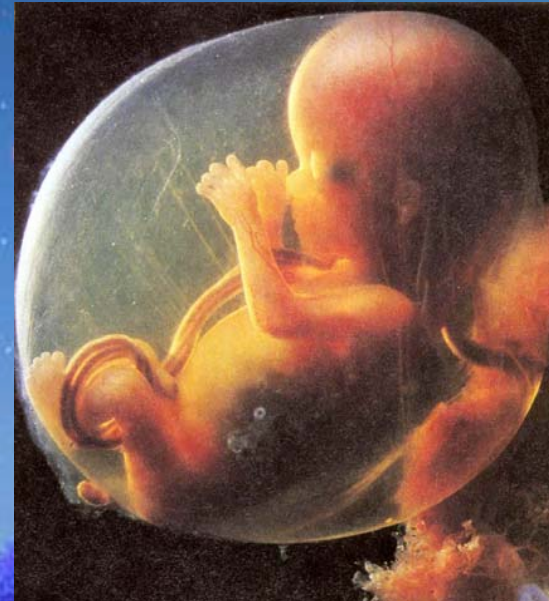


HUMAN EMBRYOLOGY

Department of Histology and Embryology
Jilin University



Chapter 2

General Embryology

Development in Fetal Period

8.1 Characteristics of Fetal Period

- 210 days, from week 9 to delivery.
- characteristics:
 - maturation of tissues and organs
 - rapid growth of the body
 - During 3-5 month, fetal growth in length is 5cm/M.
 - In last 2 month, weight increases in 700g/M.
 - relative slowdown in growth of the head compared with the rest of the body

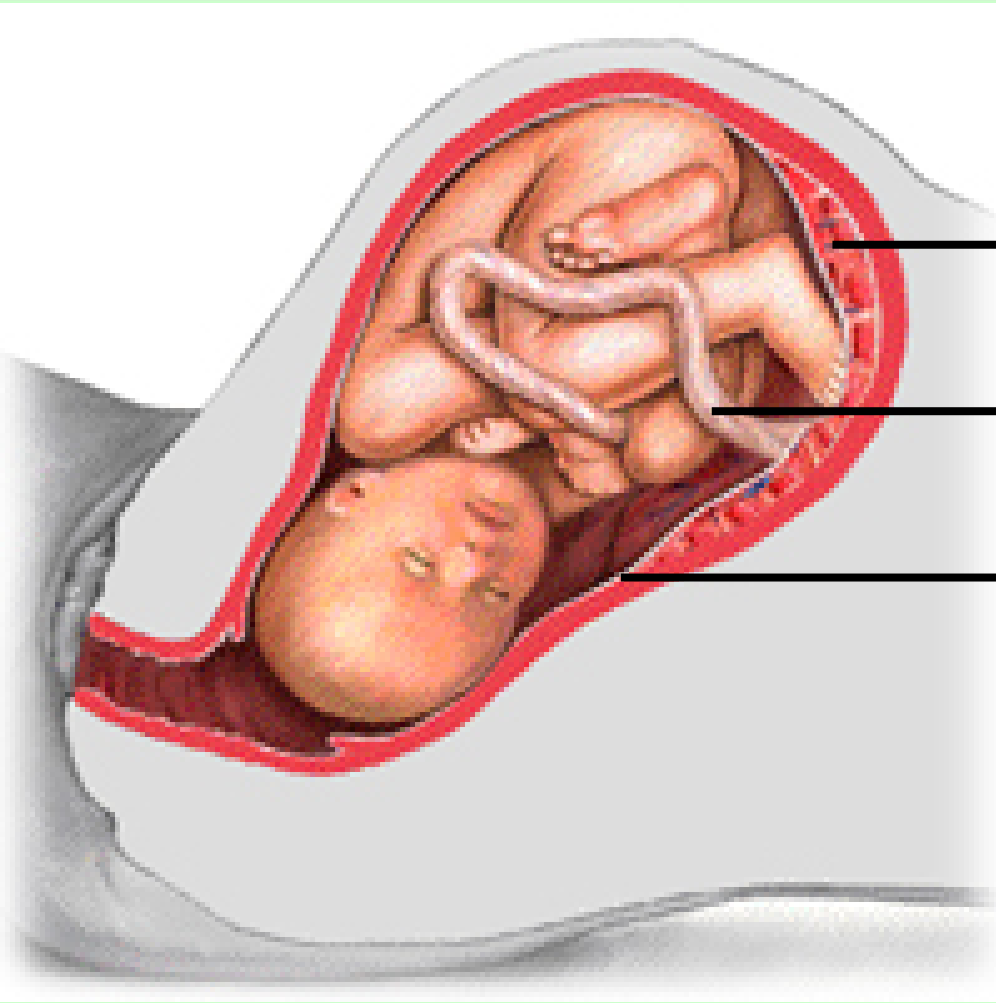
8.2 Fetal AGE

- ❑ Fertilization age lasts 266 days, from the moment of fertilization to the day when the fetal is delivered.
- ❑ menstrual age last 280 days, from the first day of the last menstruation before pregnancy to the day when the fetal is delivered.
- ❑ The formula of expected date of delivery: year +1, month -3, day+7.

Chapter 2

General Embryology

Fetal membranes and placenta



placenta { Villous chorion
Decidua basalis }

Umbilical cord { Afterbirth/
secundines }

Fusion of amnion,
smooth chorion,
decidua capsularis,
decidua parietalis } Fetal
membrane }

9.1 Fetal Membranes

- The fetal membrane includes chorion, amnion, yolk sac, allantois and umbilical cord, originating from blastula.**
- They have functions of protection, nutrition, respiration, excretion, and producing hormone to maintain the pregnancy.**

[delivery](#)

1) Chorion: villous and smooth chorion

Villus

- primary villus
- secondary villus
- tertiary villus
 - stem villus
 - free villus

chorionic plate

- trophoblast
- extraembryonic mesoderm
- Amnion
- decidua parietalis

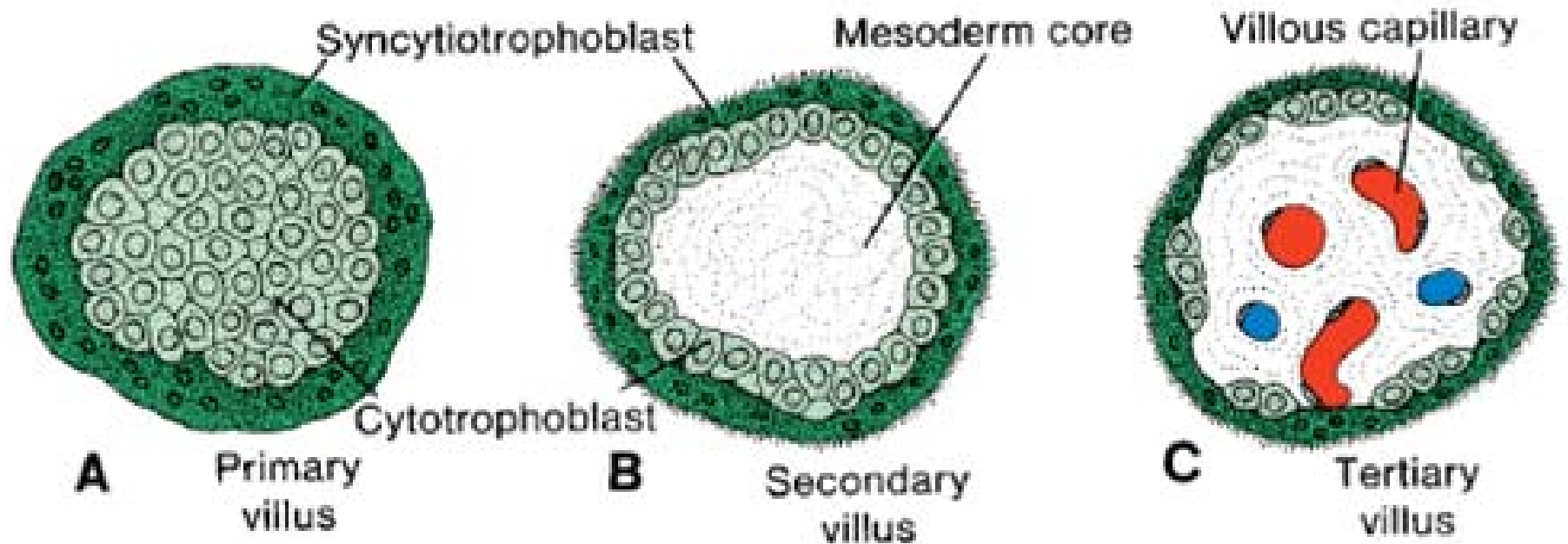


Figure 4.15 Development of a villus. **A.** Transverse section of a primary villus showing a core of cytotrophoblastic cells covered by a layer of syncytium. **B.** Transverse section of a secondary villus with a core of mesoderm covered by a single layer of cytotrophoblastic cells, which in turn is covered by syncytium. **C.** Mesoderm of the villus showing a number of capillaries and venules.

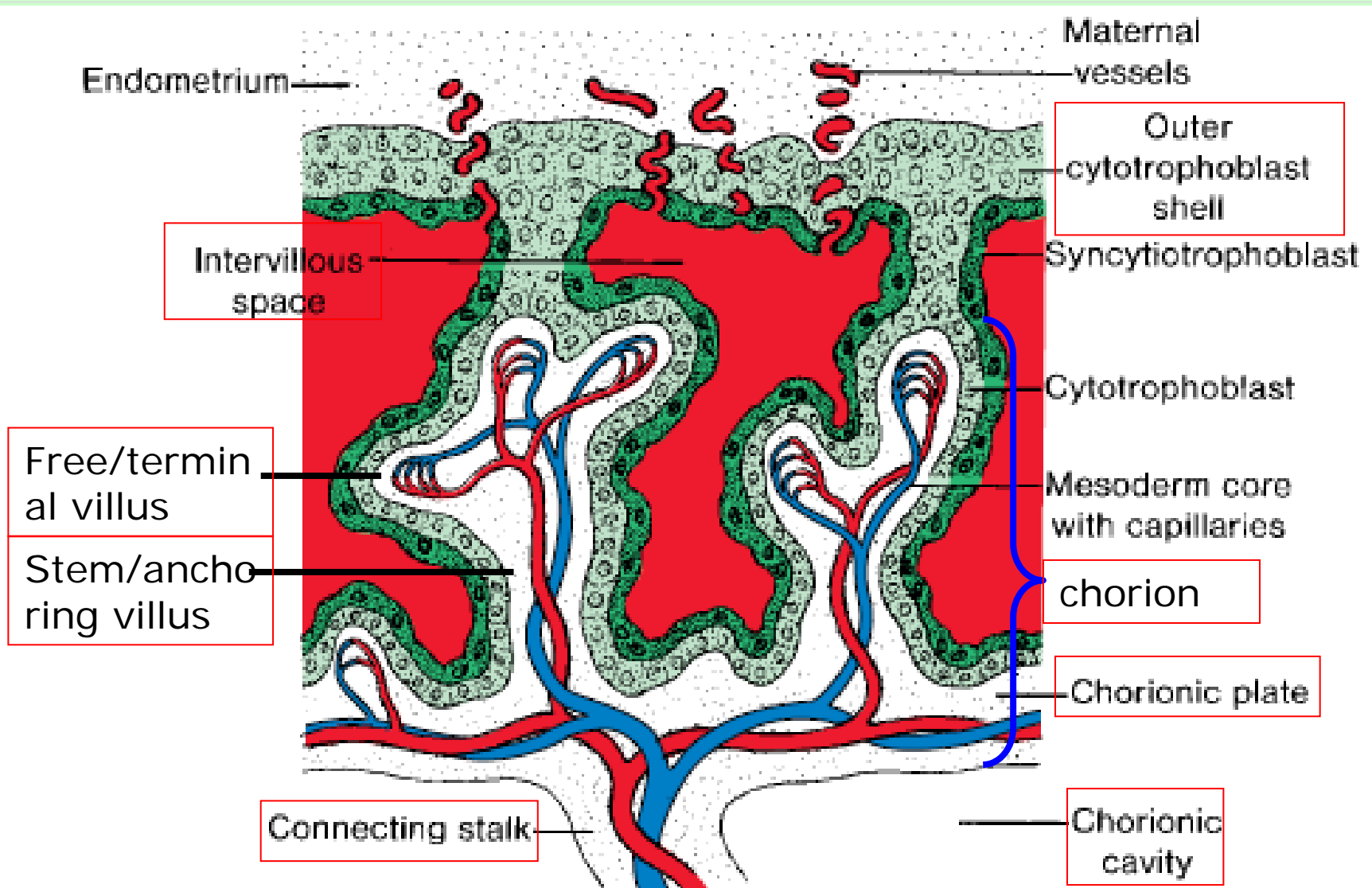
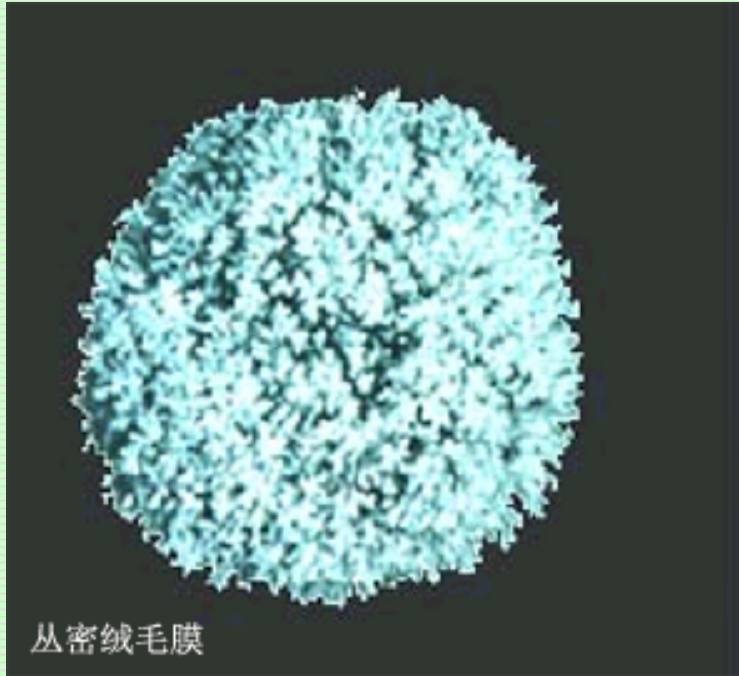
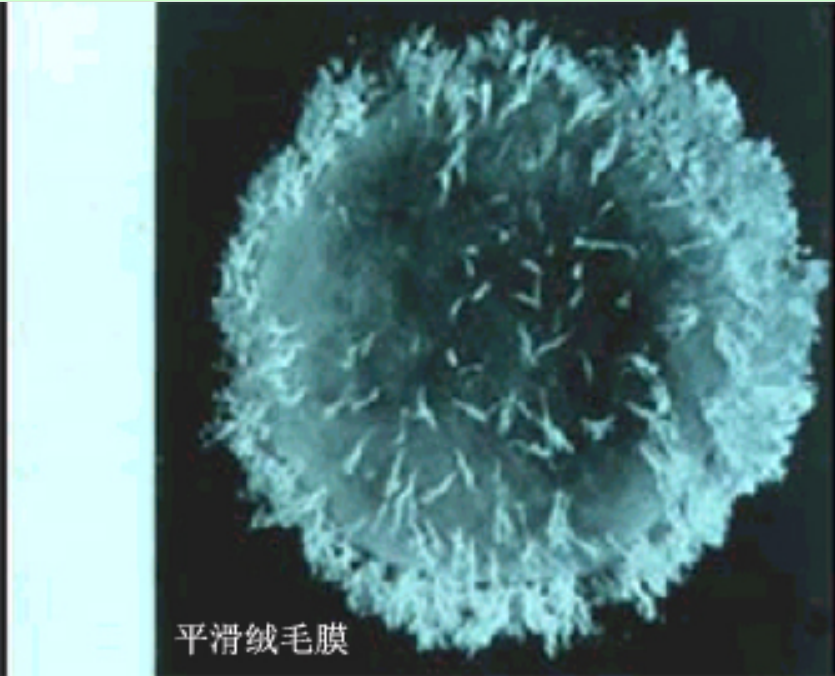


