

Ectopic Pregnancy

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Disclosures

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Relevant Financial Relationships: None

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Learning Objectives

After completing this presentation, the learner will be able to:

1. Identify the most common sonographic appearances of ectopic pregnancy.
2. Classify the various types of ectopic pregnancy and describe how to differentiate each type.
3. List a variety of sonographic techniques that can be used to assist in the diagnosis of ectopic pregnancy.

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Outline

- A. Background/Initial Evaluation
- B. Sonographic Findings- Uterus:
- C. Sonographic Findings- Adnexa:
 - 1. Tubal Ring
 - 2. Complex mass
 - 3. Tubal Ring vs Corpus Luteum
 - 4. Free Fluid
- D. Diagnosing Tubal Rupture
- E. Role of 3D imaging for Unusual Forms of EP

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Background

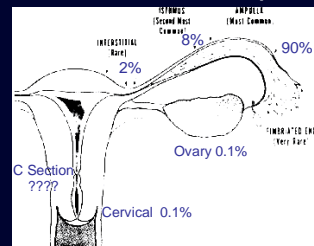
- ➔ Products of conception implanted outside of the endometrial cavity
 - ➔ 1.5 to 2.0% pregnancies
- ➔ Complications of EP are the leading cause of pregnancy related deaths during the first trimester in the U.S.

Barnhart KT. Ectopic Pregnancy NEJM 2009

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Ectopic Pregnancy

- ➔ >95% occur in fallopian tube



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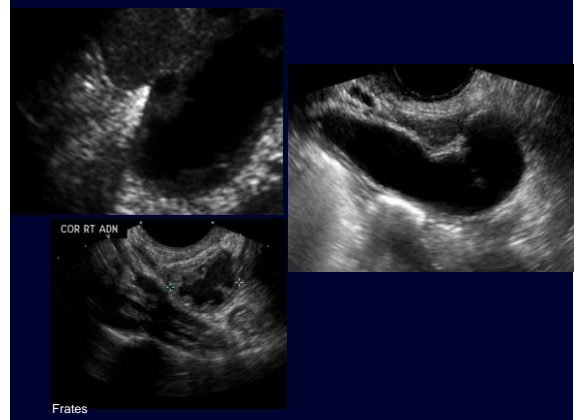
Ectopic Pregnancy

Risk Factors:

- ➔ Tubal scarring (PID, prev EP)
- ➔ IUD
- ➔ Assisted fertilization

- ➔ 25% of pregnancies occurring in pts w/ IUD or TL are ectopic
- ➔ 50% of pts with EP have no known risk factor

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Ectopic Pregnancy

- ➔ Classic presentation: pain, vaginal bleeding, adnexal mass
- ➔ Positive pregnancy test
- ➔ Ultrasound



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Pregnancy Test

- ➔ Trophoblastic tissue makes hCG 8 days after conception
- ➔ Normal pregnancy: sac **typically** seen by TVS with hCG of 1000 mIU/ml
- ➔ 17/51 (33%) patients with hCG > 2000, not treated for EP, had IUPs at follow-up*

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*Mehta et al, Radiology 1997; 205:569-573

Pregnancy Test (BWH data)

- ➔ hCG within 24 hours of US (225 EPs)
- ➔ Range 7 – 107,949 mIU/ml
- ➔ Average 3256 mIU/ml
- ➔ significantly higher with +FH in EP 20,980 vs 1,901 (no FH)
- ➔ 77% had hCG <3000, 7% had hCG >10,000

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Pregnancy Test

- ➔ BWH cautionary case
- ➔ hCG over 4000
 - ➔ Nothing in uterus, nothing in adnexa
- ➔ followupNml IUP

- ➔ Do NOT dx and treat (for EP) a stable patient until certain

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+ hCG and no IUP: **PUL**

Pregnancy of Unknown
Location

only 3 choices:

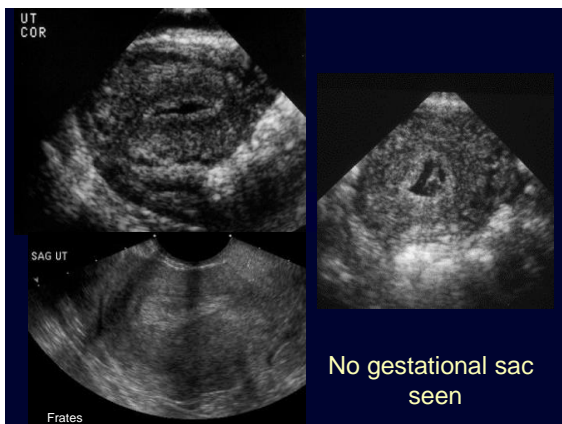
very early IUP
SAB / chemical
EP

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Uterus

- ➔ IUP
 - round, echogenic rim, contains YS, pole, FH
 - located within decidua
- ➔ Don't be misled by fluid in the endometrial cavity

