Concerns in the First trimester

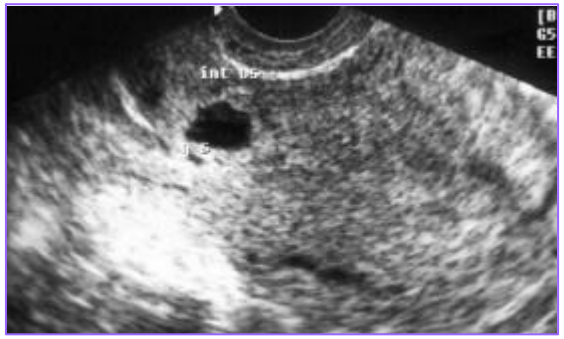
- What is the site of implantation?
- Is the embryo or fetus alive & normal growth?
- Gestational age
- Number of embryo
- Embryonic and fetal anomalies

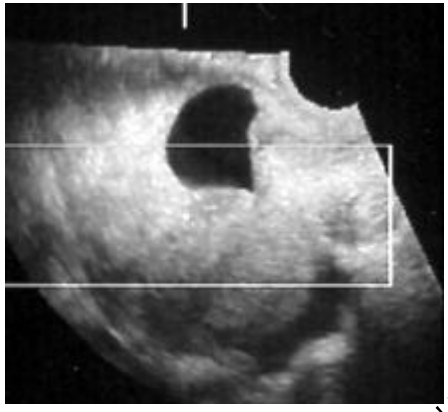
Gestational Sac

- Position: mid to upper uterus
- Size: gestational age(days) = MSD+30

  5 weeks= MSD 5mm
- Sign:
- intradecidual sign,

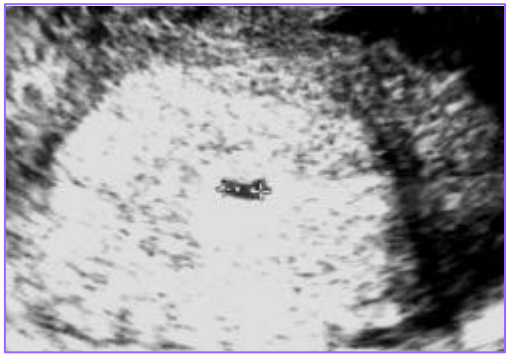
  double-decidual sign

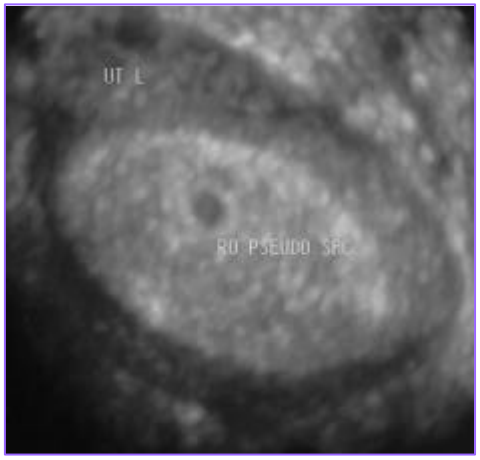




Intradecidual sign

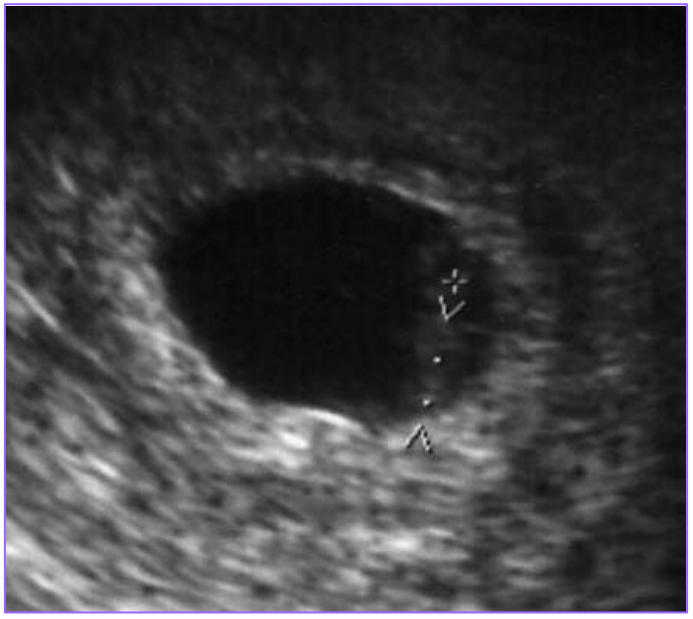
- Completely embedded sac within the thickened decidua
- DDx: pseudogestational sac





Double-decidual sign

- echogenic ring
- decidua capsularis & decidua vera.
- after 5.5 to 6 weeks o
- accurate in predicting the presence of an intrauterine pregnancy



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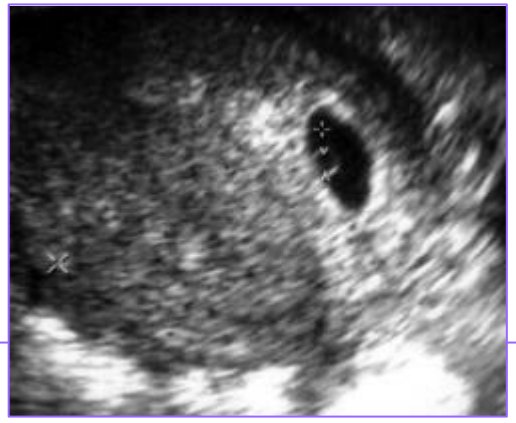
Yolk Sac