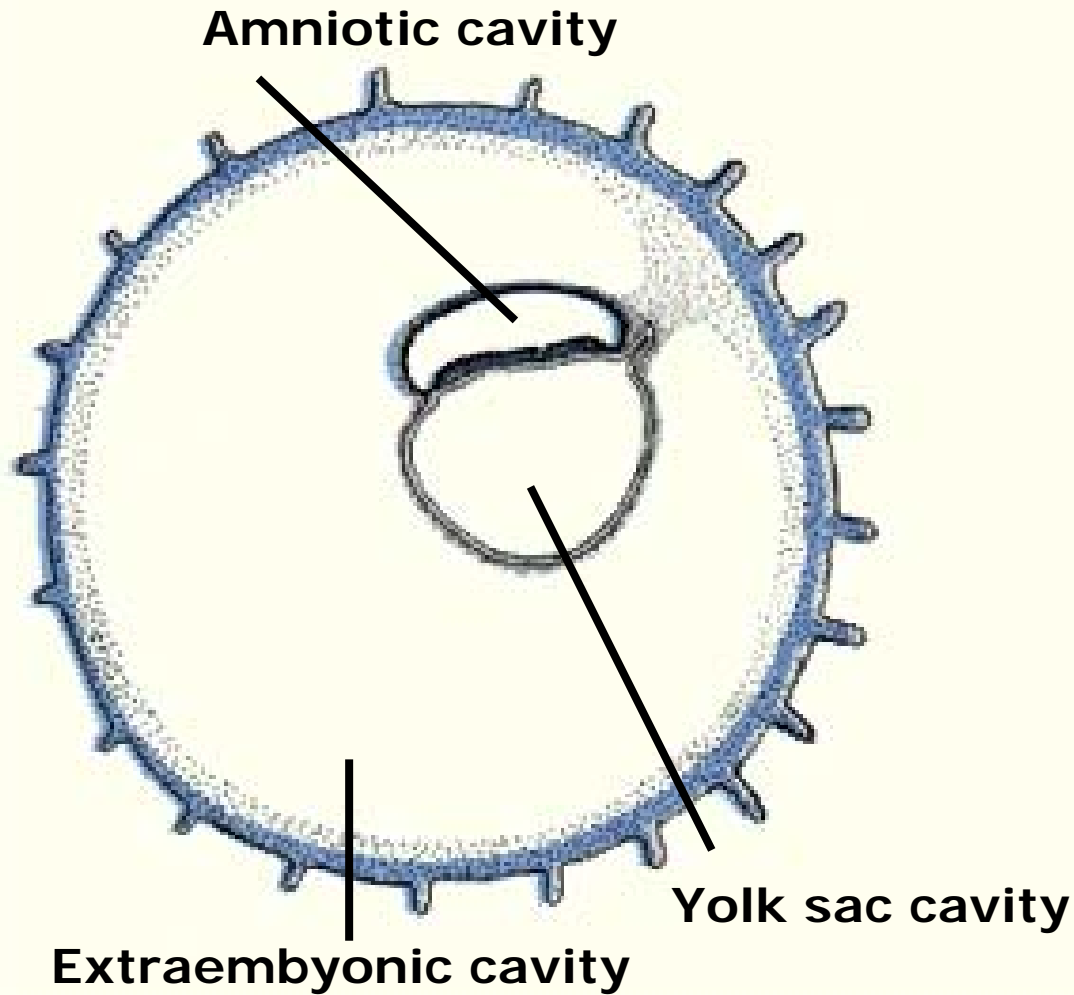
Figure 4.16 Longitudinal section through a villus at the end of the third week of development. Maternal vessels penetrate the cytotrophoblastic shell to enter intervillous spaces, which surround the villi. Capillaries in the villi are in contact with vessels in the chorionic plate and in the connecting stalk, which in turn are connected to intraembryonic vessels.



Villous chorion



Smooth chorion

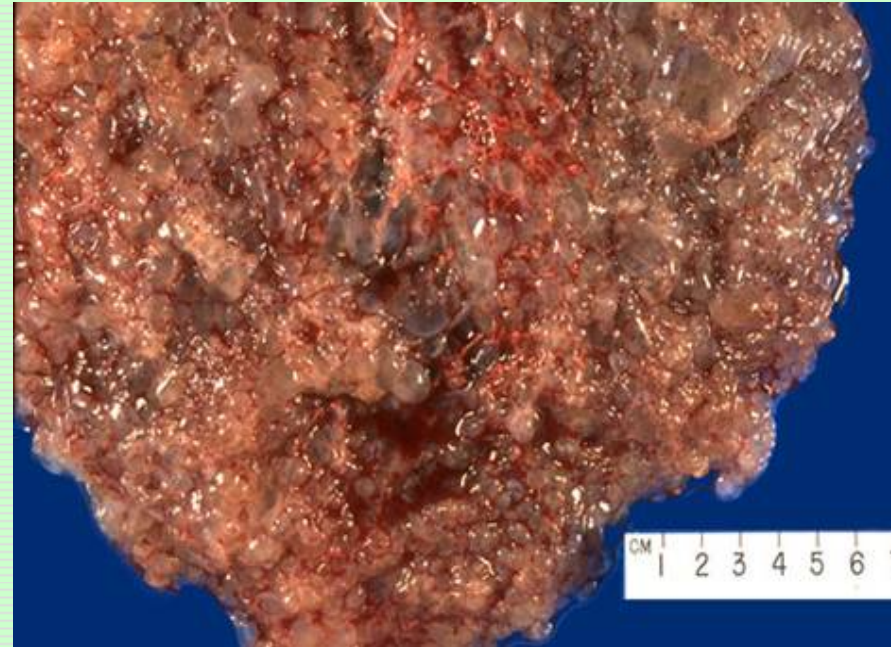


Extraembryonic cavity disappears gradually; Amnion is added into chorionic plate; Villous and smooth chorion is formed.

Formation of chorion



hydatidiform / vesicular mole
Hydropic villi like grapes



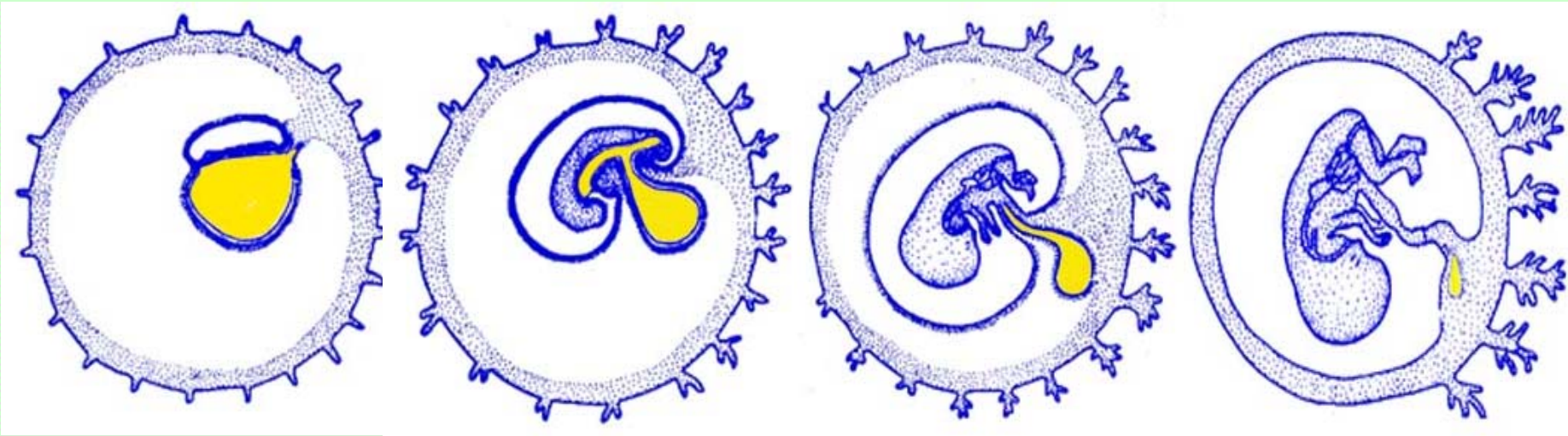
chorionic carcinoma
Dangerous to pregnant women

If trophoblast grows excessively, malignant changes would occur.

2) Amnion

Amniotic membrane:

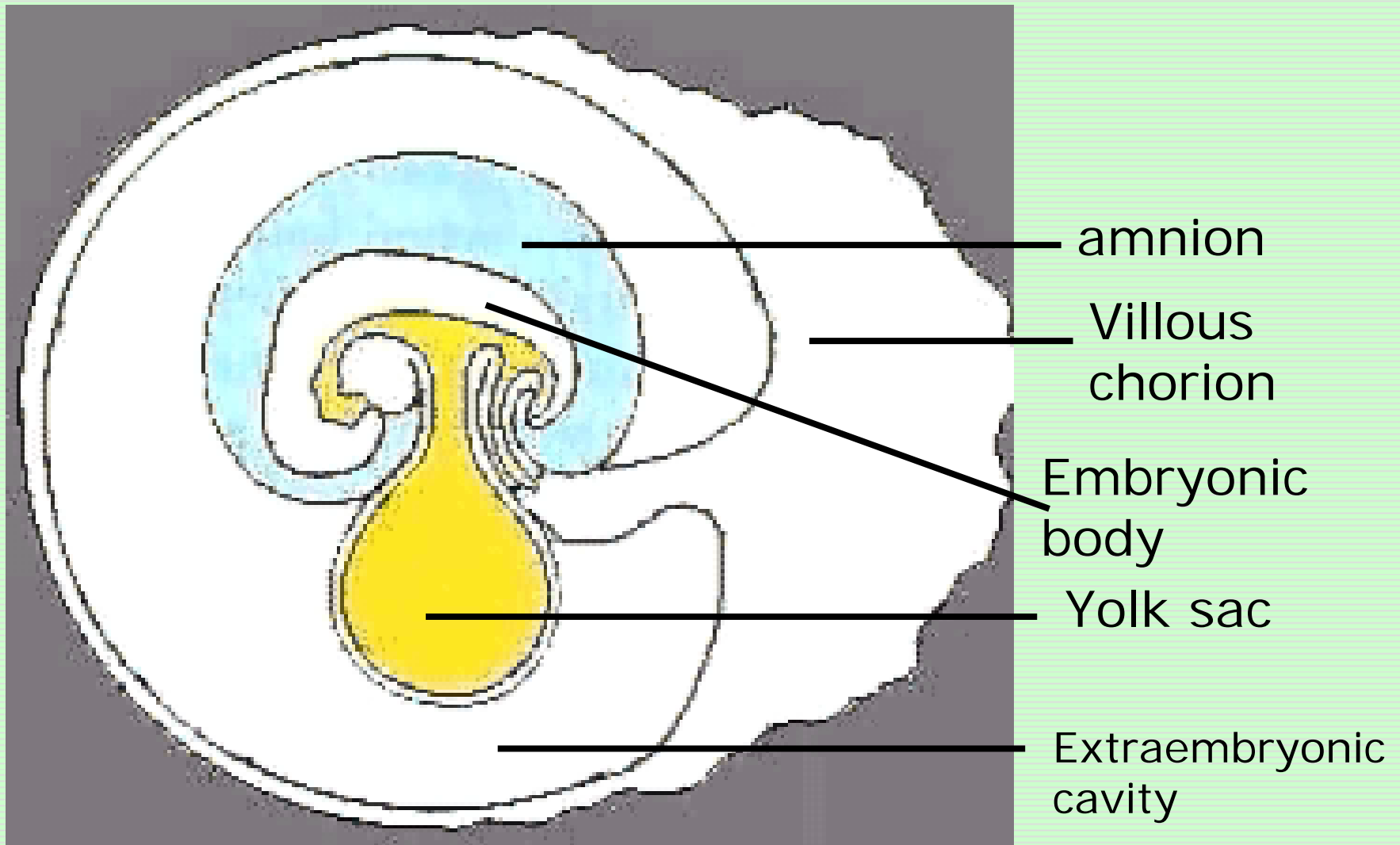
- amniotic epithelium & extraembryonic somatopleuric mesoderm



**bilaminar germ disc
second week**

**With differentiation of
trilaminar germ disc, fetus
form cephalic fold, caudal fold
and lateral folds. amniotic
cavity is dilating gradually**

**At end of the third month,
amnion comes in contact with
chorion, begins to envelop
connecting stalk, yolk sac and
allantois, giving rise to primitive
umbilical cord.**



Formation of amnion

Amniotic cavity expands, then the extraembryonic cavity become small and disappears gradually.