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US of the endometrium

- ➔ Endometrial thickness can predict presence of IUP
- ➔ Is it any good?
- ➔ Moschos et al, 2008: no IUP had an endometrium <8 mm
- ➔ 4 EP's had endometrium >25mm

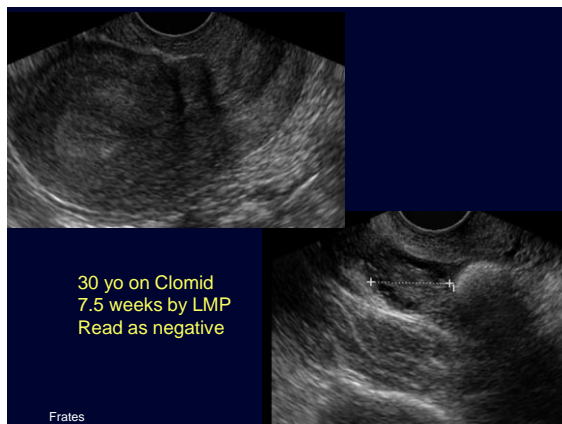
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US of the endometrium

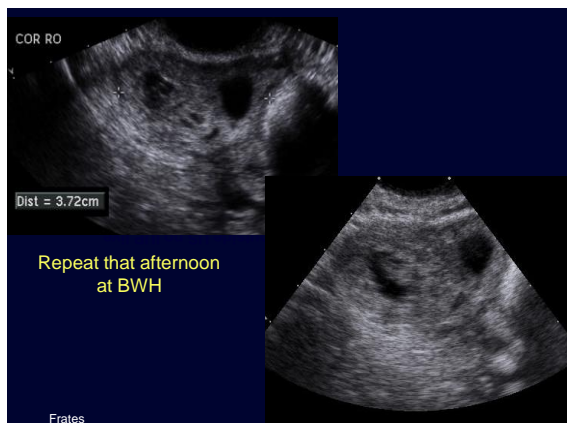
- ➔ Trilaminar pattern more frequent in ectopic pregnancy
- ➔ Is it any good?
- ➔ sens 21%; spec 93%; ppv 50%

Col-Madendag et al, Arch Gyn Obst: 2010

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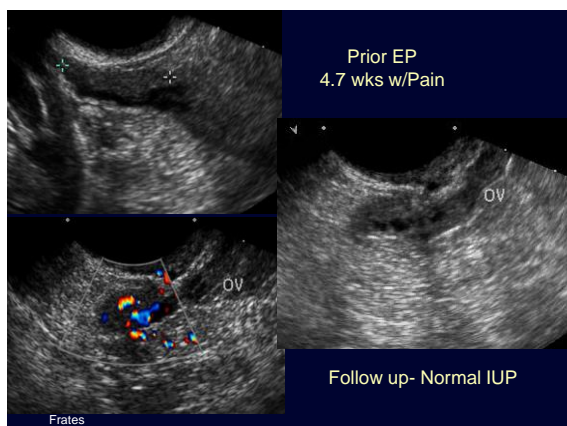


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Adnexa

- ➔ EP better diagnosed by *presence* of an adnexal mass rather than by *absence* of an IUP
- ➔ earlier identification of a mass allows earlier treatment

