

First Trimester of Pregnancy

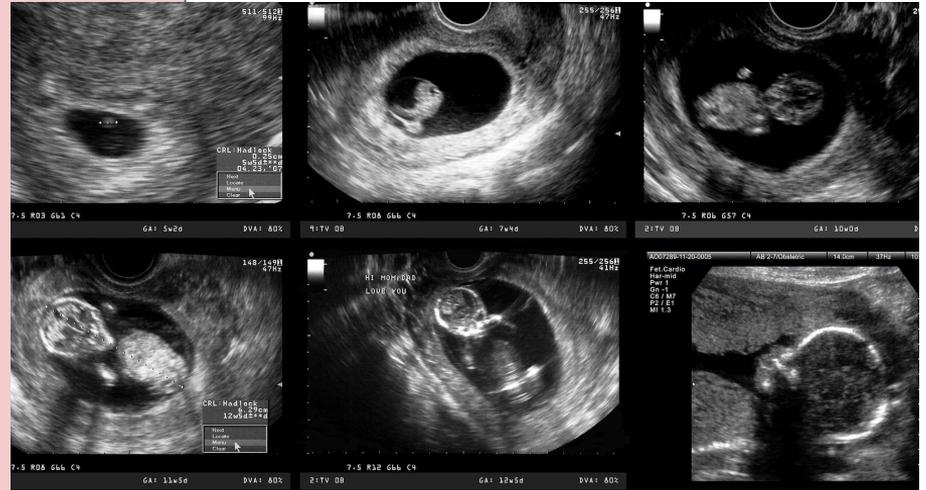
Obstetrics and Gynecology

DMS 300

Karen Chow

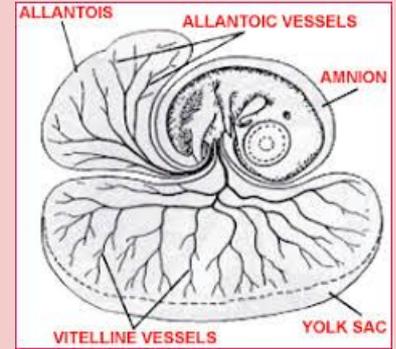
Topics

- After implantation, Embryonic Phase
- Biochemical Markers
- Sonographic techniques
- Early Gestation Parameters
- Sonography
- 1st trimester fetal anomalies
- Risk assessment



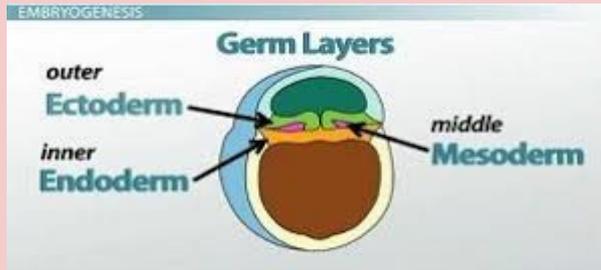
After Implantation, Embryonic Phase

- Embryo is in two layers: epiblast and hypoblast, facing the blastocele
- Amniotic cavity and fluid is formed via the amnion
- Primary yolk sac (primary umbilical vesicle) and secondary Yolk sac (secondary umbilical vesicle) is formed
 - Vitelline duct formed, connecting to midgut
 - Produces embryo's first blood cells
- Allantois protrudes into connecting stalk and forms urachus
- Yolk sac becomes part of embryonic gut, to later contribute to development of respiratory and urogenital system
- Some inner cell mass develops into embryonic mesoderm, some combine with epiblast and become endoderm, and remainder of epiblast becomes ectoderm

