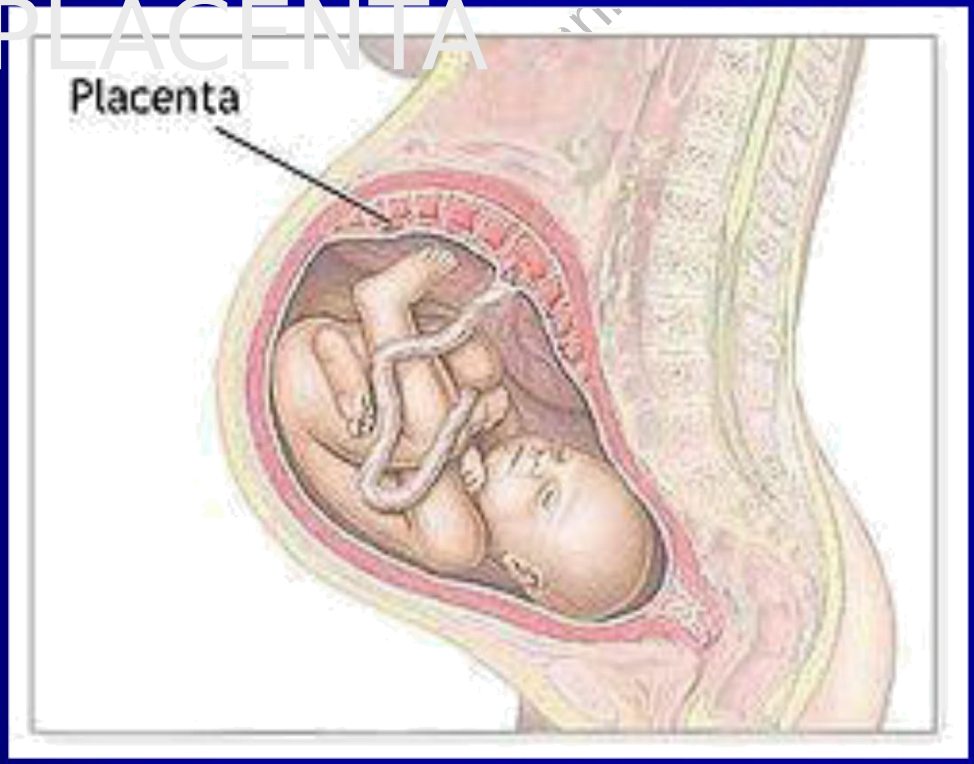
FETAL MEMBRANES & PLACENTA

FETAL MEMBRANES & PLACENTA



FETAL MEMBRANES

In vertebrate embryo only part of egg forms the actual embryo while other part is known as the extra embryonic and forms fetal membranes.

Fetal membranes consist of:

- Yolk Sac
- Amnion
- Chorion
- Allantois
- Placenta

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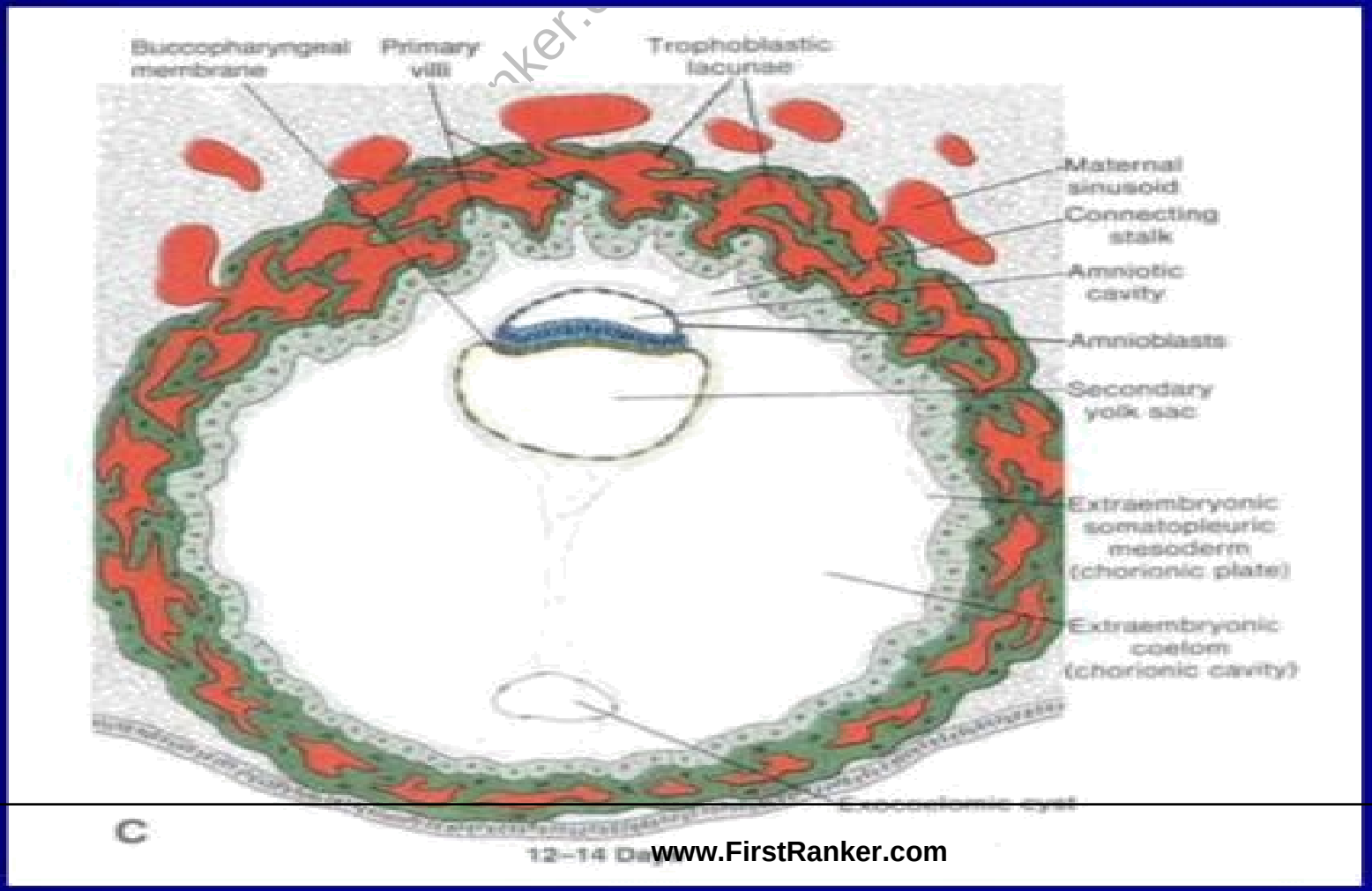
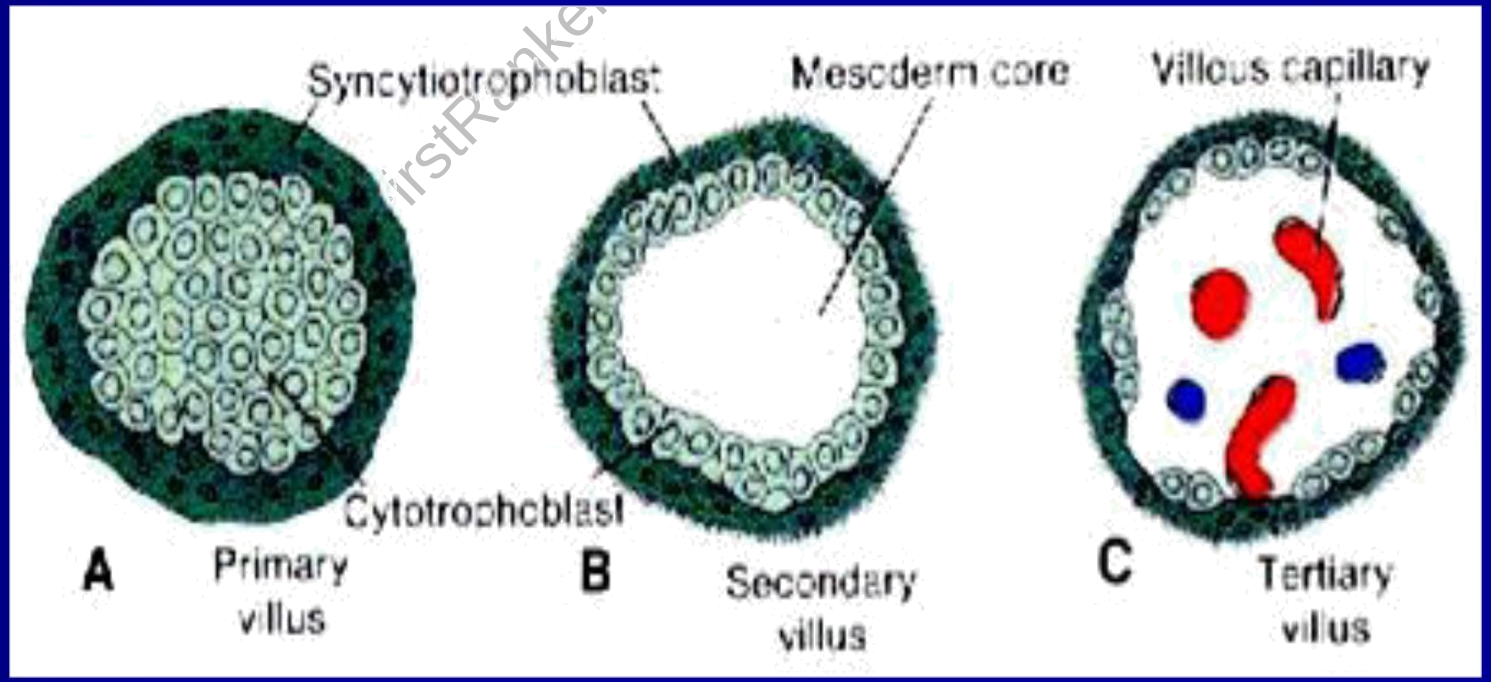
PLACENTA