important in early embryonic life

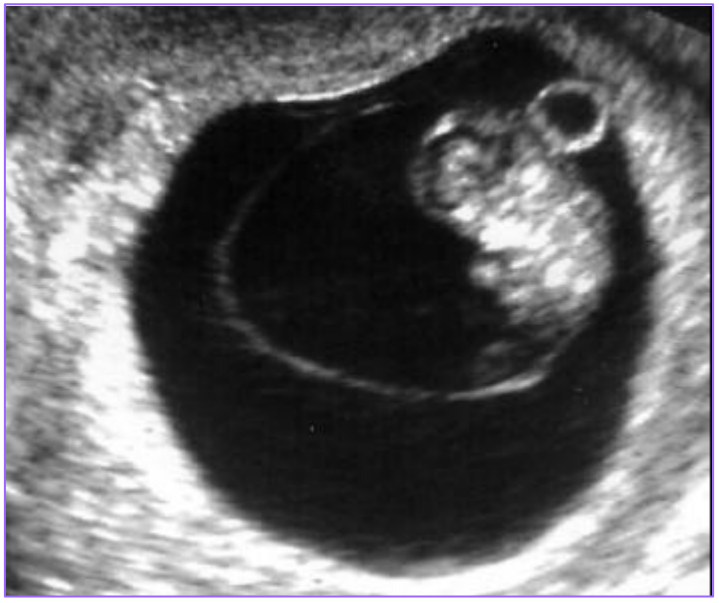
- transfer nutrient to embryo
- hematopoiesis
- formation of primitive gut



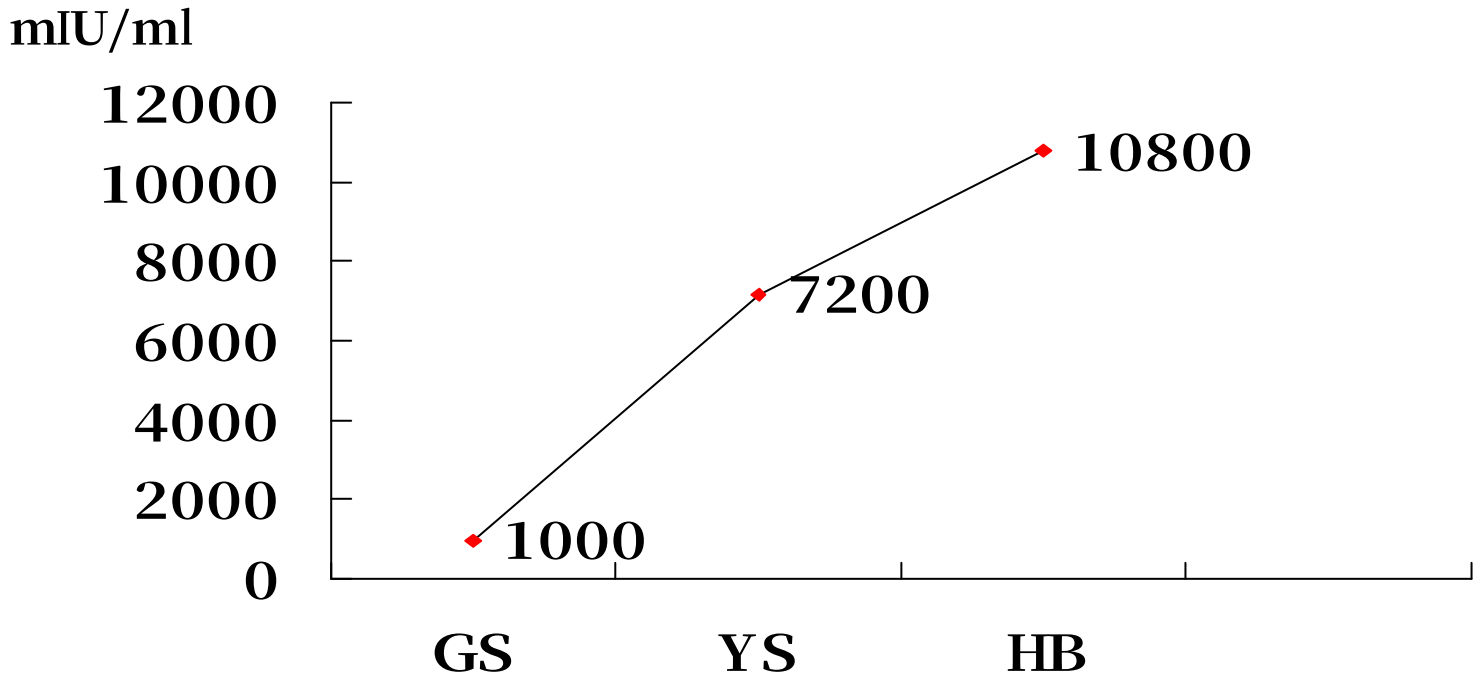
- always visualized when MSD is 8mm
- diagnostic of intrauterine pregnancy
- Increases between 5 and 10 weeks
- No detected by the end of the first trimester

