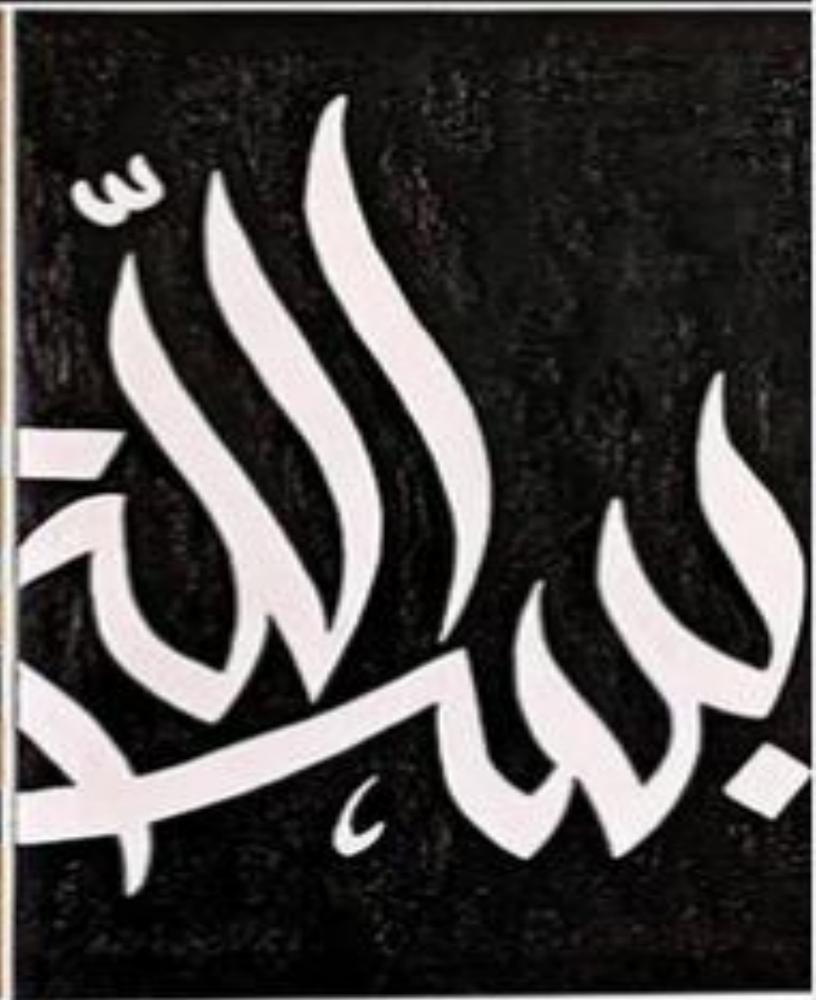
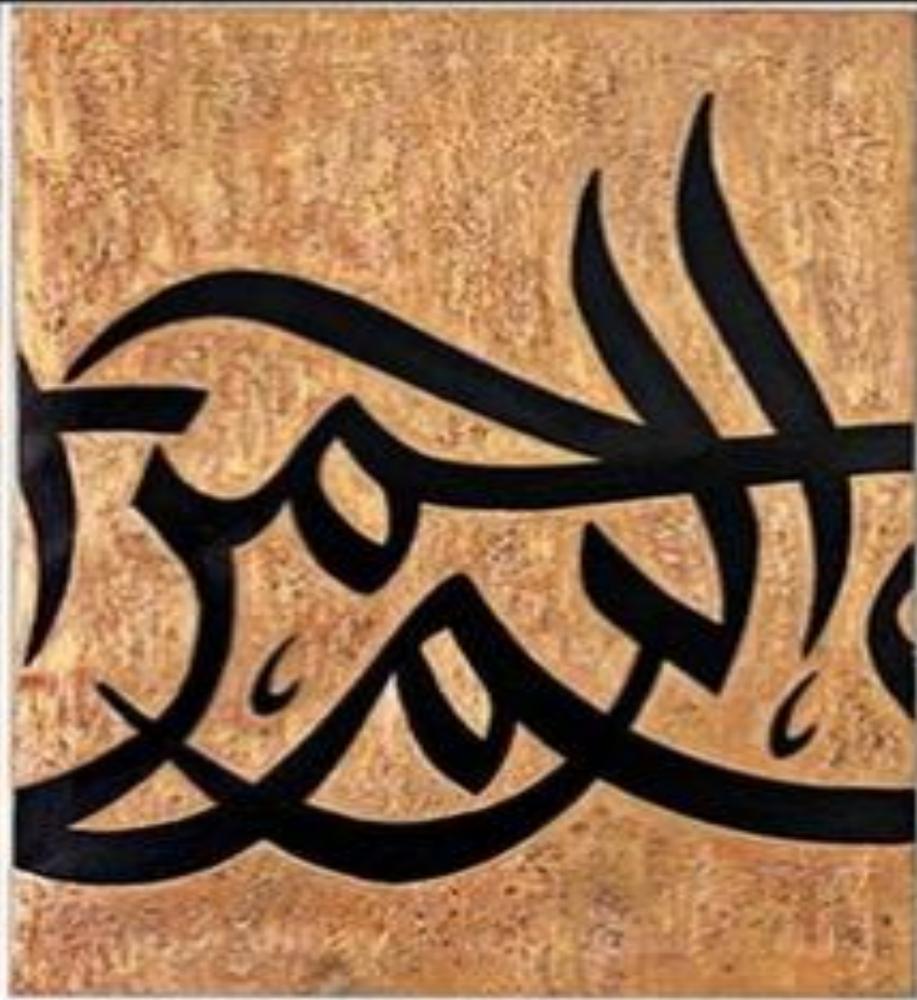




Ultrasound Findings in 1st Trimester Normal Pregnancy and Pregnancy Failure

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Introduction

- ▶ US imaging in early pregnancy should be primarily **Endovaginal**
- ▶ **Transabdominal** imaging used for:
 1. adnexal masses high in the pelvis
 2. documentation of the amount of free fluid
- ▶ Differential diagnosis in early US:
 - Viable intrauterine pregnancy (IUP)
 - Non-viable intrauterine pregnancy (IUP)
 - Ectopic pregnancy
 - IUP of uncertain viability
 - Pregnancy of unknown location



Normal Development of Early IUP between 4 and 8 Weeks of Gestational Age

Table 1: Timeline of Normal Early Pregnancy Development

Time Period	Developmental Milestone (Threshold)
Week 0	Patient has last menstrual period
Week 2	Conception occurs
Week 4.5–5.0	Gestational sac appears
Week 5.0–5.5	Yolk sac appears
Week 6.0	Embryo appears; cardiac pulsation begins, with a lower limit of 100 beats/min
Week 6.5–7.0	Amniotic membrane appears; cardiac pulsation lower limit is 120 beats/min
Week 7–8	Spine develops
Week 8	Head curvature separates from the body; four limb buds appear
Week 8.0–8.5	Intrinsic motion of the embryo occurs
Weeks 8–10	Rhombencephalon develops

4.5–5.0 weeks of gestational age

The intradecidual sign :

defined as an eccentrically located gestational sac within the echogenic decidua, with a relatively undisturbed collapsed uterine cavity visualized as a thin echogenic line, is highly suggestive of an IUP.



intra-decidual sign in a pregnant woman

double sac sign

consisting of two concentric echogenic rings surrounding the fluid collection and separated by a thin crescent of endometrial fluid, is a sign of definitive IUP.

