

Ultrasound in early pregnancy failure

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Introduction

In many settings, especially in private practice, transvaginal ultrasound is used routinely for early pregnancy confirmation. Routine ultrasound in early pregnancy appears to enable better gestational age assessment, earlier detection of multiple pregnancies and earlier detection of clinically unsuspected foetal malformation at a time when termination of pregnancy is still possible and safe.¹ In cases of complicated early pregnancy and early pregnancy failure, ultrasound, used in conjunction with the history, physical and gynaecological examination and indicated laboratory investigations, is a very useful modality in the investigation and diagnostic process.

Vaginal bleeding with or without lower abdominal pain in early pregnancy is a disturbing symptom causing anxiety for both patients and health care providers. While the majority of patients presenting with vaginal bleeding in early pregnancy will have an uncomplicated pregnancy, conditions such as miscarriage, ectopic pregnancy and gestational trophoblastic disease need to be excluded. The availability of high resolution transvaginal ultrasound imaging has made it possible to visualise embryonic development from a very early stage in pregnancy.

Transvaginal ultrasound provides superior imaging compared to transabdominal ultrasound because of its proximity to the pelvic organs. This is especially true in cases of retroverted uteri and obesity.² The fact that the procedure is performed with an empty bladder is an added benefit. Ninety nine percent of women find transvaginal ultrasound an acceptable investigation.³

Normal embryonic development on ultrasound

It is essential to understand the imaging of the normal embryology as it unfolds in early pregnancy. The embryonic stage of the pregnancy lasts up to ten completed weeks after the last normal menstruation (LNM). In the majority of cases it will not be problematic to accurately diagnose symptomatic patients in early pregnancy after 7 weeks gestation. The discussion in this article will mainly concentrate on the

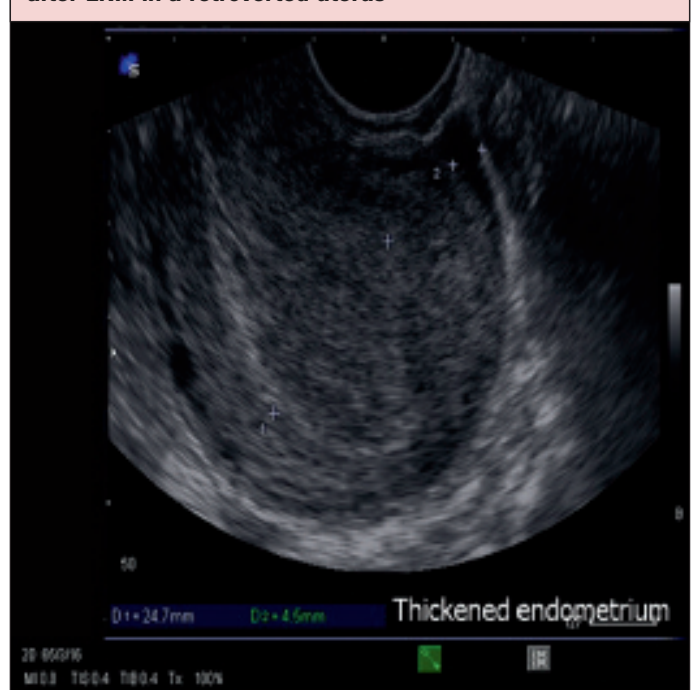
Table 1: Early ultrasound findings in normal pregnancy

Gestational age (Weeks after LNM)	Findings
4 w	Thick endometrium measuring > 20 mm
4 w 3 d – 5 w 1 d	Small gestational sac measuring 2 to 5 mm
5 w 1-5 d	Yolk sac becomes visible when MSD > 8 mm
5 w 6 d – 7 w	Embryonic pole visible when MSD > 16 mm
> 6 w	Embryonic heart activity when CRL ≥ 6 mm

gestational age < 7 weeks after the LNM.