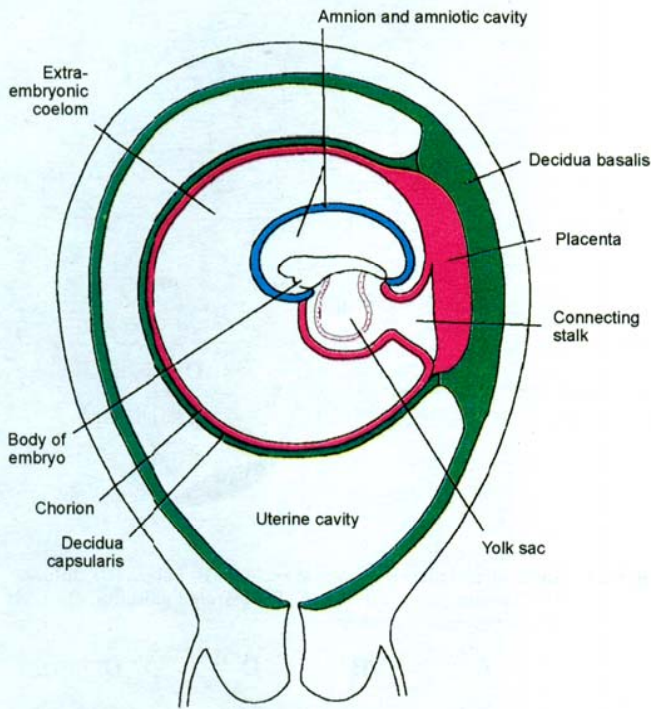


Fig. 6.26 Relationship of amniotic cavity, extra-embryonic coelom and uterine cavity. For description see text.

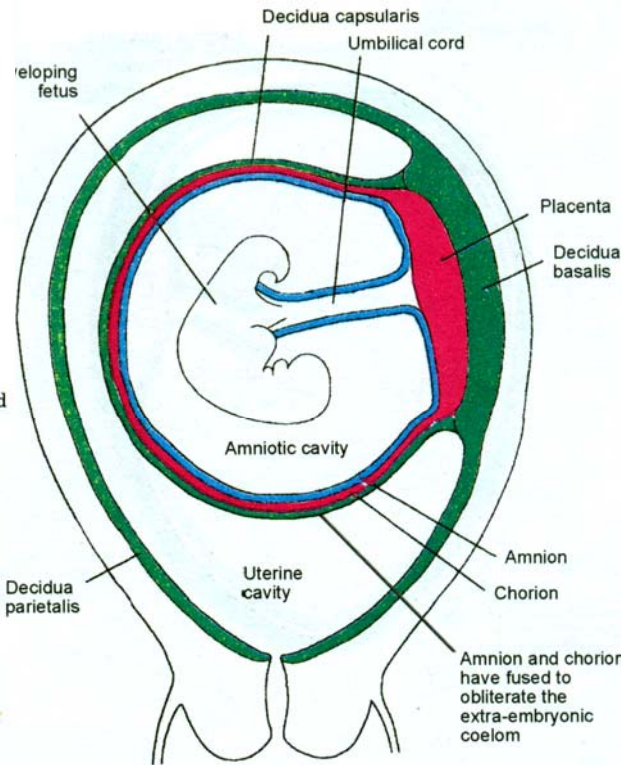


Fig. 6.27 Relationship of amniotic cavity and uterine cavity after obliteration of the extra-embryonic coelom

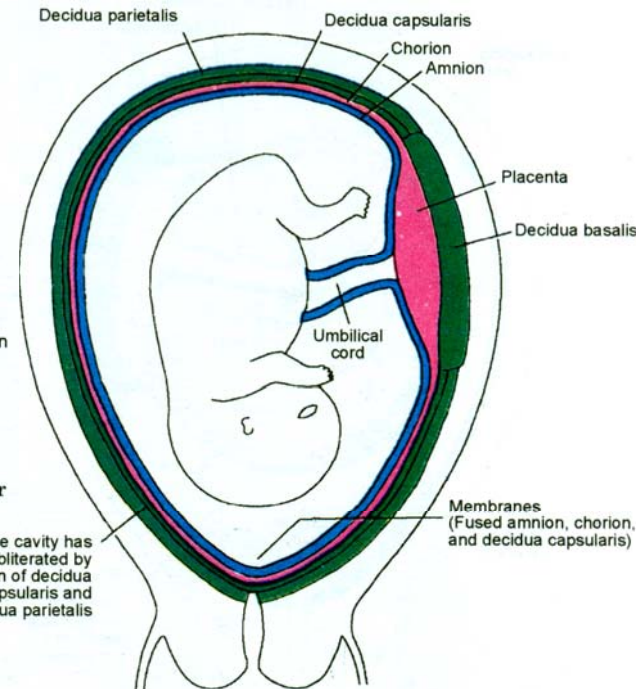


Fig. 6.28 Amniotic cavity after obliteration of the extra-embryonic coelom and uterine cavity

During further development, the uterine cavity disappears finally.

Amniotic fluid:

- ❑ derived from amniotic epithelial cells & penetration of maternal blood
- ❑ From the fifth month: fetal urine
- ❑ slight basic fluid: 1000-1500ml at 37th week
- ❑ The fluid (a) absorbs jolts, (b) prevents adherence of the embryo to the amnion, and (c) allows for fetal movements, (d) rinse the birth canal (cervix and vagina)..



□ Hydramnios /polyhydramnios:

- >2000 ml, abnormal CNS or digestive system



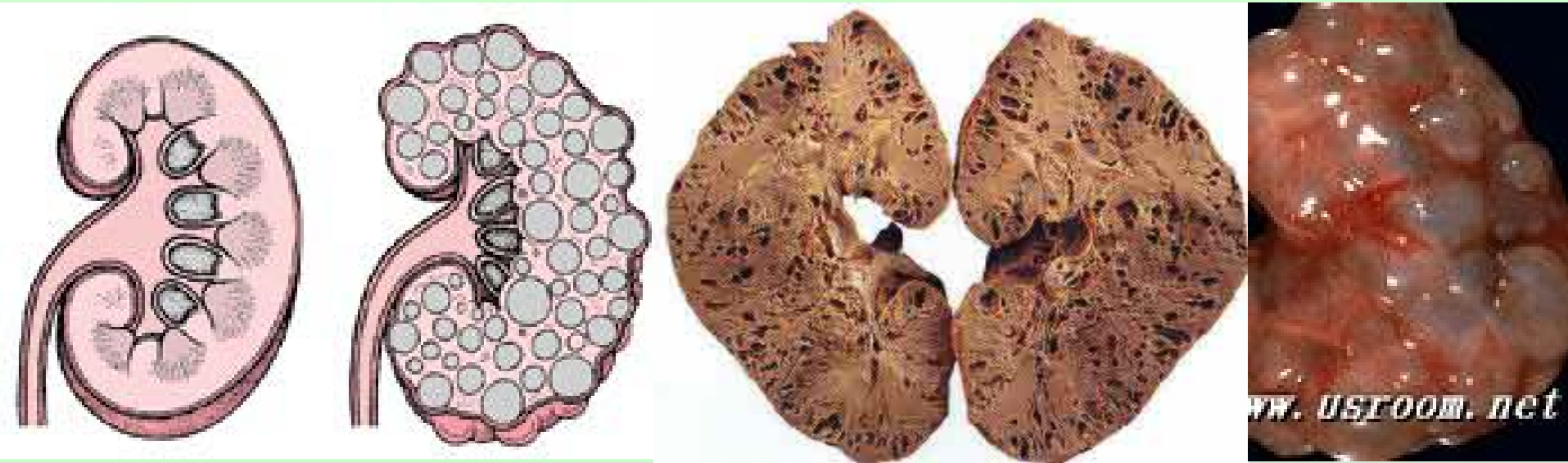
Because the nervous system of anencephalic child is underdevelopment, he/she can't swallow the fluid.



esophageal atresia showed by radioiodine angiography

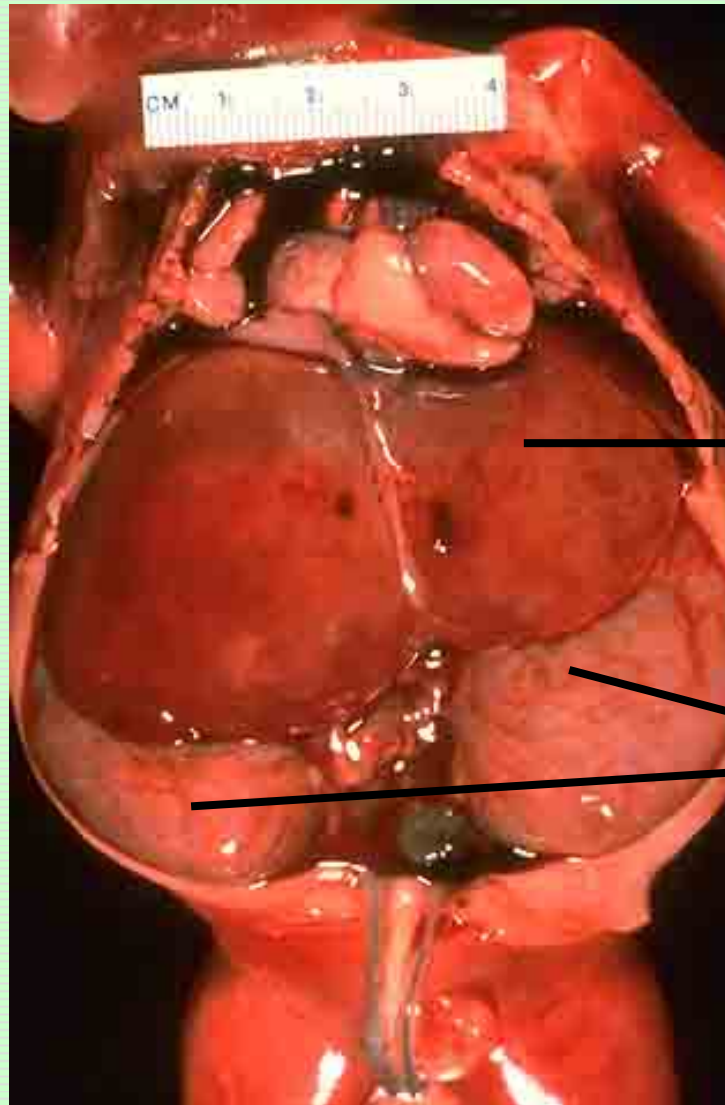
□ **oligohydramnios:**

- **<500 ml, abnormal urinary system**



normal kidney polycystic kidney sagittal section Superficial view

Because distal tubule fails to connect with collecting tubule, the urine is cumulated in renal tubule, causing many cysts.

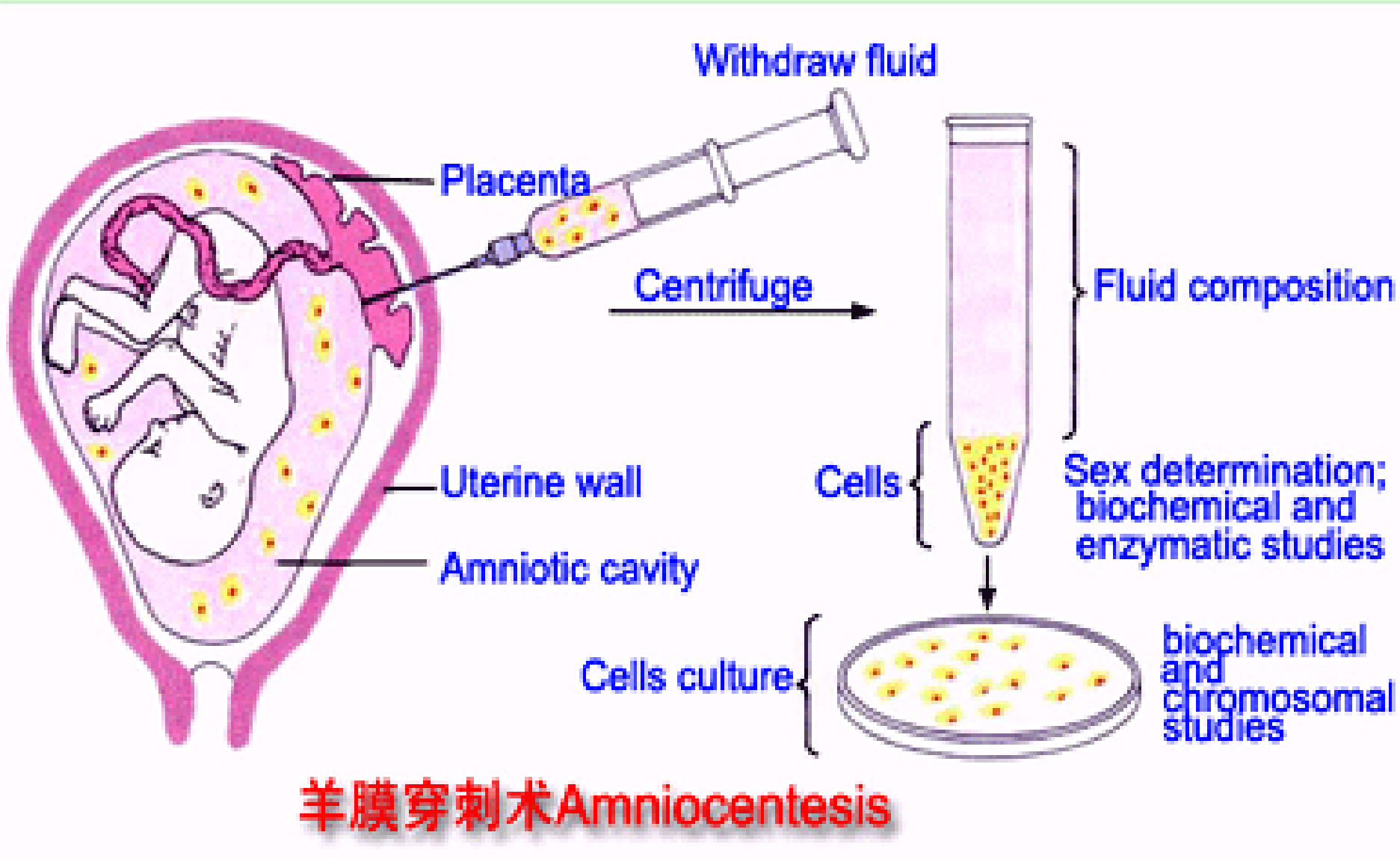


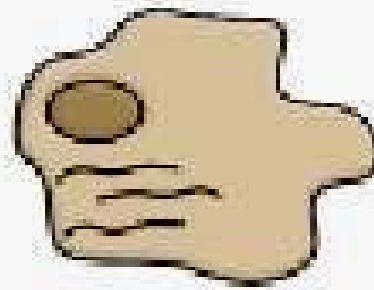
liver

**Large
polycystic
kidney**

The image shows a dead premature infant at 23rd week because of oligohydramnios caused by polycystic kidney.