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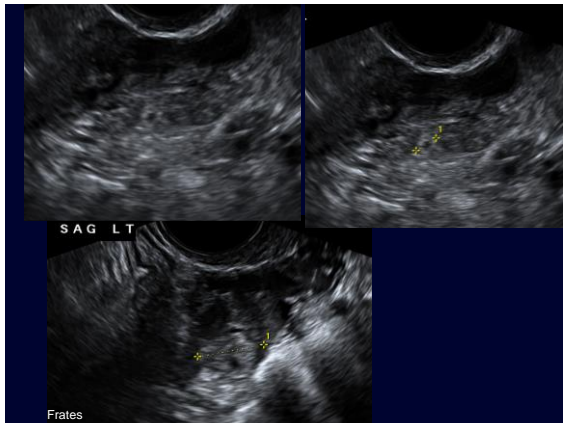
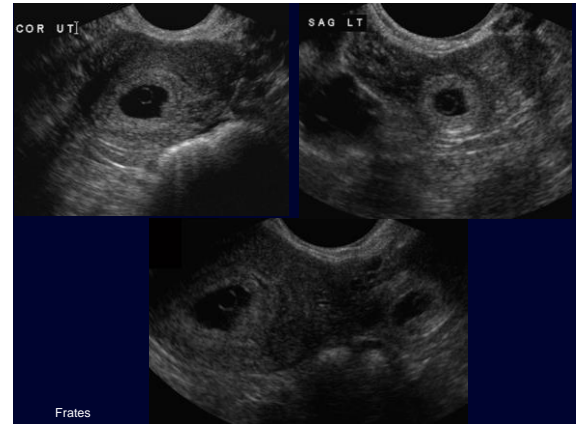
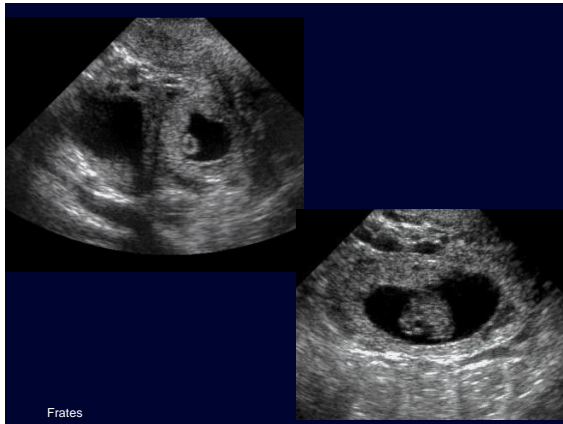
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Adnexa

- ➔ Tubal ring (Gestational sac)
 - echogenic ring, anechoic center
 - 25% of patients with EP**
 - ring + YS (8%)
 - ring + YS + cardiac activity (7%)

**Study of 231 EPs @BWH
Frates et al JUM 2014; 33:697

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Adnexa

- ➔ Complex mass
 - ➔ poorly defined borders
 - ➔ 55% EPs present with this**
 - ➔ careful search may reveal a central ring or YS
 - ➔ think hematosalpinx

**Study of 231 EPs @BWH
Frates et al JUM 2014; 33:697





Adnexa

- ➔ Meta-analysis of 10 studies
- ➔ Most appropriate criteria for making diagnosis of EP:
 - ANY noncystic extraovarian adnexal mass

Brown, Doubilet J Ultrasound Med 1994;13:259-266

Adnexa

Noncystic adnexal mass:

specificity	98.9%
sensitivity	84.4%
pos predictive value	96.3%
neg predictive value	94.8%

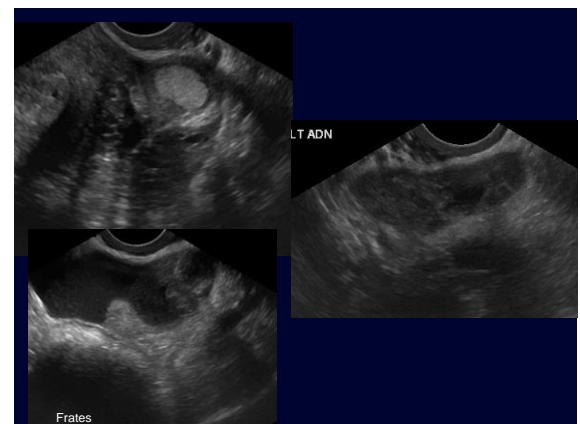
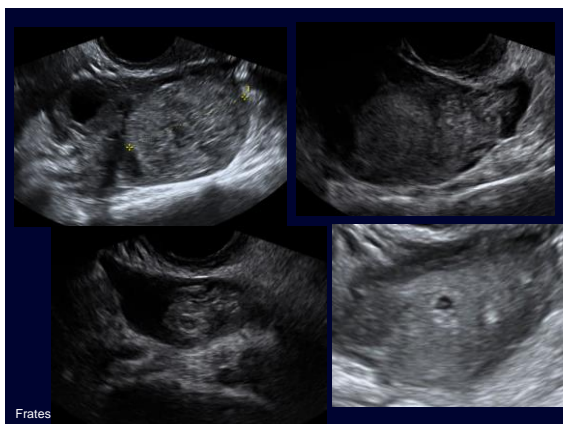
Brown, Doubilet J Ultrasound Med 1994;13:259-266

Adnexa

Noncystic nonovarian mass

specificity	99.9%
sensitivity	90.9%
pos predictive value	93.5%
neg predictive value	99.8%

Condous et al Human Reproduction 2005;1404-1409



Things to consider....