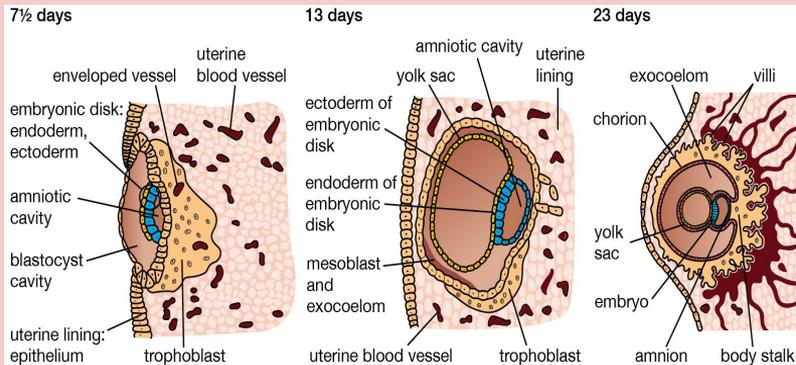


After Implantation, Embryonic Phase

- The three germ cell layers form all future tissues and organs

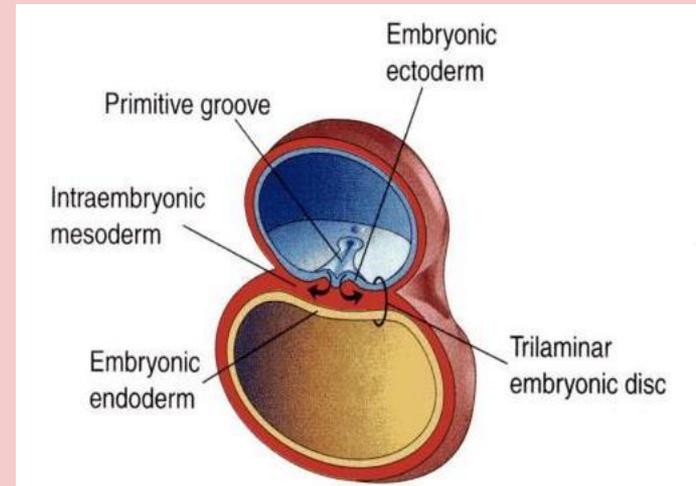


ECTODERM	MESODERM	ENDODERM
<ul style="list-style-type: none"> • Epidermis of skin and its derivatives (including sweat glands, hair follicles) • Epithelial lining of mouth and anus • Cornea and lens of eye • Nervous system • Sensory receptors in epidermis • Adrenal medulla • Tooth enamel • Epithelium of pineal and pituitary glands 	<ul style="list-style-type: none"> • Notochord • Skeletal system • Muscular system • Muscular layer of stomach and intestine • Excretory system • Circulatory and lymphatic systems • Reproductive system (except germ cells) • Dermis of skin • Lining of body cavity • Adrenal cortex 	<ul style="list-style-type: none"> • Epithelial lining of digestive tract • Epithelial lining of respiratory system • Lining of urethra, urinary bladder, and reproductive system • Liver • Pancreas • Thymus • Thyroid and parathyroid glands



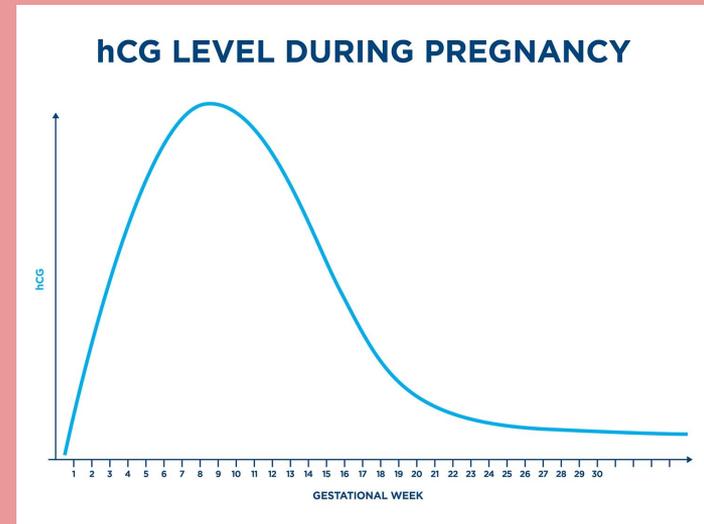
After Implantation, Embryonic Phase cont'd

- Amnion fuses with chorion, and umbilical cord will be covered by amnion
- By end of eighth week, three germ cell layers (trilaminar disc) will have already started forming organs and structures, moving into fetal stage.
- Placenta developing alongside from villi as it becomes villous chorion and chorion frondosom
- Maternal blood supplies area around villi through endometrial spiral arteries, which are then drained by endometrial veins



Biochemical Markers

- hCG levels rise quickly during pregnancy.
- At 3-5 weeks gestational age, hCG doubles every day and a half, and between 5-6 weeks hCG will double every 2.5 days
- hCG levels will continue to rise until its peak at around 8-12 weeks, where it plateaus **



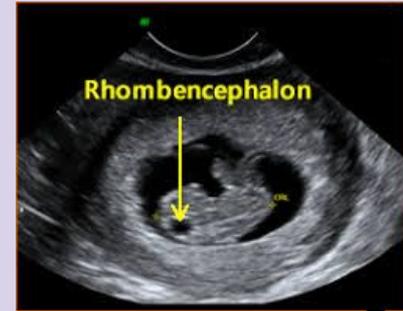
Early Gestation Parameters

- As early as 11 days after conception (4 days gestational), a sonographer could see a small fluid collection along the decidua
 - Sonolucent structure, the gestational sac
- Yolk sac seen with gestational sac at around 5 weeks (2-3mm diameter)
 - Seen transabdominally at around 6-7 weeks
 - Grows to around 5-6 mm around 11th week, then disappears after 12 weeks**
 - *Yolk sac is in chorionic cavity, embryo in amniotic cavity*
- Fetal pole seen at around 6th week
 - Heartbeat should be detectable when >7mm
- Embryo detectable at around 8 weeks sonographically either transabdominally or transvaginally
 - At 7 weeks gestational age the sac grows, sonographer sees 2 decidua layers
 - Decidua capsularis and decidua parietalis, AKA “double decidual sac sign”
 - Embryo grows 1-2mm per day, measurements should reflect gestational age.