Amnion

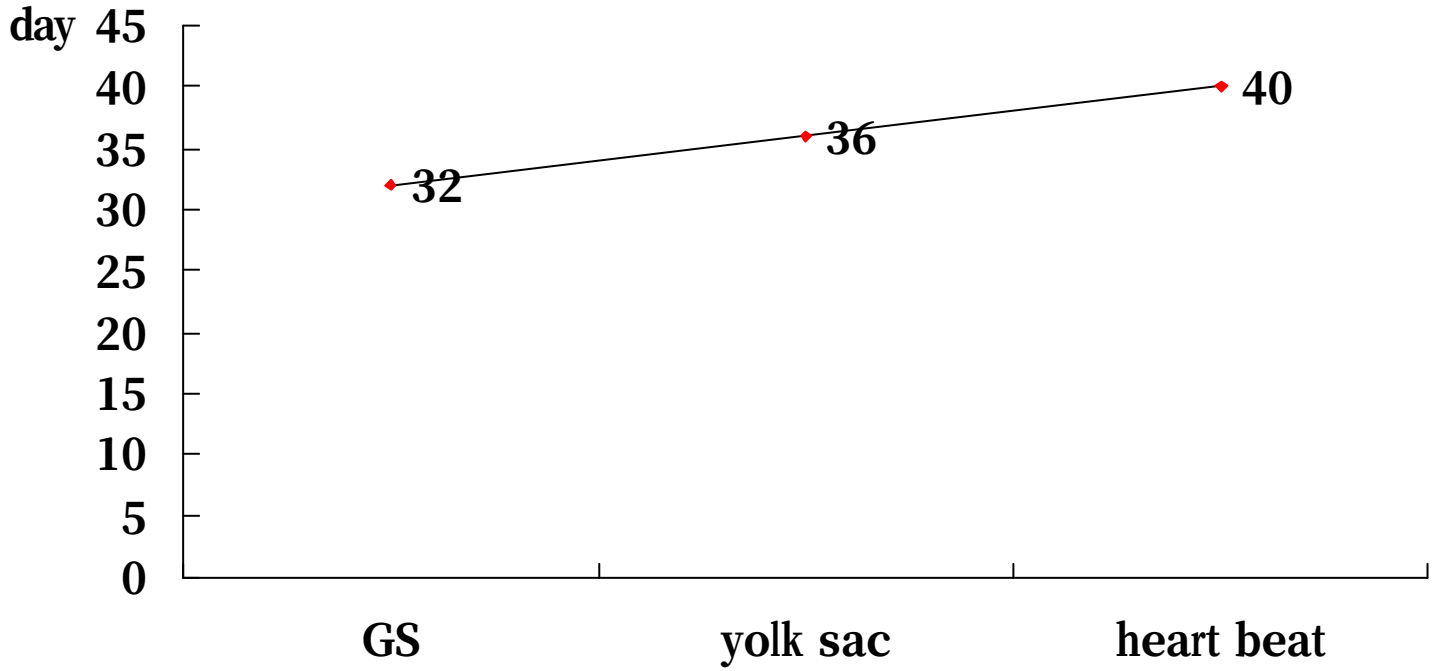
- thin, filamentous, rounded membrane surrounding the embryo
- completely surrounded by the thick, echogenic chroion
- yolk sac situated between the amnion and chorion
- chorionic fluid is more echogenic than amniotic fluid



GS, Yolk Sac and Fetal heat beat related to ? -hCG

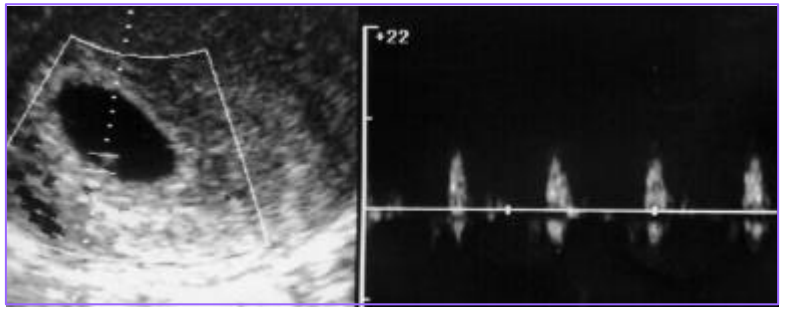


GS , yolk sac & heart beat related to gestational age



Embryo(5 weeks)

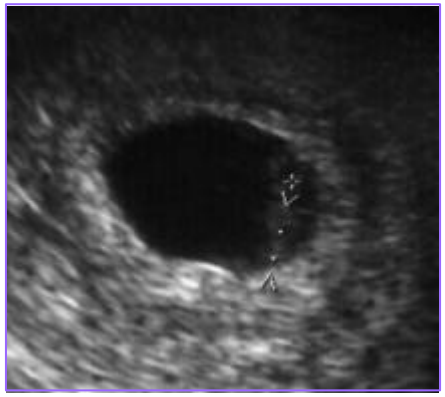
- Created ventricular system of CNS
- Three dimensional body(embryonic disc folds cephalocaudally and laterally)
- connection between the yolk sac & embryo becomes the narrow vitteline duct

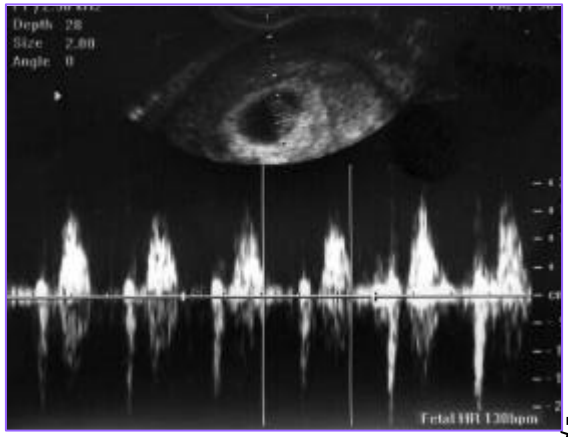


Sonographycally visible yolk sac and embryonic pole
Heart tube : start beat (100bpm)

Embryo (6 weeks)

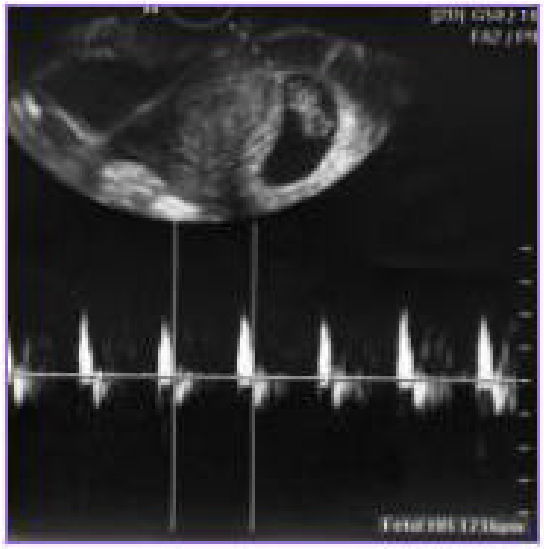
- CRL : 4-7mm
- Limb buds develop
- Small evagination from the telencephalon
- Sonographycally,impos sible to differentiate the crown from the rump
- Amniotic membrane
- FHB: 105-130 bpm

