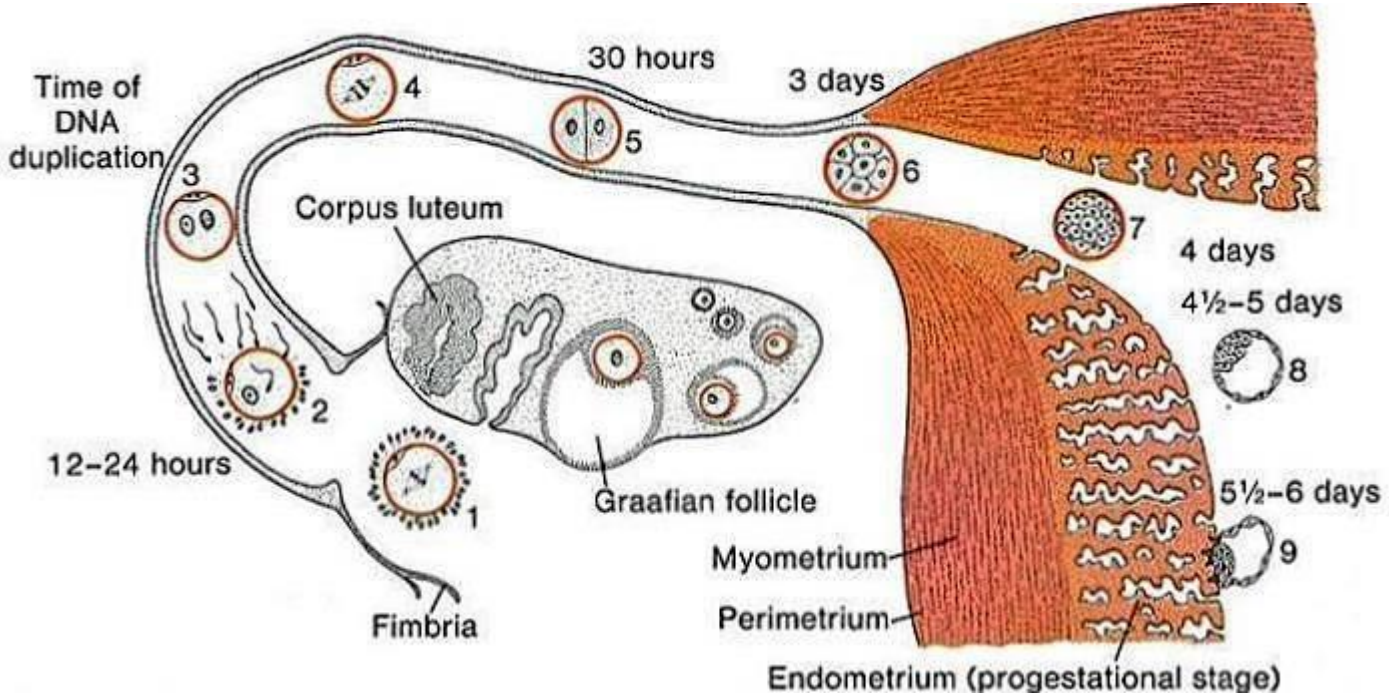
ISUOG Basic Training

Assessing normal and abnormal pregnancy from 4-10 weeks

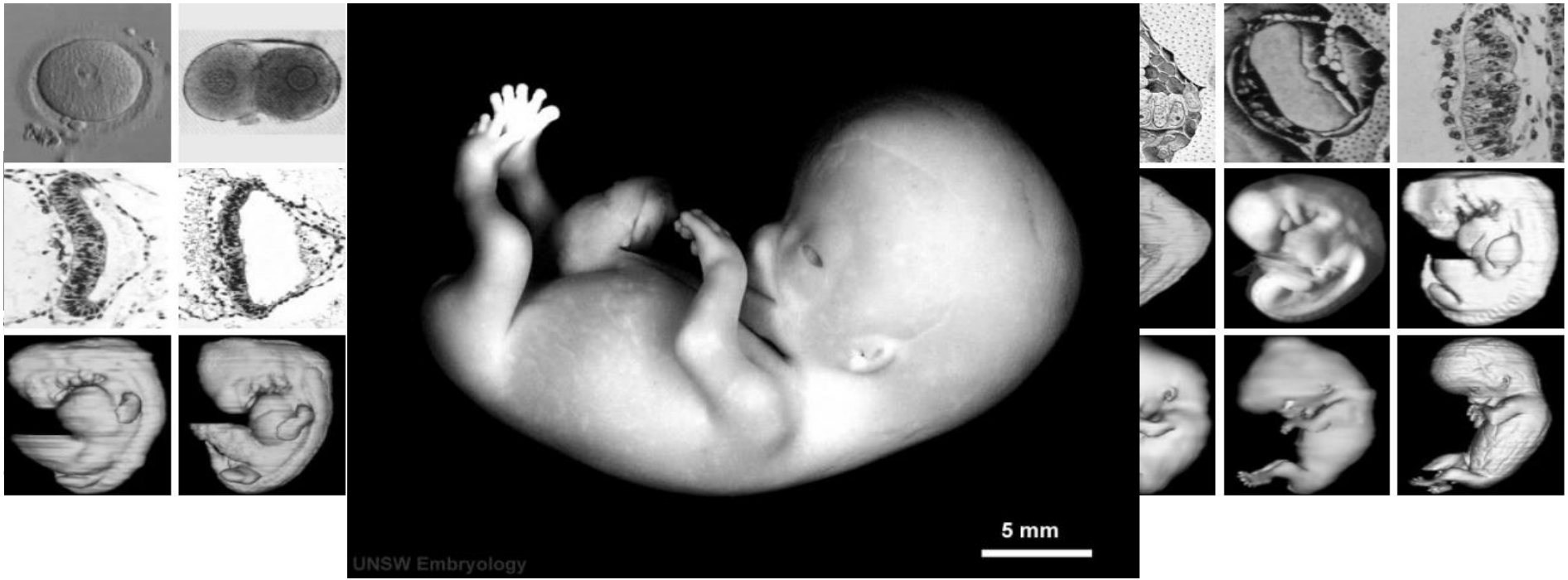
Goals 4-10 week assessment by US

- Normal appearance gestational sac (GS), yolk sac (YS) and embryo
- Assessment of mean sac diameter (MSD) and CRL
- Viability criteria and terminology in non-viable pregnancy
- Recognition of ectopics, principles of pregnancy of unknown location (PUL)
- Role hCG and management of PUL
- Molar pregnancy

Conception and implantation

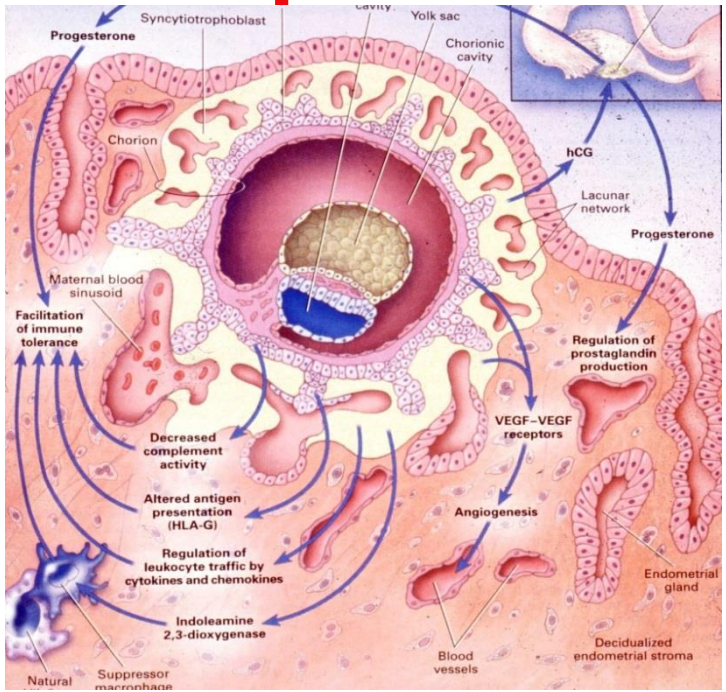


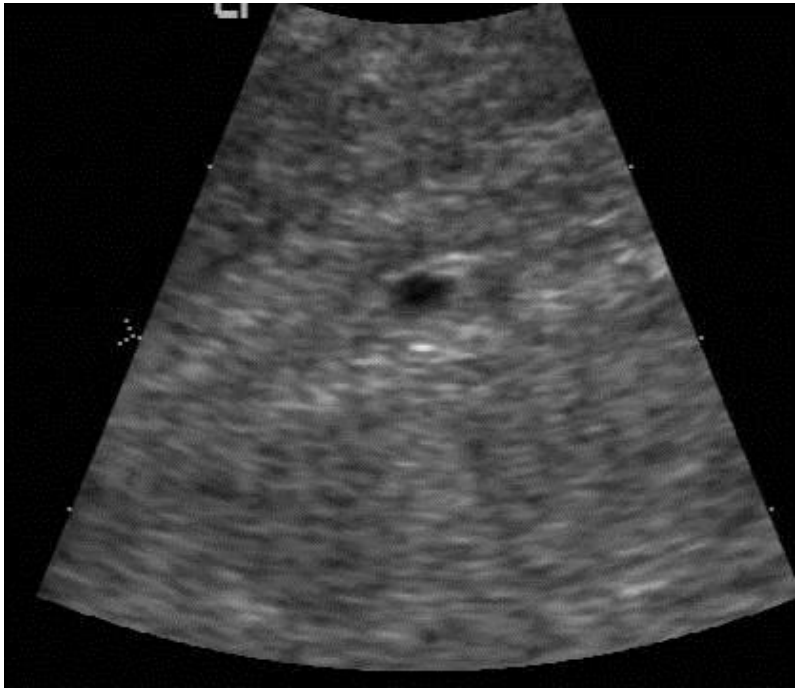
Embryo from 0-8 weeks



Source: The Virtual Human Embryo Project

Implantation-> gestational sac





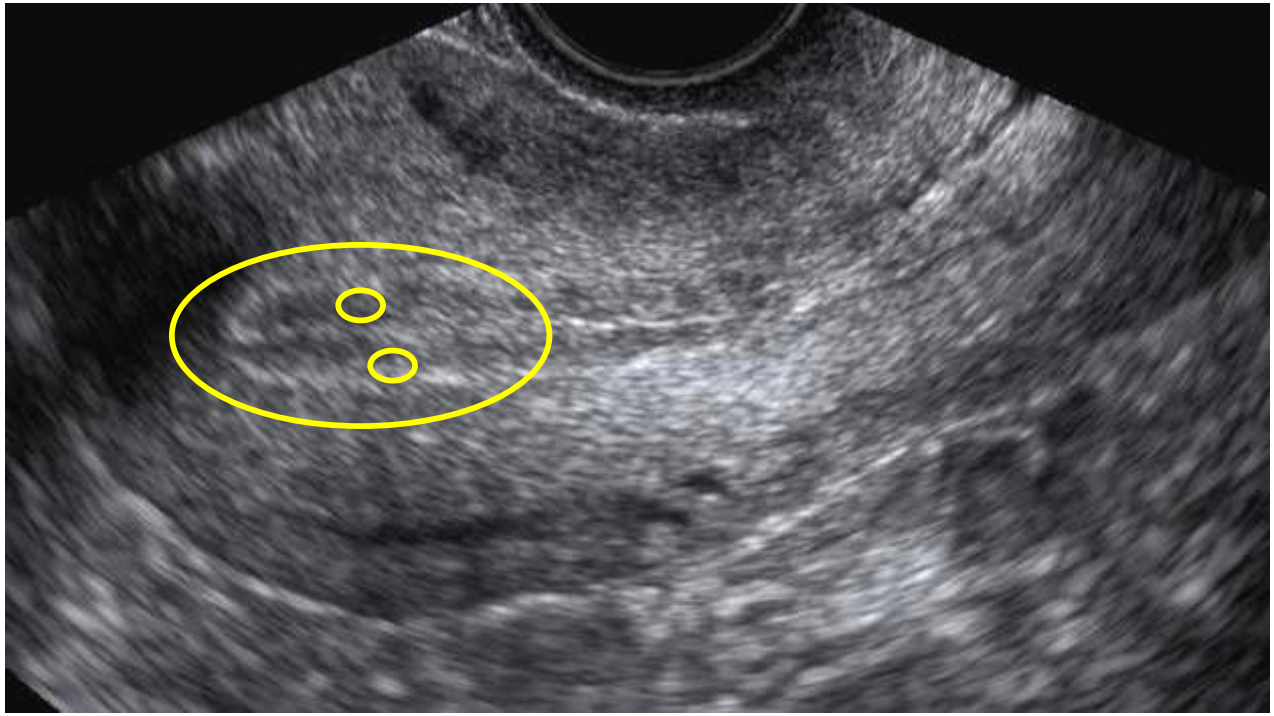
1st evidence pregnancy on ultrasound; completely embedded blastocyst 14 days post conception