- Is an organ that facilitates nutrient and gas exchange b/w maternal and fetal compartments
- As the fetus begins the 9th week of development , its demand for nutritional and other factors

13th DAY



DEVELOPMENT OF TROPHOBLAST By beginning of third week



DEVELOPMENT OF A VILLUS

- Outer cytotrophoblast shell.
- Stem (anchoring) villi
- Free (terminal) villi.

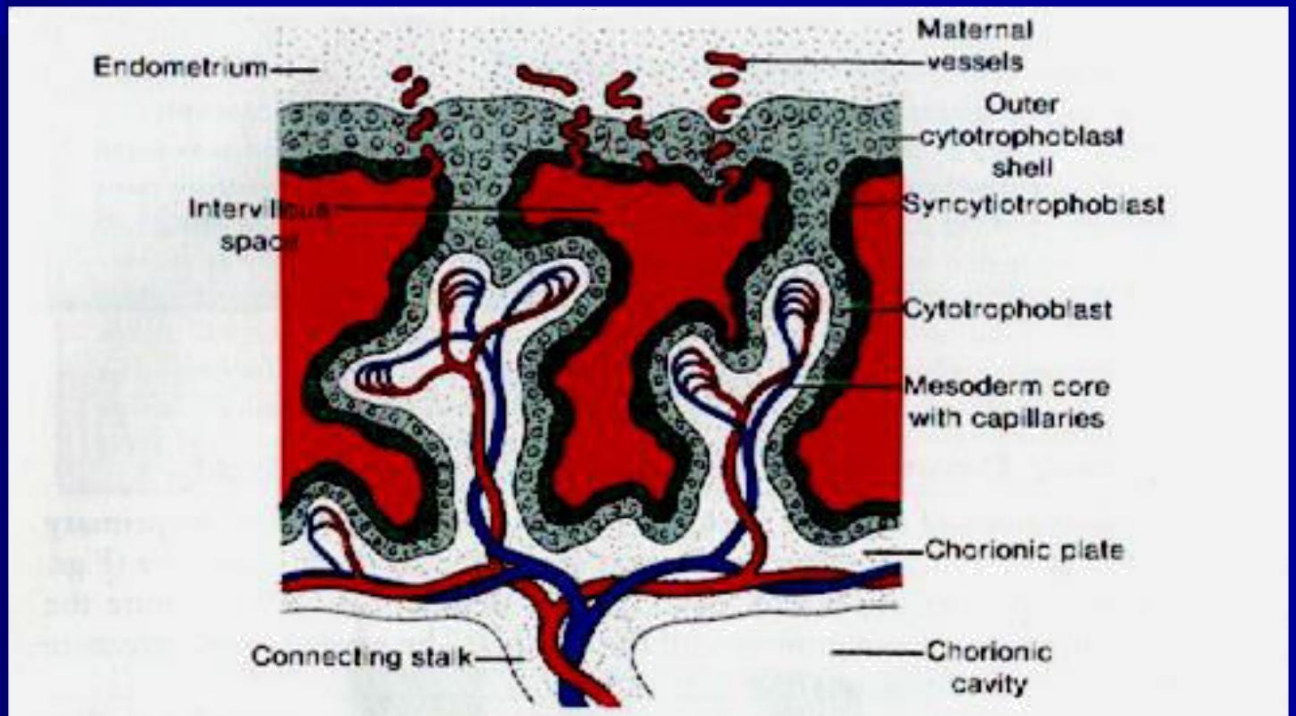


Figure 4.16. Longitudinal section through a villus at the end of the third week of development. Maternal vessels penetrate the cytotrophoblastic shell to enter intervillous spaces, which surround the villi. The capillaries in the villi are in contact with vessels in the chorionic plate and in the connecting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

TROPHOBLAST AT THE END OF THIRD WEEK OF DEVELOPMENT

- When heart begins to beat in the 4th week, villous system is ready.
- Intervillous spaces lined with syncytiotrophoblast

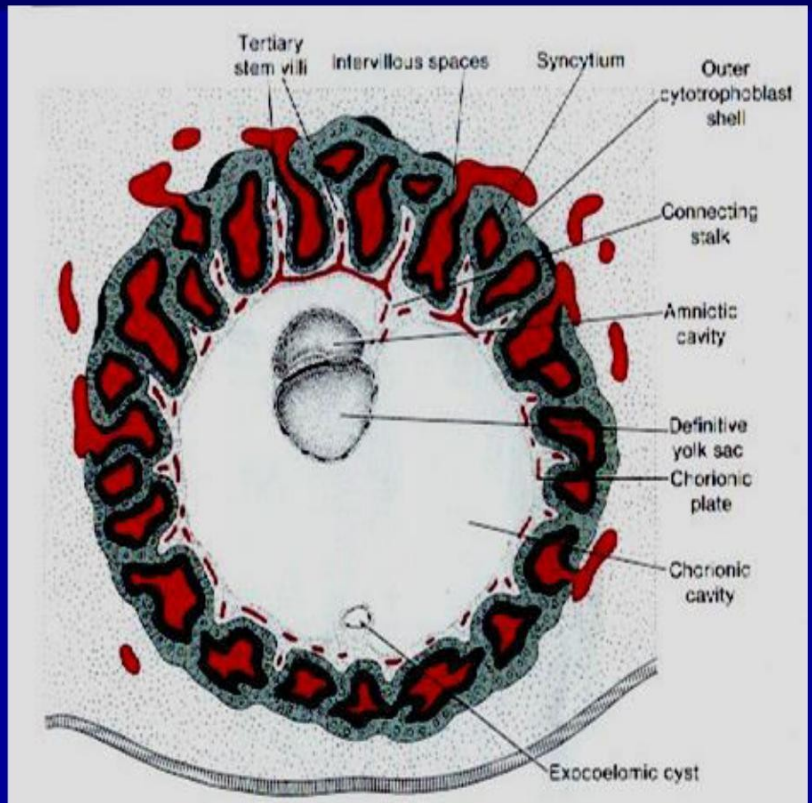


Figure 4.17. Presomite embryo and the trophoblast at the end of the third week. Tertiary and secondary stem villi give the trophoblast a characteristic radial appearance. Intervillous spaces, which are found throughout the trophoblast, are lined with syncytium. Cytotrophoblastic cells surround the trophoblast entirely and are in direct contact with the endometrium. The embryo is suspended in the chorionic cavity by means of

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CHANGES IN TROPHOBLAST

- Placenta consists of two components:
  - Fetal portion is derived from trophoblast and extraembryonic mesoderm
  - Maternal portion is derived from uterine endometrium