Early Gestation Parameters cont'd

- Fetal brain forming from ectoderm
 - Forebrain (prosencephalon)
 - Midbrain (mesencephalon)
 - Hindbrain (rhombencephalon)
- Rhombencephalon can be seen at 7 weeks
 - Sagittal views will show a diamond shape sonolucent structure in posterior portion of brain
- Limb buds will appear at around 8 weeks
 - Hands and feet at around 10 weeks
- At 8 weeks, embryonic gut will herniate out
 - Normal, will recede at around 12 weeks, not to measure greater than 7mm
 - Do not mistake for pathology



Early Gestation, Sonography

- Pregnancy can also be dated by measuring gestational sac if LMP unknown
 - Ex: 2-3mm is approx 5 weeks gestational age
 - MSD (mean sac diameter) grows at around 1mm per week
- Crown rump length (CRL)
 - Measured at longest axis
 - Zoom in to get accurate measurement
 - Critical to assigning estimated due date (EDD)
 - Errors can affect risk estimation for aneuploidy, or chromosomal abnormalities
- Gestational sac
 - Measure maximal diameter, three orthogonal planes
- Yolk sac
 - Measure maximal diameter

Early Gestation, Sonography cont'd

- While surveying, imperative to capture uterus AND adnexal spaces when identifying, placing, and sizing gestational sac
 - Check for presence of abnormal masses and fluid
- When gestational sac is detected, report:
 - Location to rule out ectopic pregnancy
 - Whether yolk sac and/ or embryo seen
 - MSD for estimated gestational age
 - If embryo seen, CRL preferred
 - Presence or absence of fetal heartbeat
 - Abnormalities
- Survey cervix



Gestational age	Embryologic change	Sonographic appearance
23 d	Blastocyst implantation	Blastocyst measures 0.1 mm and is too small to visualize
3.5–4 wk	Decidual changes at implantation site	Focal echogenic decidual thickening at implantation site
4–4.5 wk	Trophoblastic tissue	High-velocity and low-impedance trophoblastic flow at the implantation site on TVCFD
4.5–5 wk	Exocoelomic cavity of the blastocyst	Gestational sac (a sonographic term) is always seen when it measures > 5 mm and the serum β -hCG is between 1000 and 2000 mIU/mL (IRP)
5–5.5 wk	Secondary yolk sac	Yolk sac is seen as a thin-walled cystic structure within the gestational sac and should always be seen when the GS is > 10 mm; it is the first sign of a true gestational sac before the visualization of embryo
5–6 wk	Embryo	Seen as a focal echogenic area adjacent to the yolk sac; should always be seen when the GS is > 18 mm
5–6 wk	Embryonic cardiac activity	Embryonic cardiac activity should always be seen when the embryo is > 5 mm; normal heart rate ranges from 100–115 beats/min between 5–6 wk of gestation

Abbreviations: CG, human chorionic gonadotropin; GS, gestational sac; IRP, international reference preparation; TVCFD, transvaginal color flow Doppler.

Early Gestation, Sonography cont'd

- **ALARA!!!** Embryonic and fetal development is at the highest risk of disruption in first trimester
 - Mindful of duration and level of exposure
 - Keep an eye on TI levels-- bone absorbs the most heat, posing threat to brain and spinal cord
 - TIB only to be selected after 10 weeks**
 - M mode and B mode is lowest level of exposure
- NO doppler unless clinically indicated to do so
- “In general, the main goal of a fetal ultrasound is to provide accurate information which will facilitate the delivery of optimized antenatal care with the best possible outcomes...” **