NEJM 2001;345/1400

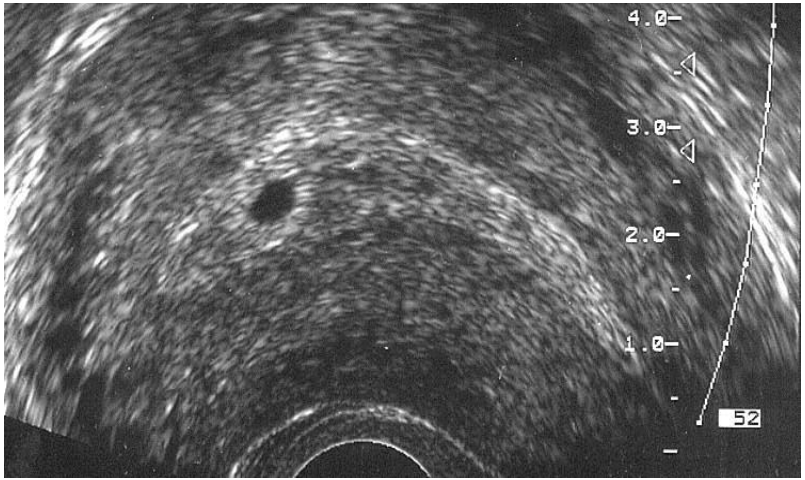
Gestational sac

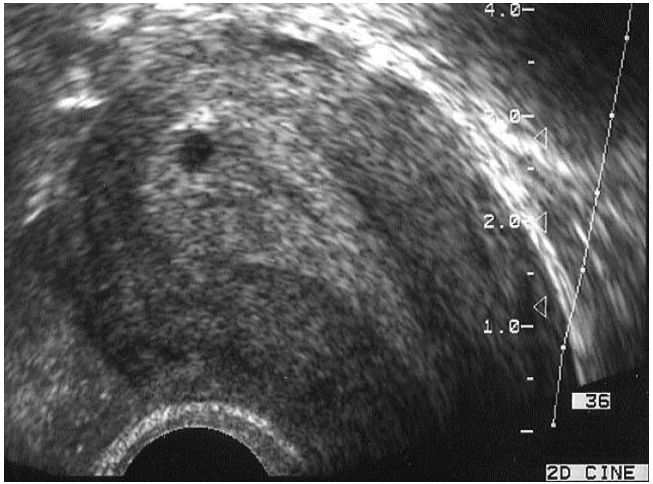
- Small, round fluid collection inside uterine cavity
- Normally positioned in mid-to upper uterine cavity
- Surrounded by
- Visible at approximately 4 weeks gestation
- Beware of difference in gestational age and embryo age

Location of gestational sac within upper half of uterus



4^0 weeks - 2 mm





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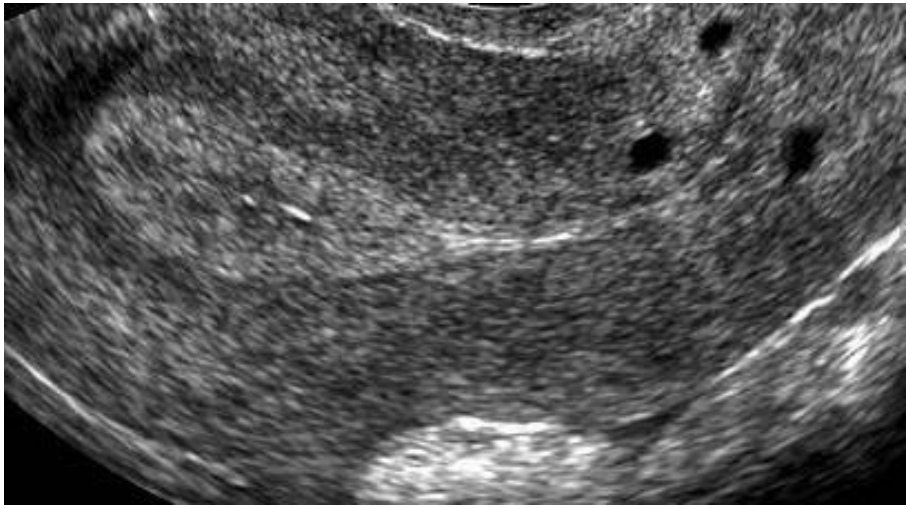
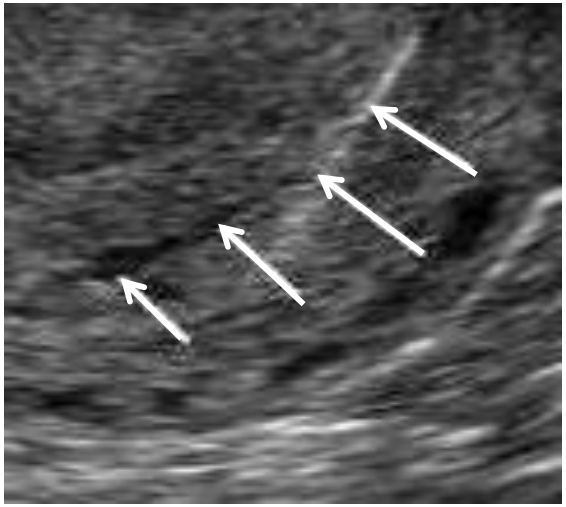
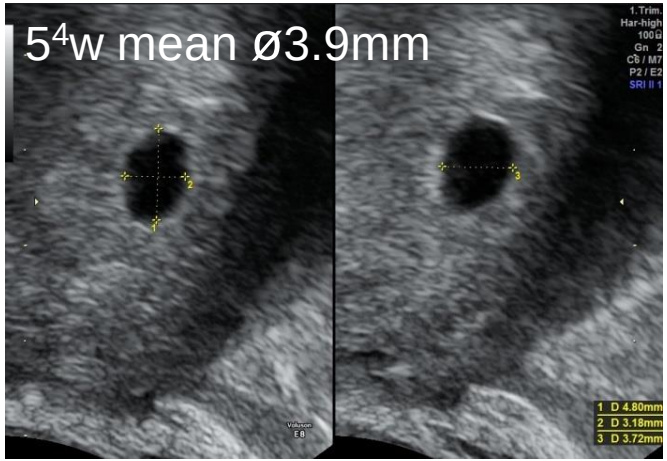
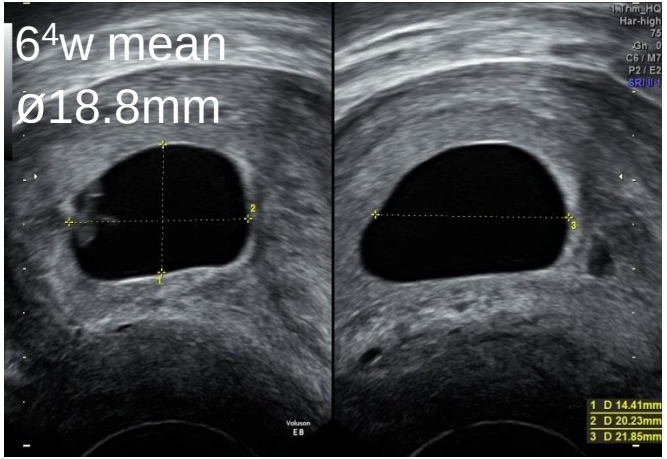
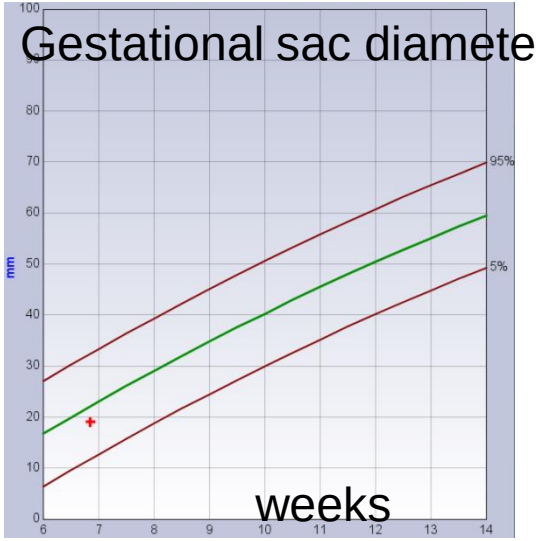




Gestational sac measurement





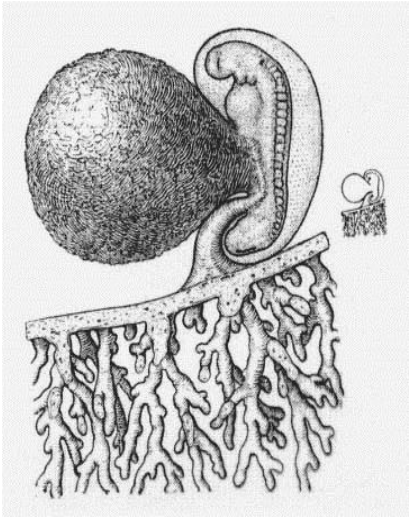


Mean of 3 orthogonal planes
Growth in early pregnancy 1mm/day

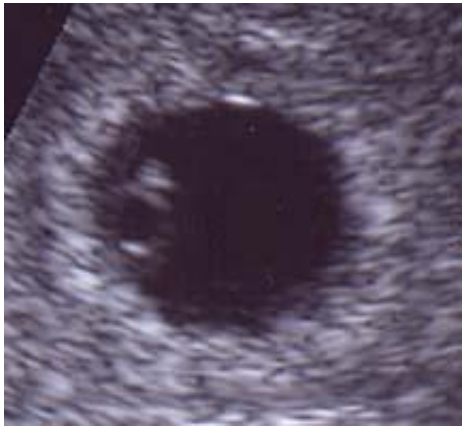
Knez et al Best practice Reseach Clin O & G 2014;28:621-36

Yolk sac

- First structure identified within gestational sac
- Confirms intra uterine pregnancy, 100% PPV
- Spherical in shape
- Echogenic periphery
- Sonolucent center
- Attaches to embryo by vitelline duct

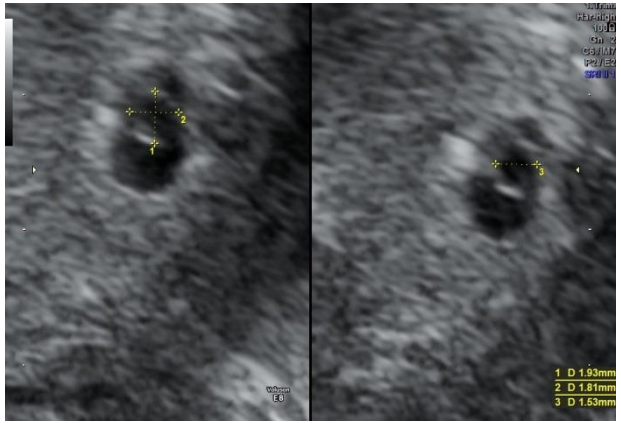


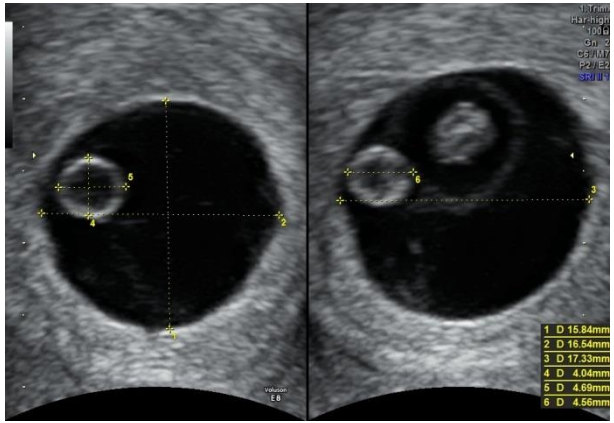
Yolk sac

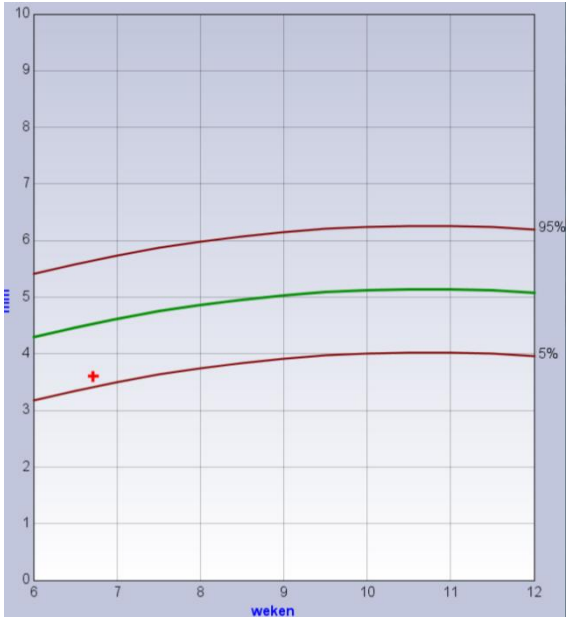


- Imaged ~ 5 - 5.5 w
- Imaged when MSD ~ 5-6 mm
- Imaged 3-5 d prior to embryo
- Diameter peaks at 6 mm at 10 w, then decreases
- Usually not visible after first trimester
- Number of yolk sacs usually equals number of amnions