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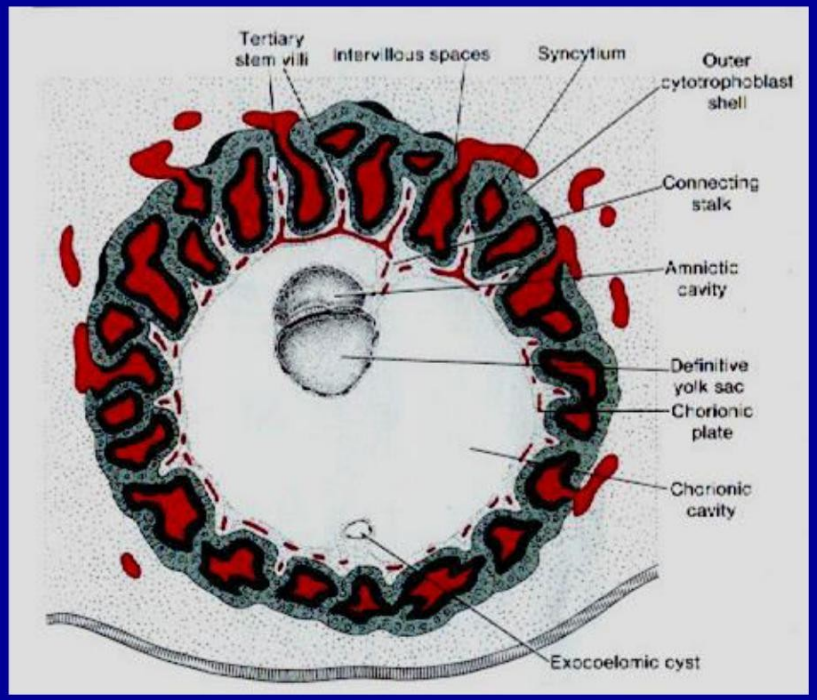
TROPHOBLAST AT THE BEGININING OF 2ND MONTH OF DEVELOPMENT

- Radial appearance of trophoblast due to increased no. of Secondary & Tertiary villi
- Villi cover the entire surface of chorion



FORMATION OF HYBRID VESSELS

- Endovascular invasion
- Epithelial to endothelial transition
- Transformation of spiral arteries from small diameter, high resistance vessels to larger diameter, low resistance vessels

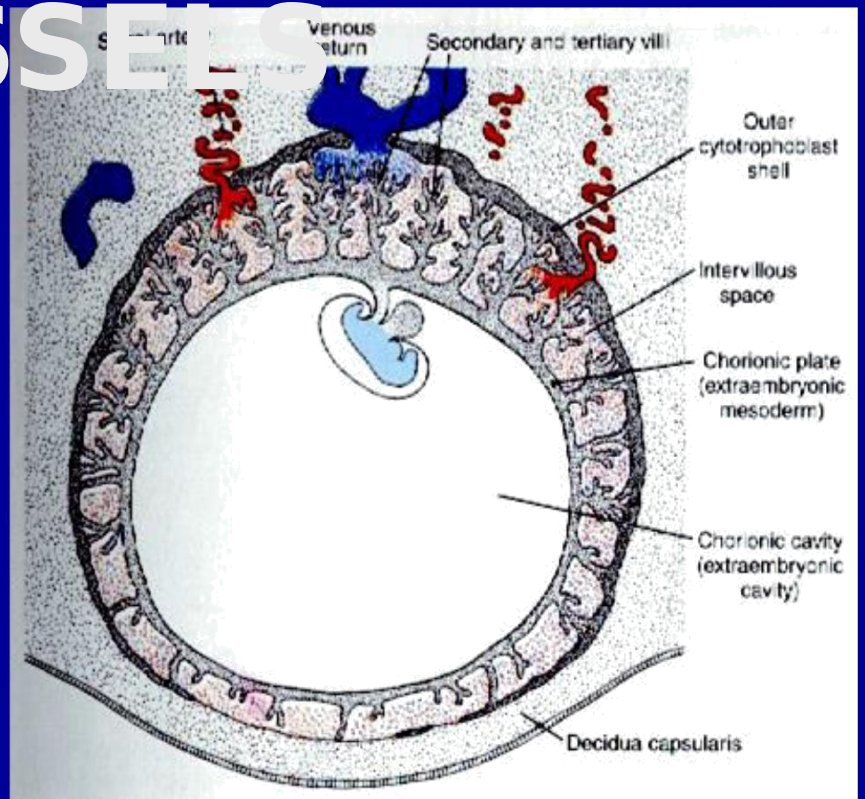


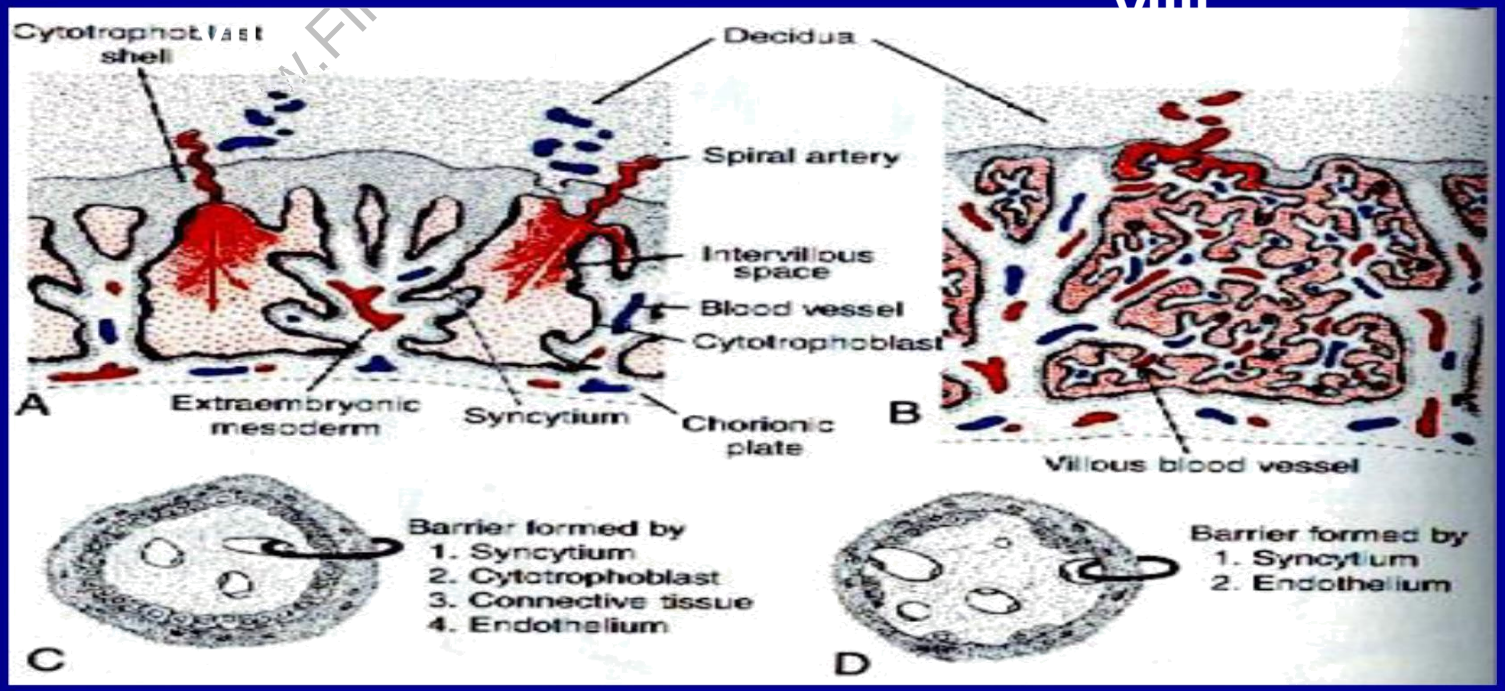
Figure 7.1. Human embryo at the beginning of the second month of development. At the embryonic pole, villi are numerous and well formed; at the abembryonic pole they are few in number and poorly developed.

