaries have several functions, one of which is to release an egg each month for potential fertilization. The fallopian tubes are tubular structures that serve as a conduit to allow the transport of the female egg from the ovaries to the uterus.

When sperm is introduced, it fertilizes the egg, forming an embryo. The embryo will then implant itself in the endometrial tissue inside the uterus. An ectopic pregnancy occurs when this fetal tissue implants somewhere outside the uterus or attaches to an abnormal or scarred portion of the uterus<sup>1</sup>.

The most common site of adhesion in ectopic pregnancies is in the ampullary region of the fallopian tube. About 95% of ectopic pregnancies develop in the ampullary, infundibular, and isthmic portions of the fallopian tubes. In pregnancies with a cesarean scar, there is a migration of the blastocyst into the myometrium due to the residual defect

in the scar from the previous cesarean. The depth of implantation determines the type of cesarean scar in pregnancy, with type 1 being close to the uterine wall and type 2 being implanted closer to the urinary bladder<sup>2</sup>.

The estimated rate of ectopic pregnancy in the general population is 1 to 2% and 2 to 5% among patients using assisted reproductive technology. Ectopic pregnancies with implantation occurring outside the fallopian tube account for less than 10% of all ectopic pregnancies<sup>3</sup>.

Ectopic pregnancy is a very challenging diagnosis. An estimated 40% of ectopic pregnancies are undiagnosed at initial presentation. Ectopic pregnancy is also a very difficult condition to identify based on the history and physical examination features because neither are sensitive nor specific for the diagnosis. The data suggest that even experienced gynecologists are unable to detect more than half of the masses created by ectopic pregnancy on physical examination. Due to these natures of the condition, laboratory data and diagnostic imaging are essential components of the diagnosis of ectopic pregnancy.

Ultrasonography is the diagnostic imaging study of choice for ectopic pregnancy. Even though an ectopic pregnancy cannot be visualized on ultrasound, the diagnosis of an intrauterine pregnancy greatly reduces the risk of an ectopic pregnancy being present. There are two sonographic approaches to the evaluation of ectopic pregnancy. The first is the less invasive transabdominal ultrasound and the second is the more invasive but more diagnostic endovaginal ultrasound<sup>4</sup>.

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Given the above, the objective of this study is to identify the markers and ultrasound aspects of an ectopic pregnancy and trace the main types of ectopic pregnancy found.

**ULTRASOUND FINDINGS IN ECTOPIC PREGNANCIES**

Ectopic pregnancy occurs when the blastocyst implants in a location other than the endometrium of the uterine cavity. Unusual implantation sites for ectopic pregnancy include the cervix, interstitial segment of the fallopian tube, scar from a previous cesarean section, uterine myometrium, ovary and peritoneal cavity (figure 1). Heterotopic and ectopic twin pregnancies are other rare manifestations. Ultrasonography (US) plays a central role in the diagnosis of uncommon ectopic pregnancies <sup>5</sup>.

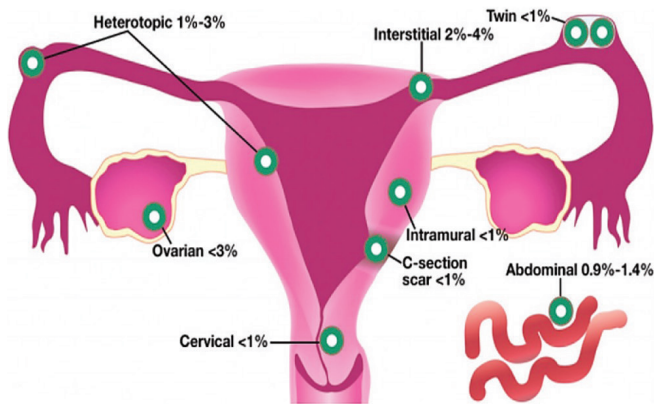


Figure 1 – Diagram showing the locations and incidence rates of uncommon ectopic pregnancies <sup>5</sup>

Ectopic pregnancy accounts for approximately 2% of all pregnancies and is the most common cause of pregnancy-related mortality in the first trimester. Initial evaluation consists of hormone measurements and pelvic ultrasound. A history of pelvic pain along with an abnormal level of human chorionic gonadotropin beta should trigger an evaluation for an ectopic pregnancy <sup>6</sup>.