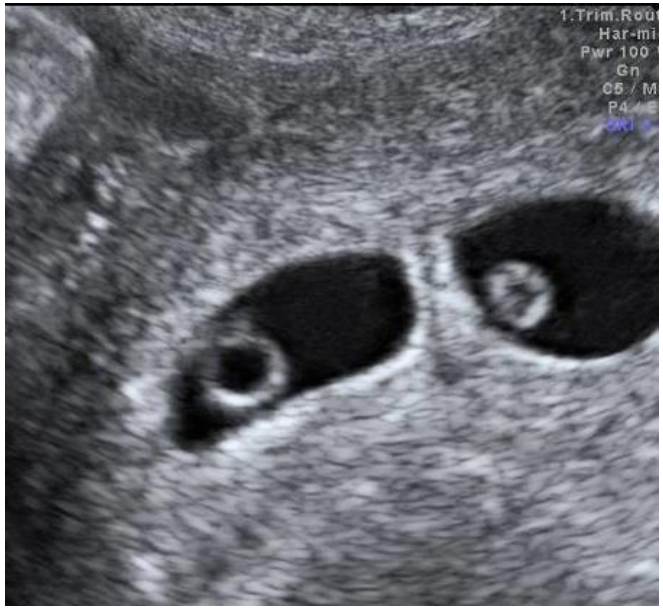
Yolk sac 5^0 and 7^4 weeks



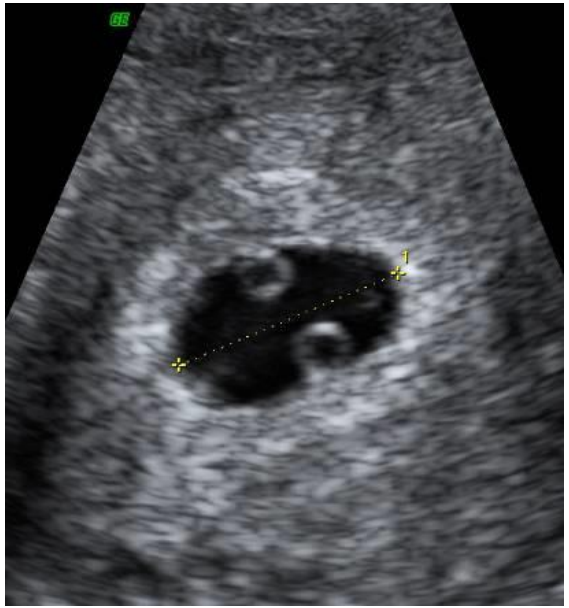




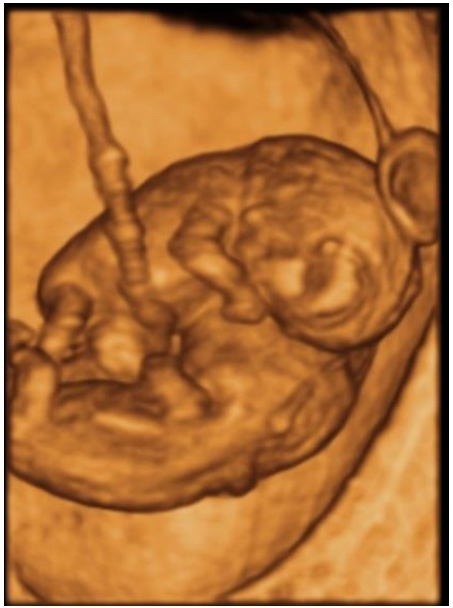
Yolk sac in multiple pregnancy



Dichorionic diamniotic monoamniotic



Monochorionic diamniotic

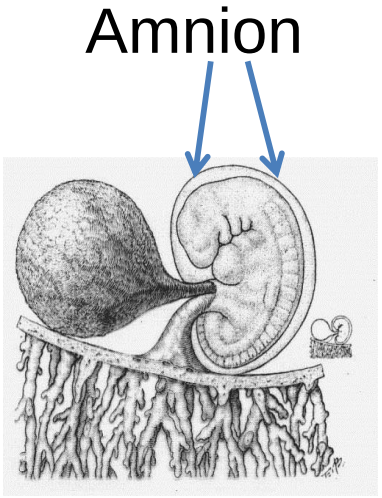


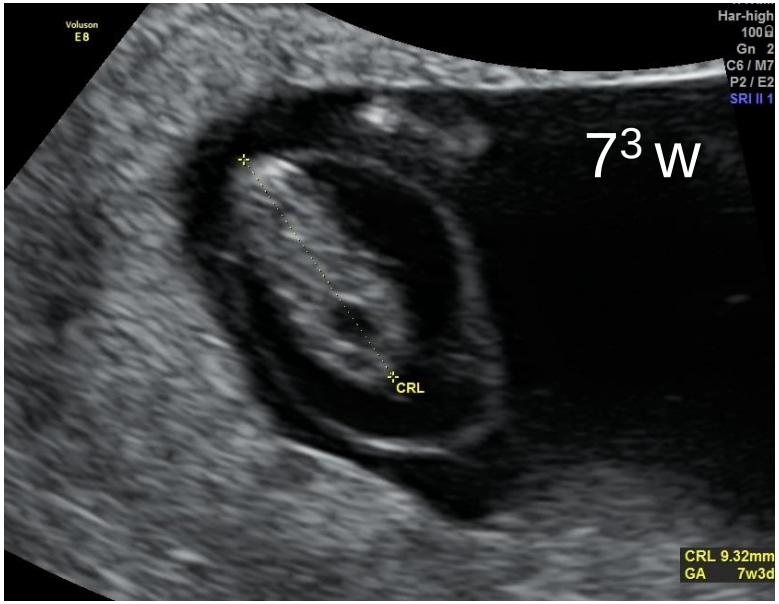
Monochorionic

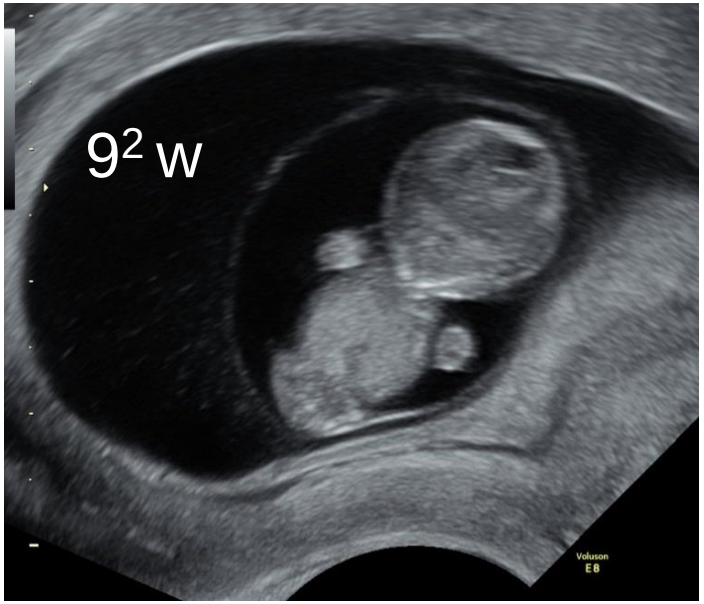
Amnion

- First seen ~ 5.5 w – small membraneous structure continuous with the embryo
- Contains clear fluid
- Separates the embryo and amniotic space from the extraembryonic coelom
- Obliterates the coelomic cavity by 12-16 weeks

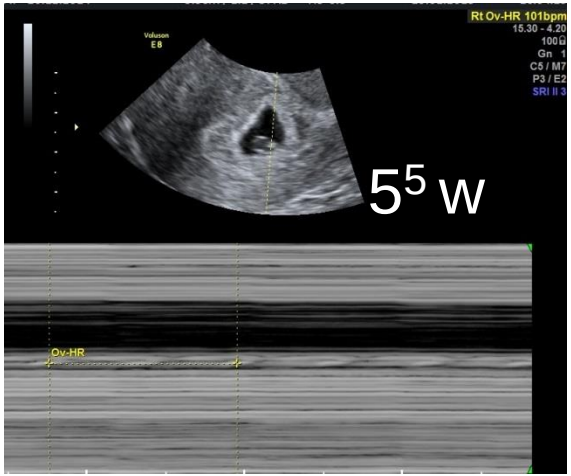
Amnion

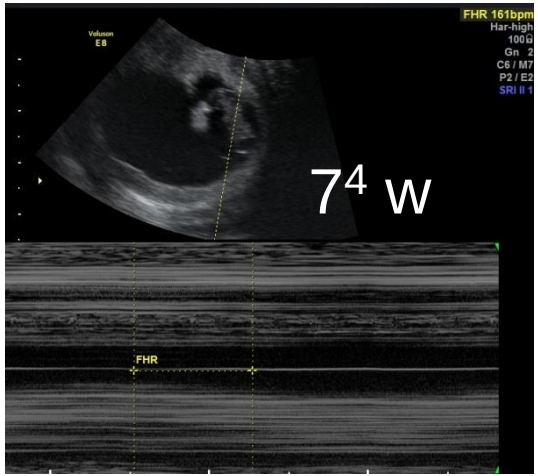

Amnion

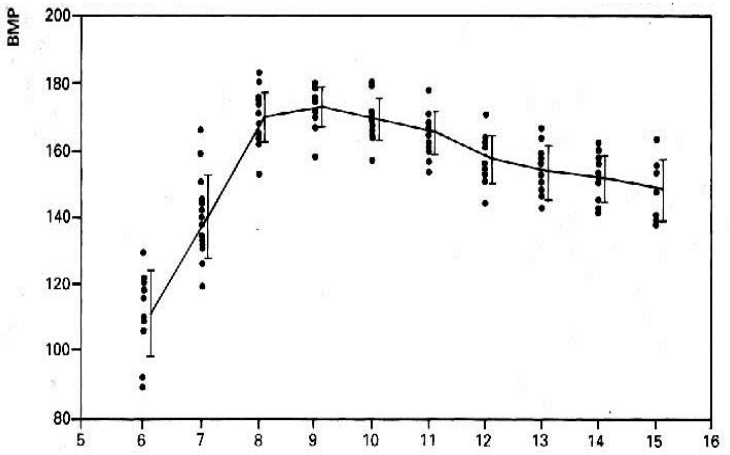

Voluson
E8
Har-high
100
Gn 2
C6 / M7
P2 / E2
SRI II 1
7³ w
CRL
CRL 9.32mm
GA 7w3d


9² w
Voluson
E8

Heartbeat use M-mode







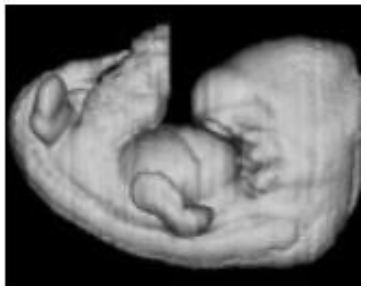
Heartbeat visible form CRL > 2-4 mm

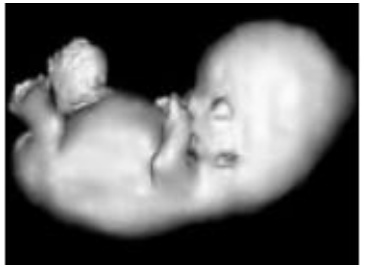
Rapid frequency 5-9 weeks

Use M-mode ↑

Crown Rump Length (CRL)

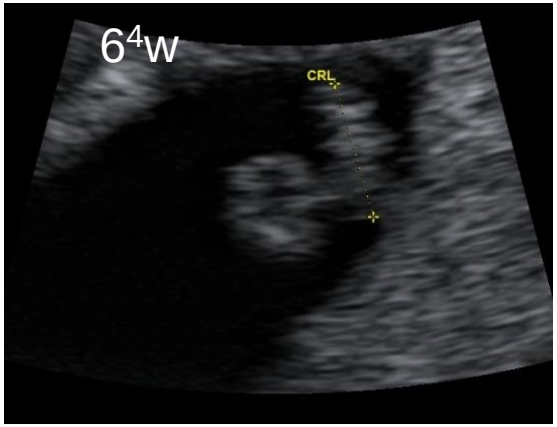
- ISUOG guideline
- Midline sagittal section of whole fetus
- Ideal orientation horizontally
- Magnification fill most of width of screen
- Fetus in neutral position
- Amniotic fluid between chin and chest
- Endpoints clearly defined