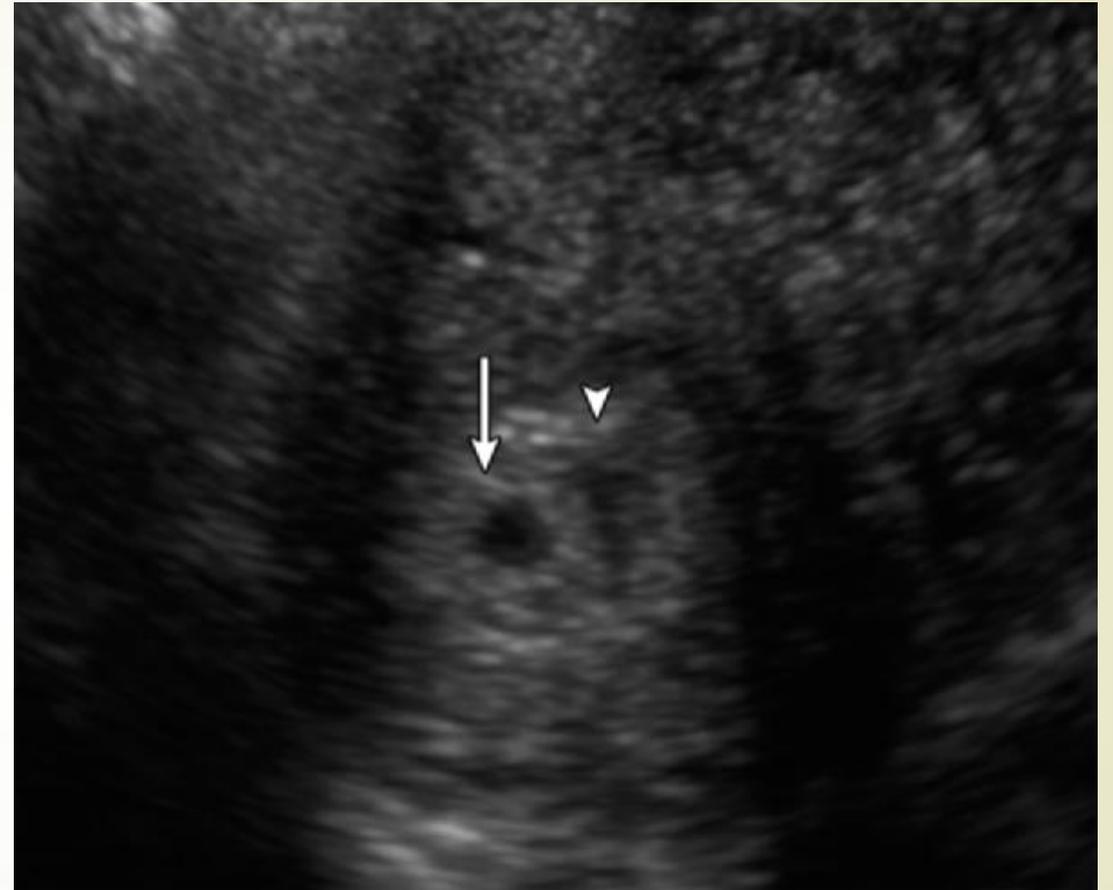
The outer echogenic ring:

decidua parietalis,

the inner ring :

decidua capsularis and chorion

The intradecidual sign is visible before the double sac sign because in the intradecidual sign, the gestational sac is not large enough to deform the contour of the uterine cavity, while in the double sac sign, the gestational sac has grown large enough to protrude into the endometrial cavity.





The US appearance of early gestational sacs is variable, and while these two signs are highly suggestive of an early IUP, they will be absent in at least 35% of gestational sacs.

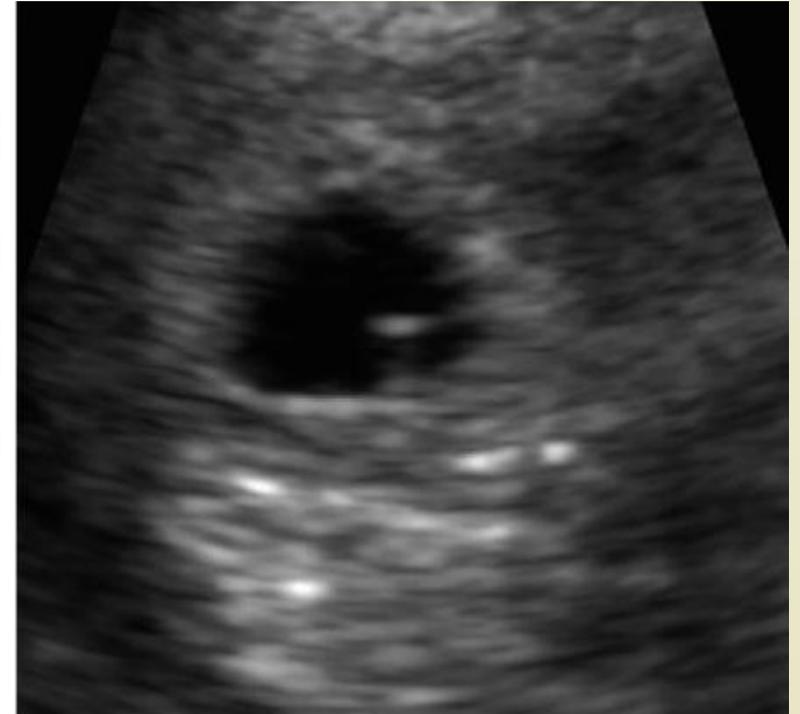
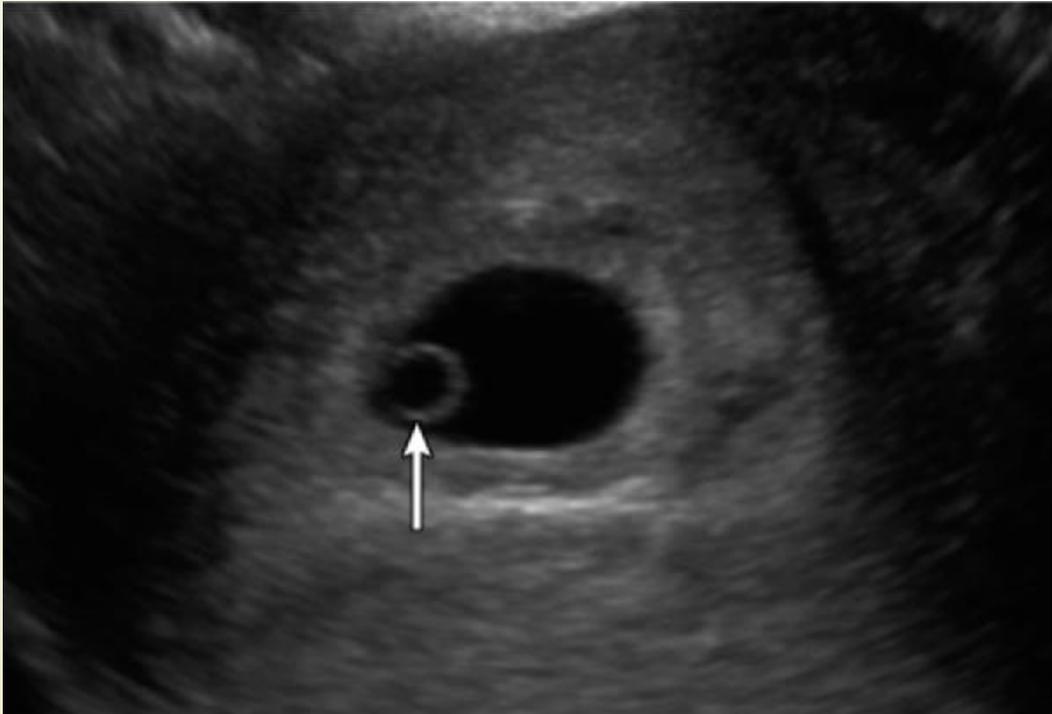
Thus, absence of these signs does not exclude an IUP. A nonspecific, empty, rounded intrauterine fluid collection seen in a pregnant patient has more than a 99.5% probability of representing a gestational sac.

Therefore, on the basis of the much higher prevalence of IUP compared with ectopic pregnancy and the fact that a minority of ectopic pregnancies have small intrauterine fluid collections, a nonspecific fluid collection with a smooth, rounded, or oval contour represents an IUP until proven otherwise.

5.0–5.5 weeks :

Yolk sac is the earliest intra gestational sac structure to be visualized at US.

round 3–5-mm structure, usually eccentrically located within the gestational sac.

