Pregnancy Unknown Location

PUL

"BE STEADFAST, IMMOVABLE, ALWAYS ABOUNDING IN THE WORK OF THE LORD, KNOWING THAT IN THE LORD YOUR LABOR IS NOT IN VAIN."

"Be strong and immovable…" 1 Corinthians 15:58

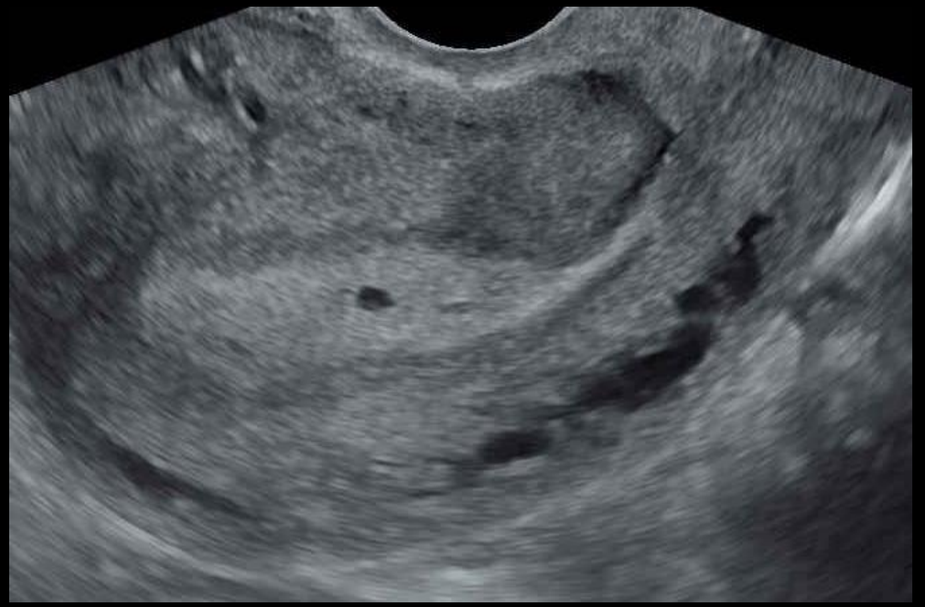
PUL - Pregnancy Unknown Location

- Incidence: 8-10%
- Occurrence: varies with accuracy of LMP, skill of sonographer,
- Sonographic Finding: empty uterus (with +PT); 20% have pseudo sac
- Differential Diagnosis: early IUP, abnormal IUP, spontaneous miscarriage, ectopic pregnancy
- Prognosis: majority prove to be IUP (56%), ectopic (31%), miscarriage (13%)

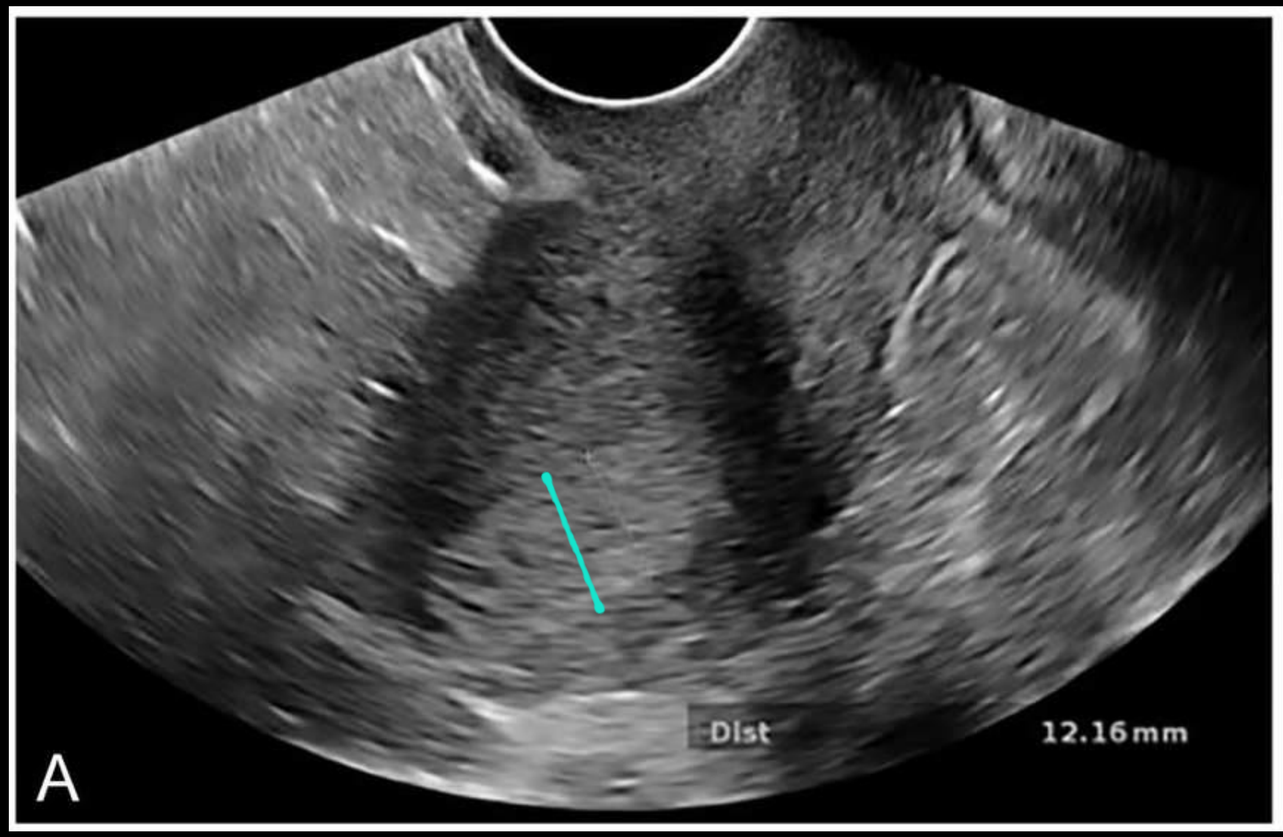
Is the endometrial stripe (ES) an indicator of a normal IUP?

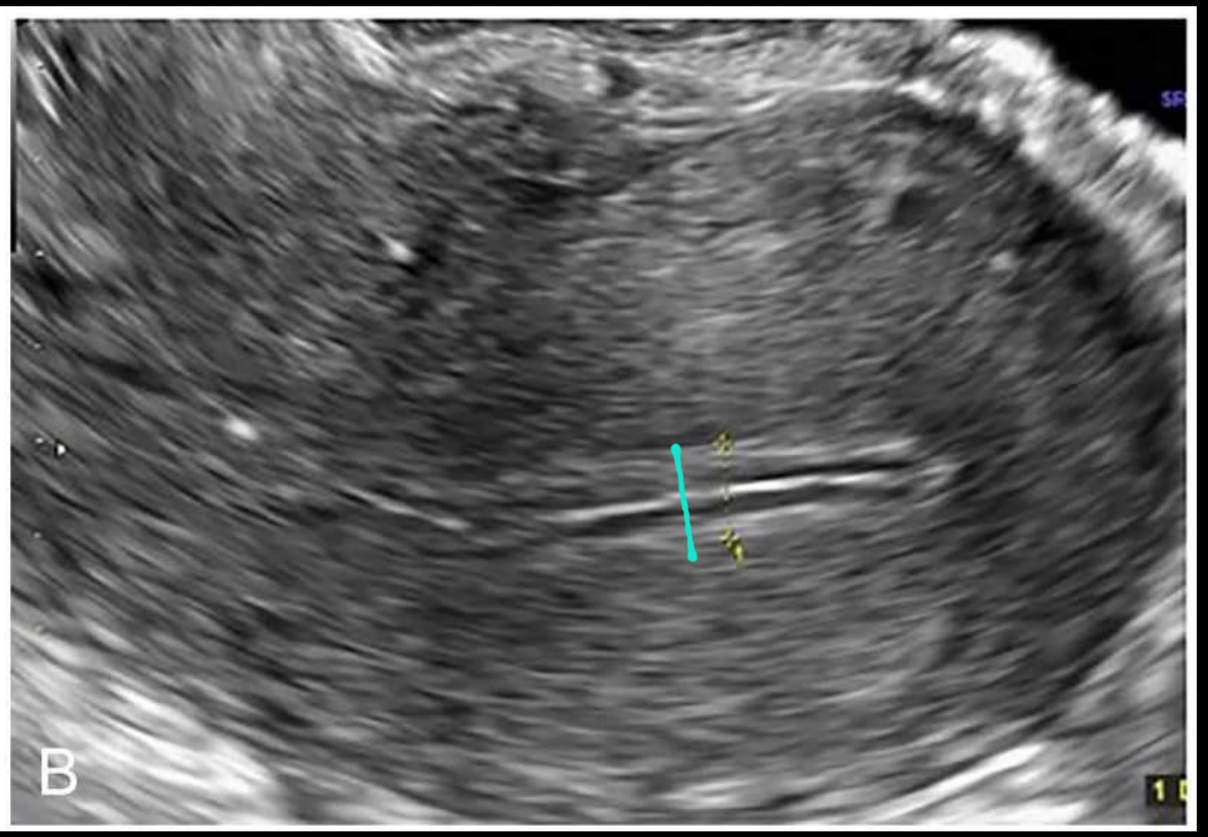
Pregnancy

chorio decidual reaction



echogenic endometrium



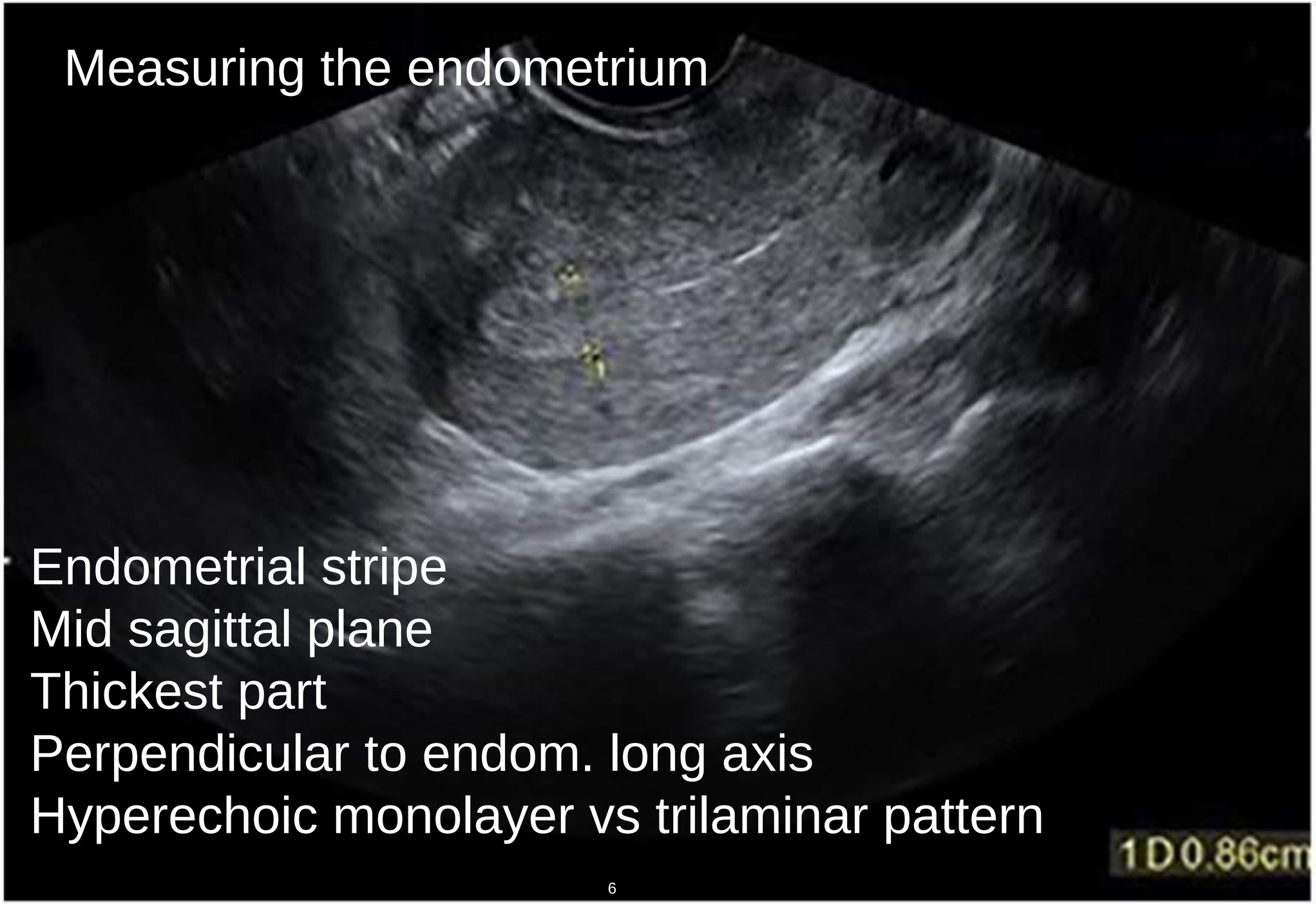


Hyperechoic monolayer
confirmed IUP

Trilaminar (27%)
confirmed Ectopic

JDMS, "Predicting the Outcome of a PUL: Endometrial Stripe"

Measuring the endometrium



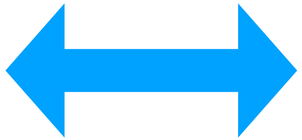
- Endometrial stripe
- Mid sagittal plane
- Thickest part
- Perpendicular to endom. long axis
- Hyperechoic monolayer vs trilaminar pattern

PUL Outcomes

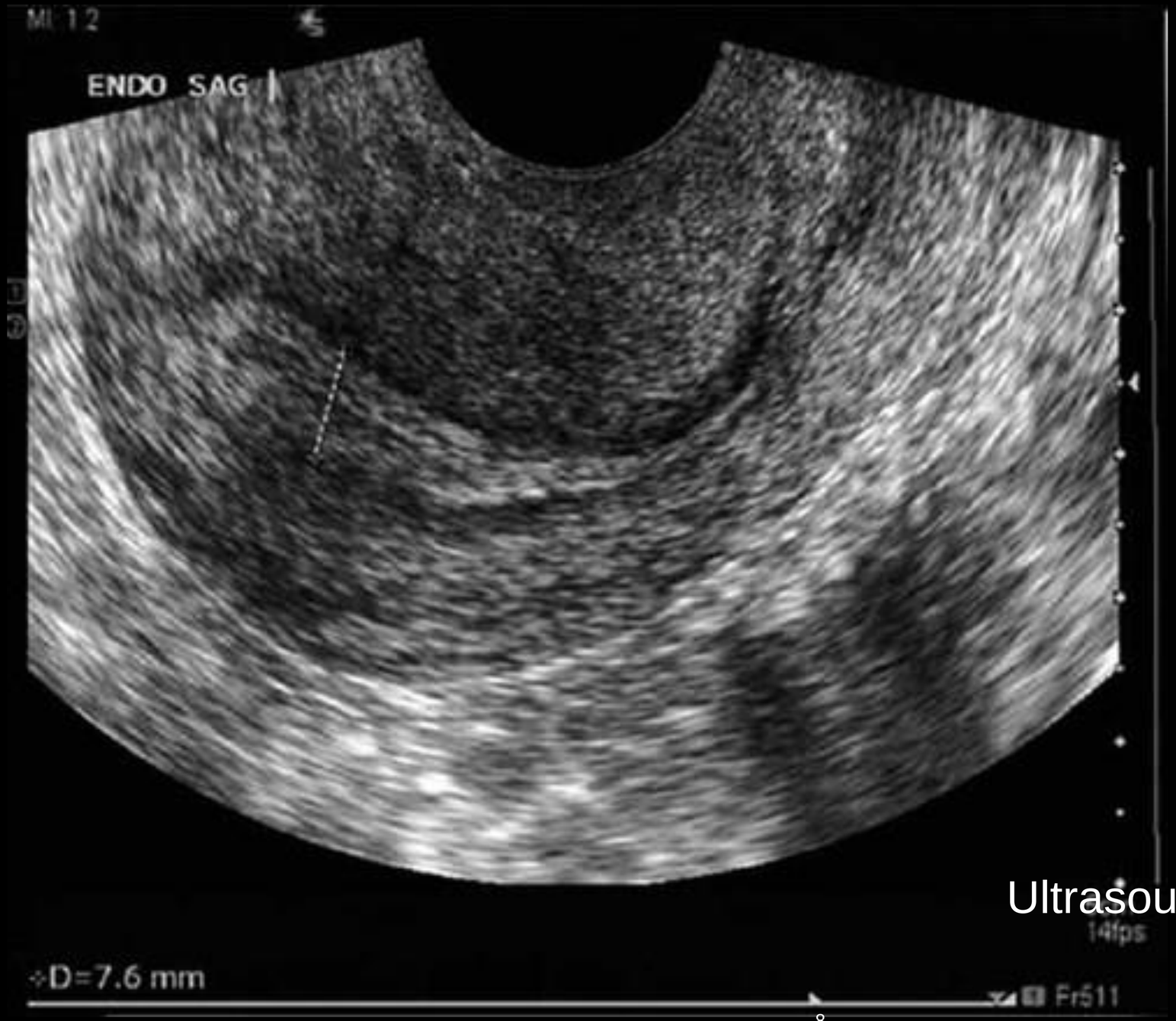
Table 1. The Mean Endometrial Thickness Given Different Types of Pregnancy Outcomes.

Pregnancy outcome	Mean (mm)	Standard deviation (mm)
Intrauterine pregnancy	14.8	5.3
Ectopic pregnancy	10.3	6.1
Early pregnancy failure	9.7	5.5

*One-way ANOVA test was used. ANOVA = analysis of variance.
†Significant *P* value.

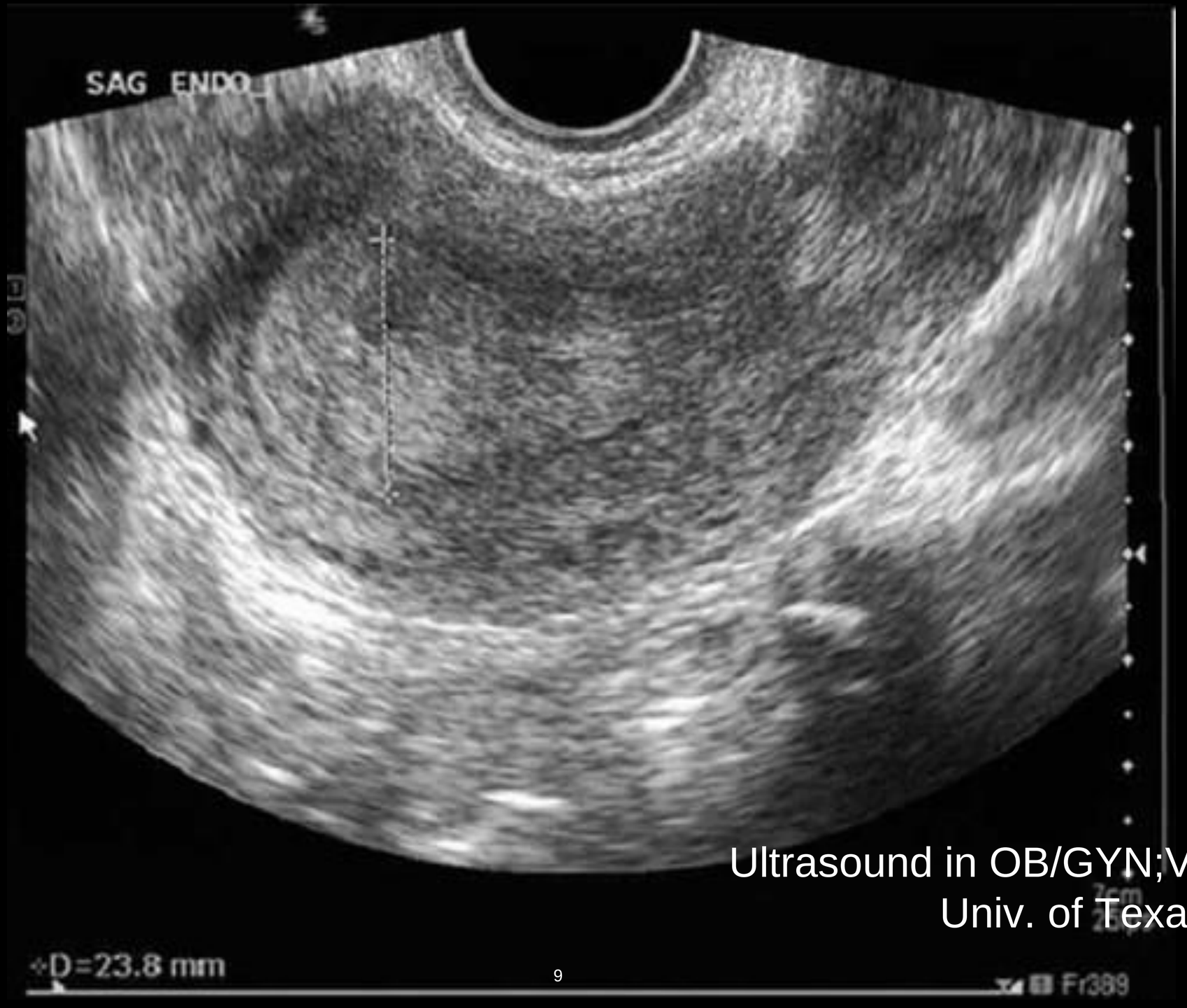


330 participants in Iran Medical School



Pregnancy Loss

Ultrasound in OB/GYN;Vol32.Issue7
Univ. of Texas



IUP

Ultrasound in OB/GYN;Vol32.Issue7
Univ. of Texas

Study: Predicting Ectopic Pregnancy
Result: Cut-off Endom. stripe 11 mm

Sensitivity 73% (positive correlation)
Specificity 39%
Positive predictive value 56%
Negative predictive value 85.5%

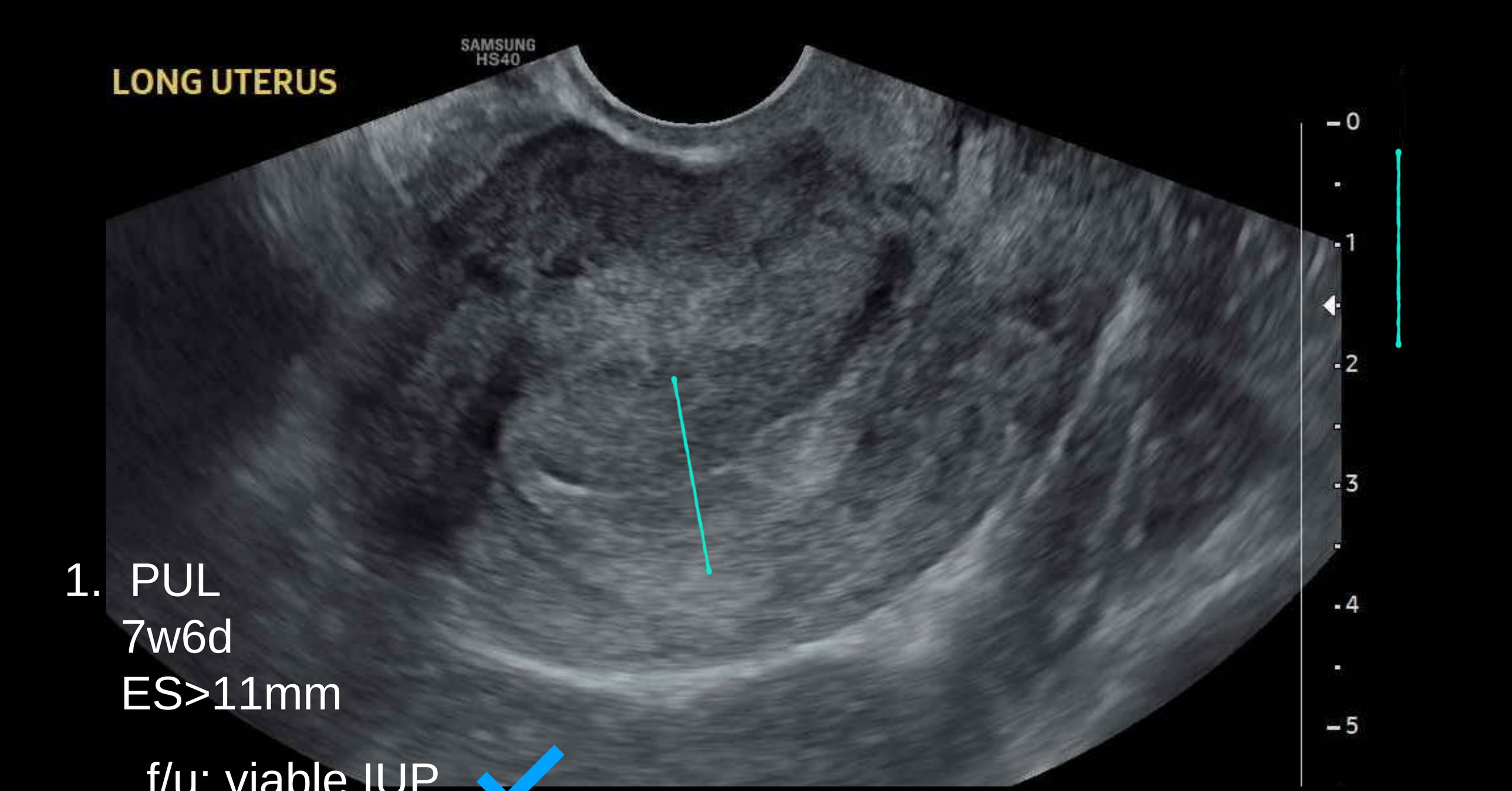
Negative predictive value means not ectopic!

Poll: What do you think?

Do you believe there is a correlation?

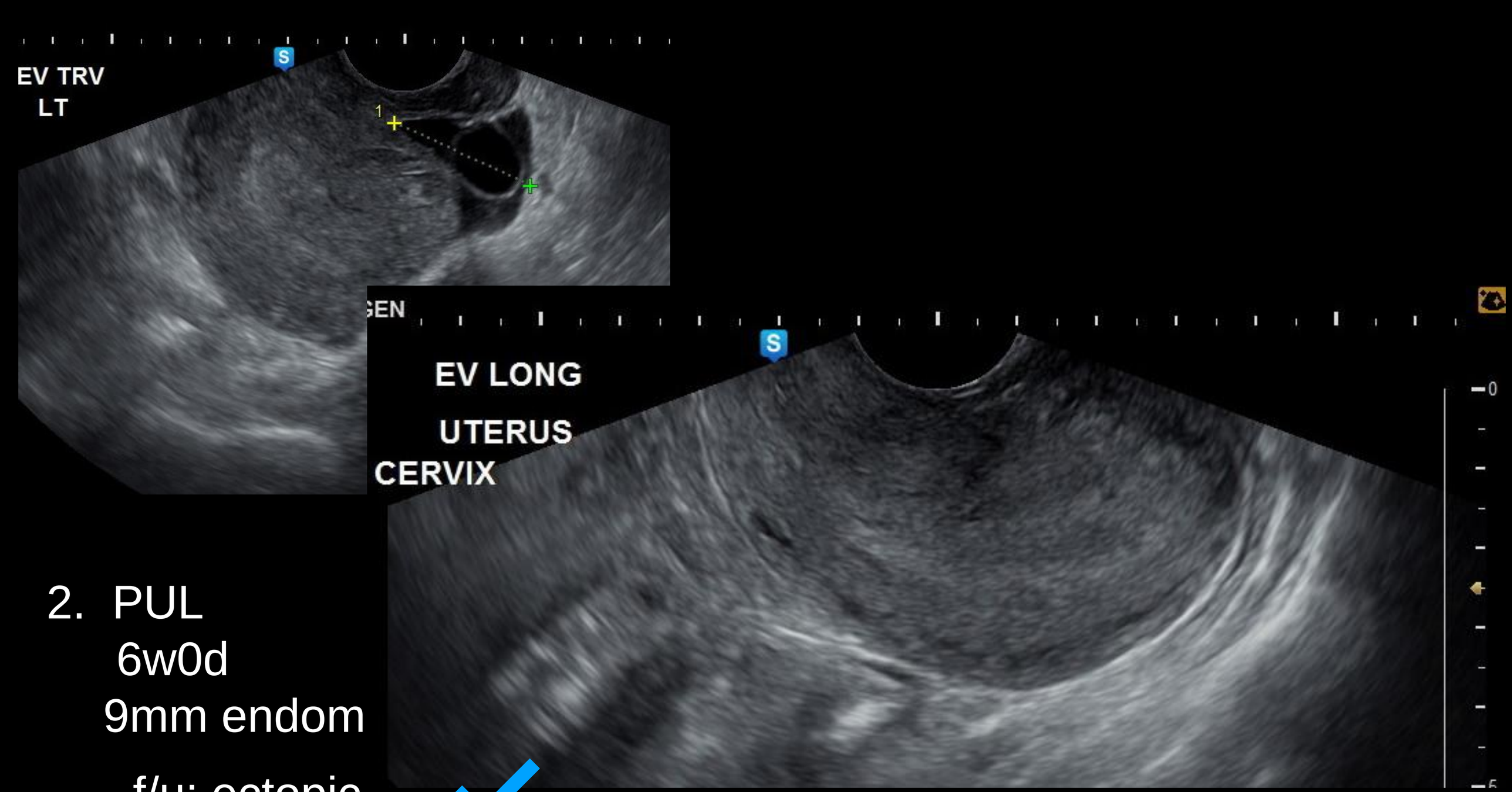
Would this information be useful?

- Let's review some cases - multiple clinics
- November, 2022 to present
- PUL or unable to confirm IUP
- follow up when available



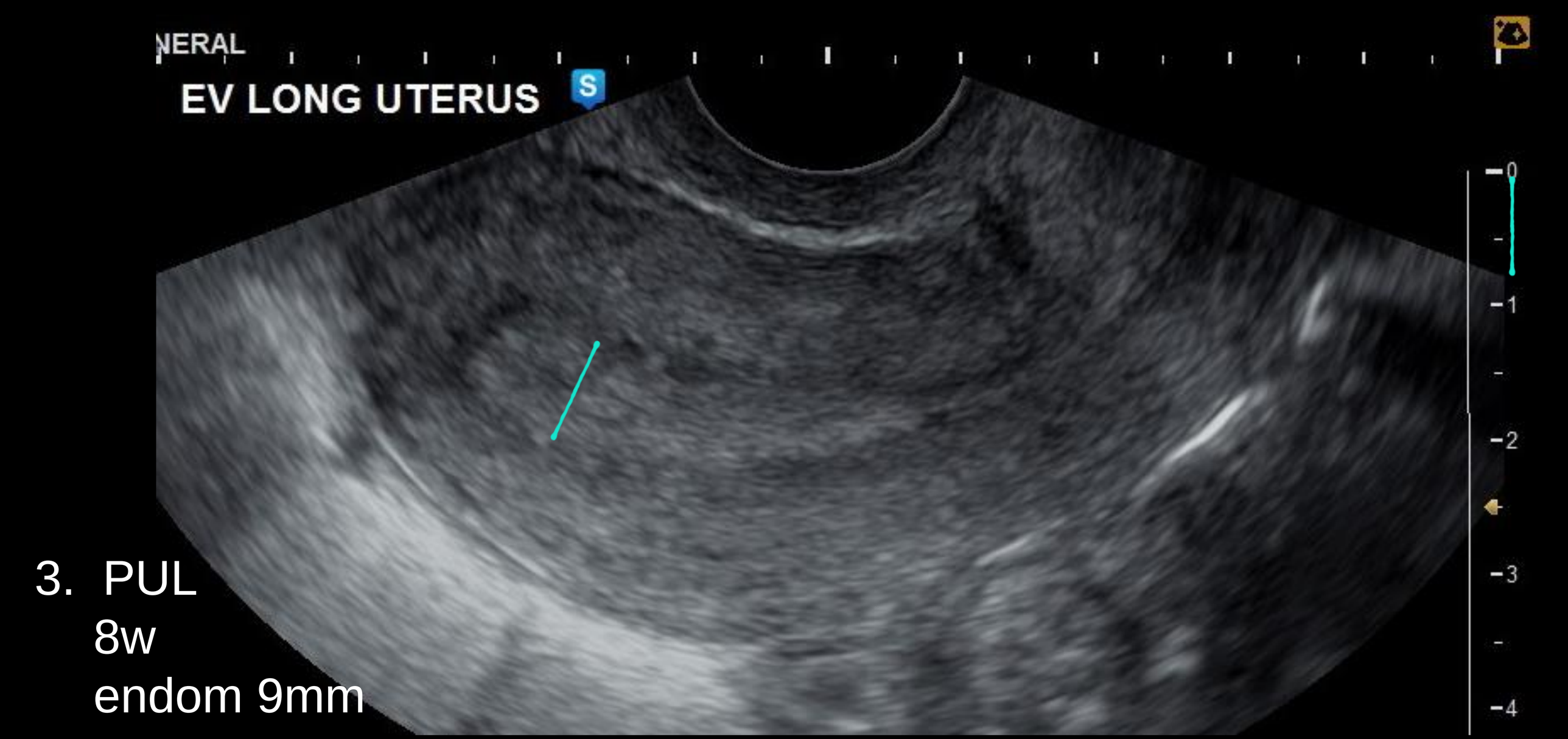
1. PUL
   7w6d
   ES>11mm

   f/u: viable IUP ✓



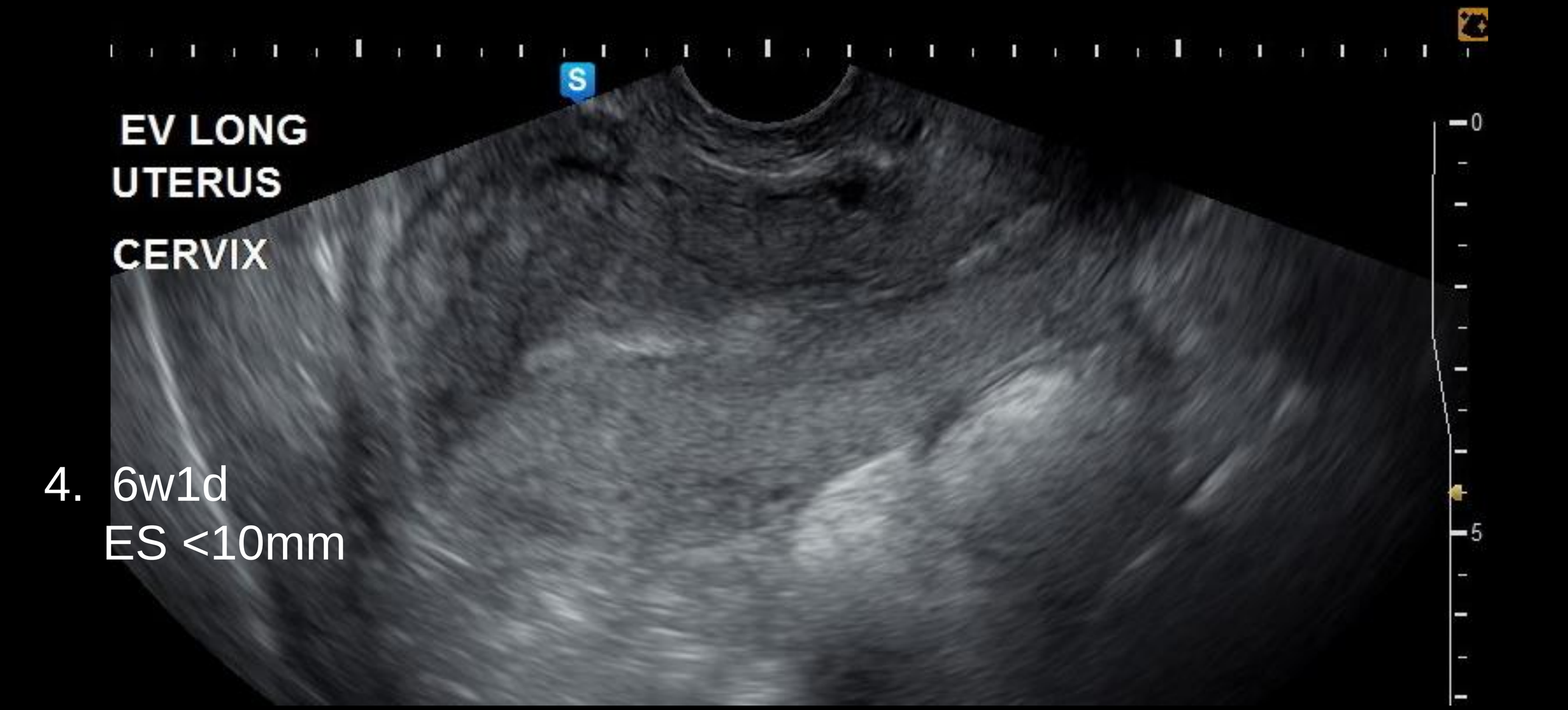
2. PUL
   6w0d
   9mm endom

   f/u: ectopic



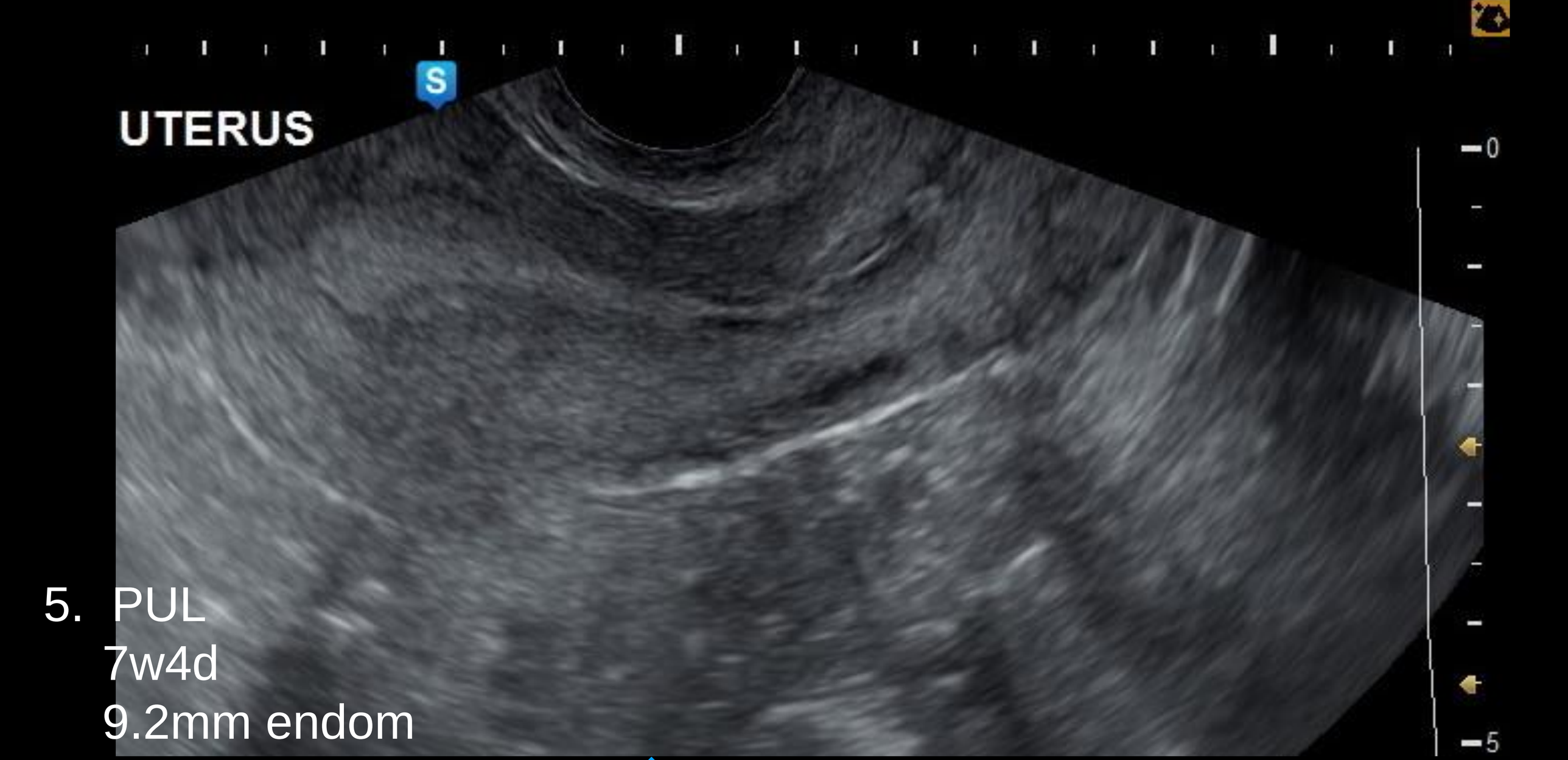
3. PUL
   8w
   endom 9mm

f/u: ER - IUP/misc "early pregnancy failure"



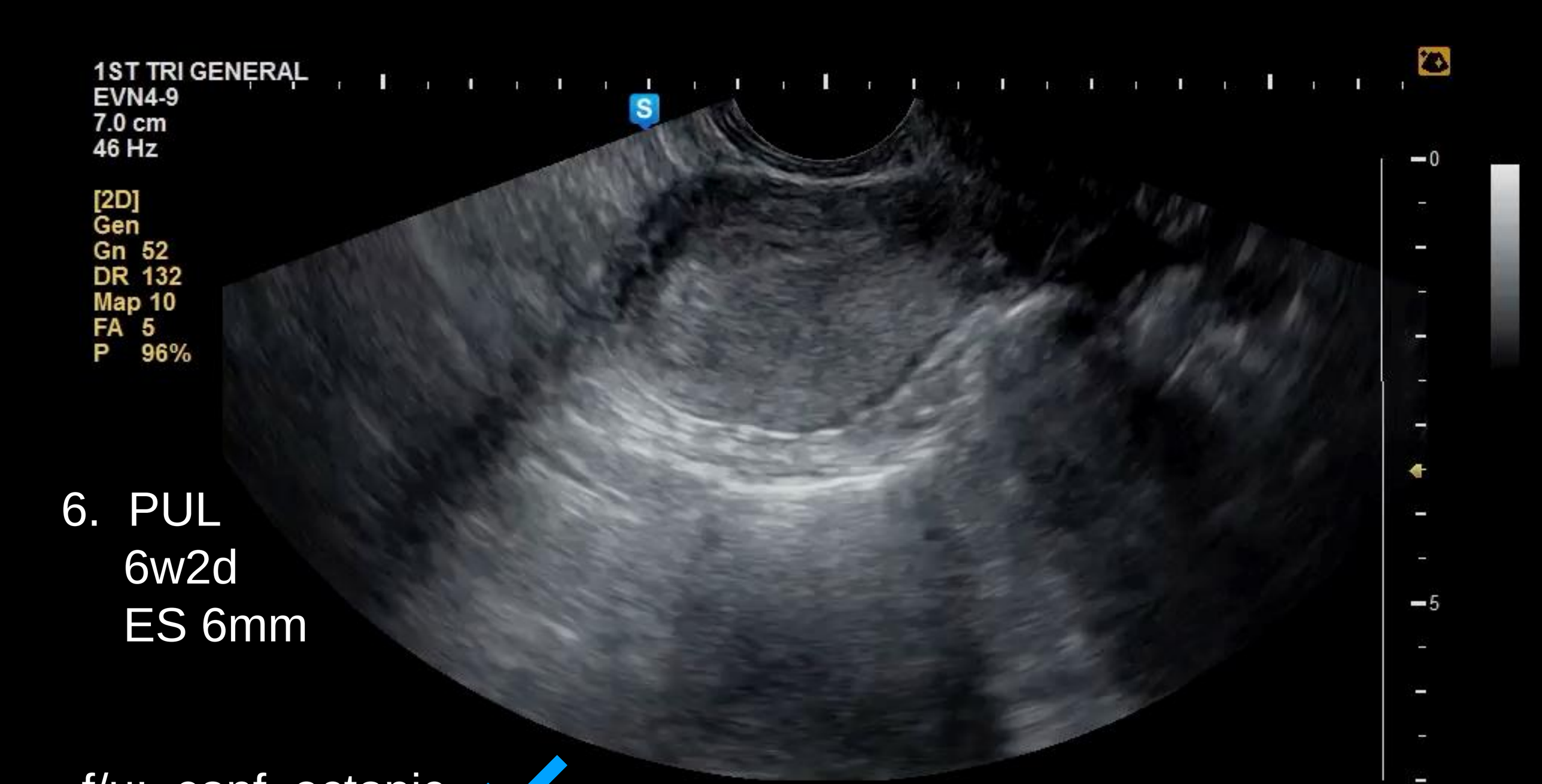
4. 6w1d
   ES <10mm

f/u: conf. ectopic ✓ (72% demonstrated high echogenicity)



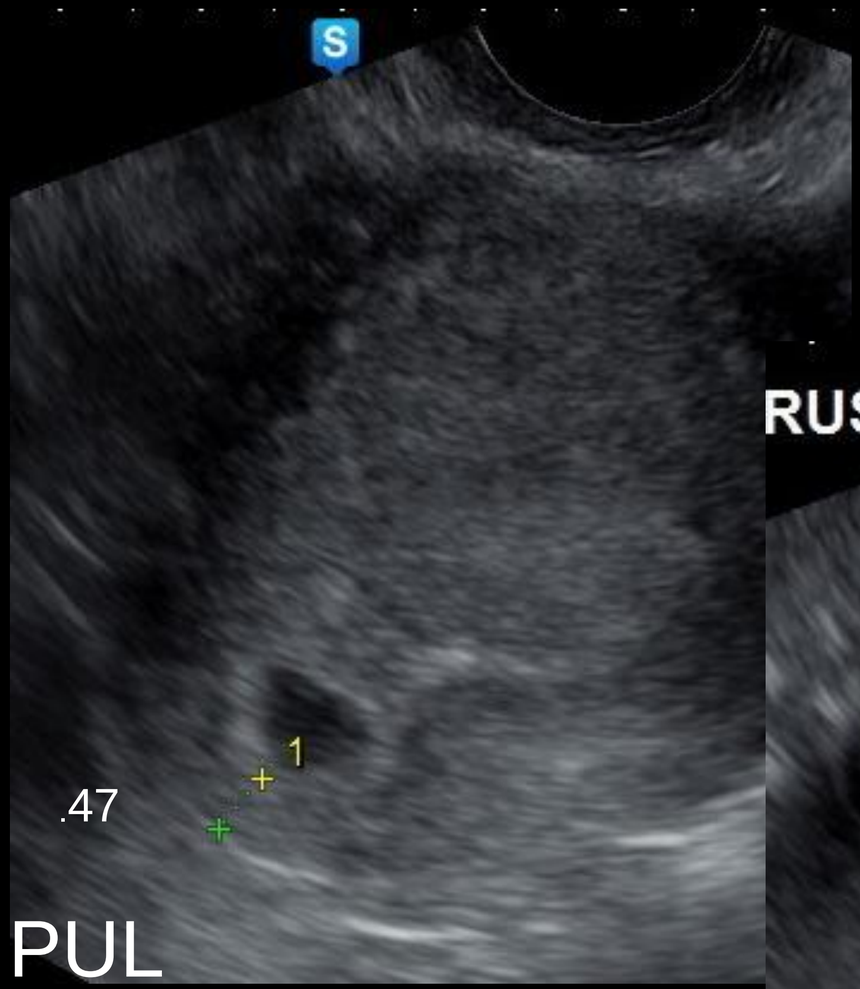
5. PUL
   7w4d
   9.2mm endom

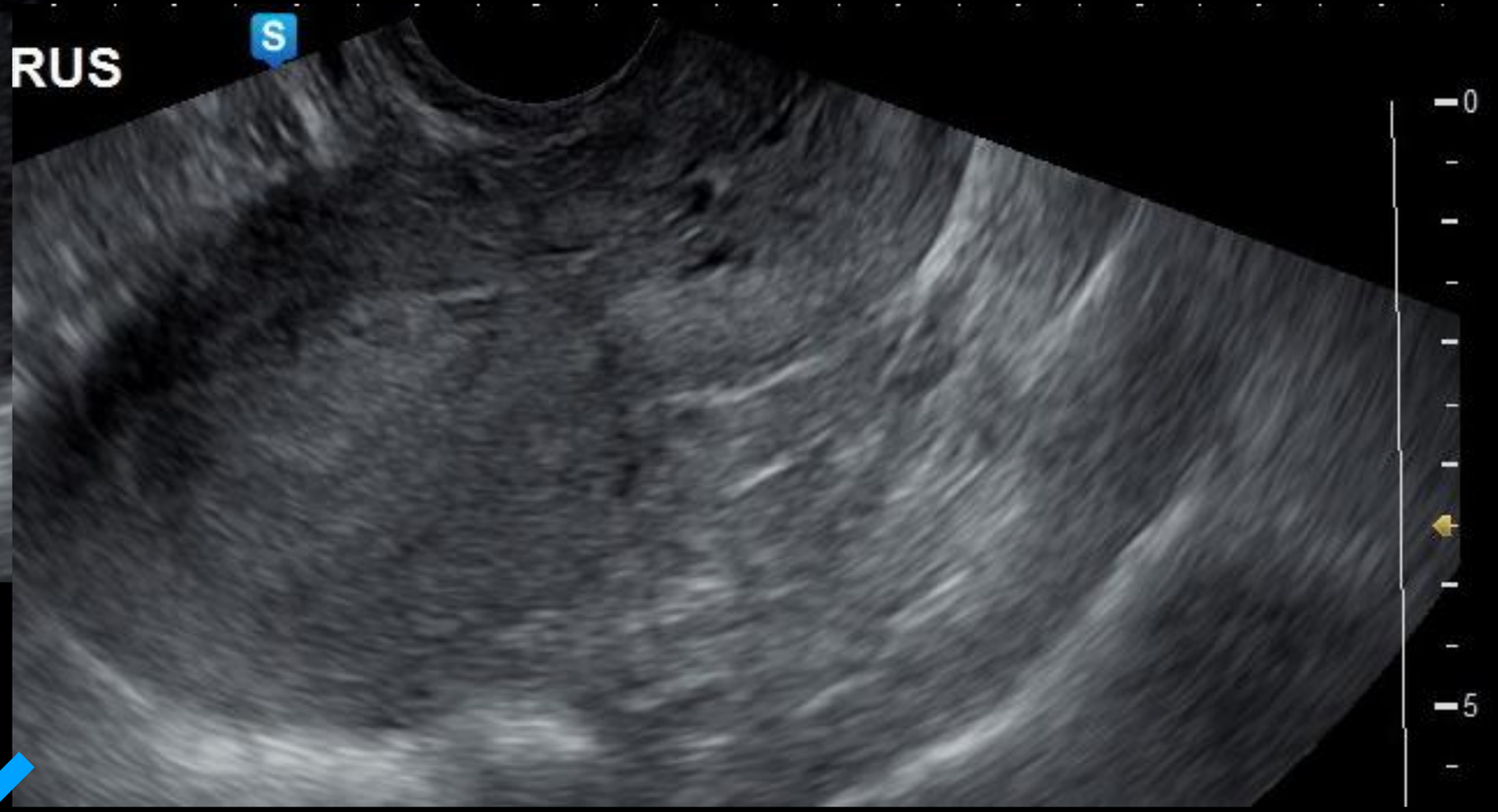
f/u: confirmed ectopic ✓



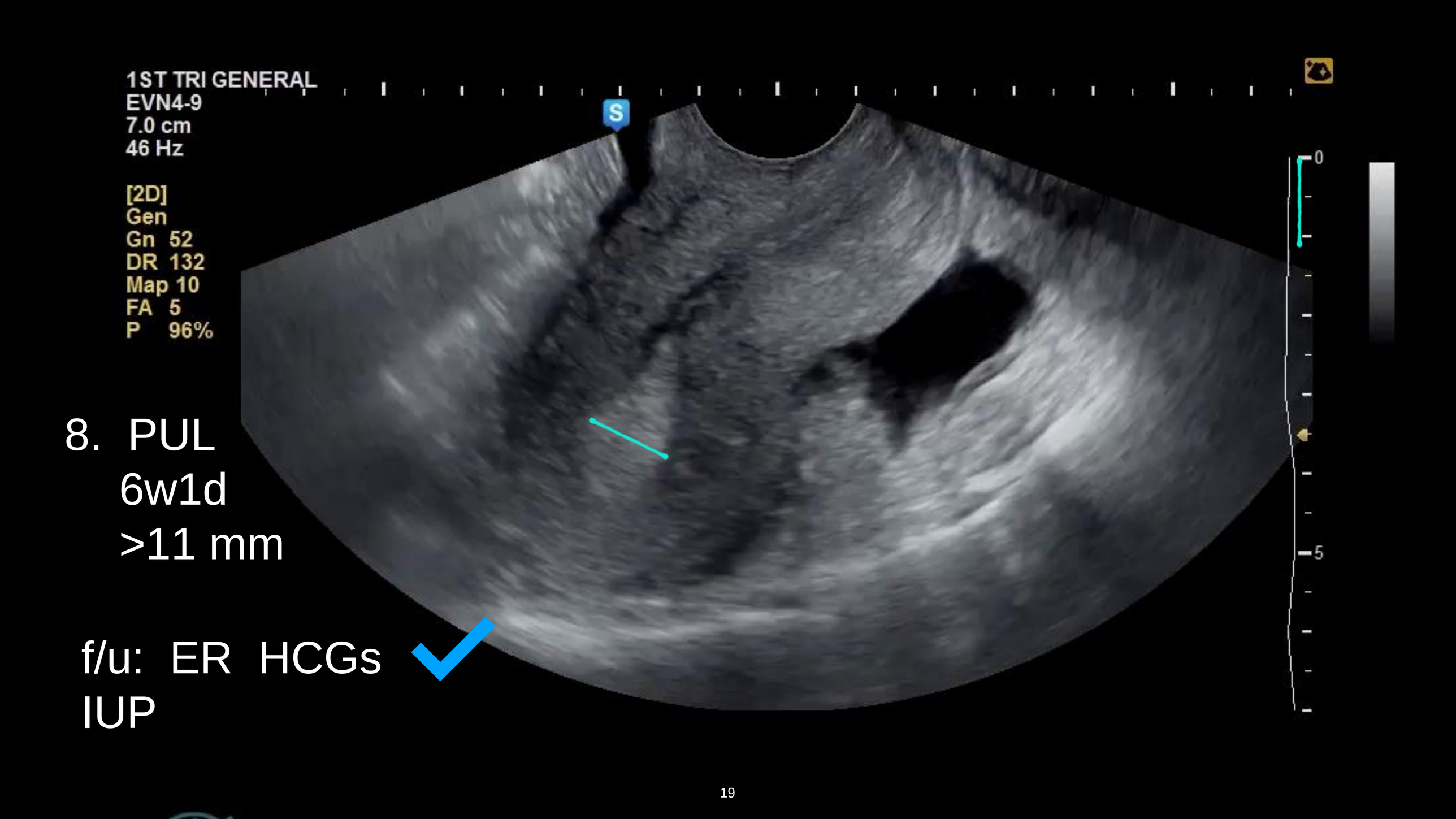
6. PUL
   6w2d
   ES 6mm

f/u: conf. ectopic ✓



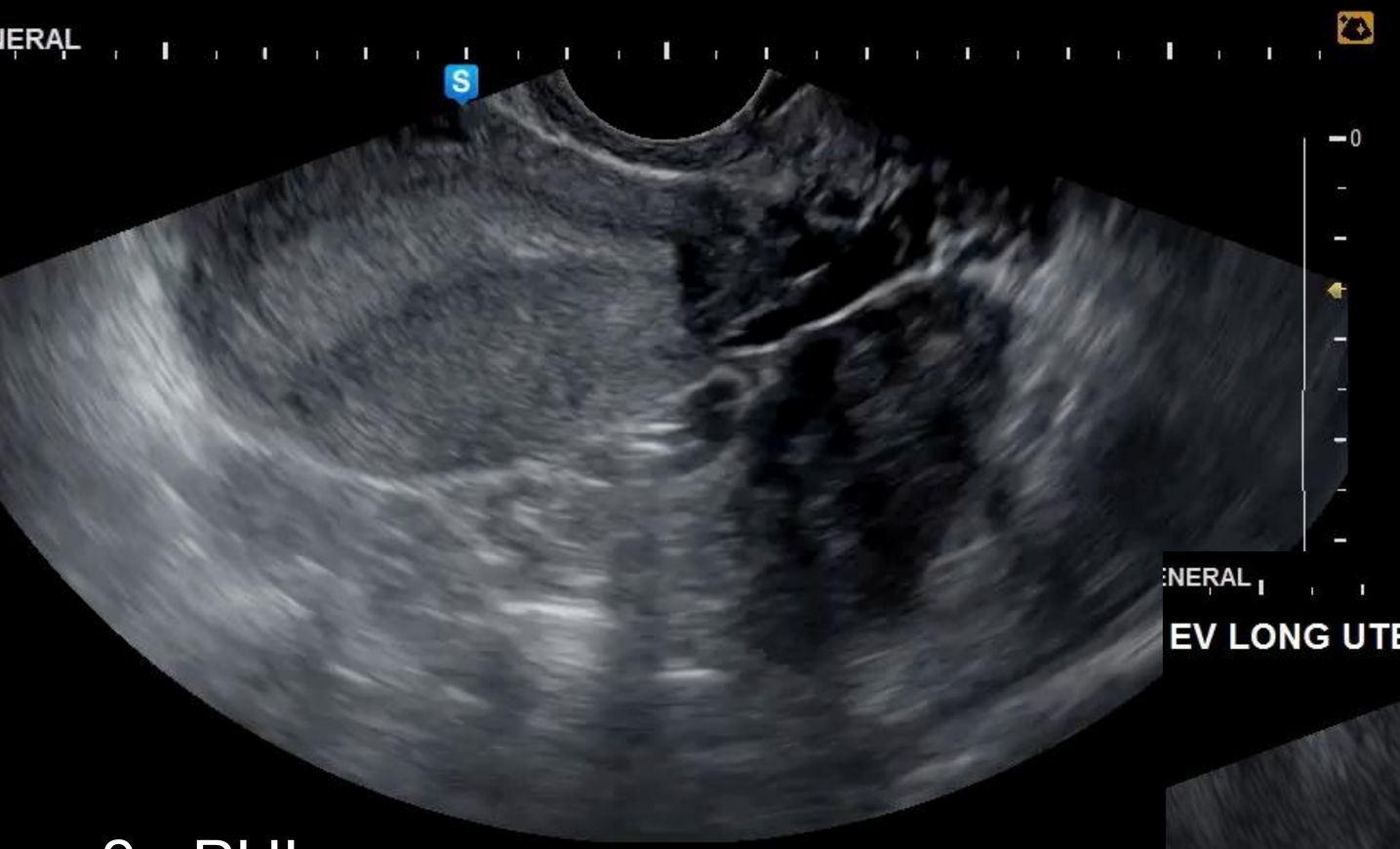


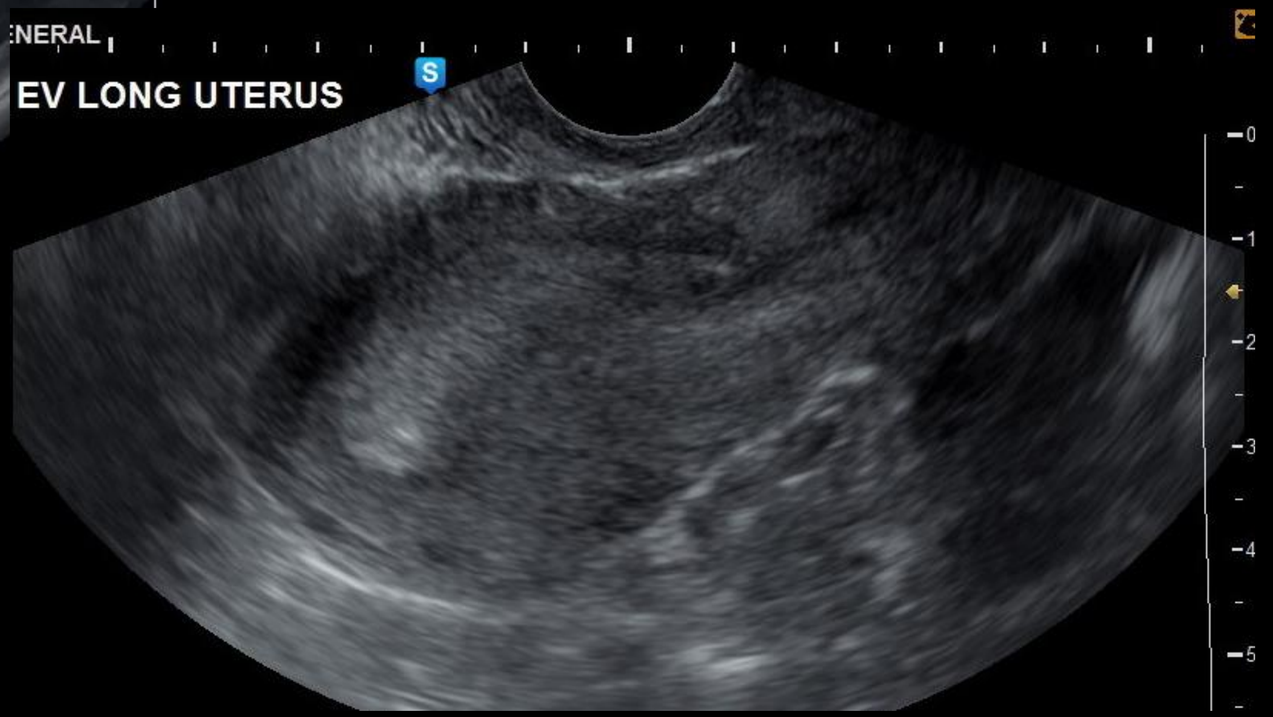
7. PUL
   8w3d
   10mm endom
f/u: conf ectopic
(?cornual)