- ➔ Can the mass be separated from the ovary?
- ➔ What is the echotexture of the mass?

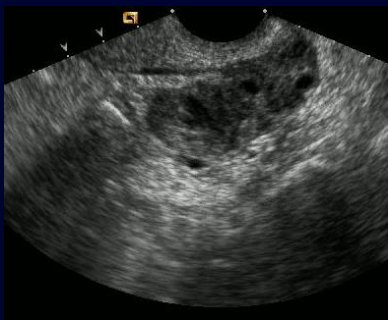
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Movement of Mass



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No Movement of Mass



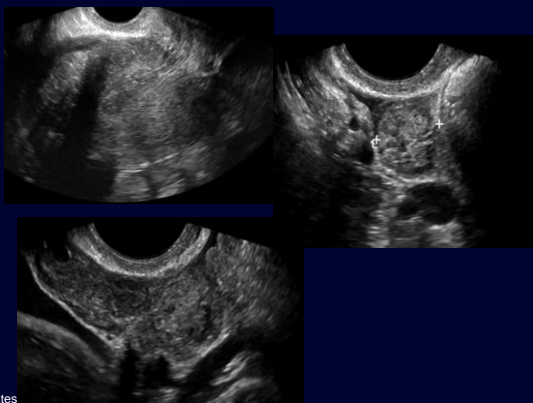
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Movement of Adnexal Mass

- ➔ 21/23 patients with EP showed movement of mass with palpation
- ➔ 6/49 patients without EP showed movement of mass with palpation
- ➔ NPV = 96.1%
- ➔ PPV = 77.8%

Blaivas et al JUM 2005; 24:599-603

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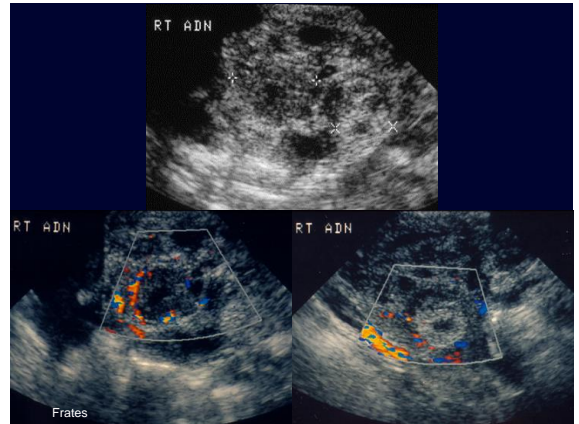


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Persistent pain, everything OK at OSH



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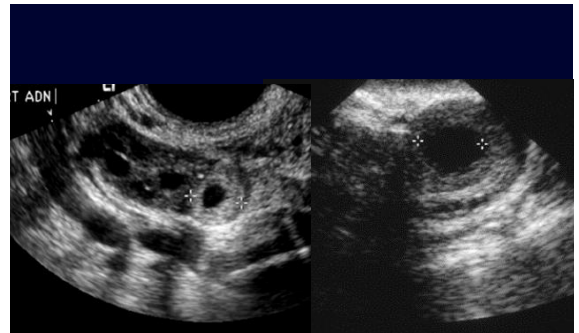
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Tubal Ring vs Corpus Luteum

- ➔ 26 patients with tubal ring (+ YS or FH)
 - ➔ 88% rings more echogenic than ovary
- ➔ 13 patients w/empty ring
 - ➔ 77% more echogenic than ovary
- ➔ 45 pts with IUP
 - ➔ corpus luteum more echogenic than ovary in only 3%

Frates, Visweswaran, Laing JUM 2001; 20:27-31

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Relative echogenicity of an adnexal ring is a useful differentiating characteristic between TR and CL (when can't localize confidently)