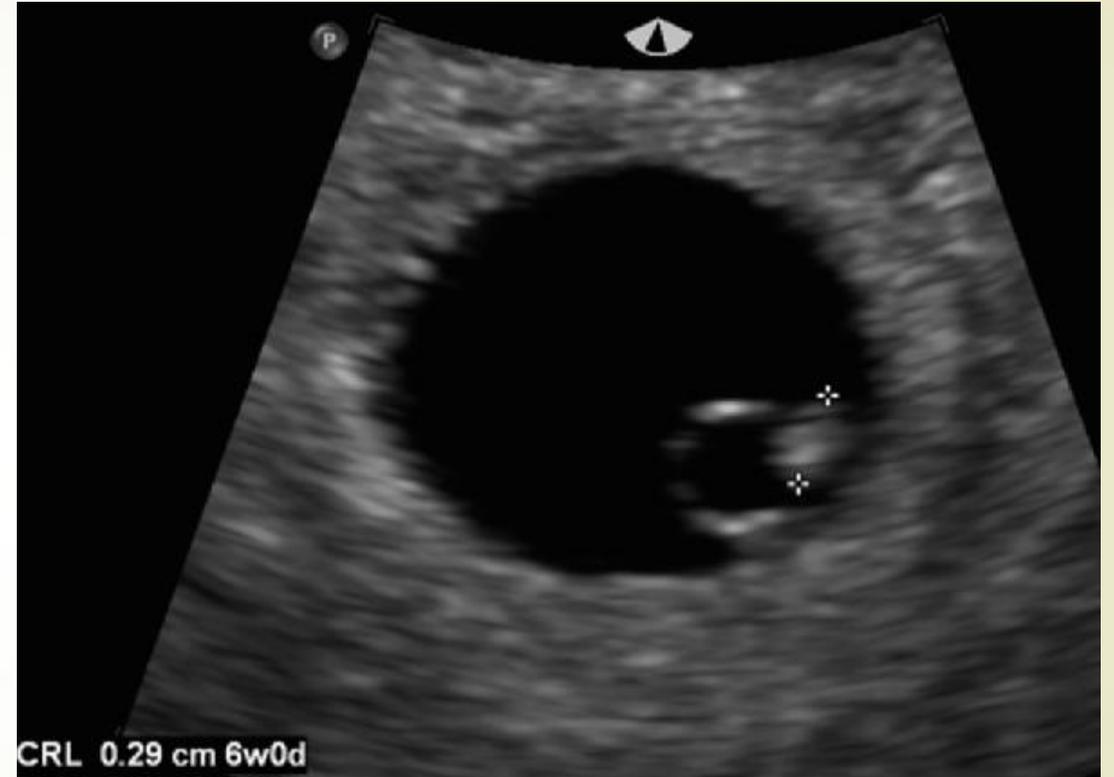


6 weeks of gestational age

embryo is visible .

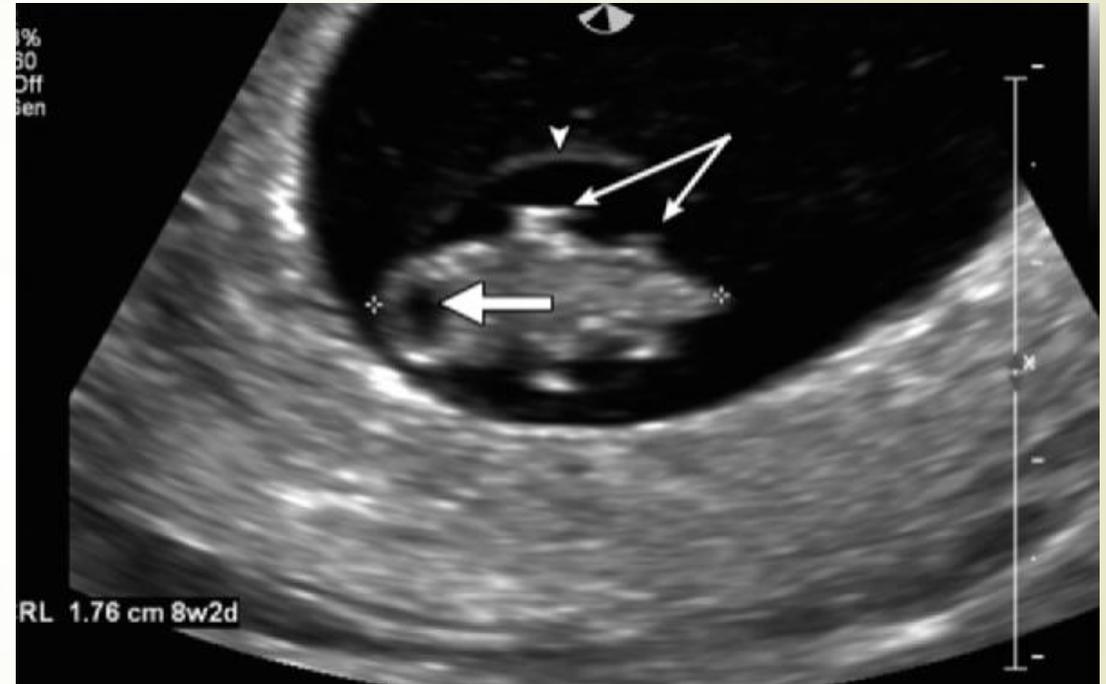
The length of the embryo is measured from the head (crown) to the buttocks (rump), hence the term crown-rump length (CRL) ,which is the most accurate measurement of gestational age through the first 12 weeks of pregnancy.

The embryo should be visualized when the MSD is at least 25 mm .



6.5 - 7 weeks of gestational age

- Visualization of amniotic membrane
- amniotic membrane is thinner than the yolk sac, and although it is seen more easily after 7 weeks, it can be seen as early as 6.5 weeks of gestational age.
- Between 6.5 and 10 weeks of gestation, a linear relationship exists between the diameter of the amniotic cavity and the CRL, with the mean diameter of the amnion 10% larger than that of the CRL.
- In normal gestation, the chorionic cavity, amniotic cavity, and CRL grow proportionally until the onset of fetal urine production at about 10 weeks.
- fusion of the amnion and chorion at 14–16 weeks



6 -7 weeks of GA

Ultrasound established measurement of **7 mm and larger as the CRL** at which **cardiac activity** should be present.

The embryonic heart rate accelerates over the first 6–8 weeks of gestation, with the lower limit of normality near 100 beats per minute at 6.2 weeks of gestation and 120 beats per minute at 6.3–7.0 weeks of gestation.