8. PUL
   6w1d
   >11 mm

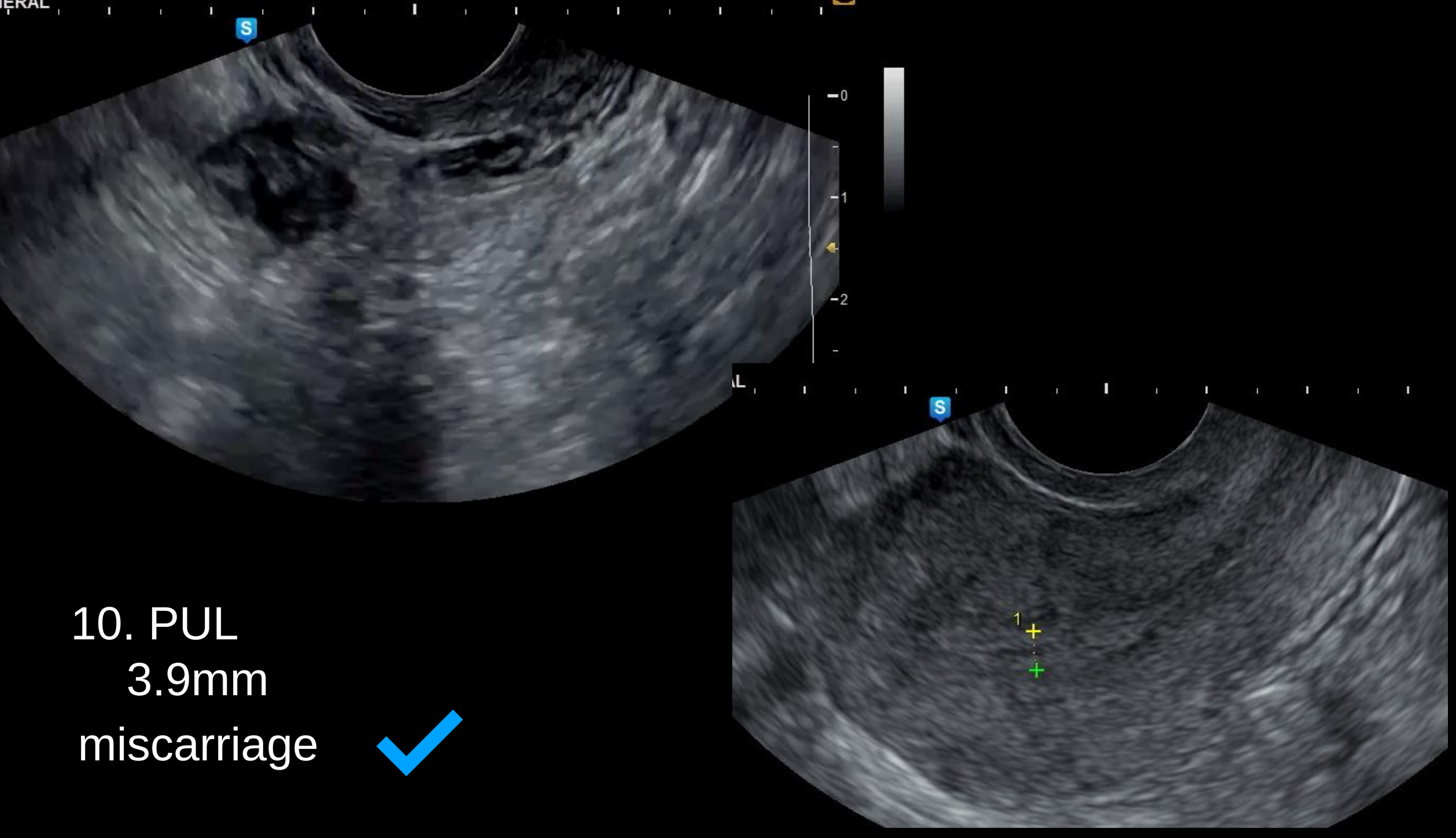
f/u: ER HCGs ✓
IUP



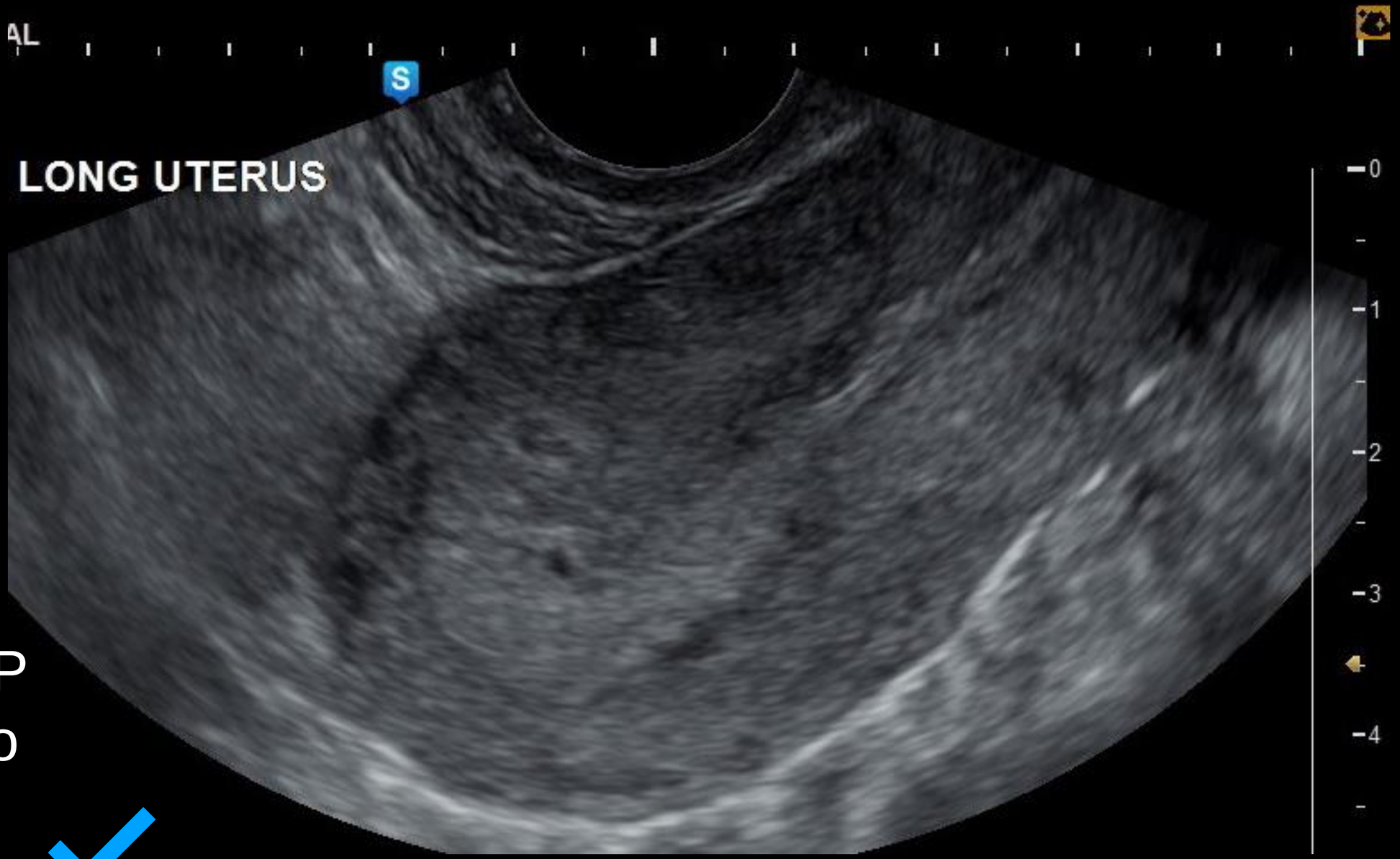


9. PUL
PCOS 8w5d LMP
approx. 10mm
precautions

***f/u IUP :)**

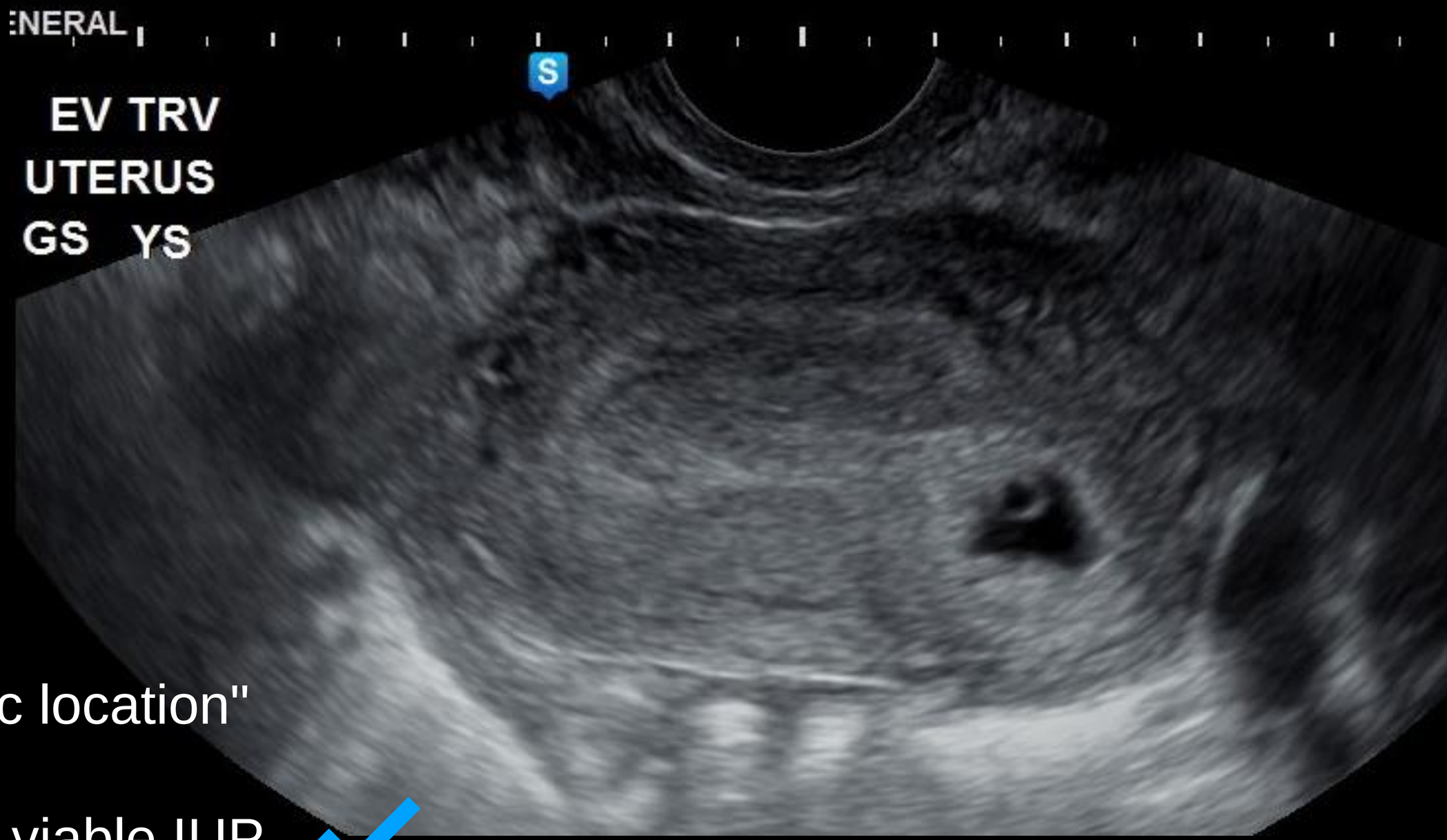


10. PUL
3.9mm
miscarriage



11. PUL 6w6d LMP thick endo

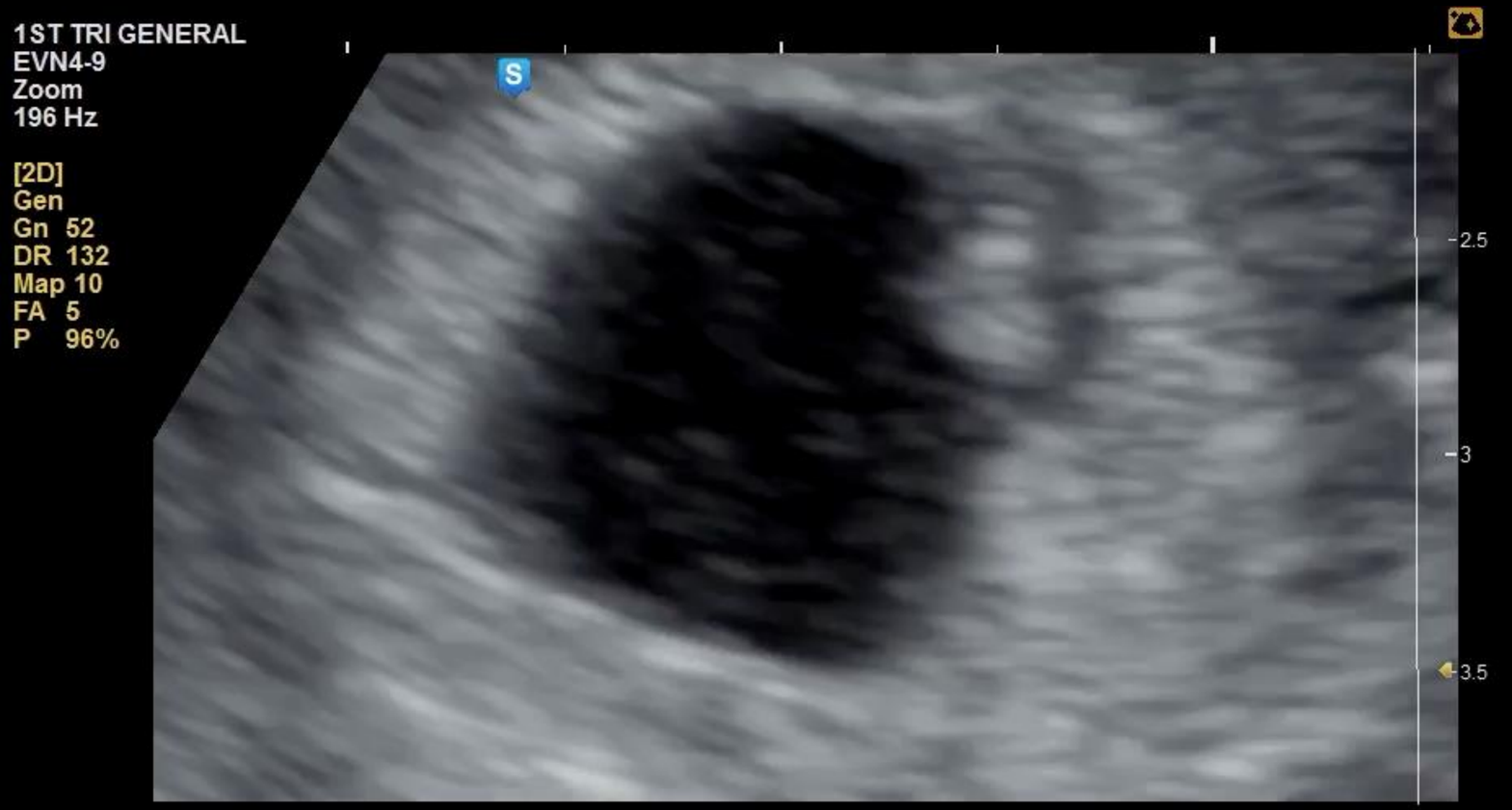
f/u: IUP ✓

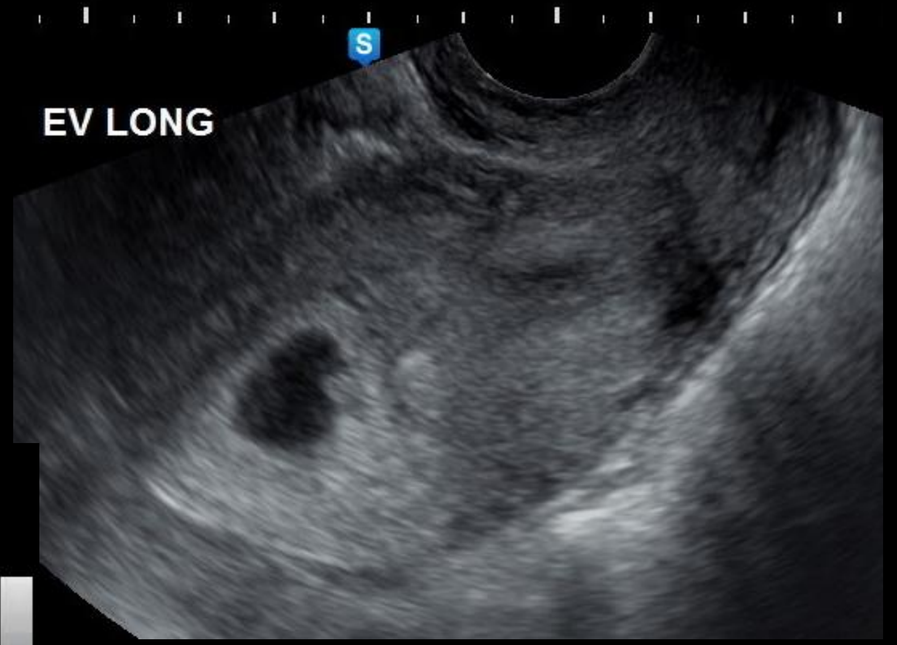


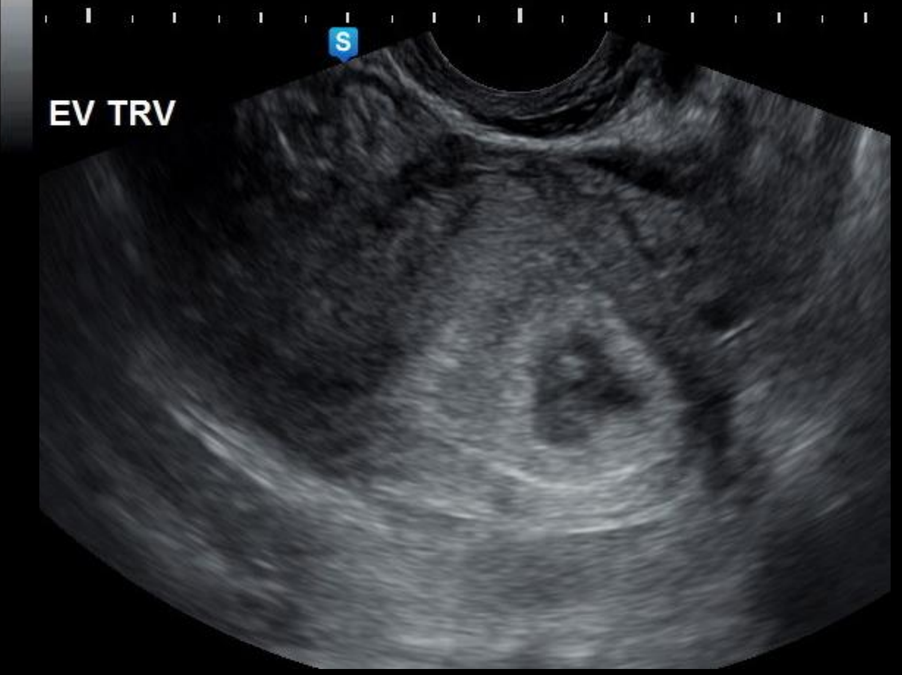
12. 6w1d
    >11 mm
    "eccentric location"

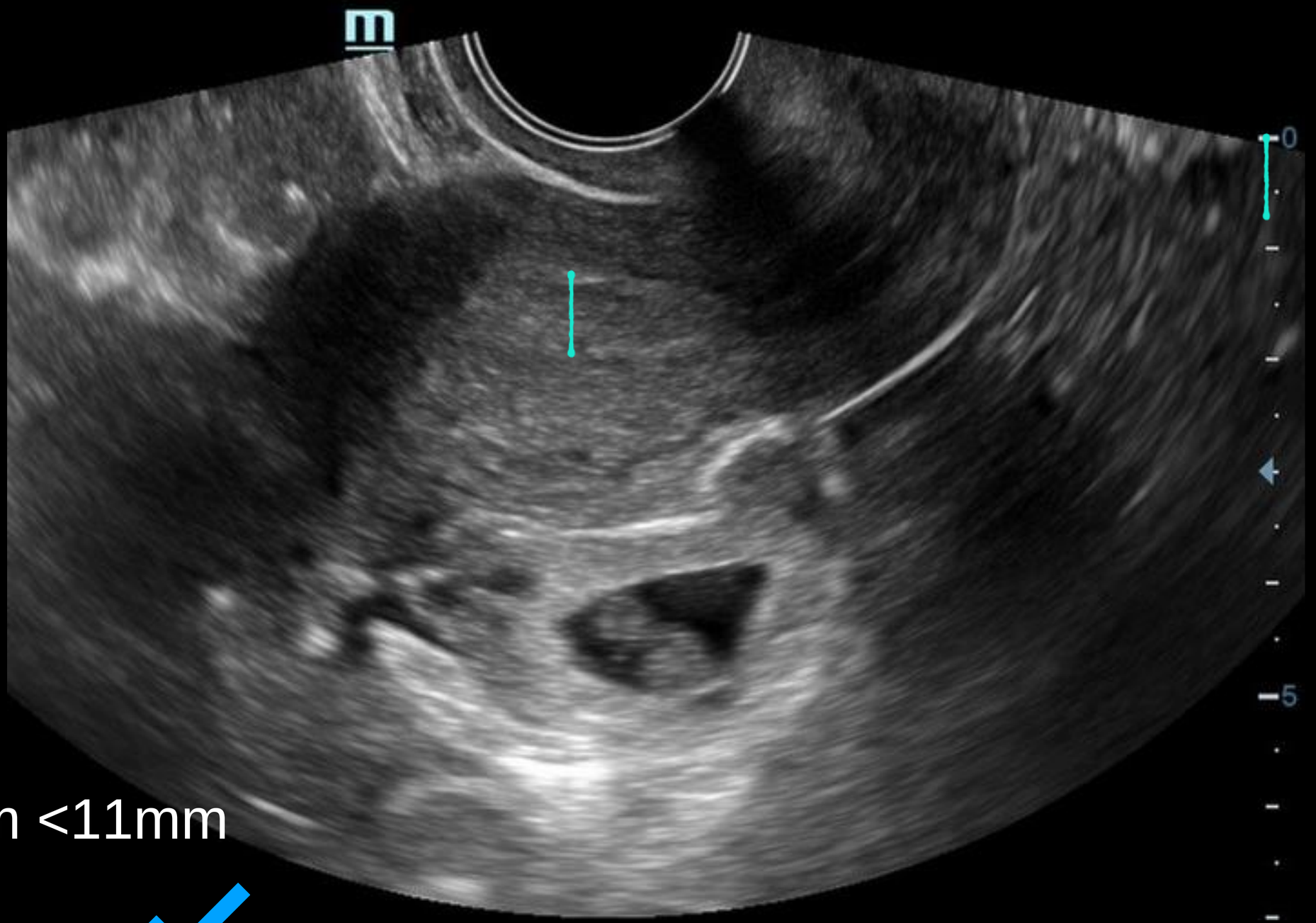
    f/u: conf. viable IUP

12
F/U
1 wk later
miscarriage



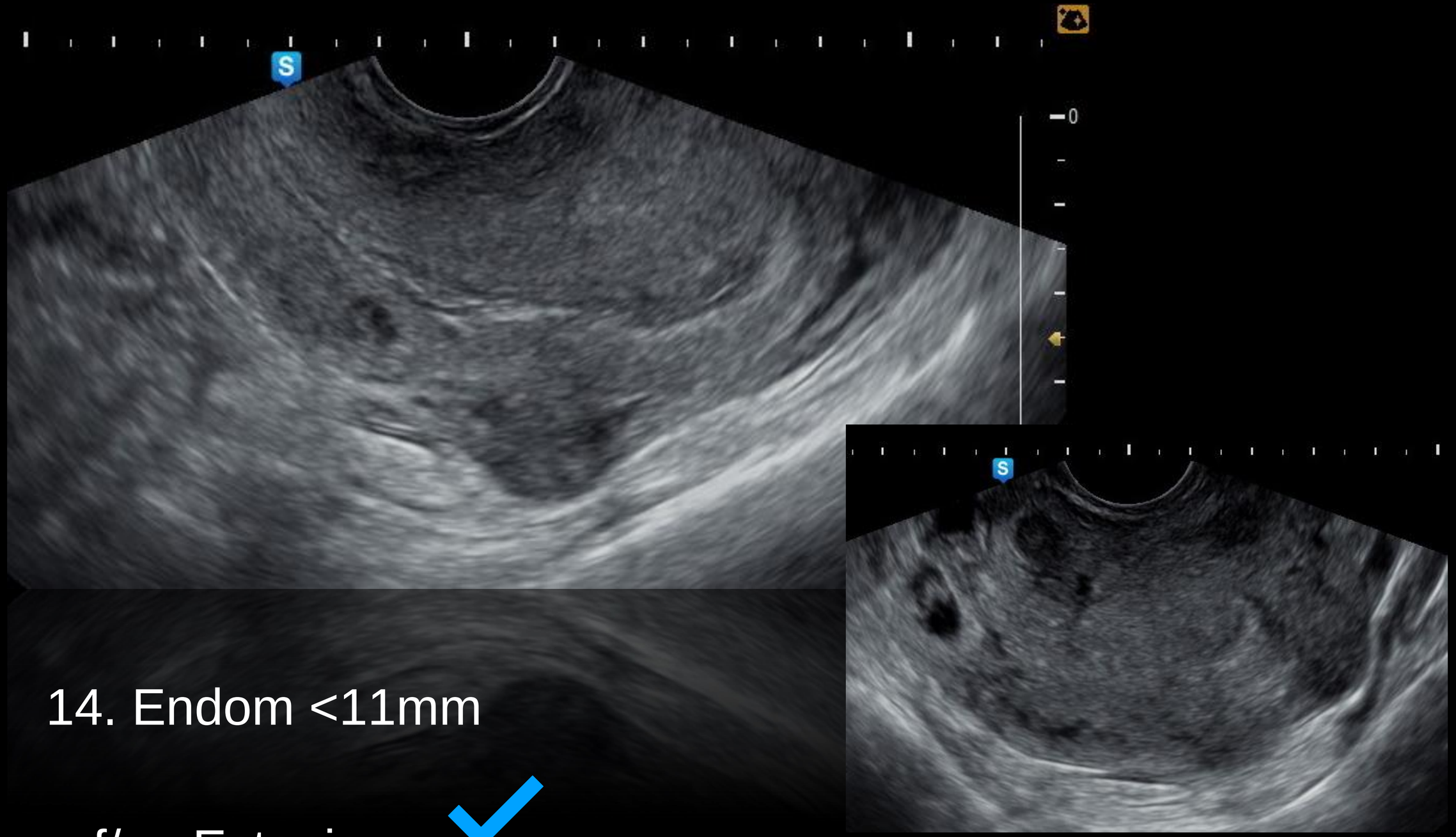






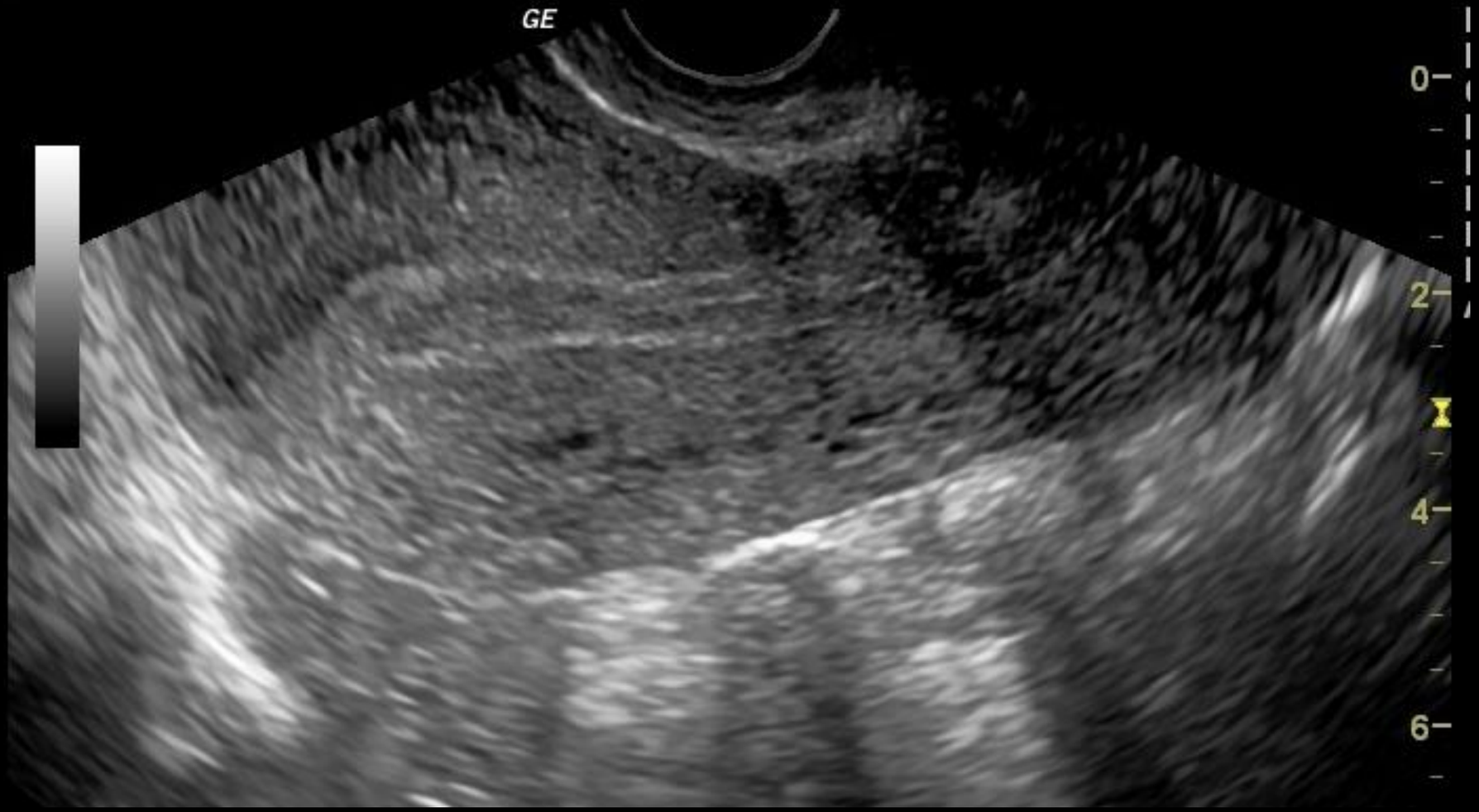
13. Endom <11mm

f/u: Ectopic



14. Endom <11mm

f/u: Ectopic

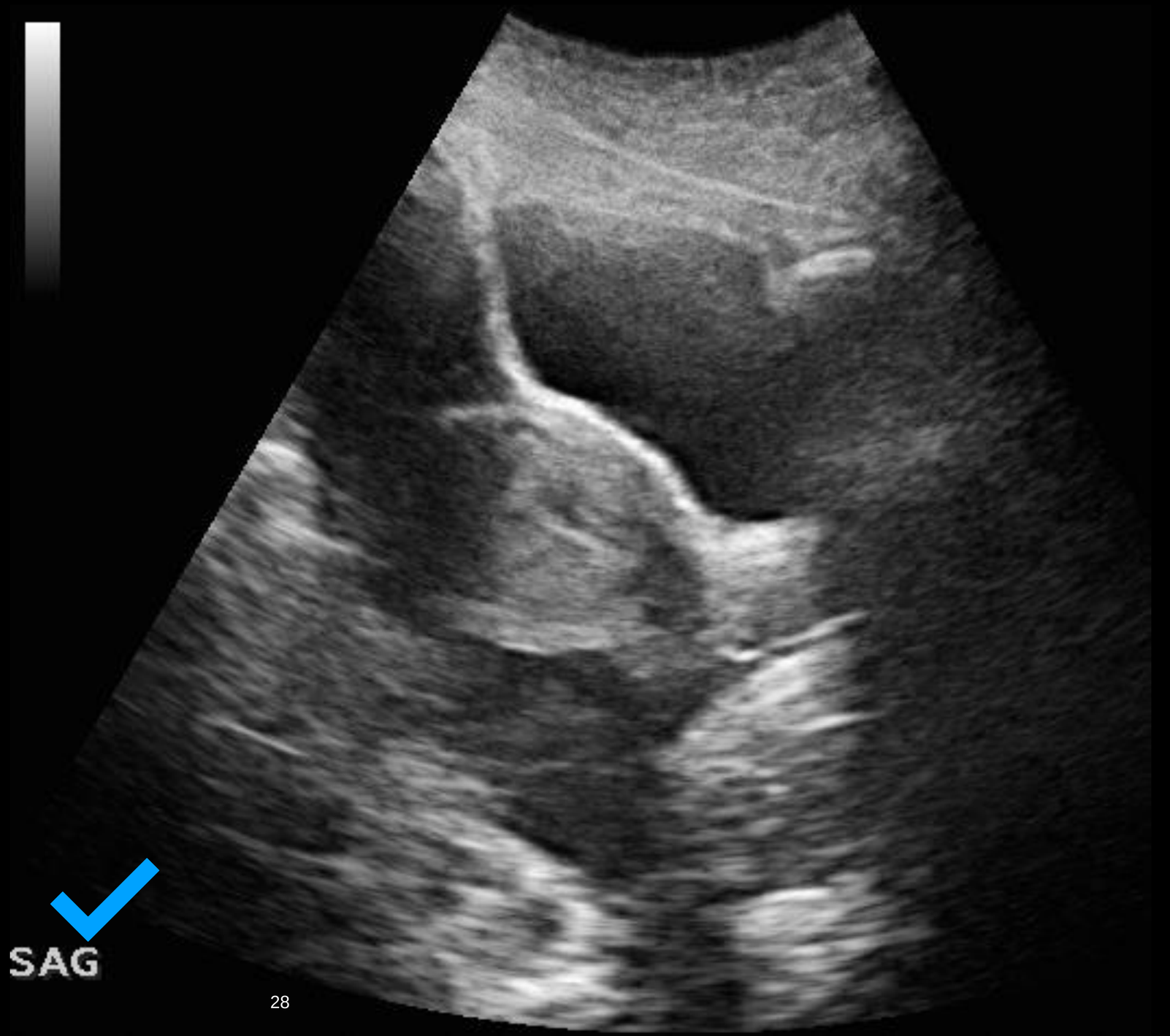


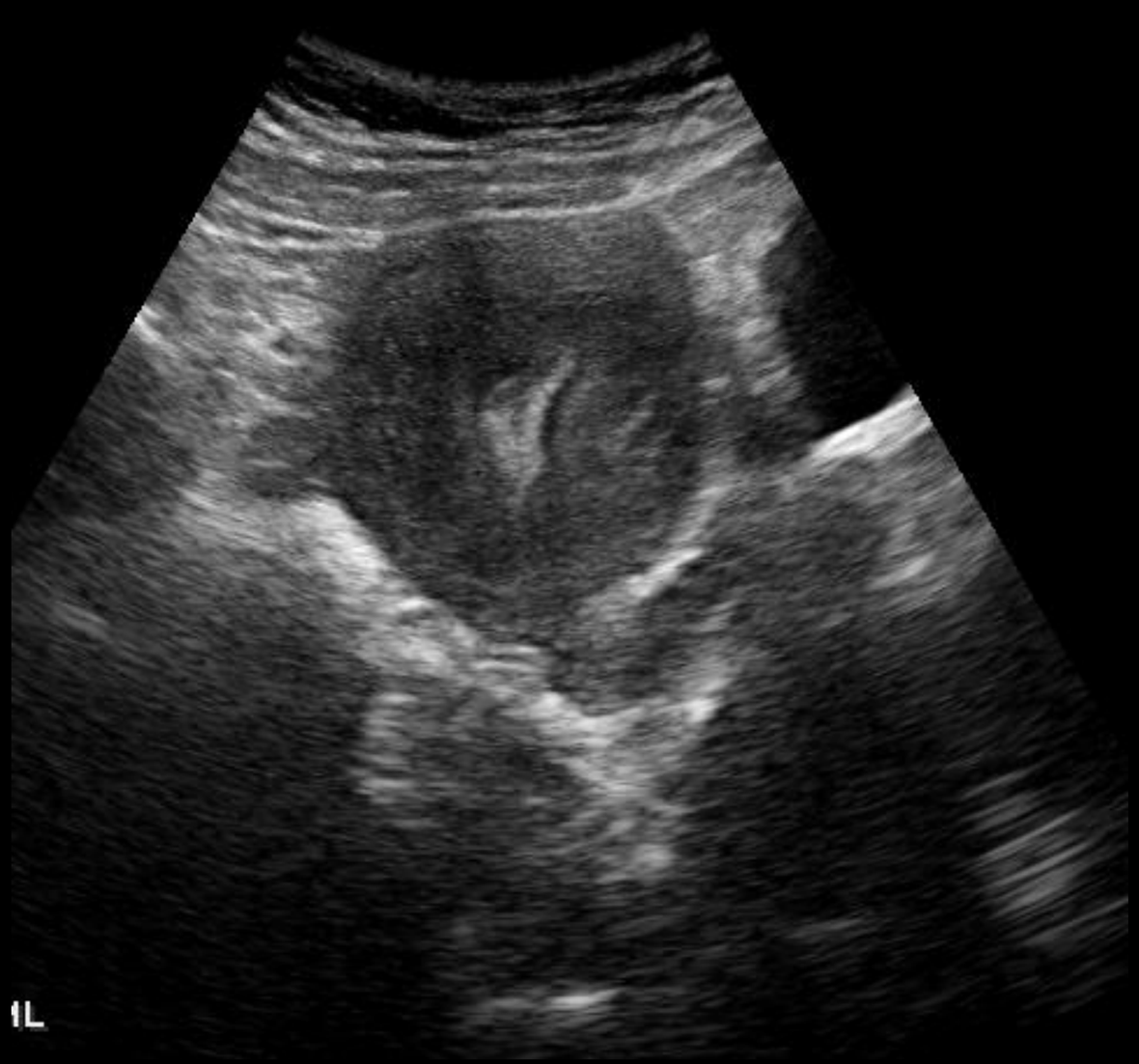
15. endom <11mm

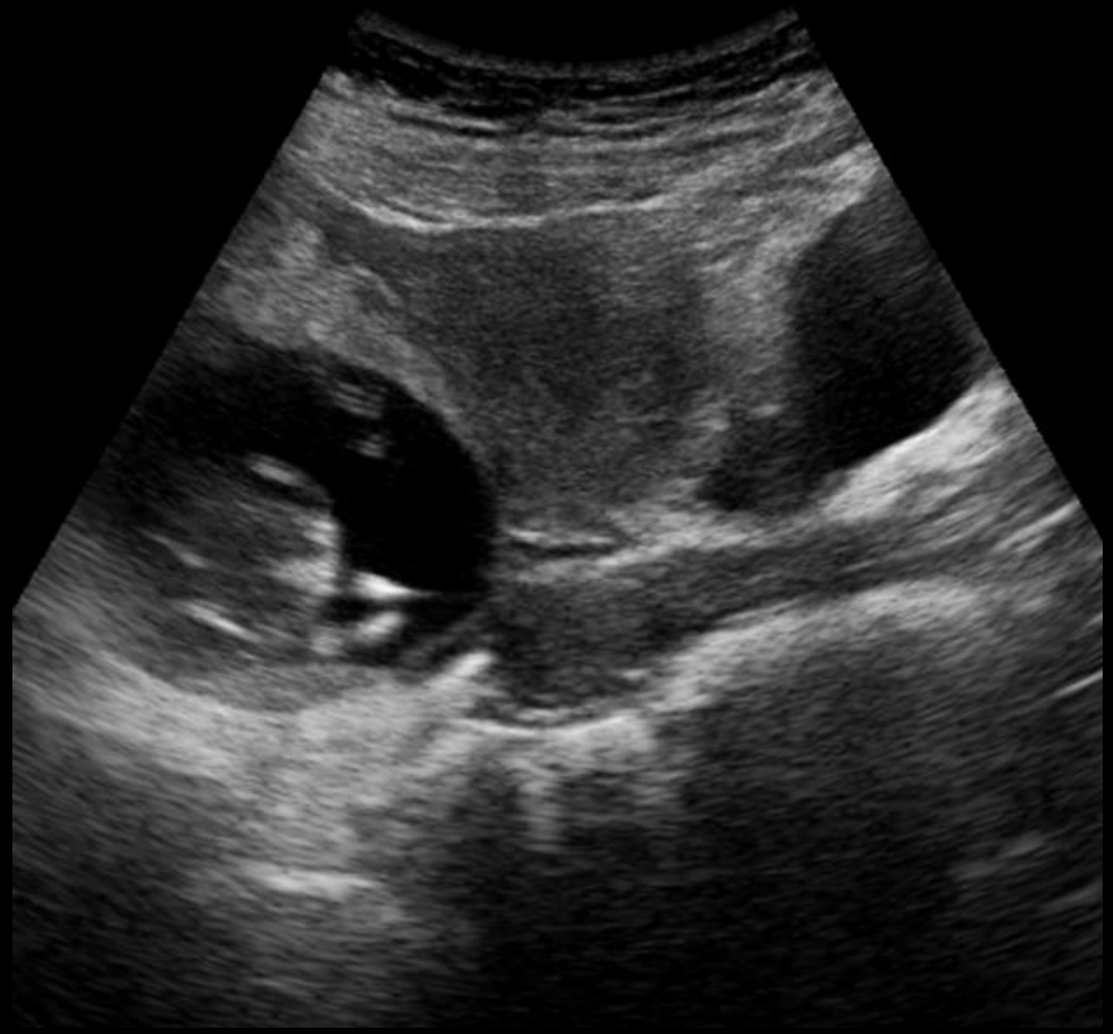
f/u: ectopic in fallopian tube confirmed ✓