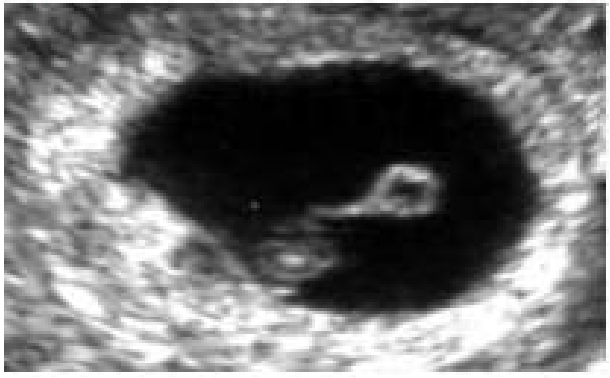




Embryo (7 weeks)

- CRL : 8-14mm
- normal umbilical hernia
- Cephalic pore, rhombencephalic cavity
- FHB: 160-130 bpm
- Blood flow in the vittelin duct
- Limb buds

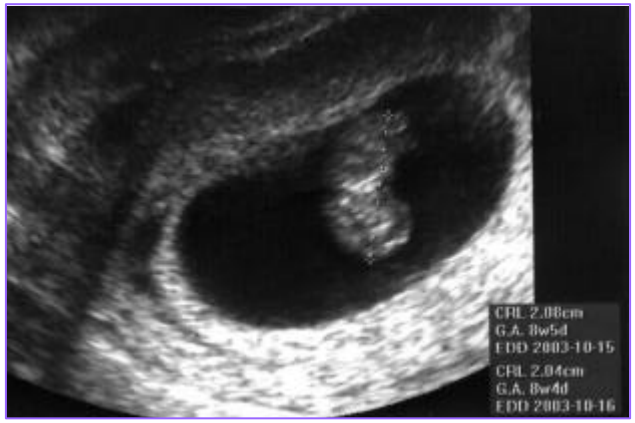


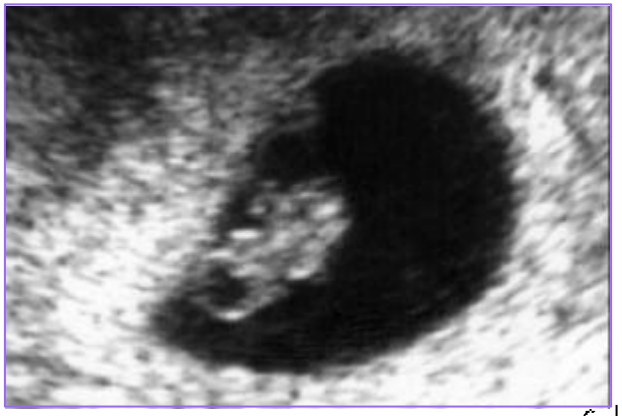


Embryo(8 week)

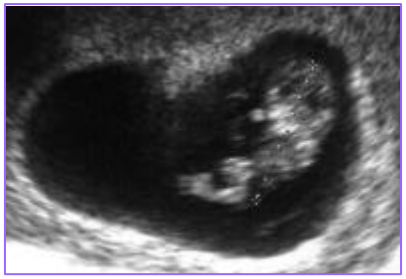
- CRL : 15-22mm
- Membranous part of the interventricular septum
- Haematopoiesis shift from the yolk sac to the liver
- Cloacal membrane ruptures from urinary pressure, anal membrane becomes defined
- Choroid plexuses in rhomencephalon

- C-shaped configuration
- Sonolucent cephalic end(large hole in the head)
- Embryonic movement
- Heart beat 110-140bpm





Embryo(9weeks)



- CRL: 23-31mm
- Chondrocranium and skeletogenous layer of the head
- Thickening thalami
- Cartilaginous vertebrae
- Dividing pleuroperitoneal cavity by diaphragm
- Anal membrane ruptures
- Kidney ascend to level L1-3
- Genital tubercle

- clear visualization of trunk, head, limb buds (Detectable fingers and toes)
- Increased movements of arms and legs
- Accepable image of the profile
- Physiological hernia
- Spine:Hypoechogenic parallel lines
- Genital tubercle

Fetus(10weeks)

- CRL: 32-41mm
- Marrow formation of humerus
- Cerebellar hemispheres unite in the midline
- Commencement of skull bone and spine ossification
- Maximal extent of midgut herniation

Fetus (11weeks)

- Complete the skull bone ossification (11-12weeks)
- Basic structure of the brain
- BPD 측정
- 장관은 복부 내 제자리로 환원
  (20%: 12weeks에도 관찰)
- 소변 생성 시작하여 양수 내로 배출

Fetus (12week, 13week)

- Decidua capsularis는 decidua parietalis에 부착
- 장기 관찰 가능
- Feet, hands

- Assessment of heart (43-95%)
- Determination of gender(87-90%)