**ABDOMINAL PREGNANCY**

Abdominal ectopic pregnancy is an extremely rare entity, representing 1% of all ectopic pregnancies and is associated with high maternal and fetal morbidity and mortality. The risk of maternal mortality from an abdominal ectopic pregnancy is seven to eight times greater than the risk from a tubal ectopic pregnancy and 90 times greater than the risk from an intrauterine pregnancy. It is a modality of difficult diagnosis that usually occurs late <sup>7</sup> – figure 2.

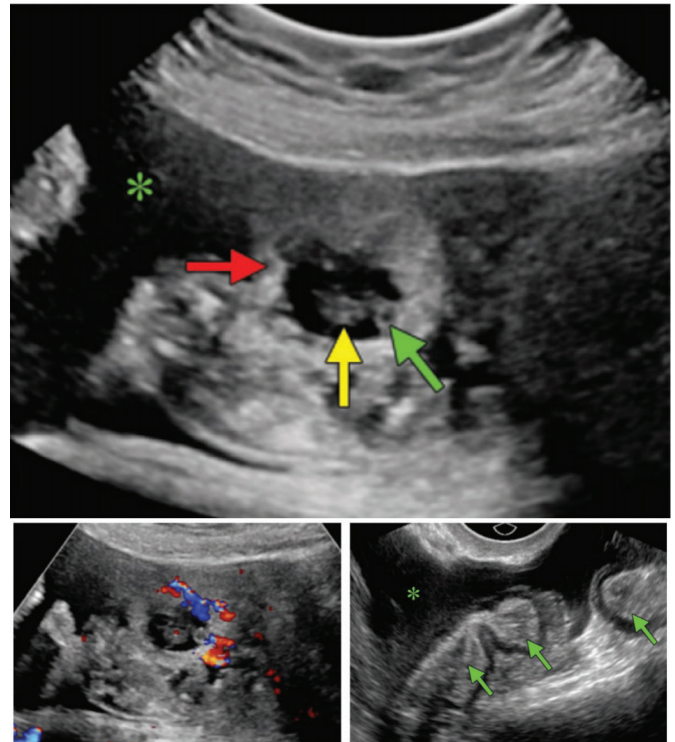


Figure 2 - Abdominal ectopic pregnancy. (a) Sagittal transabdominal grayscale US image shows a fetal pole (yellow arrow) and yolk sac (green arrow) in an intra-abdominal gestational sac. Note the peripheral echogenic margins (red arrow) around the gestational sac. Hemoperitoneum (\*) is also seen. (b) Sagittal transabdominal color Doppler US image shows peritrophoblastic flow flowing around the gestational sac. (c) Sagittal transvaginal grayscale US image shows intestinal loops (green arrows) and hemoperitoneum (\*) around the abdominal gestational sac <sup>5</sup>

A reported case illustrates a patient with diarrhea and mild abdominal cramping. On transvaginal ultrasound, the uterus was empty with an identified extrauterine sac containing a yolk sac and a fetal pole with cardiac activity. Diagnostic laparoscopy was performed, which confirmed an abdominal pregnancy with implantation in the rectum <sup>8,9</sup> – figure 3.

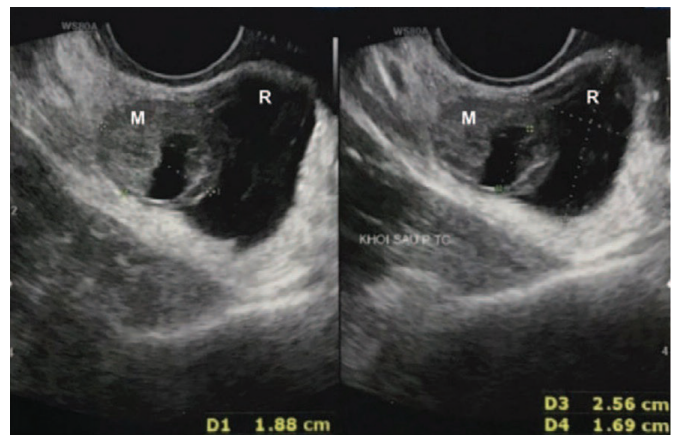


Figure 3 – Rectal ectopic pregnancy <sup>8</sup>



Features of abdominal ectopic pregnancy: Absence of a gestational sac in the endometrium or cervix; Absence of tubal or ovarian pregnancy; Intraperitoneal gestational sac with echogenic margins; Peritrophoblastic flow around the gestational sac; Placenta outside the limits of the uterine cavity; Hemoperitoneum or pelvic hemorrhage and fetal heart activity in the peritoneal cavity<sup>5</sup>.