16.
endom "thin"

f/u: ectopic confirmed

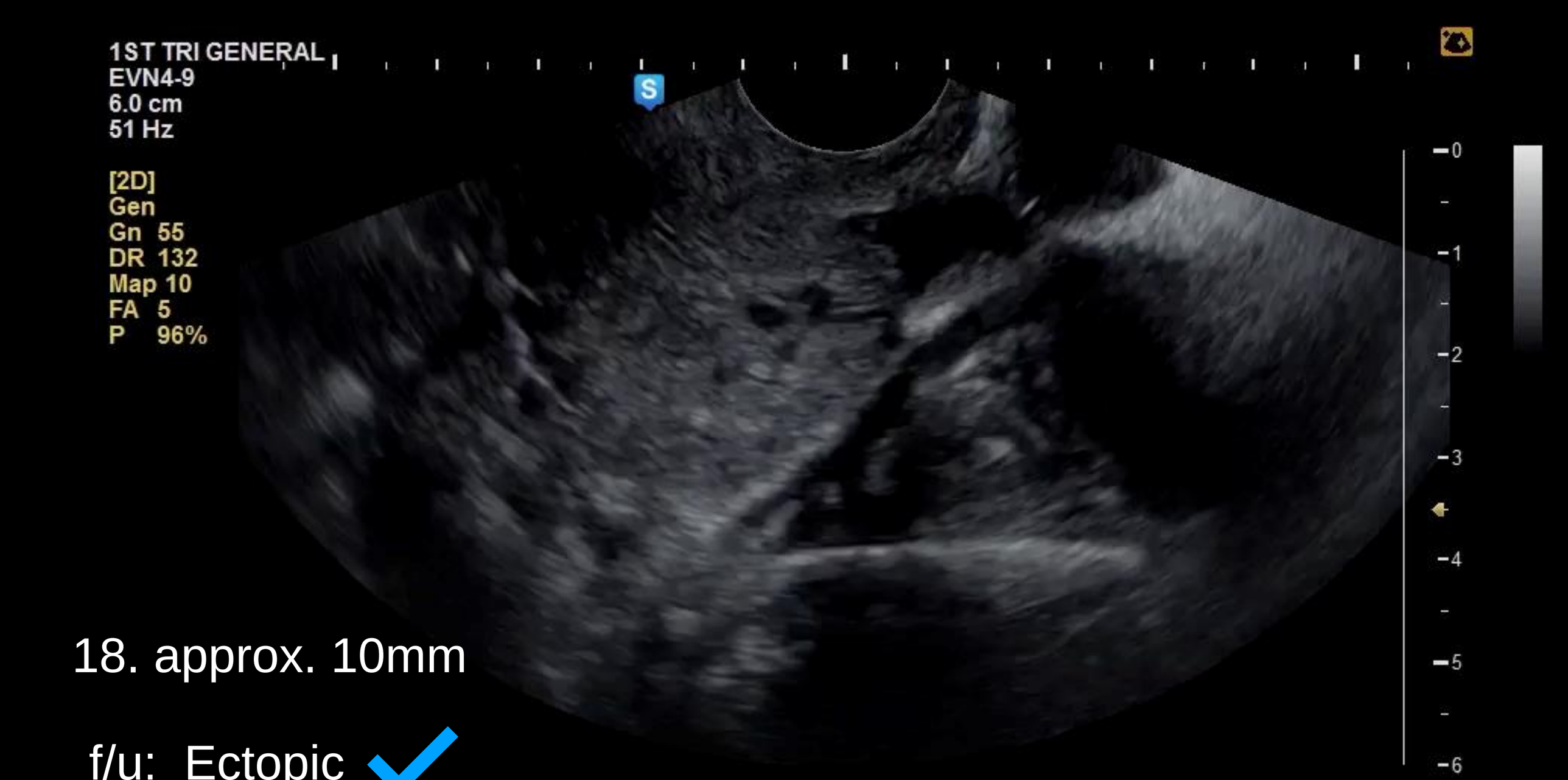






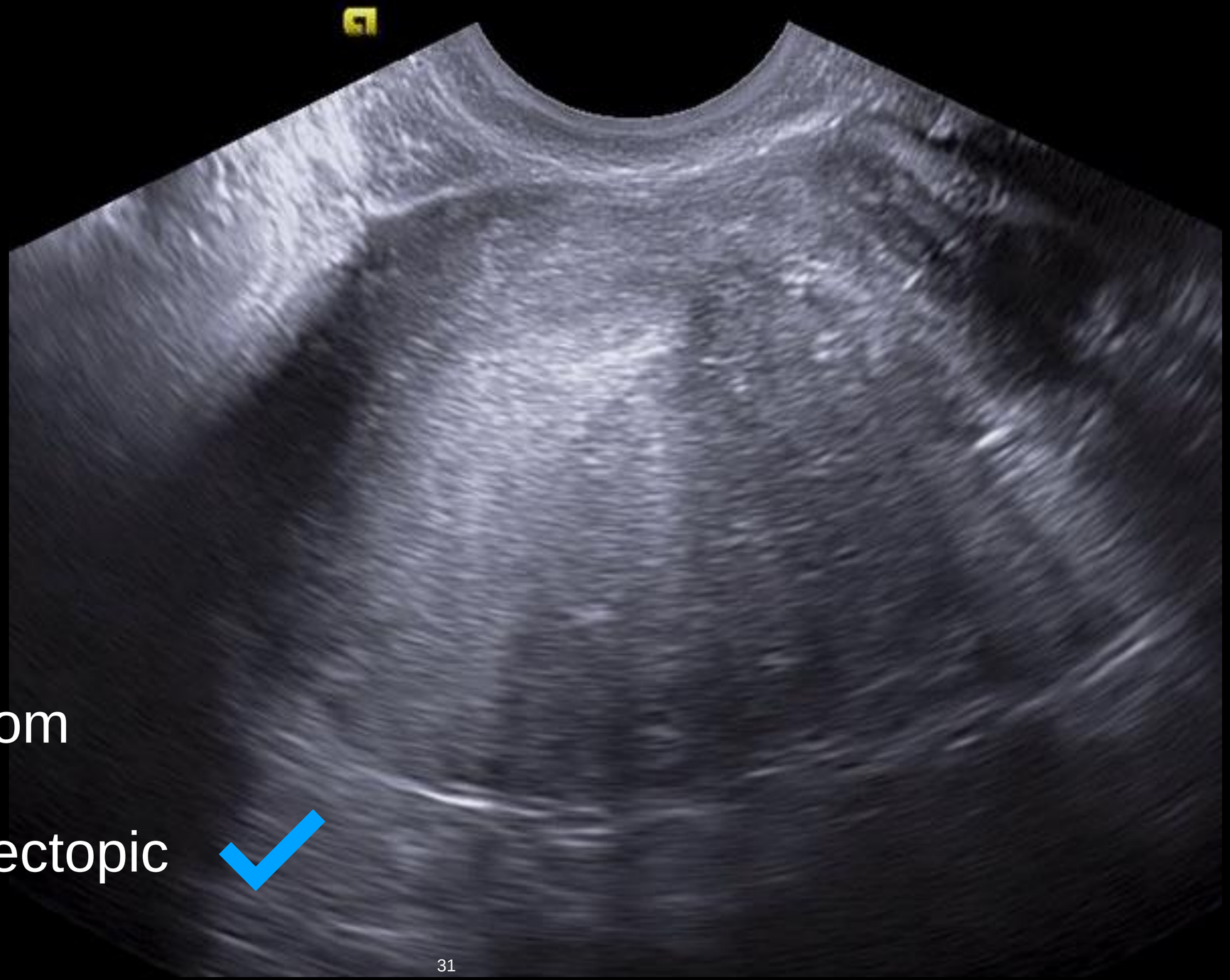
17. thin endom

f/u: ectopic confirmed



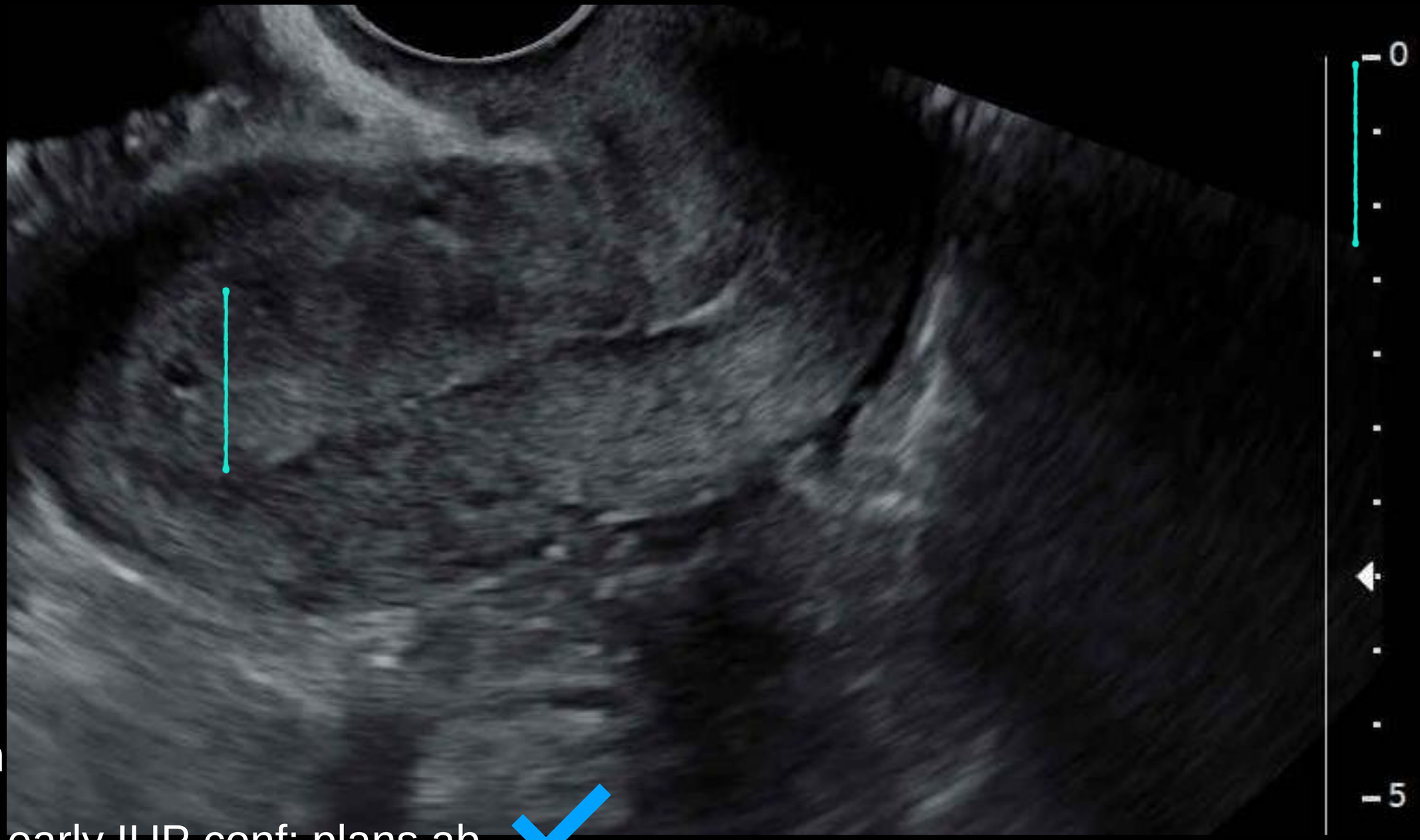
18. approx. 10mm

f/u: Ectopic ✓



19. "thin" endom

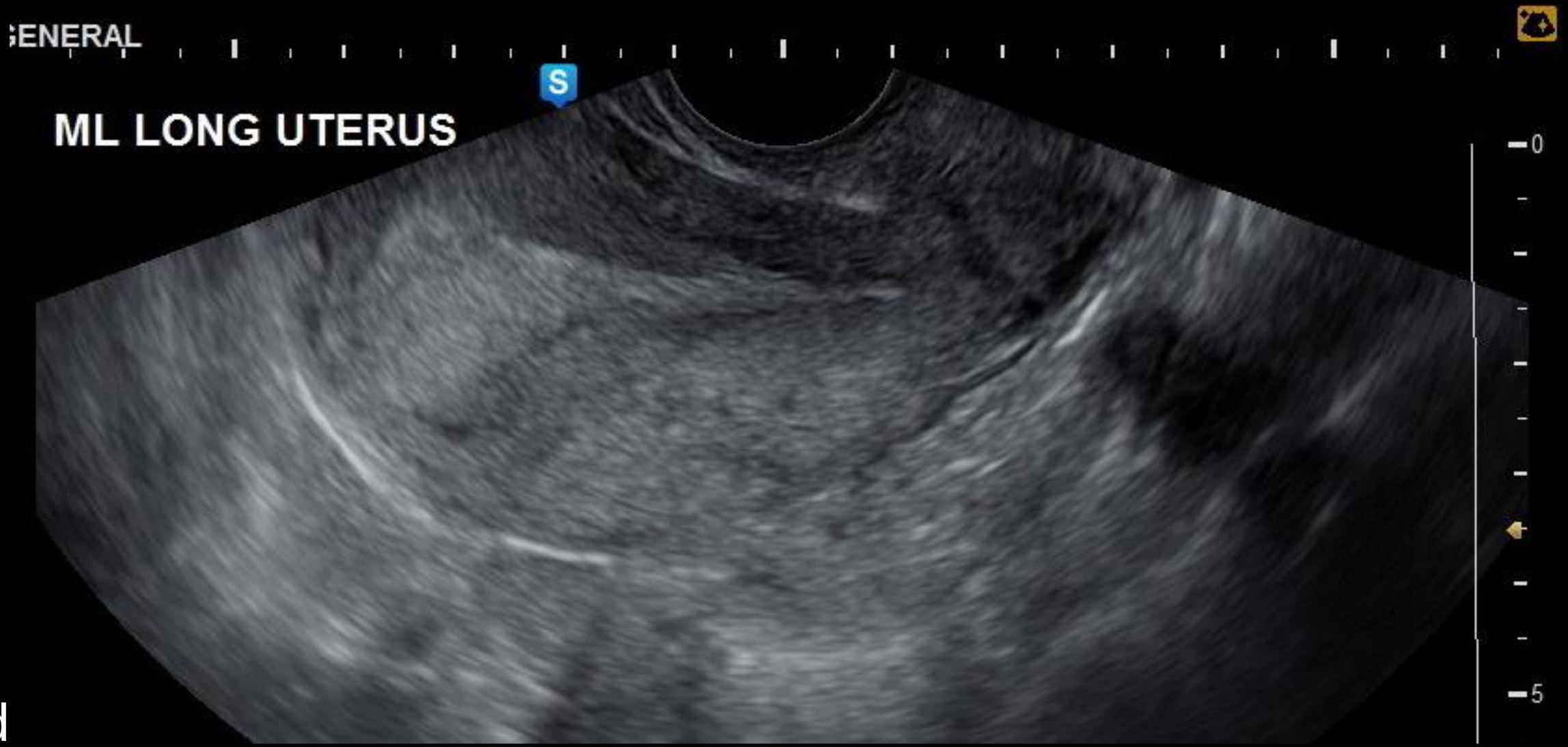
f/u: confirmed ectopic ✓



20.

9w2d
PUL
>11m

f/u: early IUP conf; plans ab

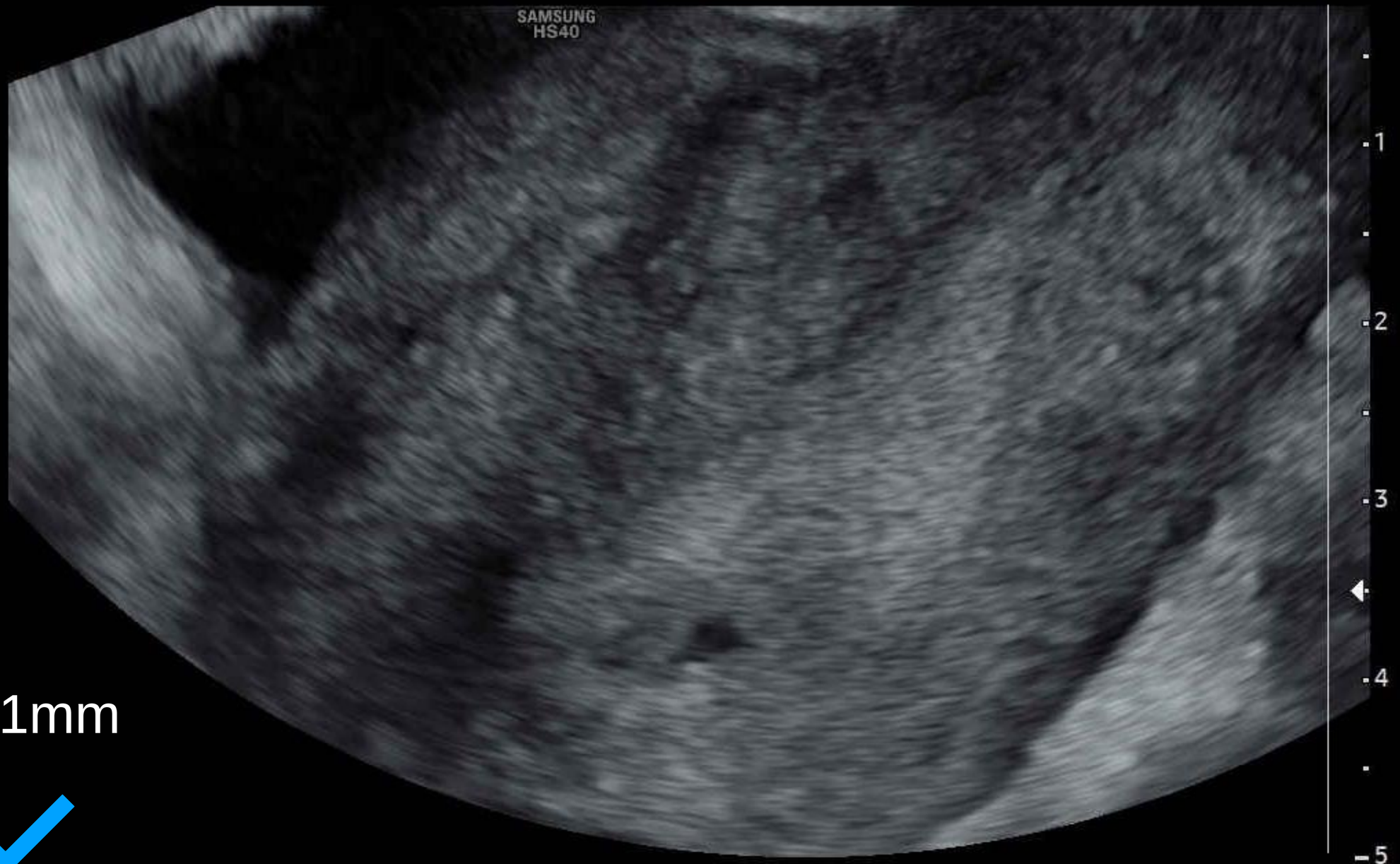


21.

6w2d

endom >11mm

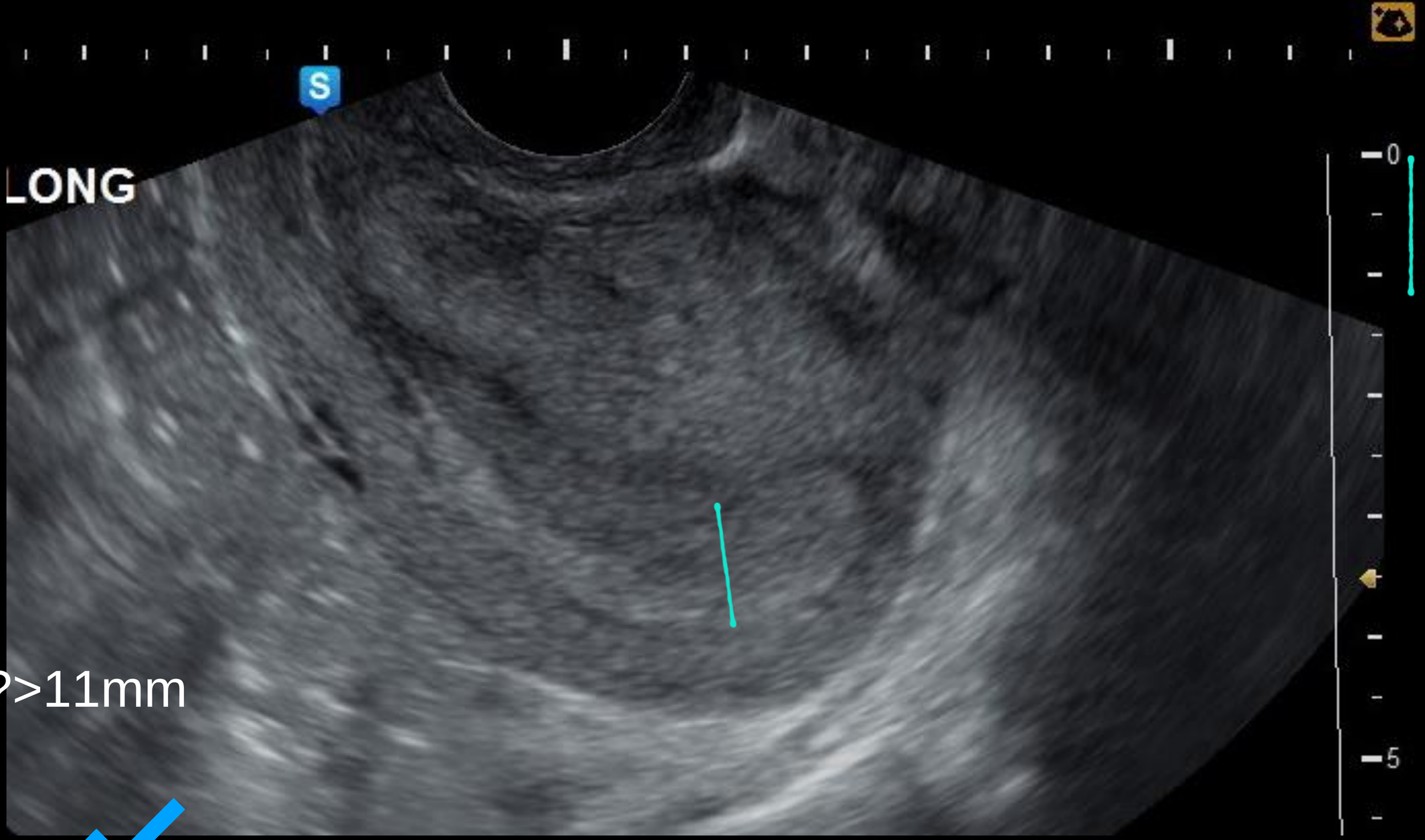
f/u: confirmed IUP



22. 6w3d
endom >11mm

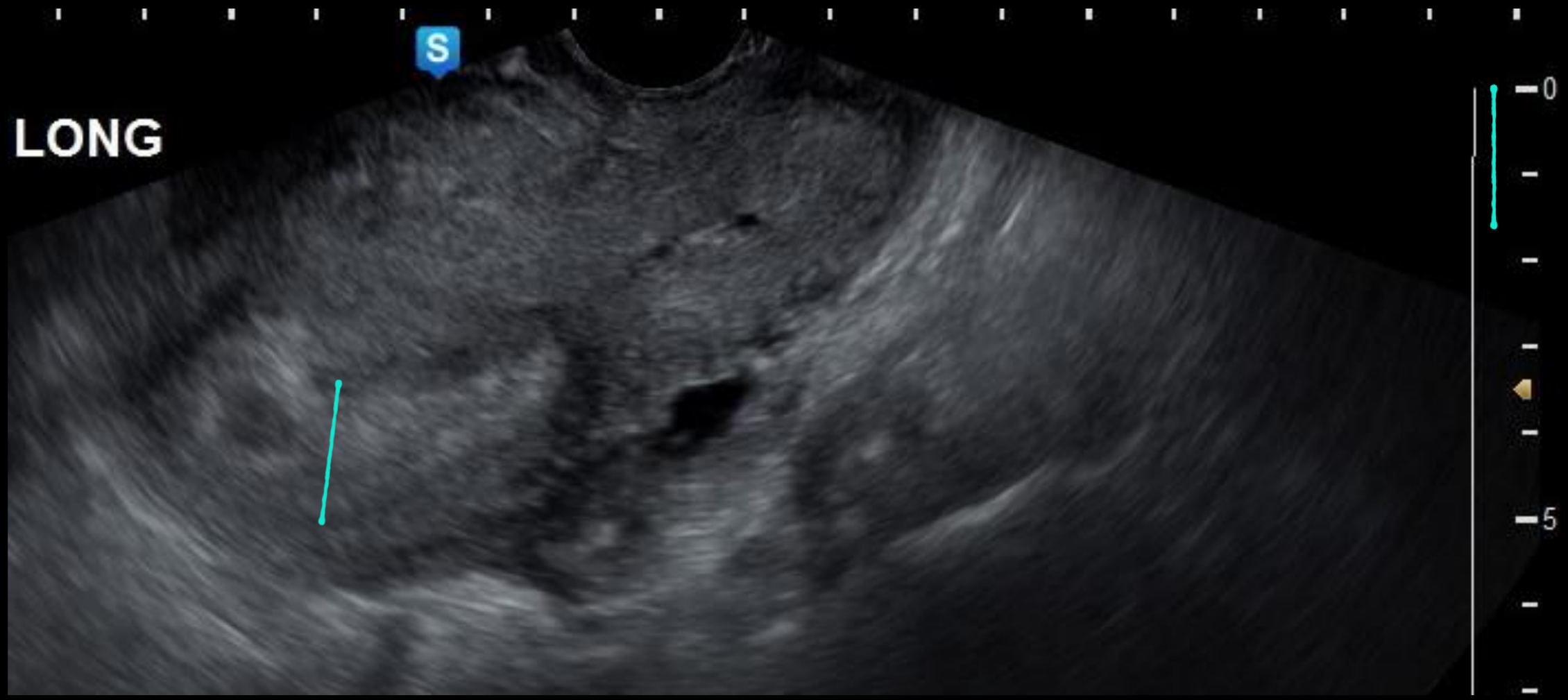
f/u: IUP

23.



7w6d
endom ?>11mm

f/u: IUP



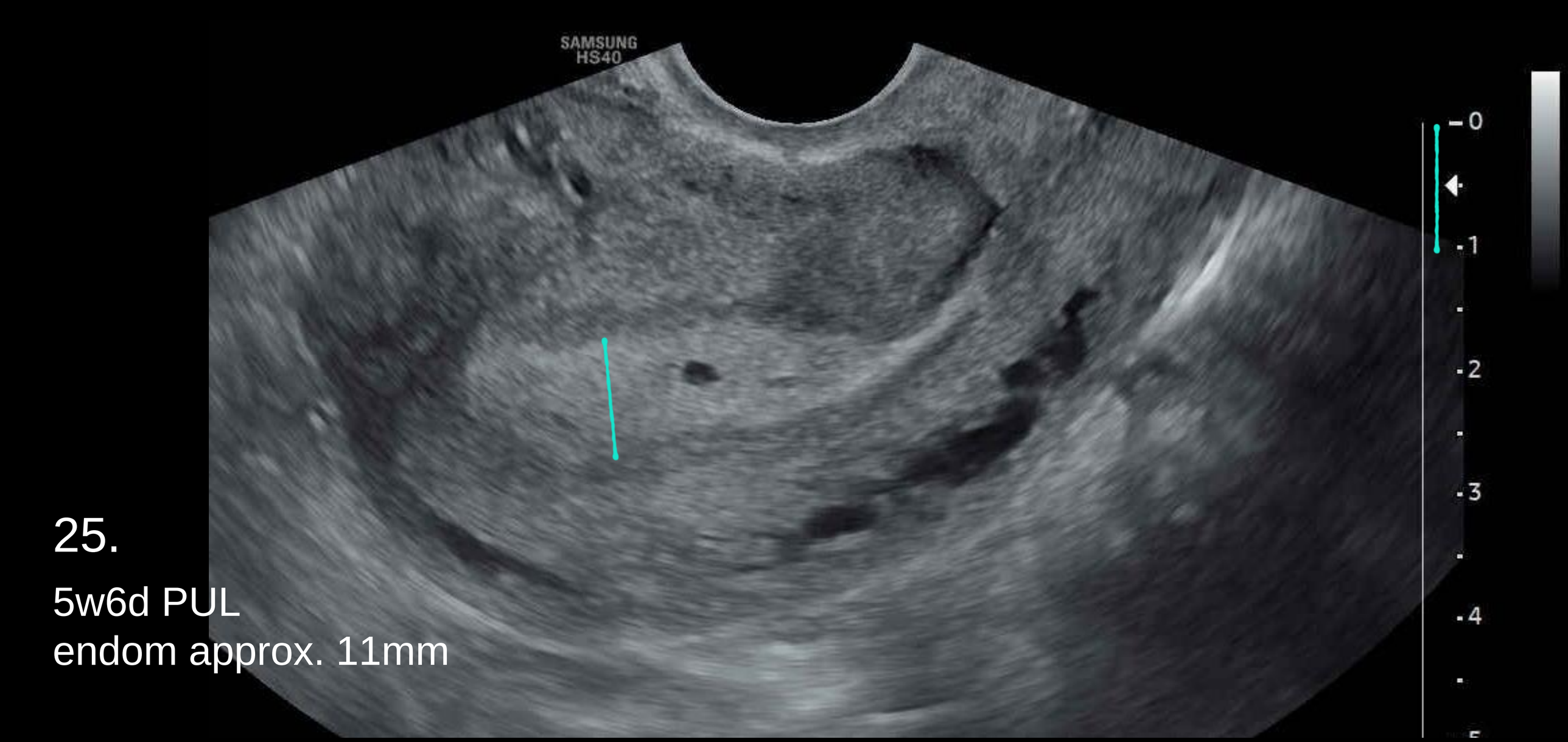
24.

6w5d

PUL

endom >11mm

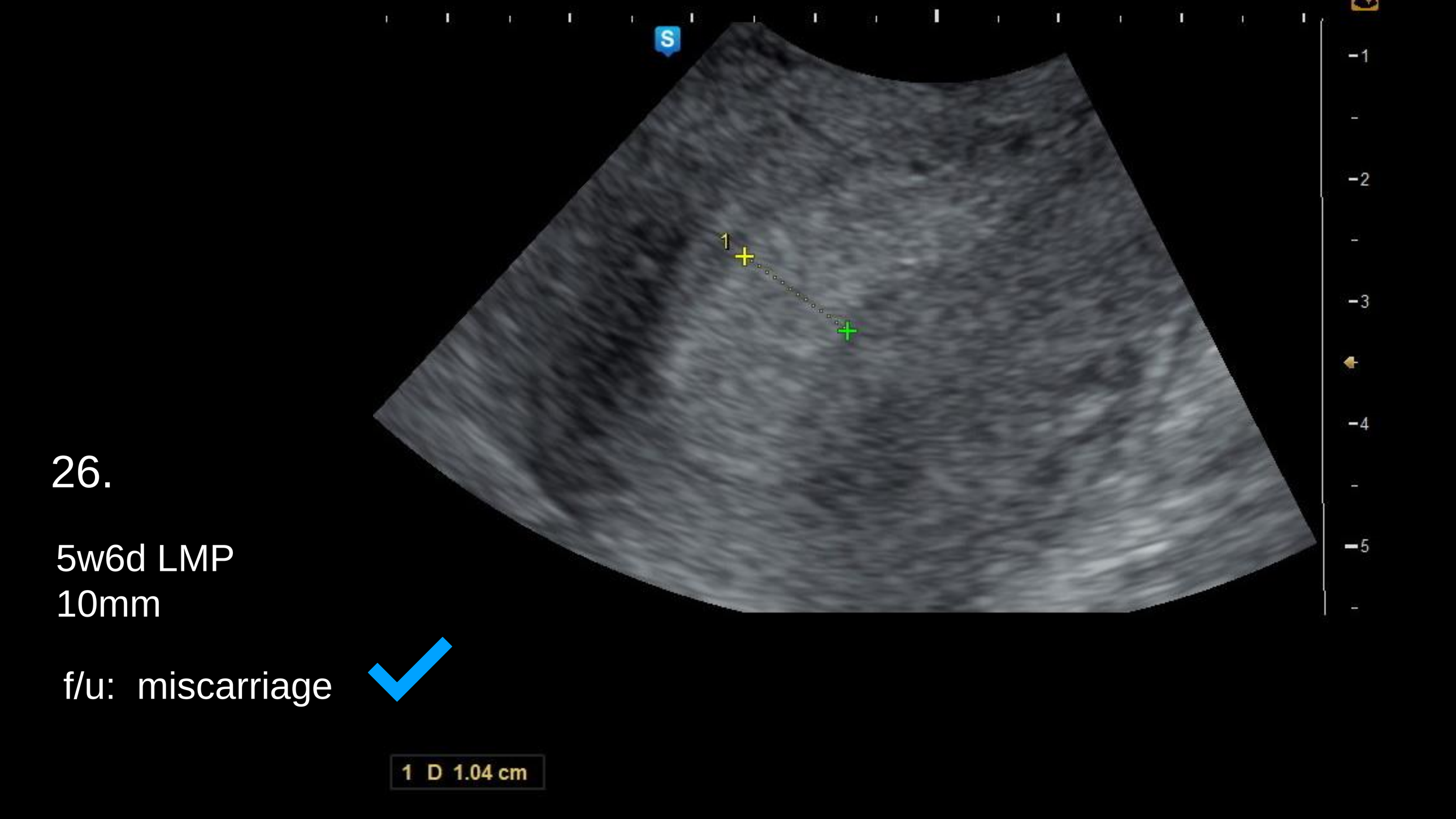
f/u IUP



25.

5w6d PUL
endom approx. 11mm

f/u: HCGs inc
Prob. early IUP

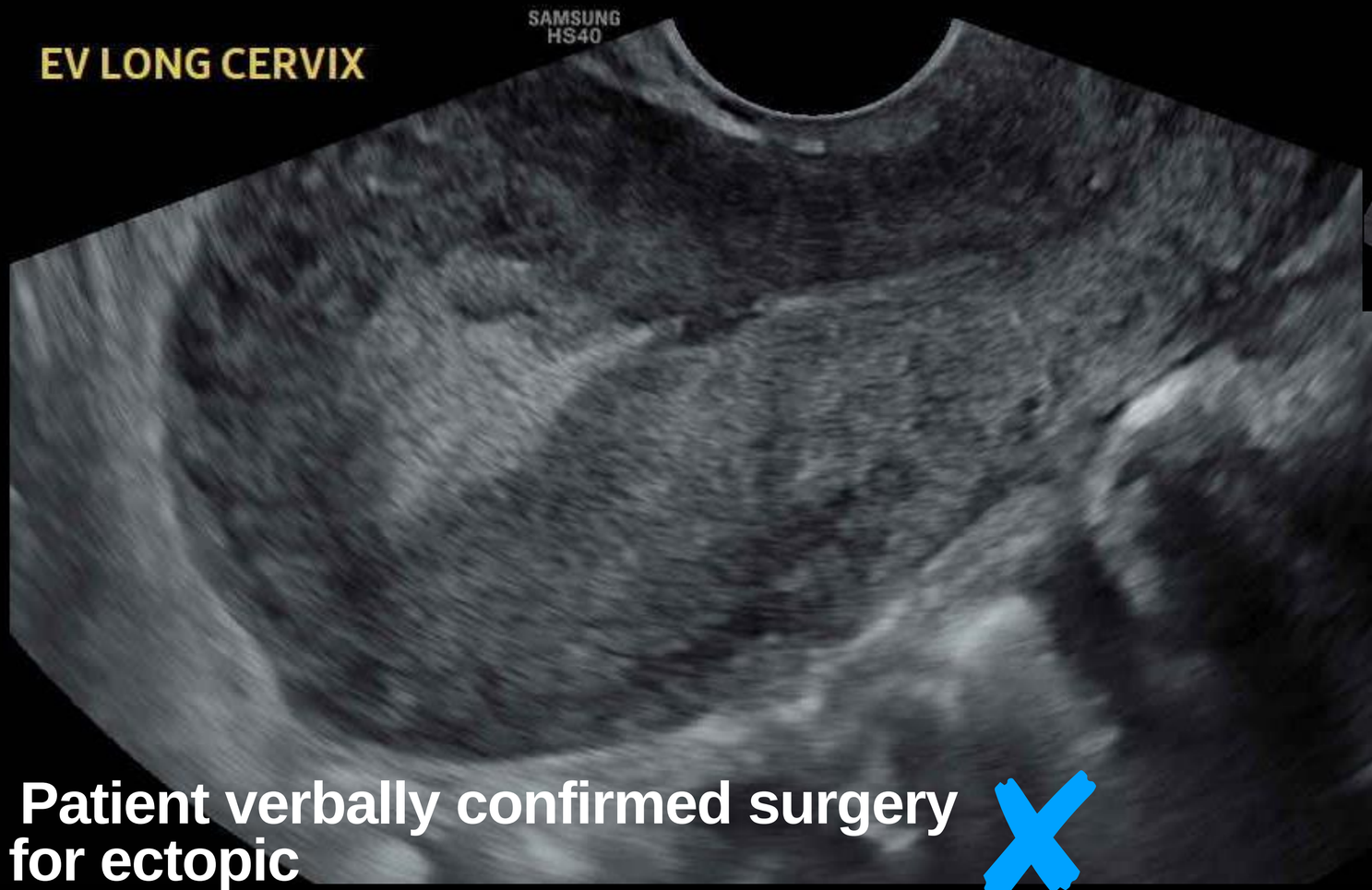


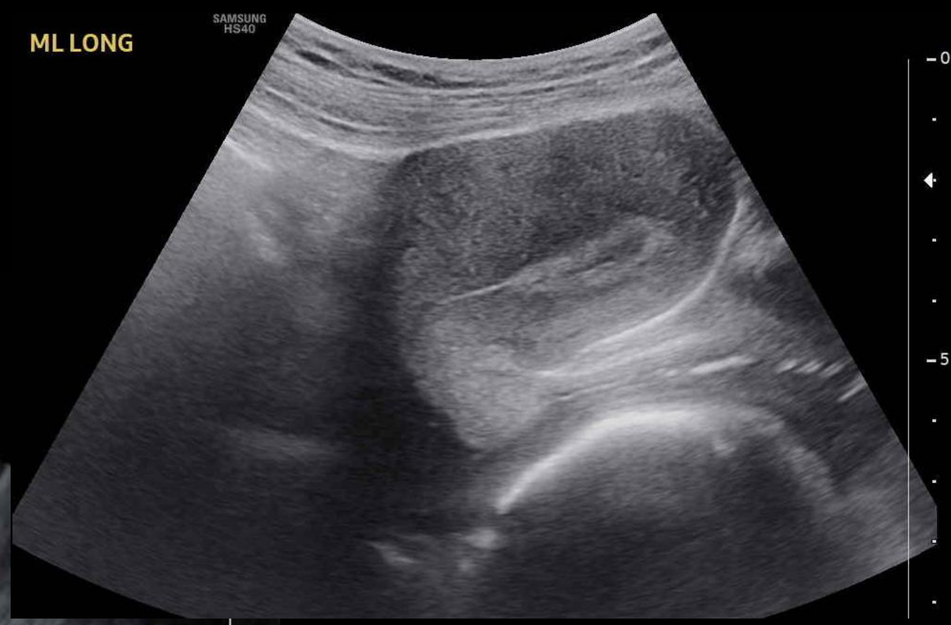
26.

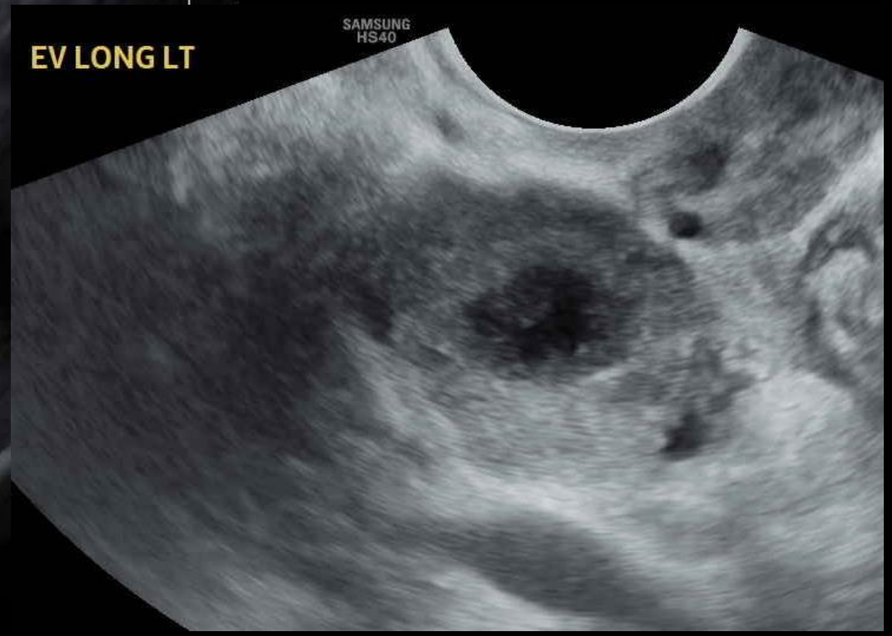
5w6d LMP
10mm

f/u: miscarriage

27. 8w1d LMP
irregular endom. >11mm





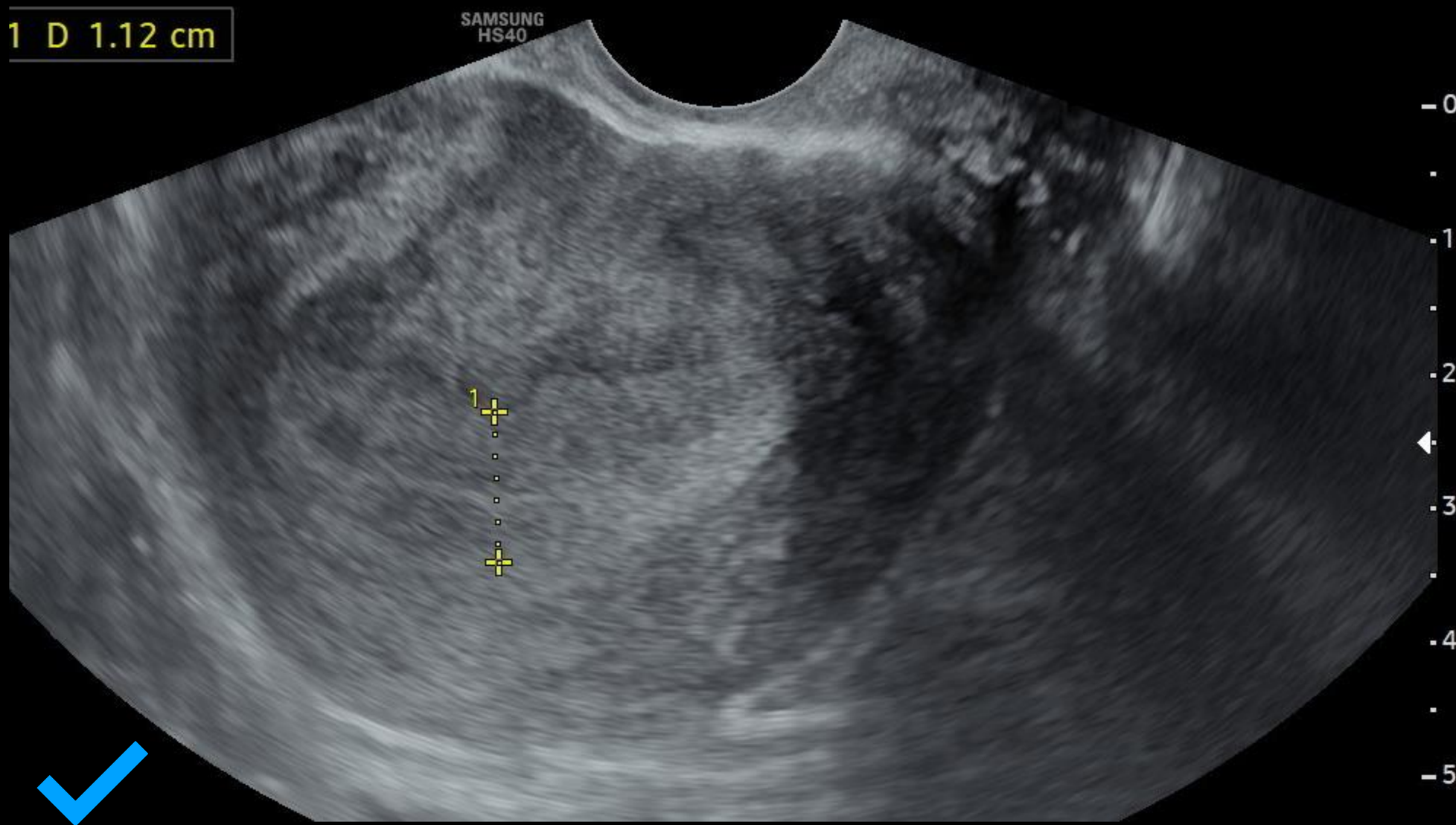


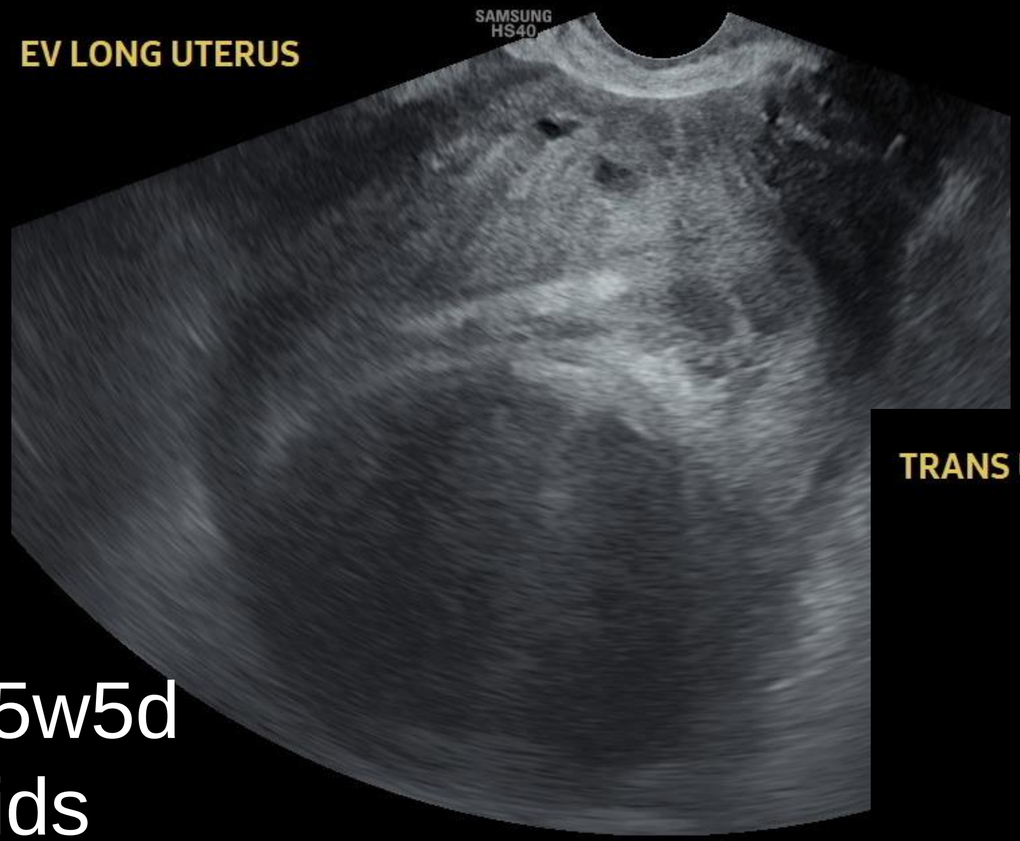
f/u: Patient verbally confirmed surgery for ectopic

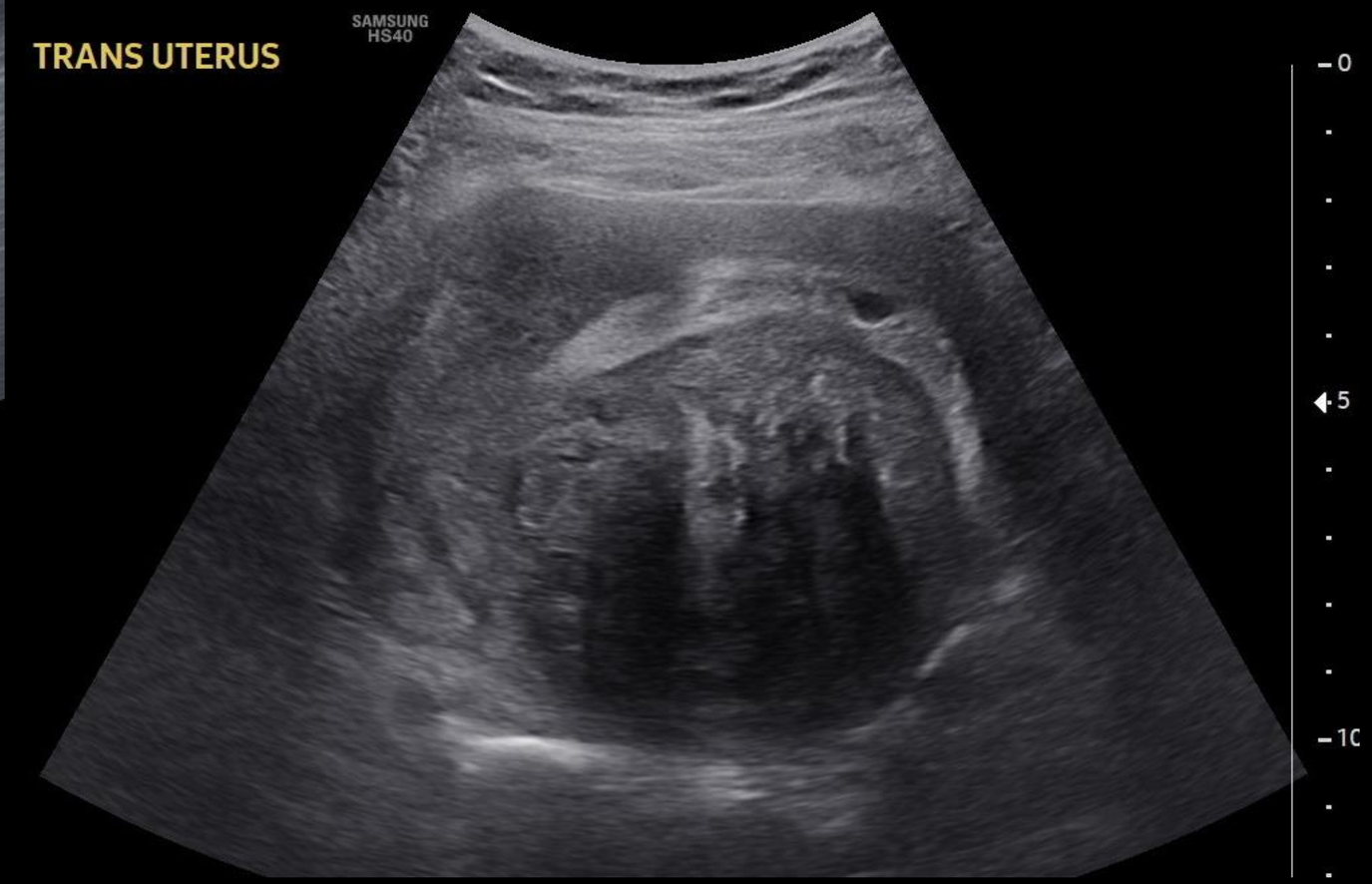
(heterogeneous endometrium common in abnormal outcomes)

28.
7w4d LMP
11mm endom

f/u: viable IUP

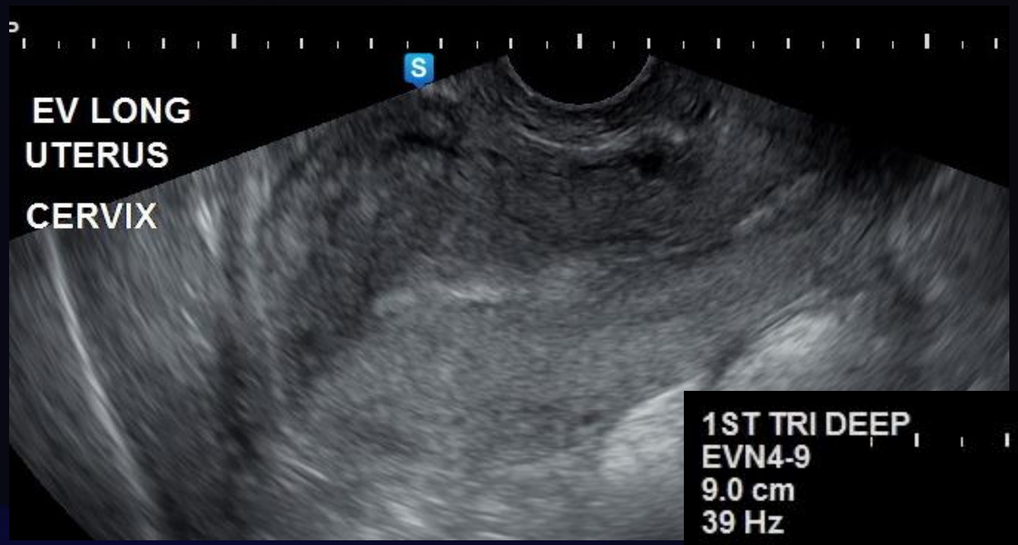


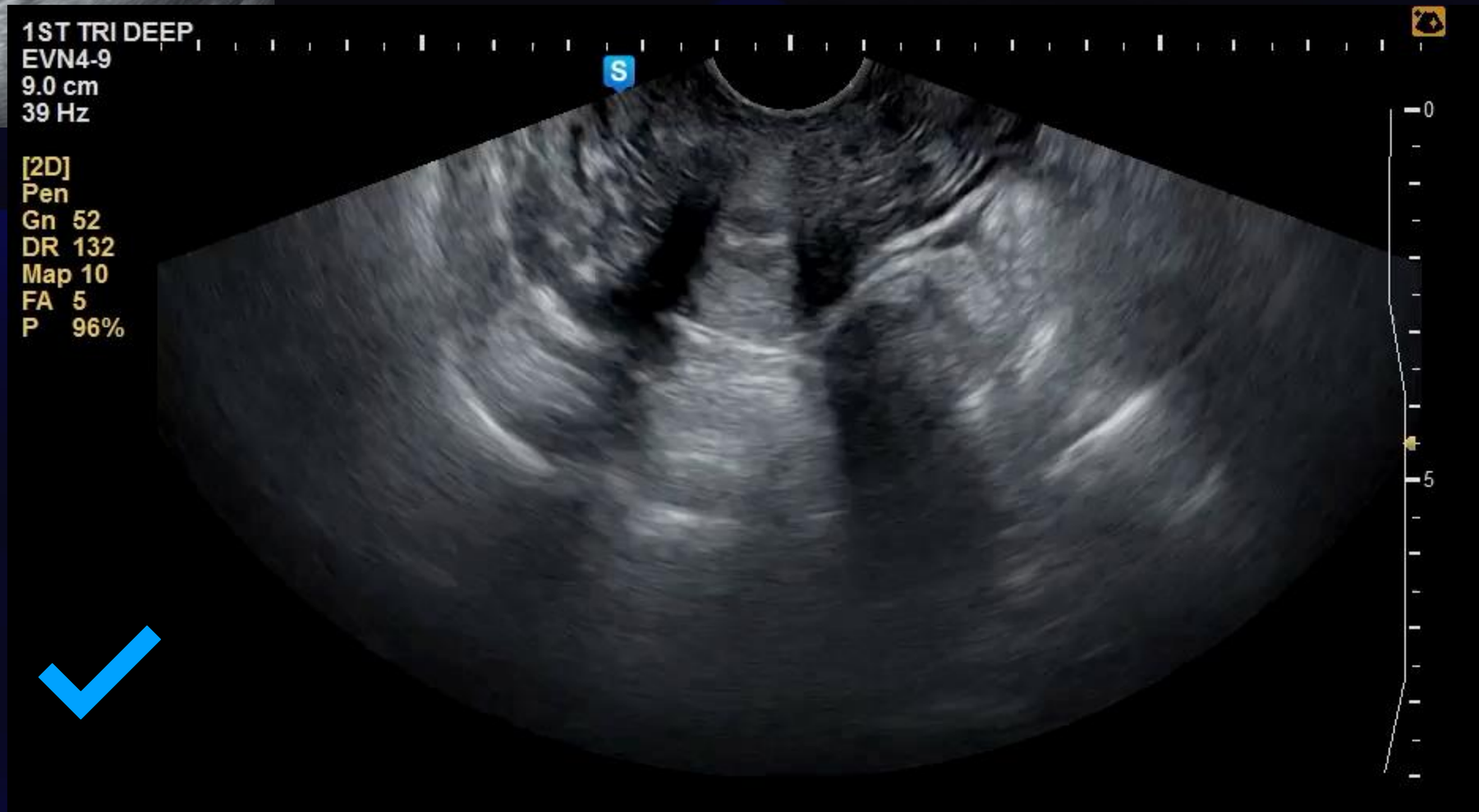




29. 5w5d
fibroids
thin endom

f/u: miscarriage ✓





30. 6w1d
fibroid
ES <10mm

confirmed ectopic

PUL Outcomes

>11mm endom (12) and confirmed IUP **11**	**<11mm endom (18) and confirmed ectopic** **13**
>11mm endom and confirmed ectopic **1**	**<11mm endom and confirmed IUP** **5 (4 miscarried 1 PCOS)**

Conclusion

PUL with ES >11mm
likely earlier than dates, IUP

PUL with ES <11mm
more likely ectopic
or failed pregnancy

PUL Outcomes

This data is perhaps 75- 85% accurate.

Still assume ectopic when +PT and empty uterus.

PUL Outcomes

Endometrial thickness <11mm
more likely to be ectopic or failed pregnancy

Add good pic of endometrium
Measure, but don't report.

PUL Notes

- ES increases = likelihood normal IUP increases*
- Each mm increase is 27% increase in normal IUP!*
- Heterogeneous ES may indicate bleeding or breaking down of sac, whereas homogeneous ES is expected in normal IUP
- Normal IUP visualized with transvaginal ultrasound at 4w3d
- ES in IUP typically 17mm (13-25)
- ES similar between ectopic and failing PULs
- We must assume ectopic when IUP not seen (only 1/5)
- High echogenicity 72% ectopics
- Heterogeneous hyperechoic endom. associated with abnormal outcomes

Sample Verbage for inconclusive u/s with no signs of pregnancy in uterus or no YS in uterus:

Unable to confirm IUP. No signs of pregnancy seen in uterus. Advised pt to f/u in ER within 24 hours to rule out ectopic pregnancy or miscarriage, or immediately go to ER if she has any vaginal bleeding or abdominal pain > menstrual cramping.

OR

Unable to confirm IUP. Possible GS seen in uterus with no other signs of IUP. Advised pt to f/u in ER within 24 hours to rule out ectopic pregnancy or miscarriage, or immediately go to ER if she has any vaginal bleeding or abdominal pain > menstrual cramping.

Legal Advice October 2020 PUL

1. When a patient has a positive pregnancy test but no IUP or fetal pole, she has an ectopic pregnancy until proven otherwise—even if the adnexa appear normal;
2. The medical director must be notified before the patient leaves the office;
3. The medical director should personally (and strongly) recommend a same-day visit to the ER or the patient's Ob; and
4. The patient should sign a statement indicating that they have been informed of the danger of a potential ectopic pregnancy.
5. Additionally, do not ever schedule a follow-up appointment for a patient with a suspected ectopic. This implies continuation of care and is a legal nightmare to defend.