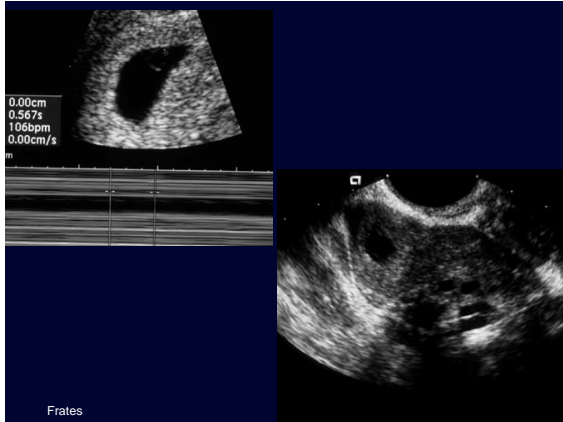
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Tubal Ring vs Corpus Luteum

- ➔ Comparison of EP and CL to endometrial echogenicity
- ➔ wall more echogenic than endometrium: EP 32%; CL none
- ➔ wall less echogenic than endometrium: EP 31%; CL 84%

Stein et al JUM 2004; 23:57-62

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Use both location *and* echogenicity

Tubal Ring vs Corpus Luteum

- ➔ Doppler characteristics can distinguish between EP and CL
- ➔ EP RI = 0.15 to 1.6
- ➔ CL RI = 0.39-0.7
- ➔ RI of $>.7$ was 100% specific and PPV of 100%, but only present in 31% of EPs

Atri JUM 2003; 22:1181-1184

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Free Fluid: is it reliable?

- ➔ anechoic vs echogenic
 - ➔ echogenic fluid correlates with hemoperitoneum
 - ➔ suggests high risk for EP

Nyberg et al Radiology 1991

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Echogenic Fluid

- ➔ 185 pts to OR for EP
- ➔ 125 pts echogenic fluid- 98%+ blood
- ➔ 30 anechoic fluid- 0% blood
- ➔ 30 no fluid- 0% blood
- ➔ Echogenic fluid correlates with hemoperitoneum
 - ➔ Sens 100%, Spec 95%, PPV 98%

Sickler et al, JUM 1998 17:431-435

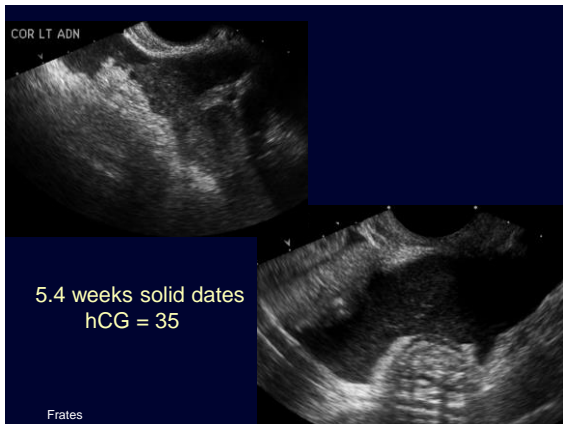
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Free Fluid: is it reliable?

- ➔ 38/523 PUL patients with isolated free fluid
- ➔ 42% of 38 had EP
 - ➔ 22% of those with moderate fluid
 - ➔ 73% of those with large fluid
- ➔ pts with isolated CDS fluid are at moderate risk for EP; risk increases if echogenic or large

Dart et al; Am J Emerg Med 2002; 20:1-4

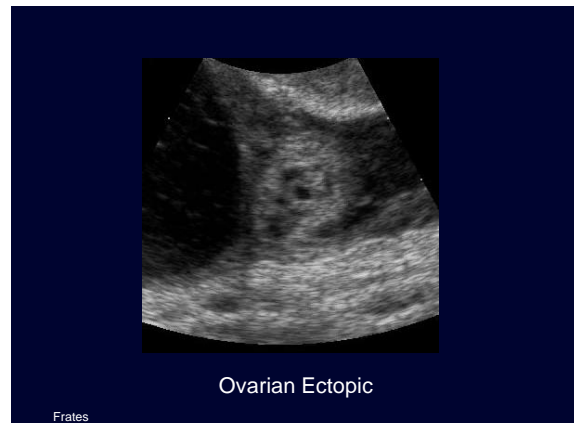
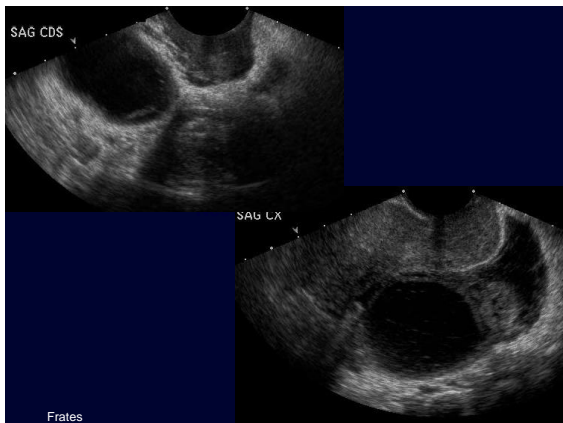
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Negative Exam

- ➔ EP not seen: very early GA, high BMI, fibroids, inexperience, ovarian pathology
- ➔ 5% in the BWH series
- ➔ Stable patient: followup hCG and US
- ➔ Unstable patient: to the OR

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Ovarian Ectopic

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Diagnosis of Tubal Rupture

➔ Why?