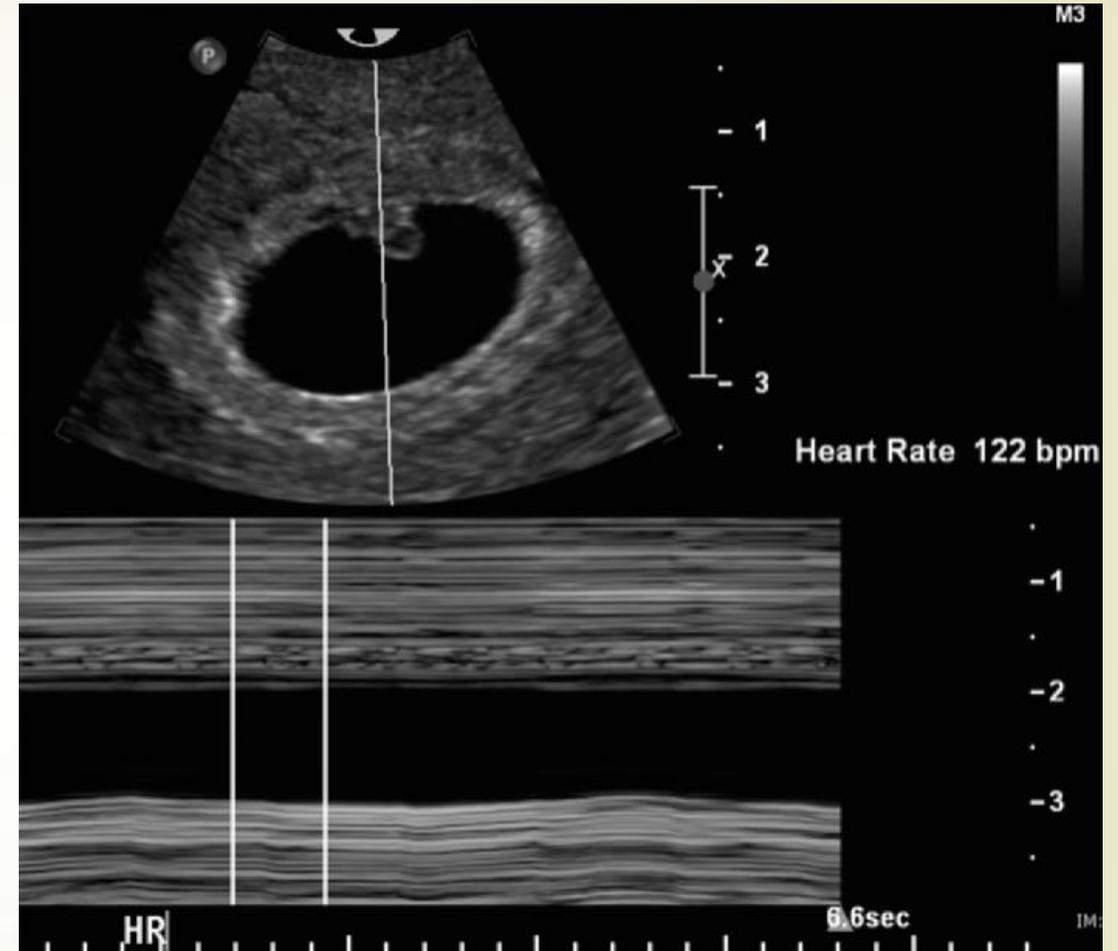


Table 2: US Findings Diagnostic of Pregnancy Failure

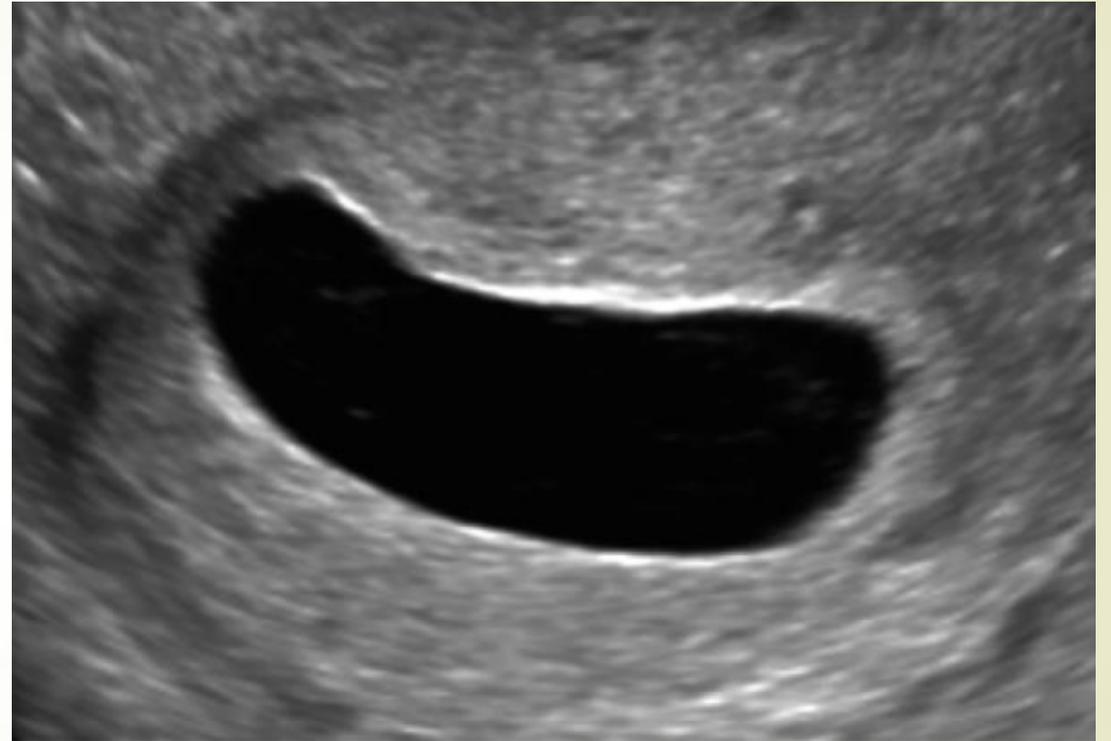
Finding	Imaging Appearance
Absent cardiac activity by the time the CRL is a certain size	CRL \geq 7 mm with no heartbeat
Absent embryo by the time the gestational sac is a certain size	MSD \geq 25 mm with no embryo
Absent embryo by a certain point in time; requires two US examinations	Absence of embryo with a heartbeat 2 or more weeks after US showed gestational sac without yolk sac Absence of embryo with a heartbeat 11 or more days after US showed gestational sac with yolk sac



- ▶ Endovaginal US image shows a nonviable IUP. An amorphous embryo (arrowhead) is seen with a CRL of 20 mm, projecting to a gestational age of 8 weeks 4 days, but there was no cardiac activity. These findings are consistent with a nonviable IUP because the CRL measures at least 7 mm. Note the irregular gestational sac contour (arrow), a sign of poor prognosis.

Endovaginal US image demonstrates a nonviable IUP. There is an empty gestational sac with an MSD of 29 mm.

Fine linear echogenic debris is noted in the sac, but there is no yolk sac or embryo. The estimated gestational age is 8 weeks 1 day. The findings are in keeping with nonviable IUP because the MSD measures at least 25 mm



Endovaginal US images show findings of uncertain pregnancy viability at initial US and a nonviable IUP at follow-up US. (a) Initial image shows a round gestational sac that contains a yolk sac (arrow) and a possible adjacent embryo. The MSD is 14 mm, projecting to a gestational age of 6 weeks 1 day. (b) Follow-up image obtained 13 days later shows lack of appropriate growth of the gestational sac, with an MSD of 16 mm, projecting to a gestational age of 6 weeks 3 days. There is a 4-mm embryo (single arrowhead) within an expanded amnion (arrow). No cardiac activity was detected. A yolk sac is present (double arrowhead). Findings are diagnostic of pregnancy failure