STRUCTURE OF VILLI AT DIFFERENT STAGES OF DEVELOPMENT

Syncytial knots

Anchoring

Free villi



STRUCTURE OF CHORION

- Difference b/w embryonic and abembryonic poles of chorion
- Chorion frondosum
- Chorion laeve

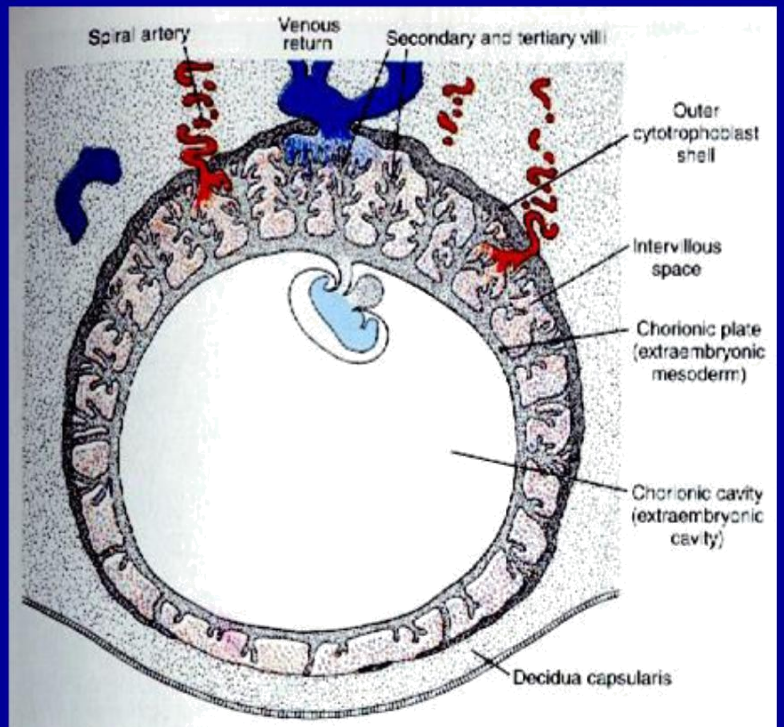
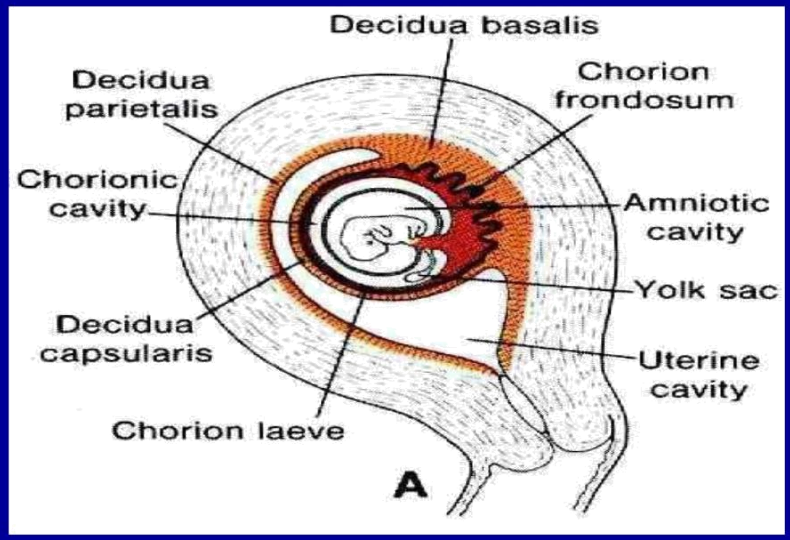


Figure 7.1. Human embryo at the beginning of the second month of development. At the embryonic pole, villi are numerous and well formed; at the abembryonic pole they are few in number and poorly developed.

STRUCTURE OF DECIDUA (GRAVID ENDOMETRIUM)

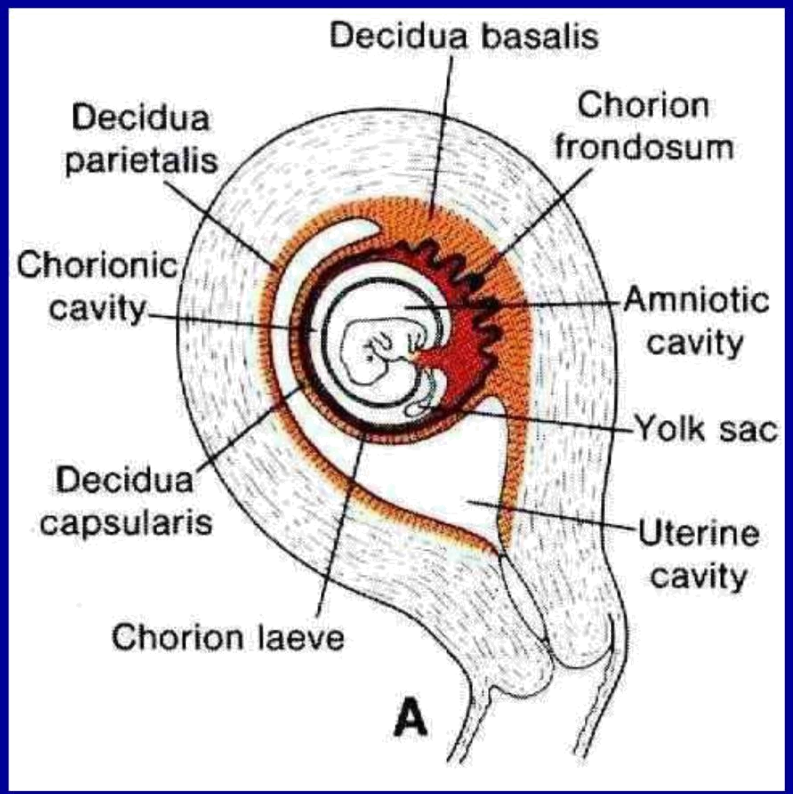
This difference b/w embryonic and abembryonic poles is also reflected in the structure of decidua

Decidua (that which falls off) is the functional layer of endometrium which is shed during parturition.

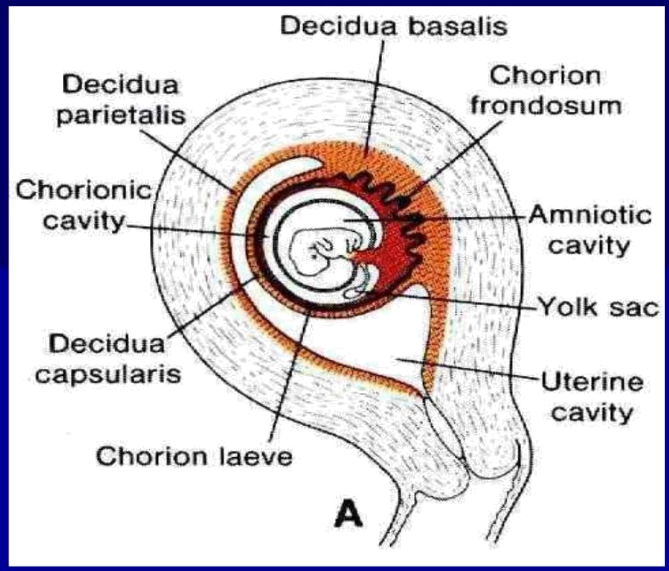


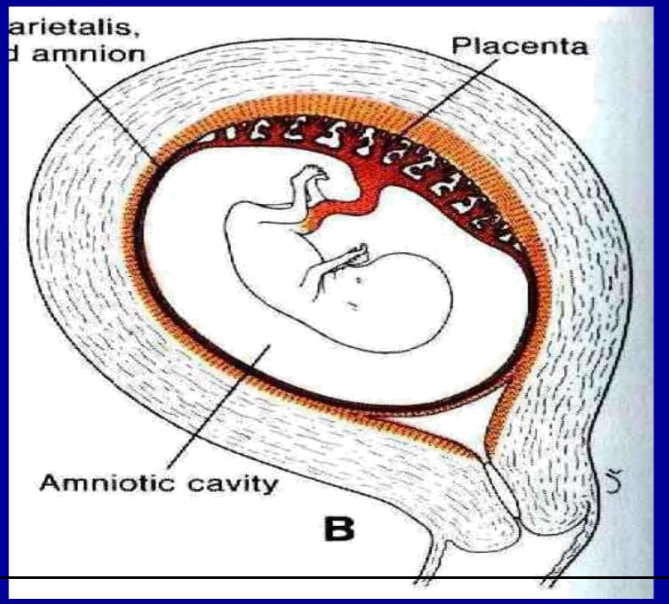
PARTS OF DECIDUA

- **Decidua basalis** (deep to the conceptus/underlying the conceptus or b/w it and the muscular wall of uterus).
- **Decidua capsularis** (overlying the conceptus/covering the chorionic sac and interposed b/w sac and uterine cavity).
- **Decidua parietalis** (remaining lining of uterine endometrium