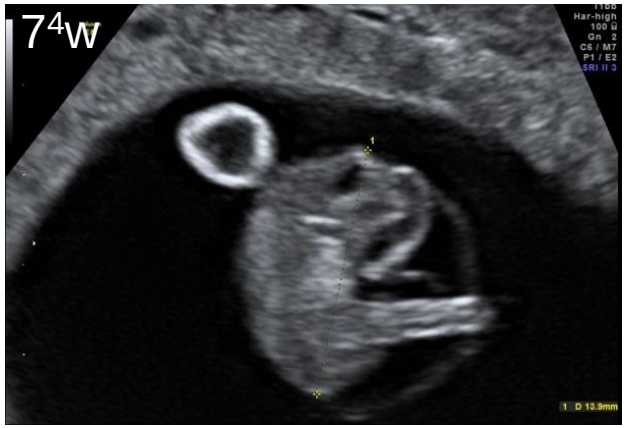


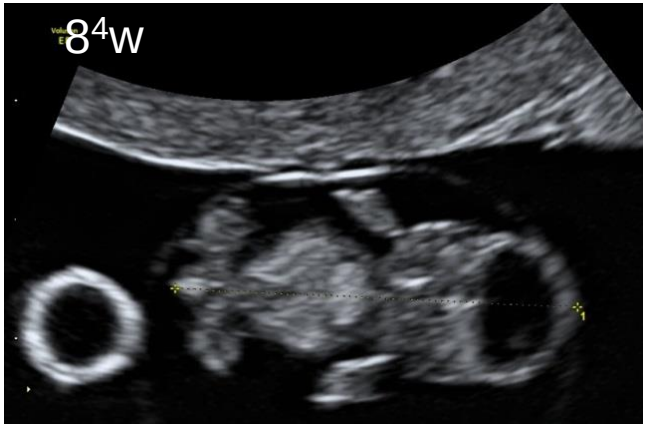


ISUOG guideline 1st trim us scan UOG 2013;41:102-113

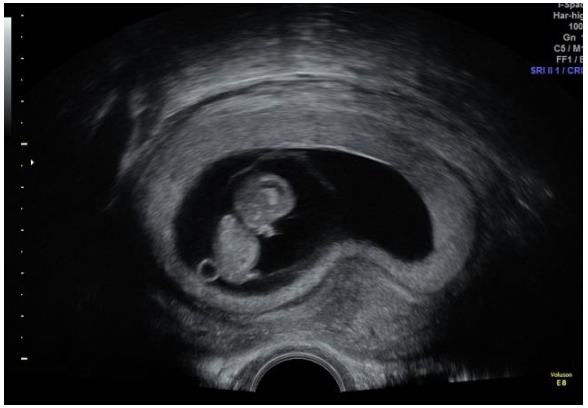
Embryo 6-8 weeks

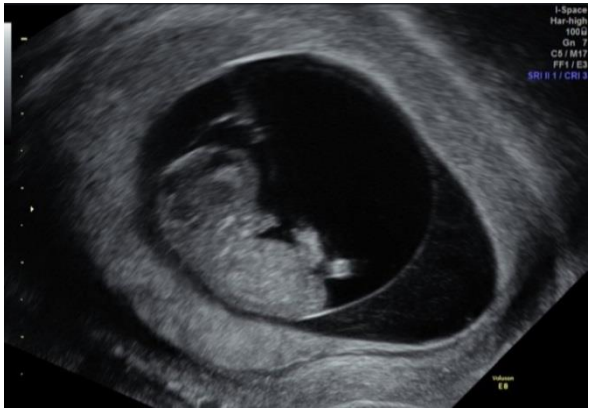


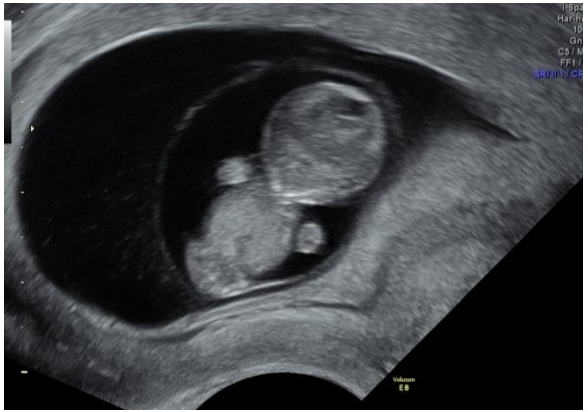


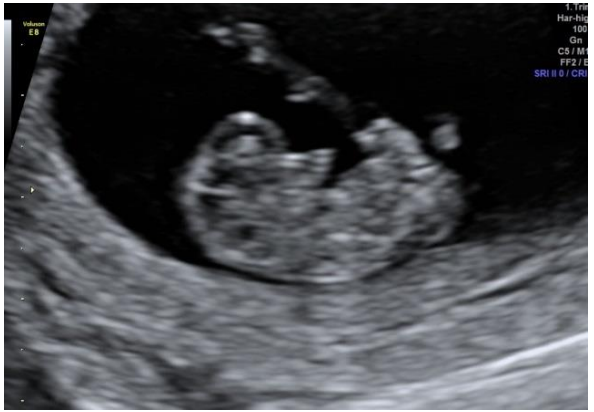


9^4 weeks

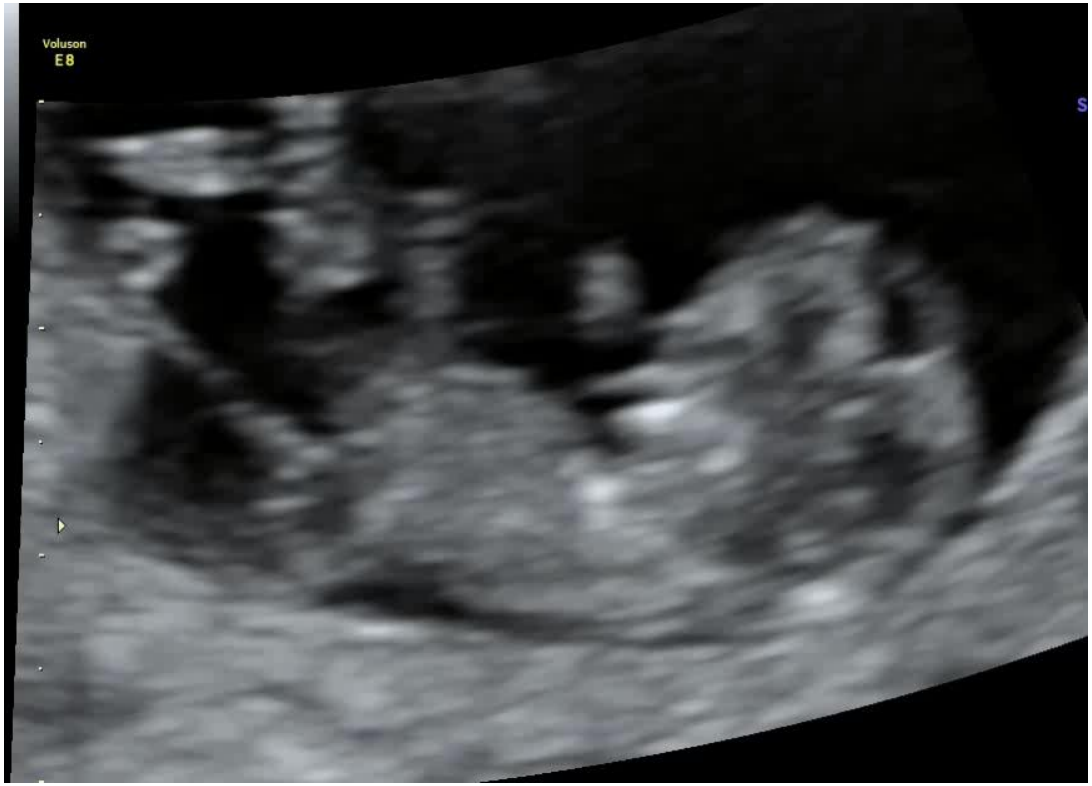








10 weeks



Practical rules early pregnancy

	Transvaginal ultrasound		Abdominal ultrasound	
	Gestational age	Measurement	Gestational age	Measurement
GS	4^0	2 mm	5^0	10 mm
YS	5^0	2 mm	6^0	3 mm
Heartbeat	5^4	70 bpm	6^4	110 bpm
CRL	5^3	3 mm	6^3	6 mm
Movement	7^0		7^0	

CRL in cm + 6,5 = GA in weeks

Pain & blood loss in early pregnancy

Event	Frequency
Pain & vaginal bleeding	1:5 pregnant women
Blood loss	50% continue into normal pregnancy
50 % remaining blood loss	Non viable, of which 10—15% ectopic pregnancy

Pain in early pregnancy late symptom!!

Obstetric cause:
Miscarriage, ectopic, haemorrhage ruptured corpus luteum cyst, ovarian torsion
Non-obstetric cause:
Cystitis, appendicitis, ureteric stones, constipation

Knez et al Best Practice Res Clin O & G 2014;28:621-636

Terminology early pregnancy events 1

Terminology	Comment
Viable	Results in liveborn baby
Nonviable	Cannot result in liveborn baby (failed intrauterine pregnancy, ectopic pregnancy)
Intrauterine pregnancy uncertain viability	TV ultrasound - intrauterine GS, no heartbeat
Empty sac	GS: absent structures, minimal debris, no heartbeat
Human chorionic gonadotropin	Positive serum pregnancy test serum hCG > 5 IU/mL

Doubilet et al NEJM 2013;369:1443-51

Terminolgy early pregnancy events 2

Terminology	Ultrasound findings
Fetal loss	Previous CRL and heartbeat followed by loss of heartbeat
Delayed miscarriage/early pregnancy loss	US intrauterine pregnancy: reproducible loss heart activity, failure increase CRL over 1 w or persisting empty sac at < 12 w
Ectopic pregnancy	+ blood/urine hCG, gestational sac outside uterus
Heterotopic pregnancy	Intrauterine + ectopic pregnancy
Pregnancy of unknown location (PUL)	No identifiable pregnancy on US with + blood/urine hCG

Farquharson et al Human Reproduction 2005;20:3008-3011

Guideline TV US intrauterine pregnancy failure and uncertain viability

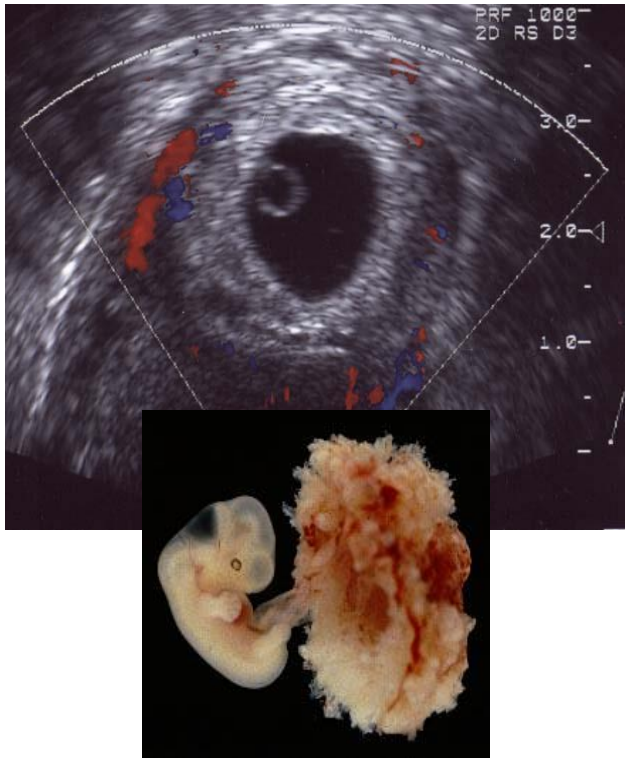
Diagnostic for pregnancy failure	**Suspicious** / not diagnostic pregnancy failure
CRL ≥ 7 mm no heartbeat	CRL < 7mm no heartbeat
Mean GS Ø 25 mm no embryo	Mean GS Ø 16-24 mm no embryo
Absence embryo with heartbeat ≥ 2 wk after scan GS without YS	Absence embryo with heartbeat ≥ 7-13days after scan GS without YS
Absence embryo with heartbeat ≥ 11 days after scan GS with YS	Absence embryo with heartbeat 7-10 days after scan GS with YS
	Absence embryo ≥ 6 wks after LMP
	Empty amnion adjacent to YS no embryo
	Enlarged YS > 7mm
	Small GS in relation to size of embryo (< 5 mm difference between mean GS Ø and CRL