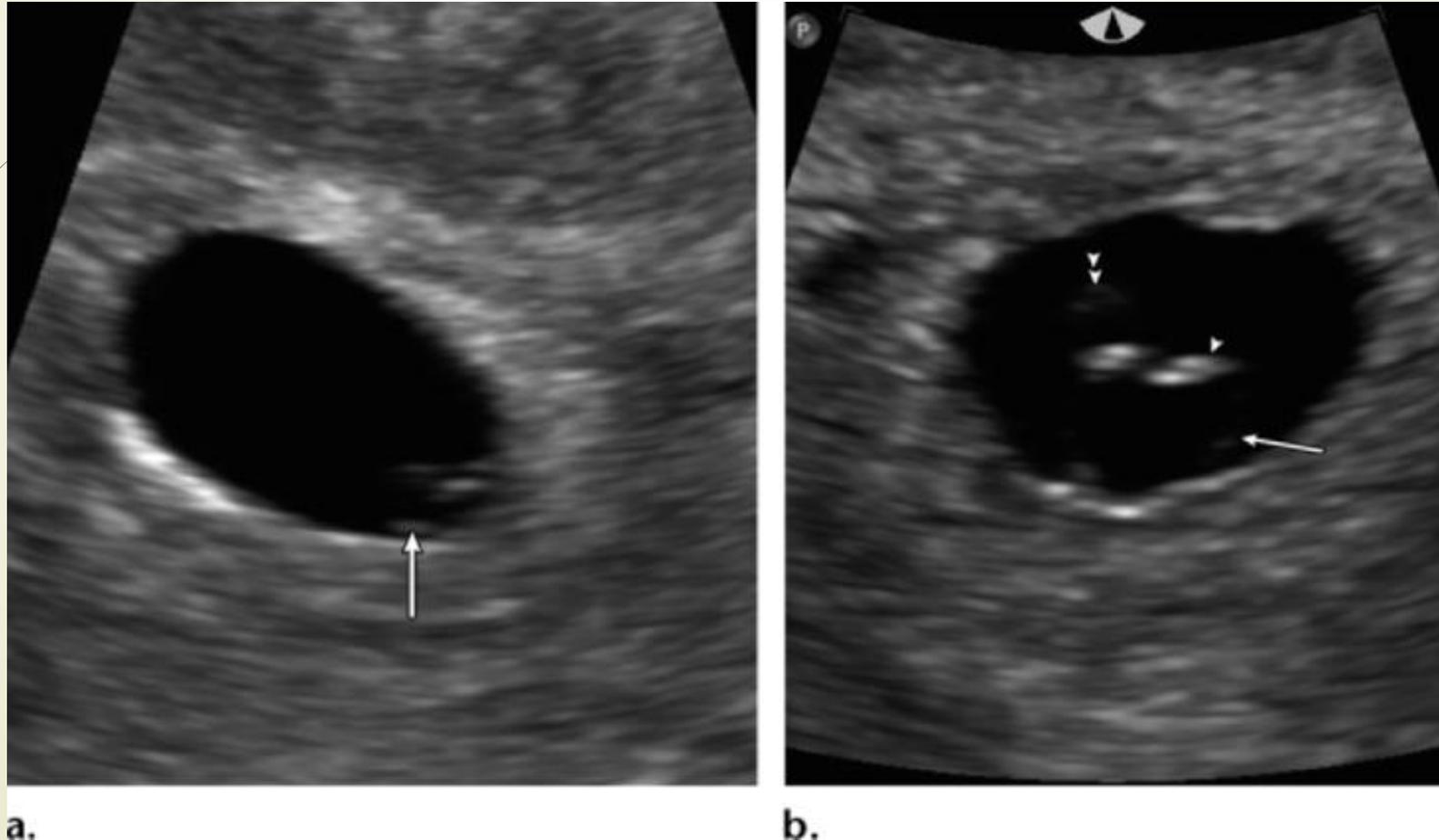


Table 3: US Findings Suspicious for, but Not Diagnostic of, Pregnancy Failure

Finding	Imaging Appearance
Absent cardiac activity by the time the CRL is a certain size	CRL <7 mm with no heartbeat
Absent embryo by the time the gestational sac is a certain size	MSD of 16–24 mm with no embryo
Absent embryo by a certain point in time	Absence of embryo with a heartbeat 7–13 days after US showed gestational sac without yolk sac Absence of embryo with a heartbeat 7–10 days after US showed gestational sac with yolk sac Absence of embryo 6 or more weeks after last menstrual period
Morphology of gestational sac, amnion, and yolk sac	Empty amnion (amnion seen adjacent to yolk sac, with no visible embryo), enlarged yolk sac (>7 mm), small gestational sac in relation to size of embryo (<5-mm difference between MSD and CRL)

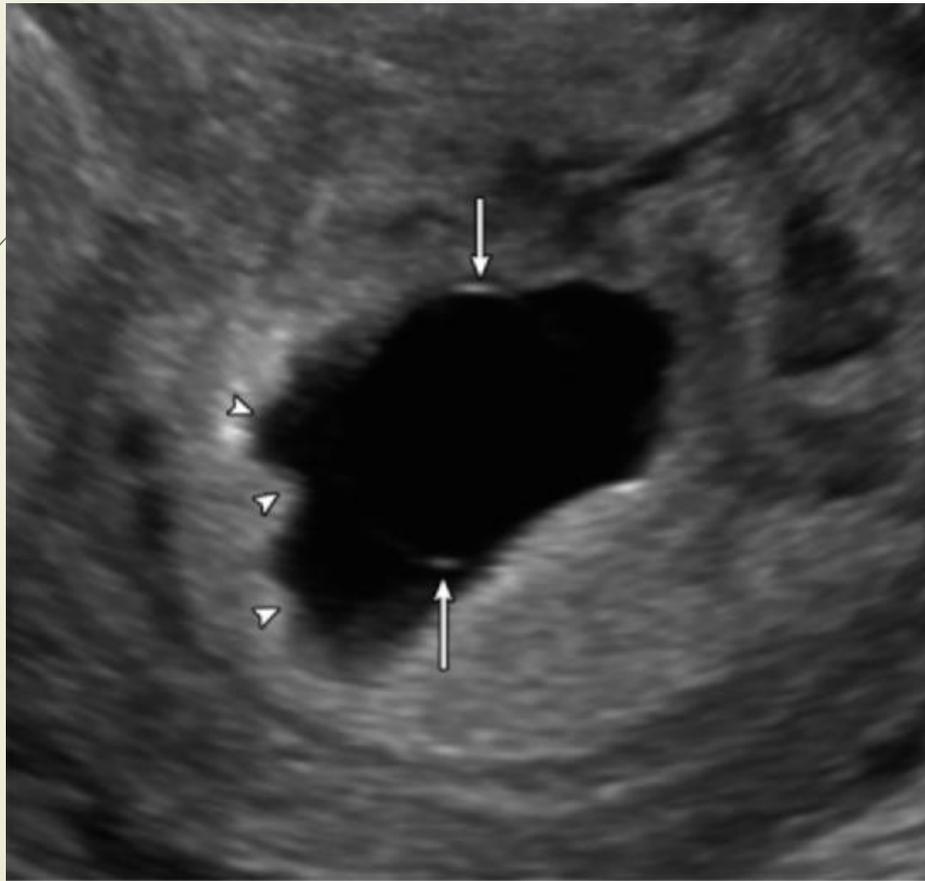


Table 4: US Indicators of Poor Prognosis in Early Pregnancy

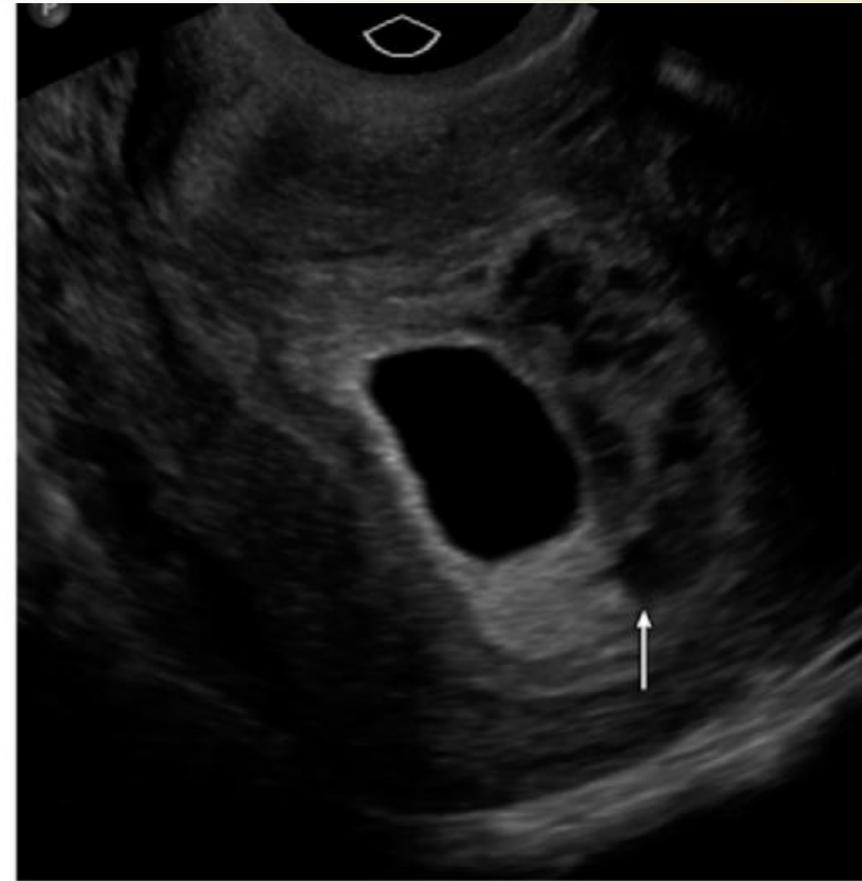
Feature	Imaging Appearance
Gestational sac	Irregular contour, low-lying position
Yolk sac	Calcified, larger than 7 mm
Amnion	Empty, enlarged, or expanded
Embryo	Amorphous shape
Cardiac activity	Bradycardia of 85 beats/min or less
Chorionic villi	Hydropic change
Subchorionic hemorrhage	Large, particularly if it encircles at least two-thirds of the gestational sac circumference

Endovaginal US images show findings suspicious for but not diagnostic of pregnancy failure at initial US and findings of nonviable IUP at follow-up US. (a) Initial findings are suspicious for pregnancy failure but not diagnostic.

There is **an irregular gestational sac** (arrowheads) with an MSD of 17 mm, an **enlarged empty amnion** (arrows), and no embryo or yolk sac. (b) Follow-up image obtained 10 days later shows a nonviable IUP. There is a lack of appropriate interval growth of the gestational sac and no embryo. Note **the hydropic changes in the chorionic villi** (arrow). The MSD is 19 mm, projecting to a gestational age of 6 weeks 6 days.