**TUBAL ECTOPIC PREGNANCY**

The fallopian tube is the most common site for an ectopic pregnancy. An adnexal mass separated from the ovary and the tubal ring sign are the most common findings of a tubal pregnancy<sup>6</sup> – figure 4.

An empty endometrial cavity with: (i) an inhomogeneous adnexal mass or (ii) an empty extrauterine gestational sac seen as a hyperechoic ring or (iii) an extrauterine gestational sac with yolk sac and/or fetal pole with or without cardiac activity<sup>6,10</sup>.

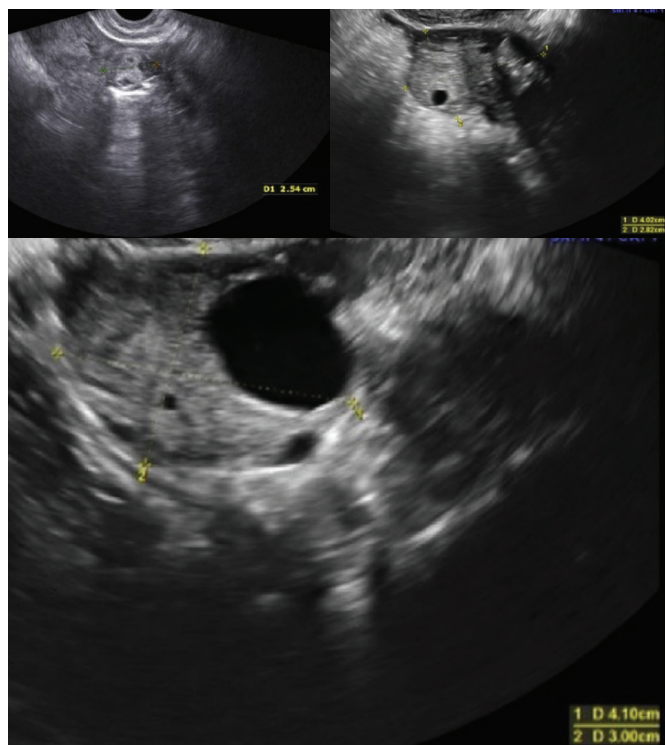


Figure 4 – Tubal ectopic pregnancy

Approximately 1/100 pregnancies are ectopic, with the conceptus usually implanted in the fallopian tube. Some tubal ectopic pregnancies resolve spontaneously, but others continue to grow and lead to tube rupture<sup>12</sup> – figures 5 and 6.