If viability in doubt rescan after 1 week

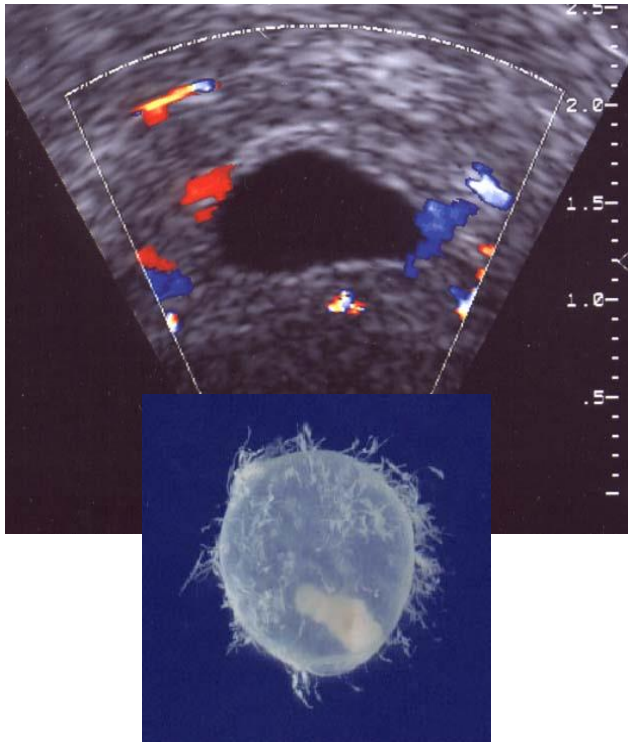
Doubilet et al NEJM 2013;369:1443-51

Early pregnancy: Vitality

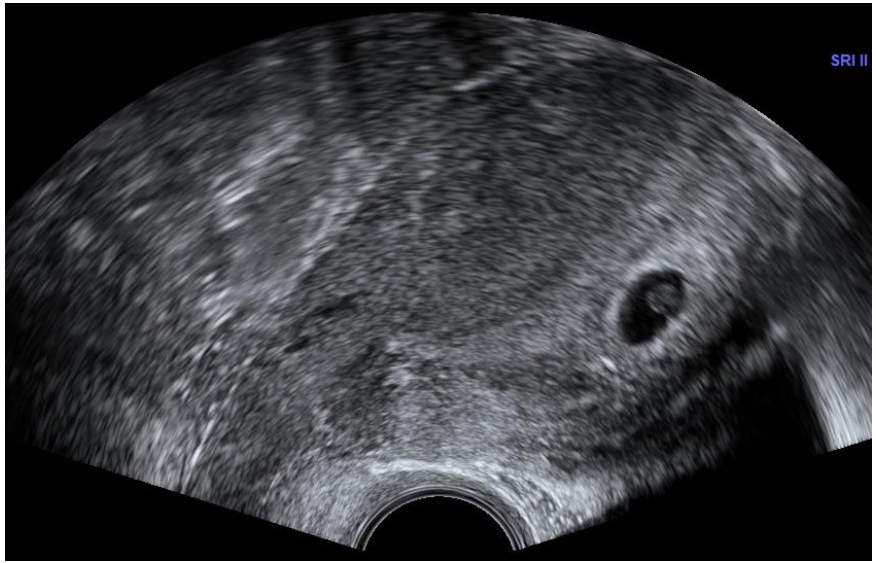
Normal

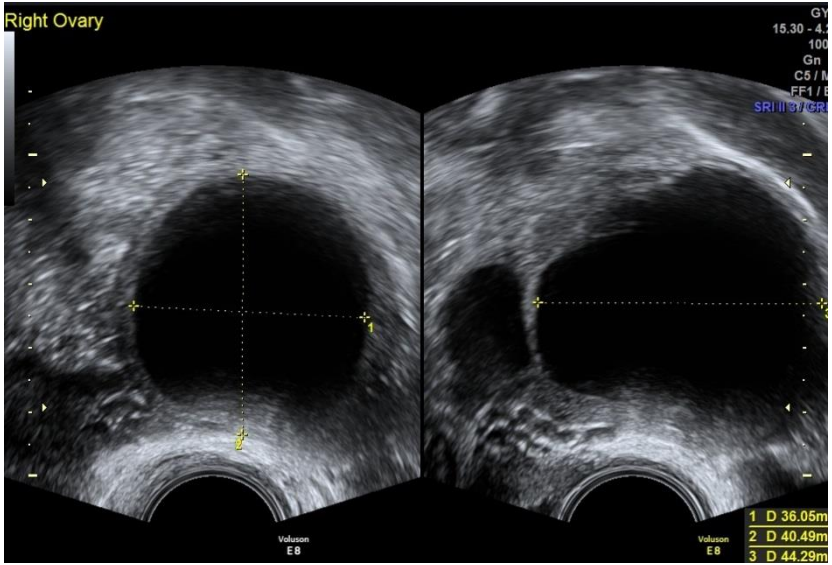


Abnormal



Uncertain viability 6^2 weeks

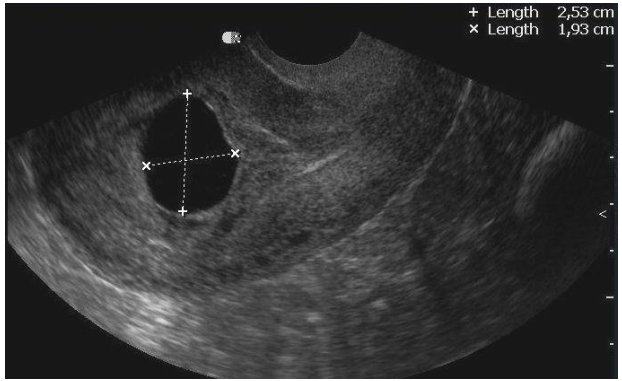


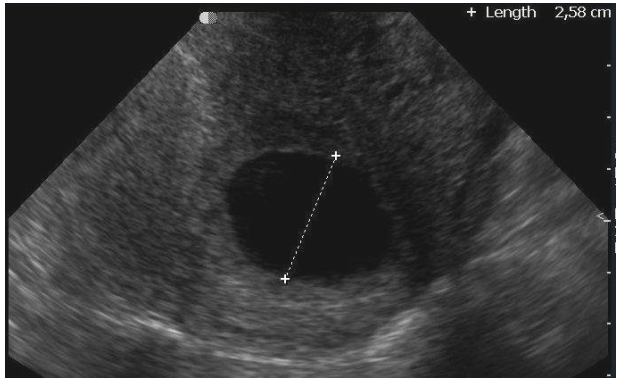


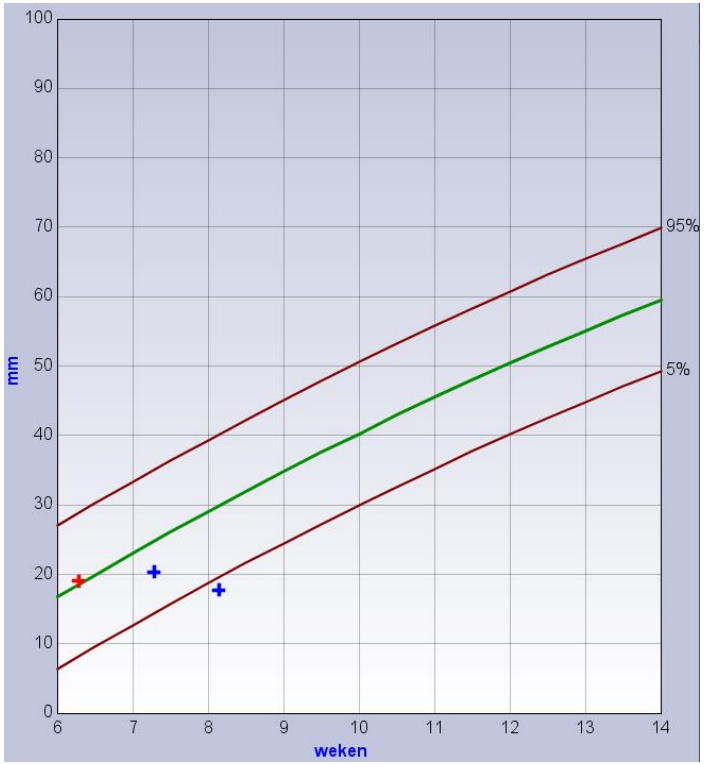
GS and YS, no heartbeat

Repeat scan 1 week

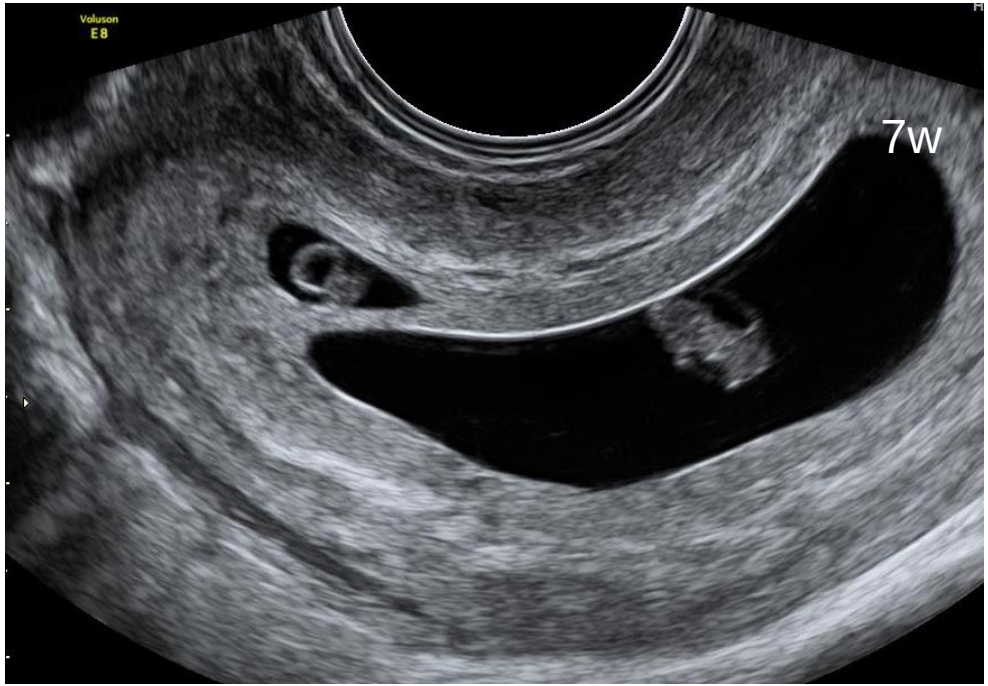
Gestational sac: failing pregnancy

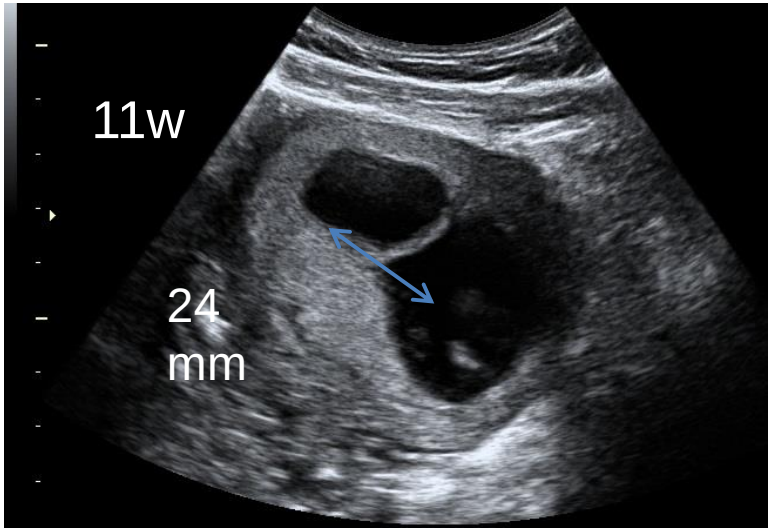






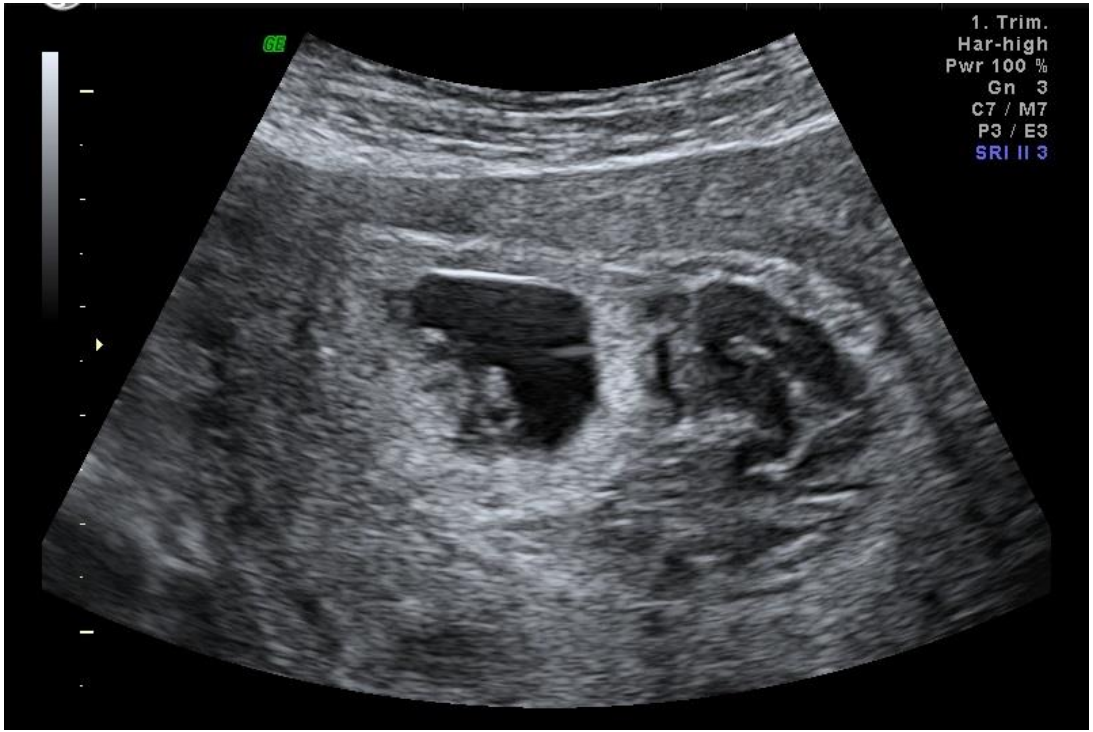
Twin pregnancy with vanishing twin



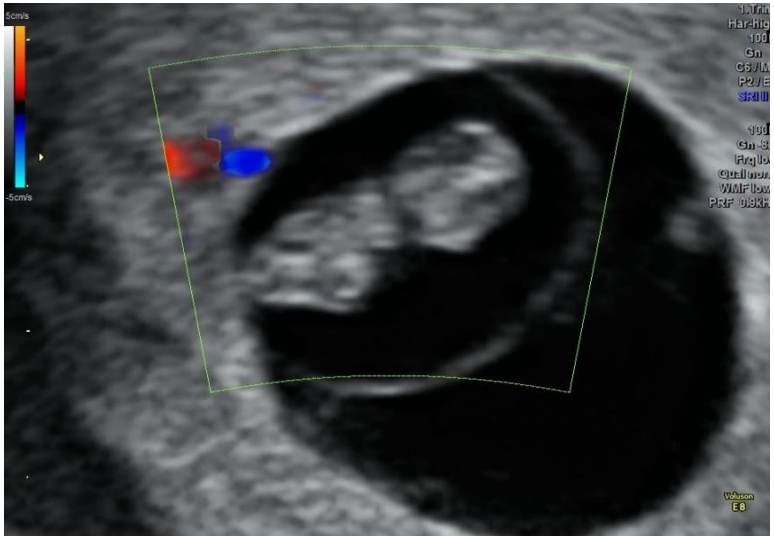


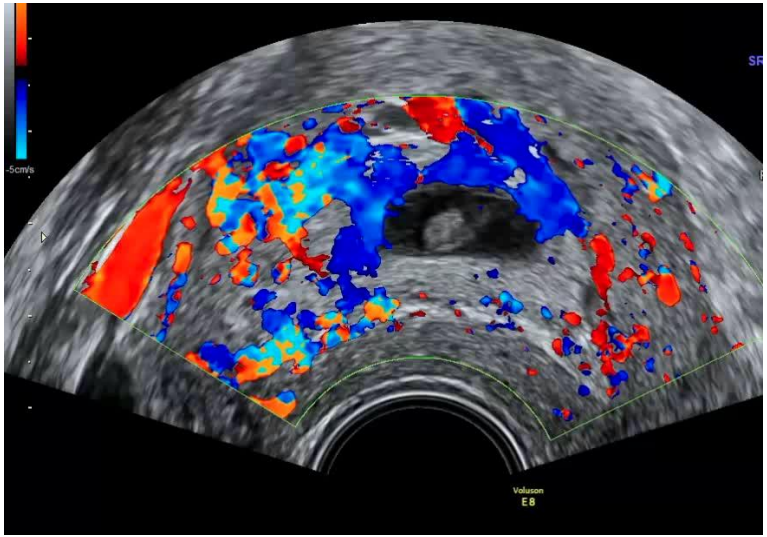
Evron et al Fertil Steril 2015;103:1209-14