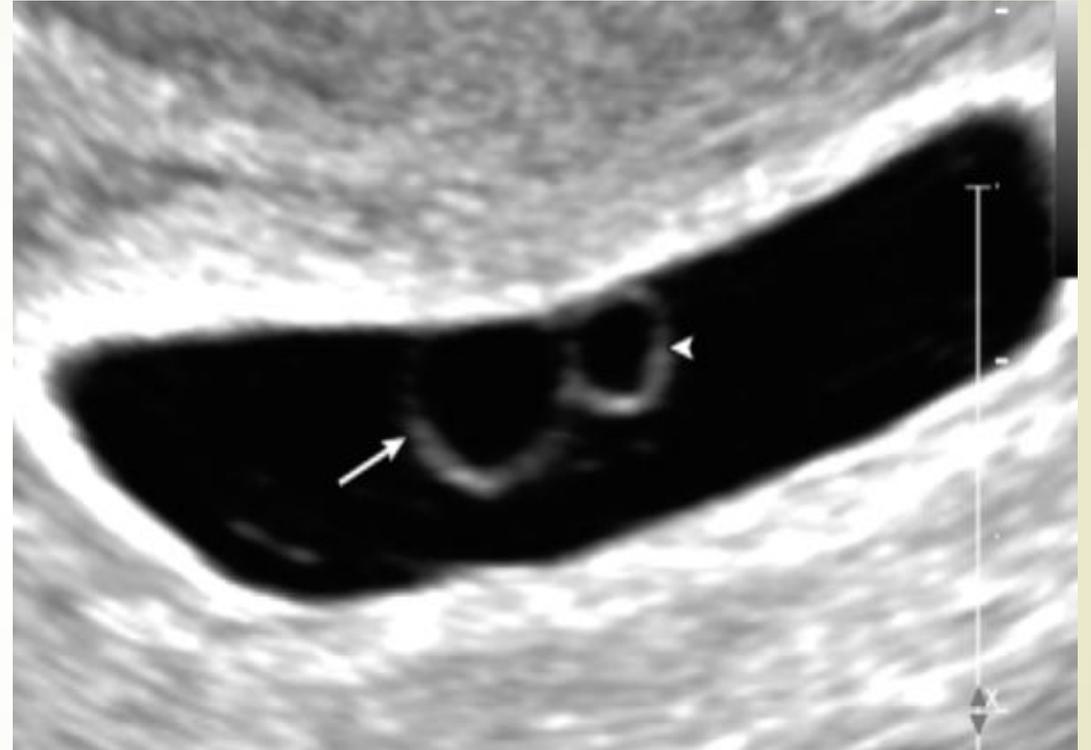
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b.

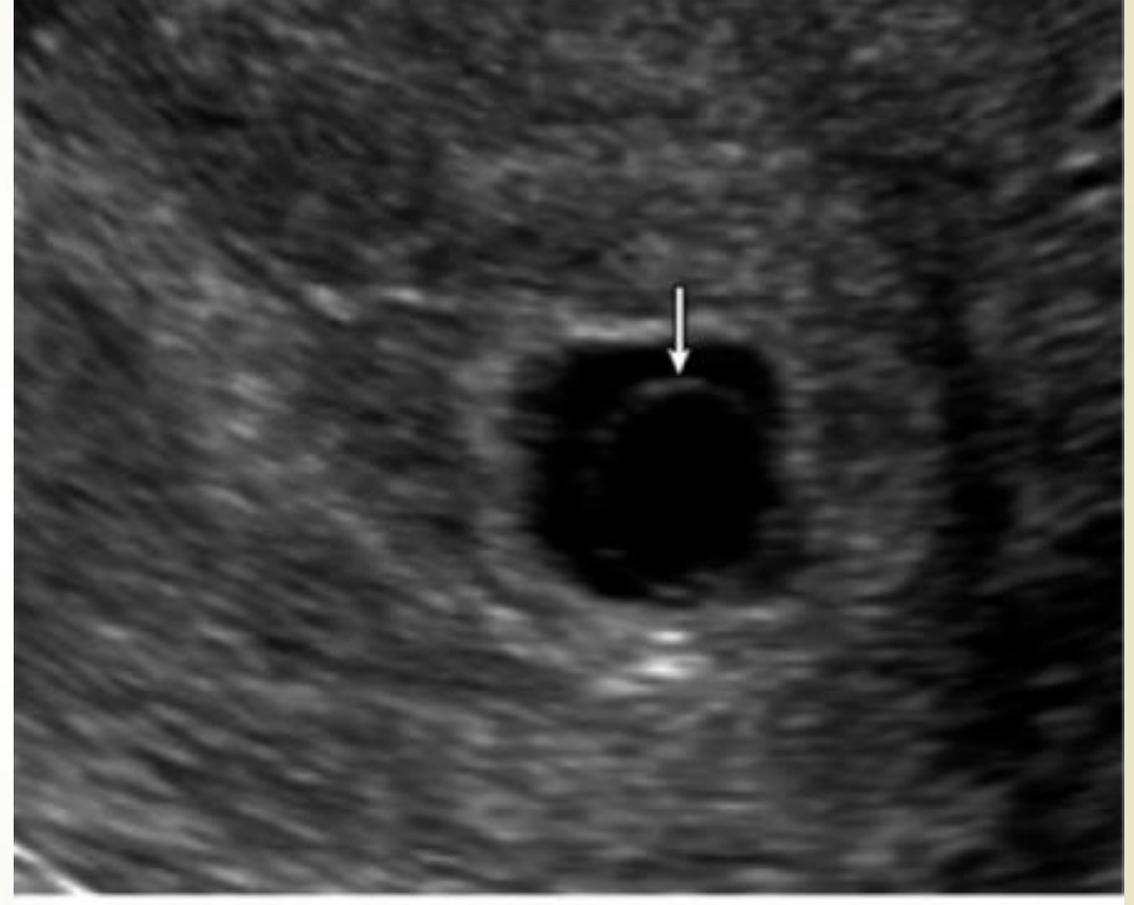
an “empty amnion,” a sign of poor prognosis.

An empty amnion (arrow) is seen adjacent to a normal yolk sac (arrowhead). The MSD is 2.2, projecting to an estimated gestational age of 7 weeks 2 days. An embryo should be present within the amnion in a normal IUP



an enlarged yolk sac, a sign of poor prognosis

An enlarged 7-mm yolk sac (arrow) is seen within an irregular gestational sac with an MSD of 10 mm, projecting to a gestational age of 5 weeks 5 days, and contains no embryo. Findings are suspicious for pregnancy failure but are not diagnostic



Initial image shows a gestational sac with an MSD of 14 mm, projecting to a gestational age of 6 weeks 1 day.

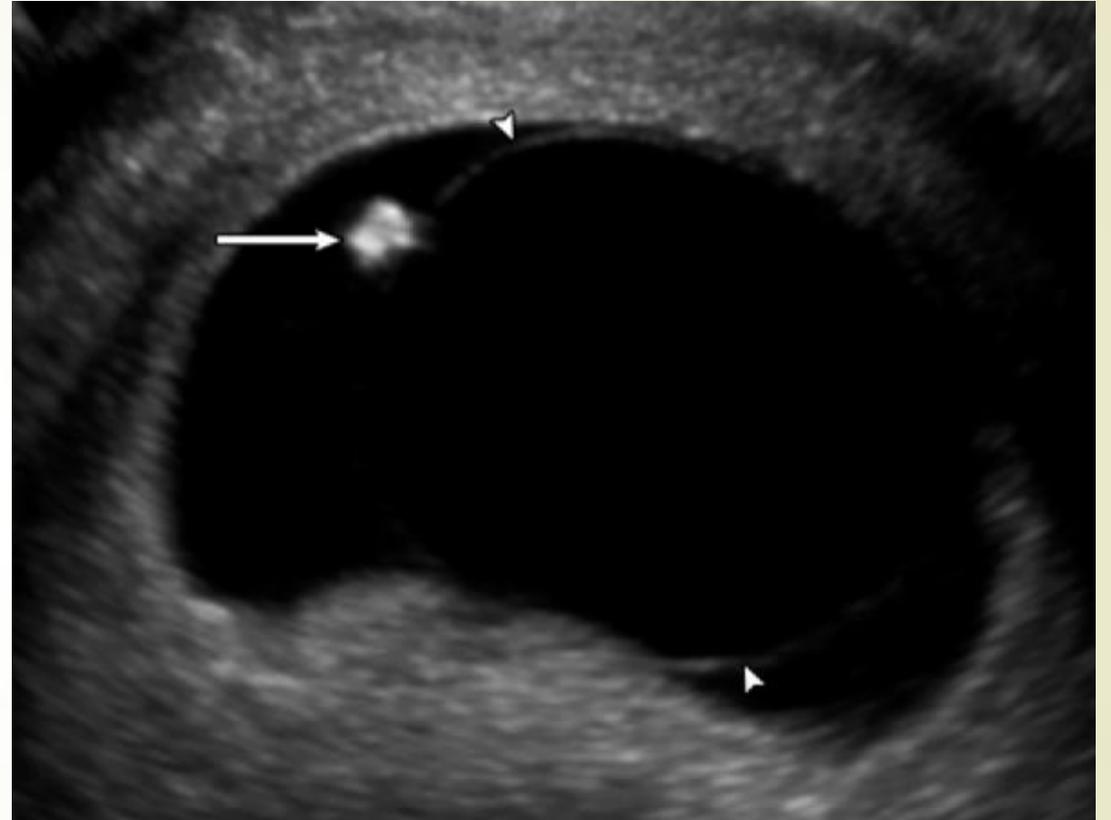
The sac contains an embryo with a CRL of 11 mm, projecting to a gestational age of 7 weeks 3 days.