- What to expect after ER visit:
  - Discharge instructions - include monitoring patient
    - serum hCG levels every 48 hours
    - "watch and wait"
    - RETURN TO ER IMMEDIATELY UPON INCREASING BACK PAIN, HEAVY VAGINAL BLEEDING/CLOTS, DIZZINESS, LIGHTHEADEDNESS, FAINTING, NAUSEA, VOMITING, FEVER, CHILLS

Here is the continuity of care.

2008 Study

- In Texas study, with 517 patients with PUL Variable: history of active vaginal bleeding
  - 7.7 % confirmed viable IUP
  - 8.3% confirmed ectopic
  - 83.9% failing PULs (included miscarriage and ectopic)

- *Moschos, "Endometrial Thickness Predicts IUP in patients with PUL" Ultrasound in OB/Gyn/Vol 32:7

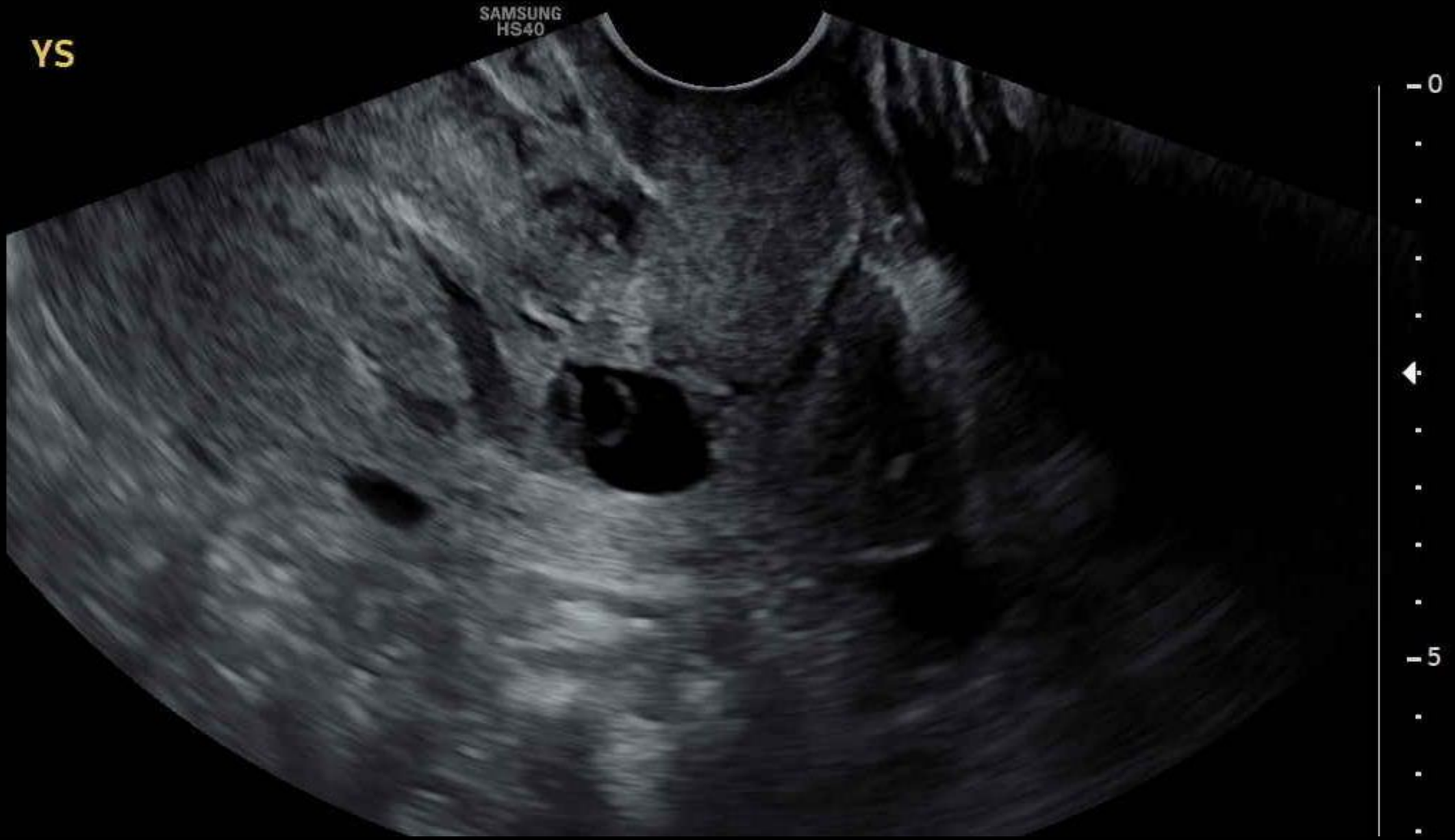
- Texas study included 4 variables:
  - maternal age
  - EGA (by LMP)
  - serum BhCG
  - Endom. thickness

- Endom. thickness:
  - Normal IUP mean endom. stripe = 17.2mm (No IUP with ES < 8mm)
  - Abnormal pregnancies: mean endom. stripe 11.9 mm
  - ES<13mm in 70% ectopics

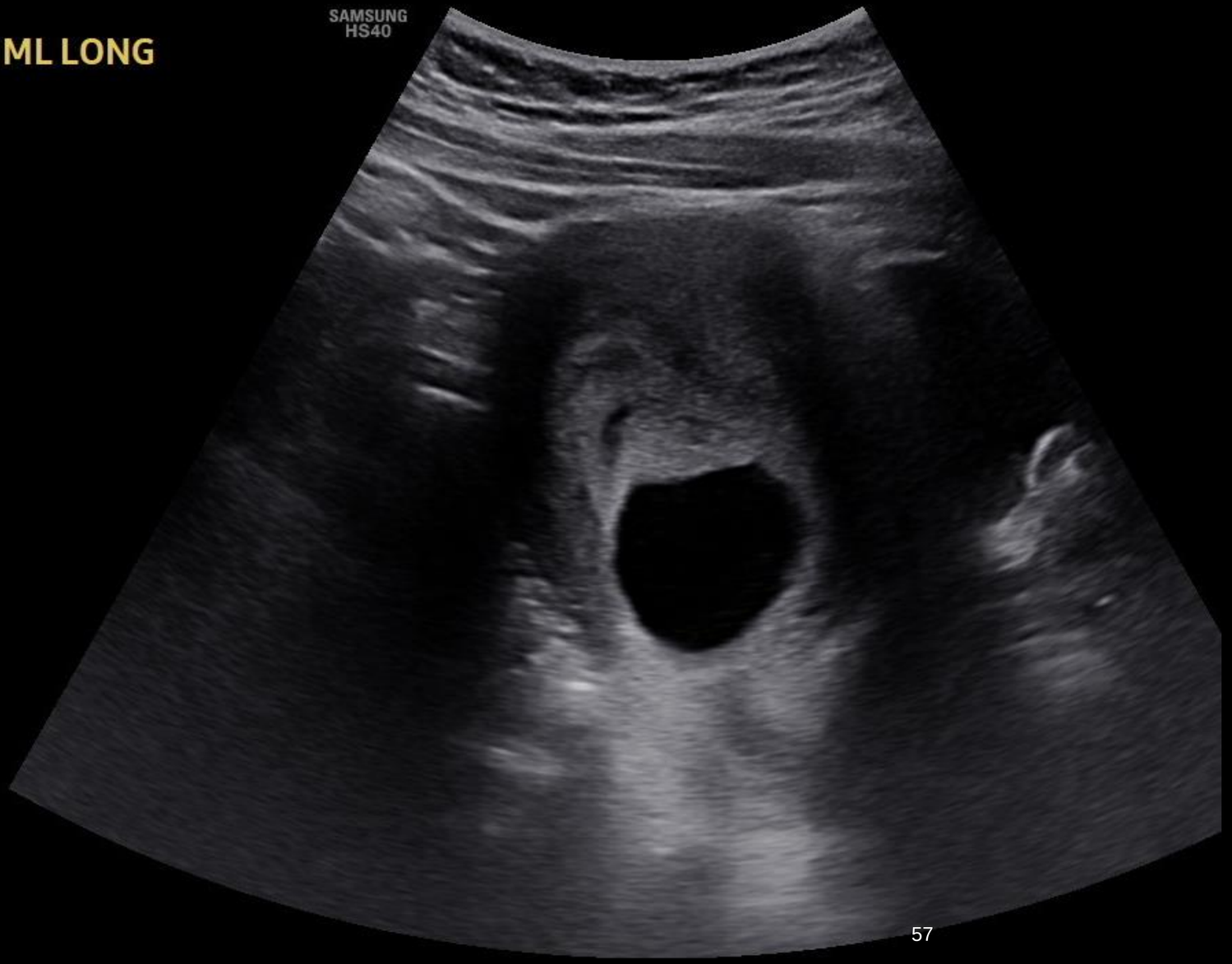
DIFFERENTIALS

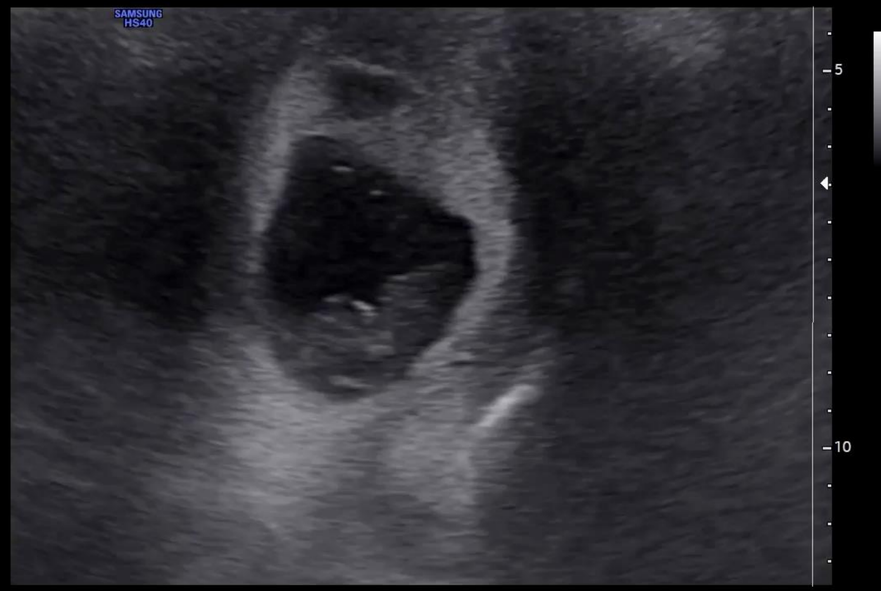
Miscarriage/Fetal Demise (spontaneous abortion)

- Finding: Miscarriage
- Incidence: 26% of pregnancies (NIH)
- Occurrence: chromosomal abnormalities, AMA, high BP
- Sonographic Finding: Absence of gestational sac, or abnormal implantation
- Differential Diagnosis: ectopic, molar, subchorionic hemorrhage,
- Prognosis: Expectant management (pass naturally within 8 wks), Medical (misopristol, generally 3 days), Surgical evacuation.

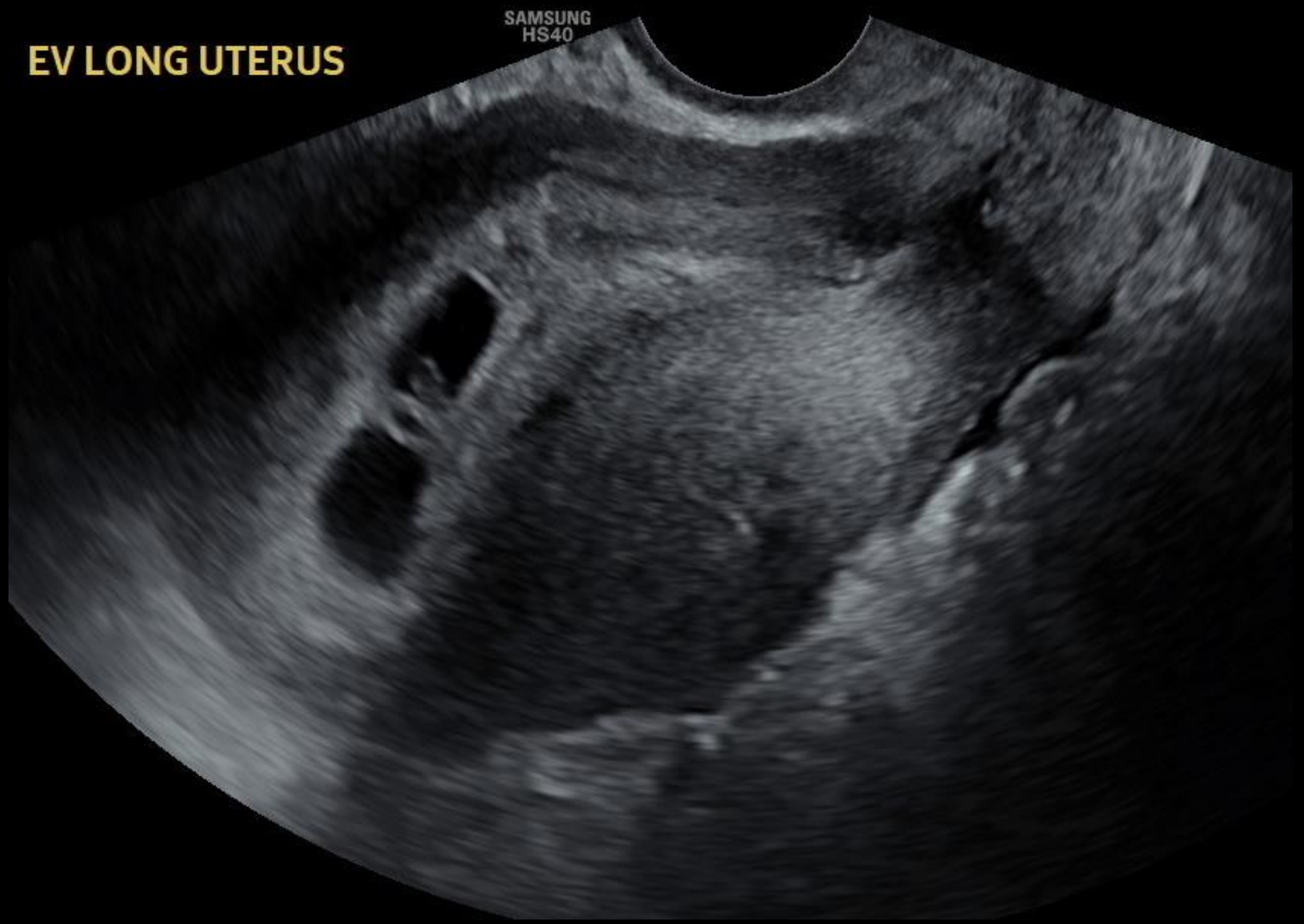

YS
SAMSUNG
HS40
0
5

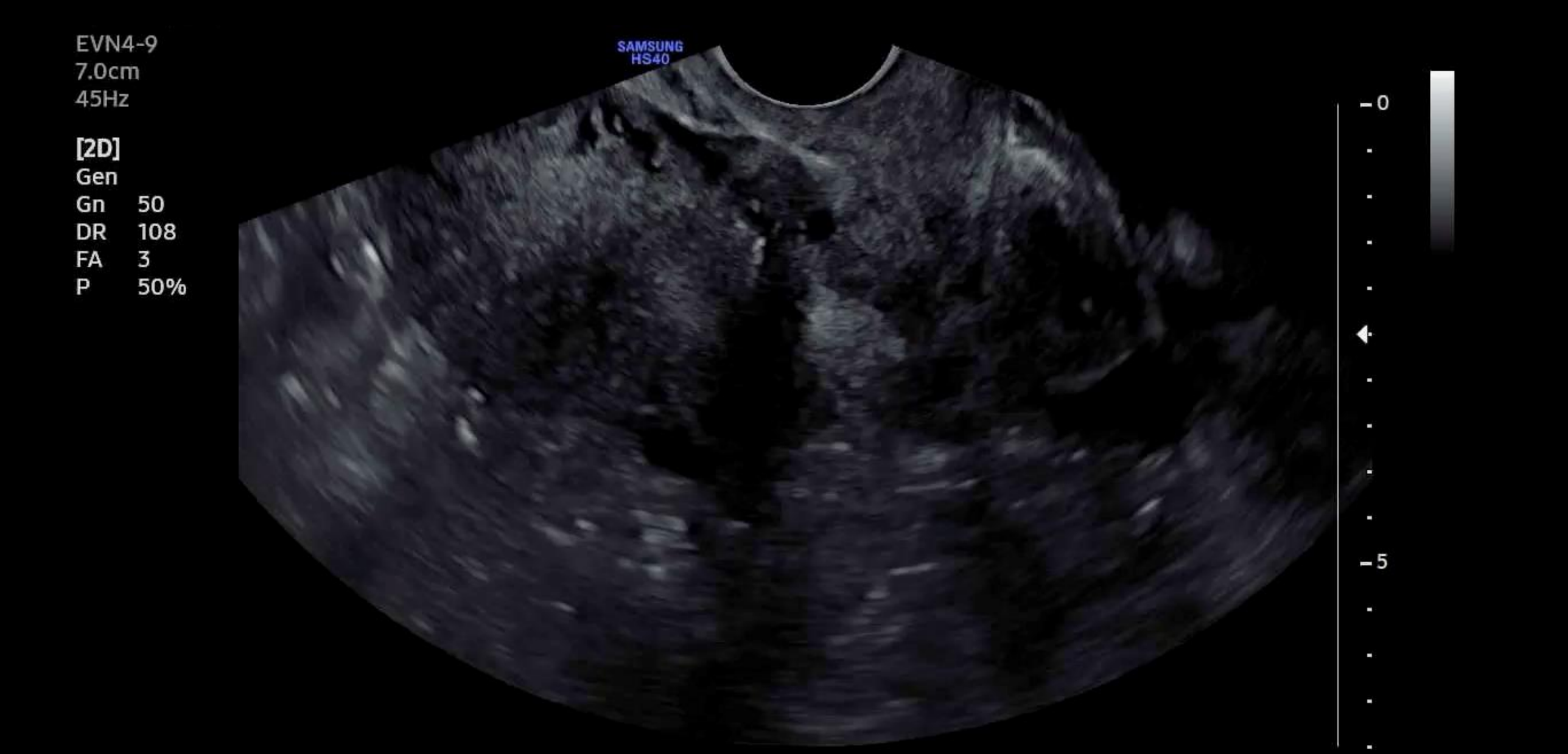
GS near cx


ML LONG
SAMSUNG
HS40

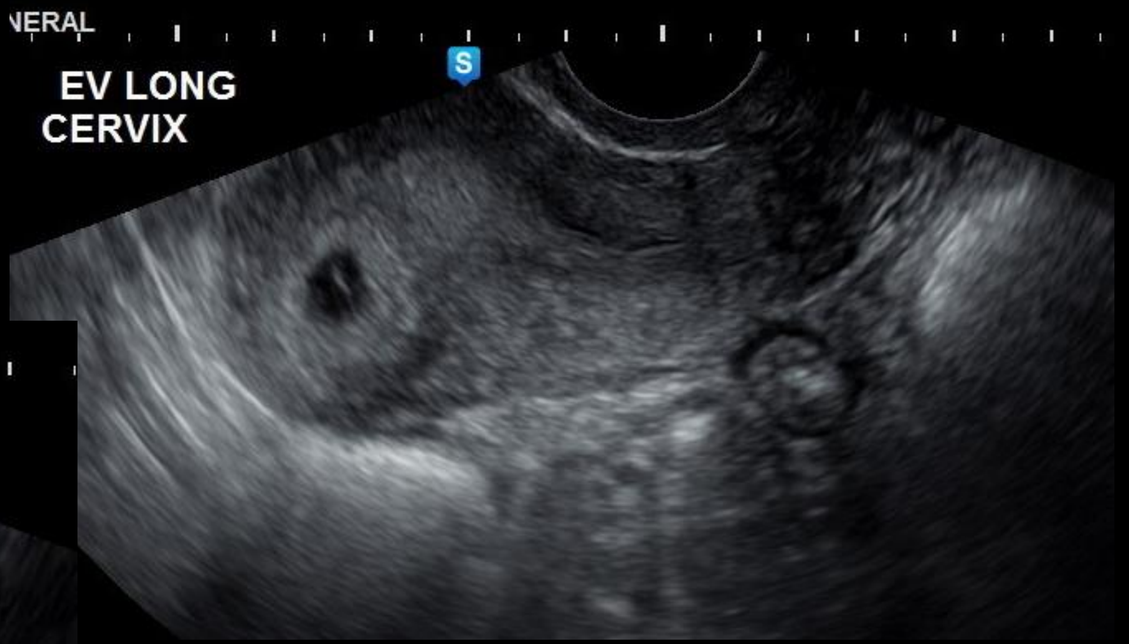

CA2-8AD
13.0cm
45Hz
[2D]
Gen
Gn 51
DR 112
FA 7
P 50%
SAMSUNG
HS40
5
10

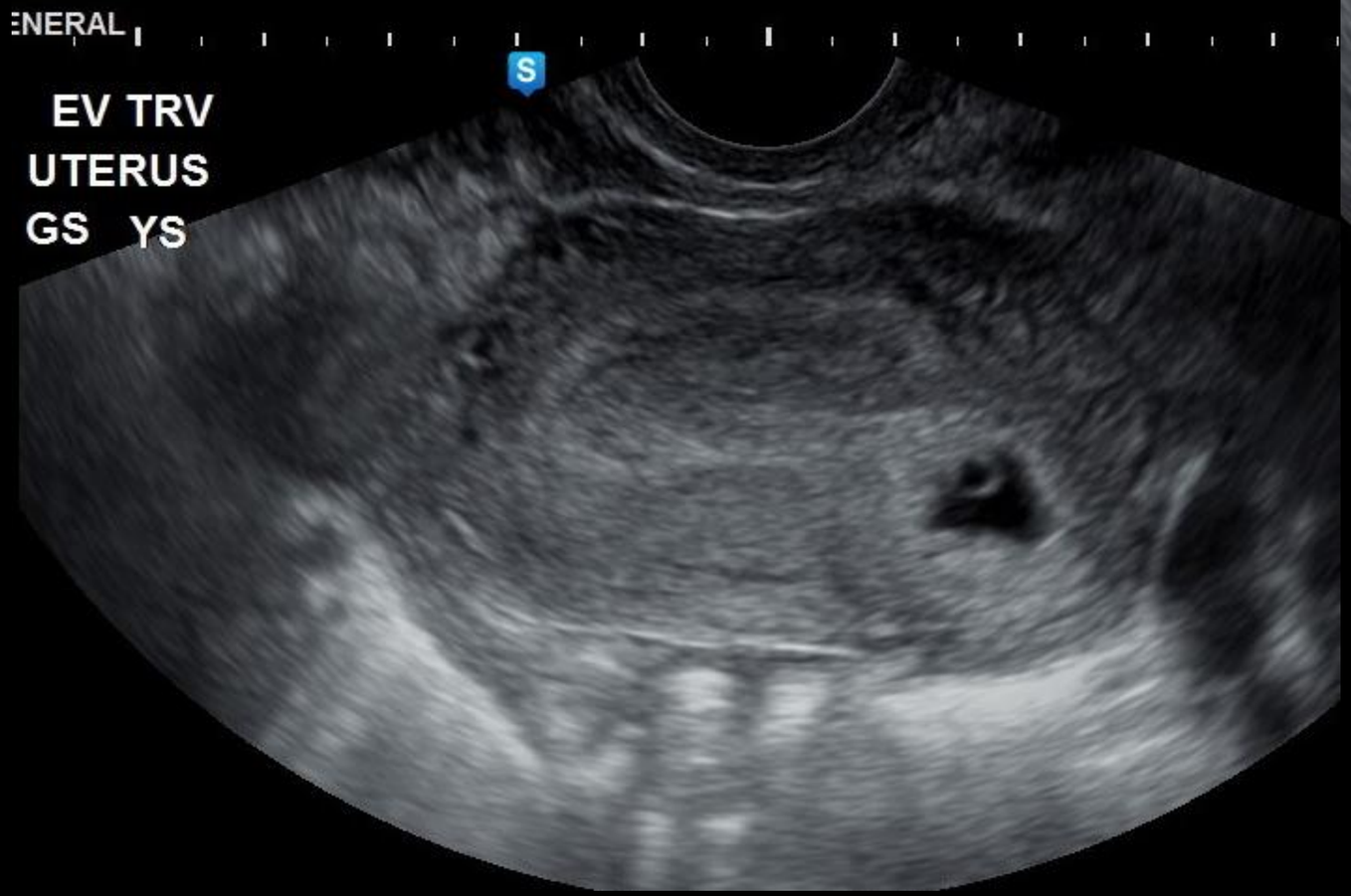
one week prior



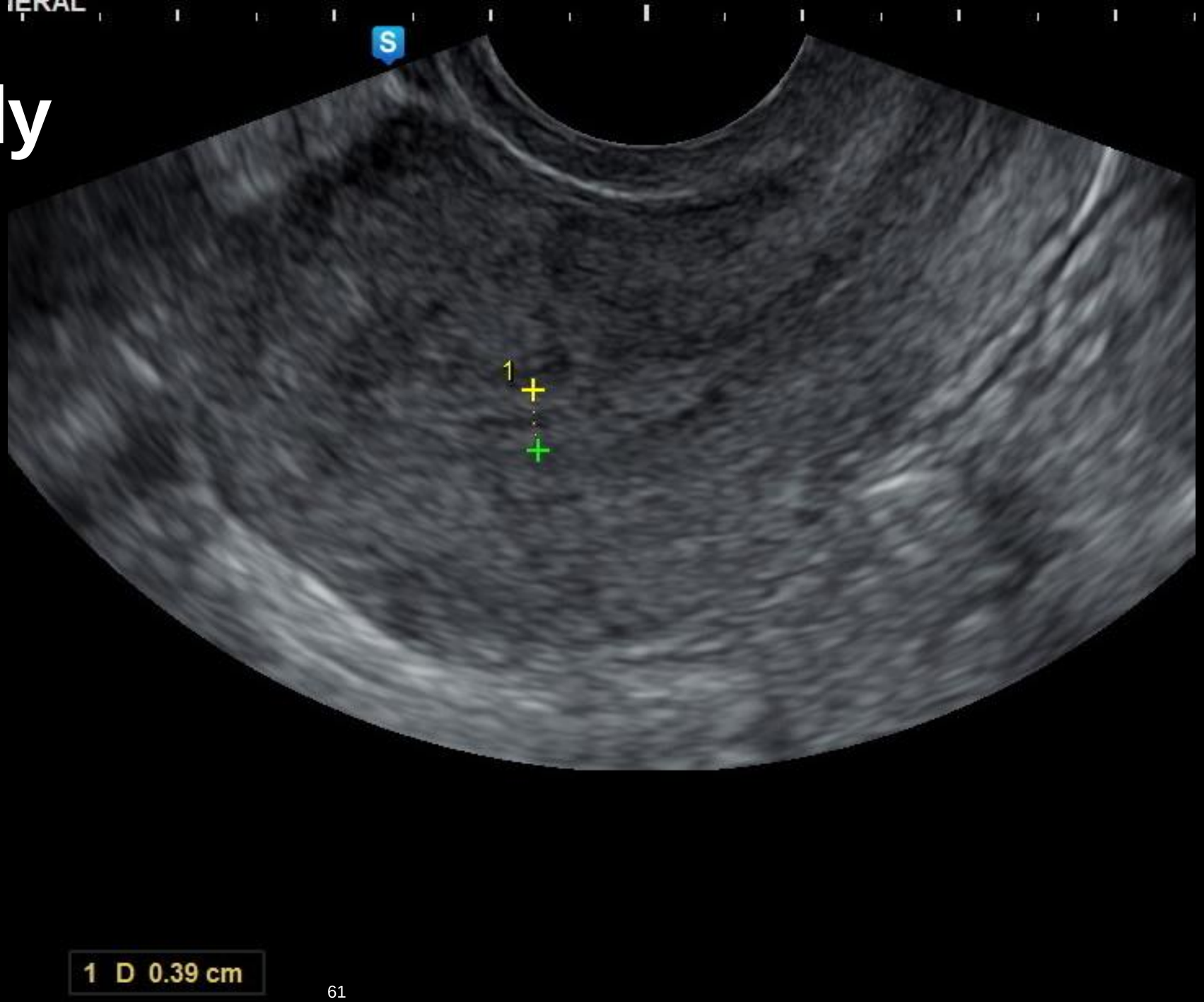

EVN4-9
7.0cm
45Hz
[2D]
Gen
Gn 50
DR 108
FA 3
P 50%
SAMSUNG
HS40
0
5

"Eccentric" location ended in miscarriage (implantation)

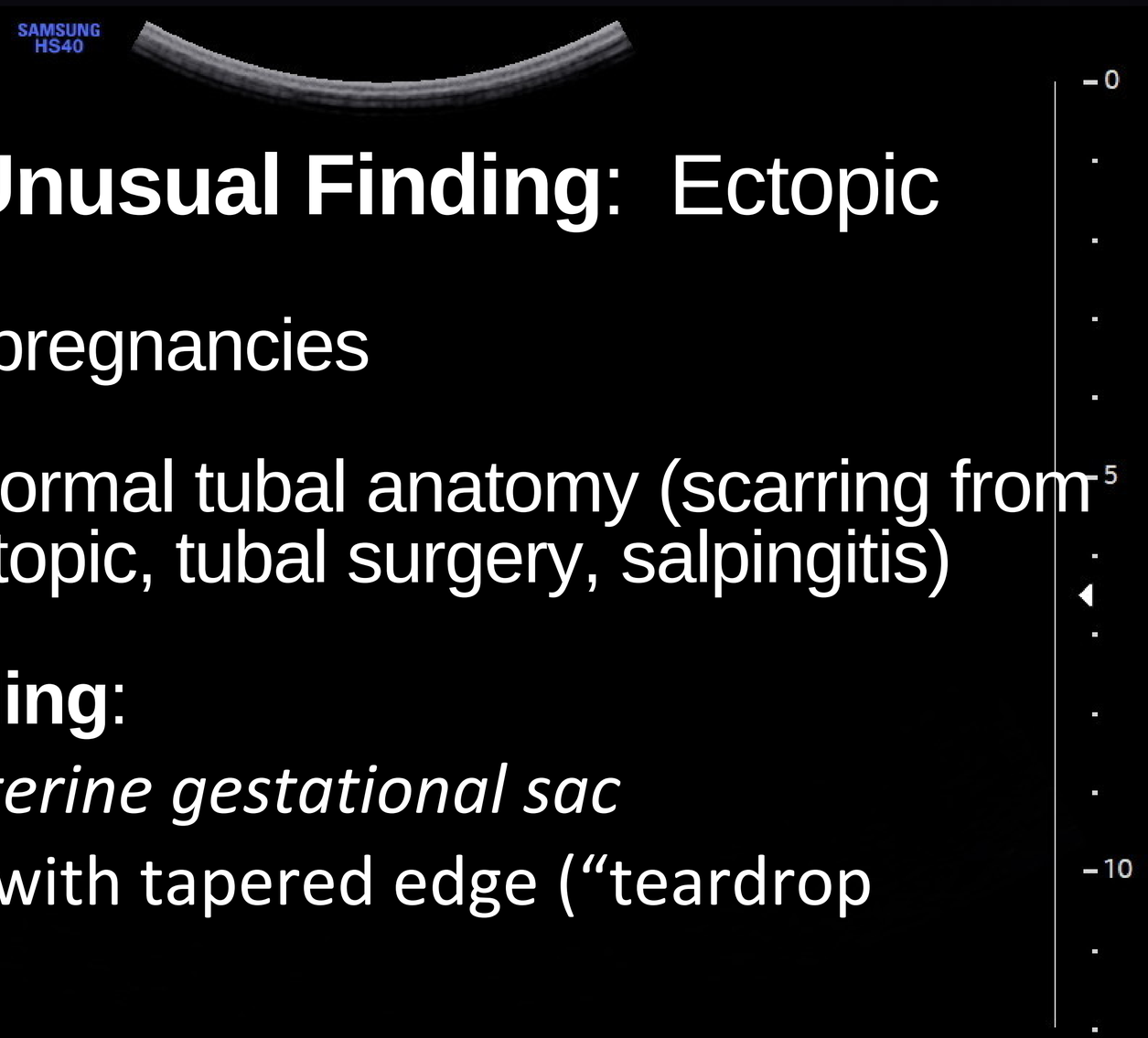




Patient verbally confirmed miscarriage



Unusual Finding: Ectopic



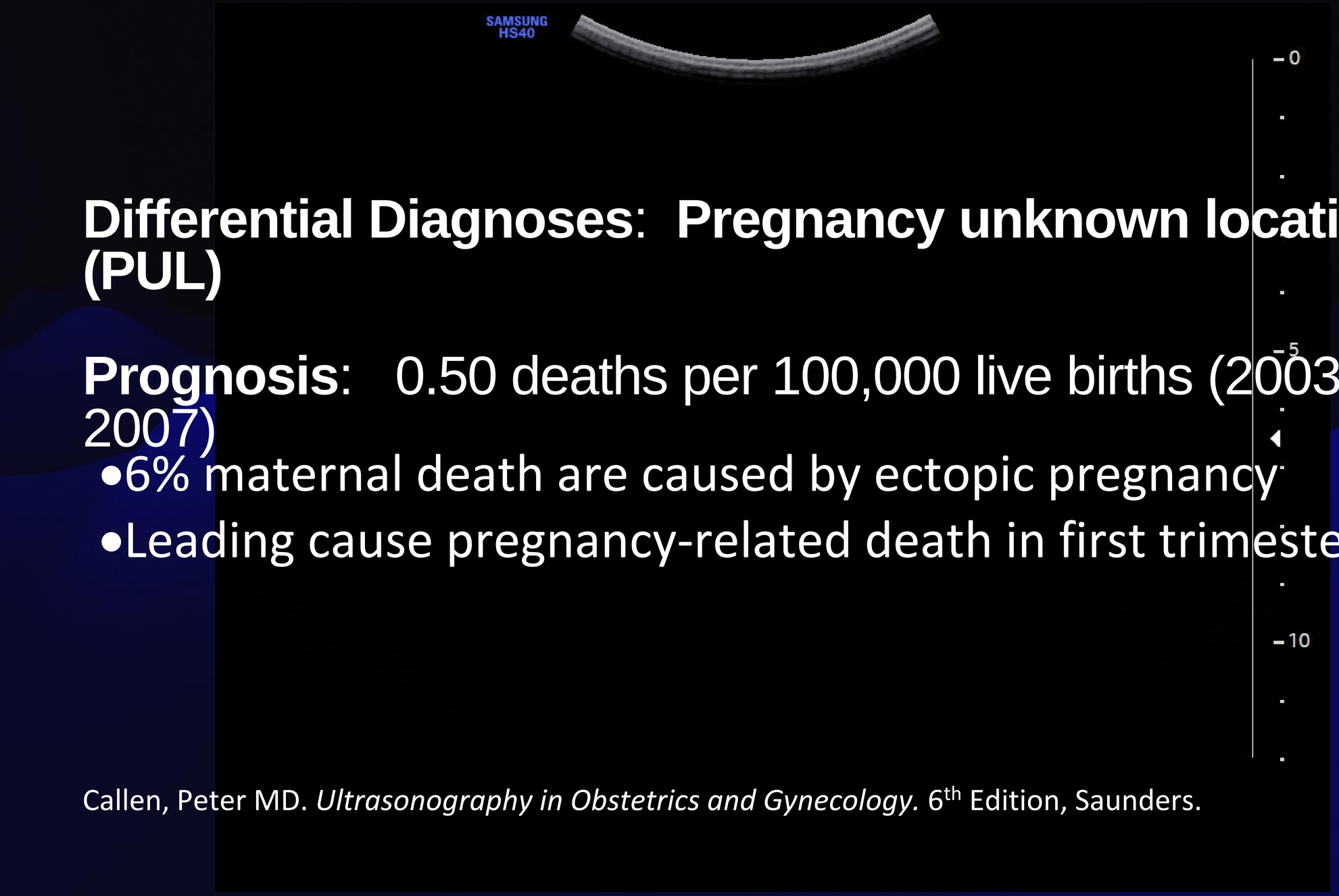
Incidence: 2% of pregnancies

Occurrence: Abnormal tubal anatomy (scarring from STDs/PID, prior ectopic, tubal surgery, salpingitis)

Sonographic Finding:

- *Absence of intrauterine gestational sac*
- Endometrial fluid with tapered edge (“teardrop appearance”)
- Free fluid in cul-de-sac
- *Visualization of extrauterine gestational sac with yolk sac or extrauterine embryo*

NIH



Differential Diagnoses: **Pregnancy unknown location (PUL)**

Prognosis: 0.50 deaths per 100,000 live births (2003-2007)

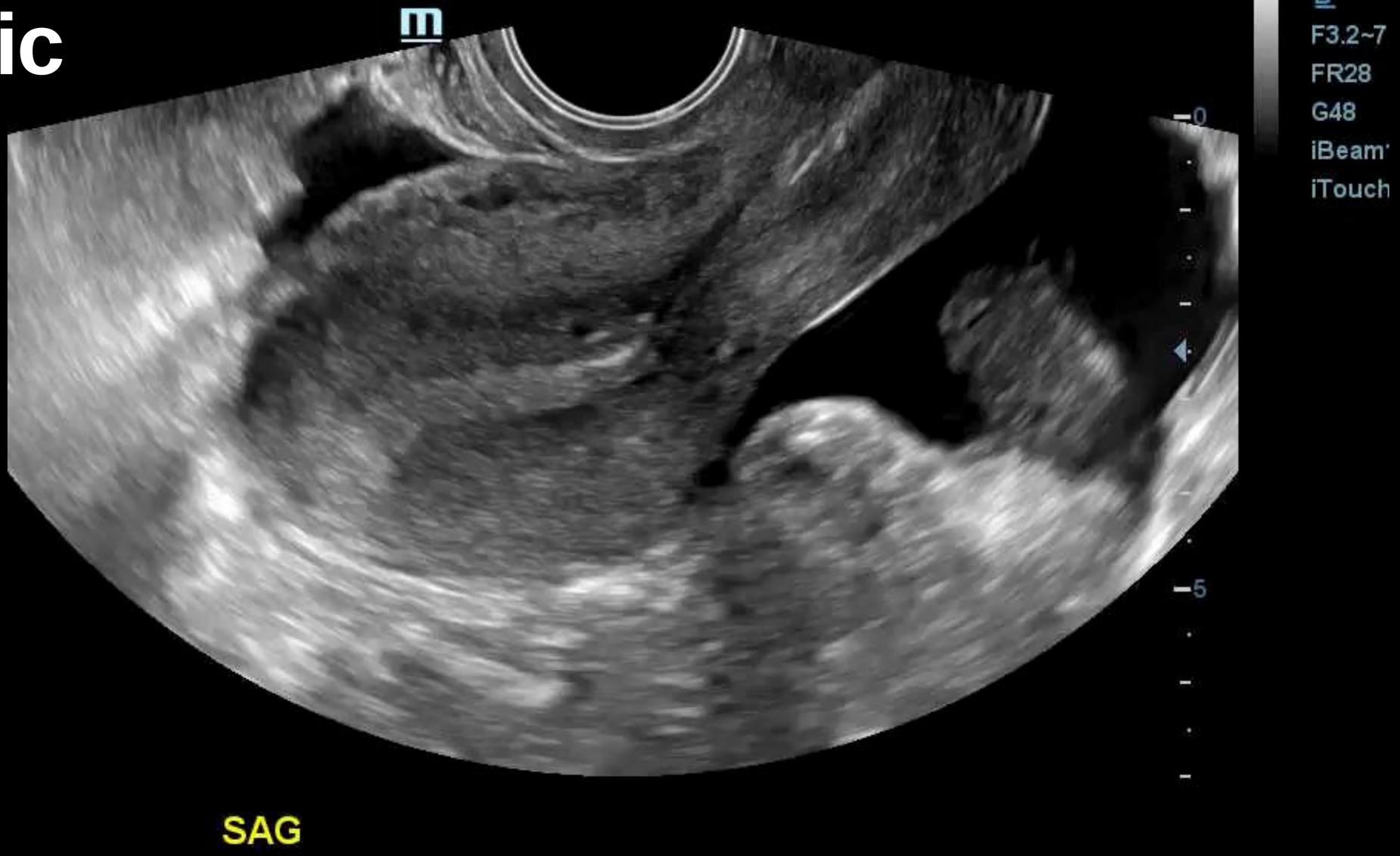
- 6% maternal death are caused by ectopic pregnancy
- Leading cause pregnancy-related death in first trimester

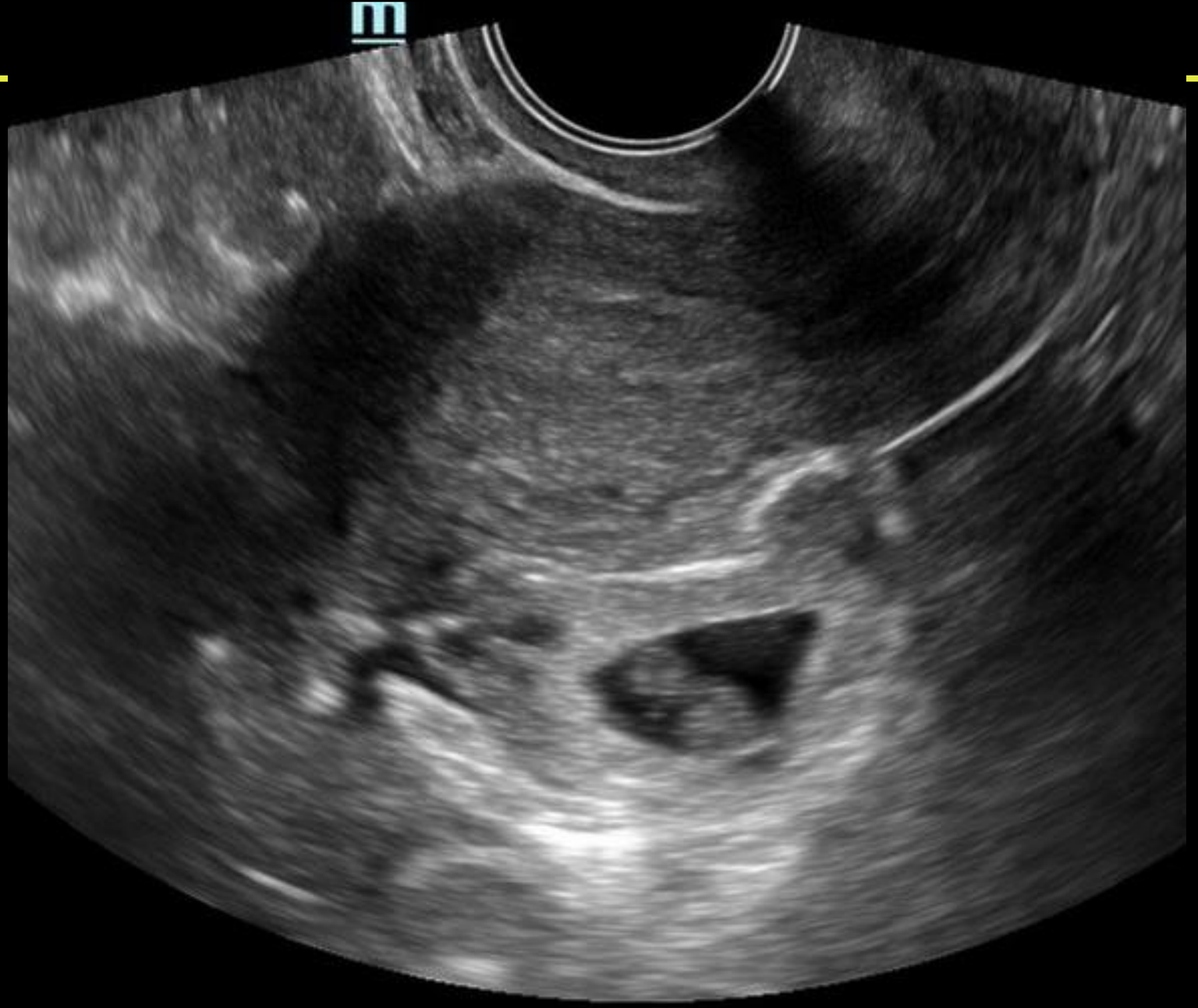
Callen, Peter MD. *Ultrasonography in Obstetrics and Gynecology.* 6th Edition, Saunders.

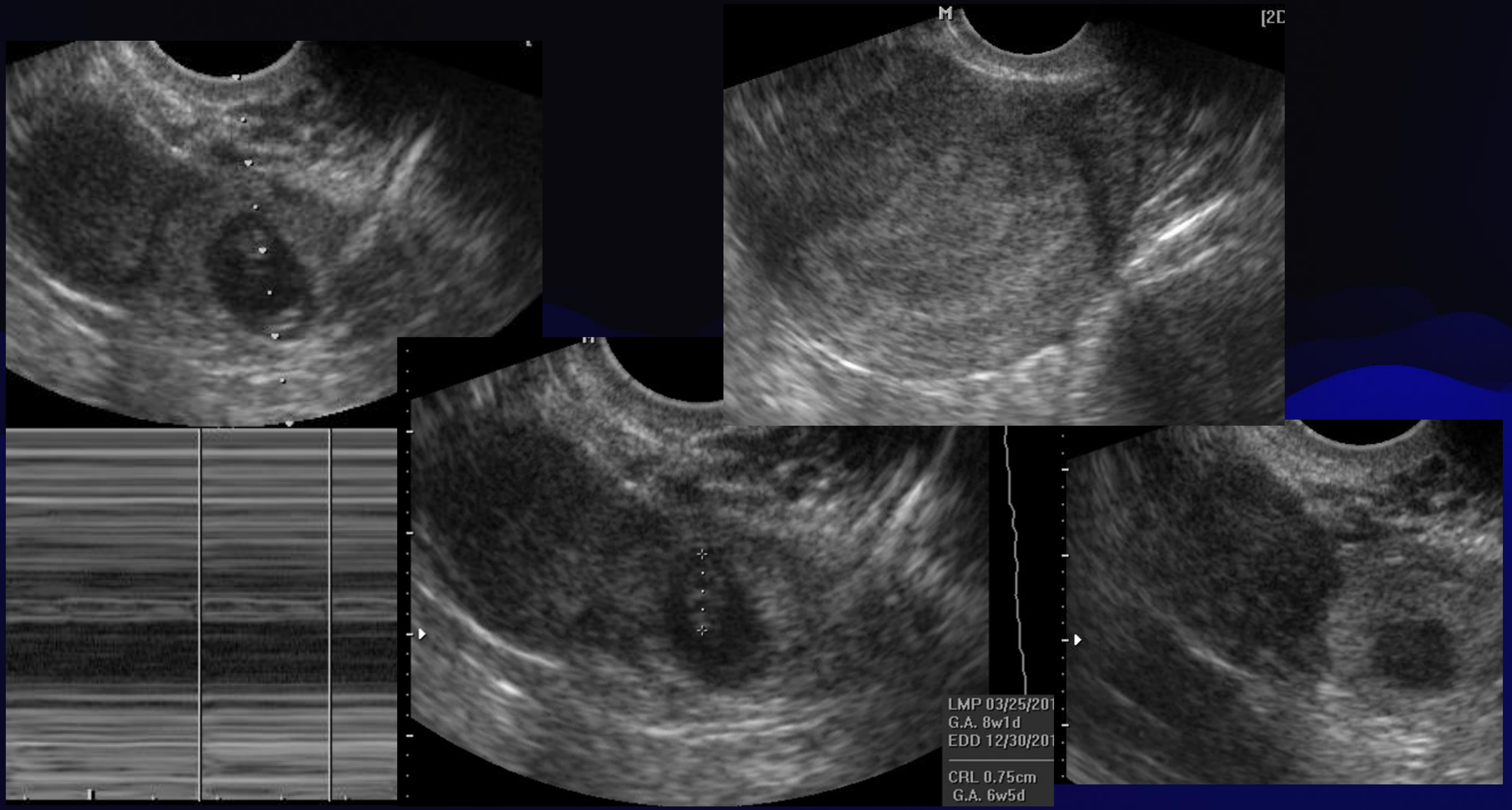
Screening - 68% of reported ectopics were not scanned

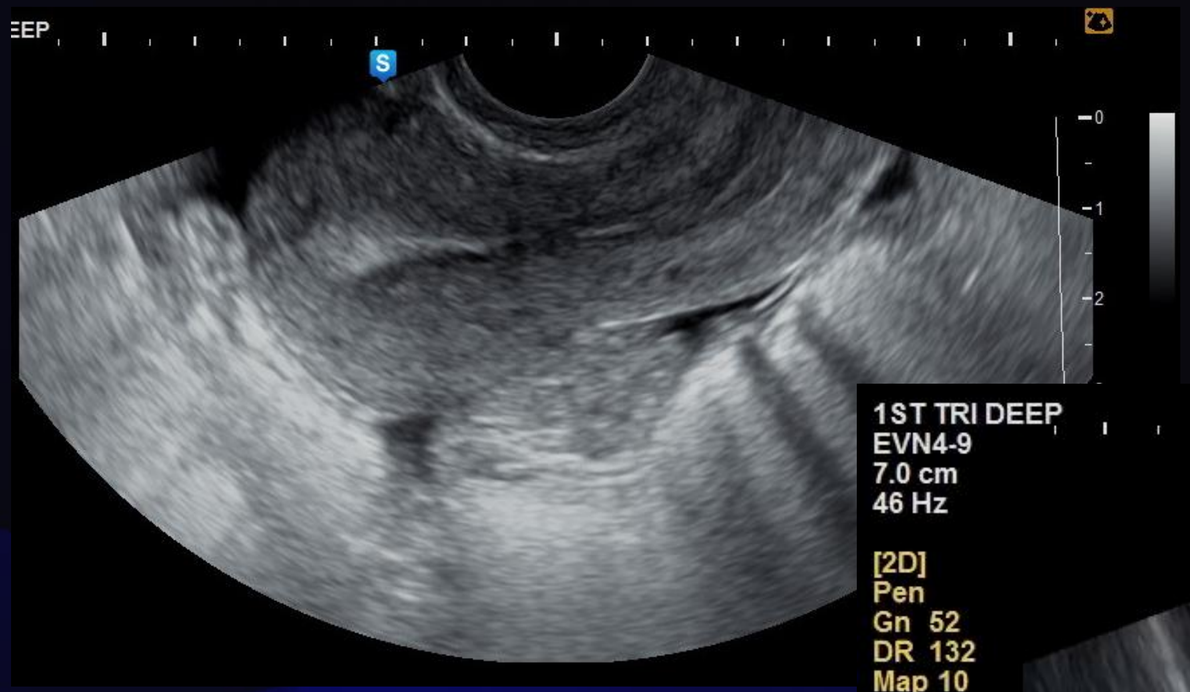
- Gestational age 5w5d by LMP
- No pain worse than menstrual cramps
- No active bleeding
- Positive PT on site