prenatal diagnosis for birth defects, genetic or molecular analyses

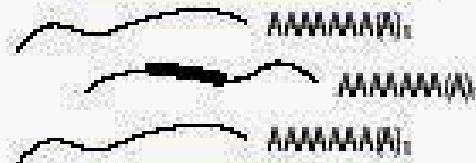




Cells or Tissue

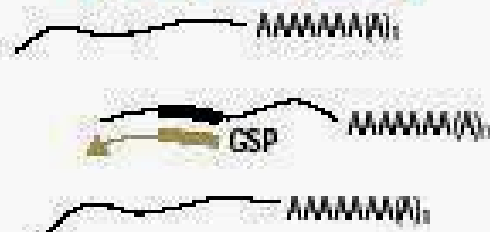
polymerase chain reaction (PCR)

RNA Isolation

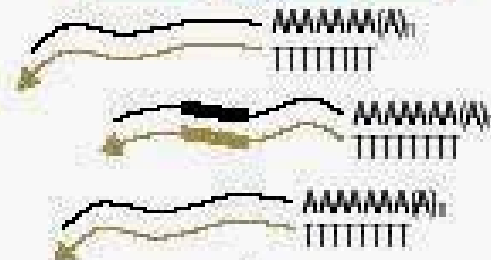


cDNA Synthesis

gene specific priming



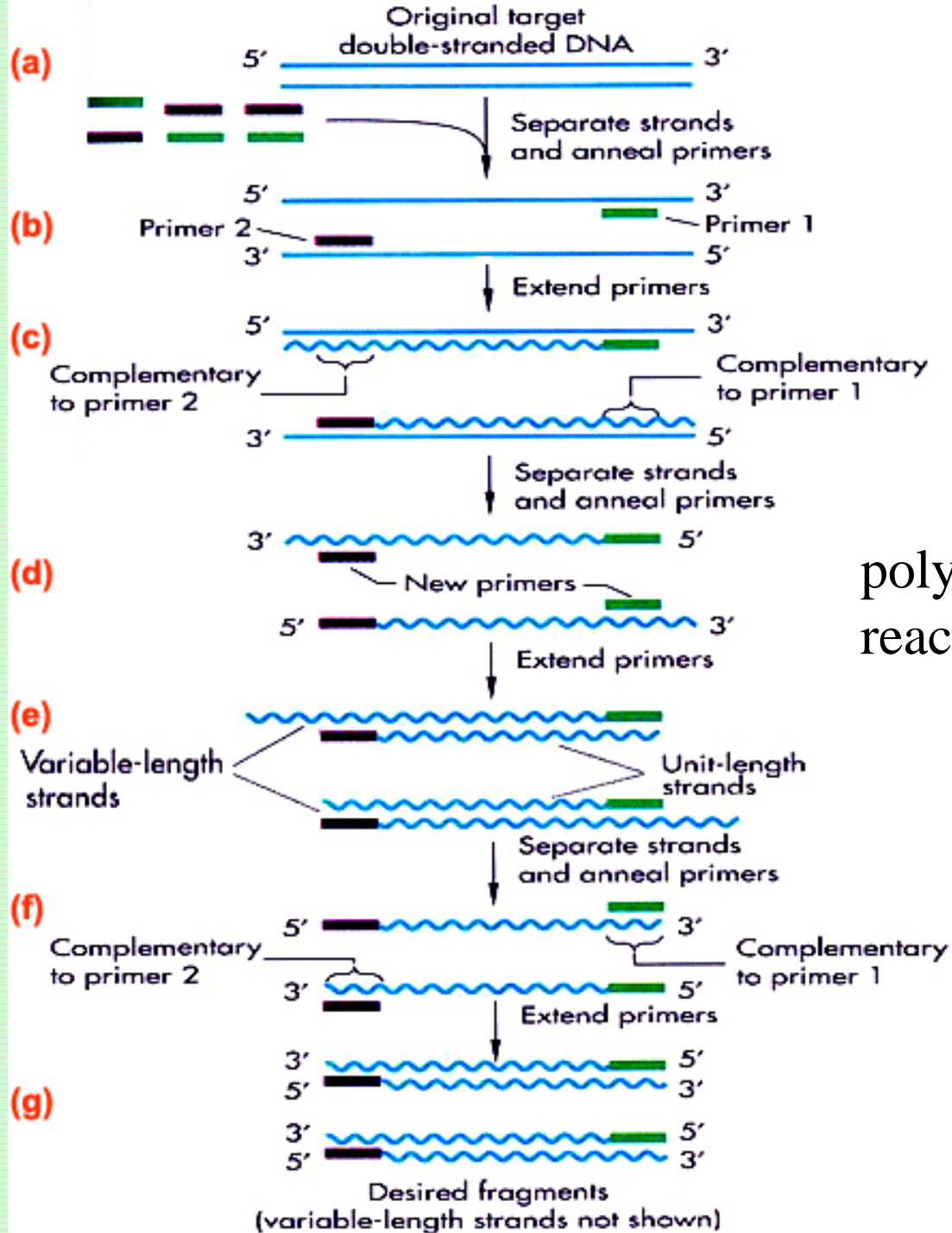
oligo(dT) priming



random hexamer priming



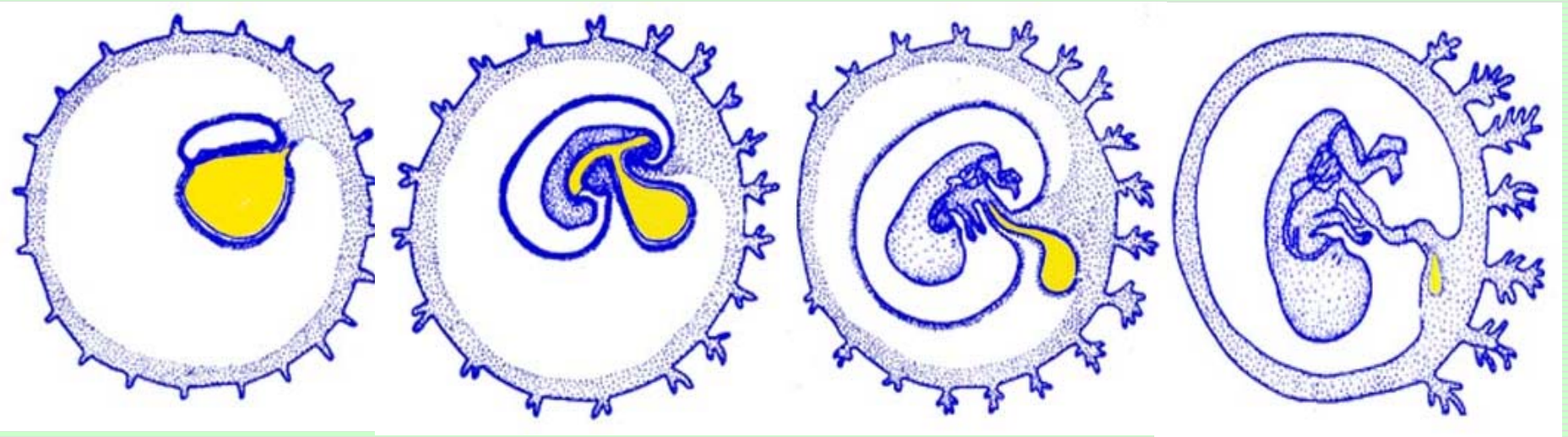
PCR Amplification



polymerase chain reaction (PCR)

3) Yolk sac

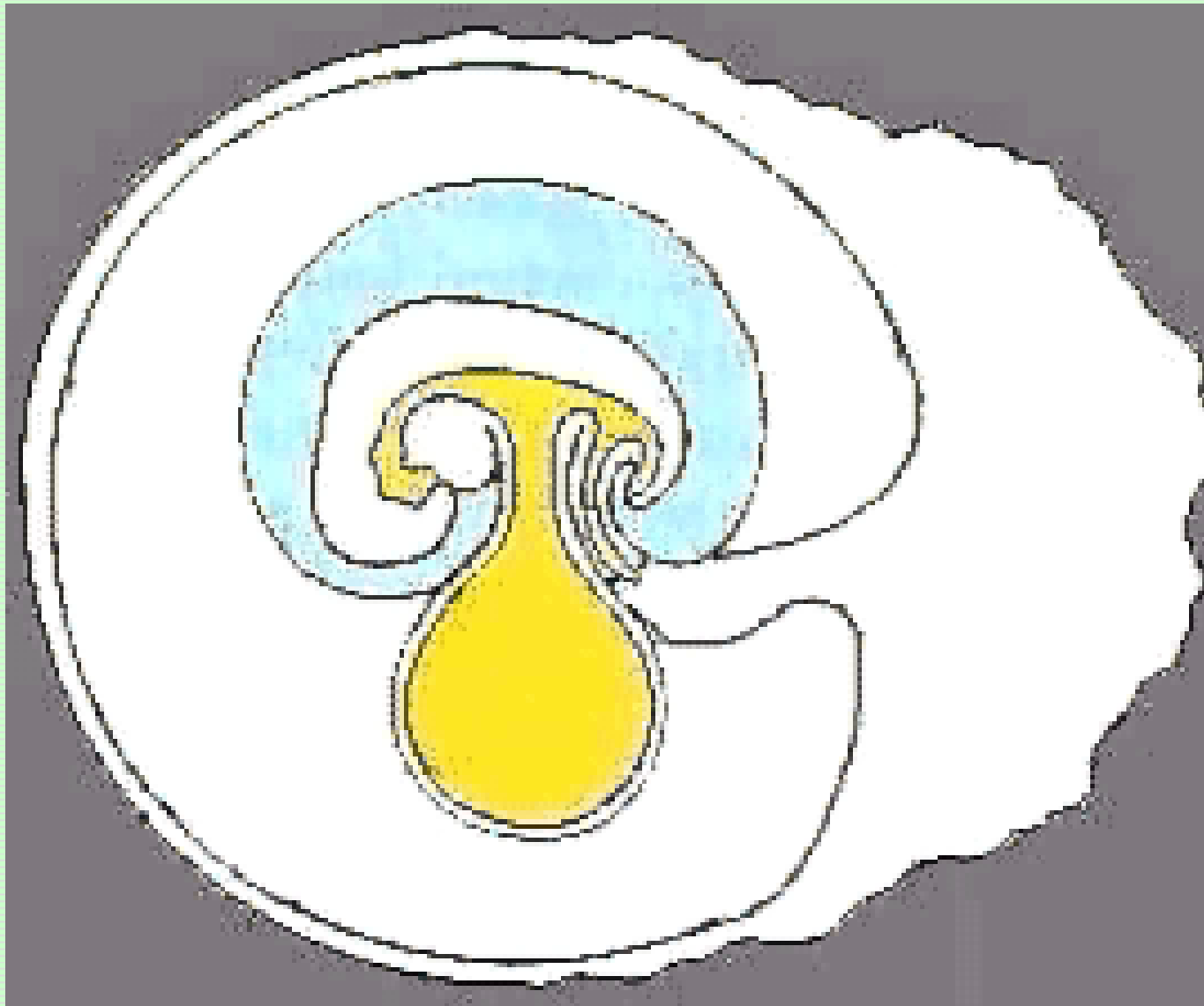
bilaminar germ disc trilaminar germ disc



- 2ne week: yolk sac is covered by extraembryonic splanchnopleuric mesoderm.
- As endoderm is folded into embryo, it becomes narrowed.
- Vitelline duct is gradually obliterated.
- The part of yolk sac outside the embryonic body is connected to primitive umbilical cord and shrinks and is gradually obliterated.



