

# EARLY FIRST TRIMESTER

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## Objectives

- Normal IUP
  - Pregnancy of unknown location
  - Criteria for early pregnancy loss
  - Early pregnancy dating
  - Multiple gestations
  - Early anomalies
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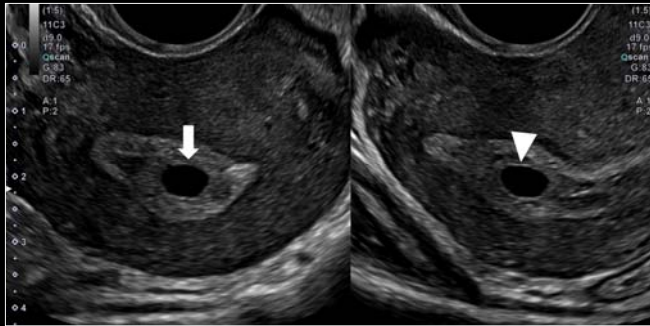
## How early can we see an IUP?

- Before 4-5 weeks, GS not visible on ultrasound
- Thickened endometrium is earliest sign of IUP \*  
*Not specific*  
*Endometrial thickness  $\leq 8$  mm suspicious for abnormal pregnancy*
- GS first visible at 4.5-5 weeks  
*2-3 mm intrauterine fluid collection with curved edges*

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\*Spandorfer and Barnhart 1994

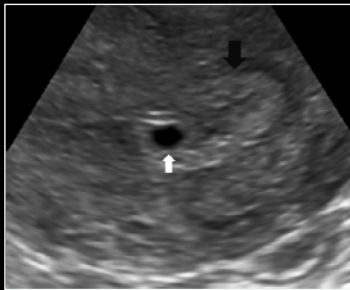
## Gestational Sac



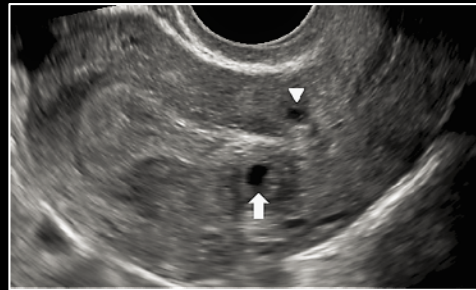
Features of the Early GS:

- ❖ *Round or ovoid shape*
- ❖ *Eccentrically situated within the thickened endometrium*
- ❖ *May see an echogenic rim*

## IUP vs Other Cystic Lesions

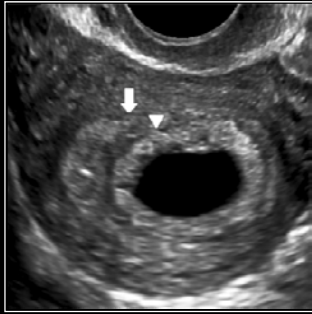


Eccentrically located GS

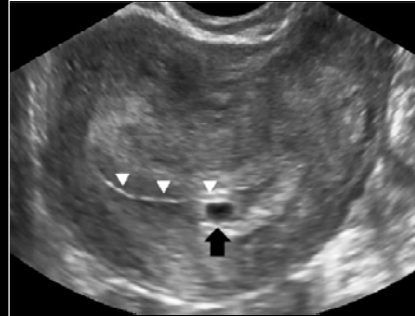


Subendometrial cysts seen external to the endometrium

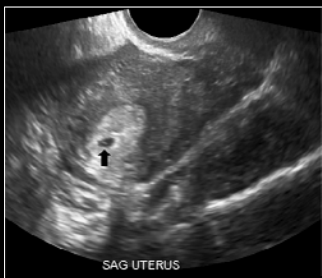
## Double Sac Sign and Intradecidual Sign



Concentric echogenic rings representing layers of decidualized endometrium



Echogenic collapsed endometrial cavity extending to eccentrically located GS



## Pseudosac vs IUP

- ❖ A round/oval fluid collection in a woman with a positive pregnancy test represents an early intrauterine pregnancy.
- ❖ As cardiac activity is not yet seen, this is reported as a pregnancy of unknown viability.
- ❖ This should not be reported as possible ectopic pregnancy with pseudosac.