Embryonic & fetal maldevelopment

- Indicating pregnancy failure

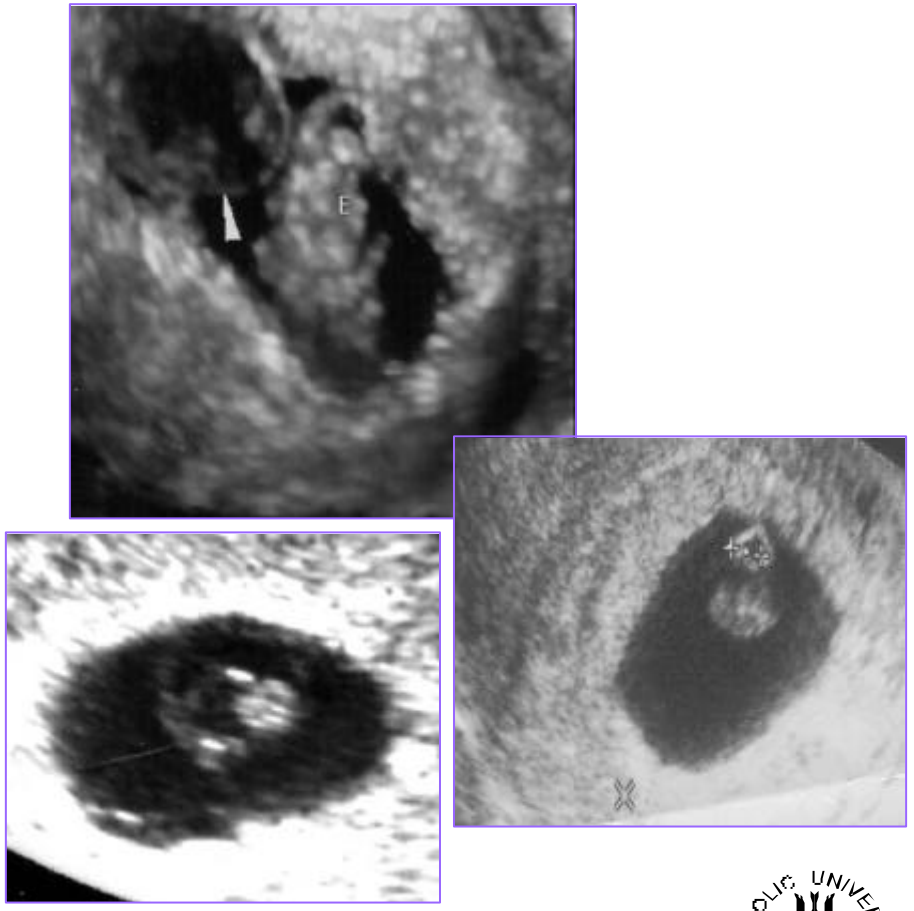
MSD is 8mm(13mm) lacking yolk sac

MSD is 16mm(18mm) lacking embryo

- Less than 0.7mm/day growth (normal: 1.1mm/day)
- MSD-CRL?5 : 80% abortion

Yolk Sac

- diameter >5.6mm between 5-10weeks: always associated with abnormal outcome
- remained irregular shape: increased risk for embryonic demise or fetal anomaly



Fetal anomalies

- Anencephaly,exencephaly, acrania
- Encephalocele
- Holoprosencephaly
- Spina bifida
- Cystic hygroma
- Ectopia cordis

- Renal agenesis
- Hydronephrosis
- Omphalocele
- Body stalk anomaly
- Abdominal cyst
- Diaphragmatic hernia
- Skeletal dysplasia

Exencephaly anencephaly sequence

- Abnormal widening at the cranial pole and alteration of its echo pattern
- Abnormal head/trunk ratio
- Exposure of brain during the embryonic period, exencephaly converts to anencephaly (Woods & Smith, 1984)

Exencephaly - Anencephaly

- Results from failure of the closure of the rostral portion of the neural tube(this normally closes during the 6th menstral week)
- Characterized by maldevelopment of the telecephalon and midbrain

A normal brain at 9-11 weeks' gestation to Acrania with exencephaly at 12 weeks' gestatation and finally progress to anencephaly at 14 weeks' gestation (Bronshtein and Ornoy, 1991).

Exencephaly - Anencephaly

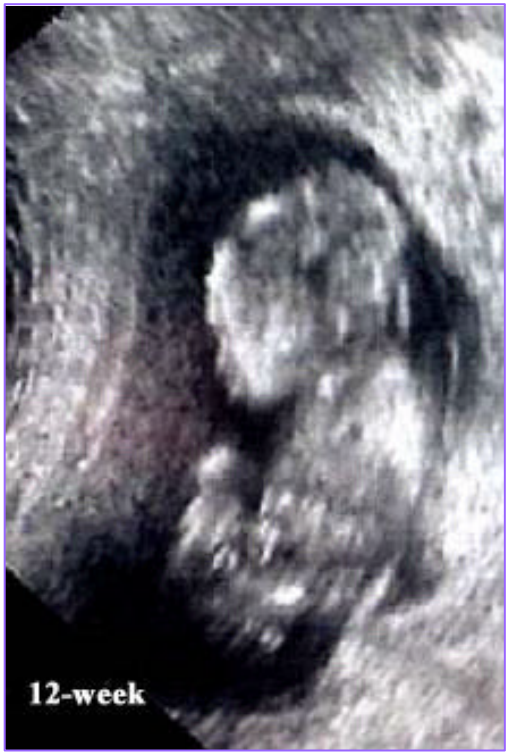
- Mickey Mouse sign (frog's eye appearance)

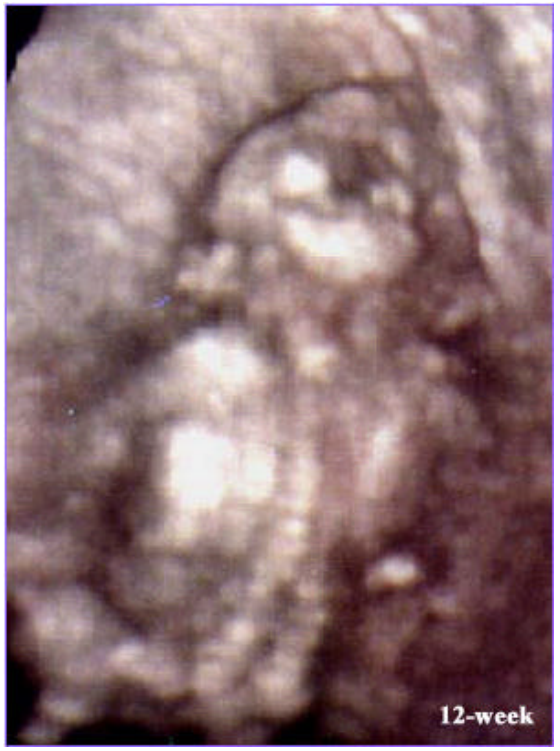
Absence of cranium

Abnormal mass of tissue floating to either side of the head

- Symmetric cranial defects and bulging eyes : 2-5% recurr
- Amniotic band에 의한 경우: asymmetric cranial defects, microphthalmia, facial defects, severe nasal deformity, no risk of recurrance