Haematoma



Miscarriage





8 weeks no heartbeat

Ectopic pregnancy

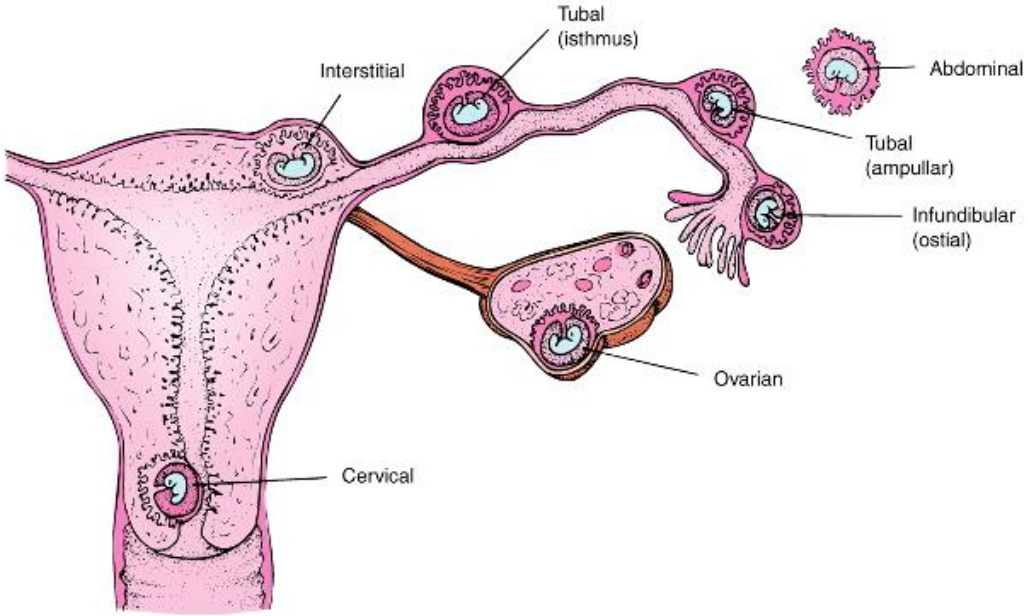
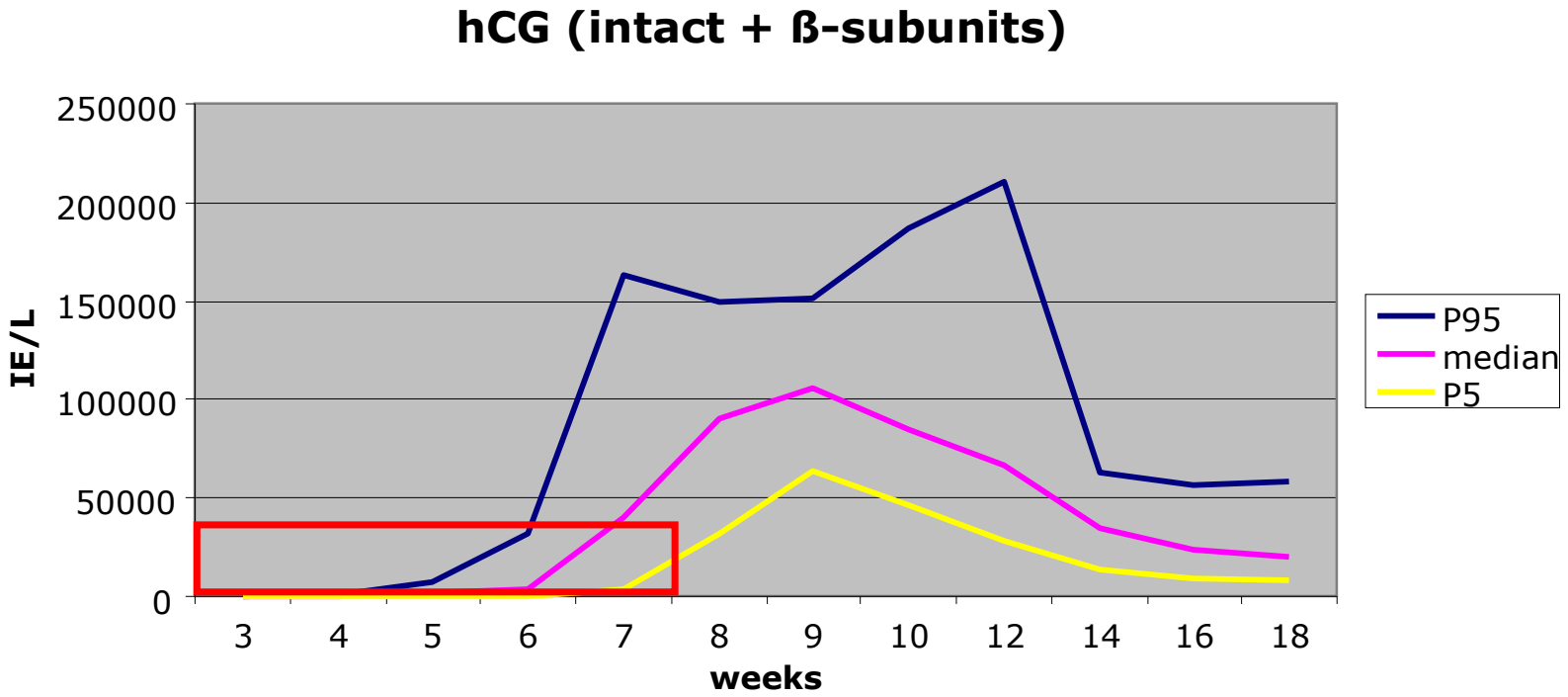


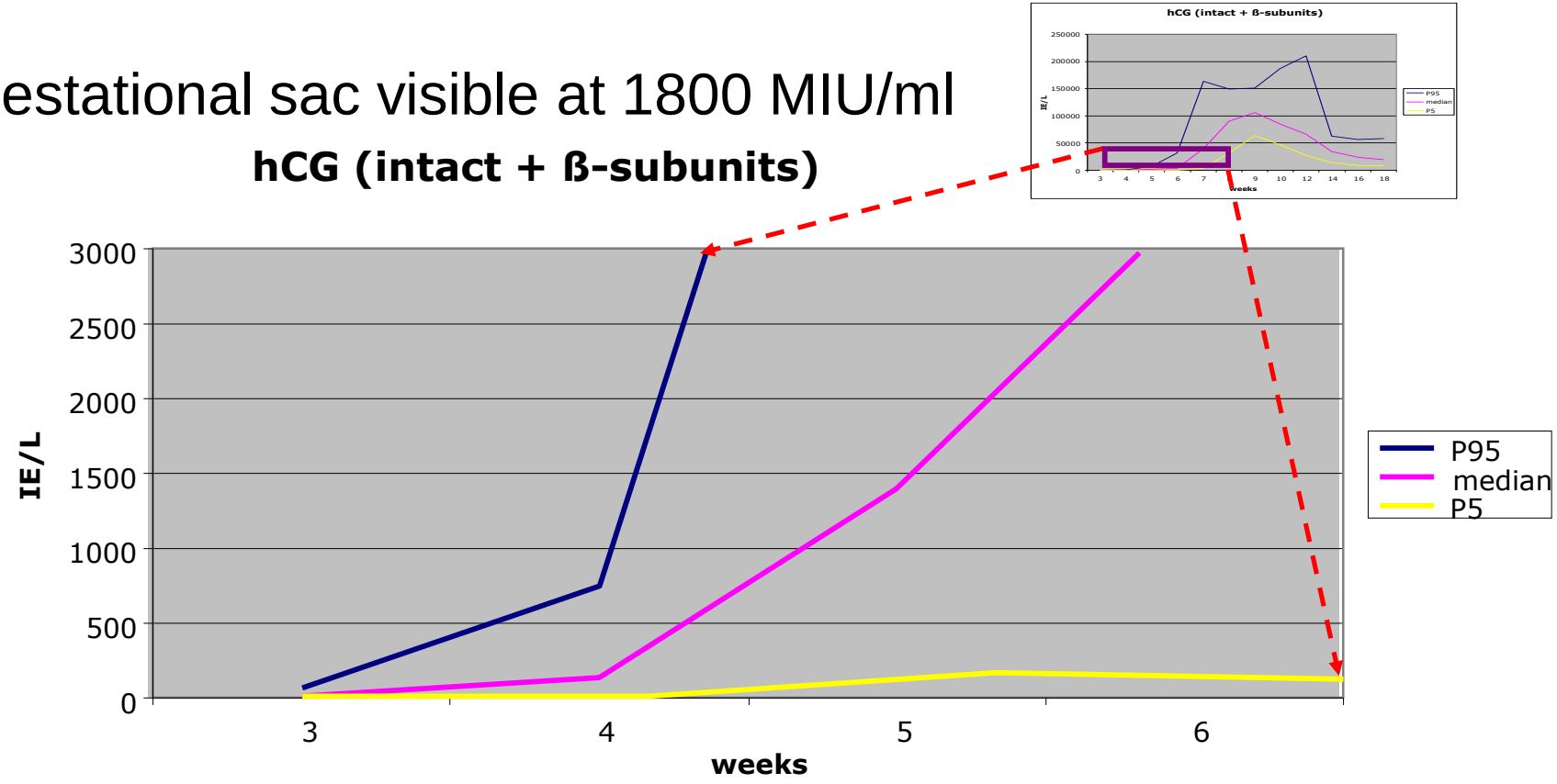
Figure 46-9 Sites of ectopic pregnancy.