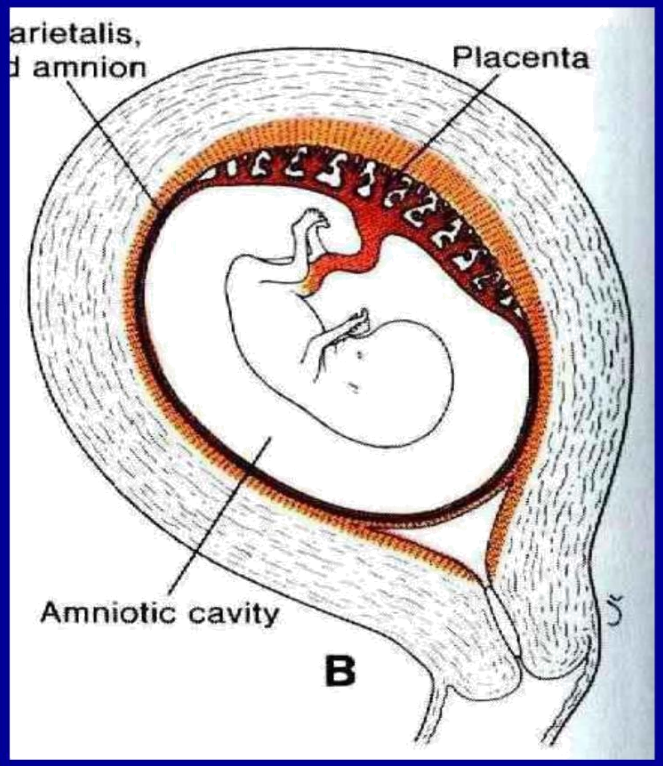
- With growth of chorionic vesicle, D.Cap. is stretched & degenerates
- Chorion leave then comes in contact with uterine wall (the Decidua Parietalis) and two fuse and obliterates the uterine lumen.
- Fusion of amnion and chorion together form amniochorionic membrane which ruptures during labour





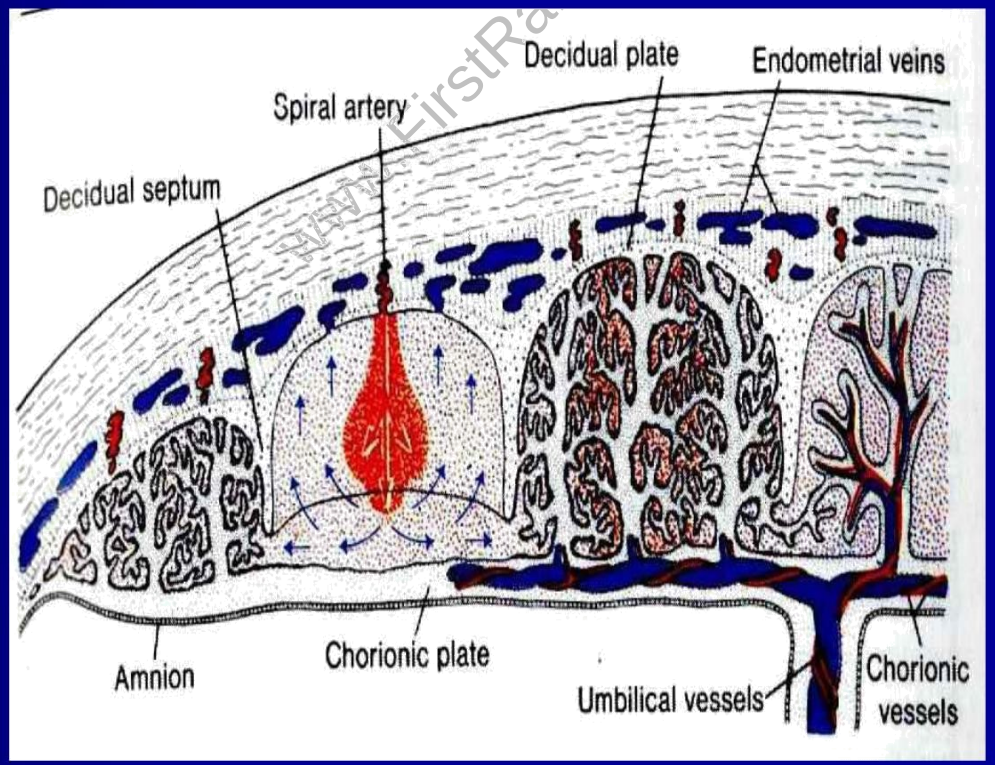
STRUCTURE OF PLACENTA

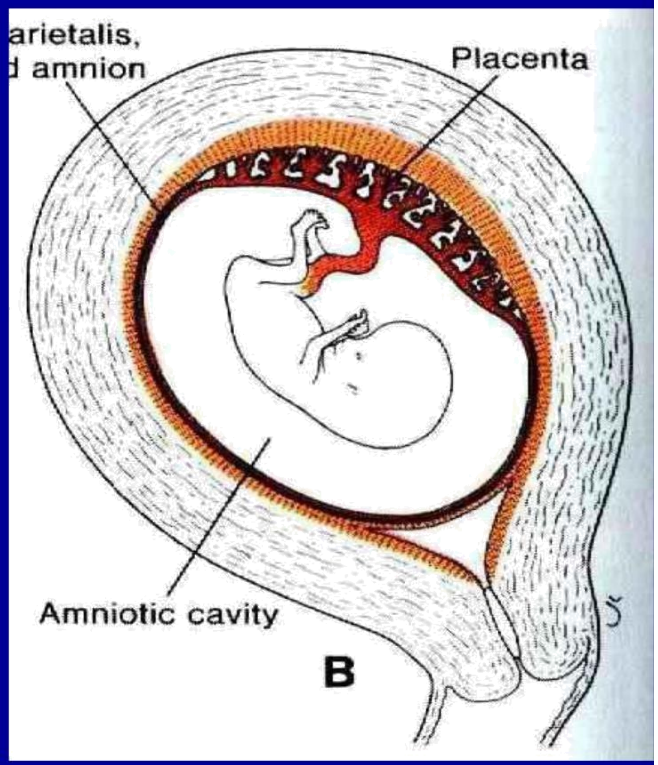
- Placenta consists of two components.
  - Fetal portion (Chorion Frondosum)
  - Maternal portion (Decidua basalis)