## It's all in the math...

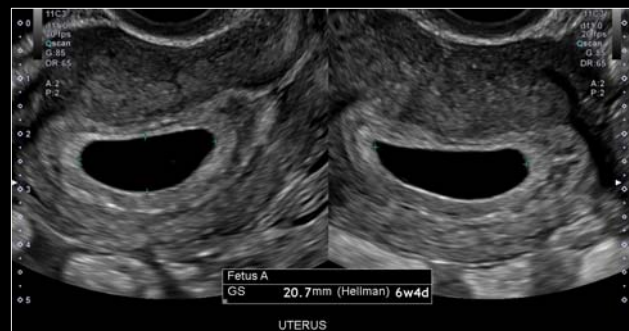
- 99.5% probability that a non-specific round, empty intrauterine fluid collection in a woman with a positive B-hcg test represents an intrauterine pregnancy

*Low incidence of ectopic pregnancy coupled with low incidence of intrauterine fluid in the setting of ectopic pregnancy*

Benson and Doubillet 2010

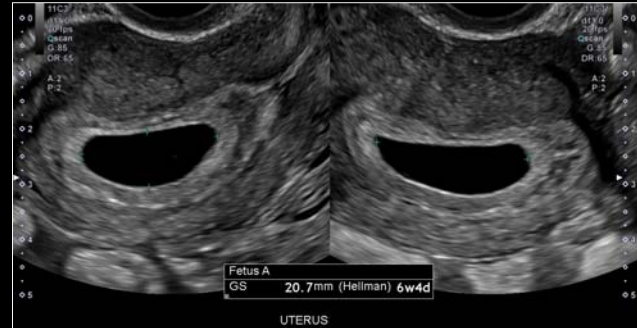
## Mean Sac Diameter

- Measurement of the gestational sac in three orthogonal planes
- Normograms to correlate with gestational age  
*If embryo is visible, CRL is more reliable for dating*
- Rate of growth of MSD is reported at around 1.1 mm/day but this is variable



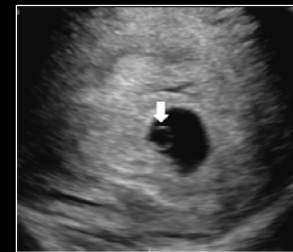
## Poll Question: What is diagnosis?

- A. Early pregnancy loss
- B. Intrauterine Pregnancy of Unknown Viability
- C. Pregnancy of Unknown Location
- D. Early viable intrauterine pregnancy



## Yolk Sac

- First definitive sign of an intrauterine pregnancy
- Represents primary maternal-fetal transport system
- Usually visible at 5.5 weeks when MSD reaches 8 mm
- Usually regresses by 10 weeks



### Appearance of normal yolk sac:

- (1) 3-5 mm thin echogenic circular structure eccentrically located within GS
- (2) Two echogenic parallel lines representing leading edge and posterior wall

## Embryo

- First visible at around 6 weeks
- 1-2 mm structure at edge of yolk sac
- Early embryo featureless without limb buds or distinct cranial or caudal end
- Longest length is measured and represents crown-rump length

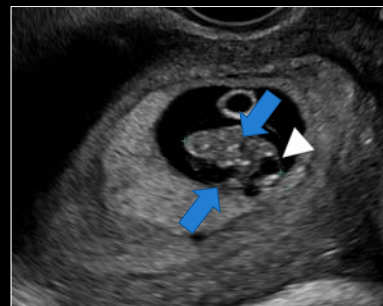


## The Developing Embryo



5 weeks 1 day

- Featureless linear echogenic structure



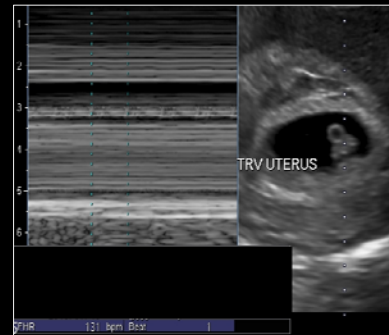
8 weeks 1 day

- Distinct cranial and caudal end
- Rhombencephalon
- Limb buds

## Embryonic Cardiac Activity

- Cardiac pulsation can be seen at 6 weeks
- Measured with M mode
- Fetal bradycardia:
  - < 100 bpm up to 6.2 weeks
  - < 120 bpm 6.3 to 7 weeks

Although ECA is virtually universally identified by CRL or 4-5 mm, the absence of ECA cannot be considered abnormal until embryo reaches 7 mm



## Normal Sequence of Early Pregnancy

Week 0: LMP occurs

Week 2: Conception

Week 4.5 – 5: Gestational sac appears

Week 5 – 5.5: Yolk sac appears

Week 6– 6.5: Embryo appears; cardiac pulsation begins with lower limit 100 bpm

Week 8: Head curvature separates from body; limb buds appear

Week 8 – 8.5: Intrinsic motion of embryo occurs

Week 8 – 10: Rhombencephalon develops

Rogers et al 2015



## Pregnancy of Unknown Location (PUL)

- Positive B-hcg hormone test (either serum or urine)
- No evidence of intrauterine pregnancy
- No evidence of ectopic pregnancy
- Usually by TVS location of pregnancy can be confirmed in around 90%
- Incidence is 8-31% of women presenting for early pregnancy ultrasounds\*