vitelline duct



Derivative of yolk sac

The mesoderm covering yolk sac forms blood island

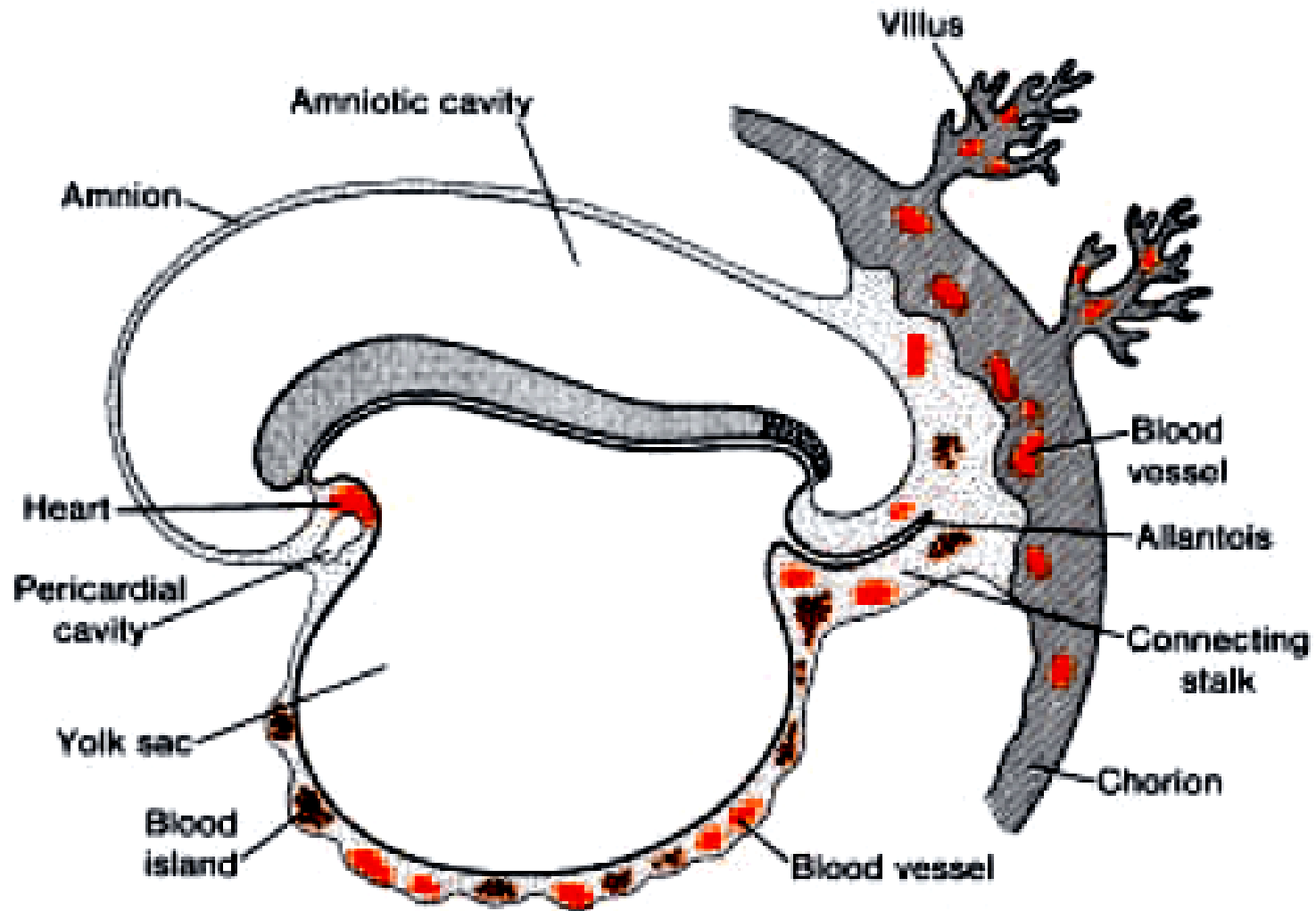
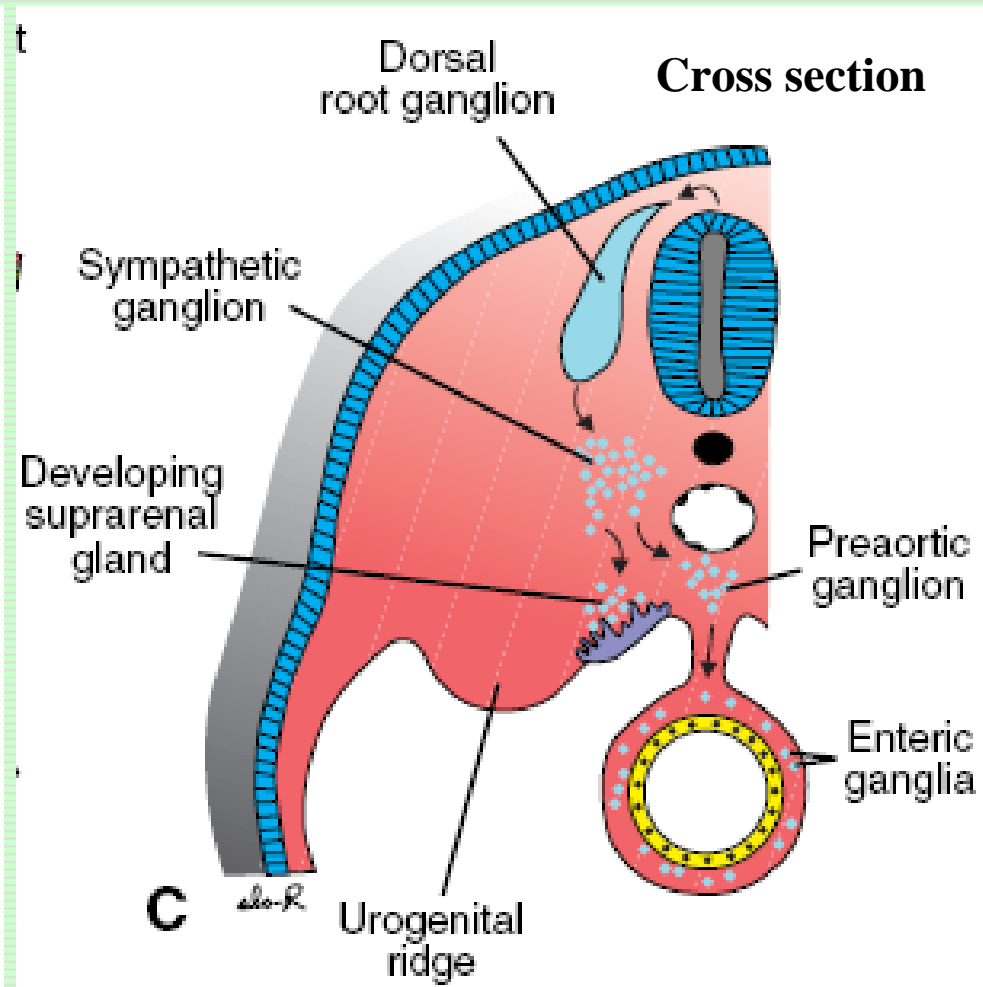
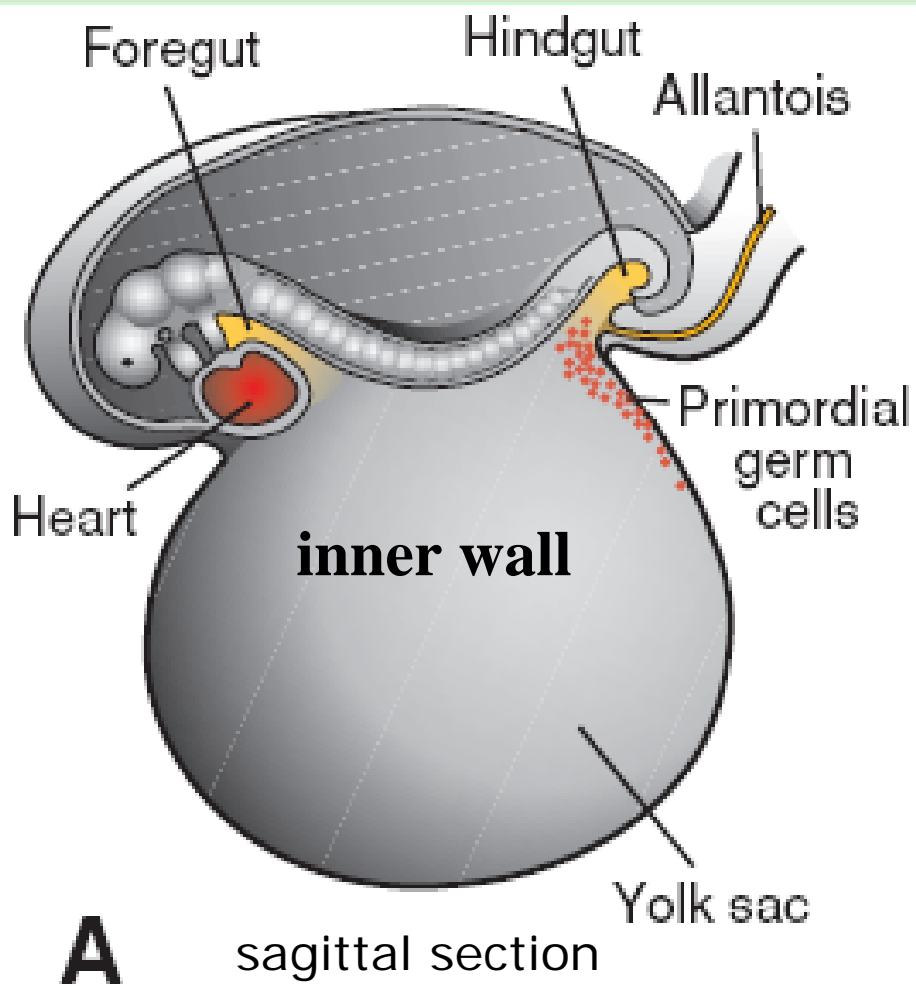
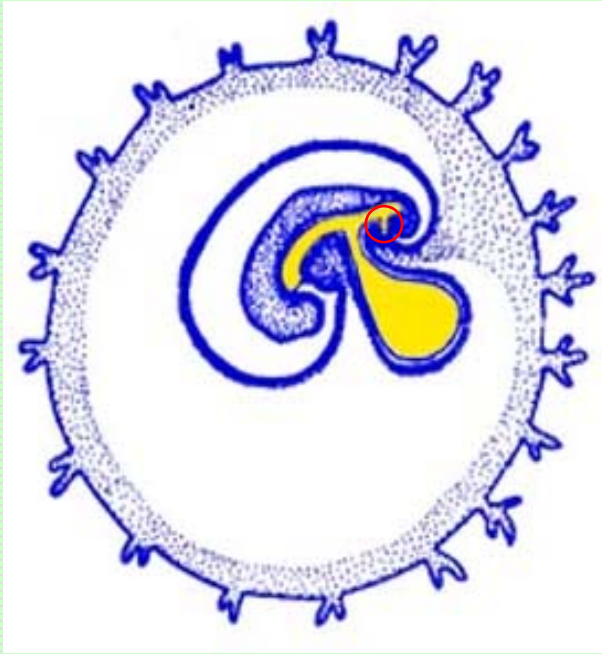


Figure 5.15 Extraembryonic blood vessel formation in the villi, chorion, connecting stalk, and wall of the yolk sac in a presomite embryo of approximately 19 days.



A 3-week-old embryo showing primordial germ cells in endoderm lining inner wall of yolk sac close to attached allantois.

4) Allantois (allantoic diverticulum)



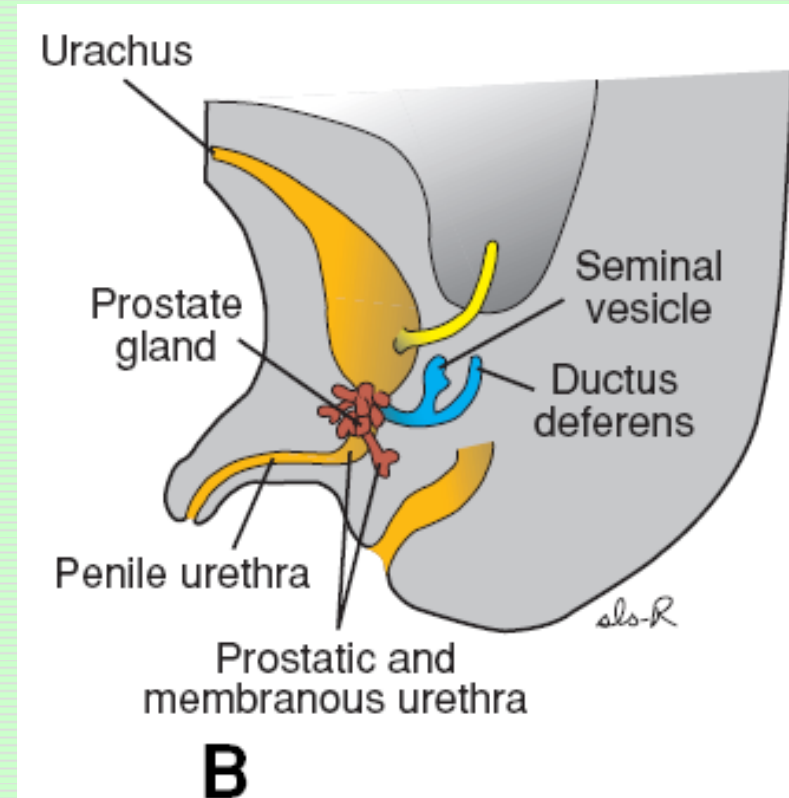
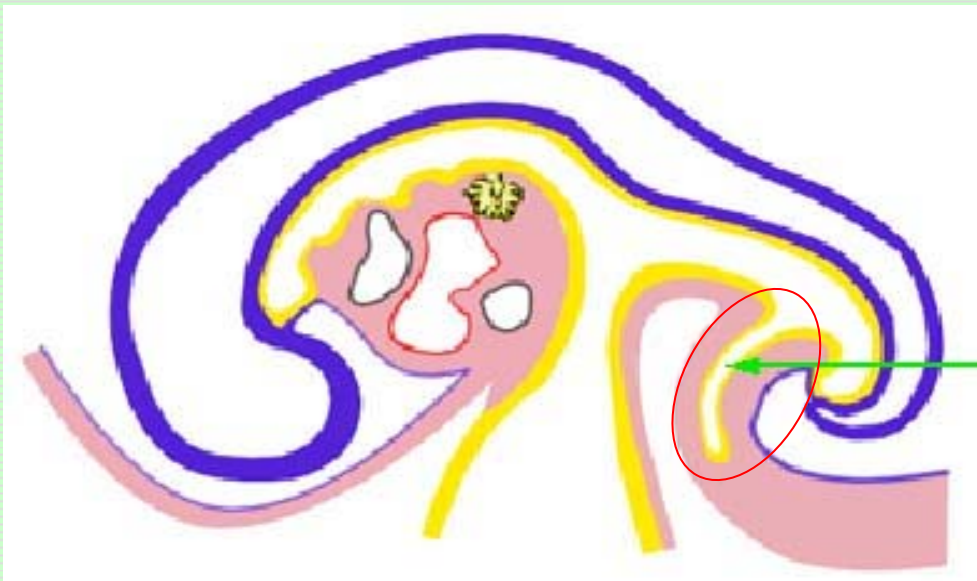
- **Distal portion:**