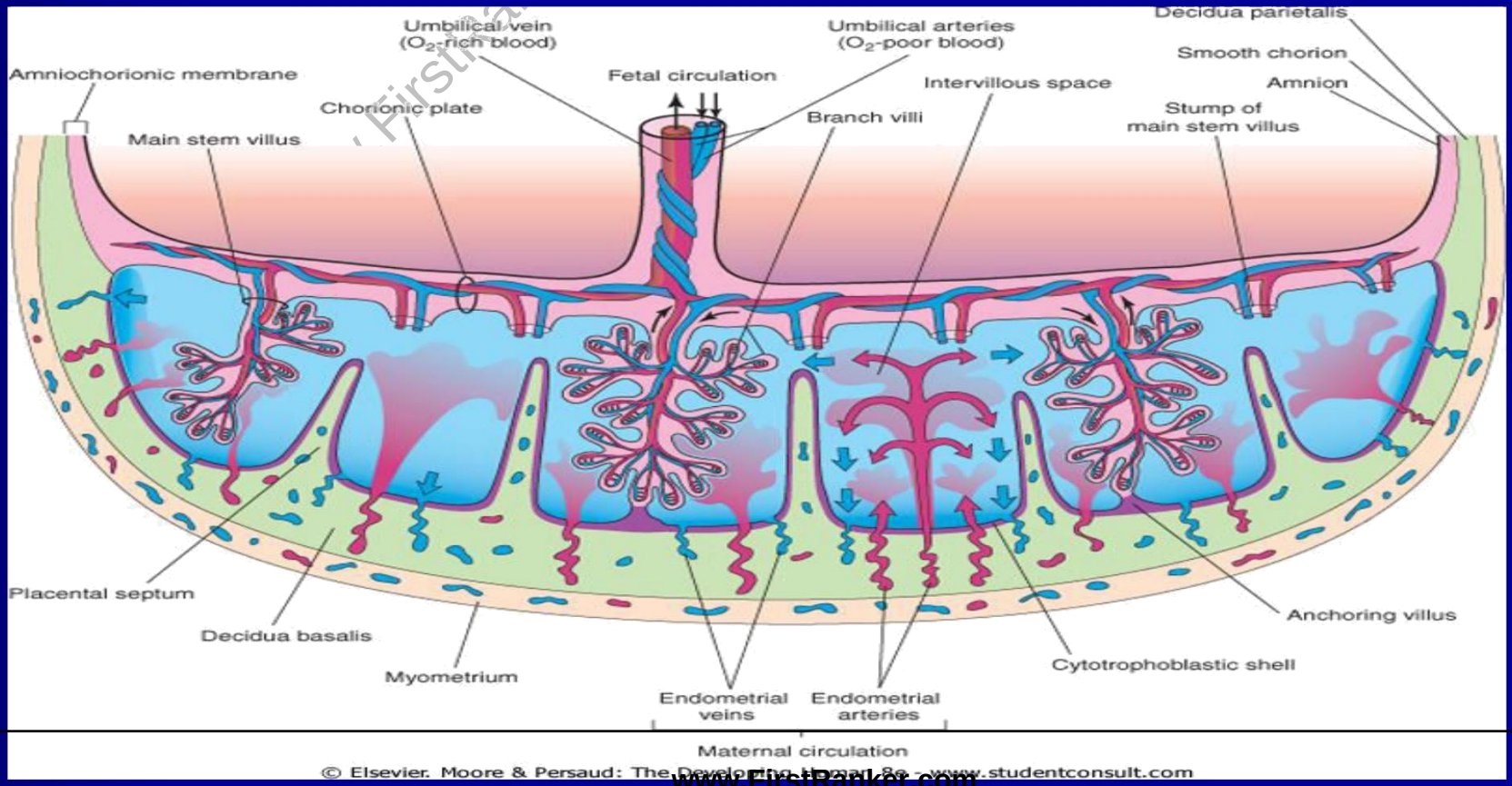
Maternal portion

- Fetal side placenta is bordered by chorionic plate
- Maternal side is bordered by decidua basalis.
- Junctional zone: Trophoblast & maternal cells intermingle
- Intervillous space: b/w decidual plate & chorionic plate

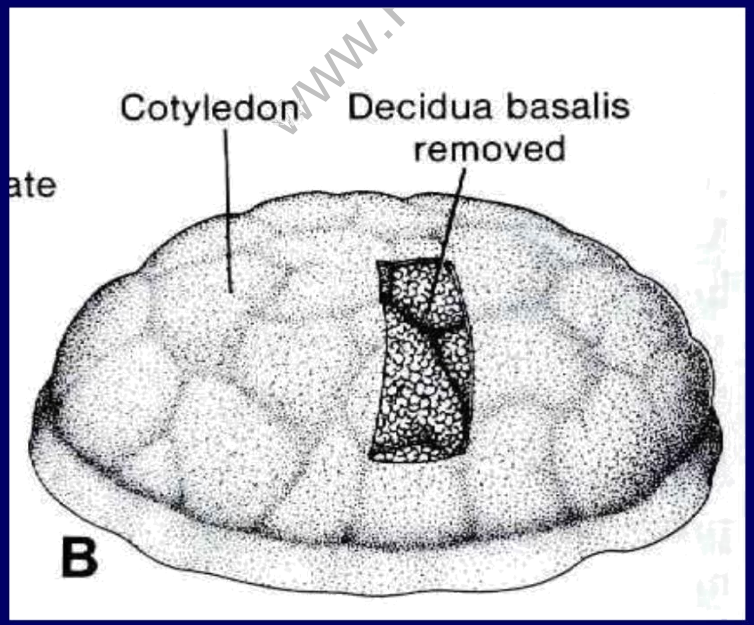


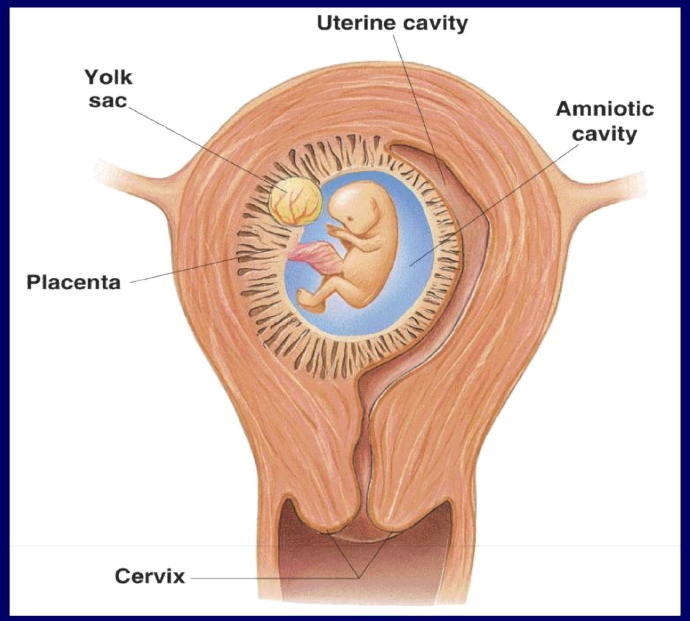


- During **4th to 5th month** **decidual septa** project into intervillous spaces but do not reach chorionic plate.
- Septa have a core of maternal tissue but surface is covered by syncytial cells which separates the maternal blood from fetal tissue of villi.



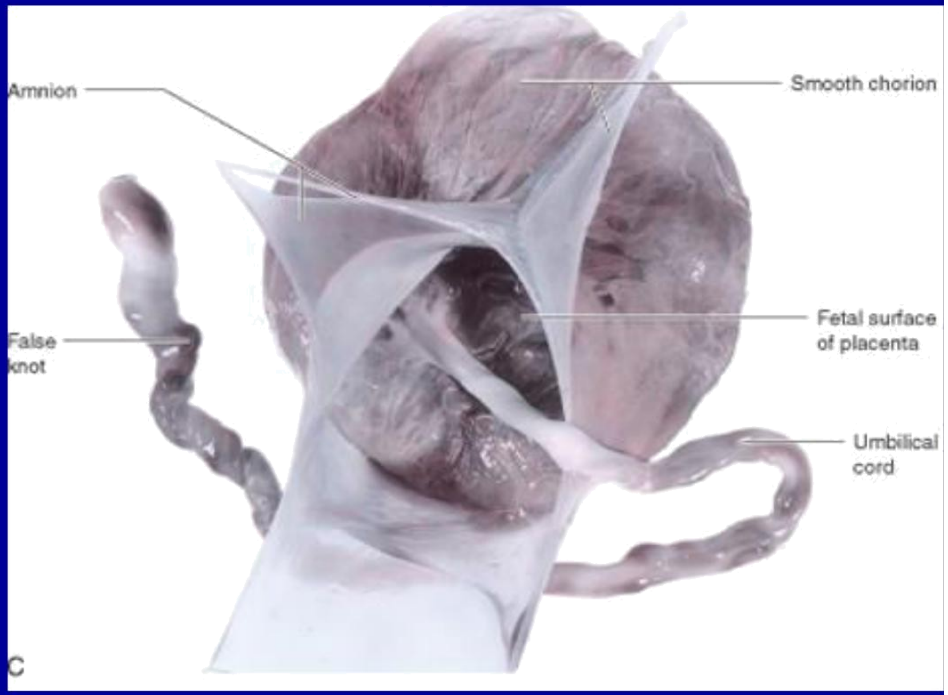
- Placenta is divided into cotyledons by septa however contact between them is maintained.
- Placenta enlarge with advancement of pregnancy and may occupy 15 to 30% of uterine space.