Encephalocele





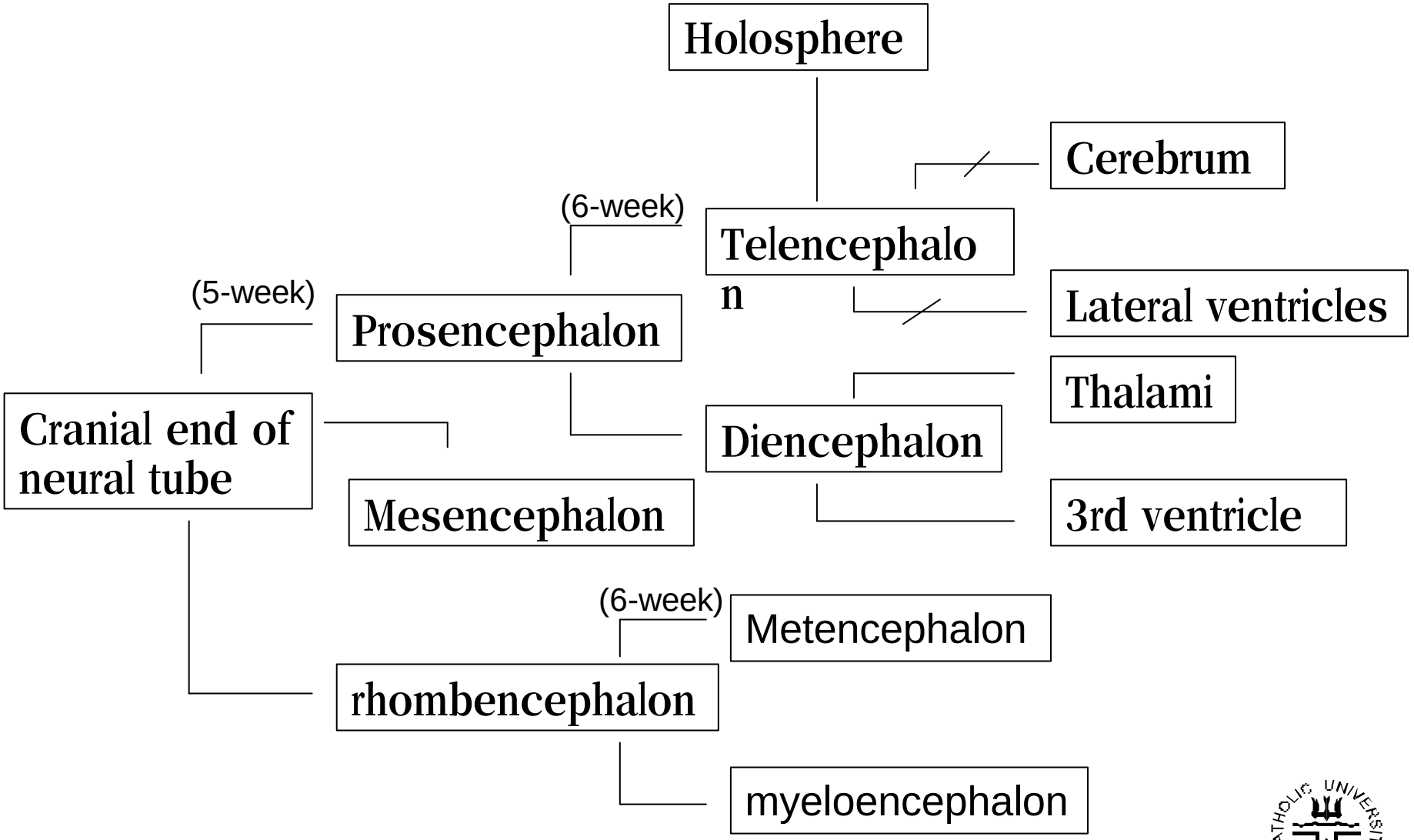
Herniation of the intracranial contents through a bony defect in the skull

Iniencephaly

- Neural tube defect
- Missing Occipital bone
- A large hole connecting to the foramen magnum
- Fusion and disintegration of the vertebrae
- Shortening of CRL
- Torsion of chest, Shortened trunk, Lung hypoplasia
- Star gazing position
- Malformation of internal organ
- Large cystic hygroma-like structure
- Not Completely assessed vertebra column
- Relatively long upper limbs , short upper limbs

Spina bifida

- Cranial sign: lemon sign
- Cerebellar sign: banana sign
- Small rhombencephalic cavity
- Dysraphic defect of the spine
- Visualization of CBLL is not easy before 14 weeks, it might be confused with choroid plexus of the 4th ventricles


Holosphere
Cerebrum
(6-week)
Telencephalon
(5-week)
Prosencephalon
Lateral ventricles
Thalami
Cranial end of neural tube
Diencephalon
Mesencephalon
3rd ventricle
(6-week)
Metencephalon
rhombencephalon
myeloencephalon

Holoprosencephaly

- Defective division of the forebrain
- Holosphere
- Facial anomaly
- Hypotelolism
- Proboscis, cyclopia

Cardiac anomalies

- First trimester transvaginal echocardiography should be restricted to the high-risk fetus