 - Two allantoic arteries → two umbilical arteries

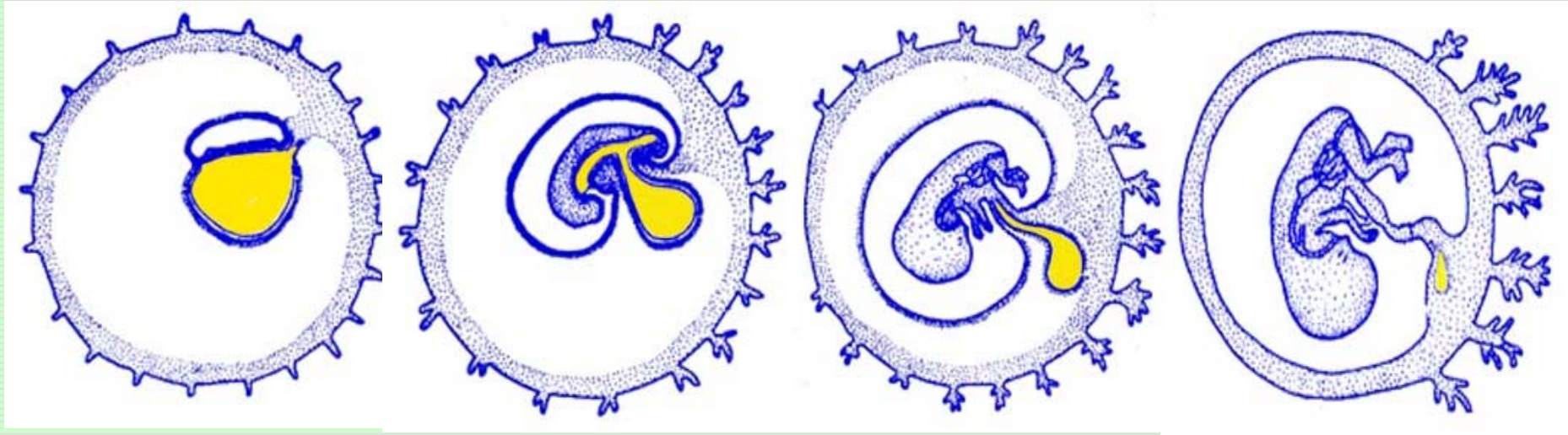
 - Two allantoic veins → one umbilical vein

 - Obliterate → urachus

- **Proximal portion: bladder**

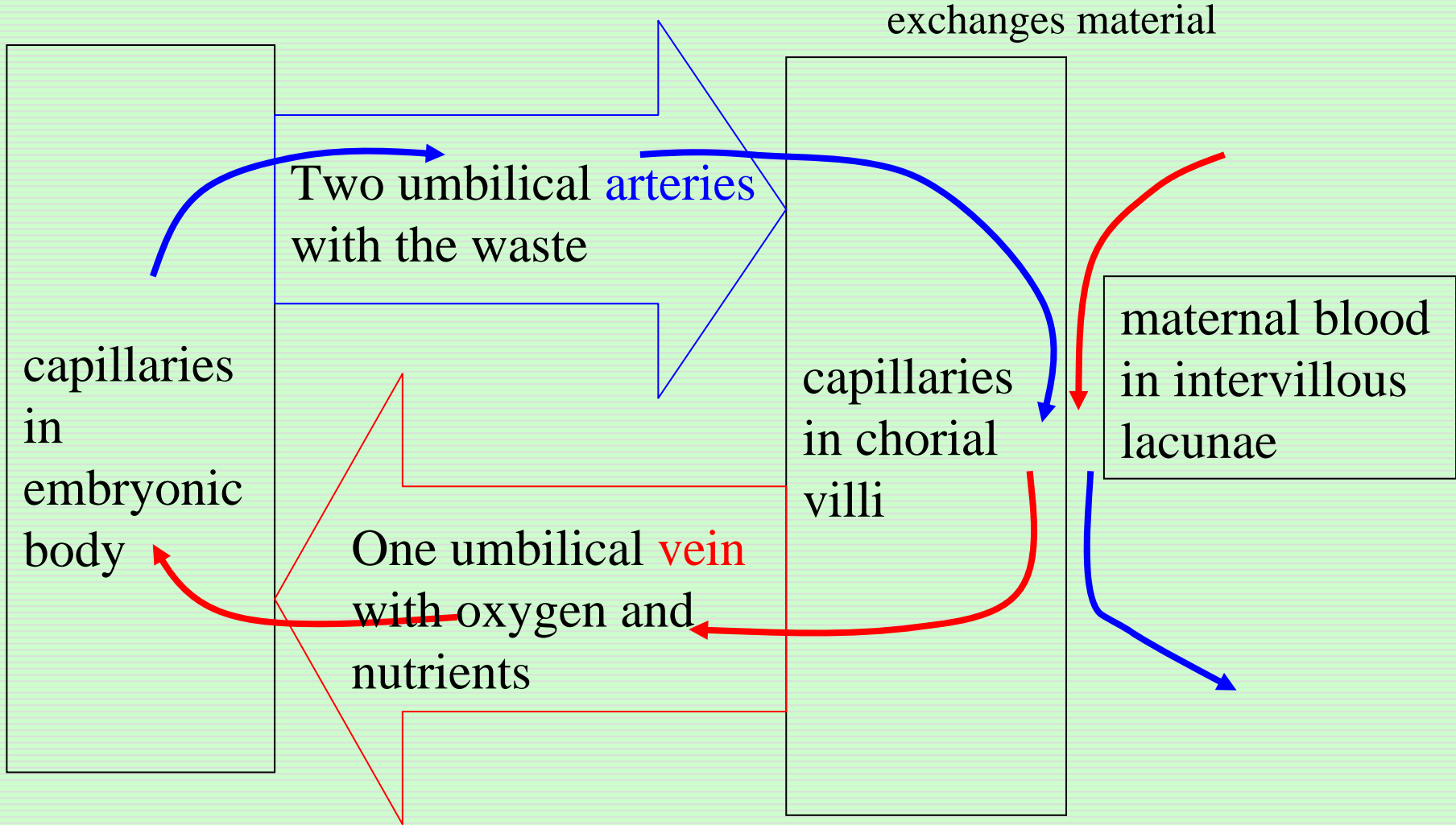


5) Umbilical cord



body stalk → umbilical cord including vitellin duct, allantois, covered by amnion

- surface: amniotic membrane
- cord: yolk sac and allantois, umbilical A & V, jelly of Wharton



- ❑ 40-60 cm long, 1.5-2.0 cm in D at birth, tortuous false knots
- ❑ long cord

circle neck or body,



suffocation /underdevelopment /

true knots,



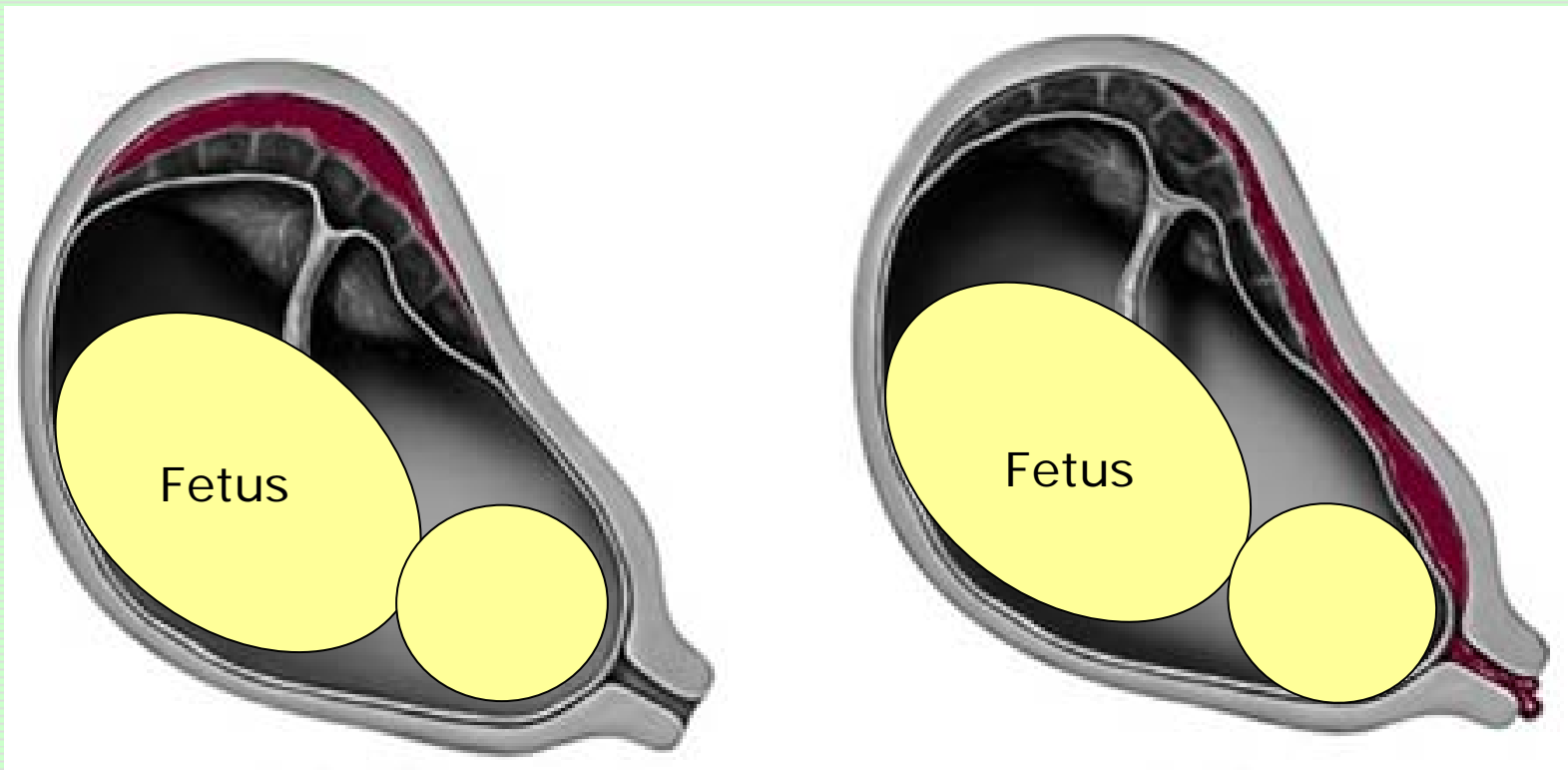
poor blood-supply



uterine-incision delivery



- During the normal delivery, the placenta is expelled after the complete birth of the fetus.
- short cord: placental abruption in early phase of delivery and severe maternal bleeding