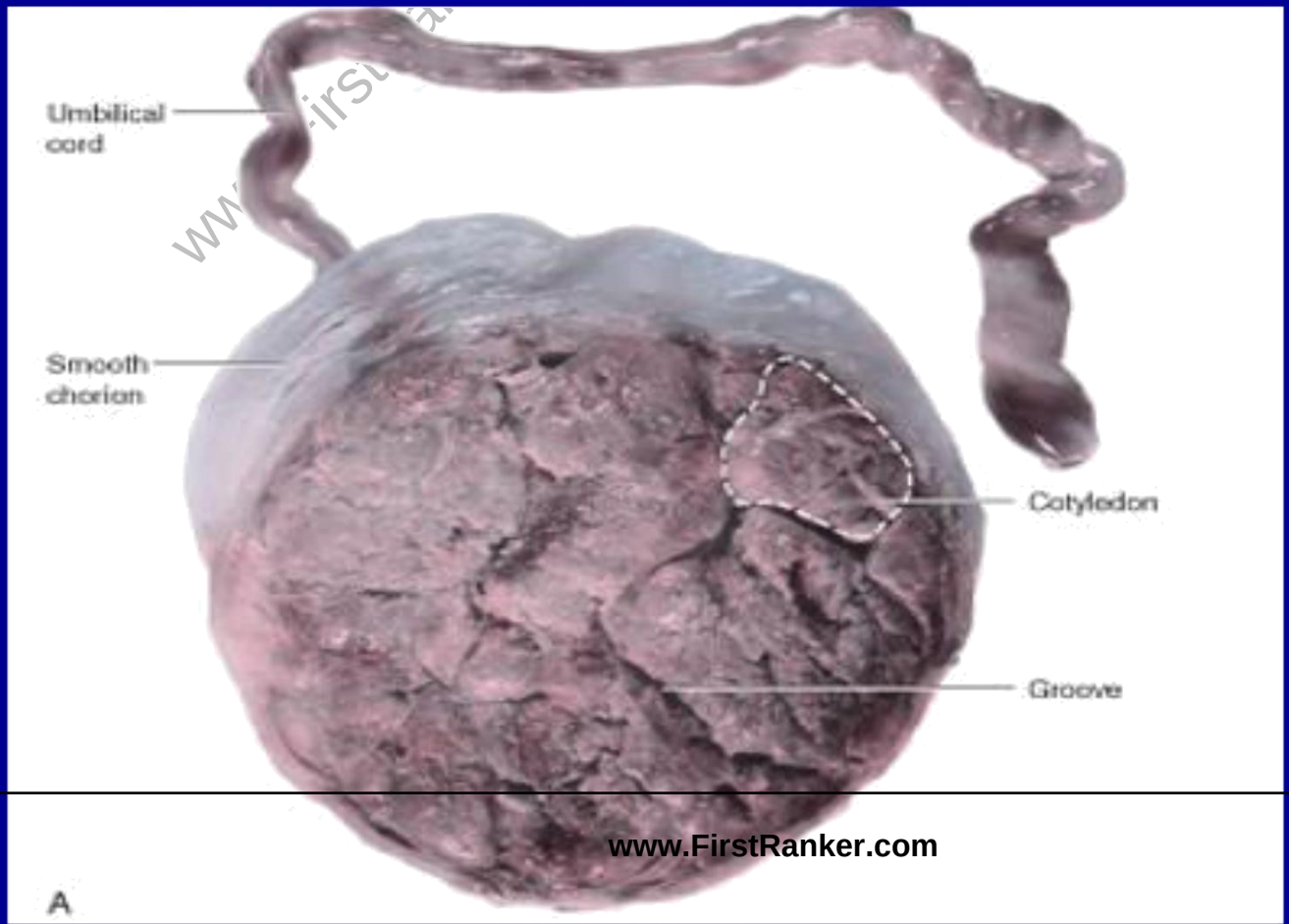


FULL TERM PLACENTA

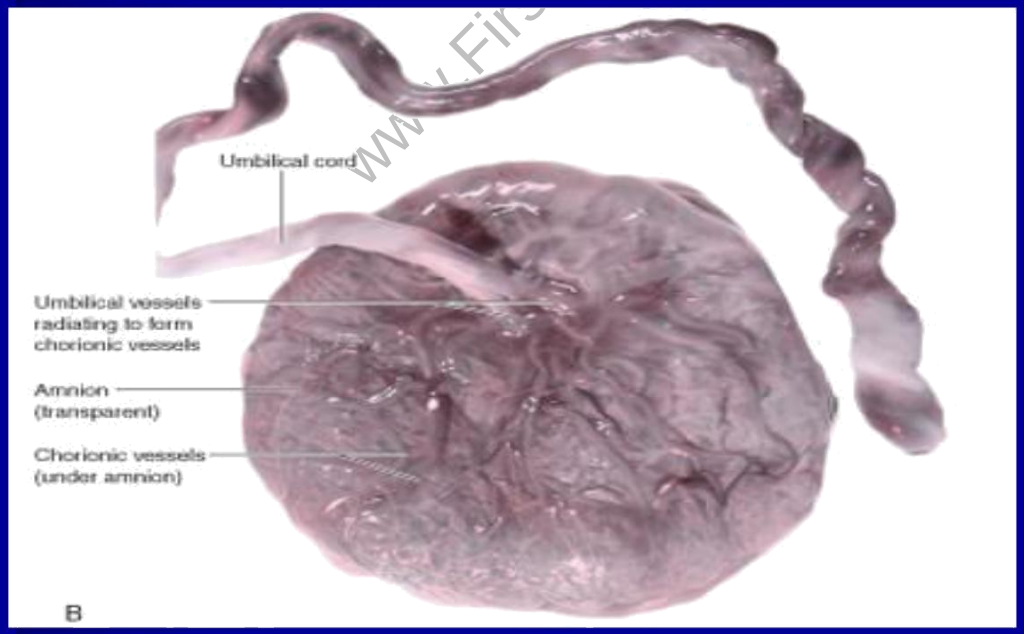
- Discoid in shape
- Diameter 15-25cm
- 3cm thick Weight
- 500-600g
- Expulsion about 30 minutes after child birth

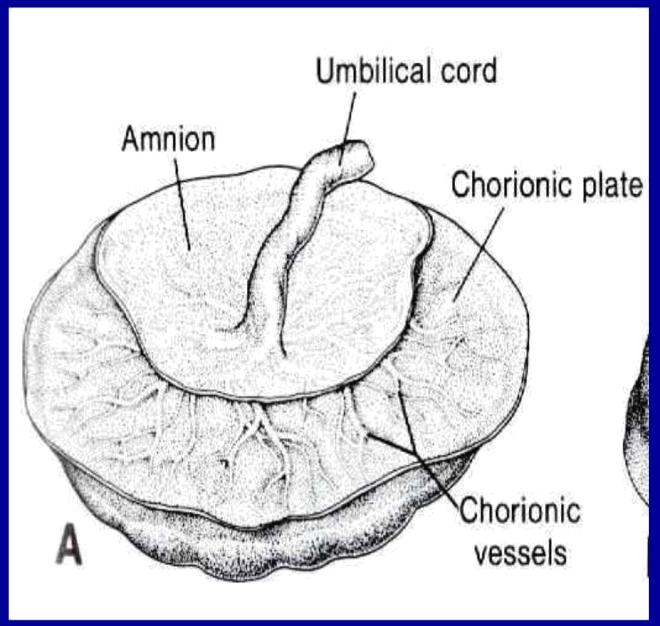


- No. of cotyledons 15-20 visible ***ON MATERNAL SIDE*** after child birth.
- Cotyledons are covered by thin layer of decidua basalis.



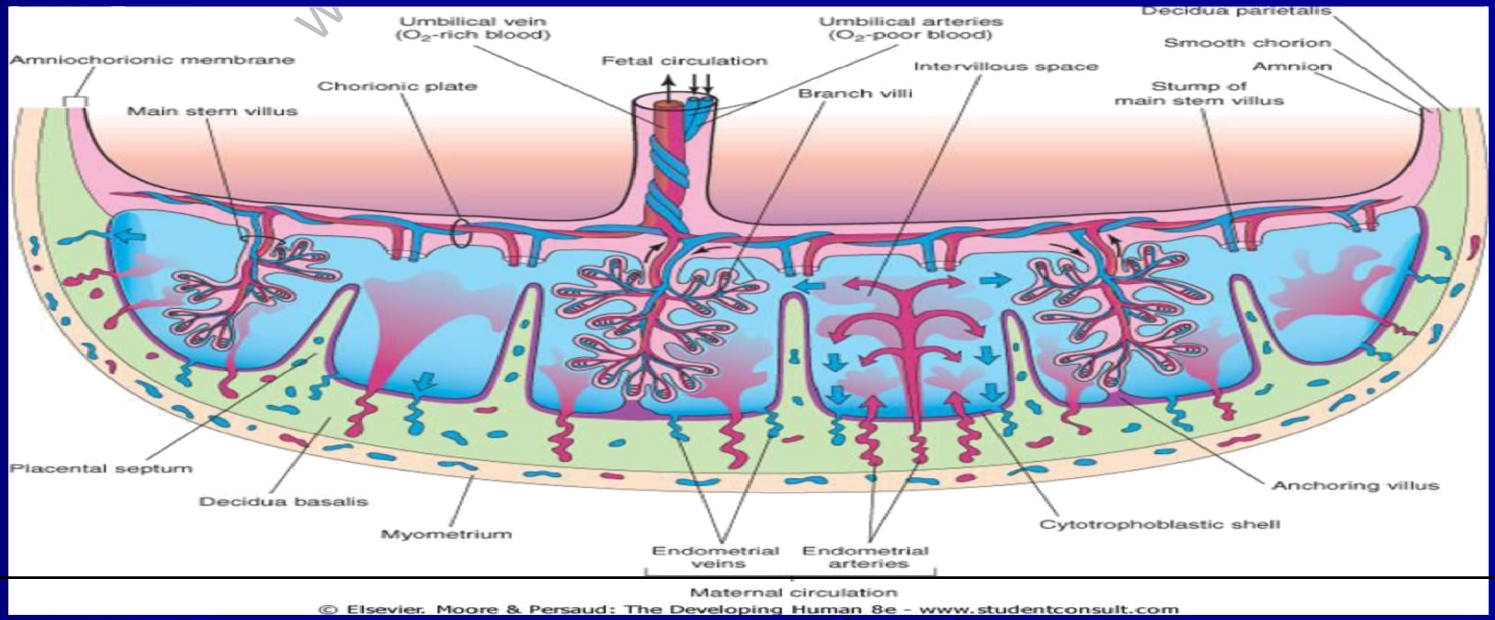
- ***FETAL SURFACE*** of placenta is covered by chorionic plate; Chorionic vessels converge towards umbilical cord
- Amnion
- Attachment of umbilical cord is eccentric