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Kirk and Bourne 2008

## Pregnancy of Unknown Location: 3 Possibilities



(1) Early intrauterine pregnancy

(2) Occult ectopic pregnancy

(3) Pregnancy loss

## Predicting Outcome in PUL: B-hcg

- Serum B-HCG:
  - ❖ *Historically BHCG >6500 iu/L when no GS sac seen had sensitivity of 100% and specificity 96% for ectopic pregnancy*
  - ❖ *With high-resolution TVS transducers, discriminatory level dropped to 1000-1500 IU/l*

*Due to wide variability in B-HCG levels at which normal IUP and ectopic pregnancy can be seen, a single time-point measurement of B-HCG is not clinically useful in setting of PUL*

## Predicting Outcome in PUL: Progesterone

- Serum progesterone:
  - < 20nmol/L: highly suggestive of nonviable pregnancy*
  - >60 nmol/L strongly associated with viable pregnancy*
  - BUT not predictive of the location of the pregnancy*

Serum progesterone can help determine viability but not differentiate ectopic from intrauterine pregnancy

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## Management of PUL

- Most PULs are not aggressive
  - Clinically stable women can be managed expectantly
  - In most cases uterine curetage does not have a role in classification on PUL
  - Single visit approach to management of PUL is not appropriate
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## DIAGNOSING EARLY PREGNANCY LOSS

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### Findings Diagnostic for EPL

SINGLE-TIME POINT	ON SERIAL ULTRASOUND
EMPTY GESTATIONAL SAC $\geq$ 25 MM	Absence of embryo with heartbeat 2 or more weeks after an US showing a GS without YS
EMBRYO $\geq$ 7 MM WITH NO HEARTBEAT	Absence of embryo with heartbeat 11 or more days after US showing GS with a YS

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## Why so conservative?

- Shift from empty sac of 8 mm to 16 mm to 25 mm due to high inter-rater reliability in measurement and reported false positive rate of 4.4% in one series using cut-off of 16 mm
- Shift from CRL of 5 mm to 7 mm due to false positive rate of 8.3% using cut-off of 5 mm

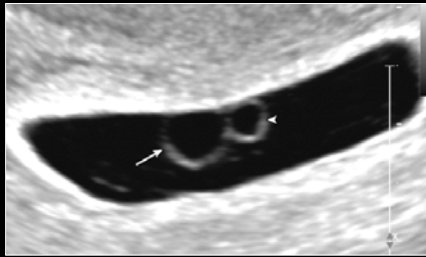
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Abdallah et al 2011

## Findings Suspicious for EPL

- CRL < 7 mm with no heartbeat
- MSD 16-24 mm with no embryo
- Absence of embryo with heartbeat 7-13 days after US showed GS without YS
- Absence of embryo with heartbeat 7-10 days after US showed GS with YS

## US Findings Suspicious for EPL

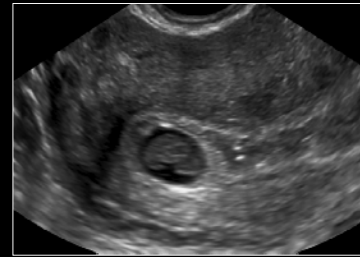


Rogers Radiographics 2011

Empty Amnion



Enlarged Yolk Sac



Small Sac Size

## Subchorionic Hematoma

- Hypoechoic or crescent shaped area behind GS
- Reported in 0.5-22%
- 2011 meta-analysis:  
*Highest risks were spontaneous abortion (9-18%) and preterm delivery (10-14%)*
- 2018 Heller  
*Subjective estimate of SCH as fraction of sac size was best correlated with outcome*  
*SCH >2/3 of chorionic surface higher risk of loss*



Tulli et al 2011



## Early Pregnancy Dating: Why?

- Reduce unnecessary induction for postdates
  - Reduce complications for prolonged postdates
  - Timing interventions and scening
  - Assess viability in prematurity
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## Early Pregnancy Dating: How?