occult bleeding

external hemorrhage

Color Doppler Imaging

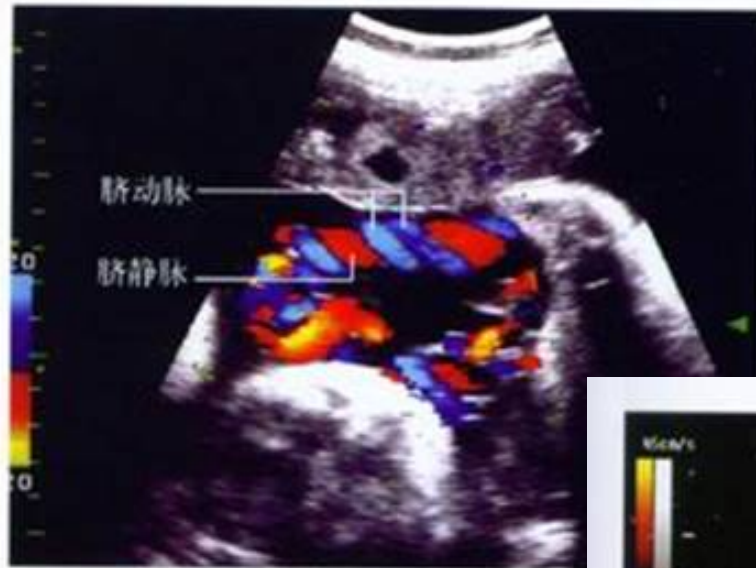


图 6-5-1 正常脐带内两条脐动脉彩

Normal Umbilical cord with two arteries and one vein



图 6-5-4 单脐动脉彩超表现

Normal Umbilical cord with one artery and one vein

edema of cord

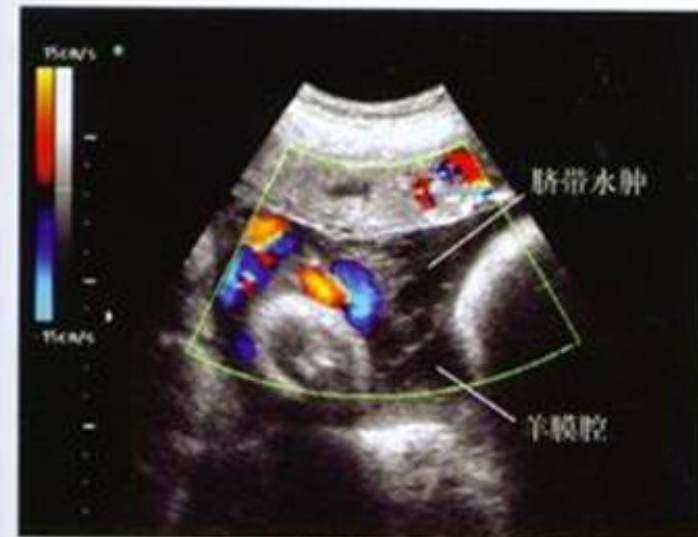


图 6-5-5 脐带水肿声像与彩超表现

Color Doppler Imaging

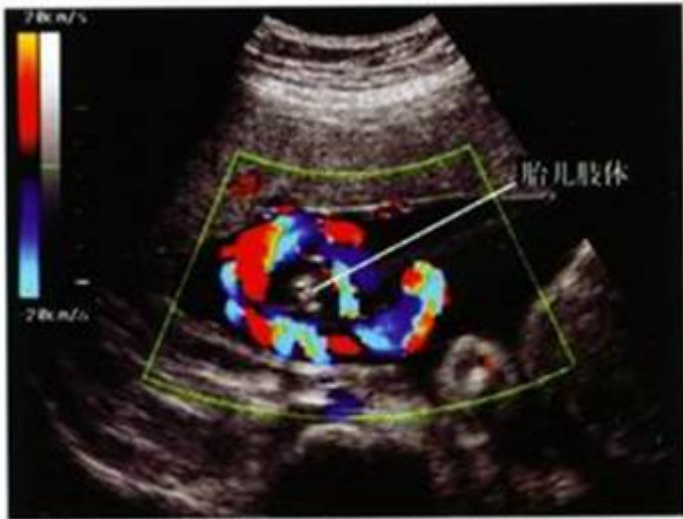


图 6-5-10 脐带绕肢体彩超表现

**Umbilical cord
winds around
embryonic body**

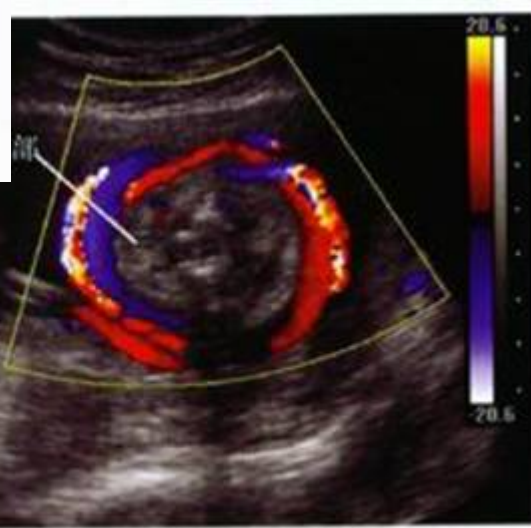


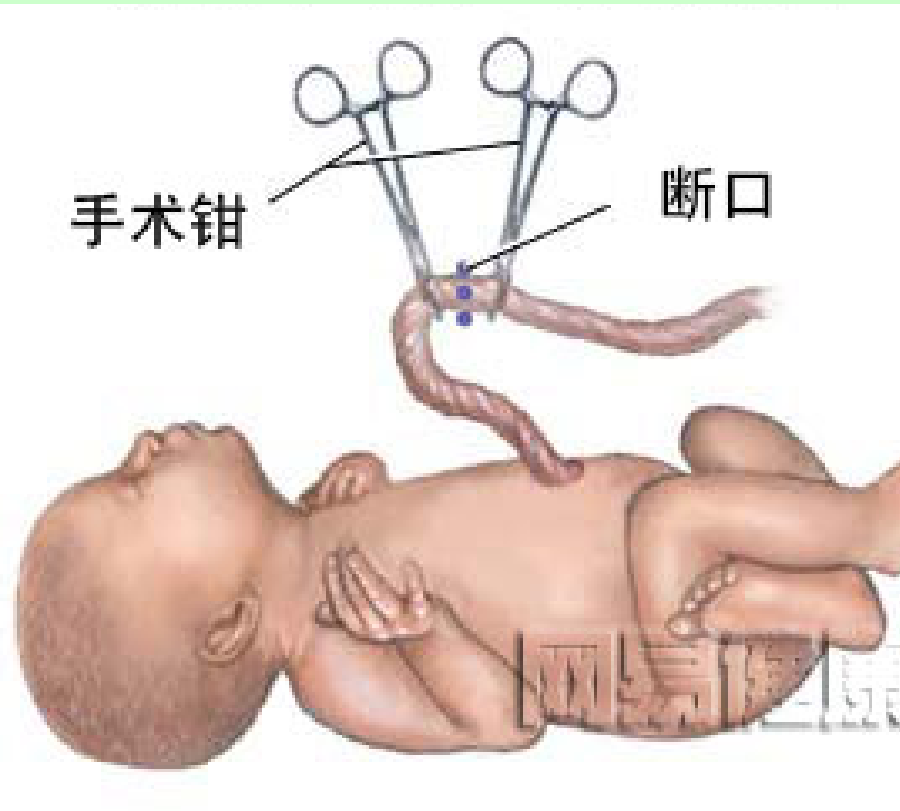
图 6-5-9 脐带绕颈彩超表现

**Umbilical cord
winds around
embryonic neck**

cyst of cord



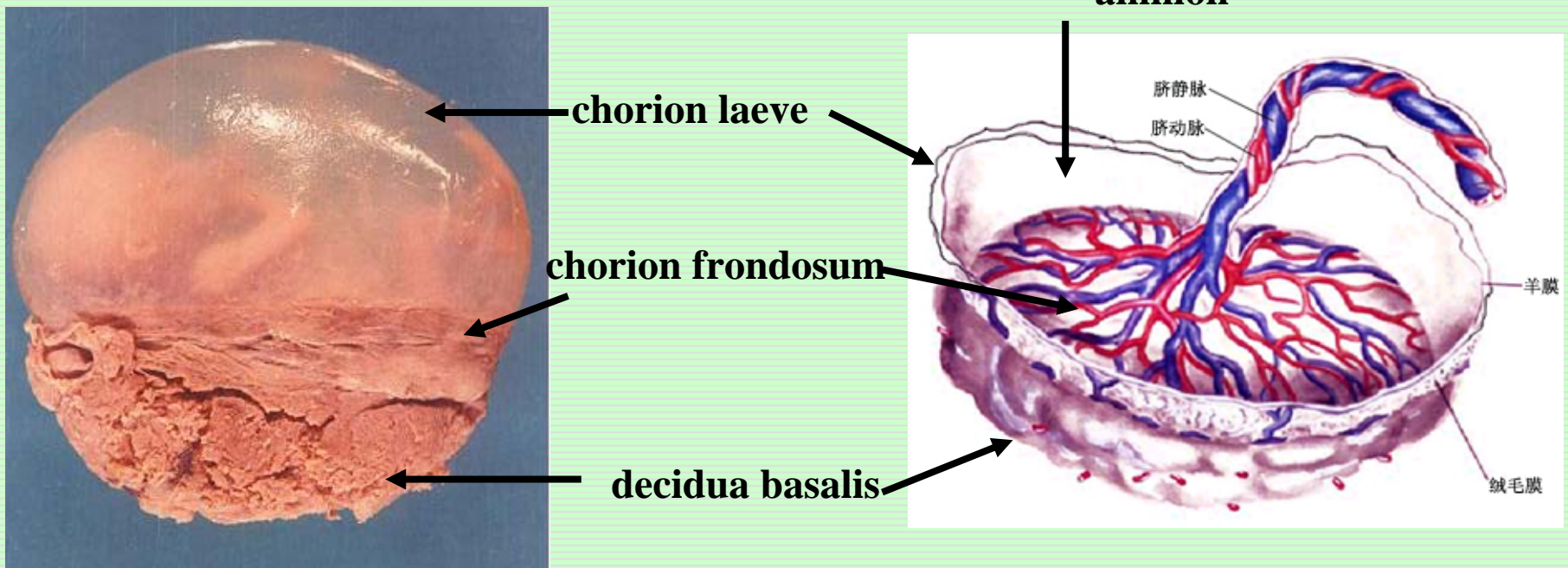
图 6-5-7 脐带囊肿彩超表现



After birth, the umbilical cord is cut off and is ligated. The end of the cord should be taken care to prevent from infection.

9.2 Placenta

- two components:
 - (a) a fetal portion, formed by the chorion frondosum;
 - (b) a maternal portion, formed by the decidua basalis.
- size: round, disc-shaped, 15-25 cm in D, 3 cm thickness, 500-600g in weight



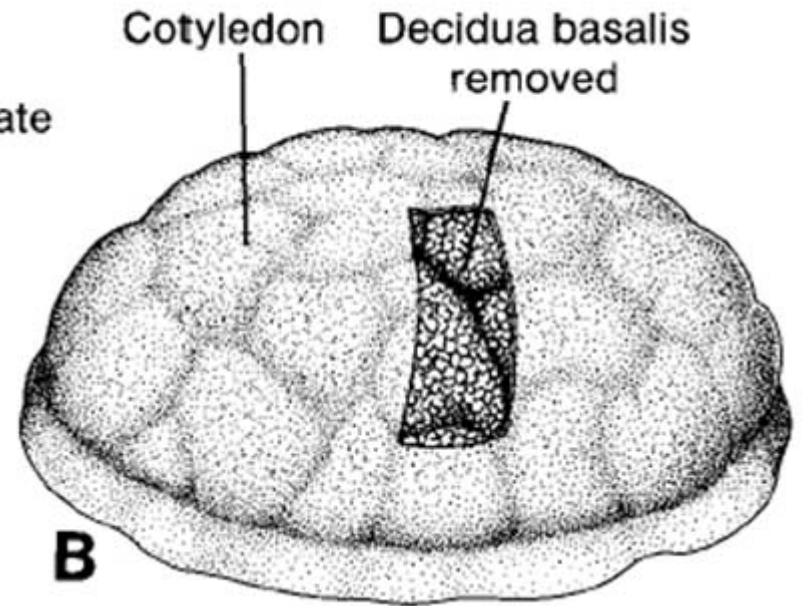
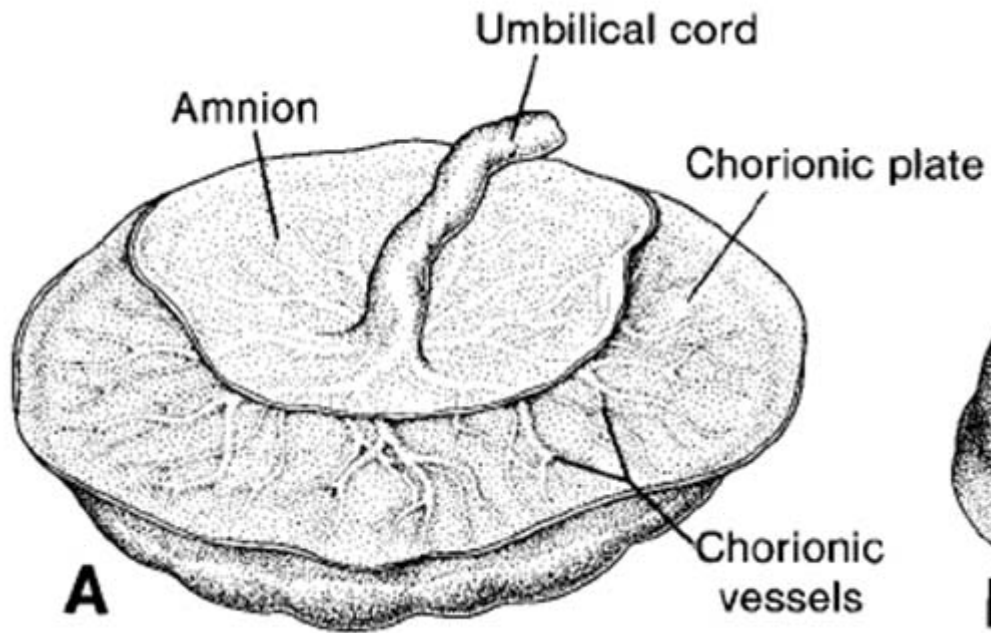
fetal side:

- ❑ **villous chorion and amnion.**
- ❑ **centrally, eccentrically or marginally umbilical cord, or insert into chorion**
- ❑ **radiate chorionic vessels under amnion in chorionic plate of chorion frondosum**

maternal side

- ❑ **rough decidua basalis**
- ❑ **15 to 20 cotyledons**

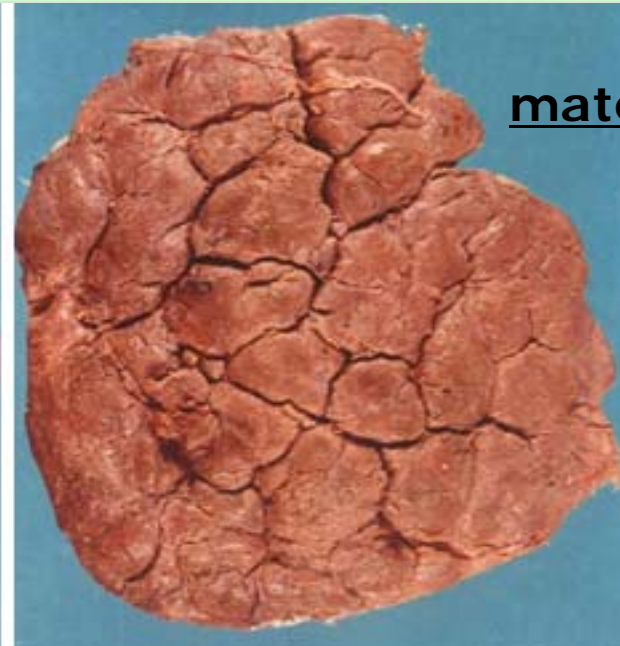




fetal side



maternal side



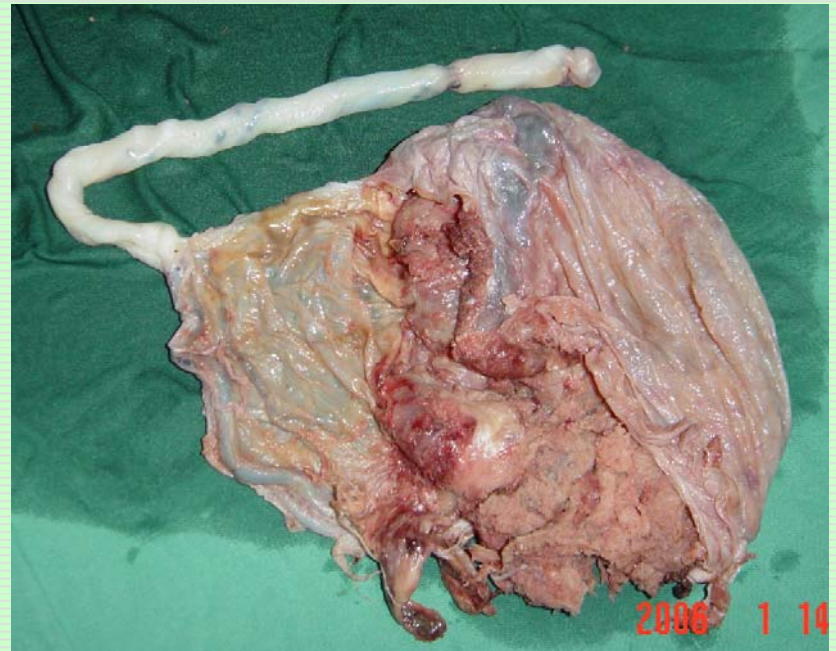


centrally, eccentrically

**radiate chorionic vessels
under amnion**



marginally



insert into the chorion

Fetal side in vertical view

- Branches of umbilical vessels walk in chorionic plate and enter villi to form net of capillaries.**
- 40-60 stem villi and numerous free villi**
- stem villus anchors to decidua basalis by cytotrophoblastic shell**
- Intervillous lacunae are filled with maternal blood.**