- ➔ Increasing trend toward medical management
- ➔ Nonsurgical management requires intact tube
- ➔ So, can TVS characterize tubal status?

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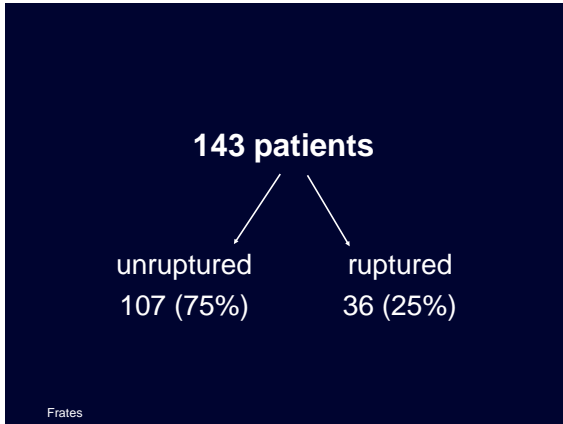
Diagnosis of Tubal Rupture

➔ Retrospective Study

- ➔ Ectopic pregnancy proven at surgery
- ➔ TVS within 24 hours before surgery

Frates et al JUM 2014; 33:697

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Adnexal Mass vs. Rupture: NS				Rupture Rate
Mass with cardiac activity	17	3	14	17.6%
Mass with yolk sac	14	3	11	21.4%
Mass with tubal ring	23	5	18	21.7%
Nonspecific mass	81	23	58	28.4%
No adnexal mass	8	2	6	25.0%

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Diagnosis of Tubal Rupture

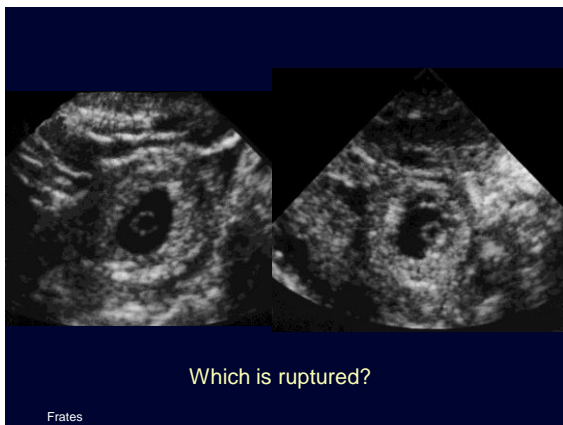
- Rate of rupture significantly higher when fluid was mod/large (33%) compared to small-none (17%) $p < 0.05$
- But: mod/large fluid had poor sensitivity (67%) and PPV (33%)

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hCG Levels vs Tubal Rupture

- 139 patients
- No cut-off level predicted rupture
- Approximately 10% of patients with hCG < 500 had tubal rupture

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Diagnosis of Tubal Rupture

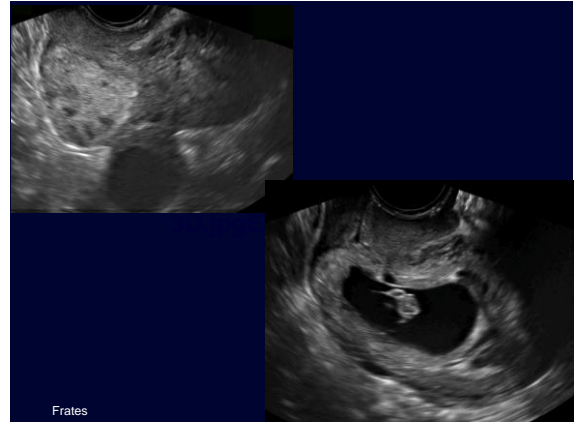
- Rupture is possible when no mass is seen, or when little or no free fluid is found
- No single appearance (including a tubal ring) excludes rupture
- No hCG level excludes rupture