1. Cases with other fetal anomalies(nuchal edema, hygroma, non-immune hydrops, omphalocele, situs inversus, persisting arrhythmia)
2. High risk family with one or more first-degree relatives with cardiac defects)
3. Pregestational diabetes mother

Cardiac anomalies

The most important disadvantages determining the diagnostic accuracy of transvaginal echocardiography, compared with 2nd-trimester echocardiography (Gembruch et al., 1993)

1. limitation of imaging planes by narrow focal range, unfavorable fetal position, limited angles of insonation
2. more difficult spatial orientation
3. small size of the fetal heart size
4. later manifestation of structural and functional changes in some congenital heart diseases

Fetal heart rate

- 5weeks: 110bpm
- 9weeks: 170bpm
- 14weeks: 150bpm
- Trisomy21, 13, turner syndrome: fetal tachycardia
- Trisomy18: fetal bradycardia
- Possible explanation:

difference in the type of associated cardiac defects

Varying degrees of developmental delay (Liao et al.,2000)

Lung cyst

- Cystic adenomatoid malformation
- Bronchpulmonary sequstraion
- Hydro-chylothrax
- Diaphragnatic hernia
- Mediastinal teratoma
- Lymphangiectagia
- leiomyosarcoma

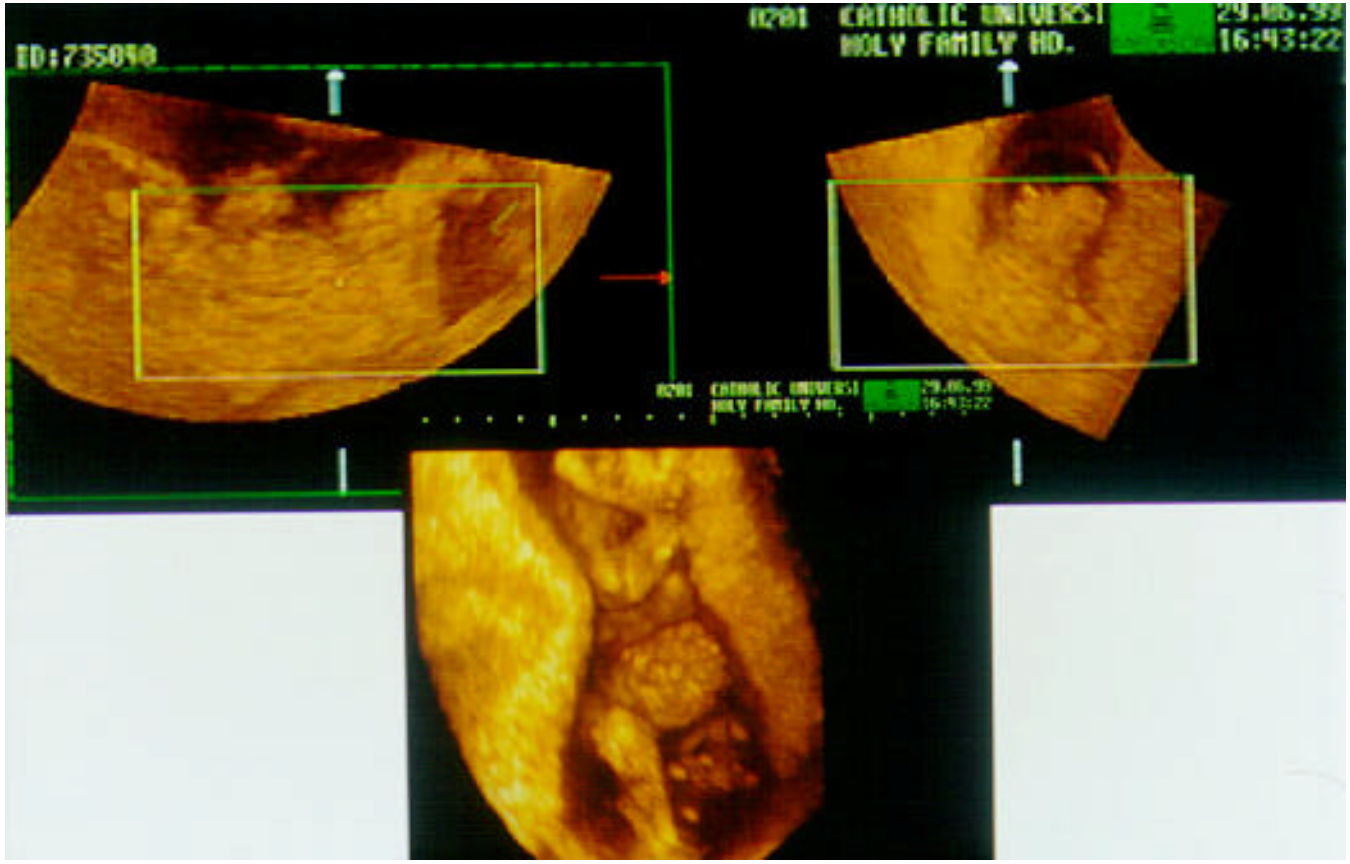
Body-wall defects

- Cranial defects: ectopia cordis,Cantrell's pentalogy, epigastric omphalocele
- Medial defects: medial omphalocele, gastroschisis
- Caudal defects: bladder exstrophy,cloacal exstrophy, omphalocele-imperforate anus-exstrophy bladder-sacral meningocele(OIES)complex
- Complex defect (limb-body-wall complex.LBWC): body stalk anomaly, body wall defect due to amniotic rupture sequence

Pentalogy of Cantrell

- Epigastric omphalocele
- Diaphragmatic defect
- Pericardiac defect
- Sternal defect
- Heart defect

Omphalocele



Omphalocele

- Epigastric omphalocele:

possible diagnosis during week 9

- Medial omphalocele:

difficult diagnosis before 12 weeks' gestation

Body stalk anomaly

- Fetus within the exocelomic cavity
- encephalocele,
- facial cleft,
- anterior abdominal wall defect,
- kyphoscoliosis,
- limb deformation.
- absent or short monoarterial umbilical cord

Pathogenesis:

- embryonic dysplasia, teratogenic exposure in early pregnancy,
- mechanical damage due to early amnion rupture and vascular disruption of the early embryo.