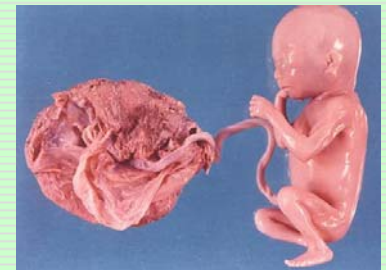
Maternal side in vertical view

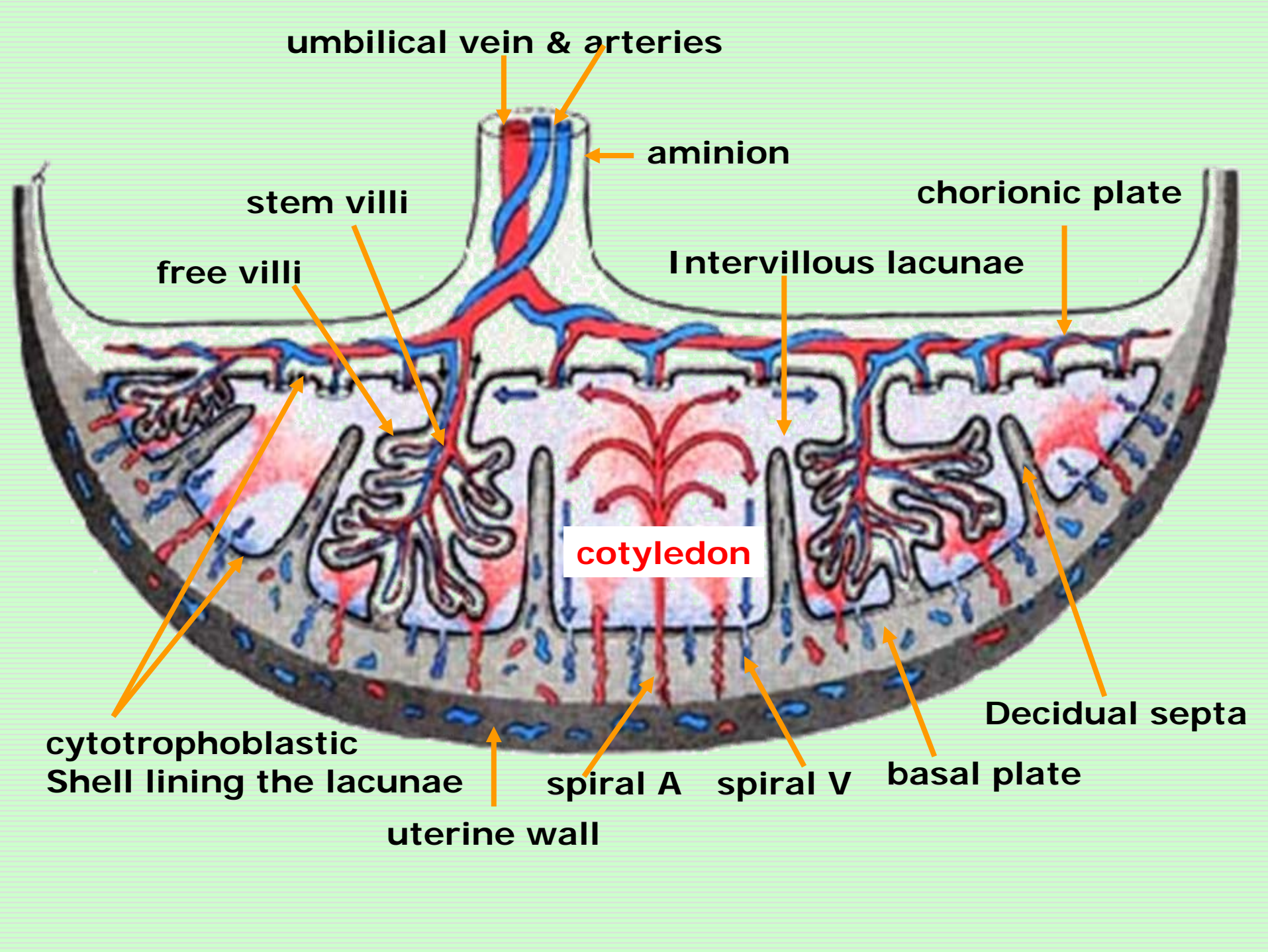
- ❑ **cytotrophoblastic shell, decidua septa, basal plate**
- ❑ **Decidua or placental septa project into intervillous spaces.**
- ❑ **placental septa separate the chorion into cotyledon.**
- ❑ **Every cotyledon contains 1 to 4 stem villi and branches.**



Blood circulation of placenta

- ❑ **mother: uterine A → spiral A → decidual plate → intervillous space → spiral V → uterine V**
- ❑ **fetus: umbilical A → villous cap. → umbilical V**
- ❑ **placental membrane carrying out material exchange separates fetal blood in chorionic capillaries from maternal blood in intervillous lacunae.**





placental barrier:

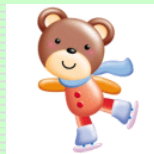
- **Between fetal and maternal blood**
- **Components:**

Early period

- **Endothelium & basement membrane of fetal capillaries**
- **thin layer of connective tissue in the villus core**
- **cytotrophoblast and basement membrane.**
- **syncytiotrophoblast.**

Later period

- **Endothelium & basement membrane of fetal capillaries**
- **Syncytiotrophoblast**
- **(increasing the rate of exchange)**



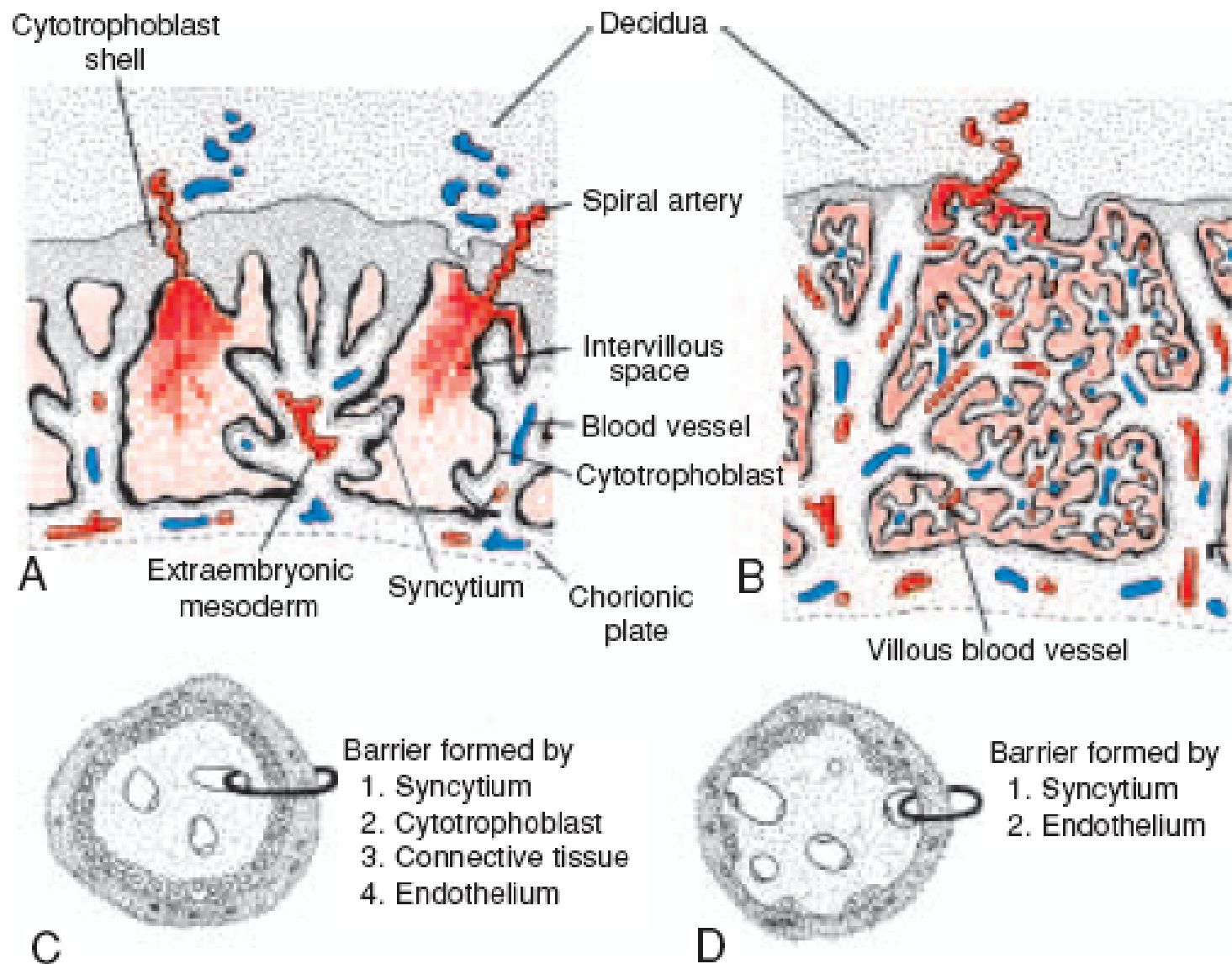


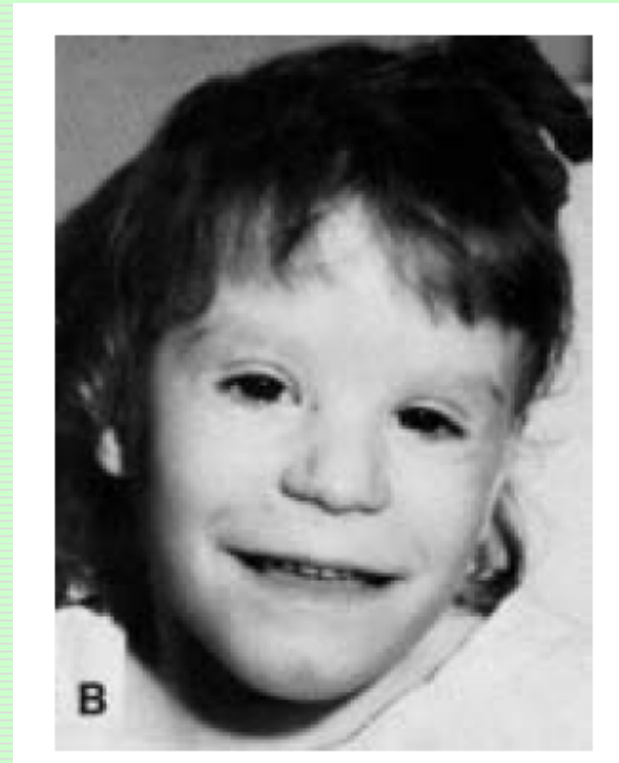
Figure 6.8 Structure of villi at various stages of development. **A.** During the fourth week. The extraembryonic mesoderm penetrates the stem villi in the direction of the decidual plate. **B.** During the fourth month. In many small villi the wall of the capillaries is in direct contact with the syncytium. **C** and **D.** Enlargement of the villus as shown in **A** and **B**, respectively.

Function of placental barrier

- ❑ block some toxic substances into fetal body
- ❑ virus, most drugs, heroin and cocaine traverse placenta easily, cause birth defects



Infants was born to mothers who took thalidomide.



Child with fetal alcohol syndrome and cardiovascular and limb defects.

Function of the placenta

- ❑ Exchange of metabolic and gaseous products
- ❑ Production of hormones

syncytiotrophoblast

human chorionic gonadotropin, HCG:

- begin: end of 2nd week
- highest level: 9th –11th week
- lowest level: 20th week, until birth
- maintains the corpus luteum.
- Appear in early stage of gestation & maternal urine, an indicator of early pregnancy

human placental progesterone, HPP

- **4th month, maintains pregnancy**

human placental estrogen, HPE

- **4th month, estriol, stimulates uterine growth and development of the mammary glands.**

Somatomammotropin/ human placental lactogen, HPL

- **highest level: 36th –37th week**
- **promotes breast development for milk production**



Questions

Fetal Membranes and Placenta

- 1. What're the fetal membranes? How many types of fetal membranes are there?**
- 2. Describe the structure and function of the placenta.**
- 3. Describe the structure and function of the placental membrane.**

Homework

- Prepare a 10min slides about the twins, multiplets and conjoined twins
- Group freely. 5 to 8 students per group.
- A deputy of each group is explaining slides voluntarily in the next class.

□ Outline

- monozygotic twins/identical twins **
- dizygotic twins/non-identical twins
- multiples: monoovular, polyovular, mixed
- Conjoined twins: reason**

special type: parasitic fetus & fetus in fetu