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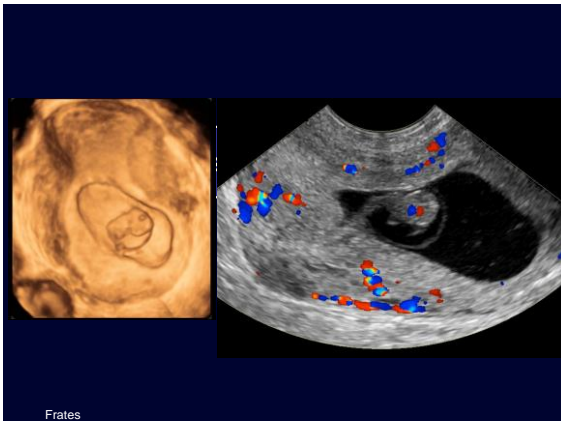
Last but not least

- ➔ 3D imaging can help localize unusual ectopics
- ➔ Cornual vs tubal vs normal
- ➔ Cervical
- ➔ C section implantation

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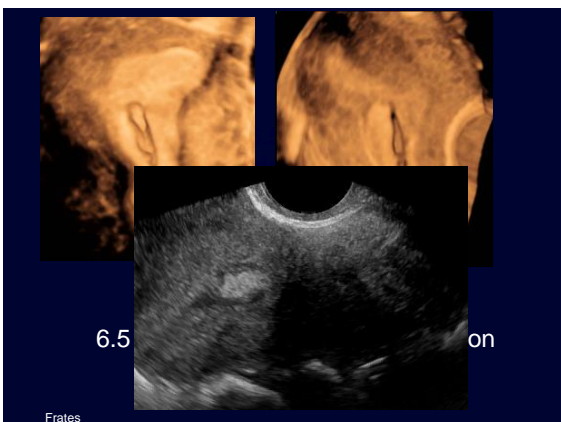


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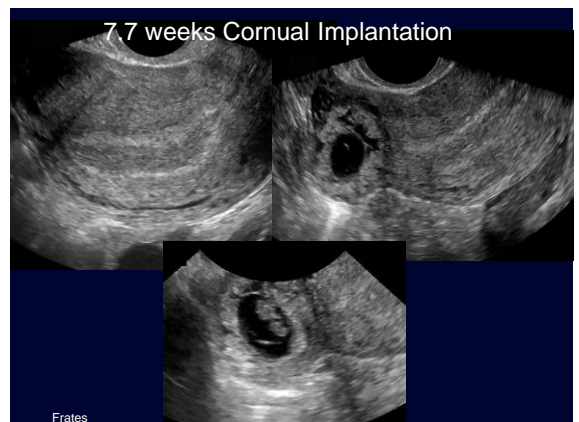
5.5 weeks ? C –section implantation