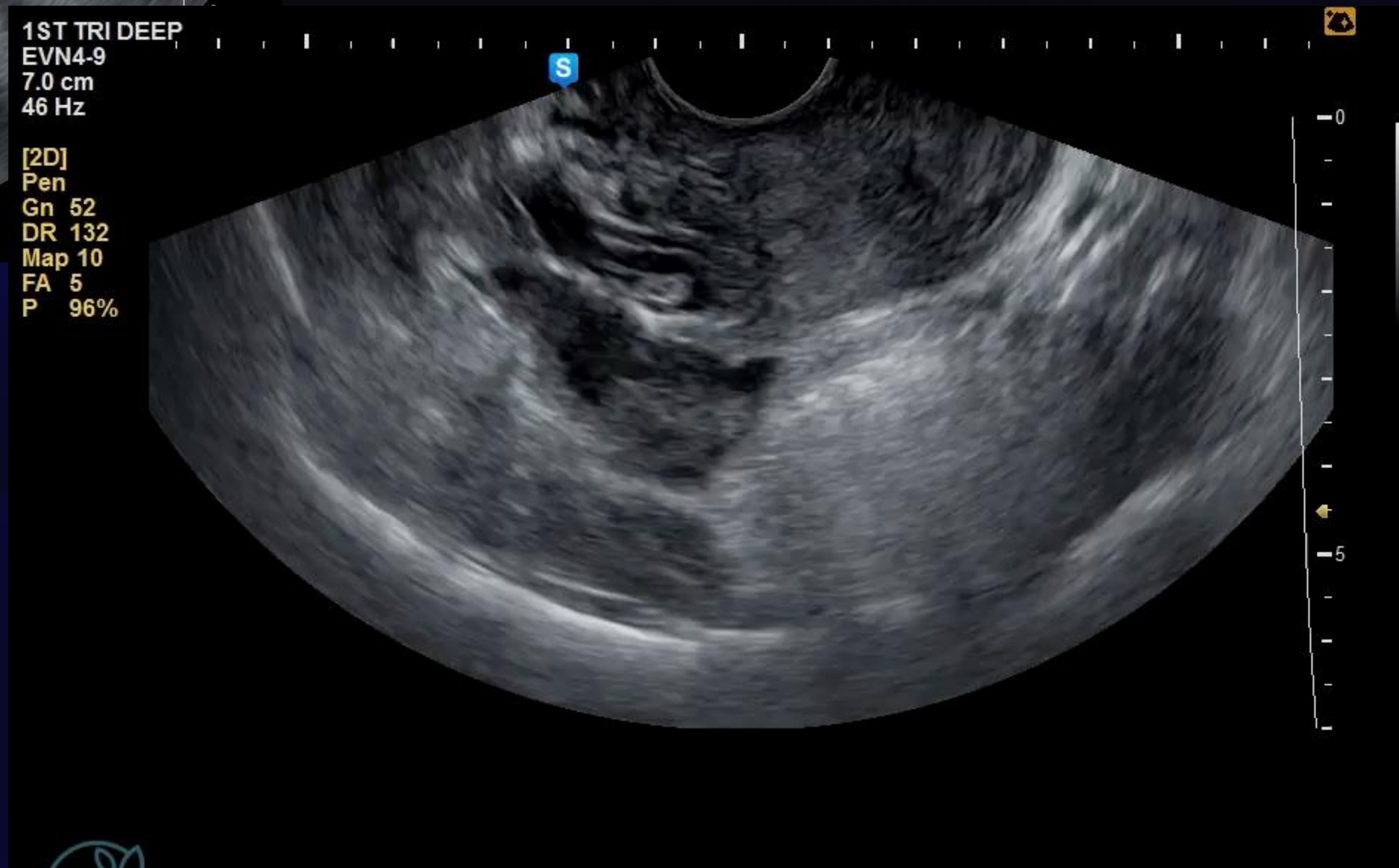
confirmed ectopic




Sag

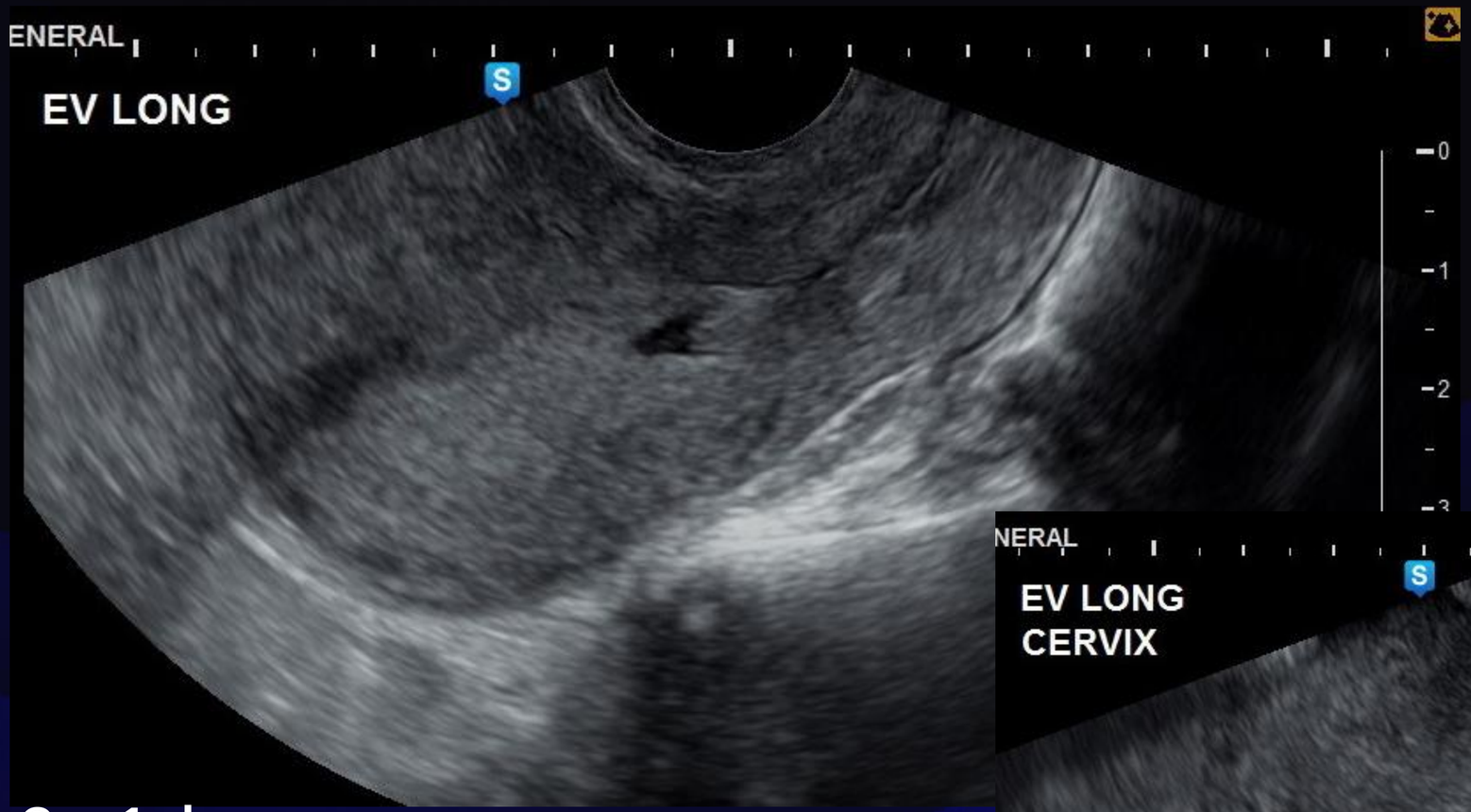

M
[2D
LMP 03/25/201
G.A. 8w1d
EDD 12/30/201
CRL 0.75cm
G.A. 6w5d

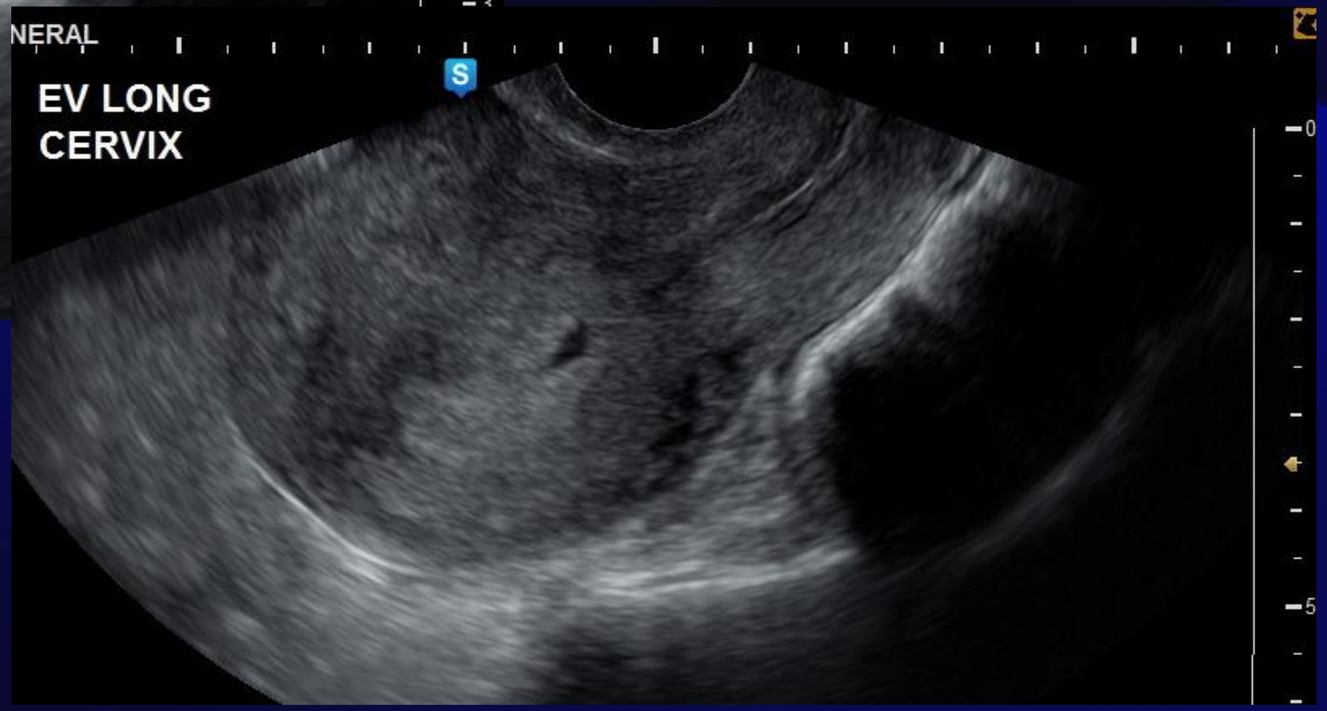




7w5d
<10 mm
ff

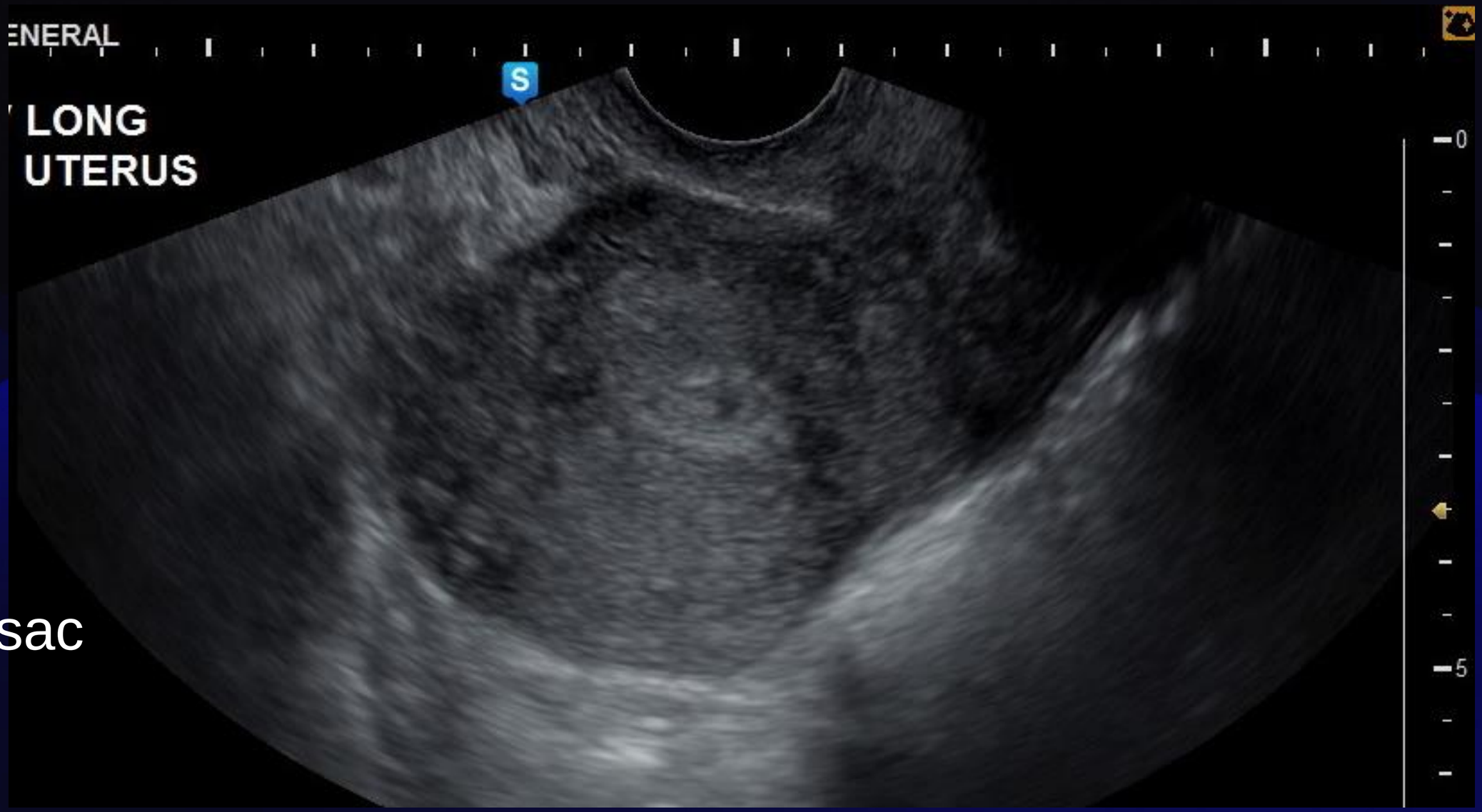
ectopic





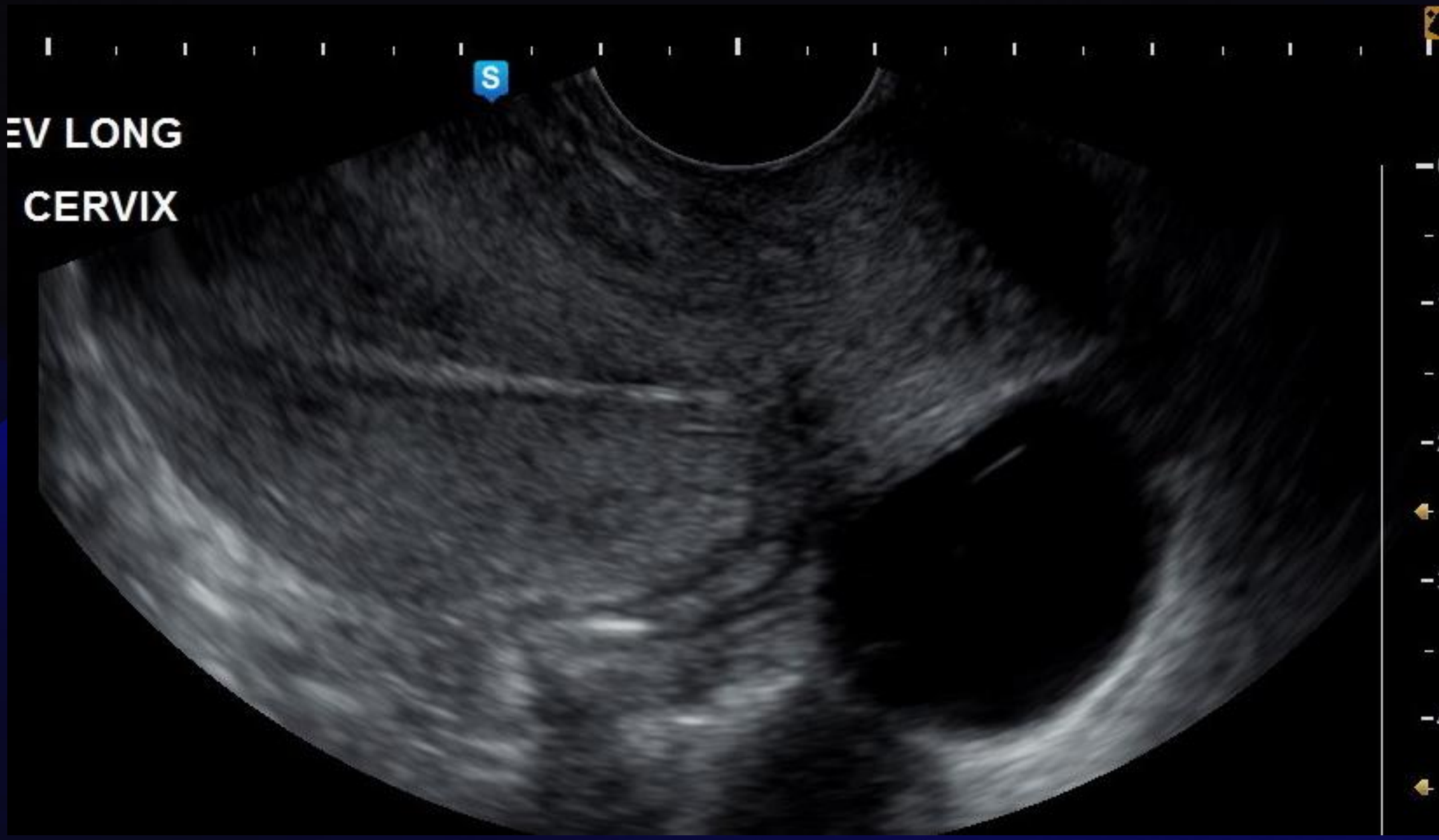
6w1d
?pseudosac

f/u:
ectopic



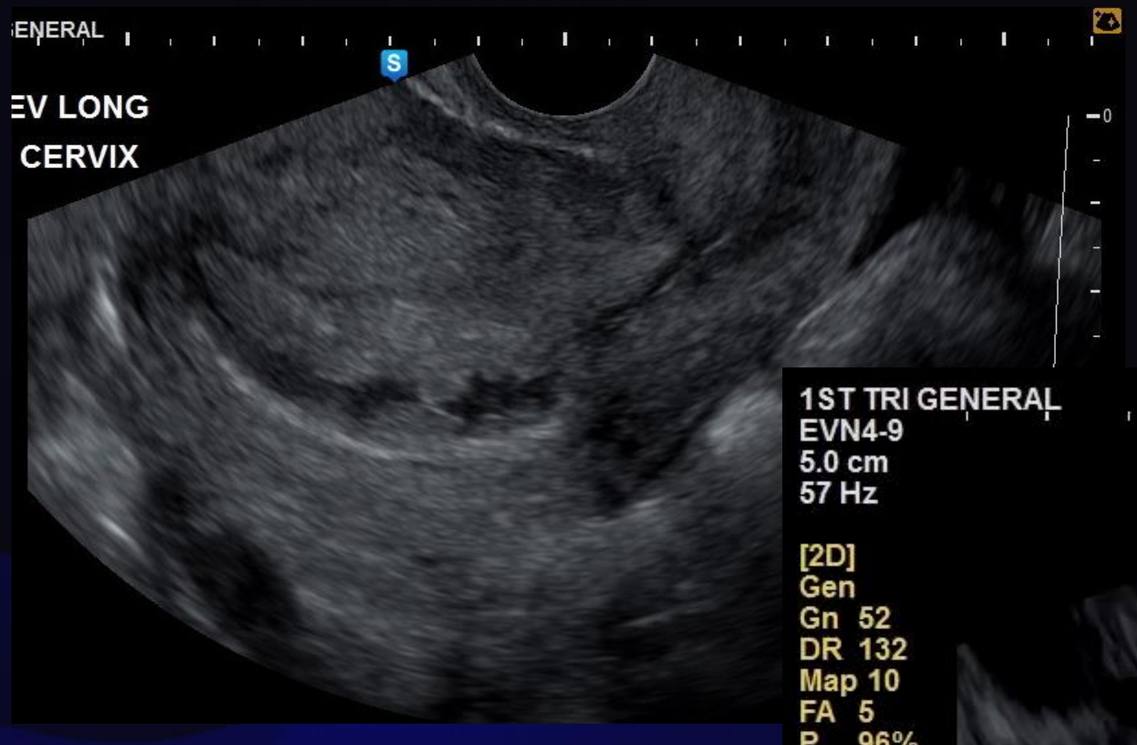
7w1d
?pseudosac

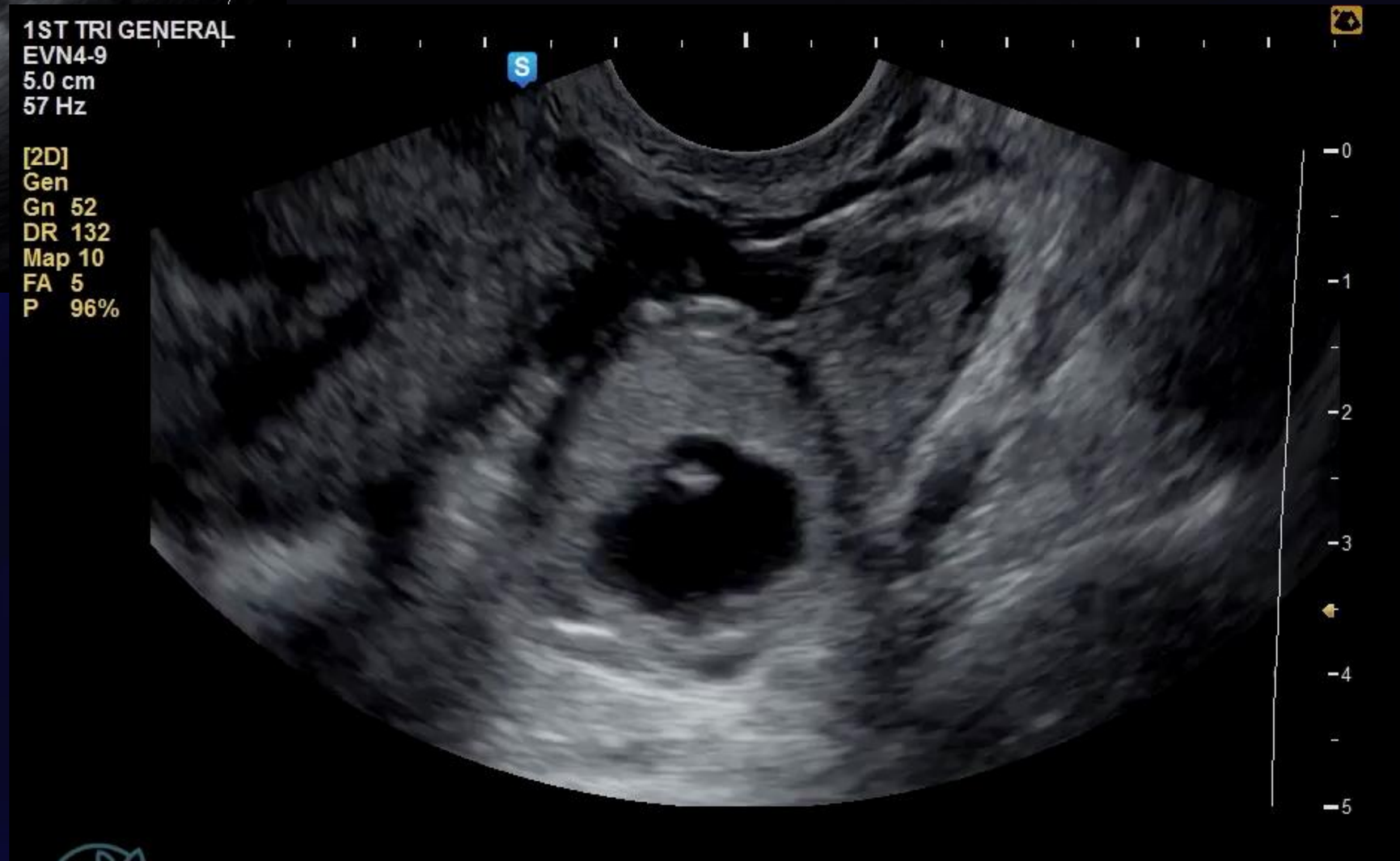
f/u:
ectopic



7w5d
?cyst

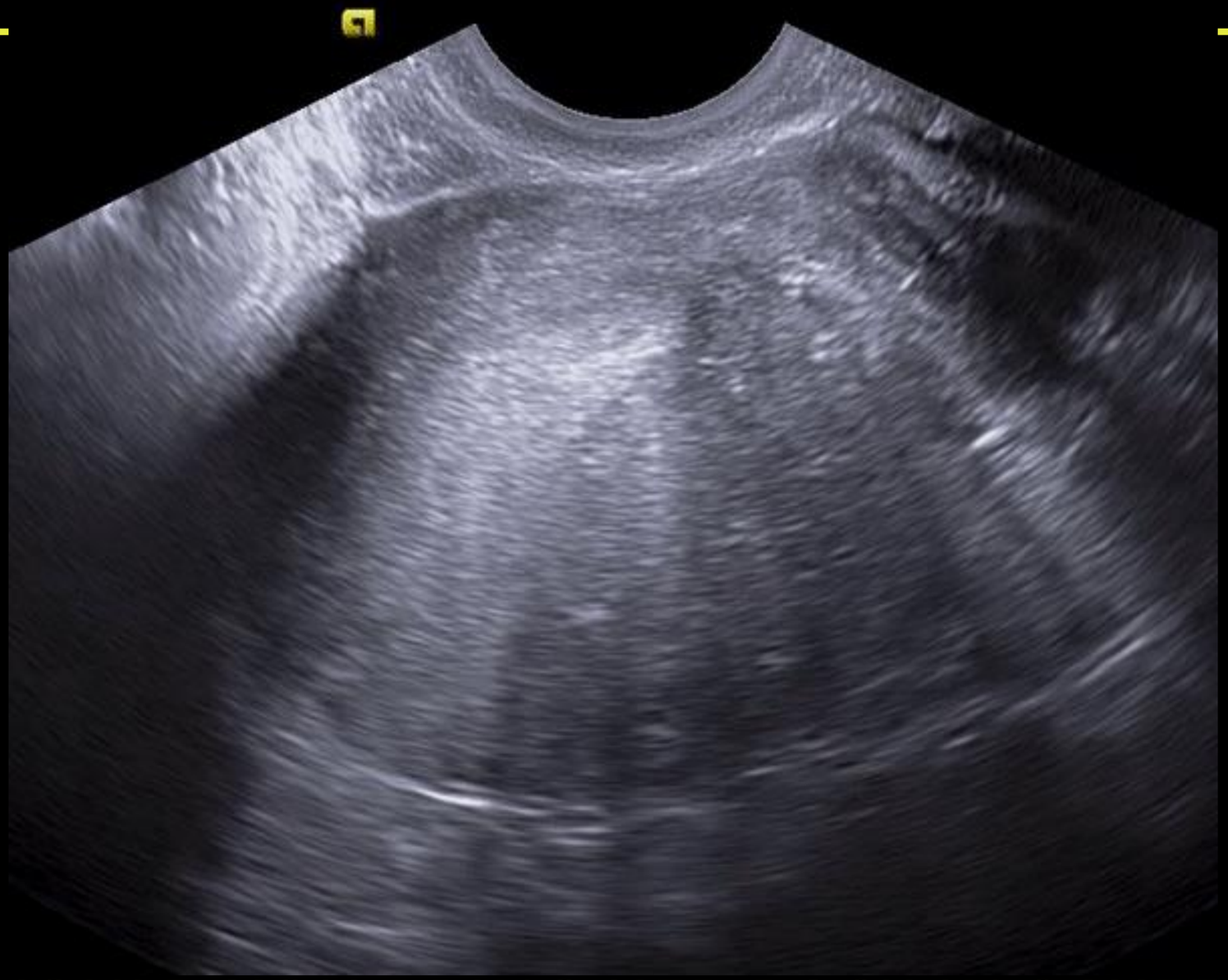
f/u:
ectopic



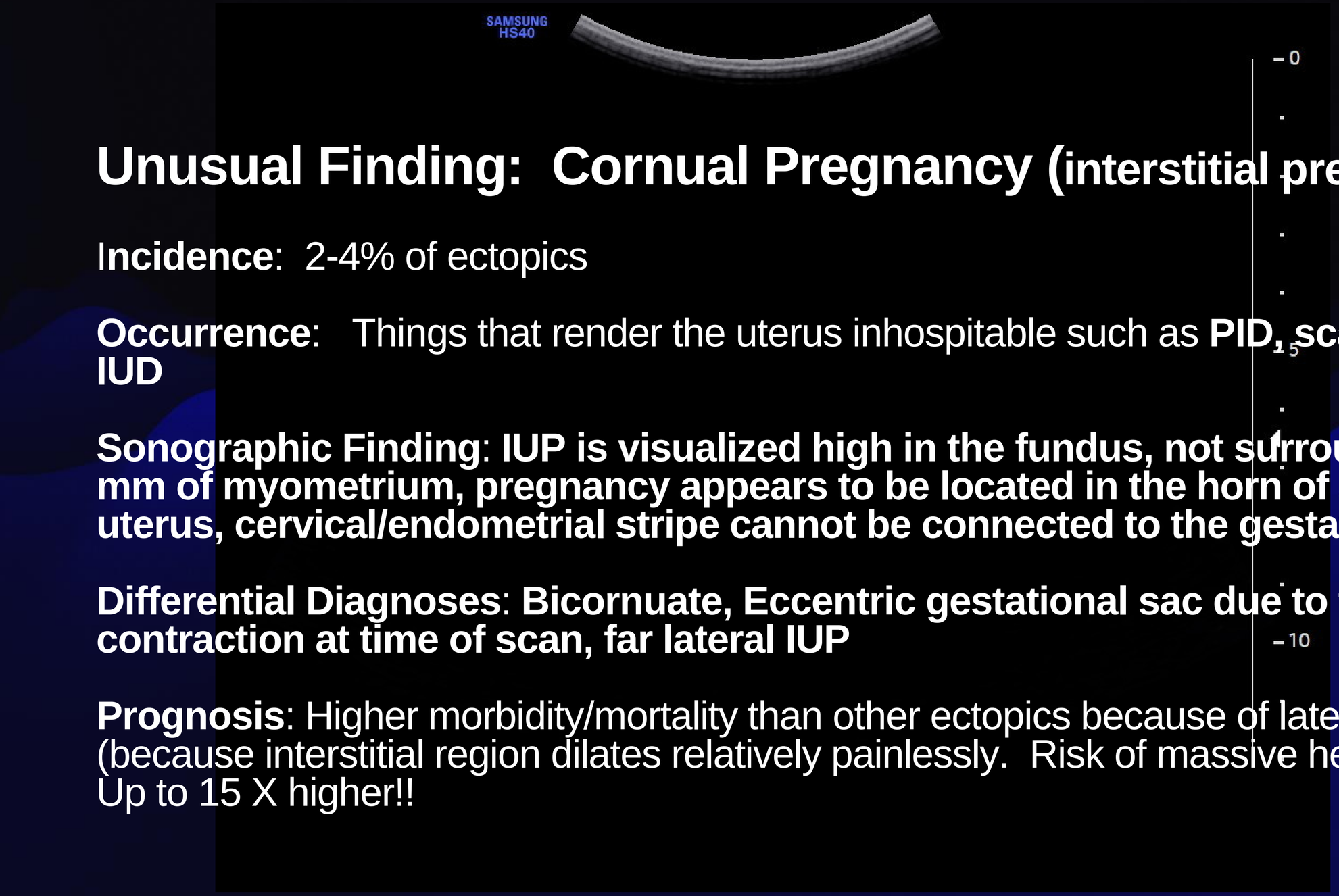


7w6d
breakdown

f/u:
ectopic



WOULD YOU BRING HER BACK IN 2 WEEKS?



Unusual Finding: Cornual Pregnancy (interstitial pregnancy)

I**ncidence**: 2-4% of ectopics

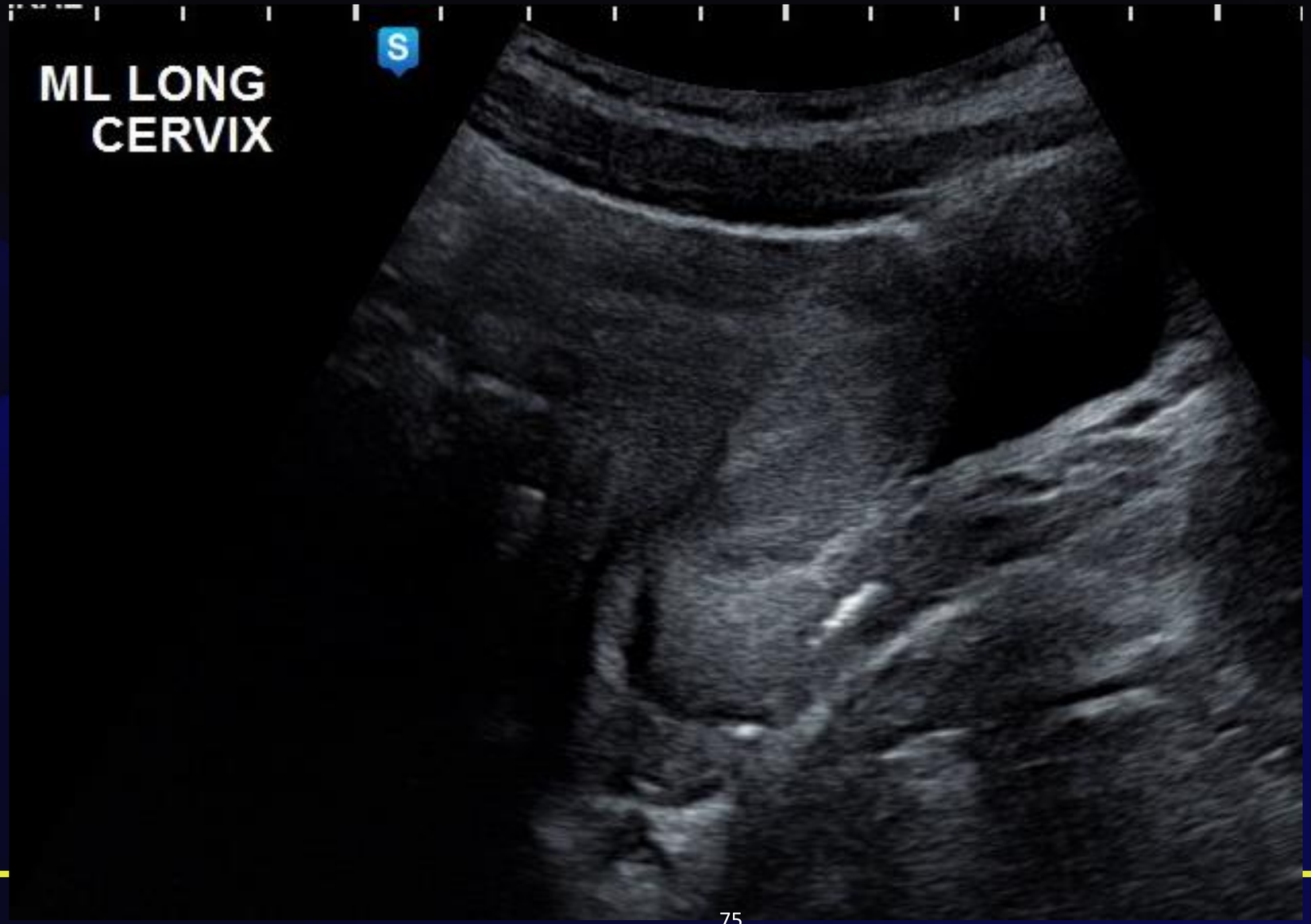
Occurrence: Things that render the uterus inhospitable such as **PID, scar tissue, IUD**

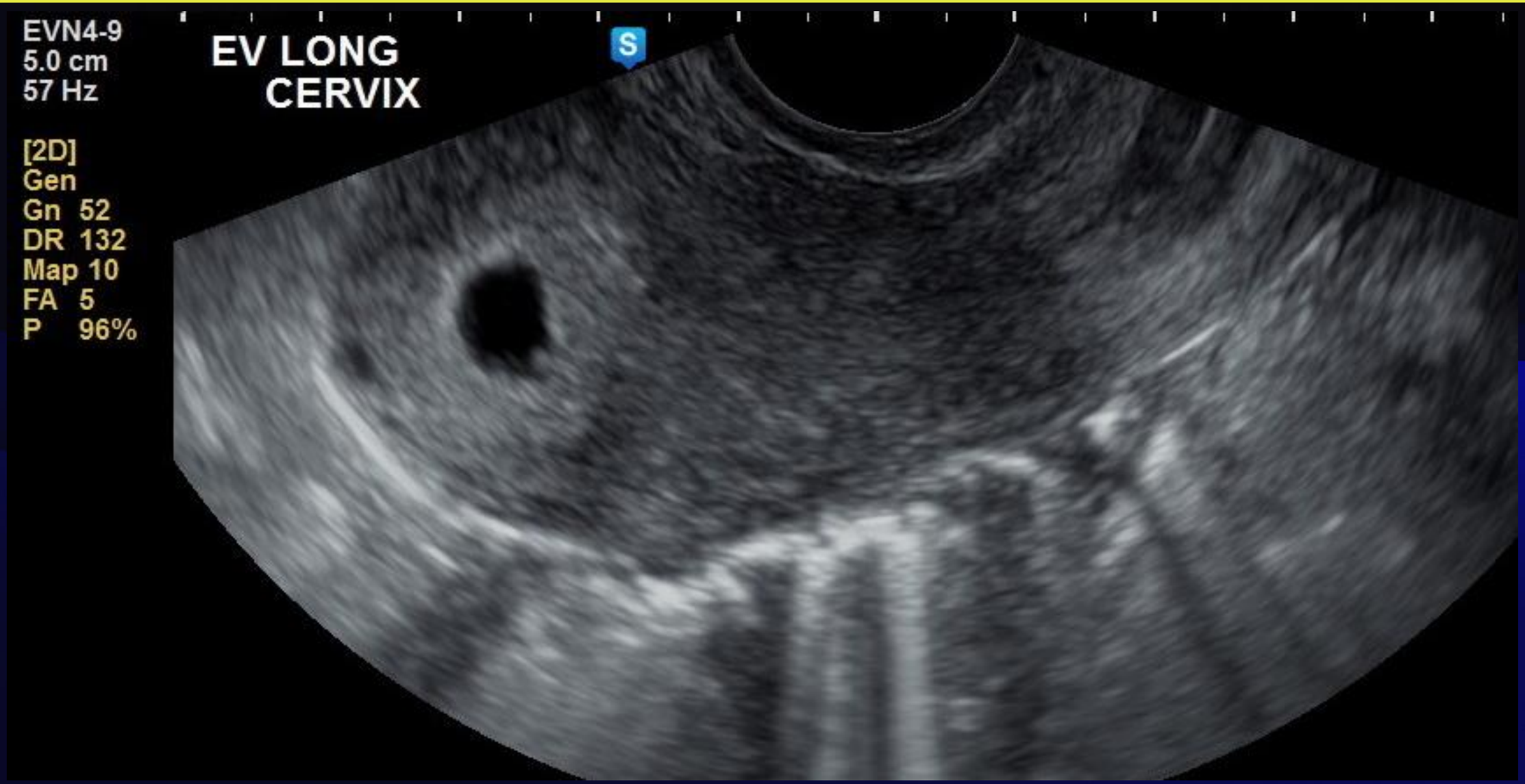
Sonographic Finding: **IUP is visualized high in the fundus, not surrounded by 5 mm of myometrium, pregnancy appears to be located in the horn of a bicornuate uterus, cervical/endometrial stripe cannot be connected to the gestational sac**

Differential Diagnoses: **Bicornuate, Eccentric gestational sac due to fibroid, contraction at time of scan, far lateral IUP**

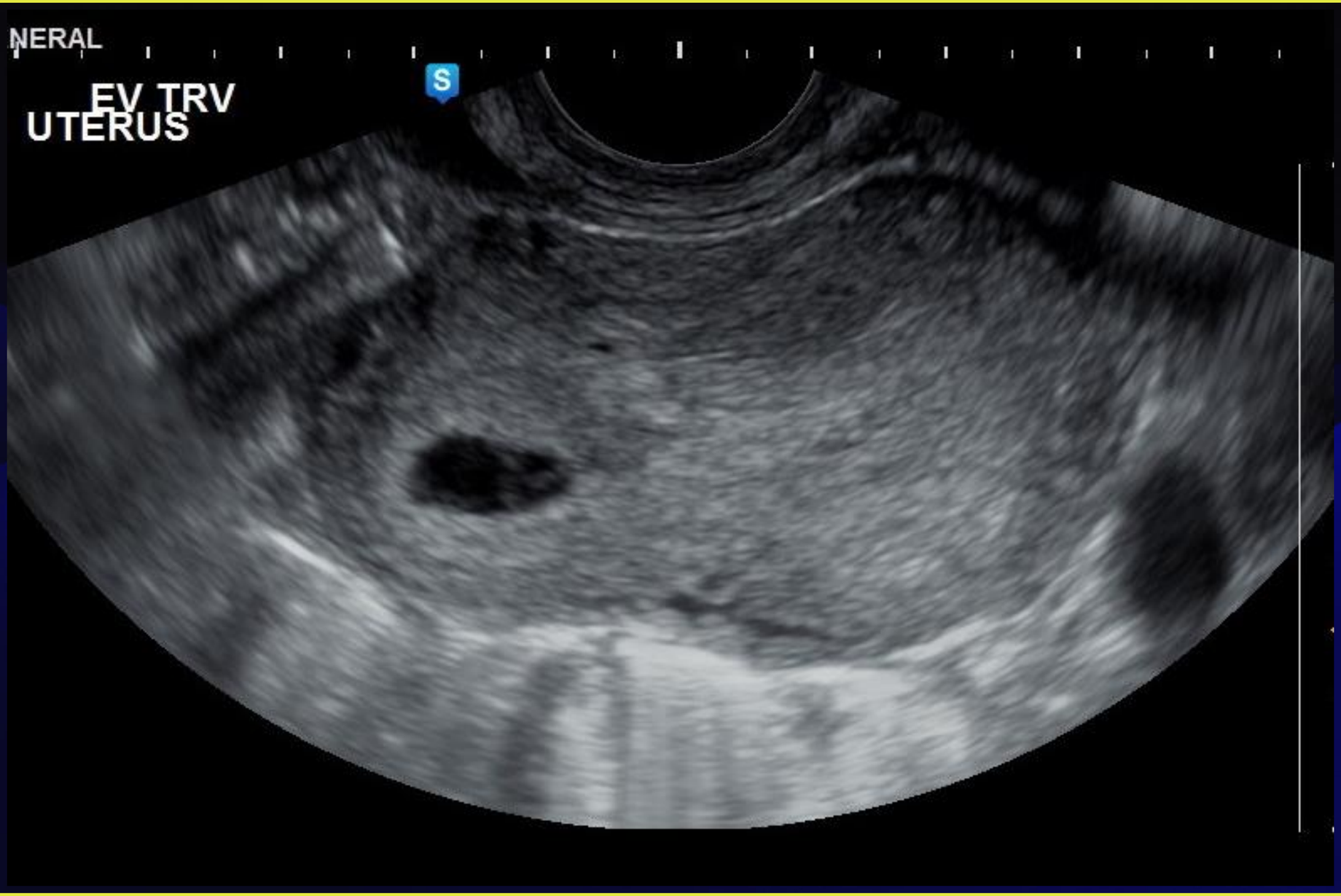
Prognosis: Higher morbidity/mortality than other ectopics because of later presentation (because interstitial region dilates relatively painlessly. Risk of massive hemorrhage Up to 15 X higher!!

Unusual Finding: Possible Cornual Ectopic



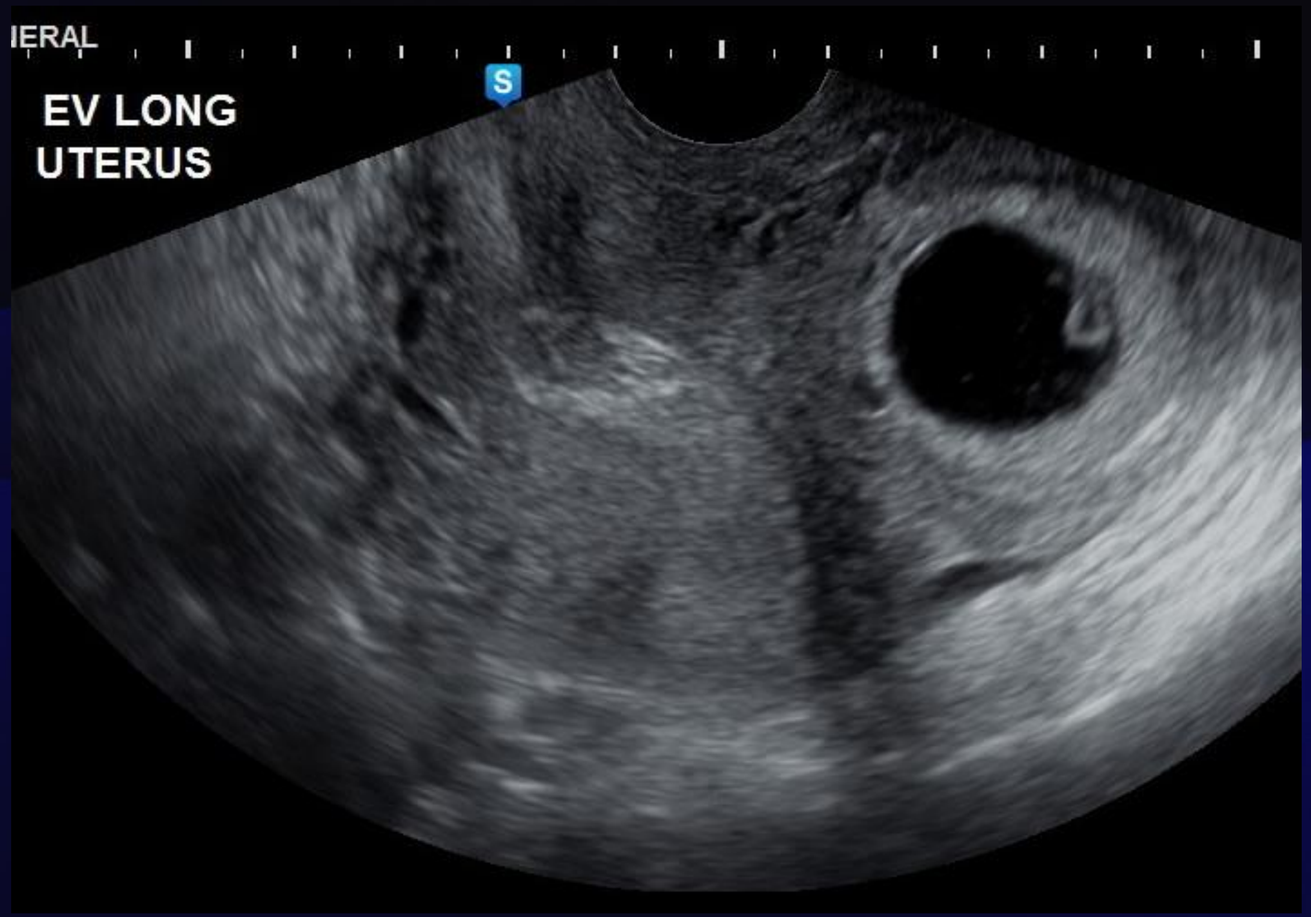


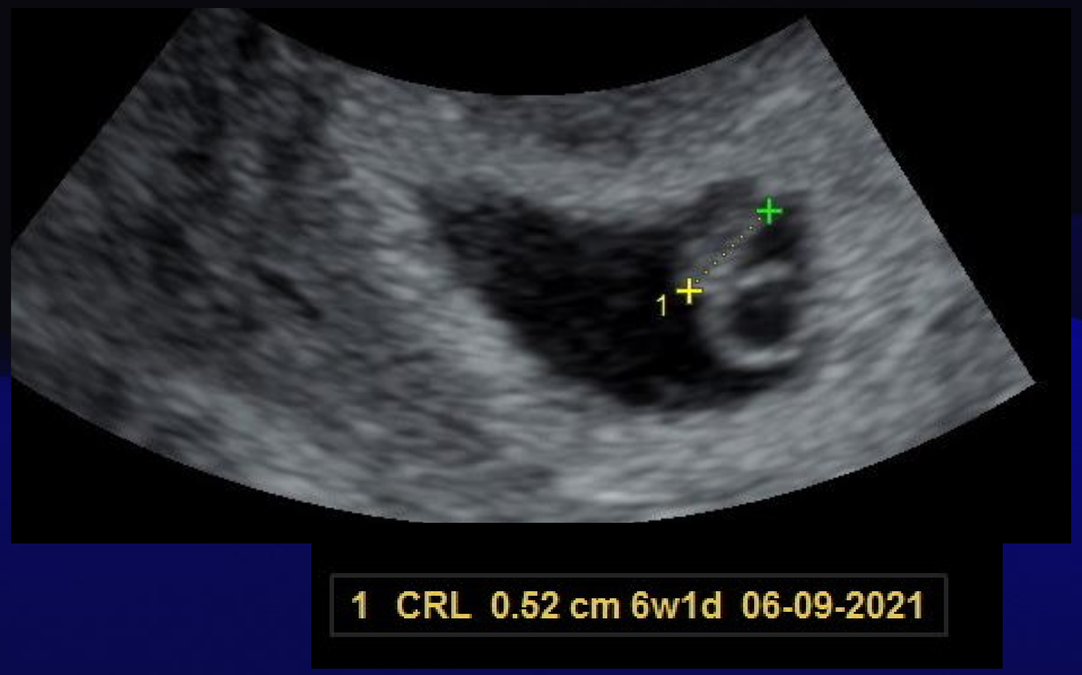
Can you connect the stripe to the gestational sac?



Patient arrived UND, left CTT; followed to 5 months!!