Early pregnancy: normal values of hCG

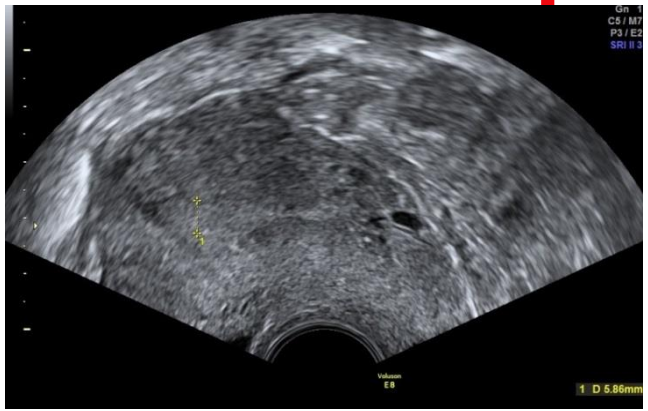


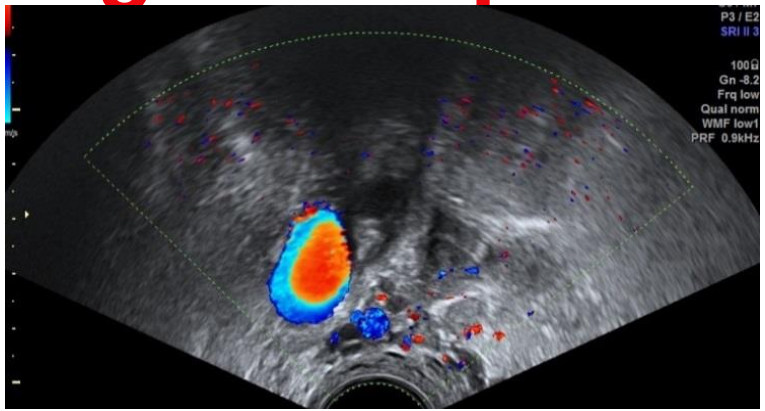
Early pregnancy: normal values of hCG

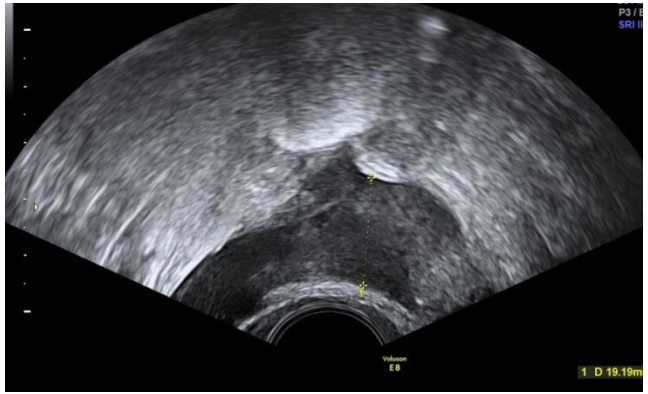
Gestational sac visible at 1800 MIU/ml

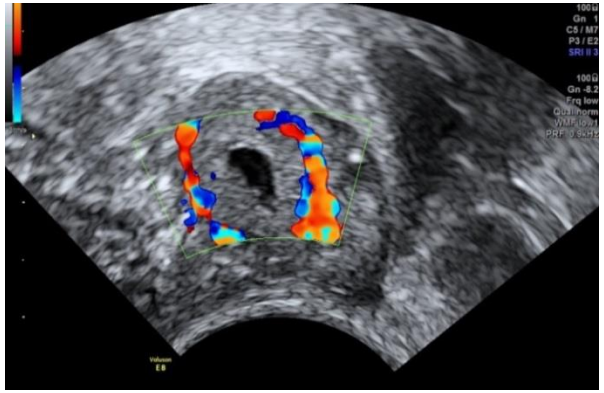


Ectopic right fallopian tube



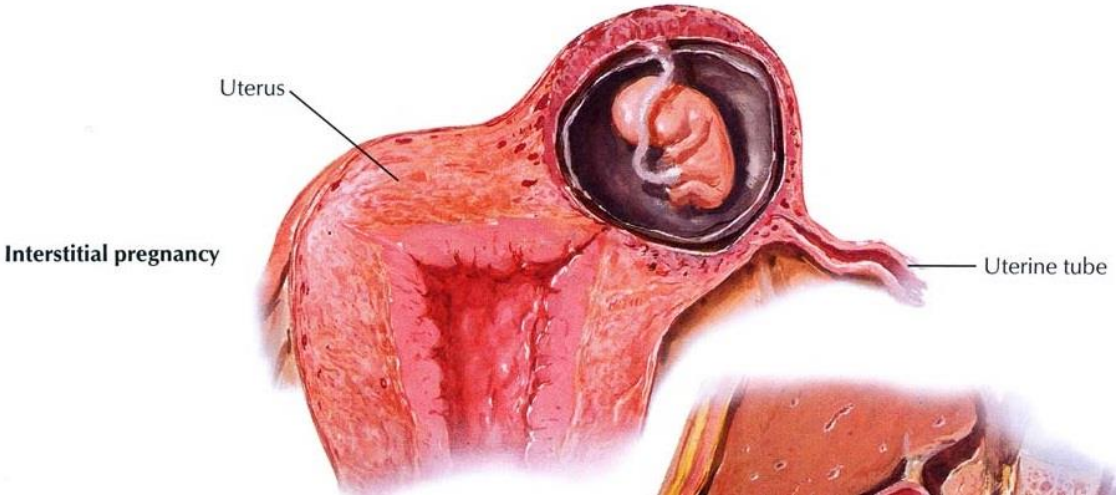


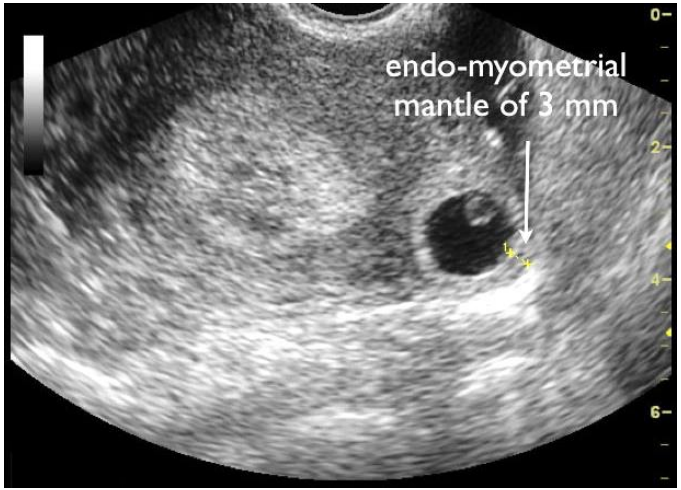




LMP 8 weeks

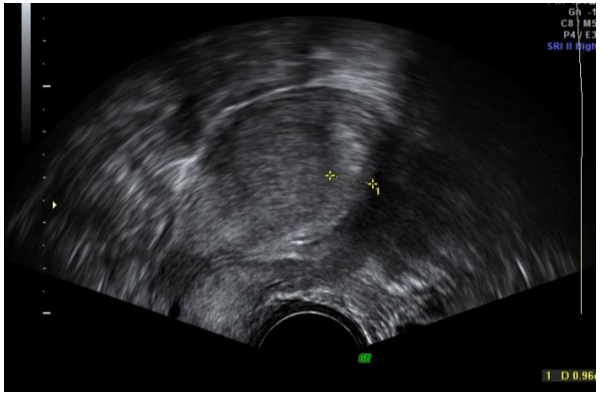
Interstitial pregnancy

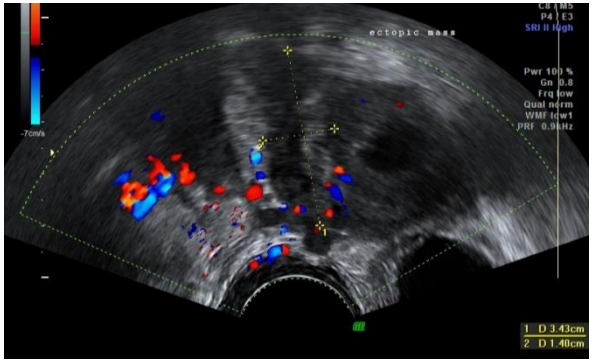


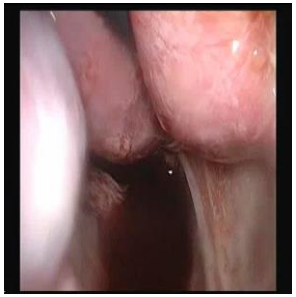


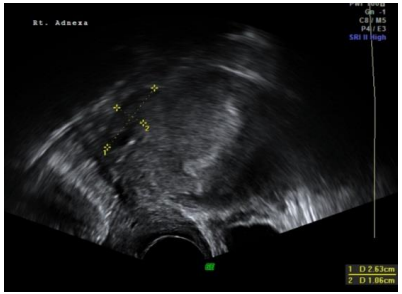
Ectopic management

Day 1 5[1]w	Abdominal pain minimal bloodloss Empty uterus L and R ovary normal	hCG 1349 IU/L Return in 2 days
Day 3 5[3]w	Empty uterus Next to L ovary ectopic mass 3.4 x 1.4 cm	hCG 1890IU/L

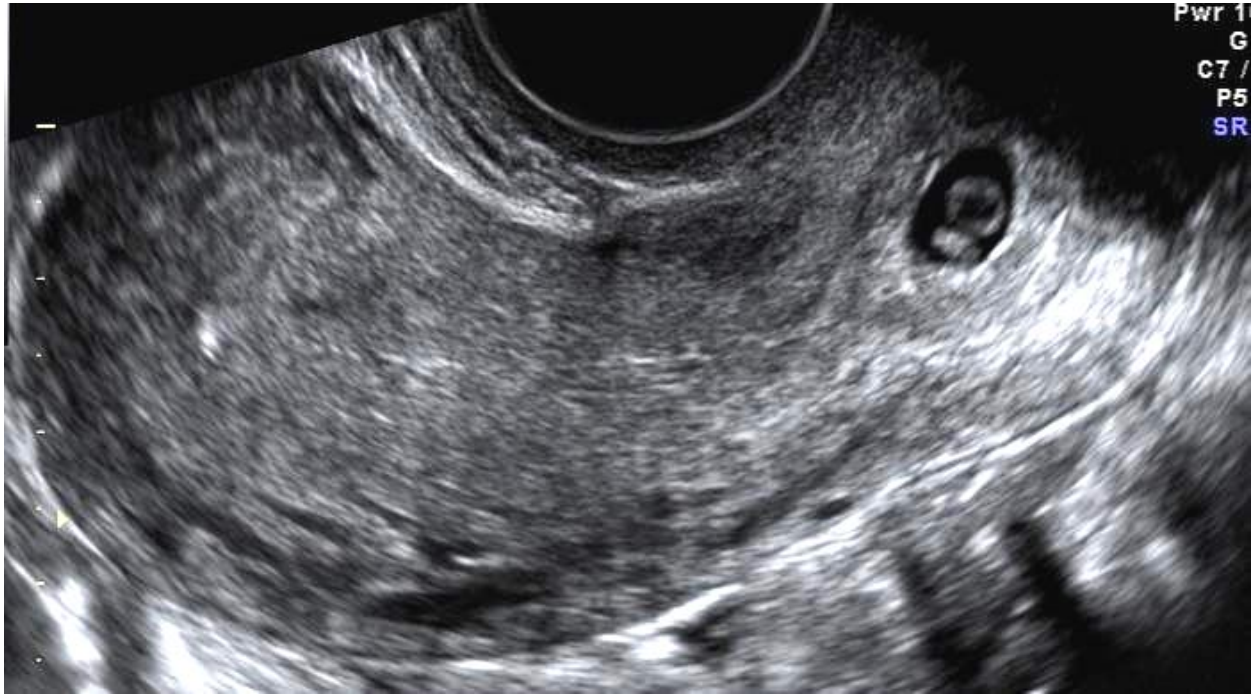




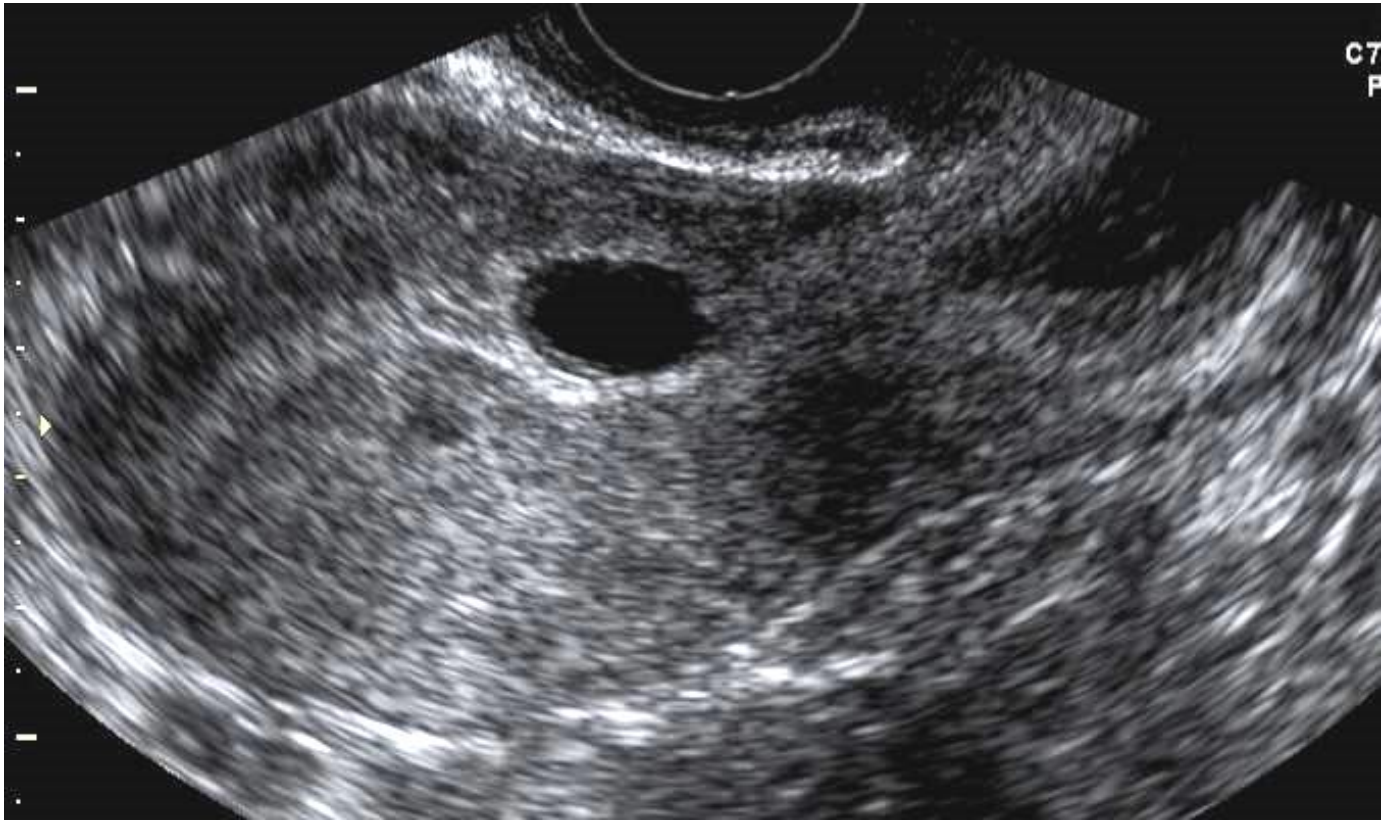




Cervical ectopic pregnancy
Gestational sac in lower segment in cervical canal



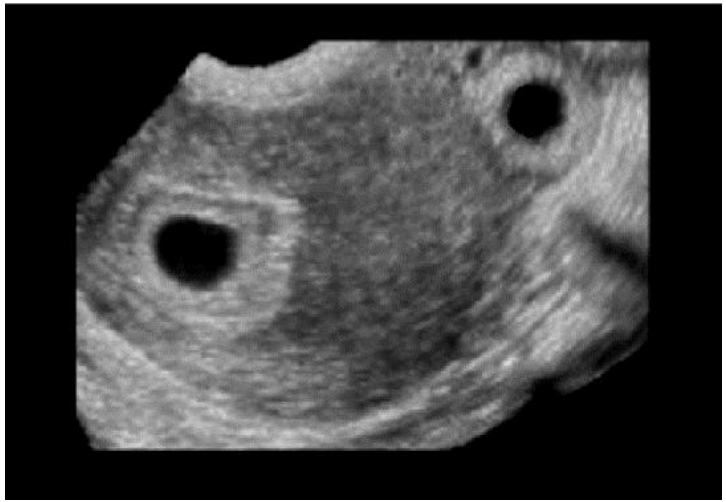
Gestational sac in lower segment - in cs scar