The first ultrasound findings suggestive of intra-uterine pregnancy is that of a thick echogenic endometrium measuring >20 mm at gestational age of four weeks after the LNM (Fig. 1). At 4 weeks 3 days up to 4 weeks 6 days a small

Figure 1: Thickened endometrium at gestational age weeks after LNM in a retroverted uterus



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gestational sac (2 to 5 mm) appears in the thick endometrium (Fig. 2). At 5 weeks and 1 day up to 5 weeks and 5 days the yolk sac should become visible when the mean gestational sac diameter (MSD) is about 8 mm. From 5 weeks 6 days to 6 weeks a visible embryonic pole measuring 2 to 4 mm appears (Fig. 3). An embryo should be visible when the MSD is > 16 mm on transvaginal ultrasound, and an embryo measuring \geq 6 mm should display heart activity. The embryonal crown rump length (CRL) measurement at 7 weeks is between 11 mm and 16 mm.^{4,5}

Figure 2: Gestational sac at 5 weeks gestation measuring 6.8 mm

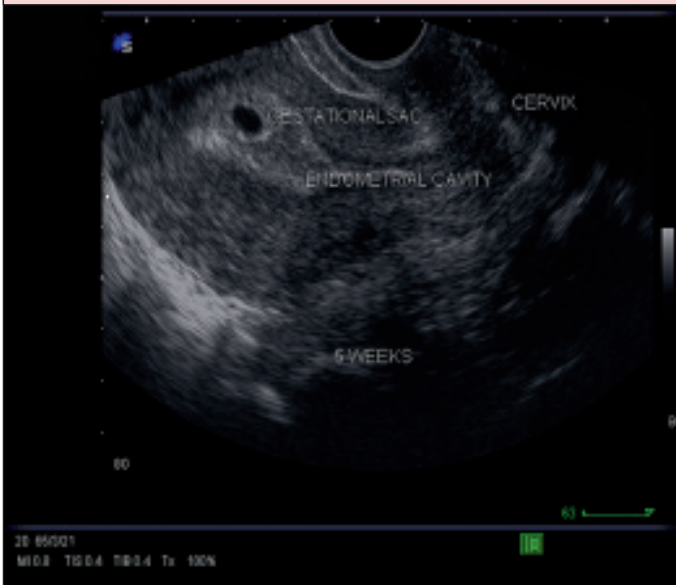


Figure 3: Embryonic pole at 6 weeks gestational age



Ultrasound findings in early pregnancy failure

Certain ultrasound findings are associated with an increased risk of early pregnancy failure. None of the findings on their own are pathognomonic, and therefore it is important to interpret isolated abnormal ultrasound findings cautiously. We

should also keep in mind that normal findings can have a wide range, and when ultrasound findings do not correlate with the clinical picture, follow-up examinations are indicated.

The Gestational Sac

The size of the gestational sac is an important indicator of the well-being of an early pregnancy. A small gestational sac signals a poor prognosis and requires serial sonographic examinations. A small gestational sac can be a result of oligohydramnios, which is associated with poor early pregnancy outcome, even in the presence of normal embryonic heart activity. Normal growth rate of the gestational sac is 1 mm per day in weeks 5 to 7 of gestation.⁵ A growth rate of < 1 mm per day is also associated with a poor prognosis.⁶

The ratio between the MSD and the CRL has also been studied. A difference of < 5 mm between the MSD and CRL is associated with an 80% risk of pregnancy failure.⁷

It is important to visualise the content of the gestational sac at the appropriate stages. A gestational sac \geq 8 mm without a yolk sac and a gestational sac > 16 mm without an embryo are important predictors for risk of early pregnancy failure.⁸

The gestational sac should be differentiated from a pseudo-gestational sac resulting from an intrauterine fluid collection. A true gestational sac is regular and eccentrically situated near the fundal region of the uterus. It is surrounded by echogenic trophoblast and a decidual reaction, resulting in two echogenic lines surrounding the gestational sac, also referred to as the double decidual sign. A pseudo-sac is situated centrally in the endometrial cavity, has an irregular shape and does not have a double decidual sign. It is caused by a fluid collection in the endometrial cavity and is frequently present in cases of ectopic pregnancy.⁸

Embryonal Heart Activity

Demonstrating embryonic heart activity in a symptomatic early pregnancy significantly decreases the risk of pregnancy loss. Embryonic demise is diagnosed when embryonic heart activity is absent in an embryo where the CRL is measuring > 6 mm. Embryonic bradycardia defined as < 100 beats per minute at 6 weeks 2 days and \leq 120 beats per minute between 6 weeks 3 days to 7 weeks, is associated with an increased risk of spontaneous miscarriage.⁶