The difference between the MSD and CRL is less than 5 mm, a sign of poor prognosis



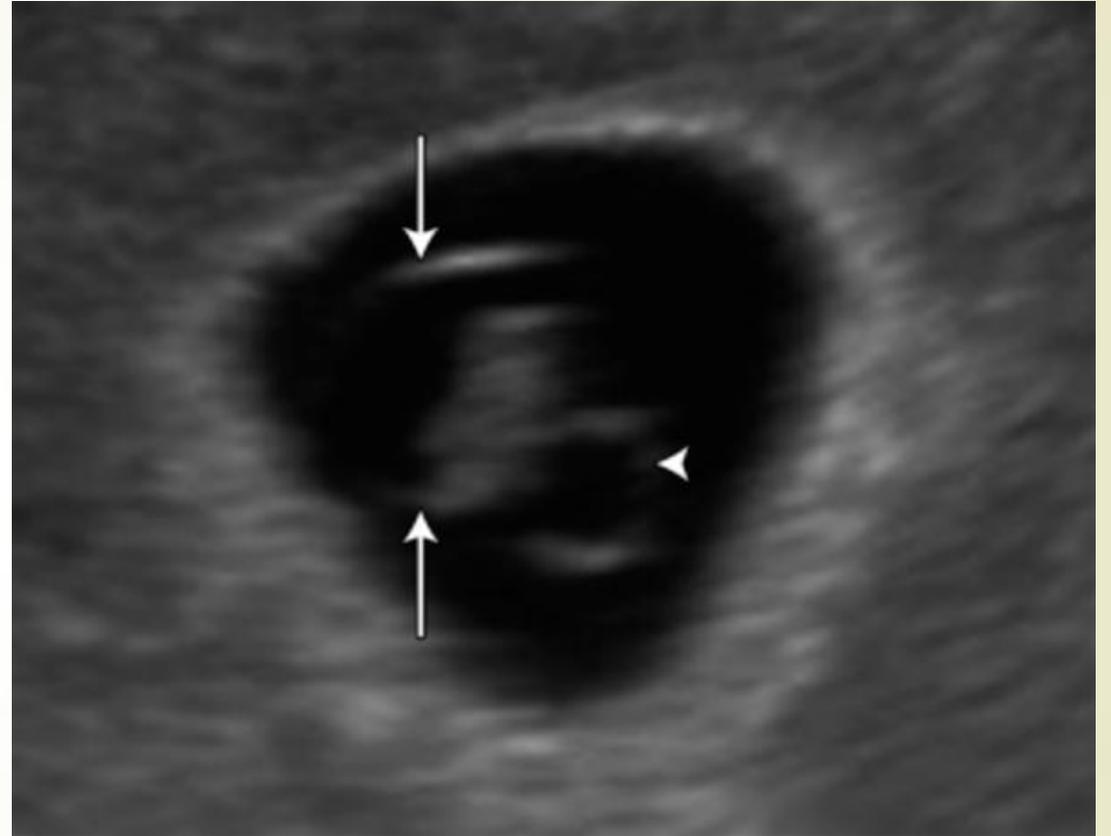
calcified yolk sac

a calcified yolk sac (arrow), which is a sign of poor prognosis. There is also an enlarged amnion (arrowheads). The CRL (not shown) was 20 mm, projecting to an estimated gestational age of 8 weeks 5 days, and no cardiac activity was seen, findings consistent with a nonviable IUP.



expanded amnion,

An expanded amnion, which is a sign of poor prognosis. The expanded amnion (arrows) surrounds a 5-mm embryo that lacked cardiac activity on M-mode images. Note the adjacent yolk sac (arrowhead). The MSD is 14 mm, projecting to a gestational age of 6 weeks 1 day.



Large subchorionic hemorrhage

A large hypoechoic collection (arrows) separates the chorion from the echogenic decidua and encircles almost one-half of the circumference of the gestational sac.

The risk of pregnancy loss is doubled in large hematomas, particularly when there is **encirclement of more than two-thirds of the chorionic circumference**





Pregnancy of Unknown Location

- ▶ Pregnancy of unknown location is the term given to the transient state of early pregnancy during which no definite IUP is visualized at US and the adnexa are normal—in other words, a “normal” pelvic US finding.

At this stage, the three main possibilities include:

- ▶ early IUP
- ▶ occult ectopic pregnancy
- ▶ completed spontaneous abortion.

Endovaginal US images in a pregnant woman show a pregnancy of unknown location, with an IUP seen at follow-up US. (a) At initial US, the patient had a b-hCG level of 334 mIU/mL (334 IU/L) and demonstrated a normal endometrium, no intrauterine fluid collection, and normal adnexa—essentially “normal” pelvic US findings. The differential diagnosis was early IUP, occult ectopic pregnancy, or completed spontaneous abortion. (b) Follow-up image obtained 7 days later shows a rounded intrauterine fluid collection with intradecidual and double sac signs, findings that confirm IUP. The MSD is 6 mm, projecting to a gestational age of 5 weeks 1 day. The b-hCG level increased to 4410 mIU/mL (4410 IU/L)