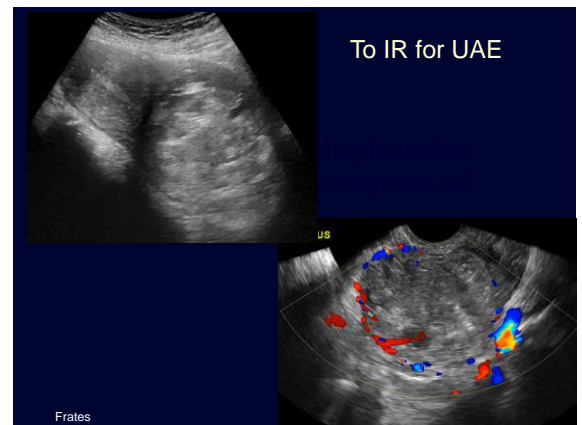
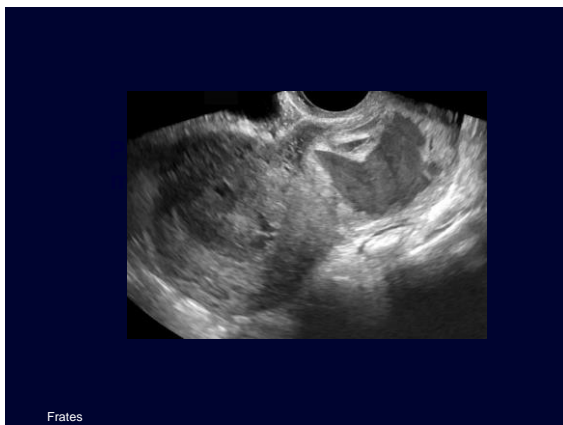
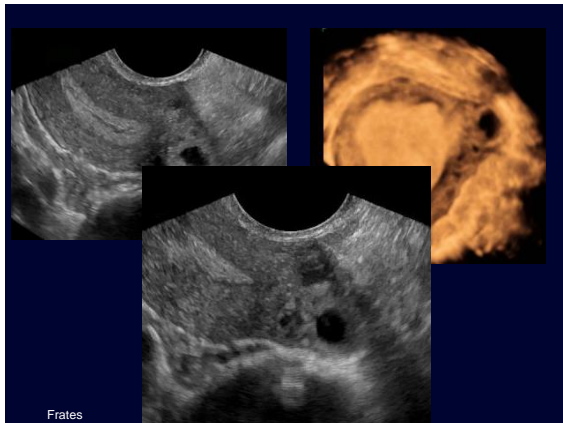
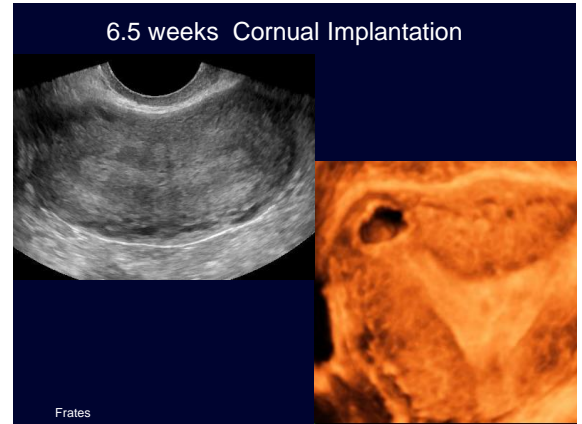
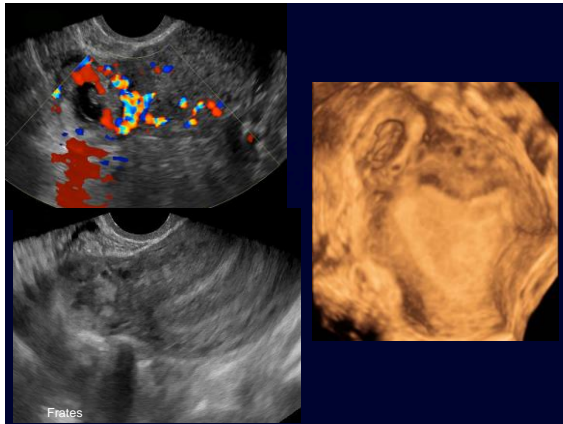
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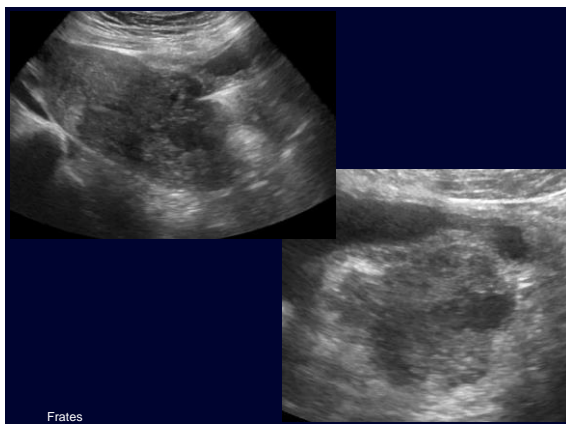


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Conclusions

Transvaginal sonography continues to be the optimal method for the evaluation of ectopic pregnancy. Early dx allows less invasive treatment options.

- Close evaluation of endometrium
- Close evaluation of adnexa
- Palpation, 3D

Follow up is best for stable patient with PUL

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Key References

*Frates MC, Doubilet PM, Peters HE, Benson CB. Adnexal sonographic findings in ectopic pregnancy and their correlation with tubal rupture and hCG levels. J Ultrasound Med 2014; 33:697-703.

*Brown DL, Doubilet PM. Transvaginal sonography for diagnosing ectopic pregnancy: positivity criteria and performance characteristics. J Ultrasound Med 1994;13:259-266.

*Blaivas M, Lyon M. Reliability of adnexal mass mobility in distinguishing possible ectopic pregnancy from corpus luteum cysts. J Ultrasound Med. 2005;24:599-603.

*Frates MC, Visweswaran A, Laing FC. Comparison of tubal ring and corpus luteum echogenicities: a useful differentiating characteristic. J Ultrasound Med 2001; 20:27-31.

Frates