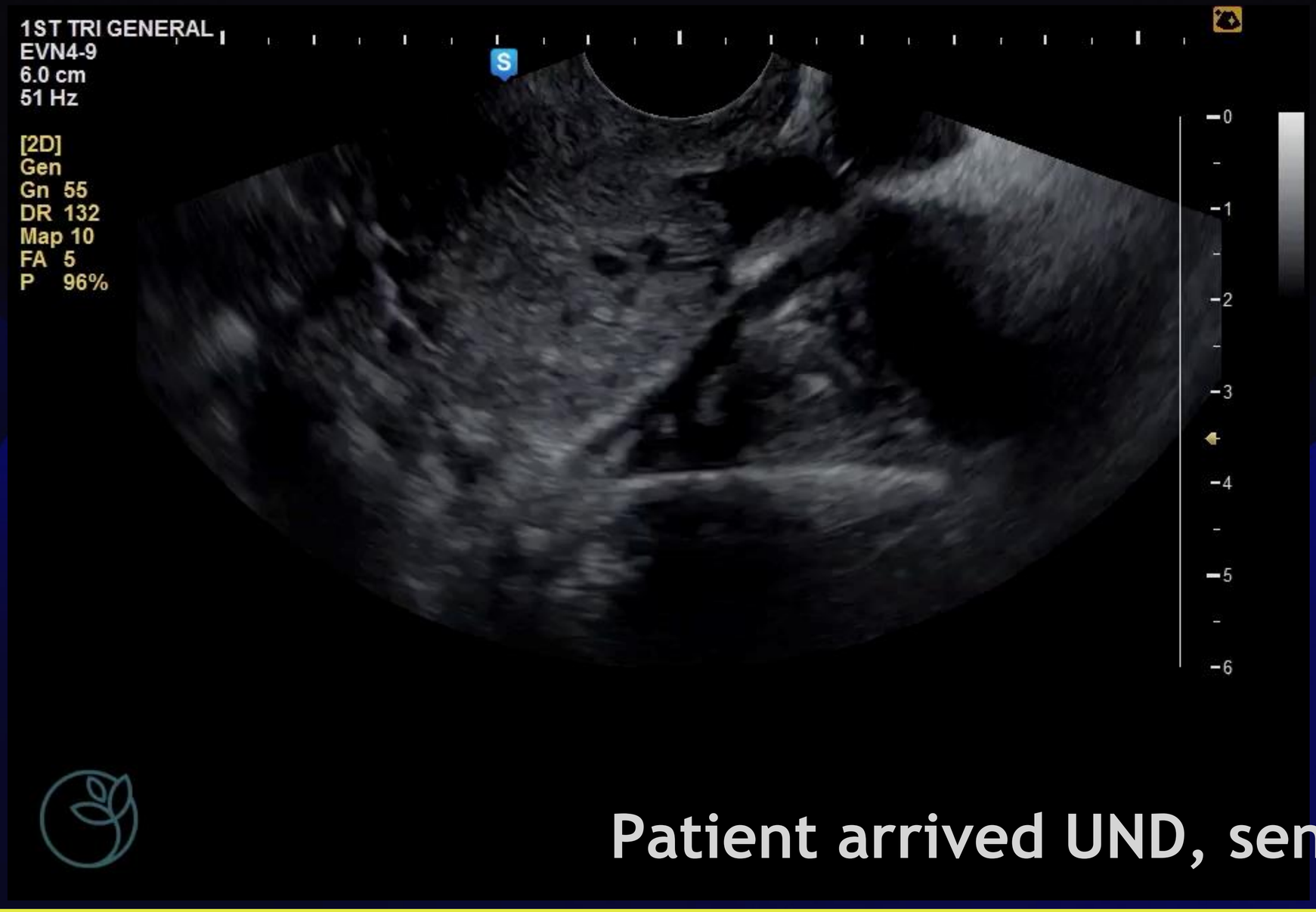
Next case: 9w5d LMP





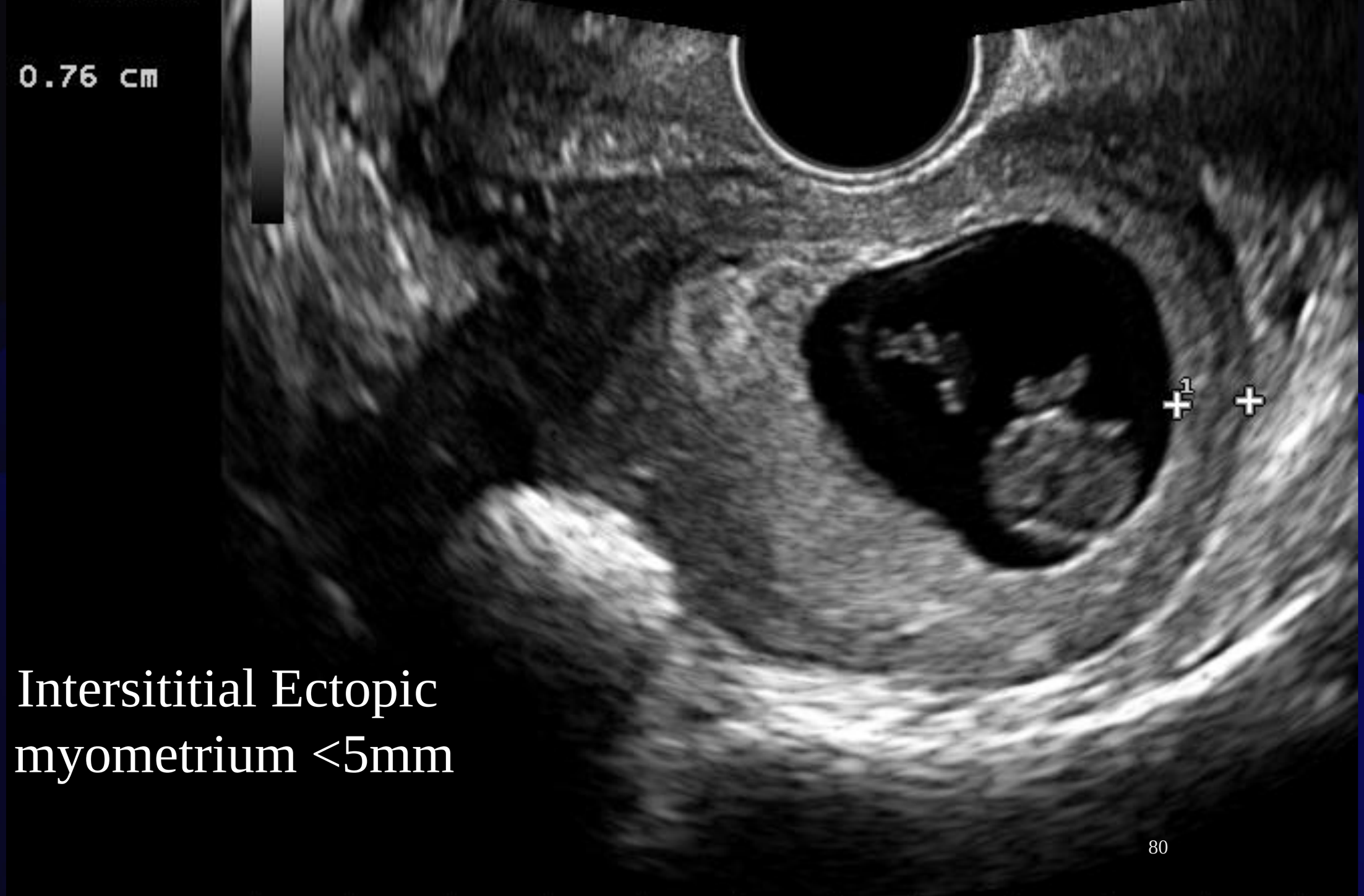
1/2

VIDEOCLIP



Patient arrived UND, sent to ER!

surgery to remove ectopic



Intersititial Ectopic
myometrium <5mm

Pregnancy Locations

Five (5) categories:

- Definite ectopic pregnancy (EP) - extrauterine gs with ys and/or embryo
- Probable EP - (inhomogeneous adnexal mass)
- PUL - pregnancy of unknown location (no sign of EP or IUP)
- Probable intrauterine pregnancy (IUP) - IU sac-like structure
- Definite IUP

Unusual Finding: Heterotopic Pregnancy

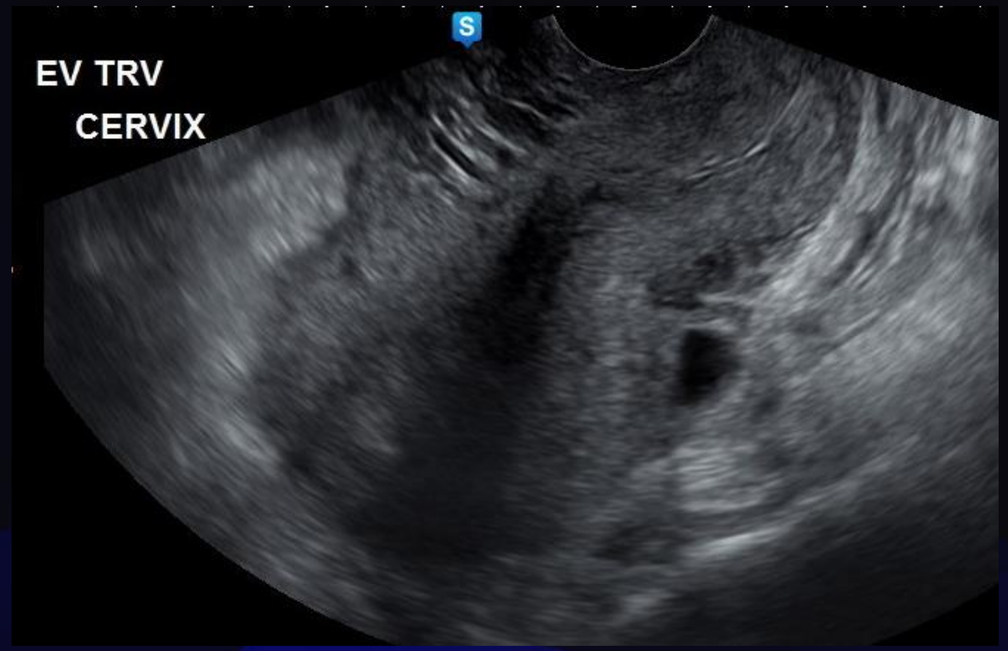
Incidence: 1:1285-3800

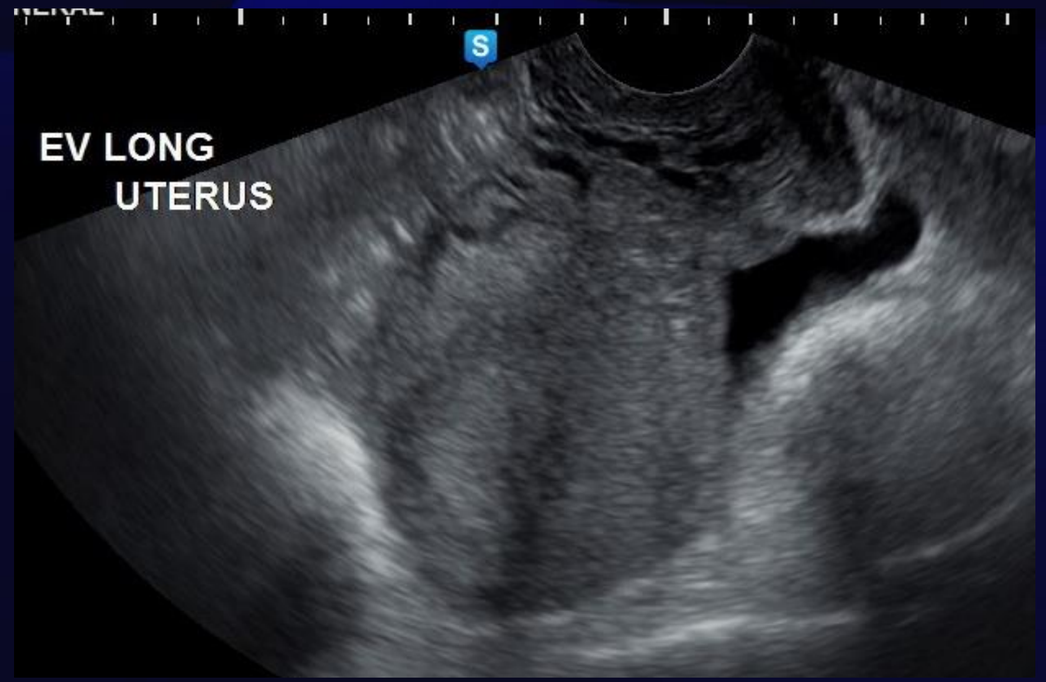
Occurrence: more common in assisted reproduction

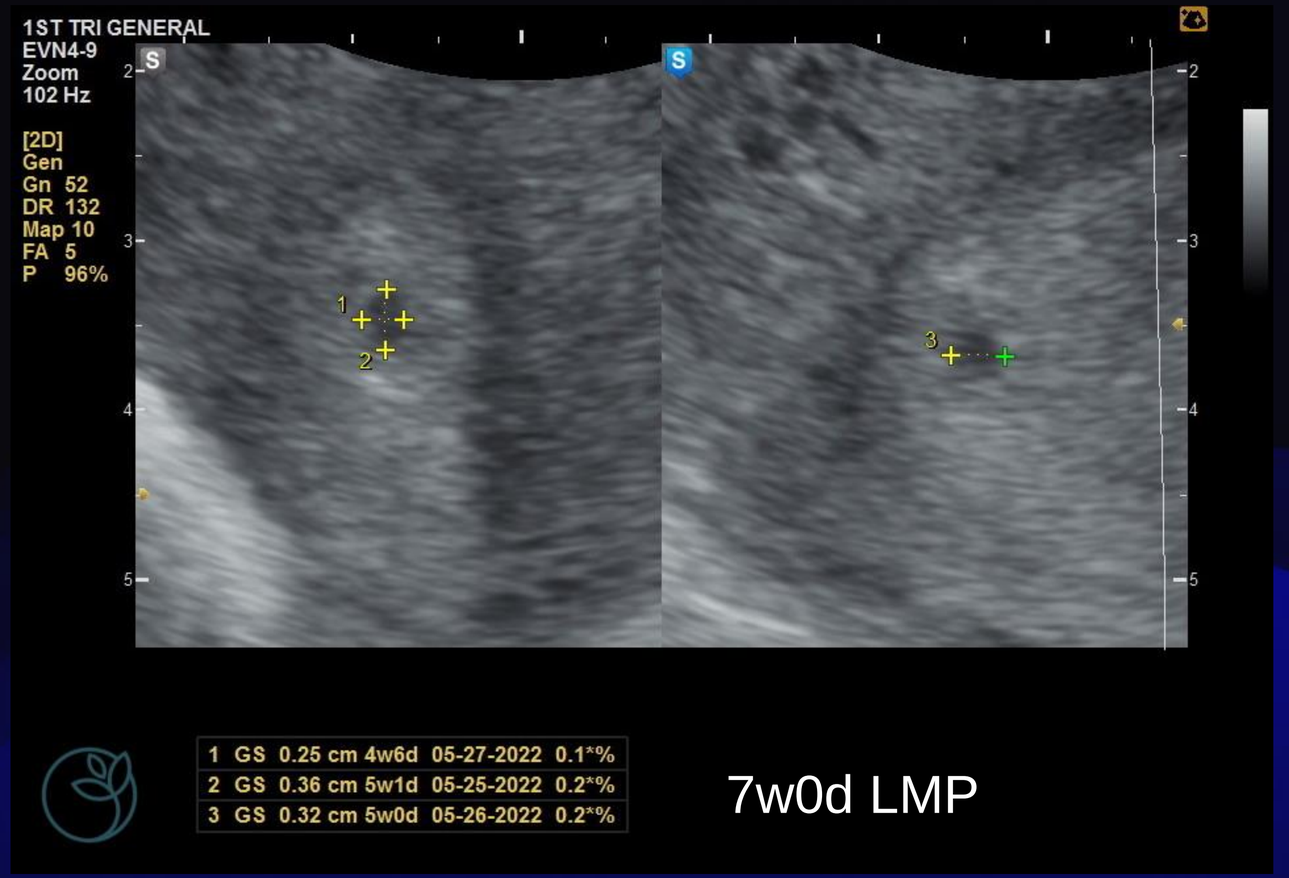
Sonographic Finding: IUP and signs of ectopic

Differential Diagnosis: IUP with CL or adnexal mass

Prognosis: laparoscopy

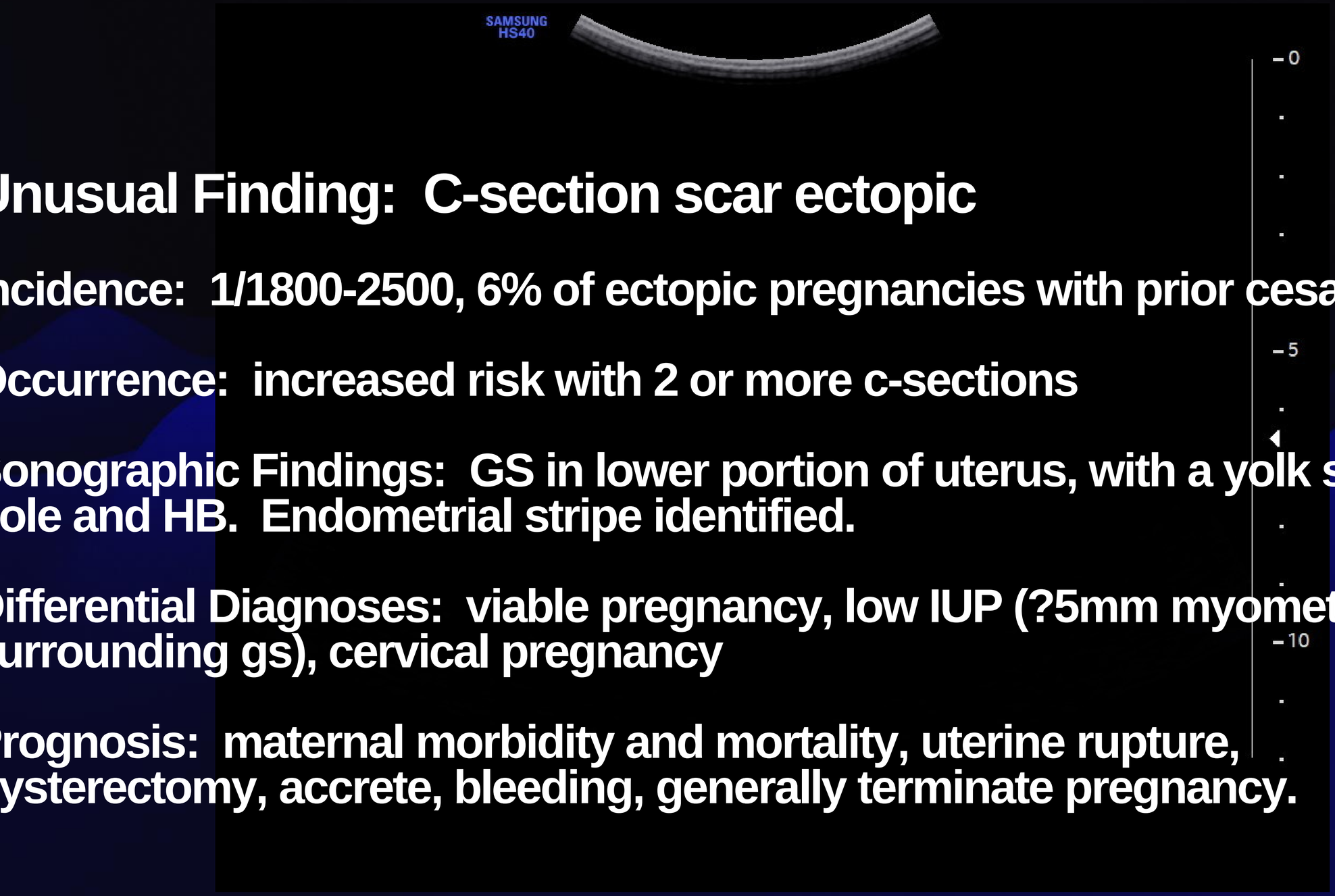






7w0d LMP

confirmed heterotopic
(took tube and now CTT)



Unusual Finding: C-section scar ectopic

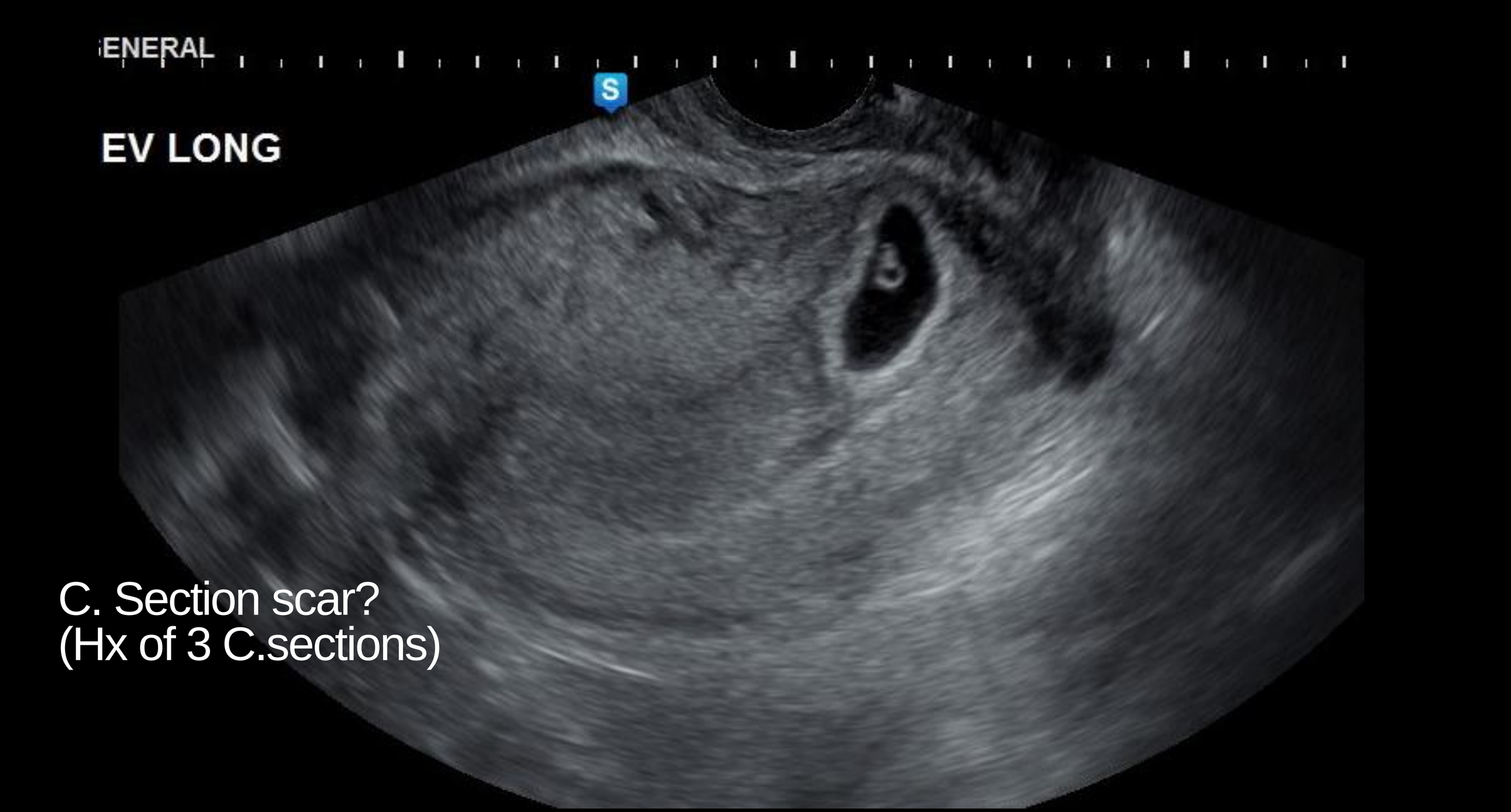
Incidence: 1/1800-2500, 6% of ectopic pregnancies with prior cesarean

Occurrence: increased risk with 2 or more c-sections

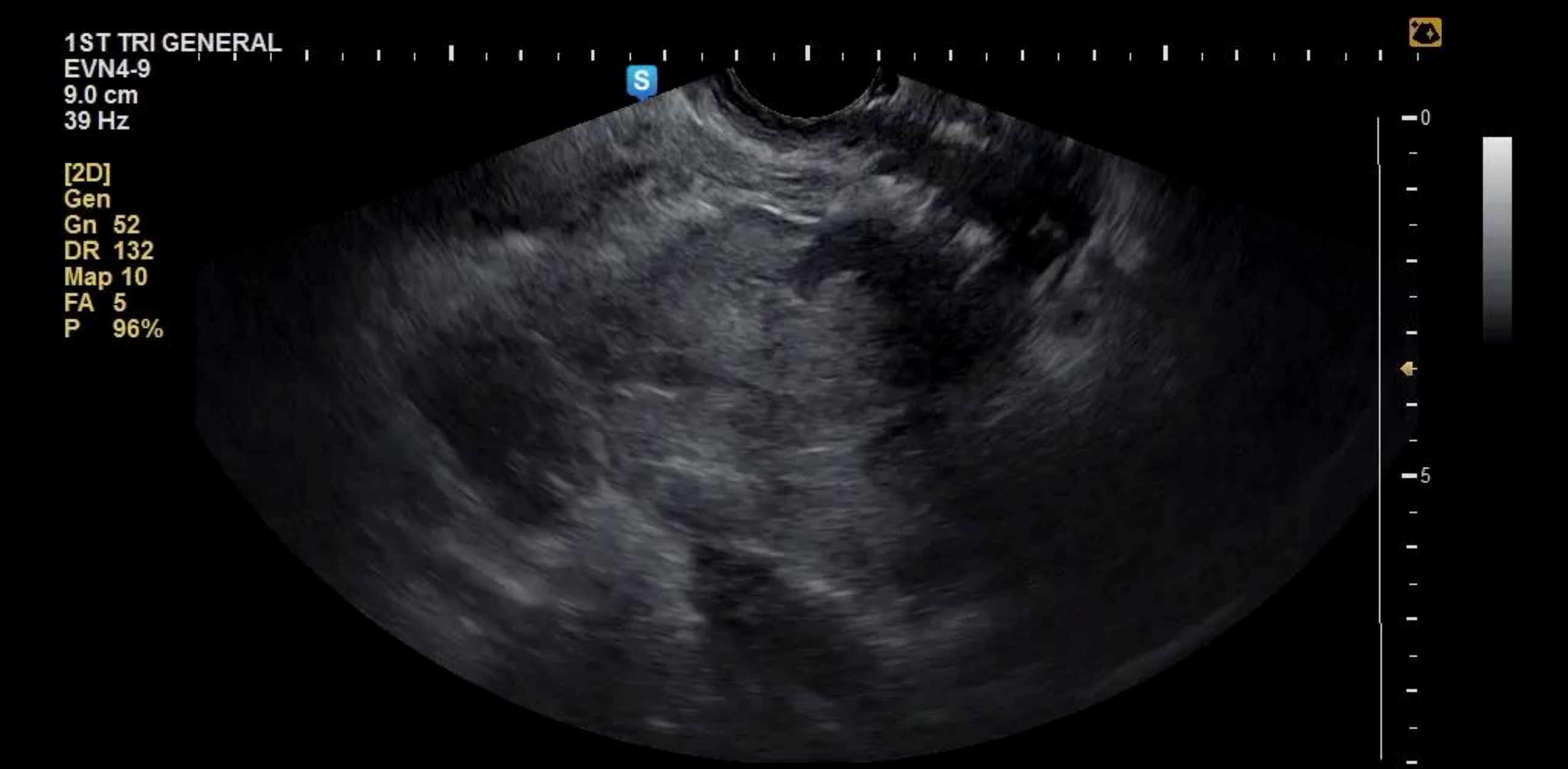
Sonographic Findings: GS in lower portion of uterus, with a yolk sac, fetal pole and HB. Endometrial stripe identified.

Differential Diagnoses: viable pregnancy, low IUP (?5mm myometrium surrounding gs), cervical pregnancy

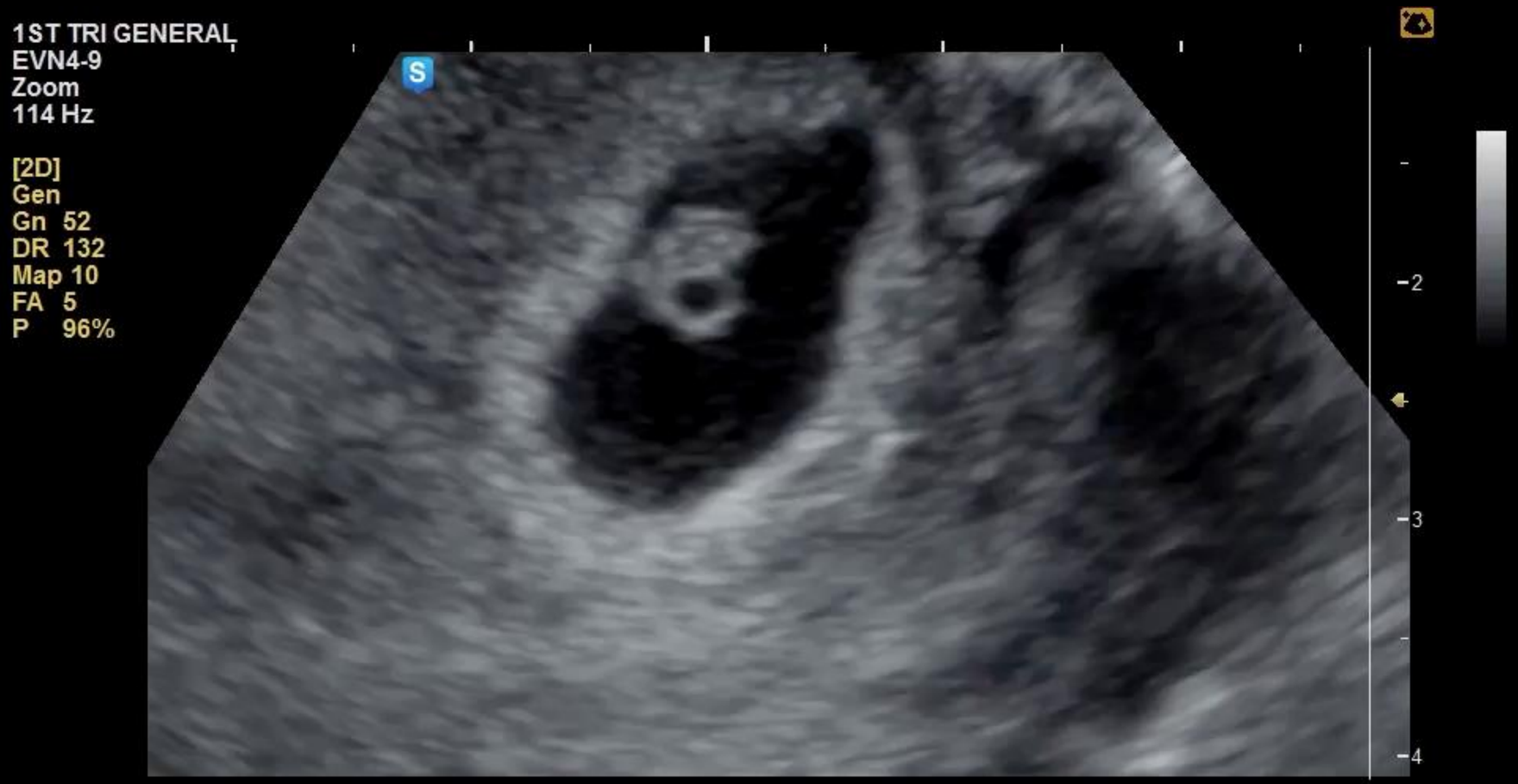
Prognosis: maternal morbidity and mortality, uterine rupture, hysterectomy, accrete, bleeding, generally terminate pregnancy.

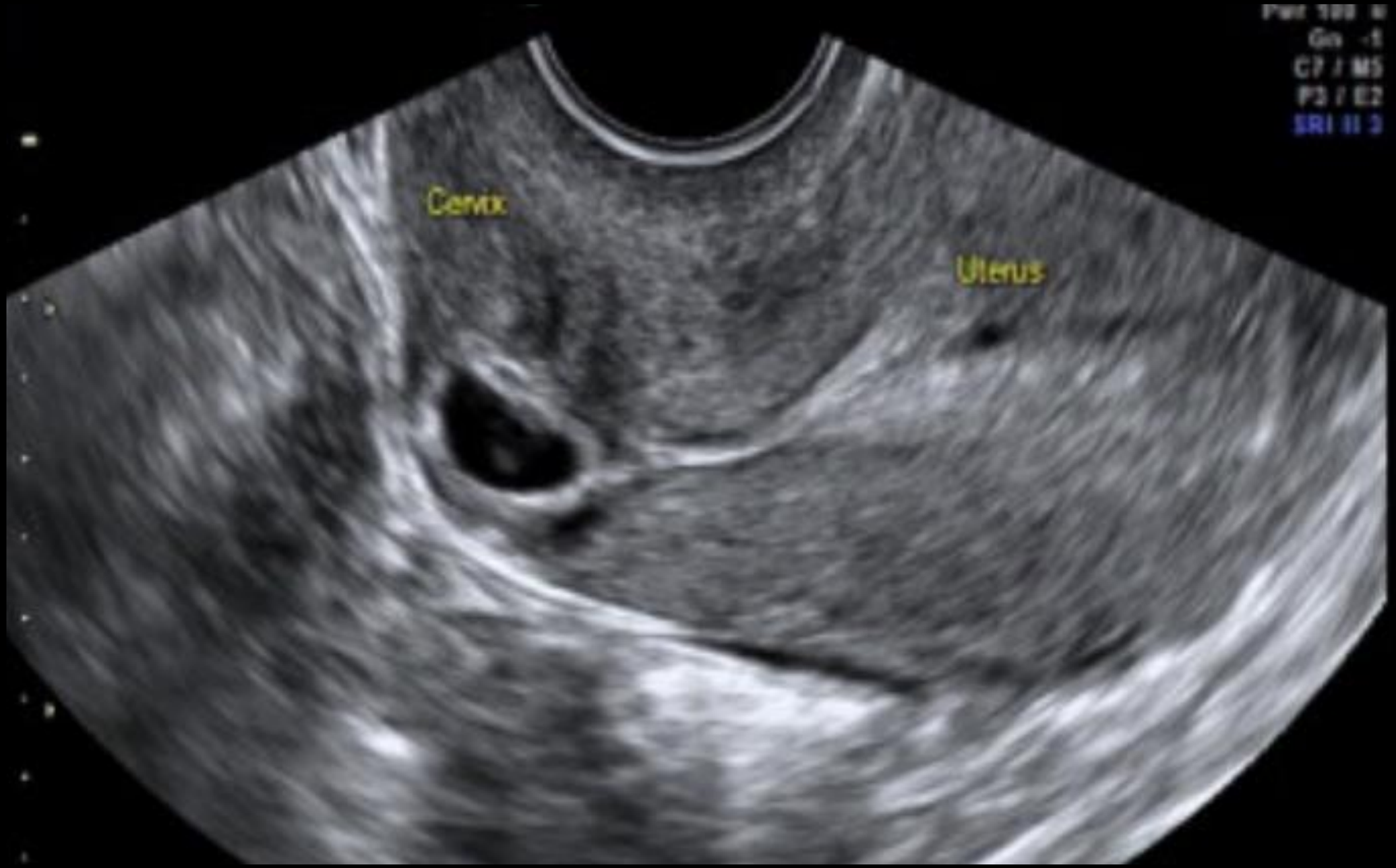


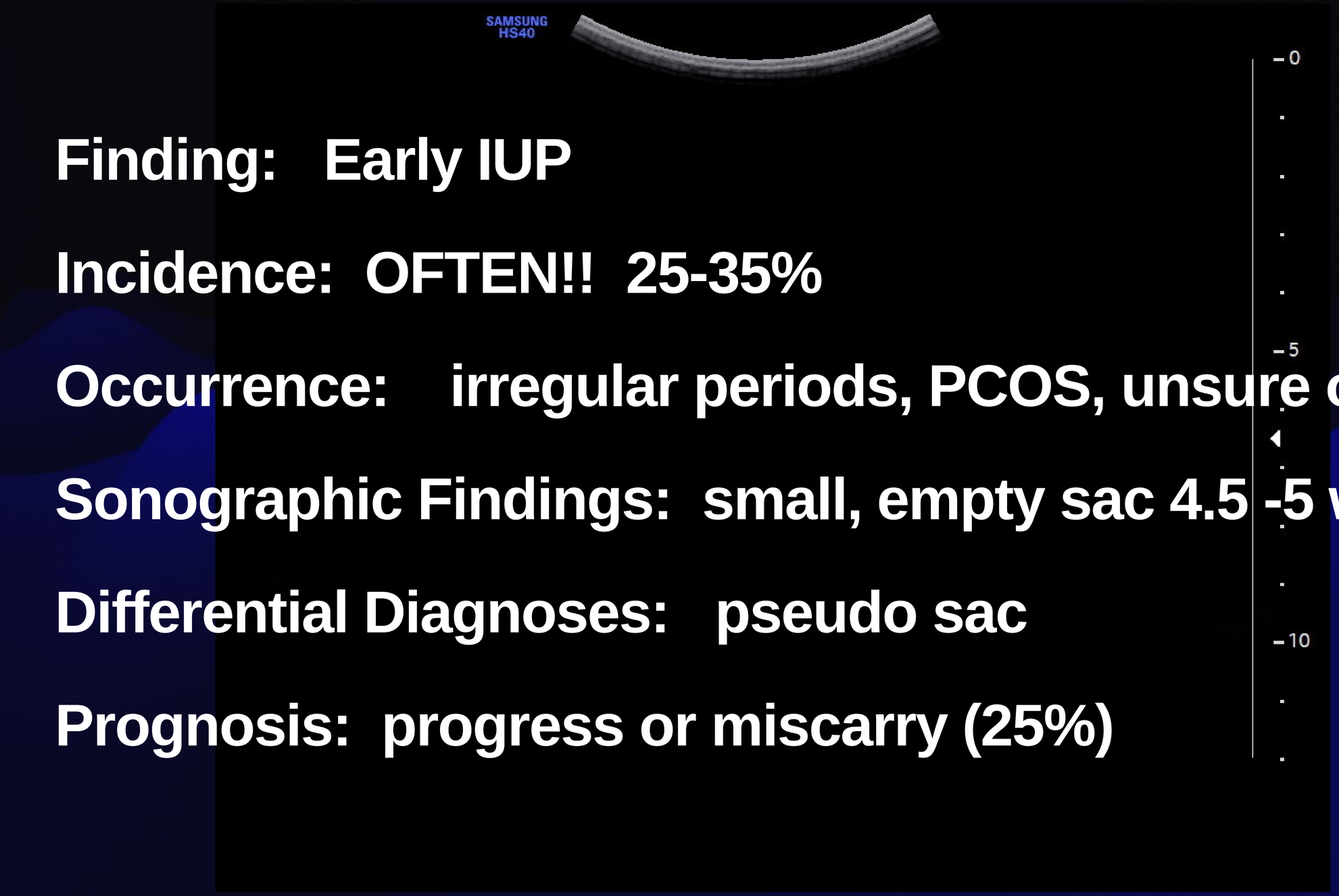
C. Section scar?
(Hx of 3 C.sections)


1ST TRI GENERAL
EVN4-9
9.0 cm
39 Hz
[2D]
Gen
Gn 52
DR 132
Map 10
FA 5
P 96%
S
0
5

THIS PATIENT WAS CALLED AND STATED SHE WAS 20 WKS PREGNANT WITH A GIRL :) !!!!




Cervix
Uterus



Finding: Early IUP

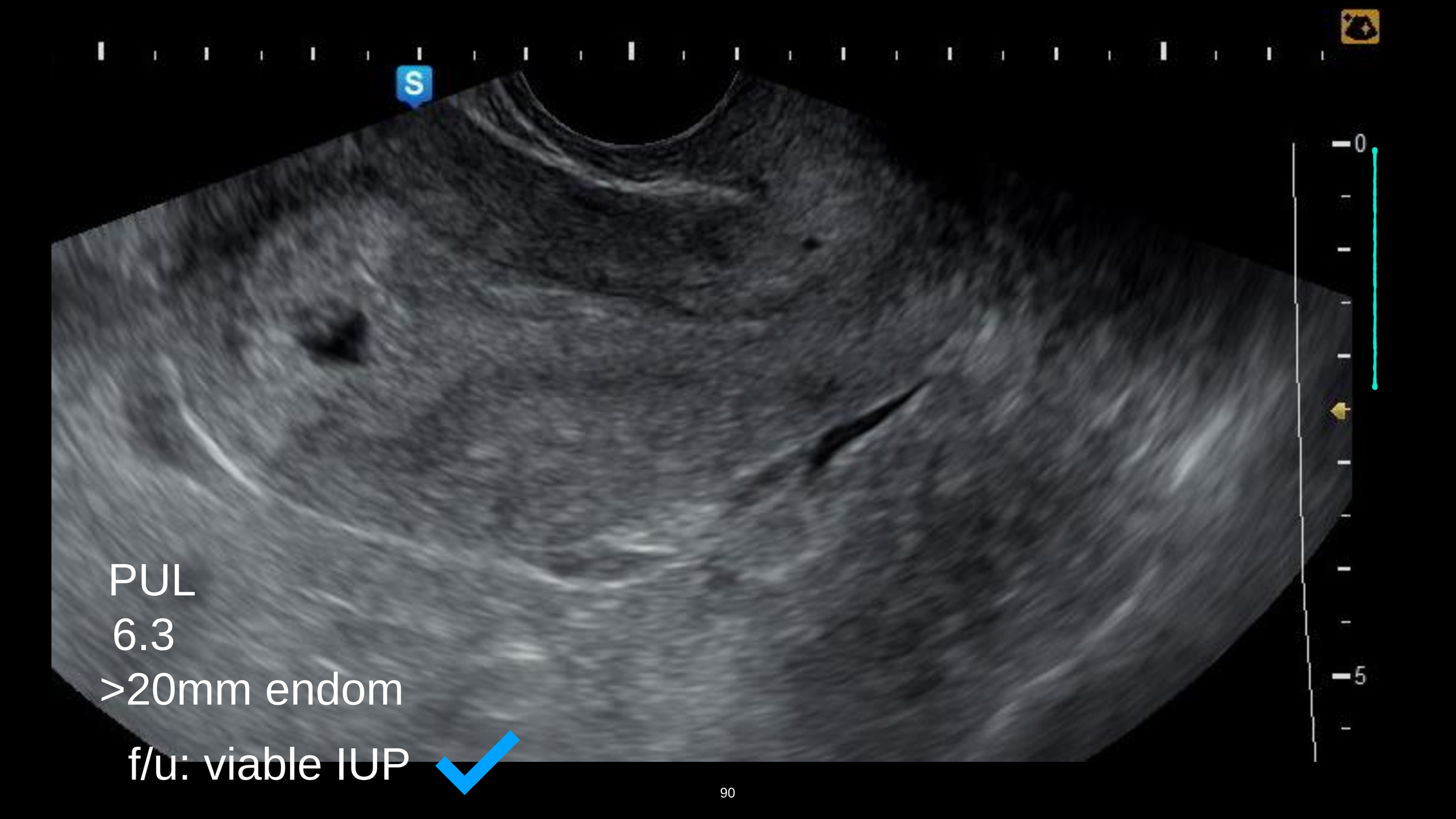
Incidence: OFTEN!! 25-35%

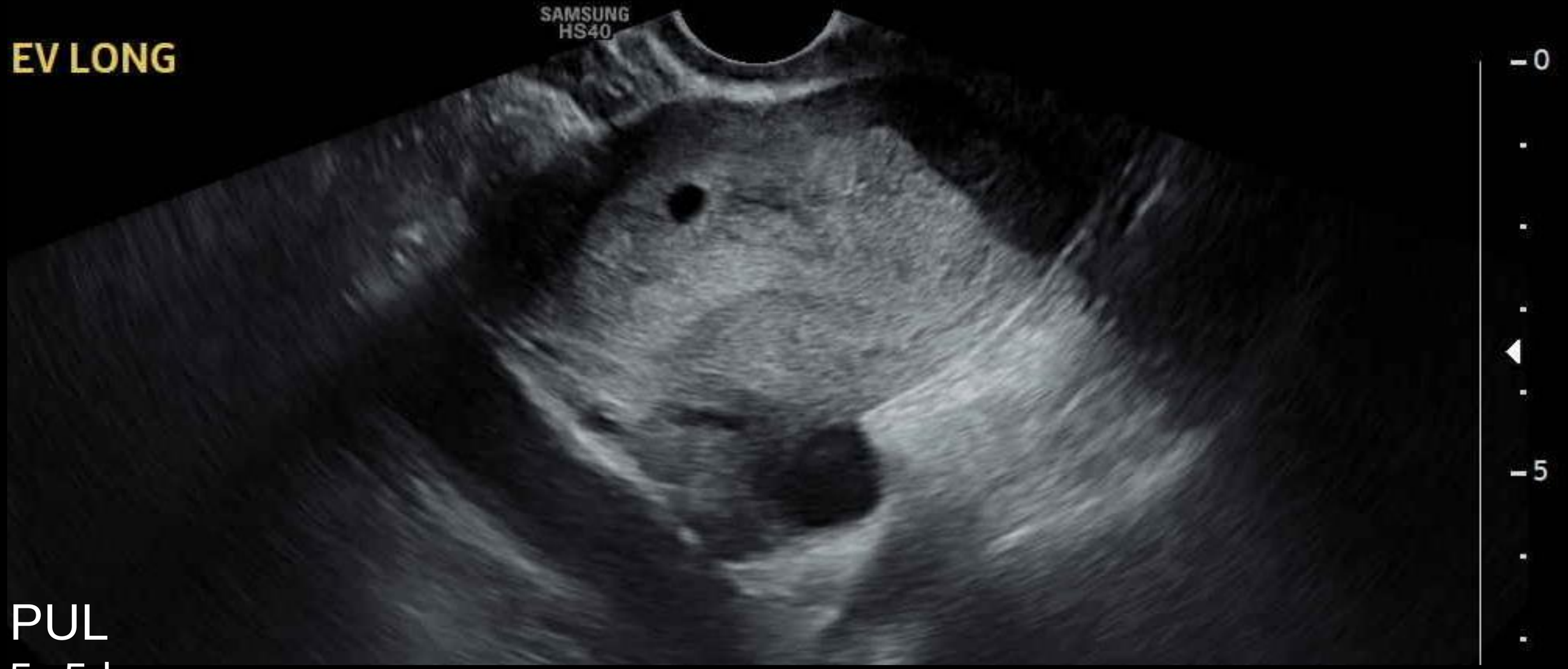
Occurrence: irregular periods, PCOS, unsure of dates

Sonographic Findings: small, empty sac 4.5 -5 wks

Differential Diagnoses: pseudo sac

Prognosis: progress or miscarry (25%)


PUL
6.3
>20mm endom
f/u: viable IUP

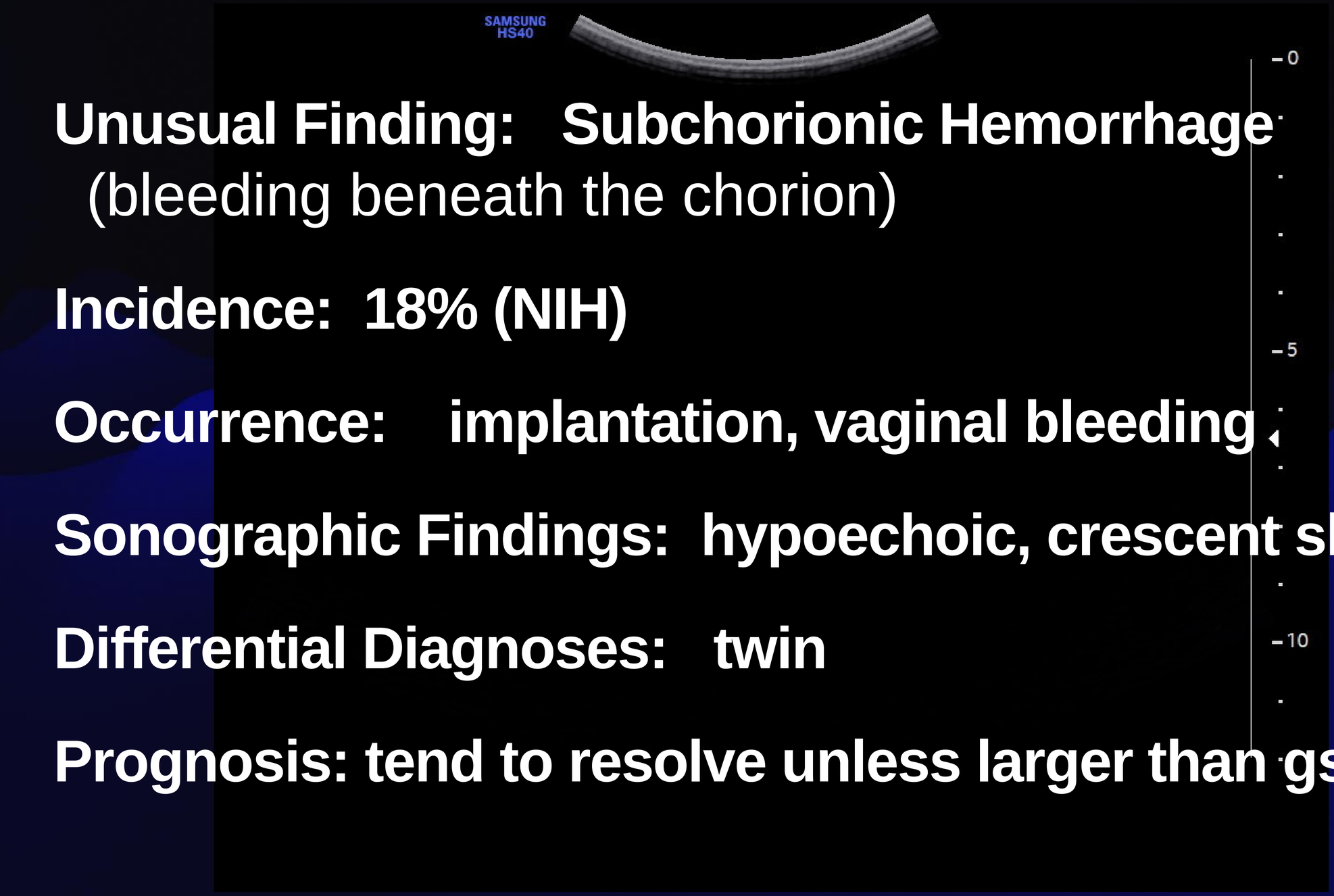


PUL

5w5d

>11 mm

f/u: conf. IUP/Abortion



Unusual Finding: **Subchorionic Hemorrhage** (bleeding beneath the chorion)

Incidence: **18% (NIH)**

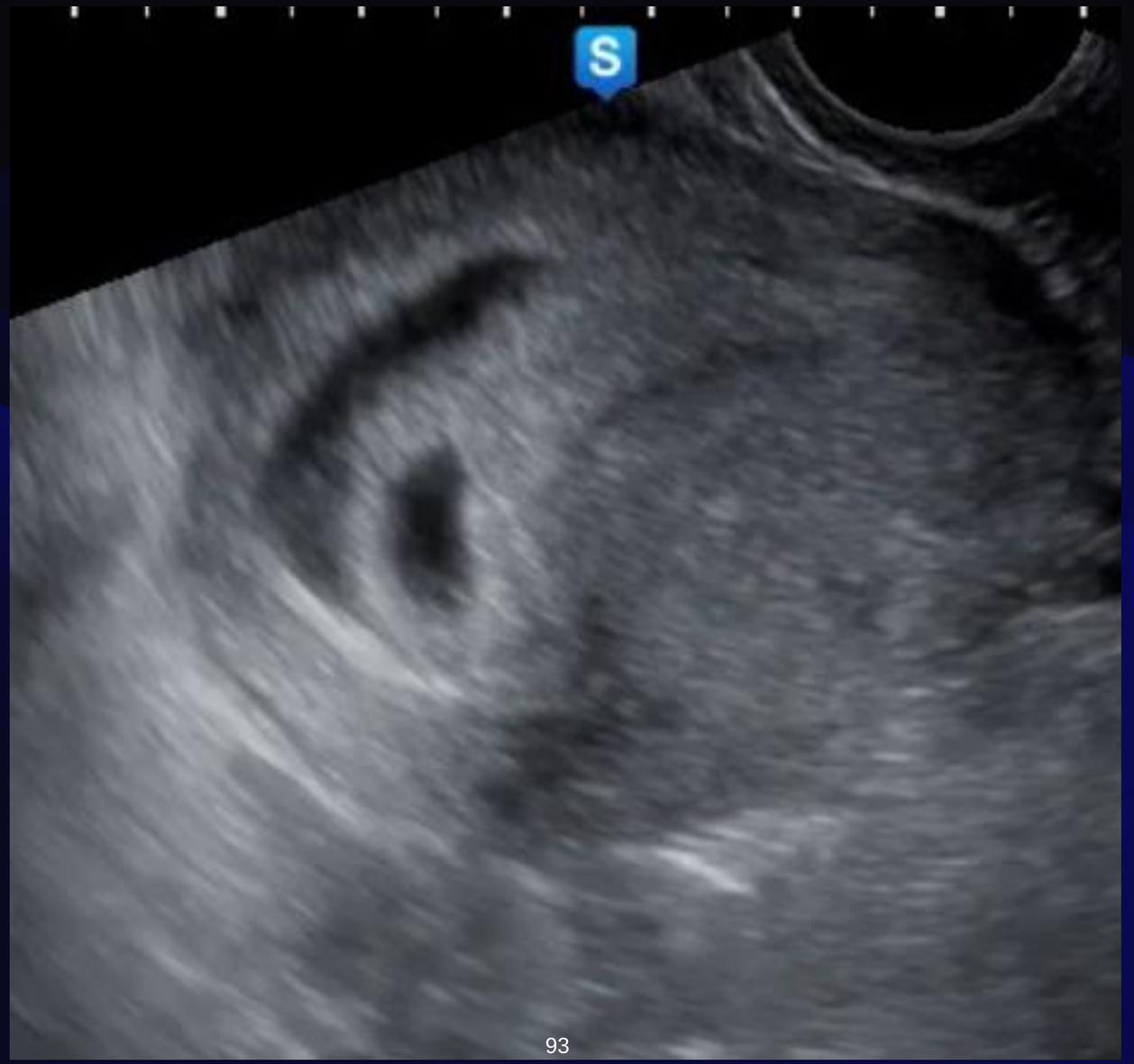
Occurrence: **implantation, vaginal bleeding**

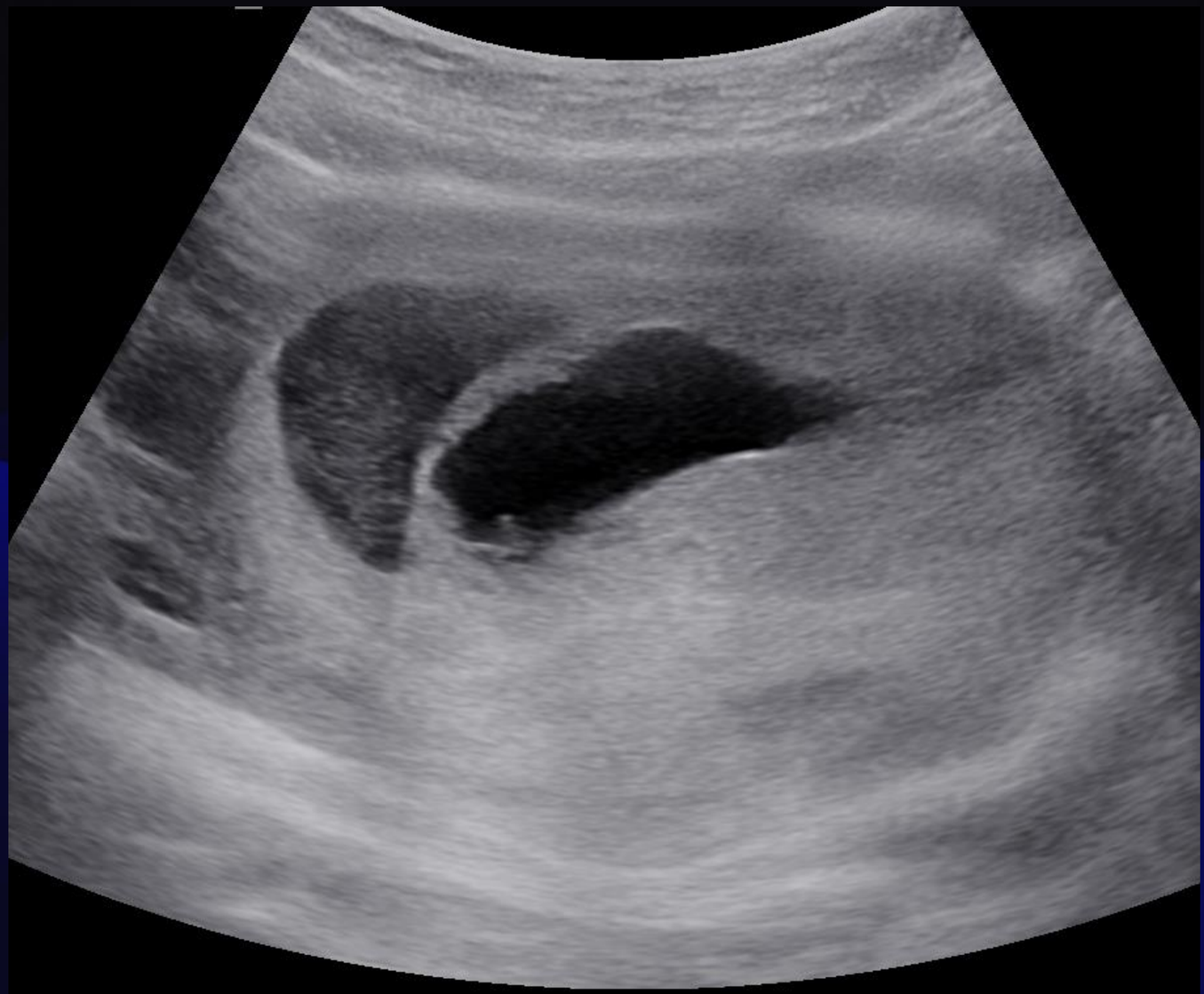
Sonographic Findings: **hypoechoic, crescent shape**

Differential Diagnoses: **twin**

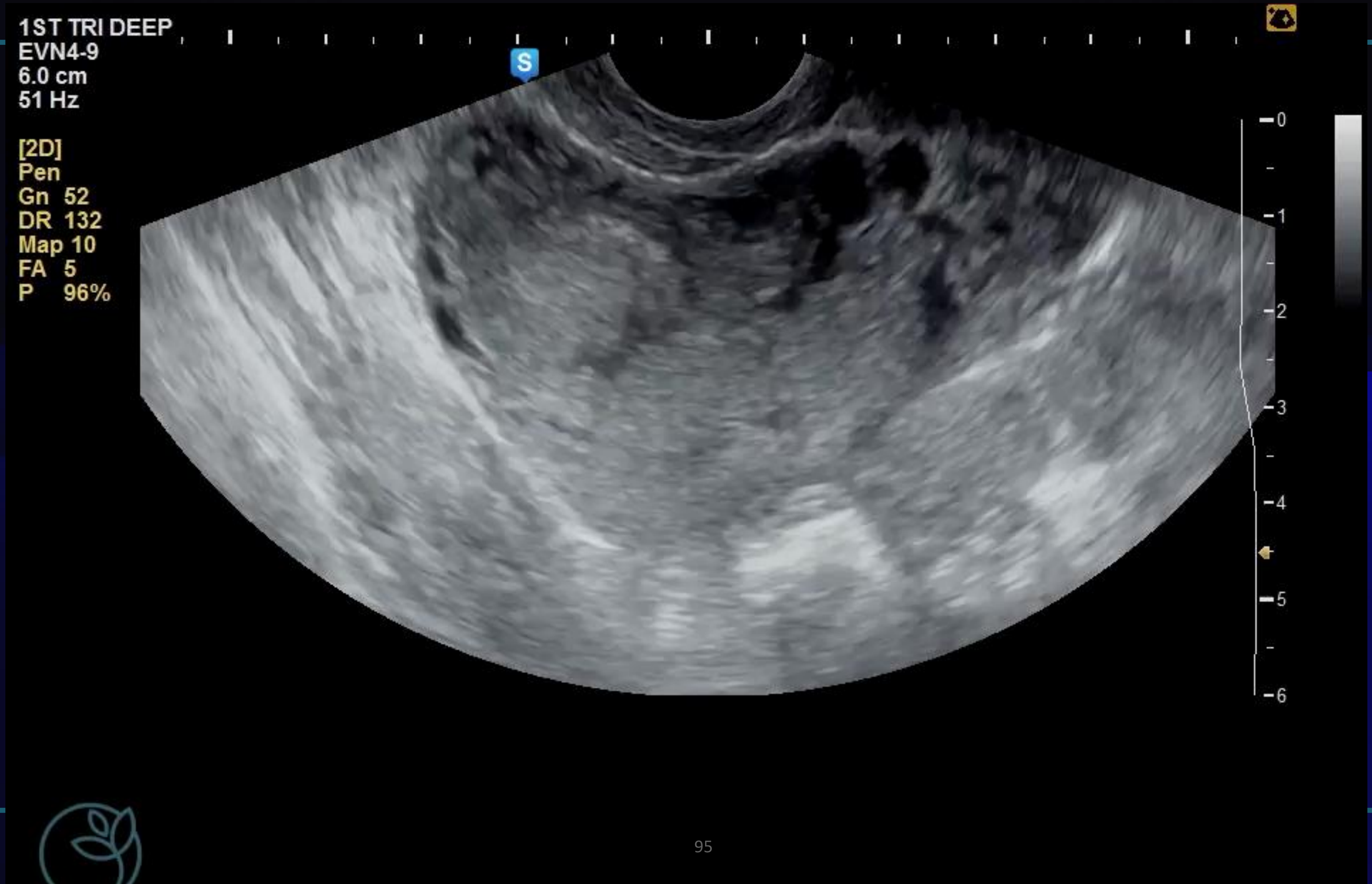
Prognosis: tend to resolve unless larger than gs