Although the embryonic heart rate should be demonstrable when the CRL is >2 mm, it would not be possible to demonstrate heart activity in 5% to 10% of normal pregnancies.⁹

Embryonic Size

Between 5 to 7 weeks gestation embryonic growth rate should be 1 mm per day.⁵ If an embryo with a CRL of up to 5 mm is visible, the risk of pregnancy loss goes down to about 7%, compared to a prevalence of spontaneous miscarriage of between 15% and 20% of clinically recognised pregnancies. As the embryonic CRL increases to between 6 – 10 mm the risk drops to around 3%. Risk of pregnancy loss is estimated to be 0.5% in embryos with a CRL of >10 mm.¹⁰

Other sonographic findings

Several other sonographic features have been studied and found not to be clinically useful in the diagnosis of early pregnancy failure. These features include gestational sac shape, echogenicity of the placenta, trophoblast thickness, and the presence of an intra-uterine hematoma.¹¹

Optimal timing for routine scanning in early pregnancy

The time since the LNM is important as it will have an influence on the findings and interpretation of an ultrasound examination. It is possible with sensitive assays for β -hCG to diagnose pregnancy at the time of the first missed period. It is thus possible to do an ultrasound too early, which might cause unnecessary anxiety and result in numerous follow-up examinations to determine the location of the pregnancy and to decide on the viability of an intra-uterine pregnancy. On the other hand, if the first ultrasound examination is deferred too late, the opportunity to diagnose an ectopic pregnancy might be missed, resulting in avoidable maternal morbidity and even mortality.

It seems that the optimal time for the first transvaginal ultrasound in asymptomatic women without a history of a previous ectopic pregnancy is 7 weeks (forty nine days) after the LNM. This would reduce the number of inconclusive ultrasound examinations without increasing morbidity due to undiagnosed ectopic pregnancies. In symptomatic women and in women with a history of a previous ectopic pregnancy deferring the ultrasound examination until 7 weeks gestation can lead to missed opportunities to diagnose and treat unruptured ectopic pregnancies.¹²

Early pregnancy failure

Clinical signs include vaginal bleeding with or without or lower abdominal pain only. The sonographic diagnosis of embryonic demise is made as follows⁵:

On transvaginal ultrasound:

- There is an embryo visible measuring > 5 mm and no heart activity is demonstrated;
- The MSD is > 8 mm without a yolk sac;
- The MSD is > 16 mm without an embryo;

On transabdominal ultrasound

- There is an embryo visible measuring > 9 mm and no heart activity is demonstrated;
- The MSD measured is > 8 mm without a yolk sac;
- The MSD is > 25 mm without an embryo.

These are guidelines and follow-up examination might be indicated prior to considering any interventions.

Ectopic pregnancy

In this day and age transvaginal ultrasound has replaced diagnostic laparoscopy as the gold standard in the diagnosis of ectopic pregnancy in patients who are clinically stable. This means laparoscopy can be reserved for treatment rather than diagnosis of ectopic pregnancy. It

goes without saying that surgery in women with ectopic pregnancies who are clinically shocked or haemodynamically unstable should not be delayed for the sake of performing an ultrasound examination. Transvaginal ultrasound has also replaced transabdominal ultrasound in the investigation and diagnosis of ectopic pregnancy, and the role of transabdominal ultrasound in this setting is indeed very limited.