- US dating most accurate in first trimester
  - Use CRL when embryo is seen
  - Measure from top of head to lowest point excluding limbs and yolk sac
  - Optimal timing between 8 -13+6 weeks
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## SOGC GUIDELINES

- Quality ultrasound more accurate than certain menstruate date for determining GA in spontaneous conception
  - Ideally all pregnant women should be offered a first trimester ultrasound but if unavailable second-trimester scan can be used to assess GA
  - If >1 early scan, the earliest US with CrL at least 10 mm should be used  
*Don't need to repeat if CRL <10 mm, use clinical judgement*
  - Between 12-14 weeks, CRL and BP similar accuracy and recommended to use CRL up to 84 mm
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# ACOG GUIDELINES

**Table 1.** Guidelines for Redating Based on Ultrasonography ↗

Gestational Age Range*	Method of Measurement	Discrepancy Between Ultrasound Dating and LMP Dating That Supports Redating
$\leq 13\ 6/7$ wk • $\leq 8\ 6/7$ wk • $9\ 0/7$ wk to $13\ 6/7$ wk	CRL	More than 5 d More than 7 d
$14\ 0/7$ wk to $15\ 6/7$ wk	BPD, HC, AC, FL	More than 7 d
$16\ 0/7$ wk to $21\ 6/7$ wk	BPD, HC, AC, FL	More than 10 d
$22\ 0/7$ wk to $27\ 6/7$ wk	BPD, HC, AC, FL	More than 14 d
$28\ 0/7$ wk and beyond <sup>†</sup>	BPD, HC, AC, FL	More than 21 d

Abbreviations: AC, abdominal circumference; BPD, biparietal diameter; CRL, crown-rump length; FL, femur length; HC, head circumference; LMP, last menstrual period.

\*Based on LMP.

<sup>†</sup>Because of the risk of redating a small fetus that may be growth restricted, management decisions based on third-trimester ultrasonography alone are especially problematic and need to be guided by careful consideration of the entire clinical picture and close surveillance.

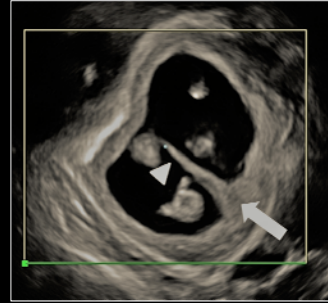
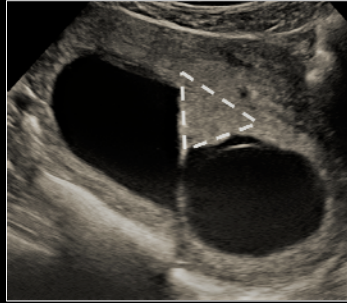
May 2017

## Multiple Gestations

- Globally twin 1-3% of all pregnancies
- 2/3 are dizygotic and 1/3 monozygotic
- Monochorionic twins need early identification for optimal care

*Assignment of chorionicity is a mandatory component of first trimester ultrasound with multiple gestations*

## Chorionicity Assignment



Lambda sign: Triangular shaped placental tissue projecting into inter-twin membrane

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## Chorionicity Assignment



T sign: Absence of lambda sign with 90 degree angle at junction between intertwin membrane and external rim

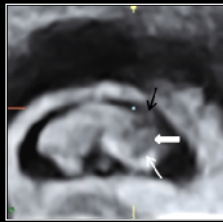
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## Early Anomalies Detection

- Shift towards earlier diagnosis of fetal anomalies into first trimester
- Detection varies depending on experience, equipment, gestational age and other factors
- Checklist approach encouraged

## Early Detection <11 weeks

- Sonoembryology refers to US appearance of developing embryo
- Area of research interest as high resolution and 3D technologies evolve



9 weeks 4 days  
 - diecephalon, mesencephalon  
 metencephalon/myelencephalon



Kurjak et al 2005

## How early is early?



Baken et al 2017

Etrodactyly ectodermal dysplasia-cleft (EEC) syndrome with bilateral split hands and feet.



Kurjak et al 2005

Bladder exstrophy at 10 weeks showing extracorporeal cyst with two umbilical arteries running alongside the cyst.

## Summary

- Round/ovoid intrauterine fluid collection with positive B-hcg should be considered an early IUP
- PUL can be managed expectantly in stable patients
- Empty sac must have MSD  $\geq 25$  mm to diagnose EPL
- CRL must be  $\geq 7$  mm with no cardiac activity to diagnose EPL
- Follow-up scans in stable patients should be performed at longer intervals (10+ days) for IUP of unknown viability

## Summary

- US is most accurate method to date pregnancy, use CRL between 8-13+6 weeks
  - Chorionicity should be assigned in the first trimester for all multiple gestations
  - Early anomalies detection is possible and growing area of interest
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