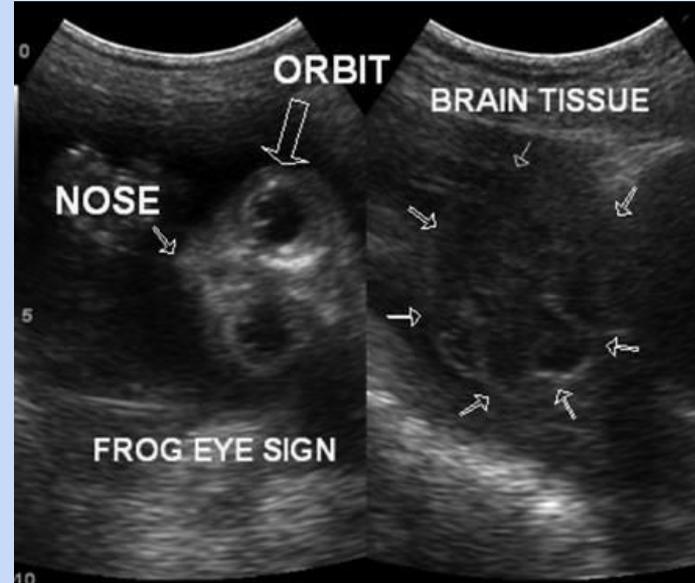
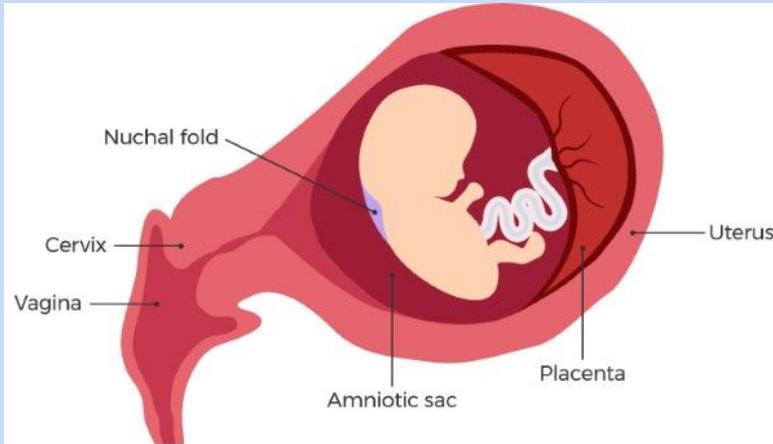
1st Trimester Fetal Anomalies

- Nuchal Translucency (NT)
 - Screening for chromosomal anomaly done at end of first trimester
 - Measures fluid at nuchal fold
 - Higher amount of fluid means increased risk of Trisomy 21 (Down syndrome), Trisomy 18 (Edward's syndrome), and Trisomy 13 (Patau's syndrome)
- Anencephaly
 - Most severe form of cranial neural tube defect-- incompatible with life
 - Absence of cortical tissue, cranial vault, Frog Eye sign or Mickey Mouse face **
 - 1:1000 occurrence, with 4:1 being female
 - Indicated by high (2x) levels of MSAFP (maternal serum alpha fetoprotein)
 - Detectable at 11 weeks, accuracy of 100% by 14th week**
- Other anomalies
 - Identified earlier with ultrasound

*“In general, screening for fetal structural and chromosomal abnormalities is a crucial part of antenatal care, the main purpose of a fetal ultrasound scan is to provide precise information that will simplify the delivery of enhanced antenatal care with the best possible outcomes for both the mother and fetus” ***



1st Trimester Fetal Anomalies cont'd



Risk Assessment

- Vaginal bleeding in a pregnancy under 20 weeks
 - Considered threatened abortion or threatened miscarriage
 - Common (15-27% of pregnancies), can originate in uterus, cervix, or vagina
 - Important to follow up
 - Heavy bleeding, especially with pain, is 3x more likely to result in miscarriage
- Fibroids, large body habitus/ uterus, surgical scars, multiple gestation
 - Hard to determine gestational age
 - Fibroids may cause preterm labor, premature rupture of membrane, fetal malposition
 - Submucosal fibroids may be associated with pregnancy loss pg 351
- Delayed fetal development
 - May be correlated with hCG levels
 - CRL at 2 standard deviations below the mean for gestational age is at risk for spontaneous abortion

Risk Assessment cont'd

- **Blighted Ovum: Empty sac**
 - Pregnancy ended before embryo formed or it was resorbed
- **Amnion seen without embryo**
 - Definitive sign of failed pregnancy
- **Bradycardia**
 - Increased risk of pregnancy loss
- **Yolk sac too large or too small, or poorly shaped**
 - Predictors of poor outcome
- **Enlarged amniotic sac**
 - May be sign of demise

Age	Normal Fetal Heart Rate
5 Weeks (Beginning)	80-85 bpm
5 Weeks	starts at 80 and ends at 103 bpm
6 Weeks	starts at 103 and ends at 126 bpm
7 Weeks	starts at 126 and ends at 149 bpm
8 Weeks	starts at 149 and ends at 172 bpm
9 Weeks	155-195 bpm (average 175 bpm)
12 Weeks	120-180 bpm (average 150 bpm)

References **

1. Stevenson, s., 2018. *Obstetrics And Gynecology*. Ch 14 ch 15
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