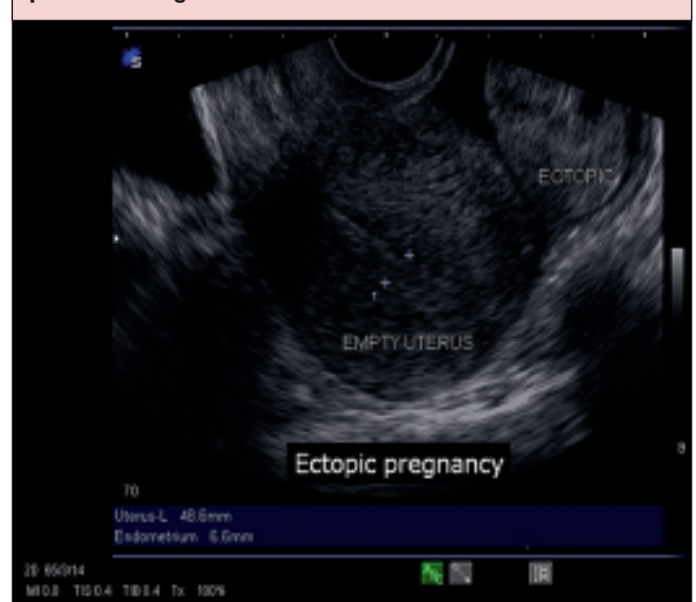
An important distinction should be made between an ectopic pregnancy and a pregnancy of unknown location (PUL). Data suggests that only 8% of pregnancies initially diagnosed as PUL will subsequently at follow-up examinations be diagnosed as ectopic pregnancies.¹³ PUL is the preferred terminology, and terms such as "query ectopic pregnancy" should be avoided, as the majority of this group will not have an ectopic pregnancy.

β -hCG values can be combined with ultrasound findings in cases where there is a high index of suspicion of an ectopic pregnancy. At a serum β -hCG level of above 1500 mIU/ml, also referred to as the discriminatory level, a gestational sac should be visible inside the uterine cavity. As already mentioned, it is important to distinguish between a true gestational sac and a pseudo-gestational sac when suspecting an ectopic pregnancy. The possibility of an ectopic pregnancy in an asymptomatic patient with an empty uterus and a β -hCG level >1500 mIU/ml is substantial.

When a solid or complex adnexal mass is present (Fig. 4), with an empty uterus at the discriminatory β -hCG level, the probability of an ectopic pregnancy is more than 90%. A live extra-uterine embryo on ultrasound examination is diagnostic of an ectopic pregnancy.⁵

Other important ultrasound findings suggestive of ectopic pregnancy include a tubal ring and free fluid in the pouch of Douglas.⁵ All these findings should be interpreted within the context of the clinical picture and the symptoms. Follow-up examinations are prudent in asymptomatic patients.

Figure 4: Ectopic pregnancy with some free fluid in the pouch of Douglas



Rather than diagnosing an ectopic pregnancy on the basis of an absent intrauterine gestational sac, some experts suggest the diagnosis of ectopic pregnancy should be based on the positive demonstration of an adnexal mass. Ultrasound diagnosis of an ectopic pregnancy can be made if one of the following signs is noted at the early pregnancy scan:

- The blob sign. This is the presence of an inhomogeneous mass in the adnexal region adjacent to the ovary and moving separately¹⁴;
- The tubal ring sign. This is a small cystic mass (gestational sac) with a hyperechoic ring around the gestational sac and is present in up to 68% of ectopic pregnancies⁴;
- A gestational sac containing an embryo with or without heart activity;

Identification of the corpus luteum may be helpful in visualising an ectopic pregnancy, as the ectopic pregnancy is on the ipsilateral side of the corpus luteum cyst in 70% to 85% of cases.¹⁴

The sensitivity of a single early trans-vaginal ultrasound examination to diagnose an ectopic pregnancy is 75% with a specificity of 99.9%. As about 9% of women at the first ultrasound examination will be diagnosed with PUL, the overall sensitivity of the first and subsequent ultrasound examinations combined is 98.3%.¹⁵

The sensitivity of a single early transvaginal ultrasound as performed by expert sonographers might not be reproducible in the hands of the general gynaecologist. Therefore the combination of β -hCG and ultrasound findings probably remains the most sensitive approach in diagnosing ectopic pregnancy.

Ultrasound and management of spontaneous miscarriage

Patients who had a spontaneous miscarriage with an endometrial thickness of less than 15 mm and no evidence of retained products of conception on transvaginal ultrasound can be classified as having had a complete miscarriage. Transvaginal ultrasound is a sensitive modality to detect retained trophoblastic tissue.¹⁶ Decision making regarding the management of spontaneous miscarriage remains a clinical one, but ultrasound examination may be of value in the decision making process.

Conclusion

Transvaginal ultrasound is a useful modality in the diagnosis and management of early pregnancy failure. It is important to interpret ultrasound findings in the context of the patient's history, symptomatology and findings of the gynaecological examination.

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