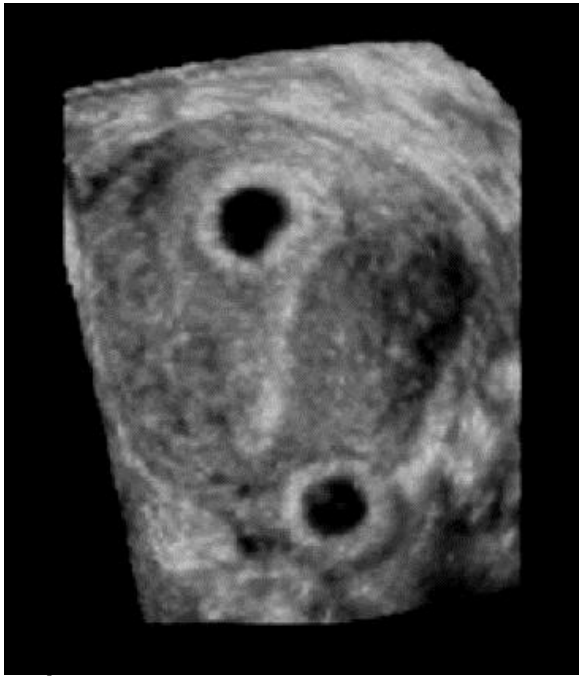
Heterotopic pregnancy

Prevalence heterotopic pregnancy

Spontaneous pregnancy	1:30,000
ART pregnancy	1:100-500



Intrauterine



Ectopic

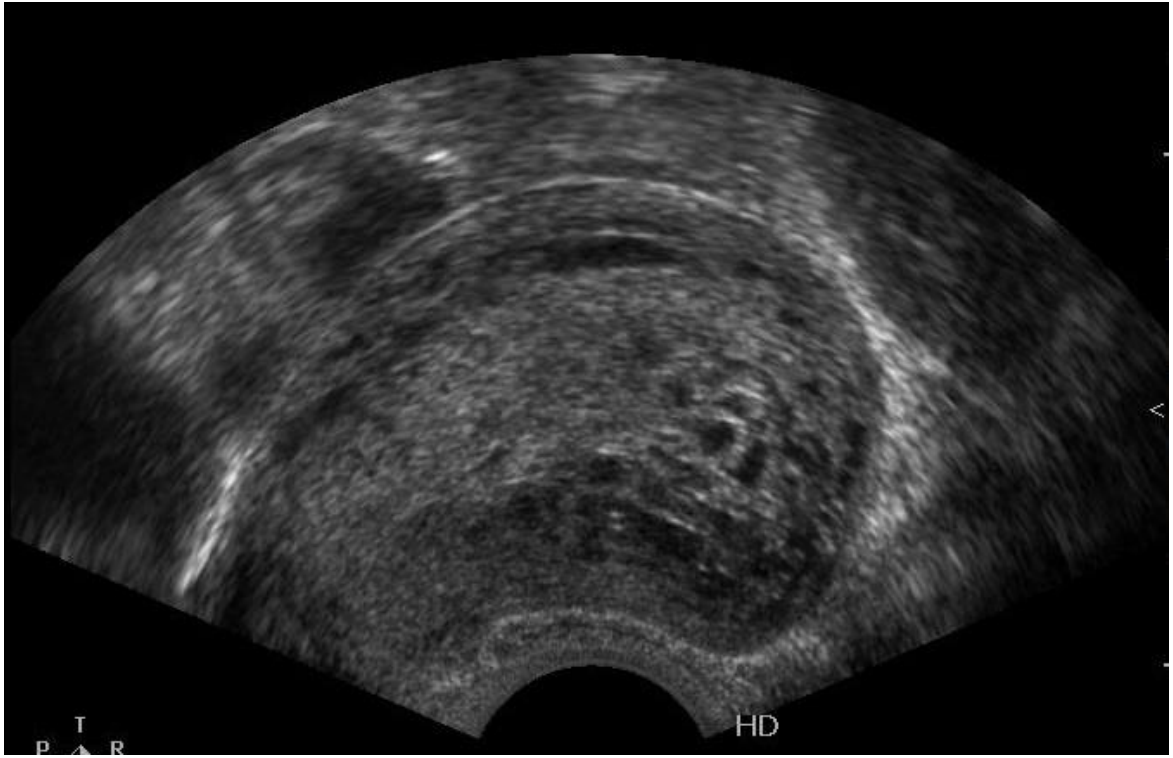
Maruotti & Russo Fert Ster 2010;94:e49

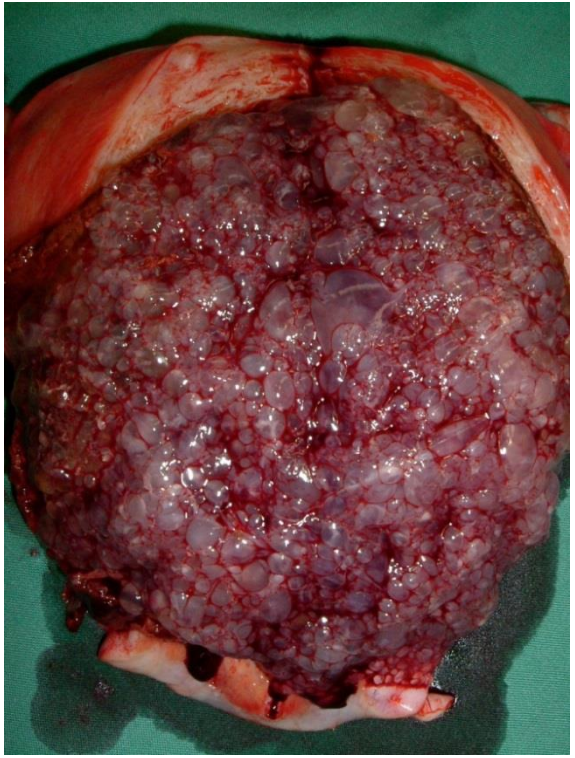
Management Protocol – Pregnancy Unknown Location (PUL)

Progesterone (nmol/L)	ß-hCG (IU/L)	Likely diagnosis	Management
< 20	>25	Spontaneous resolving pregnancy	Check urine or serum ß-hCG in 7 days
20-60	>25	Unviable or ectopic pregnancy with moderate risk requiring intervention	Check serum ß-hCG in 2 days
>60	<1500	Normal intrauterine pregnancy	Repeat scan when ß-hCG expected > 1000
>60	>1500	Ectopic pregnancy with high risk requiring intervention	Repeat scan same day by senior examiner

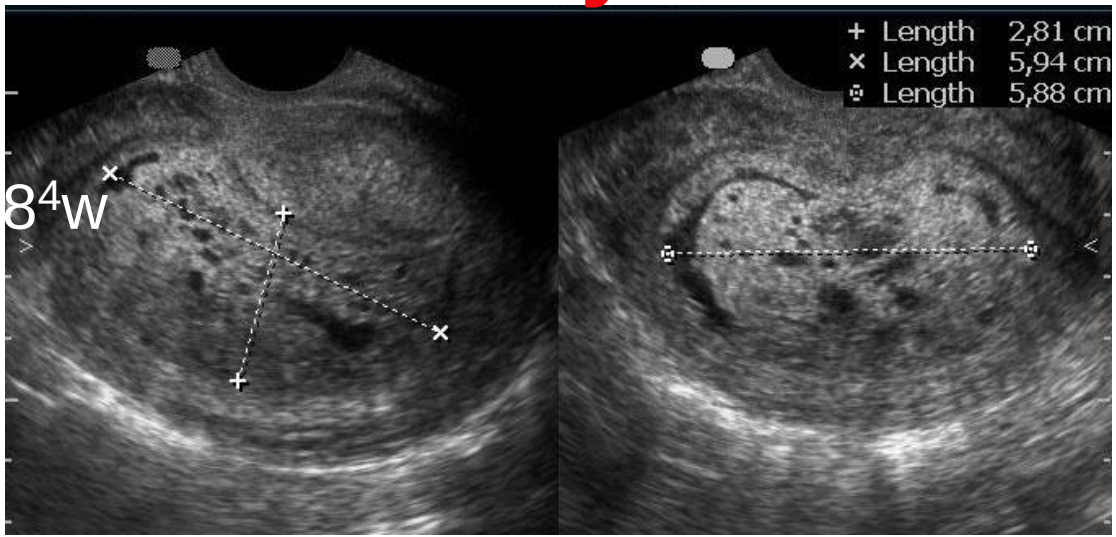
Day et al UOG 2009;33:704-710

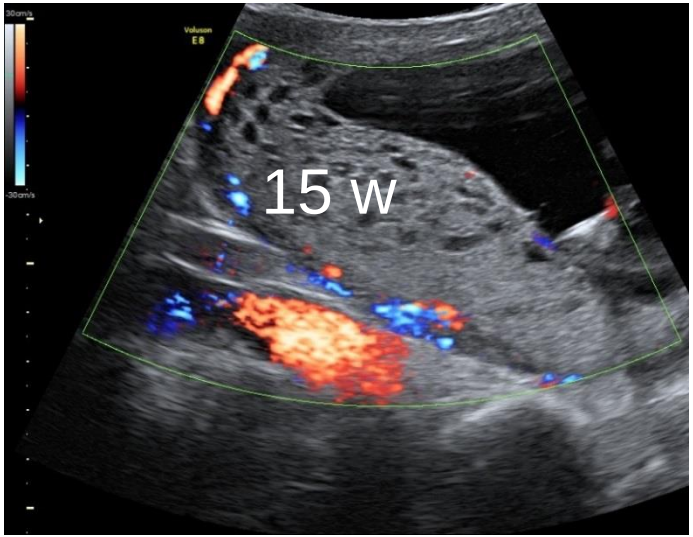
Hydatiforme mole





Hydatiforme mole





Complete HCG 330.000IU/L

Prevalence 1:1500-2000

46, XX only paternal

maternal

Persisting throphoblast 15%

Partial

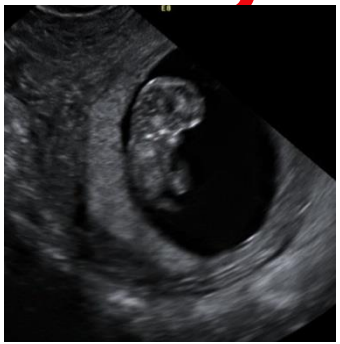
Prevalence 1:700

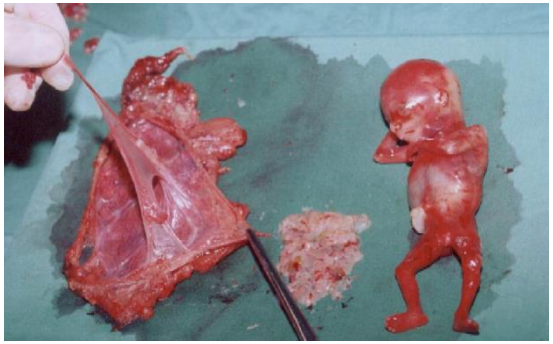
69 XXX of 69 XXY (triploïdy), paternal and

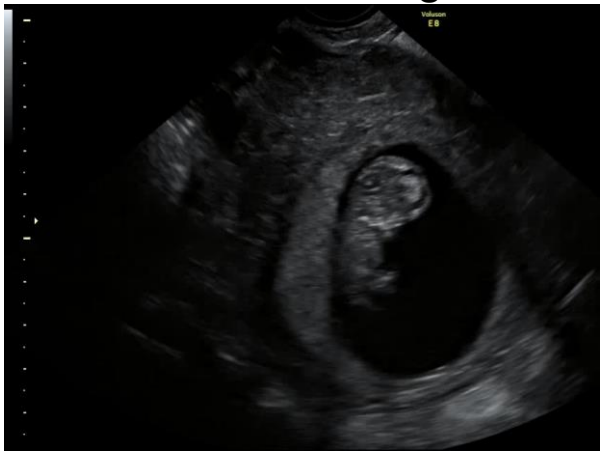
2%

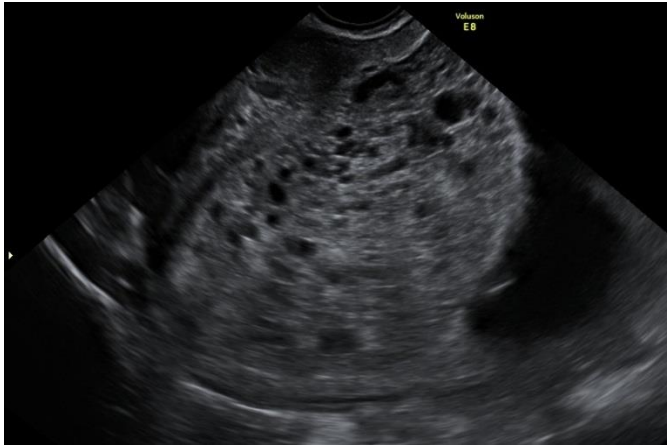
Hydatiforme mole in twin pregnancy

- Blood loss and abdominal pain 8 weeks
- US dichorionic twin pregnancy of which 1 mola
- hCG 439.467 IU/l
- Counseling: miscarriage, hypertension, preeclampsia, thyroid disease, persistent trophoblast disease, lung metastases



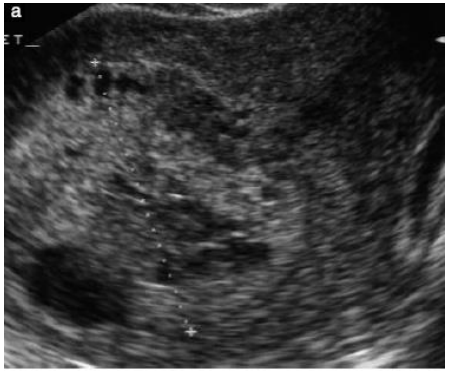


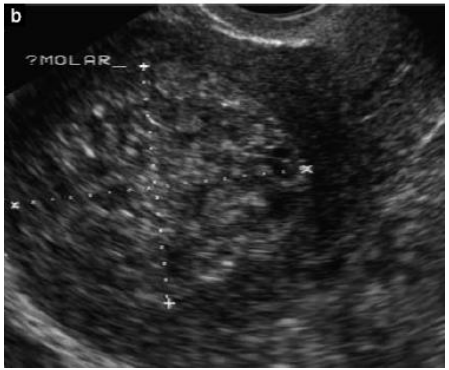




Prevalence 1:10000-100.000

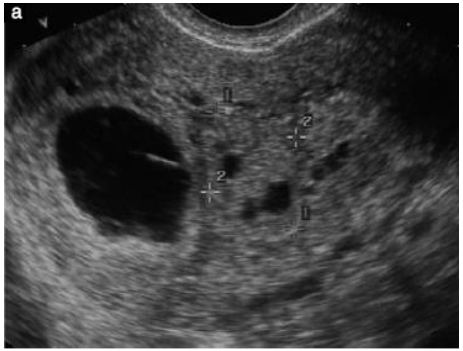
Accuracy of US diagnosis

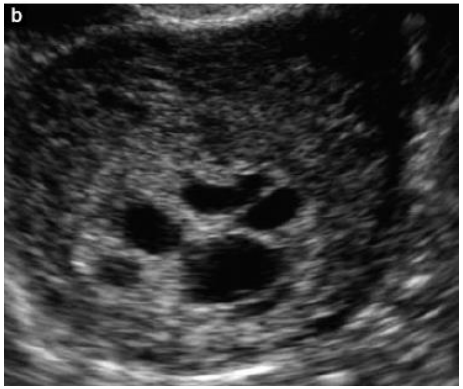




Histology:	
CHM	PHM
Accuracy US	
95%	20%

Histology:
non molar failed pregnancy





Kirk et al UOG2007;29:70-75

Conclusion

- Aware of normal appearance and assessment GS, YS & embryo from 4 weeks gestational age onwards
- Criteria and terminology of viable and nonviable pregnancy
- In doubt about viable intrauterine pregnancy: repeat scan 1 w
- Scan uterus and ovaries to recognize ectopics
- Management of PUL and role hCG and progesteron
- Molar pregnancy appearance and pitfalls
- In doubt of location of pregnancy: repeat scan within 2 days

Complete MOLA

- Karyotype: 46, XX (85%) or 46 XY (15%): all chromosomes are paternal.
- Mechanism: Androgenesis: 23, X sperm fertilizes an egg that is maternal inactivated, meaning that the egg has no active maternal chromosomes or an empty egg (no maternal chromosomes). The egg upon fertilization, duplicates the paternal chromosomes leading to 46, XX **(A).**
- In regards to 46, XY moles, the maternal inactive egg is fertilization by two sperm with one carrying the X and the other carrying the Y gene **(B).**
- Hydropische zwelling van alle vlokken; geen embryonale structuren.
- 1:2000 zwangerschappen
- Persisteren 15%

Partiele MOLA

- Karyotype 69, XXX or 69, XXY: Two sperm either 23, X or 23, Y fertilized the ovum leading to triploidy **(C)** (chomosomen zijn zowel paternaal als maternaal).
- hydropische zwelling van een gedeelte van de vlokken; embryonale structuren kunnen aanwezig zijn.
- 1: 20 000 zwangerschappen
- Persisteren 2%