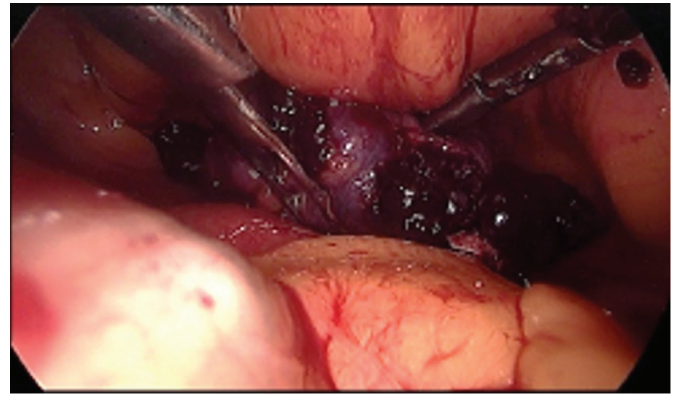


Figure 5 - Integral tubal ectopic pregnancy

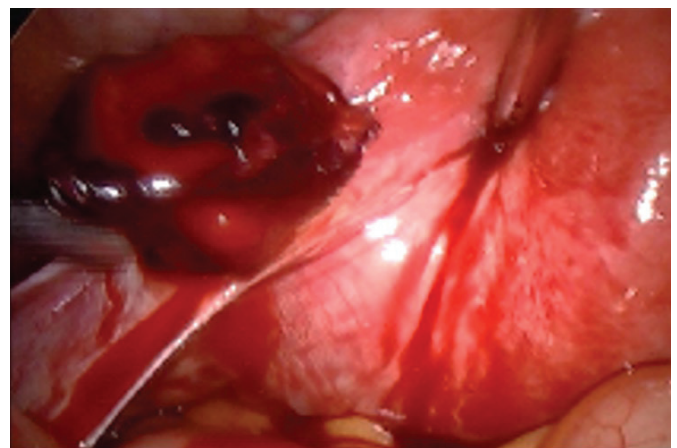


Figure 6 – Ruptured ectopic pregnancy

**INTERSTITIAL OR CORNUAL ECTOPIC PREGNANCY**

An empty endometrial cavity with products of conception located outside the endometrial echo and surrounded by a continuous border of myometrium, within the interstitial area<sup>10</sup>.

Cornual implantation, also called interstitial, occurs at the junction of the tube with the uterine body, and corresponds to 1.9% of tubal pregnancies. Interstitial ectopic pregnancy occurs when implantation occurs in the intramural path of the tube, a proximal portion of the tube about 0.7 mm wide and 2 cm long, surrounded by myometrium. Interstitial or cornual ectopic pregnancy occurs outside the uterine cavity, with implantation and development of the egg within the tube segment that penetrates the uterine wall or between the tubal ostium and the proximal portion of the isthmic segment; and may manifest as an acute abdominal condition, which requires early diagnosis and urgent care<sup>11,12</sup> – figure 7.

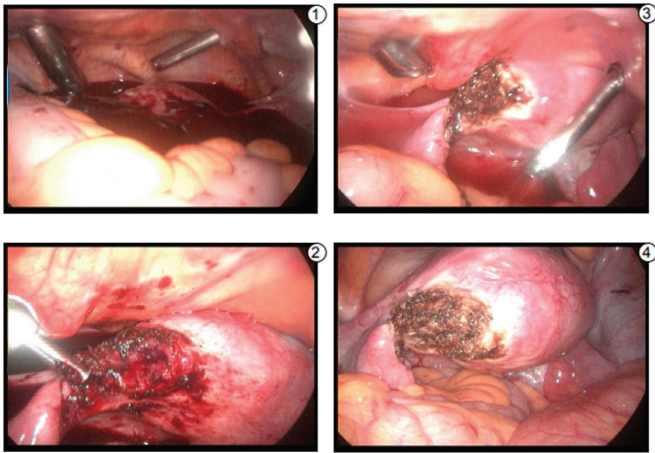


Figure 7 – Laparoscopy images of cornual pregnancy

Features of interstitial ectopic pregnancy: Empty endometrial cavity; Interstitial line sign (echogenic line that extends from the endometrium to the interstitial gestational sac); Myometrial mantle sign (gestational sac surrounded by the myometrium); Bulging sign (gestational sac in the uterine fundus resulting in abnormal bulging of the uterine contour) <sup>5</sup>.

### CERVICAL ECTOPIC PREGNANCY

Cervical pregnancy is a rare type of intrauterine ectopic pregnancy. The diagnosis and treatment of cervical pregnancy has changed enormously in the last 15 years. Prior to 1980, the diagnosis was made when dilation and curettage for presumptive incomplete abortion resulted in sudden, uncontrollable bleeding. Hysterectomy was performed to save the patient's life. Today, cervical pregnancy is diagnosed by ultrasound during the 1st trimester of pregnancy so that the patient's fertility can be preserved. Therefore, any physician should consider the possibility of a cervical pregnancy in a woman with abdominal pain and vaginal bleeding during the first trimester of pregnancy<sup>13</sup>. Cervical ectopic pregnancy is a rare form of life-threatening ectopic pregnancy, with an incidence of 1 in 9,000 deliveries <sup>14</sup>.

An empty endometrial cavity, with a barrel-shaped cervix and a gestational sac present below the level of the uterine arteries. An absent “slip sign” (when pressure is applied to the cervix using the probe in a miscarriage, the gestational sac slides against the endocervical canal, but not in an implanted cervical pregnancy) and blood flow around the gestational sac using color Doppler <sup>10</sup>.