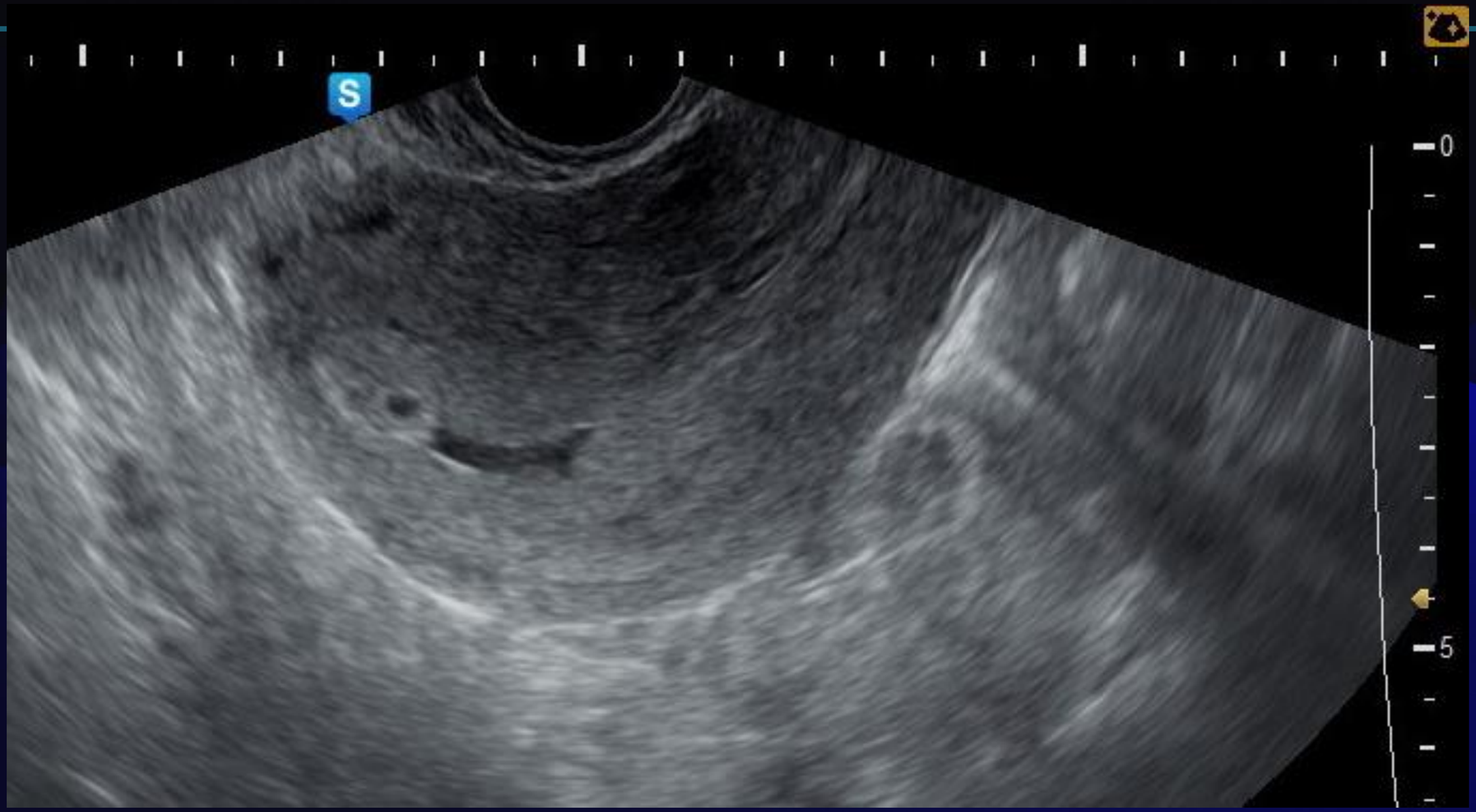
subchorionic hemorrhage



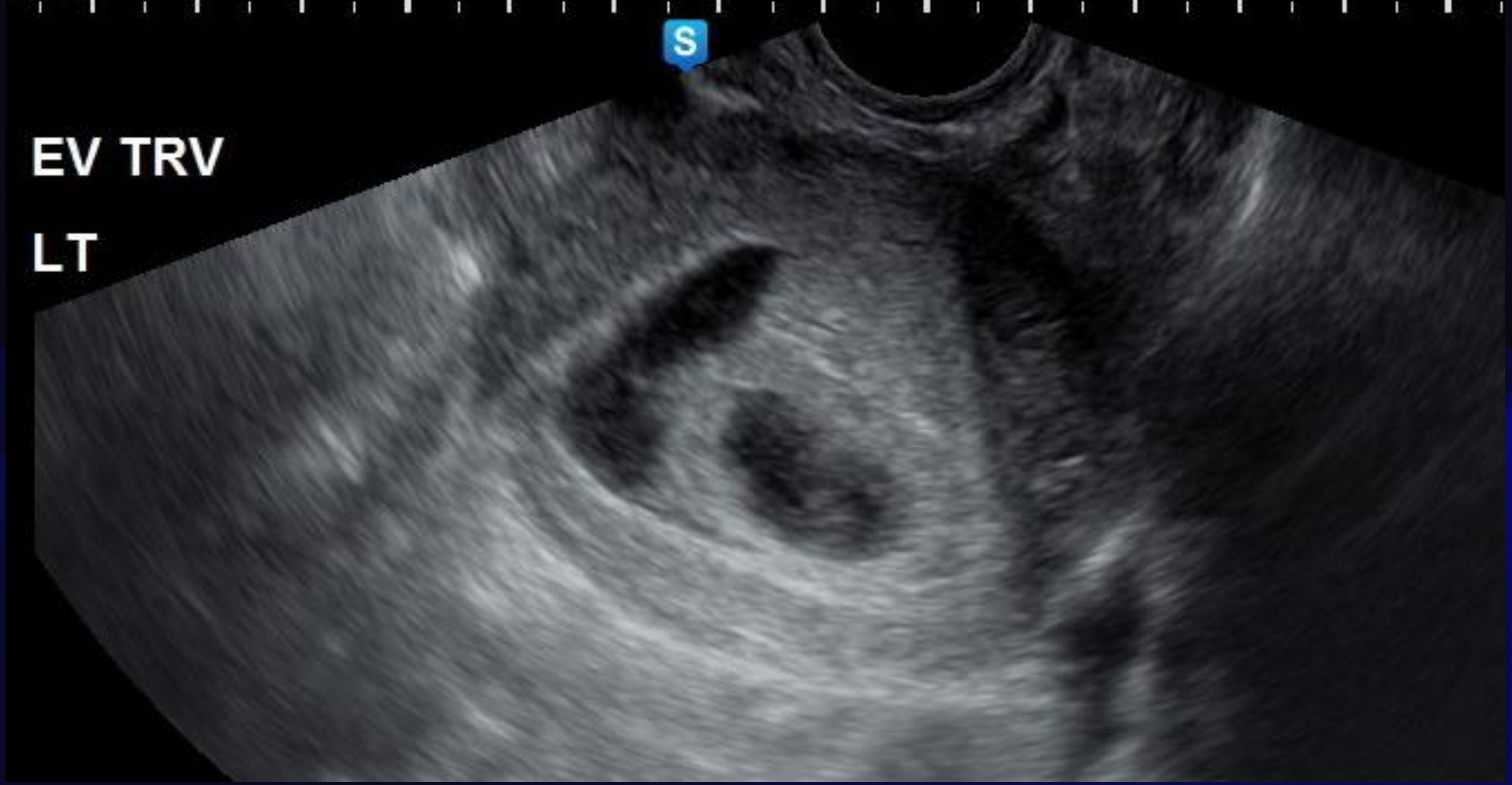


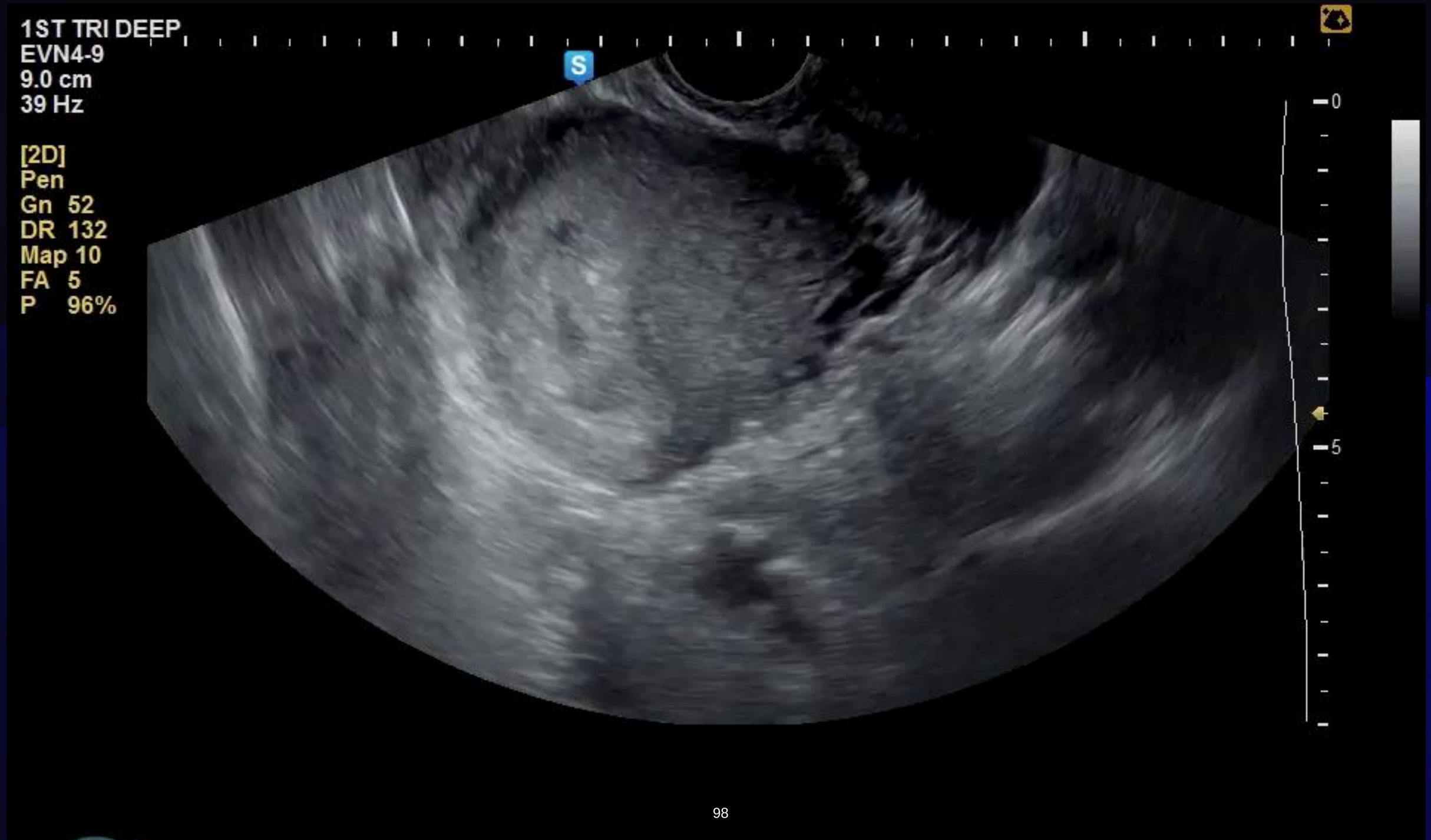
WOULD VIDEO BE HELPFUL?

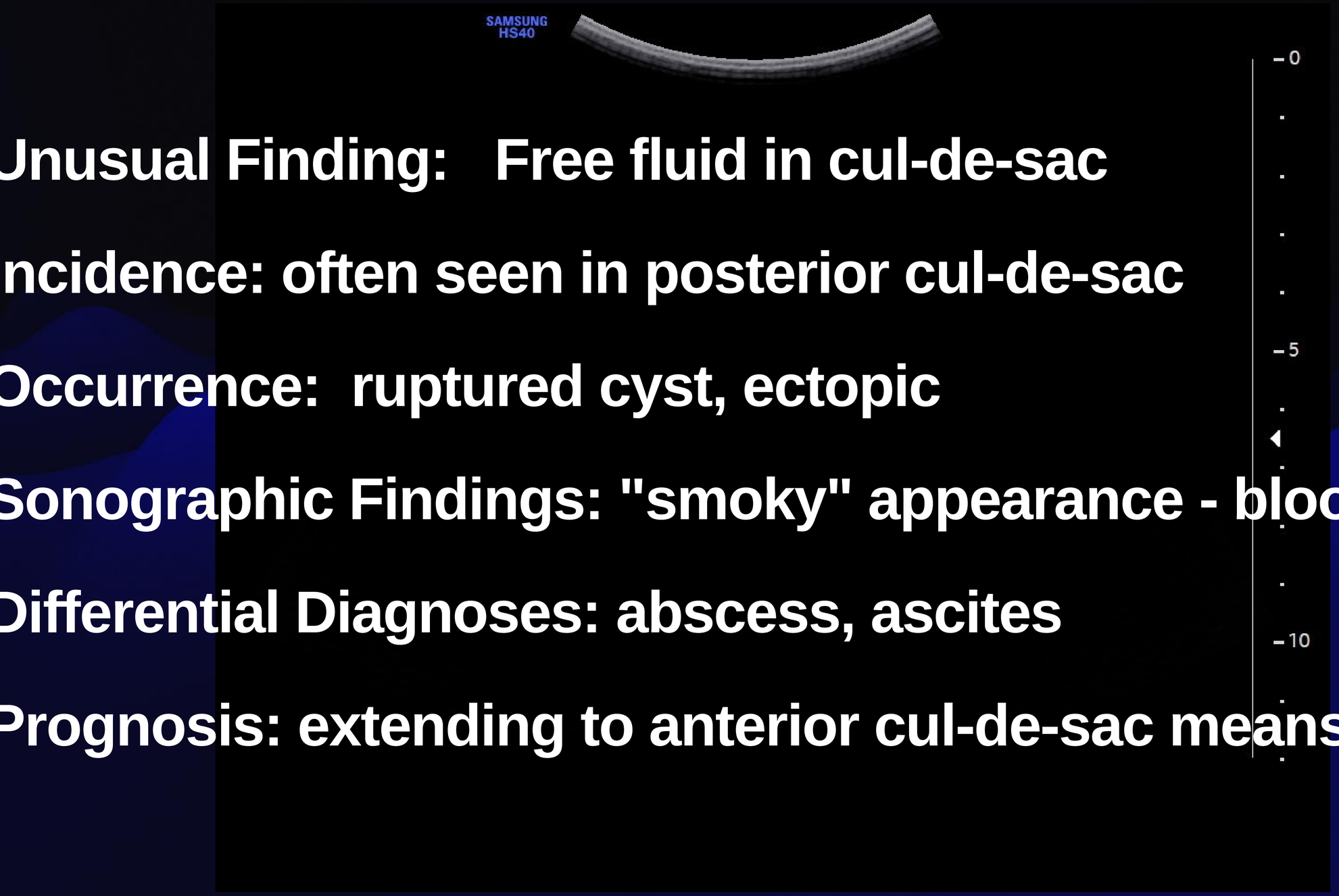

1ST TRI DEEP
EVN4-9
6.0 cm
51 Hz
[2D]
Pen
Gn 52
DR 132
Map 10
FA 5
P 96%
S
0
1
2
3
4
5
6



This example was inconclusive (unable to confirm viable IUP. Chose Ab


S
EV TRV
LT


1ST TRI DEEP
EVN4-9
9.0 cm
39 Hz
[2D]
Pen
Gn 52
DR 132
Map 10
FA 5
P 96%
0
5



Unusual Finding: Free fluid in cul-de-sac

Incidence: often seen in posterior cul-de-sac

Occurrence: ruptured cyst, ectopic

Sonographic Findings: "smoky" appearance - blood

Differential Diagnoses: abscess, ascites

Prognosis: extending to anterior cul-de-sac means large amo

FREE FLUID

Physiologically normal:

- Posterior CDS is the natural location for ABD fluid to accumulate
- Pelvic fluid fluctuates w/ menstrual cycle

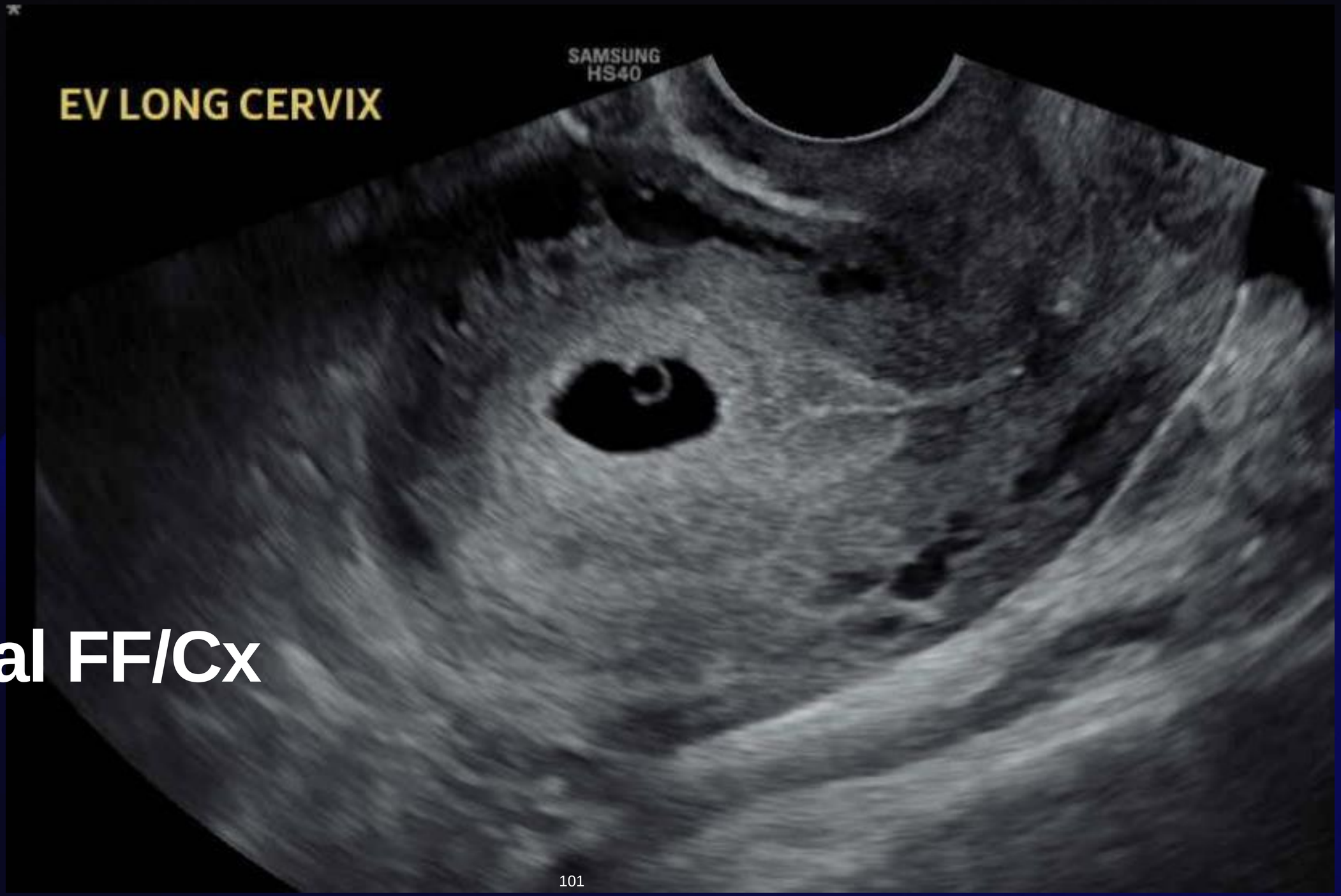
Too much:

- Fluid that extends to UT fundus
- Broad ligament may be visible

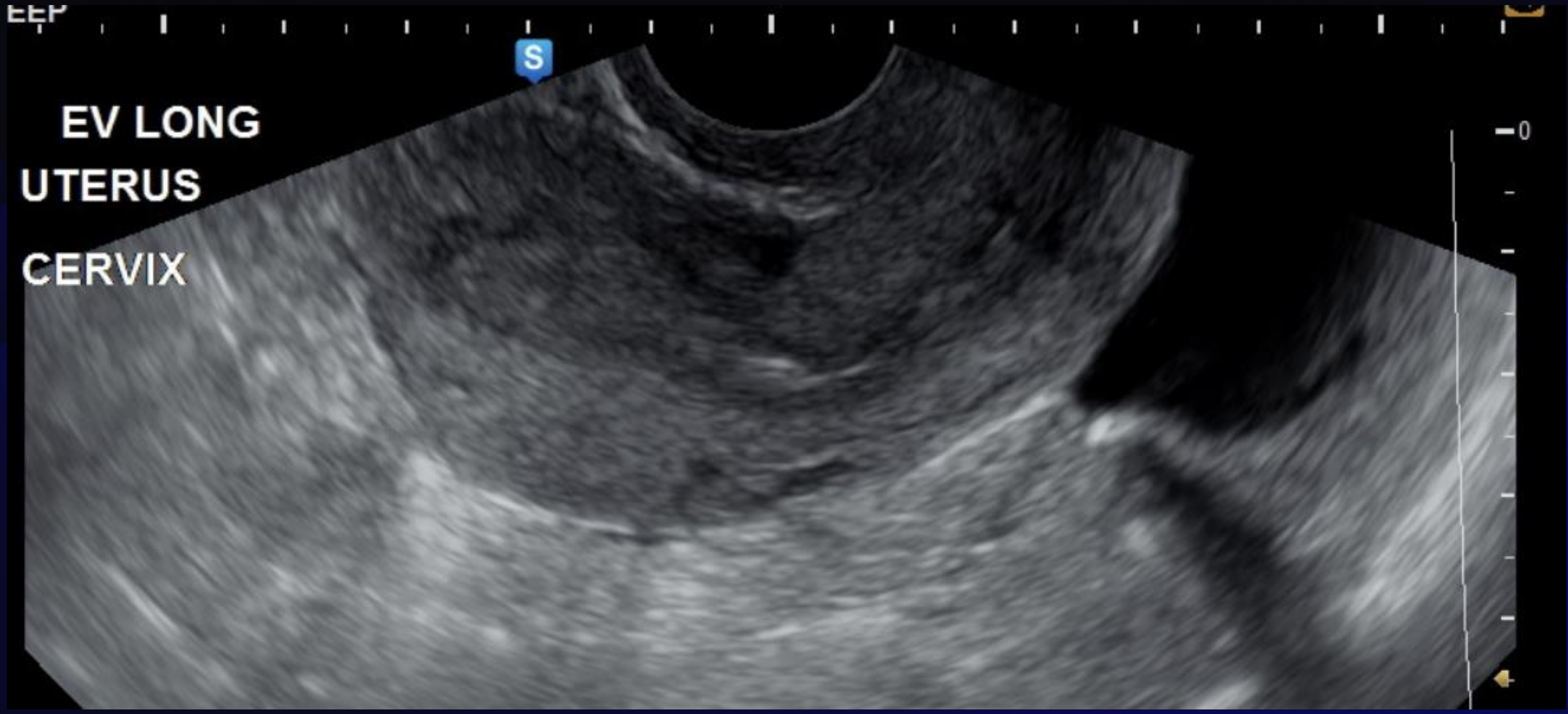
Complex:

- Septations
- Signs of hemorrhage/blood products

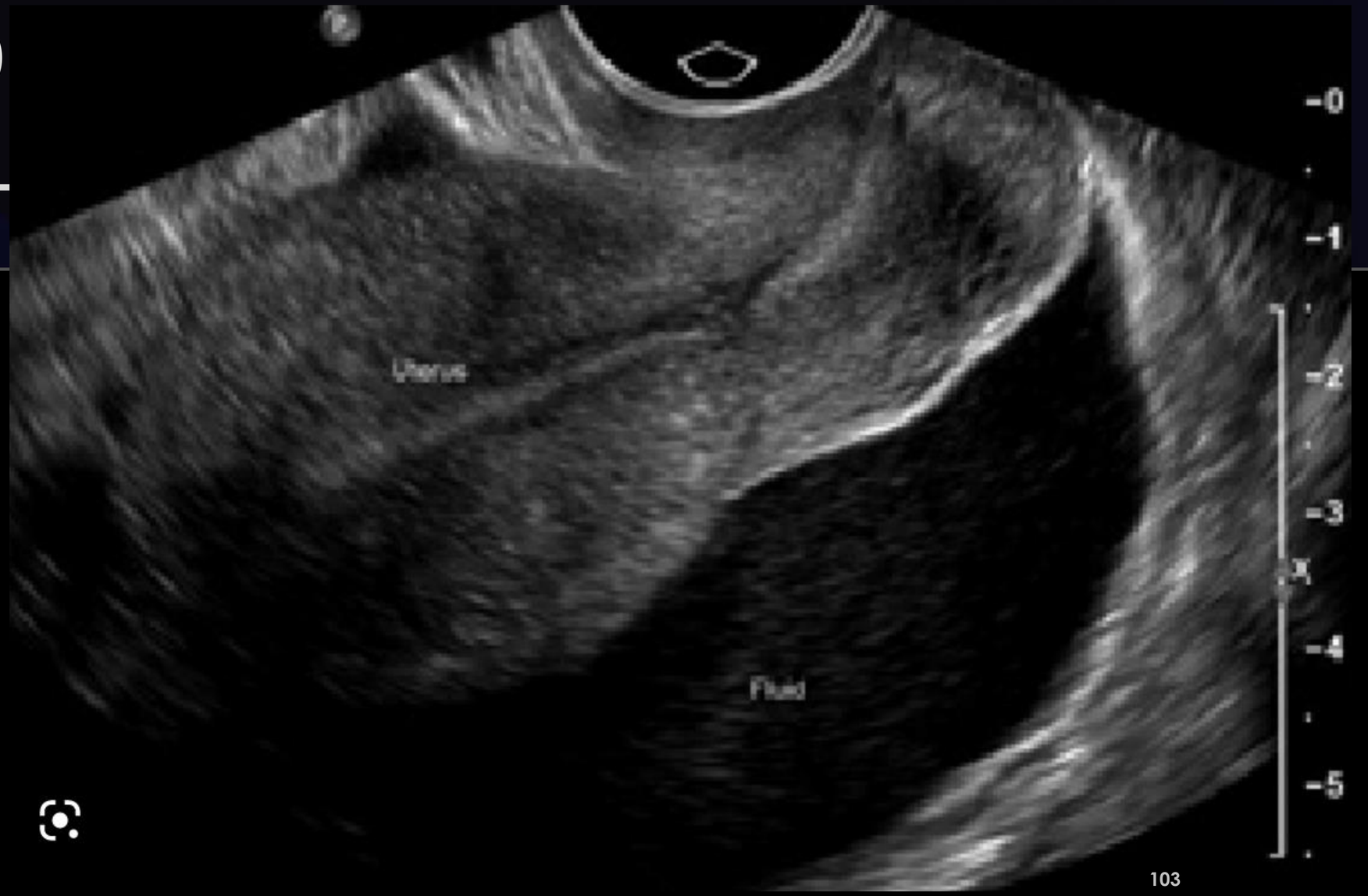
Normal FF/Cx



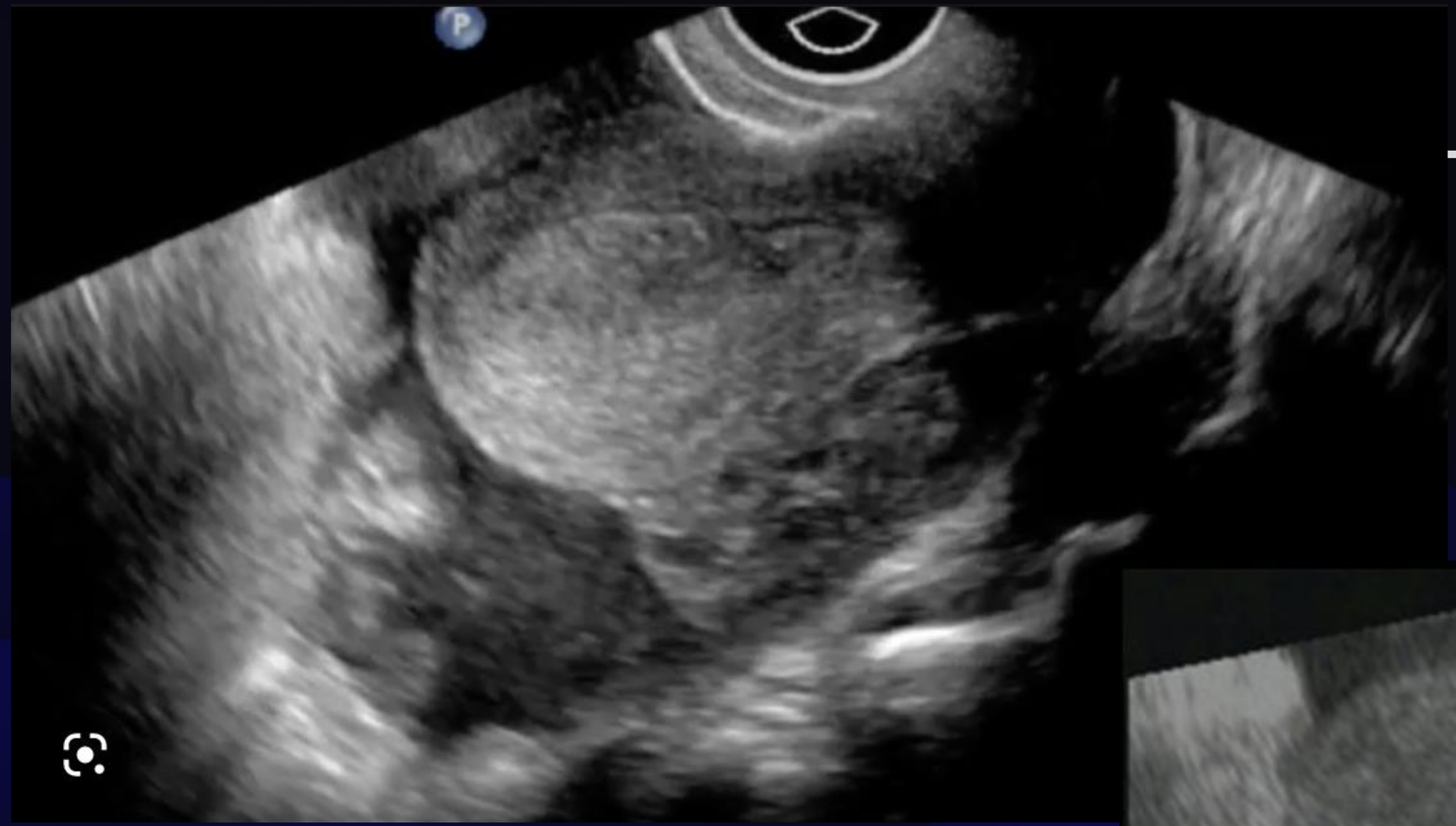
FF

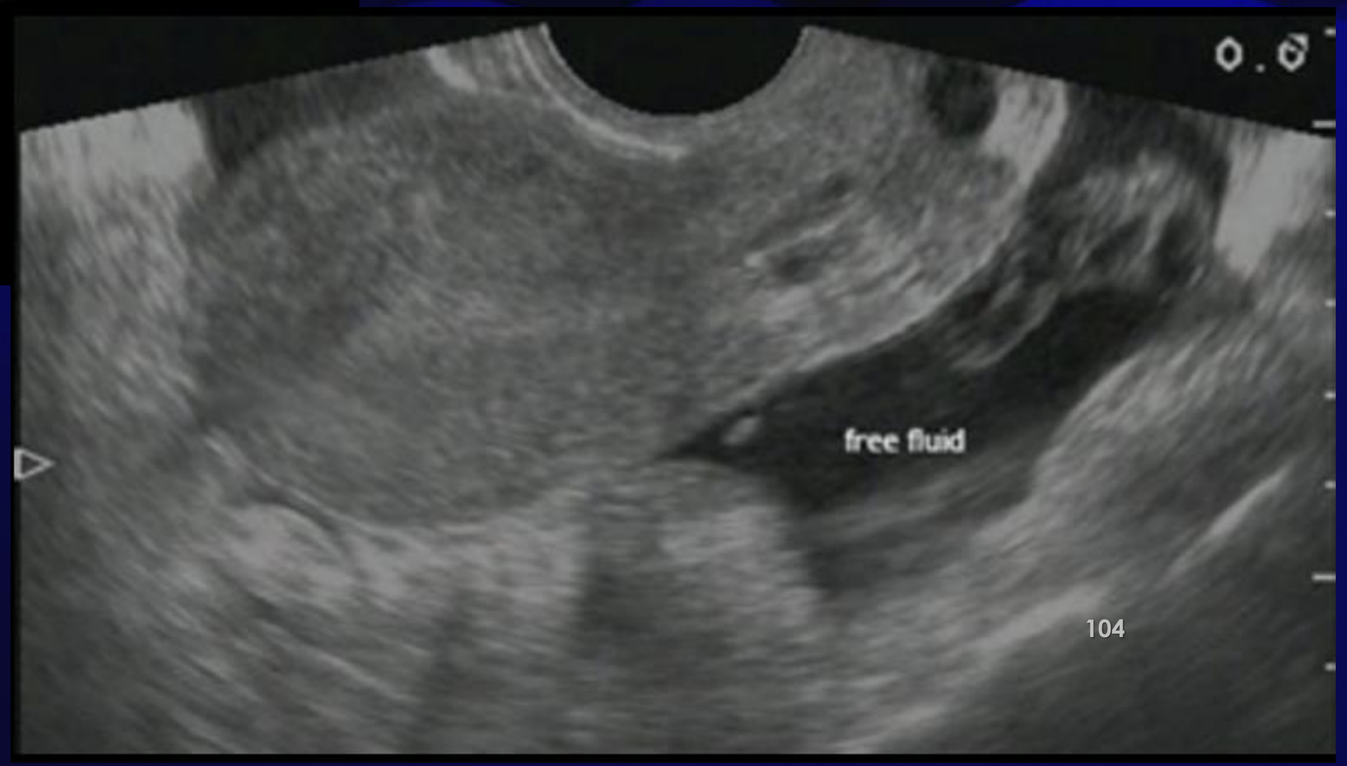


FREE FLUID

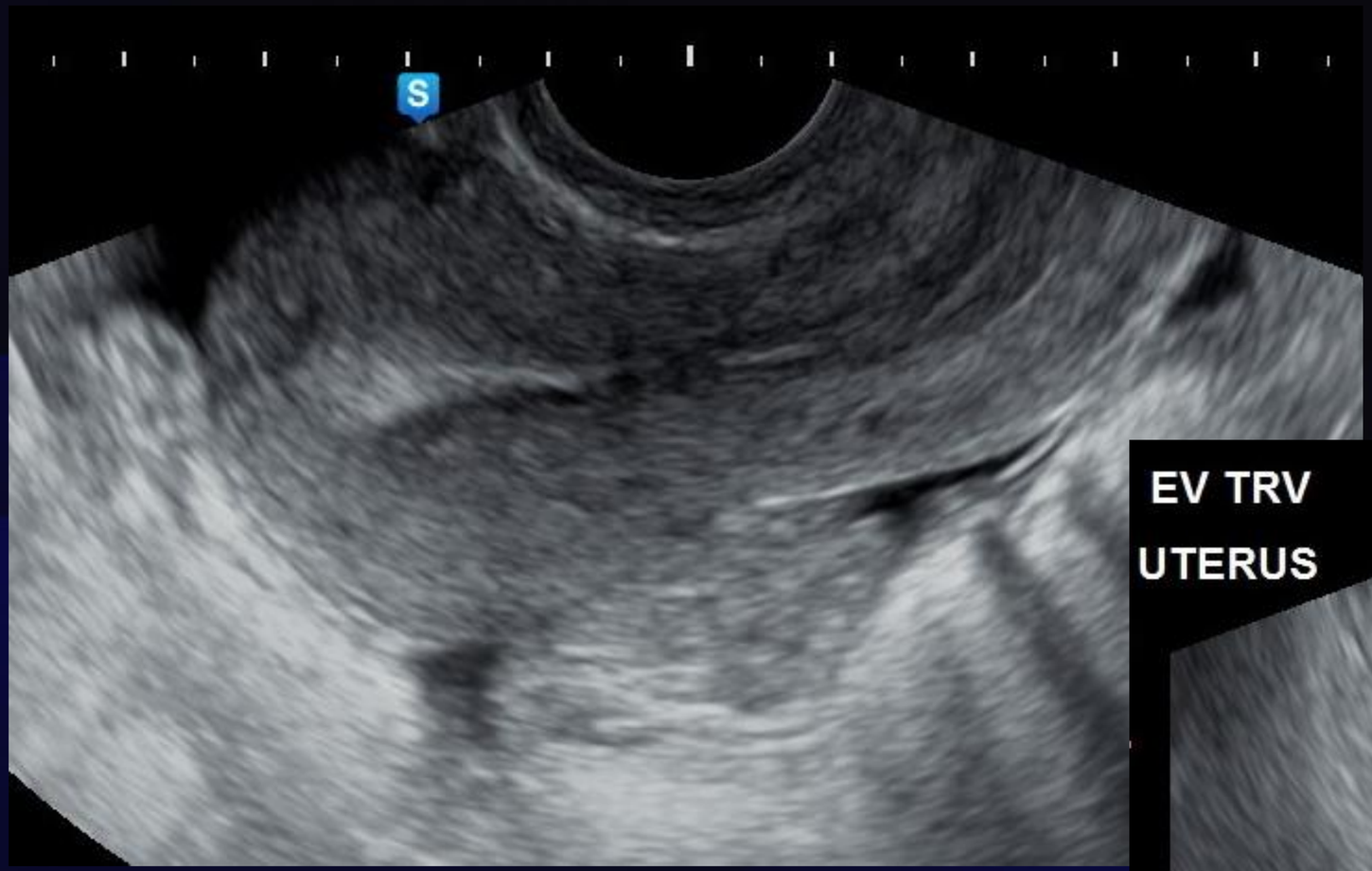


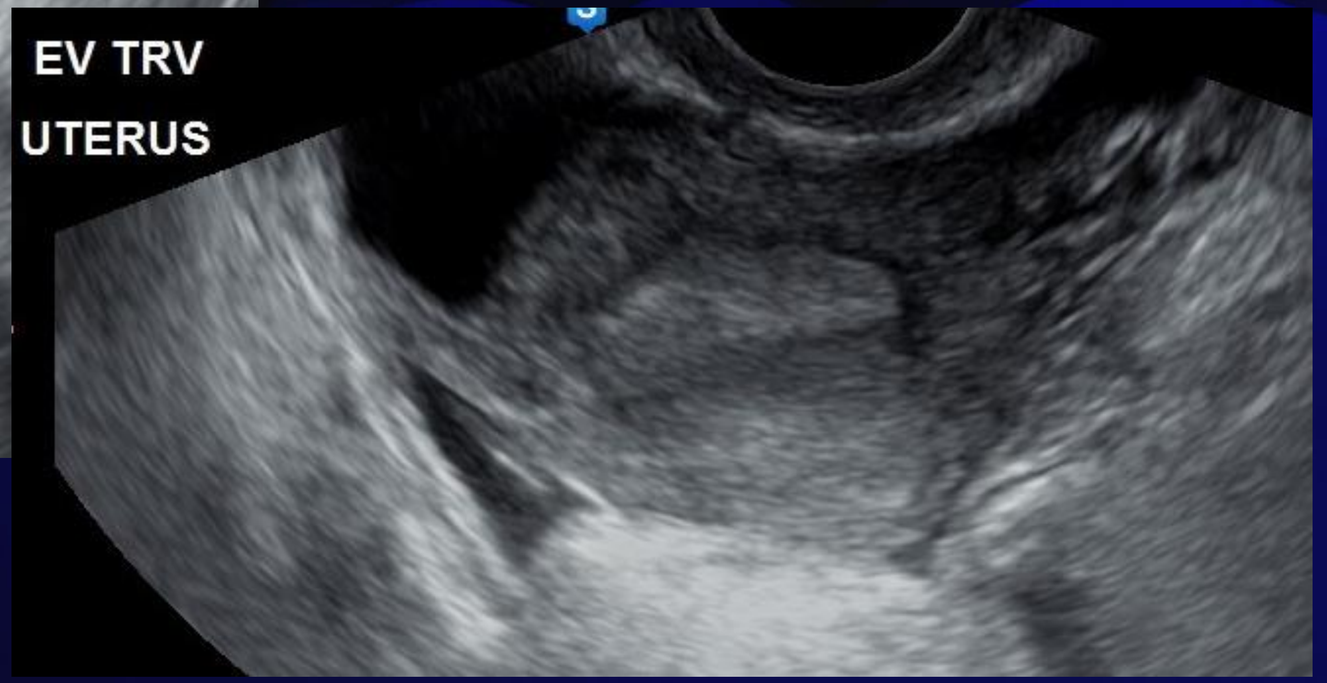
FREE FLUID - COMPLEX



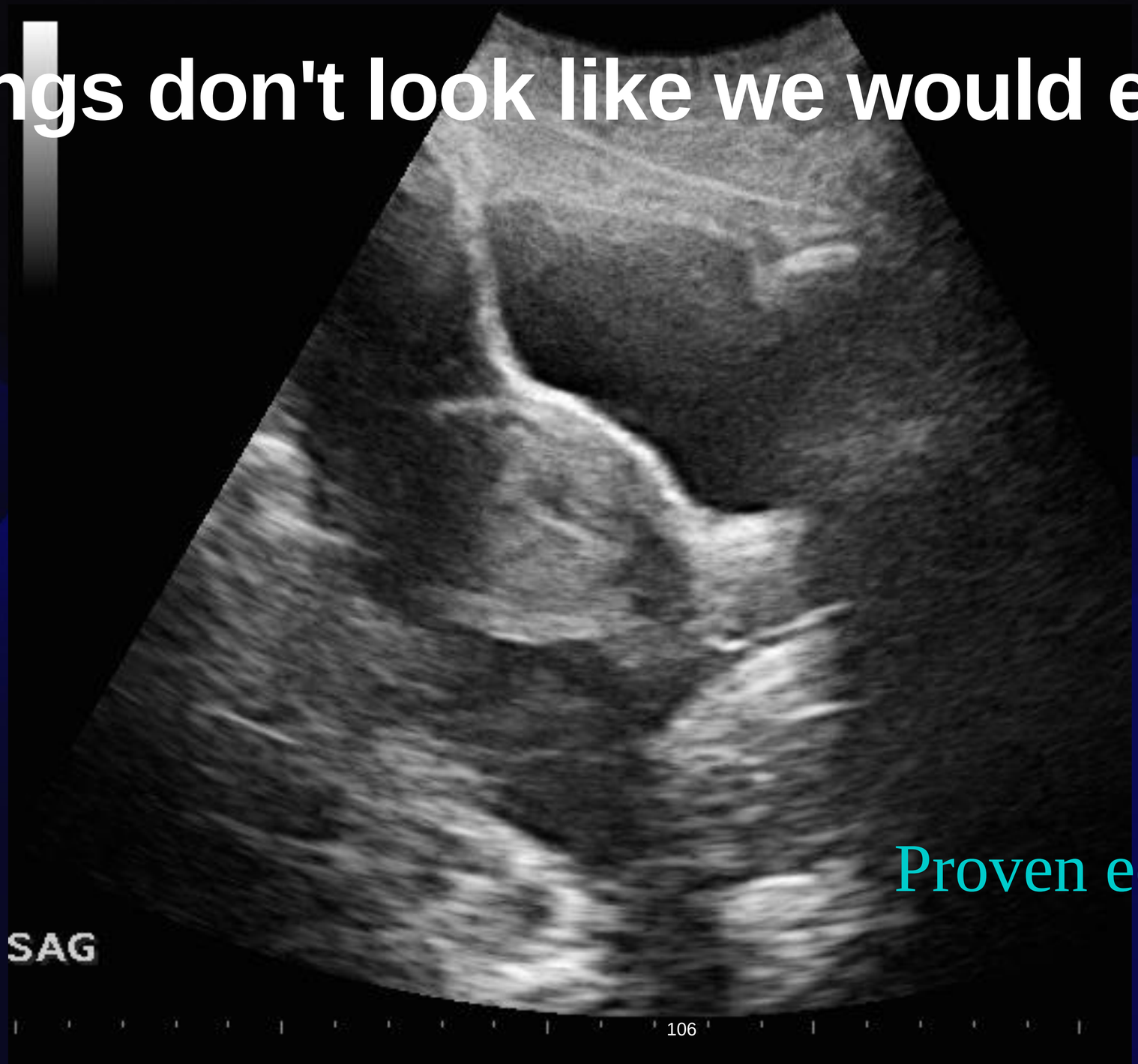


Free fluid associated with ectopic

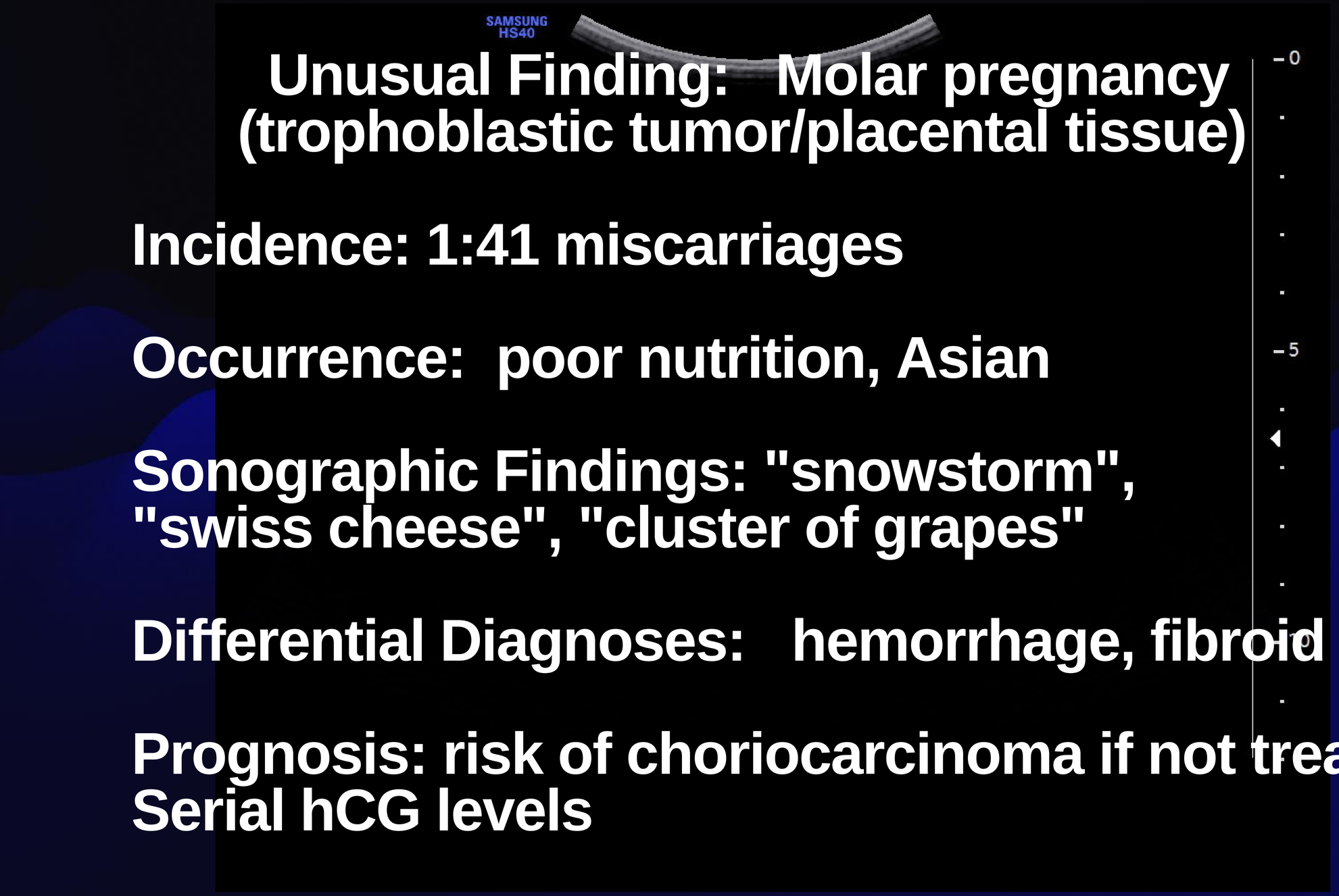




"Things don't look like we would expect"



Proven ectopic



Unusual Finding: Molar pregnancy (trophoblastic tumor/placental tissue)

Incidence: 1:41 miscarriages

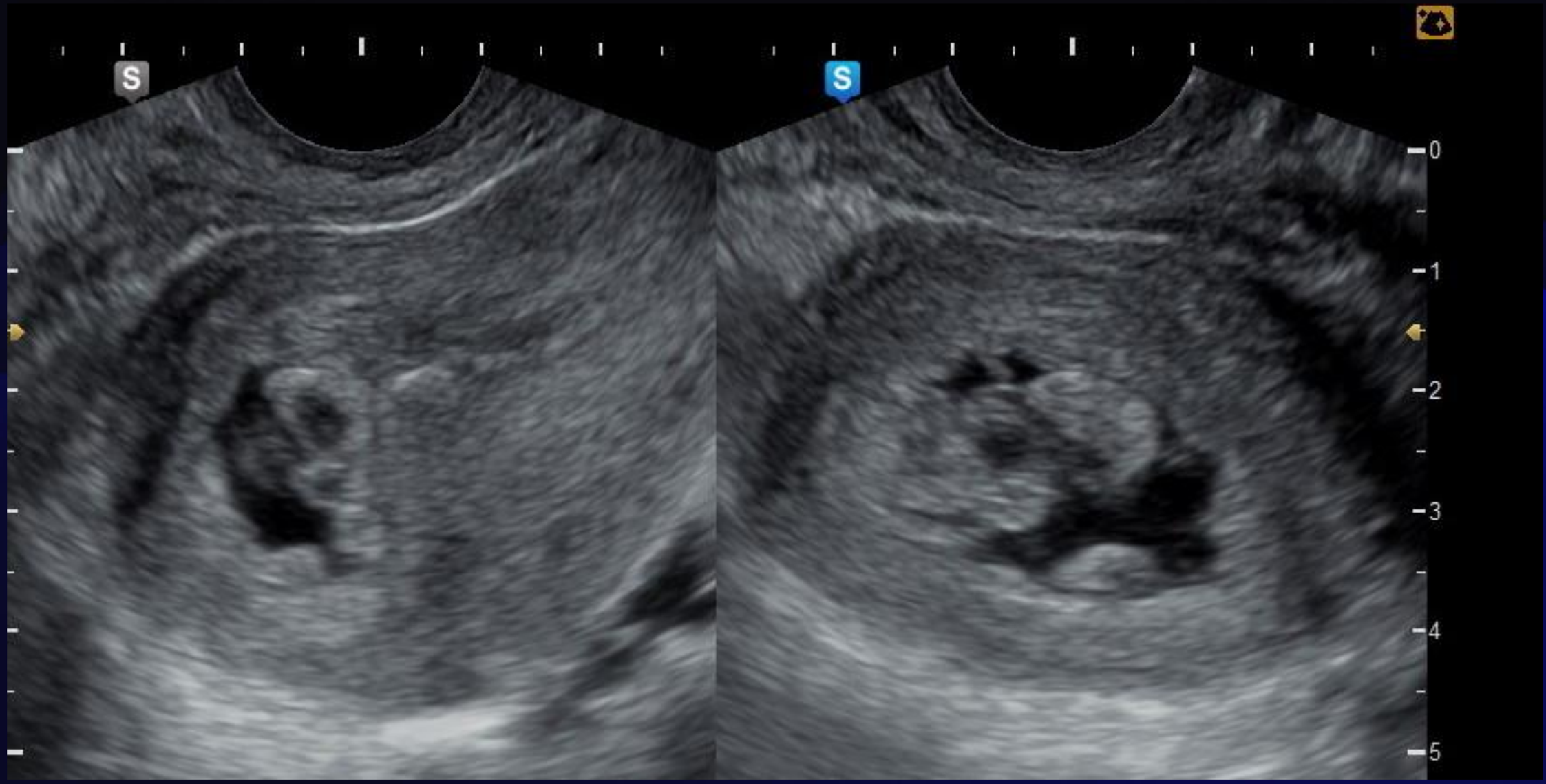
Occurrence: poor nutrition, Asian

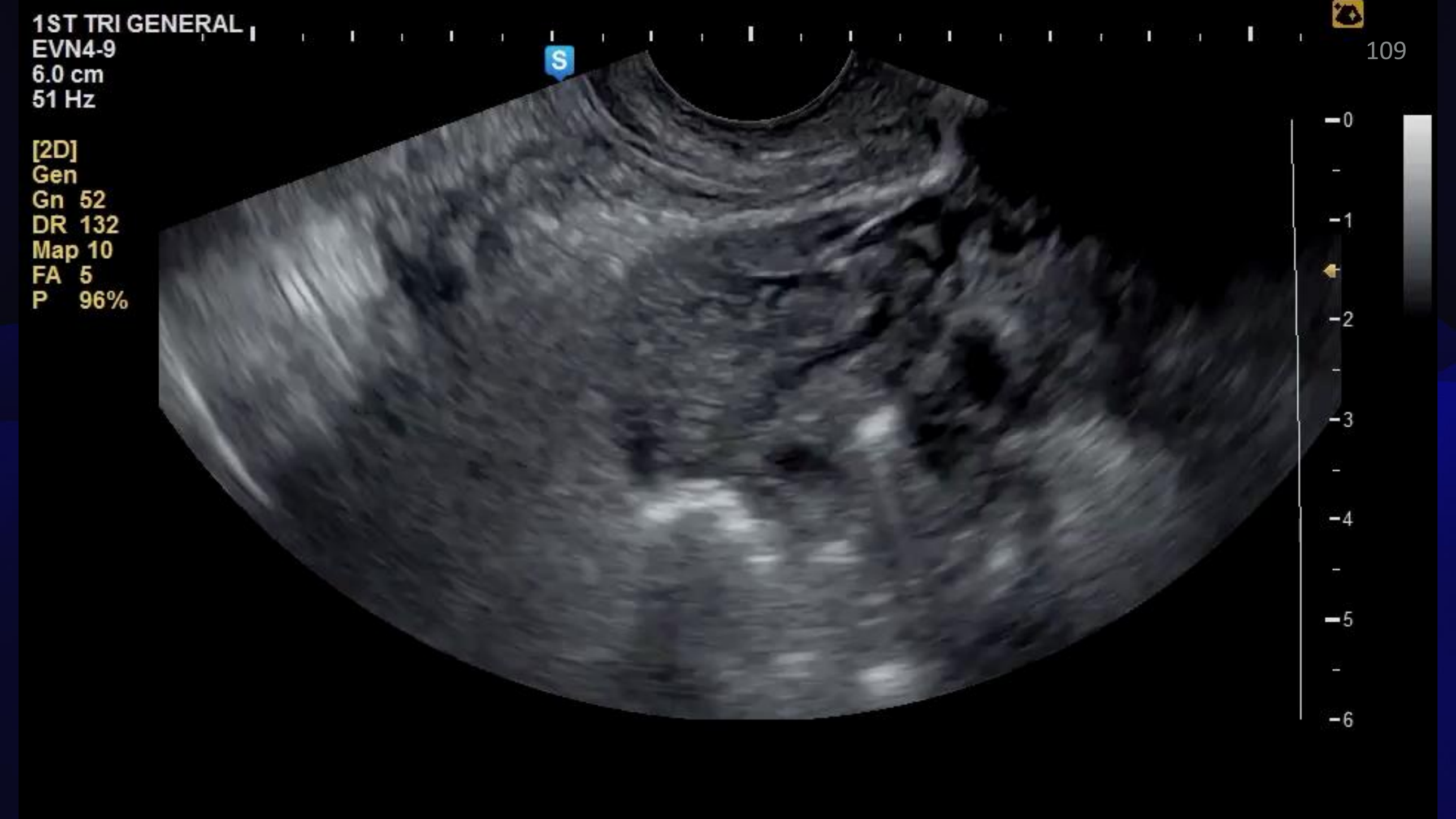
Sonographic Findings: "snowstorm", "swiss cheese", "cluster of grapes"