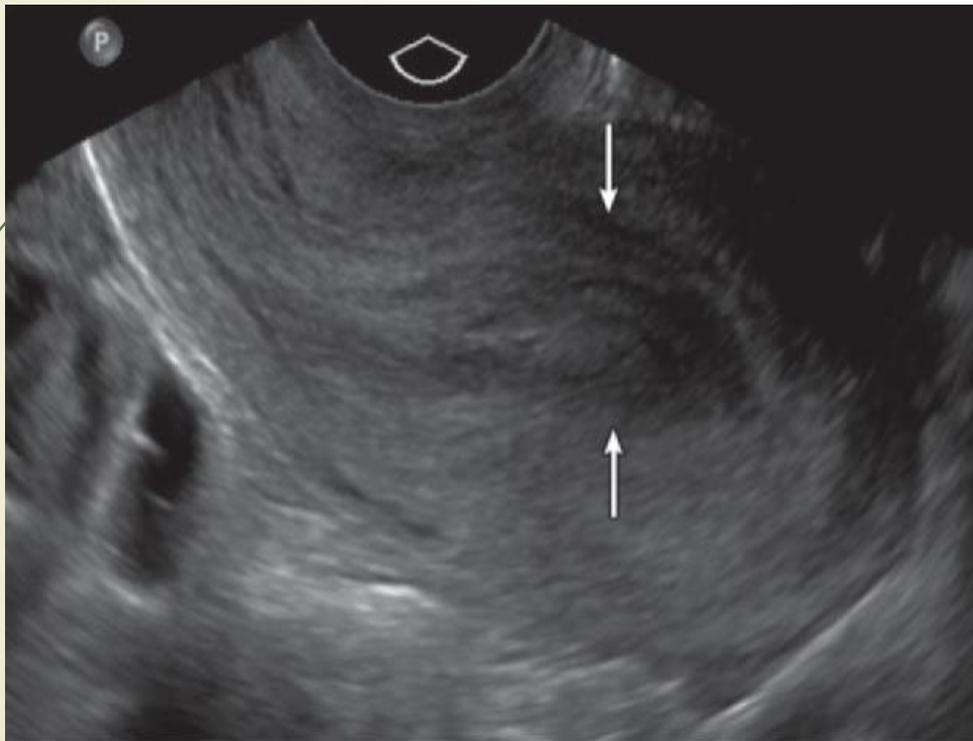
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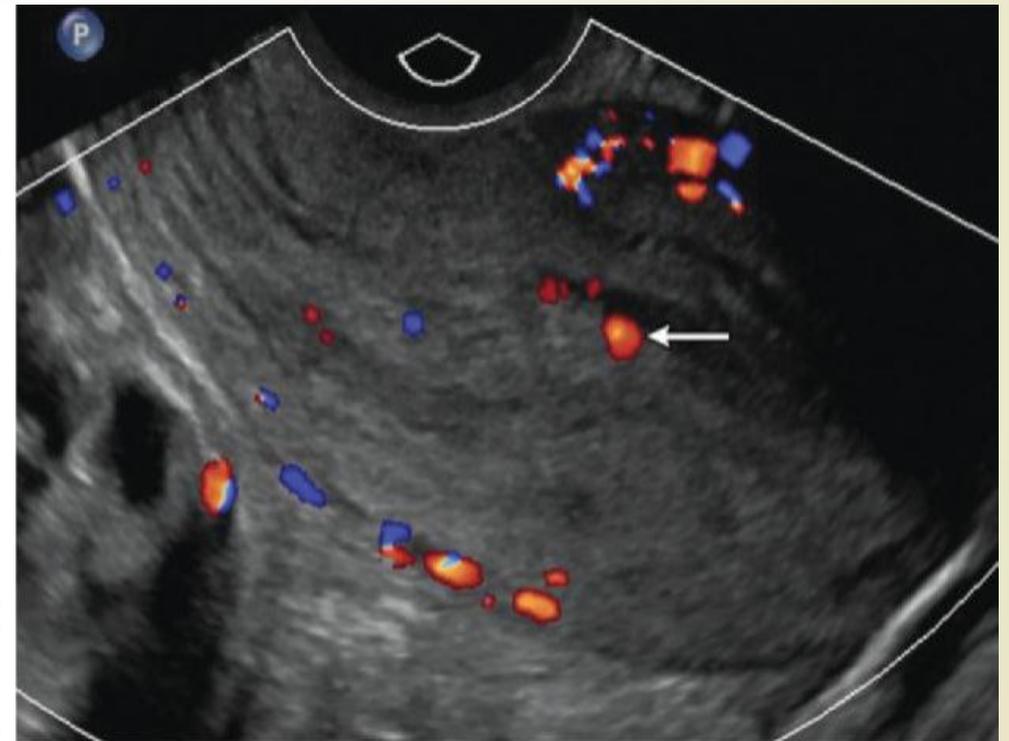
b.

Endovaginal US images in a pregnant woman with vaginal bleeding and a b-hCG level of 24,670 mIU/mL (24,670 IU/L)

show a pregnancy of unknown location, with findings favoring abortion in progress. (a) Image shows a retroverted uterus with an expanded uterine cavity (arrows) due to heterogeneous echogenic material that represents blood products. No gestational sac is identified. The adnexa are normal, with no blood seen in the pelvis. (b) Color Doppler US image shows focal trophoblastic flow at the endometrial-myometrial junction (arrow), a finding that suggests the pregnancy implantation site.



a.



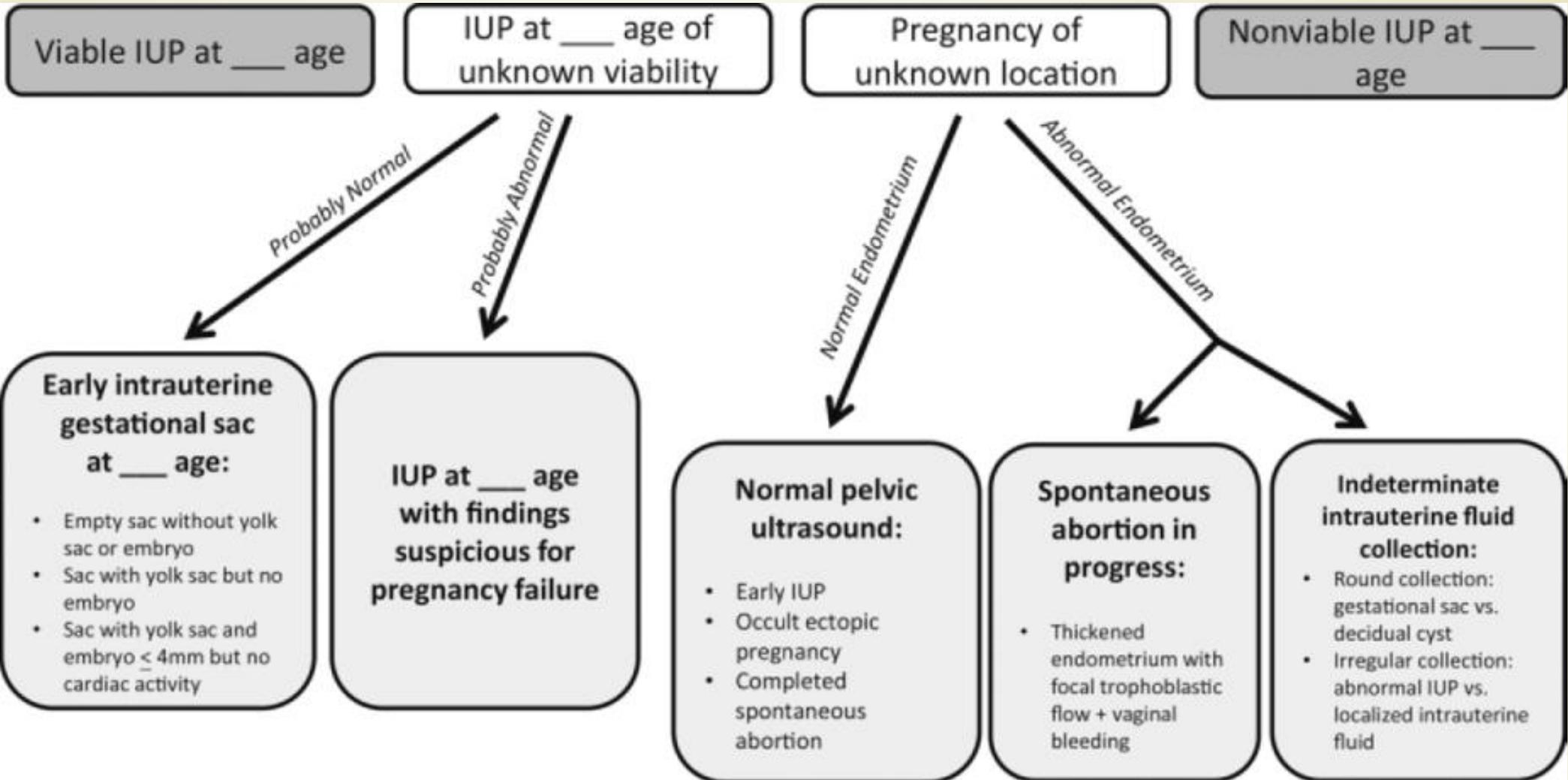
b.

IUP of unknown viability

IUP of unknown viability can apply to normal situations before development of an embryo that has cardiac activity including an empty sac, a sac with a yolk sac but no embryo, and a sac with a yolk sac and an embryo smaller than 4 mm but no cardiac activity.

A second category of unknown viability applies when there are findings suspicious for pregnancy failure (signs of poor prognosis).

follow-up US to confirm normal development of the pregnancy is recommended.





Conclusion

- ▶ Regardless of the variable imaging features, the principle to remember is that if there is a potential IUP, methotrexate should not be administered to the patient. If the patient is stable, follow-up endovaginal US should be performed, and b-hCG levels should be obtained.
- ▶ our goal must be to protect both mother and baby by providing accurate and clear interpretations that lead to intervention only in cases of definitively failed IUP or visualized ectopic pregnancy.



سیاس از توجه و همراهی شما