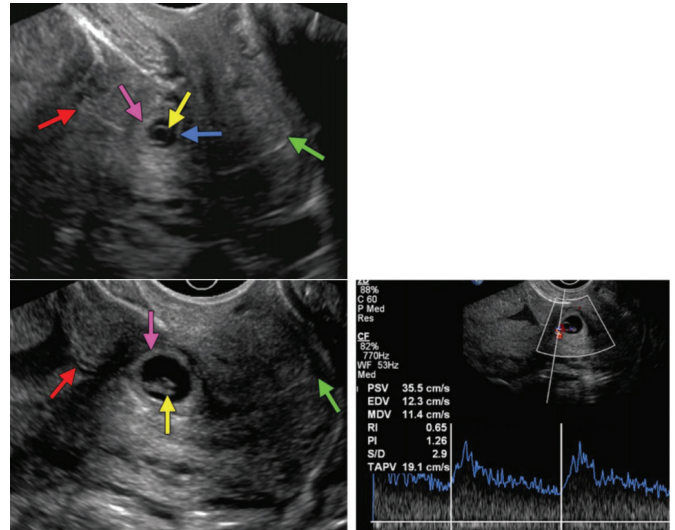


Figure 8. Cervical ectopic pregnancy. (A) Diagram shows a round gestational sac with thick surrounding margins (pink arrow) that are echogenic on US, closed internal and external orifices (red and green arrow), and yolk sac (yellow arrow). (B) Sagittal follow-up US image obtained one week later shows an increased gap in the size of the gestational sac and a distinctive fetal pole (yellow arrow), and absence of blood products in the uterine cavity or cervical canal (red and green arrows). (C) Sagittal transvaginal color Doppler US image shows increased low impedance diastolic arterial flow around the gestational sac<sup>5</sup>

### ECTOPIC PREGNANCY IN CESAREAN SCAR

Empty endometrial cavity and cervical canal with gestational sac implanted in the lower anterior segment of the uterine wall, with evidence of myometrial dehiscence in the cesarean scar. Implantation of an embryo within the anterior scar is one of the rare forms of ectopic pregnancy. There are two types of pregnancies: type 1, in which the embryo begins to progress towards the uterine cavity and can result in a live birth, despite the high risk of hemorrhage during delivery, and type 2, which consists of pregnancies in which the fetus the embryo is deeply embedded in the cesarean scar and grows towards the bladder and abdominal cavity, which is very dangerous and needs to be resolved immediately <sup>10,15</sup>.



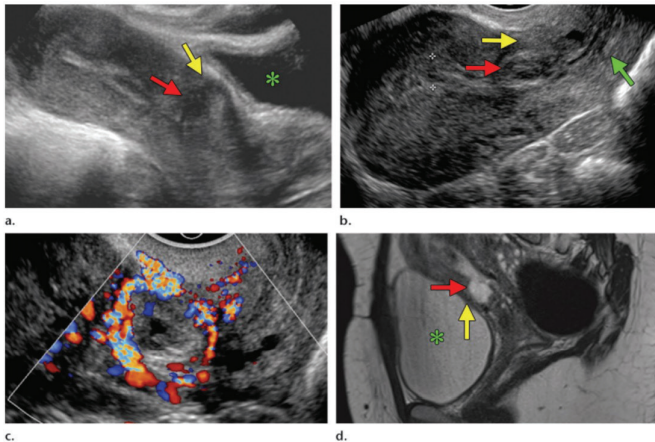


Figure 9 - Ectopic pregnancy in cesarean scar. (a) Sagittal transabdominal grayscale US image in a patient with a previous cesarean section shows a gestational sac (red arrow) on the anterior wall of the lower surface of the uterus anterior to the bladder (\*), with thinning of the myometrium (yellow arrow) seen anteriorly to the bag (b) Sagittal transvaginal US image shows the tapered myometrium (yellow arrow) anterior to the gestational sac (red arrow), which is above the closed internal cervical os (green arrow). Note the empty endometrial cavity (between the calipers). (c) Sagittal transvaginal color Doppler image showing peritrophoblastic flow around the gestational sac. (d) Sagittal T2-weighted magnetic resonance image shows the gestational sac (red arrow) in the lower anterior uterine segment and the tapered myometrium (yellow arrow) between the gestational sac and the bladder (\*)<sup>5</sup>

Characteristics of ectopic pregnancy with cesarean scar: Uterine cavity empty; Clearly visible empty cervical canal without contact with the gestational sac; No adnexal mass or free fluid in the pouch of Douglas, unless rupture of the gestational sac is present; Gestational sac in the anteroinferior uterine wall (best seen on sagittal images); Gestational sac with echogenic margins and peritrophoblastic flow at the scar site with thinning of the anterior myometrium <sup>5</sup>.