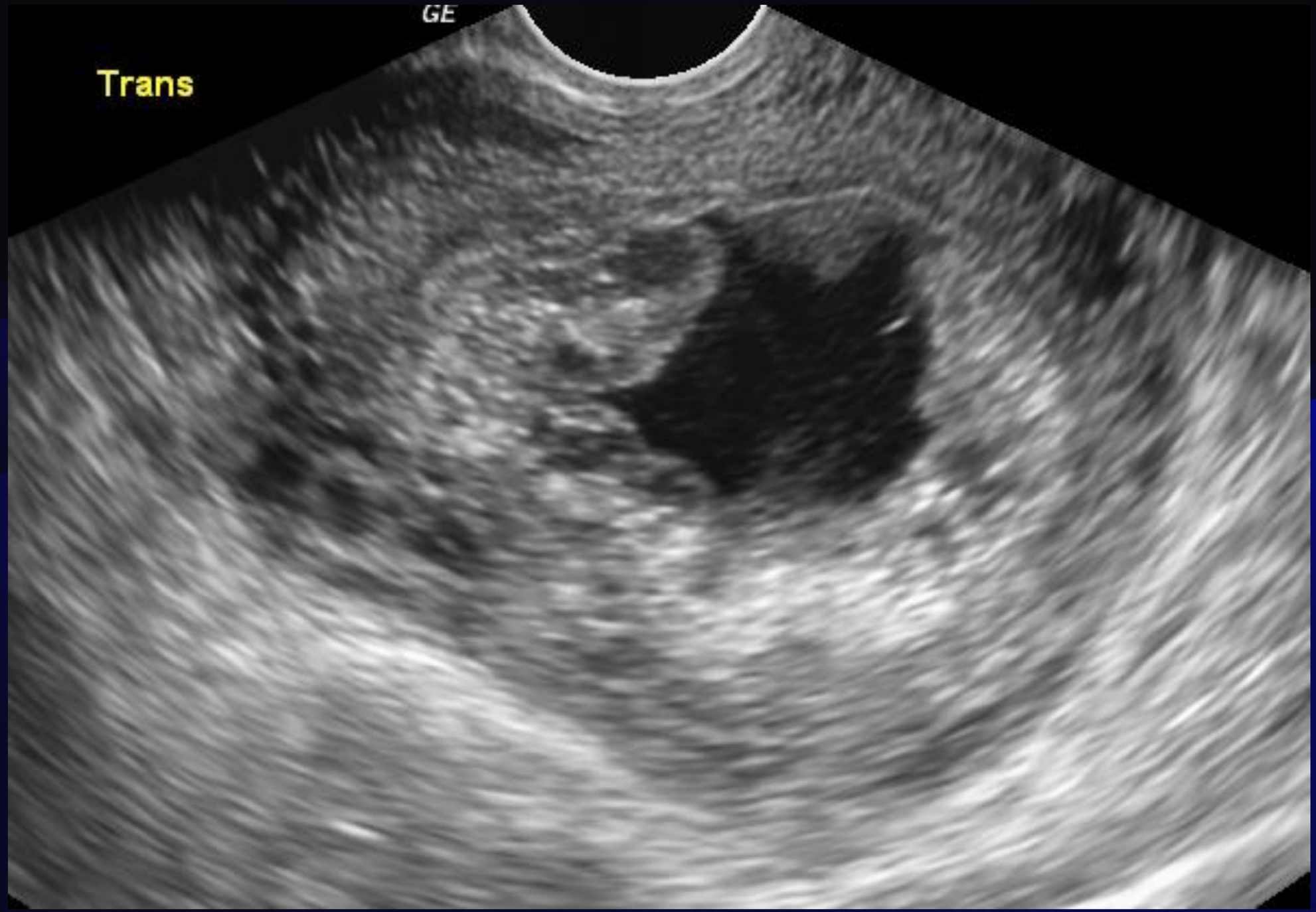
Differential Diagnoses: hemorrhage, fibroid

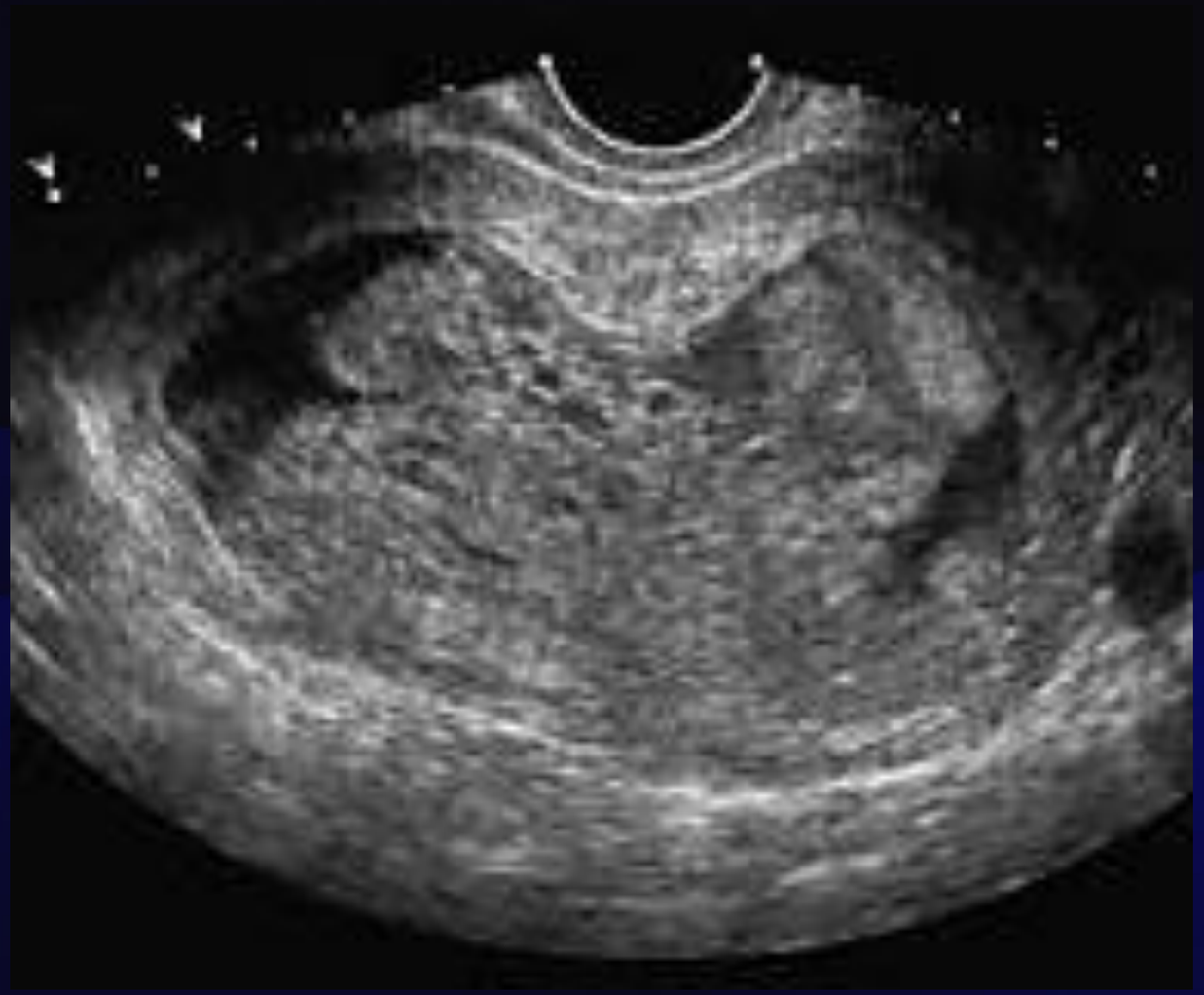
Prognosis: risk of choriocarcinoma if not treated; Serial hCG levels

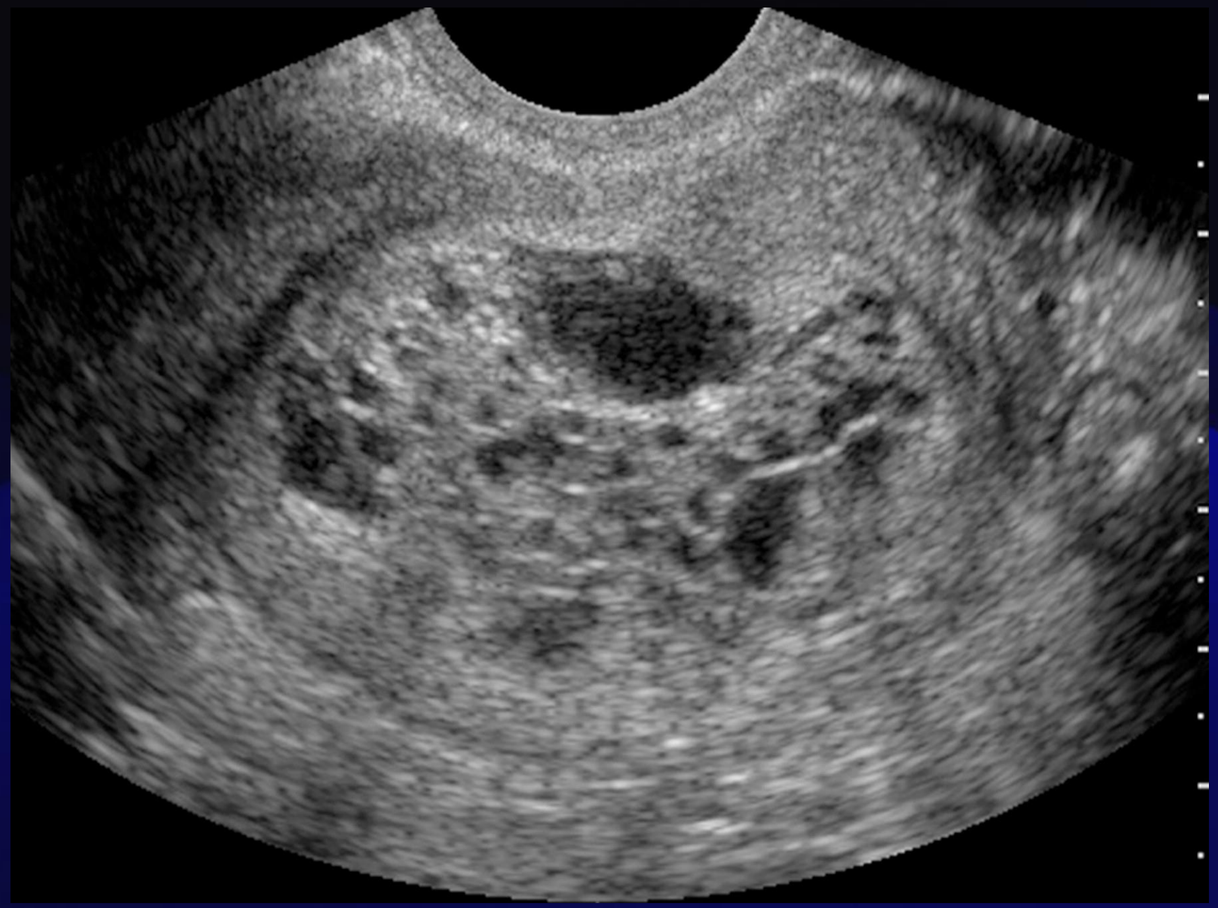
MOLAR PREGNANCY



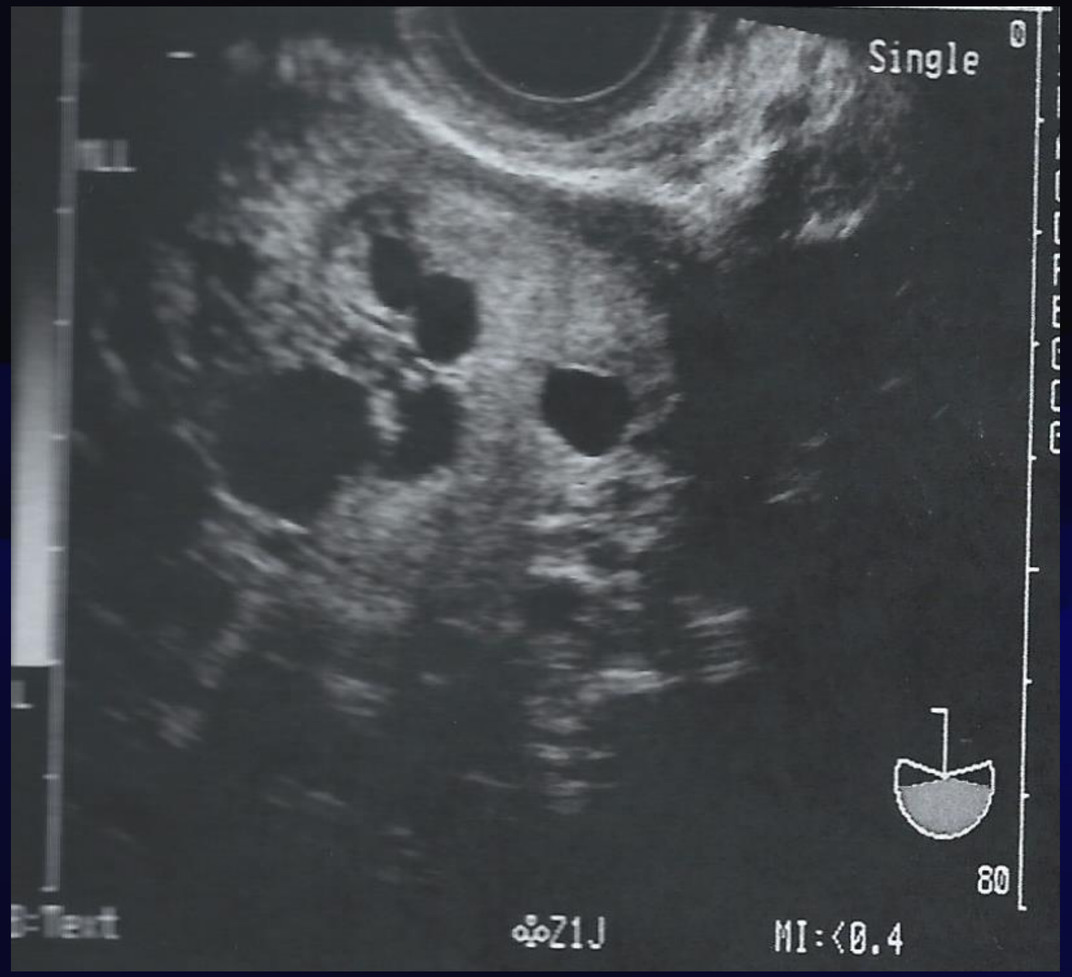

1ST TRI GENERAL
EVN4-9
6.0 cm
51 Hz
[2D]
Gen
Gn 52
DR 132
Map 10
FA 5
P 96%
S
0
1
2
3
4
5
6

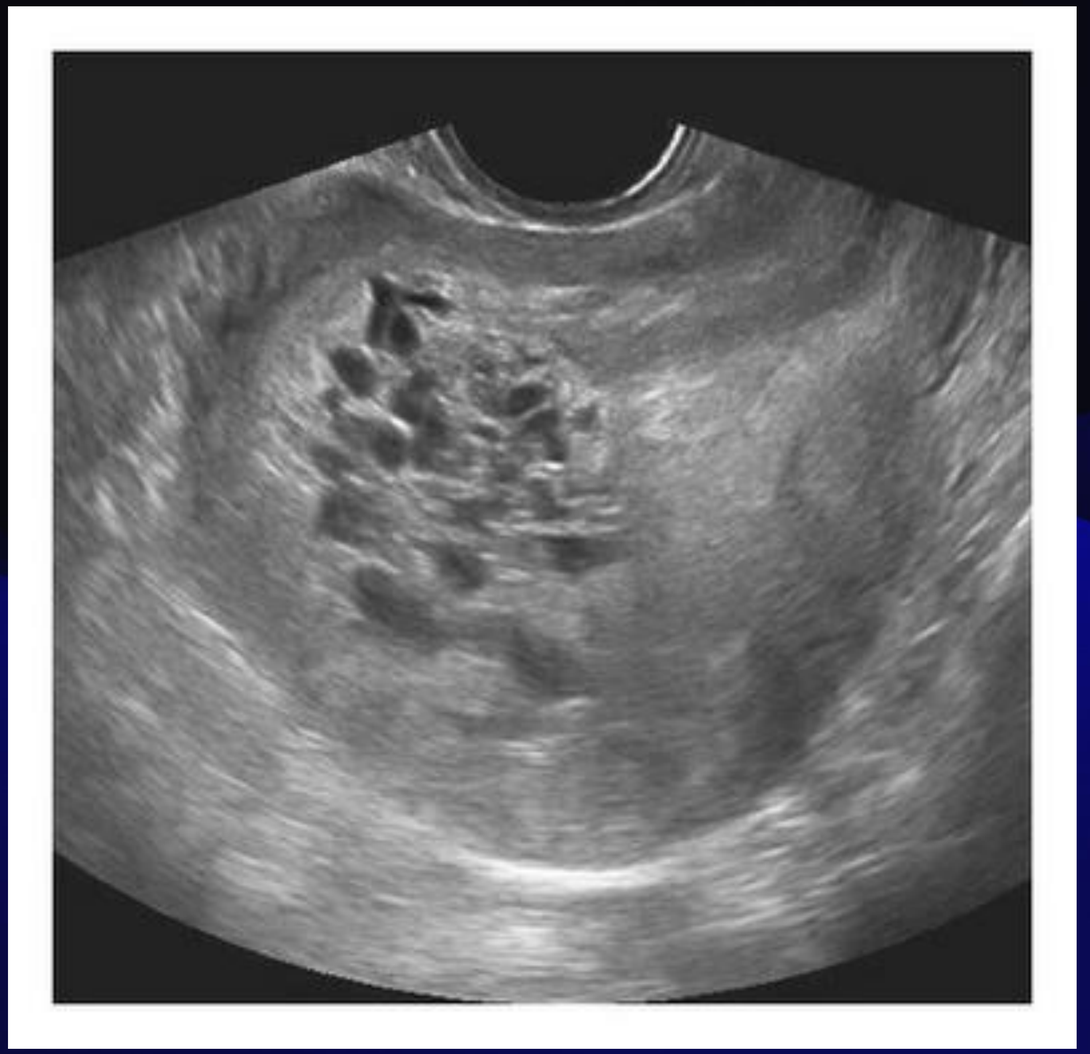

GE
Trans





Thank-you nurses for images !


Single
0
80
Z1J
MI:<0.4



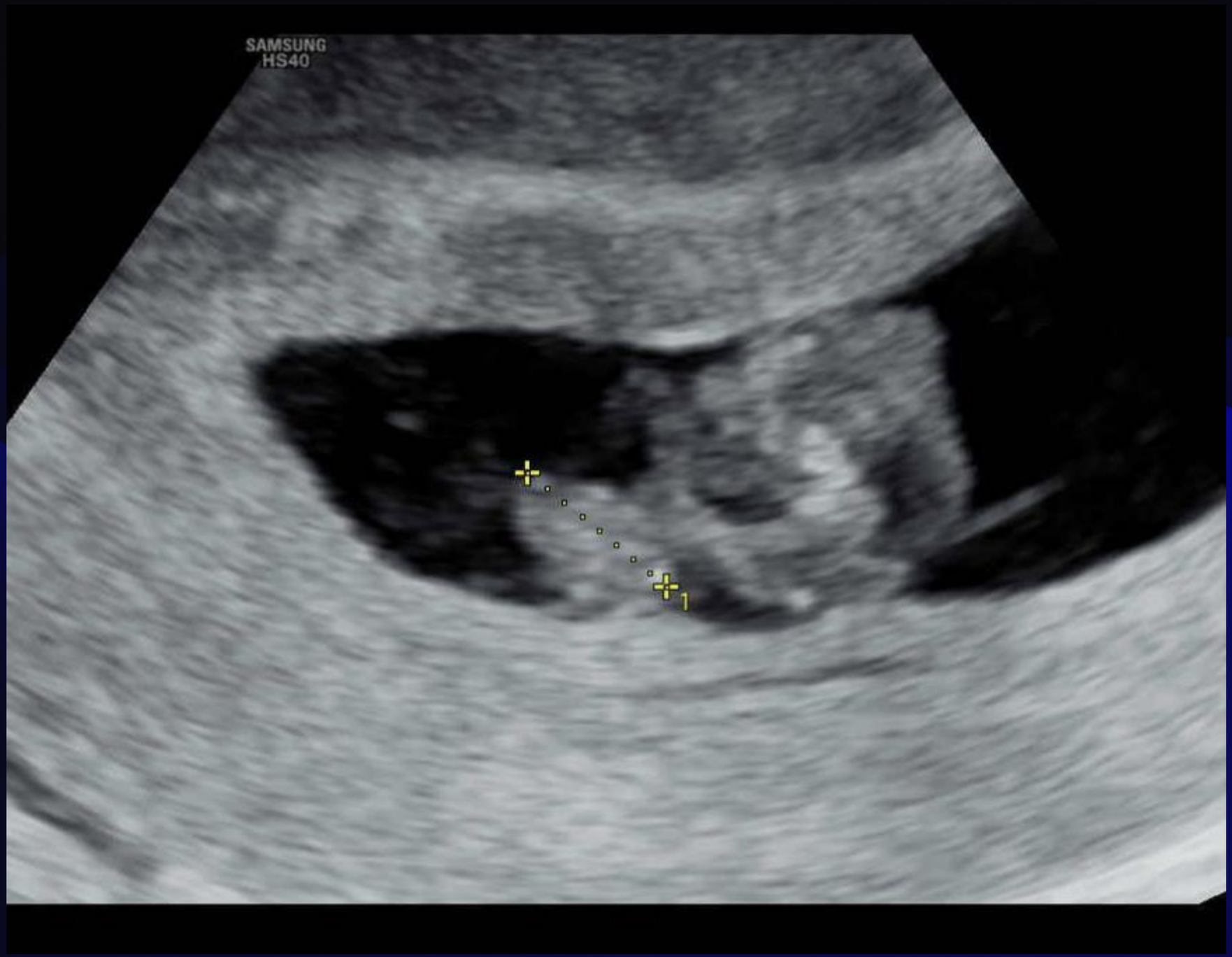
EXTRAS

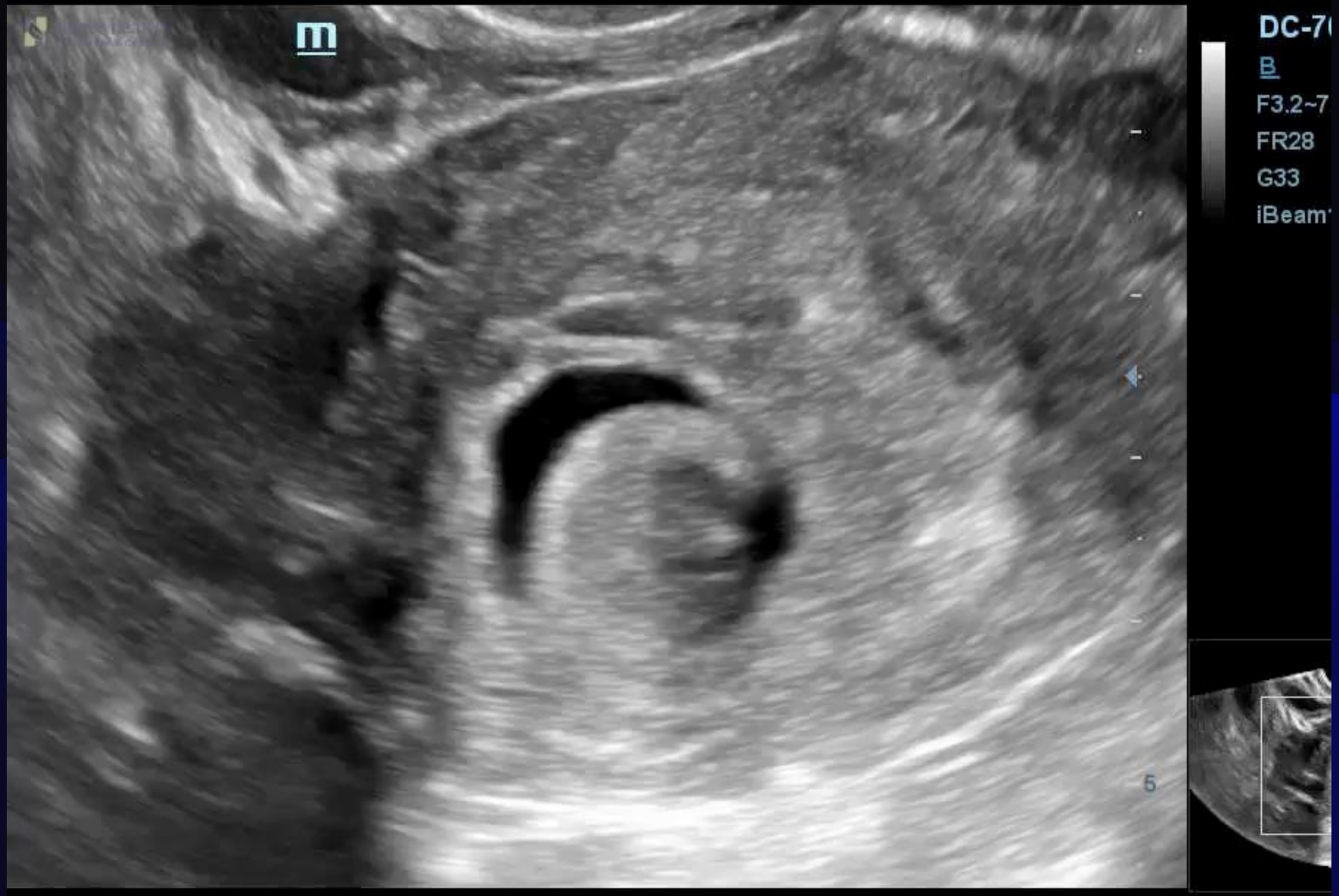
Unusual Finding: chorionic "bump"
Choriodecidual surface protrudes into gestational sac (possibly hematoma)

- Incidence: 4:1000 (.4%)
- Occurrence: more common with genetic abnormality
- Sonographic finding: "irregular convex bulge" into gestational sac
- Differential: subchorionic hemorrhage
- Prognosis: live birth rate <65%

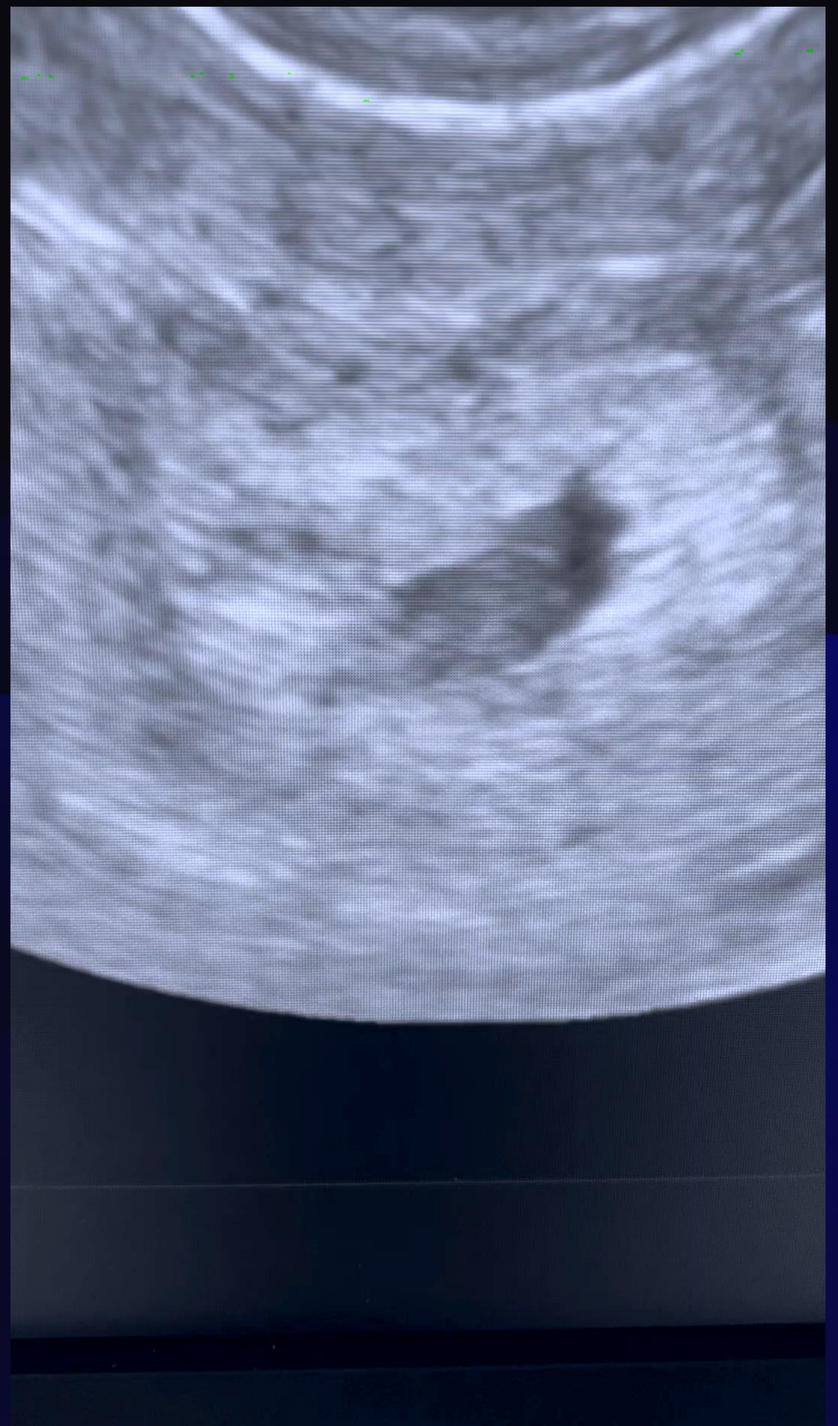
NIH: J Med US 2017.04.004

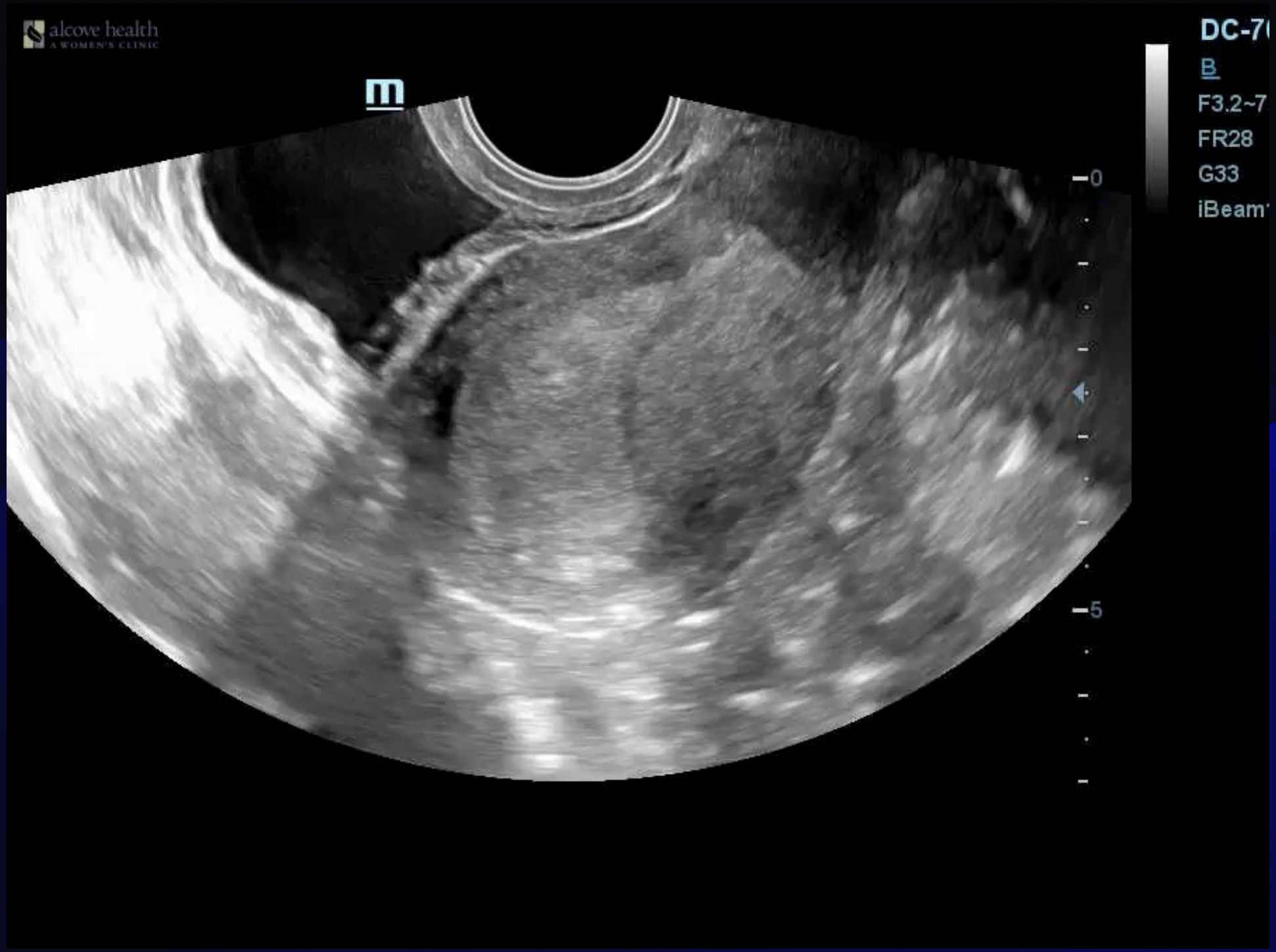
choroinic bump?

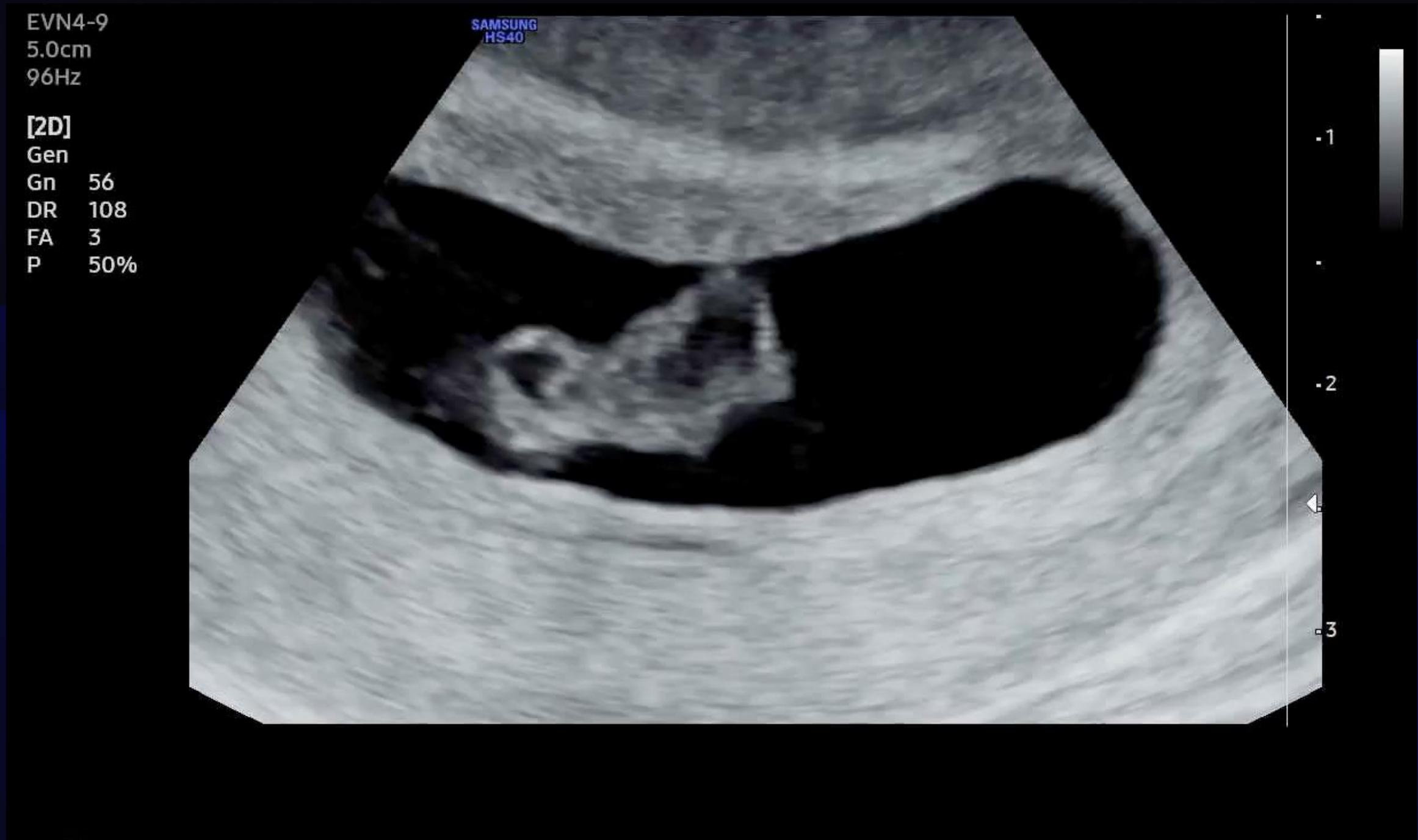



DC-7
B
F3.2~7
FR28
G33
iBeam

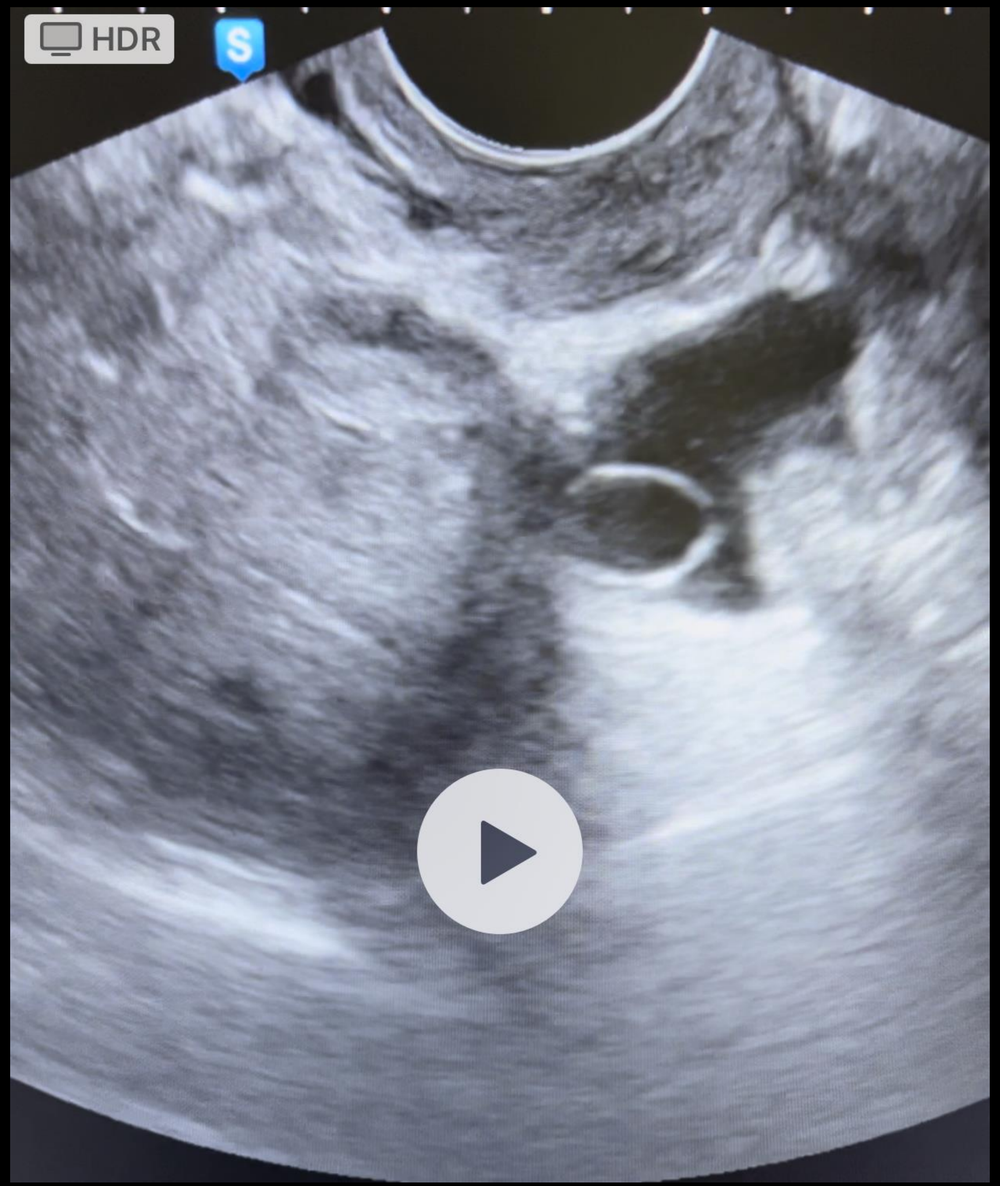
C. bump?

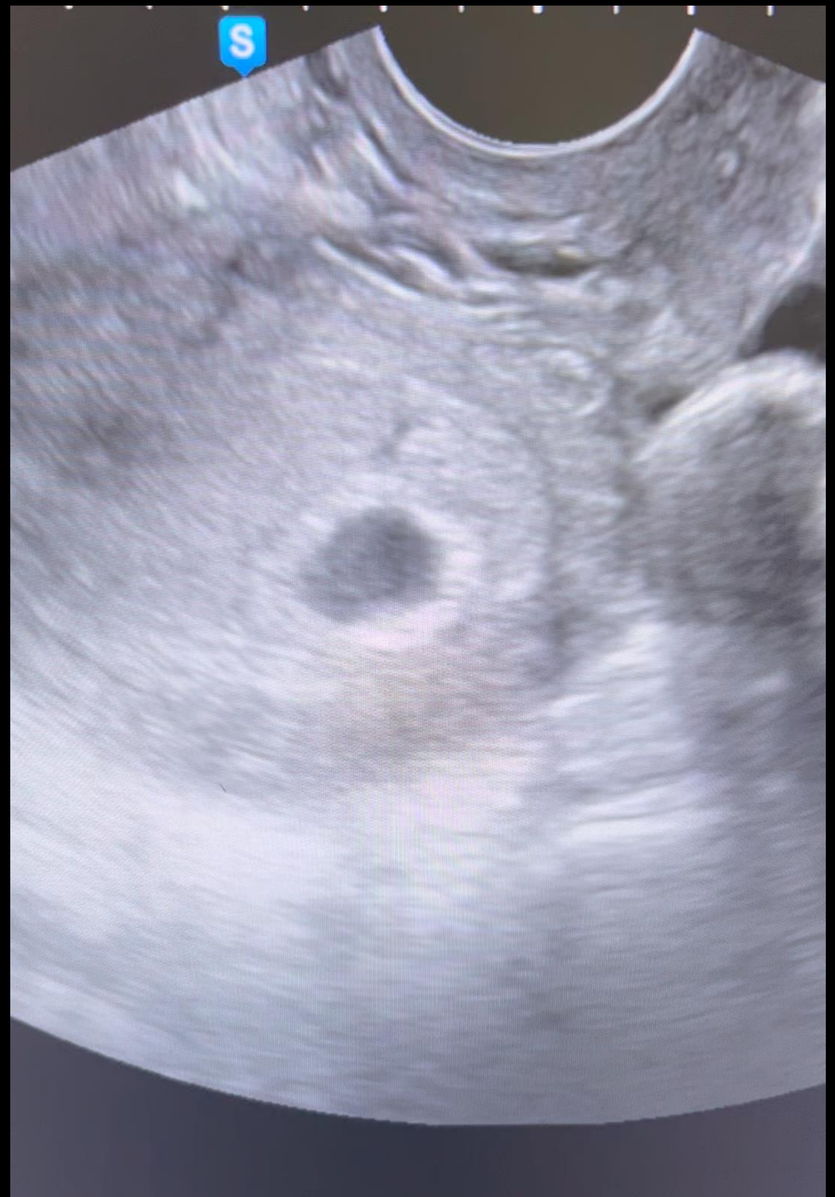



alcove health
A WOMEN'S CLINIC
DC-7
B
F3.2~7
FR28
G33
iBeam
0
5

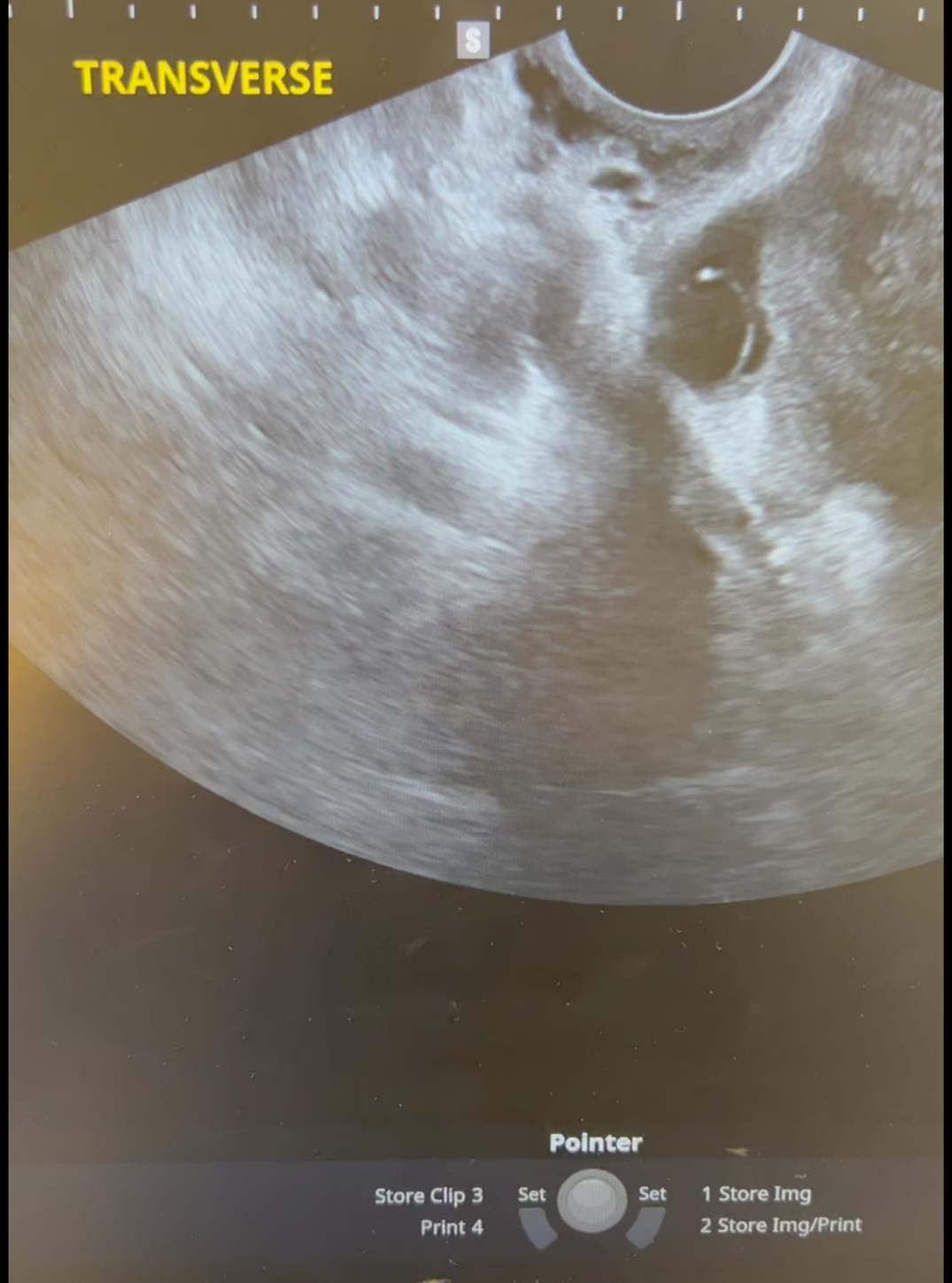

EVN4-9
5.0cm
96Hz
[2D]
Gen
Gn 56
DR 108
FA 3
P 50%
SAMSUNG
HS40
1
2
3

3 nurses have sent me these >>>>





MD suggested
? Nuvaring



Leaning on the everlasting arms..

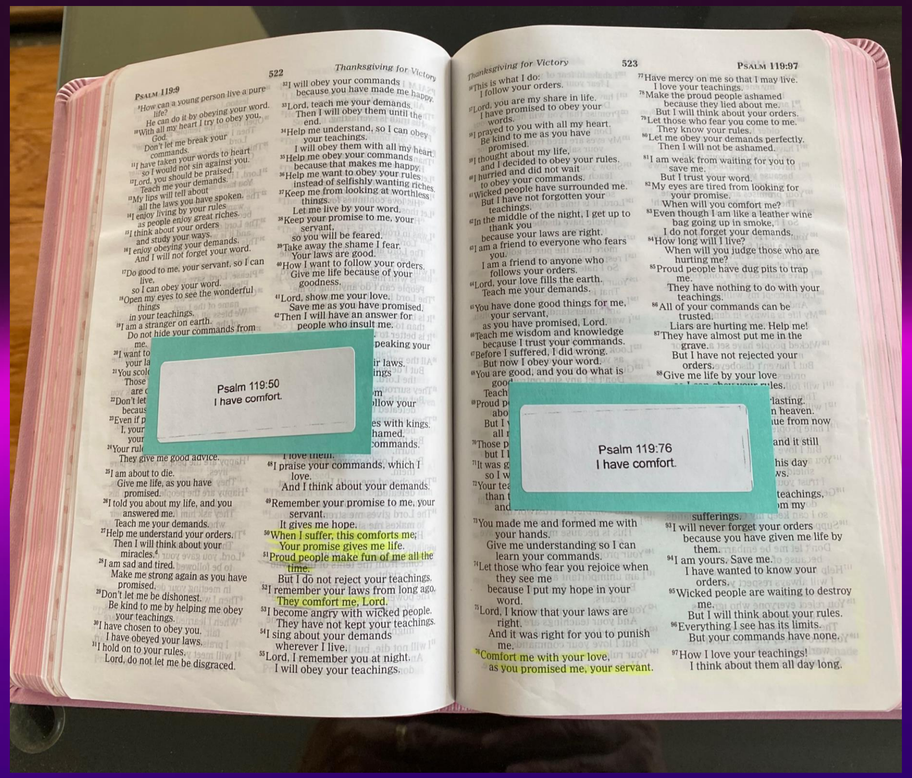
- Let us not grow weary in doing good…(Gal.6: 9-10)
- …through God’s mercy we have this ministry…(2 Corinth. 4:1)
- …never tire of doing what is right. (2 Thess. 3:13)
- Jesus drew away to lonely places and prayed. (Luke 5: 16)
- He gives strength to the weary…(Isaiah 40: 29).

References

- AIUM - American Institute of Ultrasound in Medicine
- Callen, Peter, "Ultrasound in OB/Gyn" 2017
- Cleveland Clinic. 2023
- "Ergonomics" JDMS 8/19/19
- Hajiahmadi, "Predicting the Outcome of a PUL" JDMS/Vol 39:1 Jan.23
- Kremkau, Frederick, "Diagnostic Ultrasound" 2021
- *Moschos, "Endometrial Thickness Predicts IUP in patients with PUL" Ultrasound in OB/Gyn/Vol 32:7
- NIH: J Med US 2017.04.004
- "Ultrasound of Early Pregnancy" Creighton University School of Medicine 2002

Life Affirming Language in the PMC

Bible Promises



Quality Concerns

MOMMY!!

When did I conceive?

- Practice policies can limit distractions and improve the quality of the OB ultrasound
- Concerns: Incomplete scans, poor patient communication and poor patient experience.
- Main distractions are observer and child behaviors.

Is it a boy?

Can I have a picture?

Is everything okay?

JDMS 2023, Vol.39

- limit distractions

- improve the quality of the OB ultrasound