Diaphragmatic hernia

- Diaphragm: Complete by 9wk
- Dx: usually made by 20wk, early as 12wk
- Chromosome or other anomaly : 50%
- Survival rate after postnatal surgery: 50%

Gastrointestinal anomalies

- A few cases reported during first trimester
- Esophageal atresia
- Esophageal atresia with duodenal stenosis
- anal atresia
- Intraabdominal cyst or tumors

Genitourinary anomalies

- Urinary bladder dilatation (megacystis)

Posterior valves syndrome

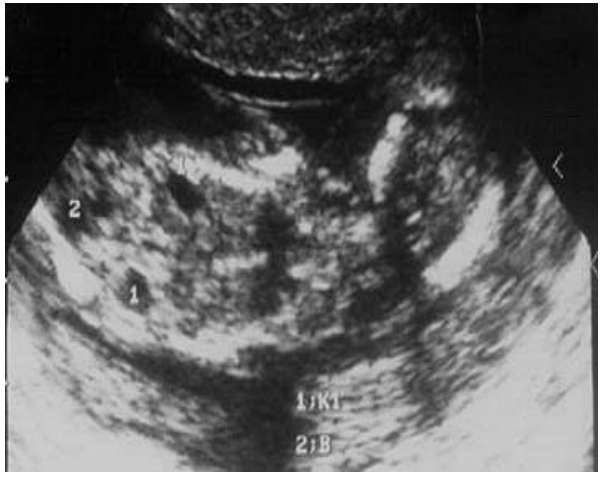
Urethral atresia

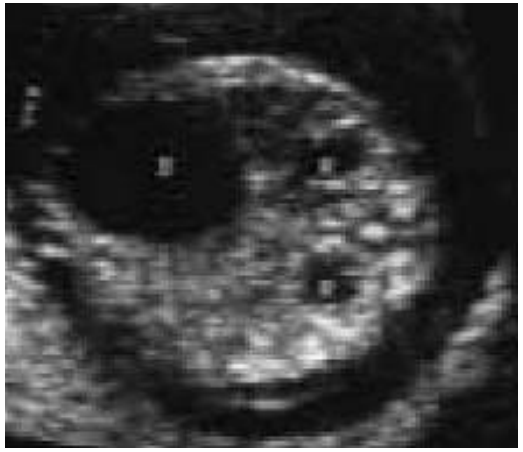
- Multicystic kidney
- Renal agenesis

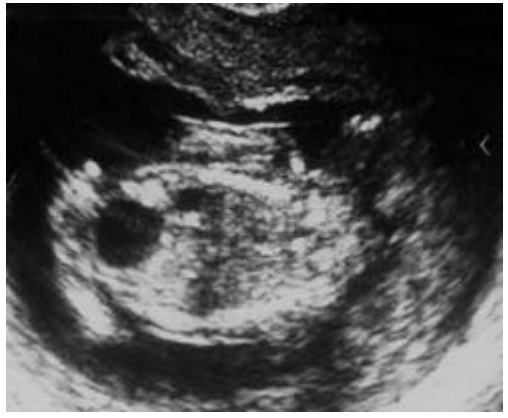
Renal agenesis

- Normal amniotic vol.
- Absence pf echogenic masses in the fetal flanks
- Hypoechogenic masses(adrenals) in the fetal flanks in association with absence of the bladder and oligohydramnios.
- Hypoehogenic masses(adrenals) in the flank in association with a small urinary bladder and normal AF prior to 17 weeks' gestation.

Hydronephrosis







13-week

Megacyctis

- Prognosis of early fetal megacystis: poor
- Associated malformation:

chromosome anomaly
Anorectal imperforation
Intestinal volvulus
Esphagial atresia
Malformation of teeth, heart, musculpskeletal system
Vesicocentesis

- U/A: Na<100mg/dl, Ca<8mg, $?_2$-microglobulin<5mg/l
- Digestive enzyme from urine & AF

Dx of anorectal imperforation with fistula

- Presence of digestive enzymes from fetal urine and amniotic samples before 15 weeks of gestation ; diagnosis of anorectal imperforation with fistula
- Digestive enzymes; leucine aminopeptidase, intestinal alkaline phosphatase, ?-glutamyl transpeptidase

- Primitive hindgut? left third to half of the transverse colon, descending colon, sigmoid colon, rectum, sup. of anal canal, epithelium of the urinary baldder, most of the urethra
- Terminal portion of the hindgut, the cloaca, is devided by the urorectal septum into the rectum and caranial part of the anal canal dorsally and the urogenital sinus ventrally.
- By 9 weeks of gestaton, the urorectal septum has fused with the cloacal memb and divided it into a dorsal

Musculoskeletal anomalies

- Reduction defects of an extremity
- Kyphoscoliosis
- Polydactyly
- Arthrogryposis
- Skeletal dysplasia:
  - achondrogenesis.
  - thanatophoric dwarfism

Hypokinesia

- Median number of fetal movements over 30-min(Jorgensen et al., 1989)
  - 10week:150
  - 11week:159
  - 12week:154
- Only a few trunk rolls, no discrete limb movements over a 20-30min(Johnson et al., 2001)
- Zellweger syndrome, arthrogryposis

Umbilical cord cysts

- Good prognosis
- Seen in the 8-9 weeks' gestation resolve by 12 to 14 weeks

Conclusion

- With EVS, it is possible to image the embryo.
- it has limitation to clarify the all development and abnormalities of embryo and fetus.
- it can suggest some information to help us to estimate and predict for embryo's future.