### ECTOPIC PREGNANCY IN THE OVARY

Ovarian-restricted pregnancy accounts for 0.5 to 1.0% of all ectopic pregnancies and is the most common type of non-tubal EP. Ovarian ectopic pregnancy occurs when a fertilized egg is retained in the ovary. Ovarian pregnancies constitute up to 3% of ectopic pregnancies<sup>16</sup>.

Features of ovarian ectopic pregnancy: Empty endometrial cavity; Gestational sac with thick circumferential echogenic margins; Gestational sac inseparable from adjacent ovarian parenchyma; Peritrophoblastic flow around the gestational sac and yolk sac and fetal pole with or without cardiac movement, depending on the gestational age<sup>5</sup>.

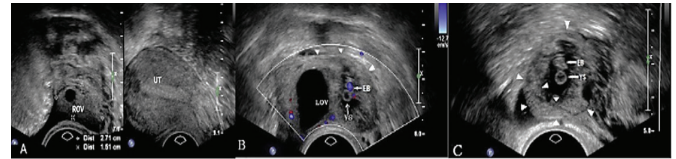


Figure 10 - Transvaginal ultrasound images of ovarian pregnancy (OP) with unruptured embryo sac type. (A) showed normal right ovary (ROV) and uterus (UT). (B) showed the left OP with an embryo sac. The yolk sac (YS), embryonic bud (EB) and color flow signals in the primitive heart were detected. White arrowheads showed the gestational sac and the rest of the ovarian tissue in the same envelope. (C) White arrowheads showed the solid hyperechoic ring characteristic of ovarian pregnancy <sup>18</sup>

Ovarian ectopic pregnancy can present with mild pain and tenderness and very subtle clinical findings and therefore can be easily missed and even released, posing a major diagnostic challenge. A high index of suspicion of ovarian ectopic pregnancy should be present even when the patient has no risk factors. Ovarian ectopic pregnancy may have a late presentation compared to tubal ectopic pregnancy. In the case of an ectopic ovarian pregnancy, the ovary can be preserved in many cases<sup>18</sup>.

### ECTOPIC PREGNANCY IN UNKNOWN LOCATION

It is characterized by an empty endometrial cavity, with no evidence of an intrauterine gestational sac or retained products of conception and no extrauterine pregnancy seen<sup>10</sup>.

### FINAL CONSIDERATIONS

Ectopic pregnancy occurs when a fertilized egg implants outside the uterine cavity. The estimated prevalence of ectopic pregnancy is 1% to 2%, and ruptured ectopic pregnancy is responsible for 2.7% of pregnancy-related deaths.

Risk factors include a history of pelvic inflammatory disease, smoking, fallopian tube surgery, previous ectopic pregnancy, and infertility. Ectopic pregnancy should be considered in any patient who presents early in pregnancy with vaginal bleeding or lower abdominal pain in which intrauterine pregnancy has not yet been established.

The definitive diagnosis of ectopic pregnancy can be made with ultrasound visualization of a yolk sac and/or embryo in the attachments.

Most often, the patient's symptoms combined with serial ultrasound and trends in human chorionic gonadotropin beta levels are used to make the diagnosis.

Serial levels of beta human chorionic gonadotropin, serial ultrasound, and sometimes uterine aspiration can be used to arrive at a definitive diagnosis.

Treatment of diagnosed ectopic pregnancy includes clinical treatment with intramuscular methotrexate, surgical treatment via salpingostomy or salpingectomy and, in rare cases, expectant management.

A patient diagnosed with an ectopic pregnancy should be immediately transferred for surgery if she has peritoneal signs or hemodynamic instability, if the baseline human beta chorionic gonadotropin level is high, if fetal cardiac activity outside the uterus is detected on ultrasound.

It is up to the sonographer to be attentive and recognize the signs and markers of ectopic pregnancy.

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