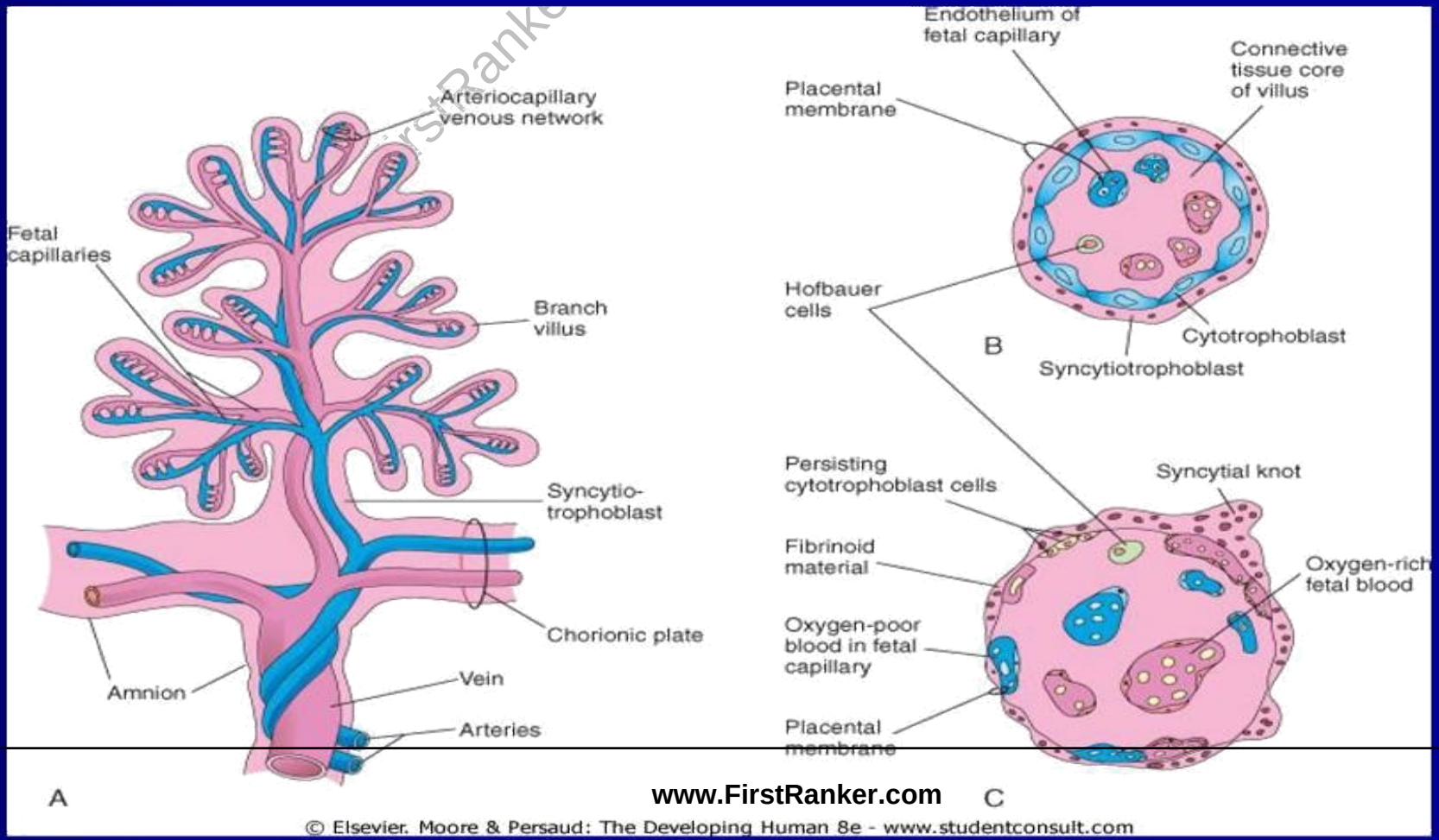


CIRCULATION OF THE PLACENTA

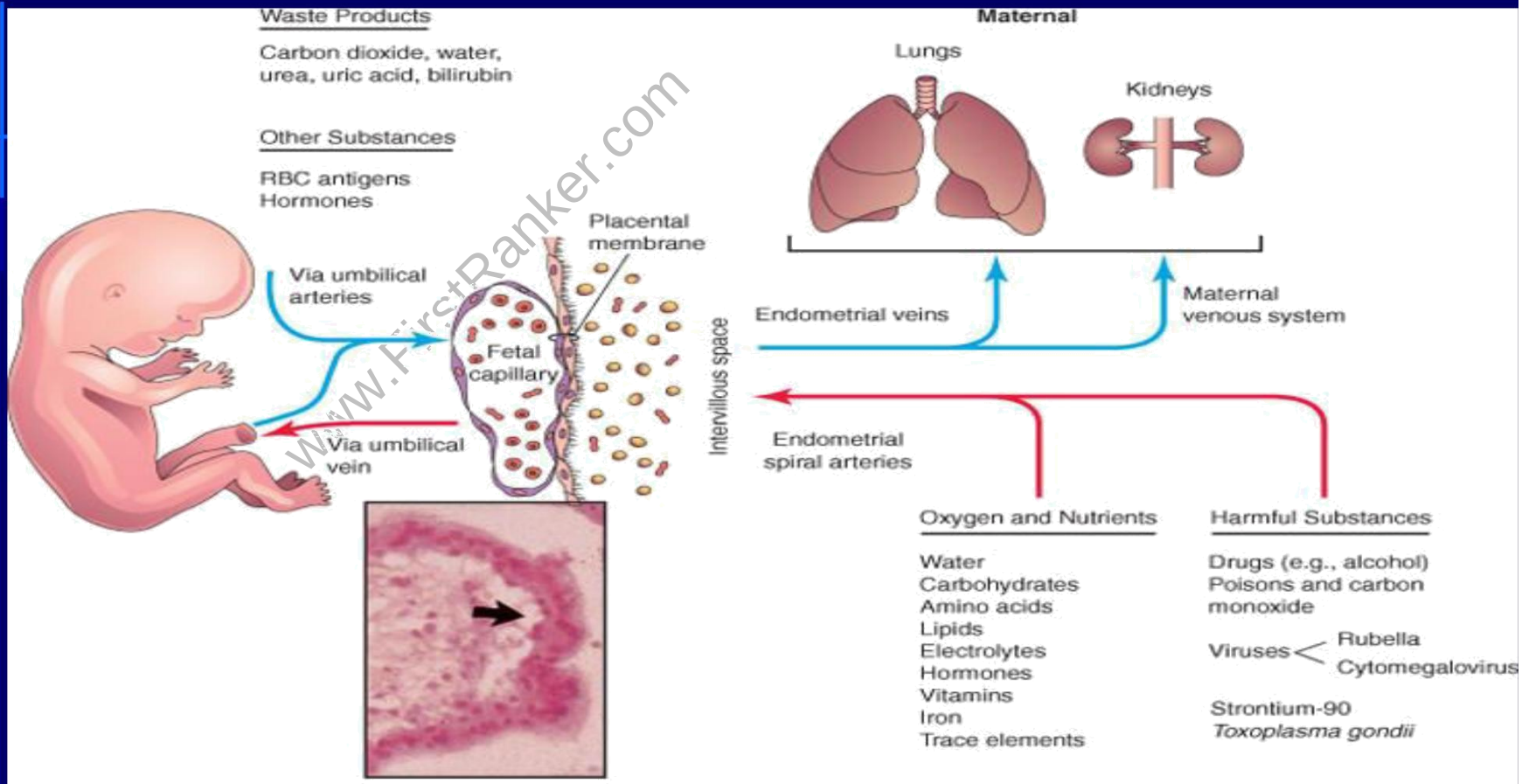
- Cotyledons receive their blood through 80-100 spiral arteries
- Collectively the Intervillous spaces of a mature placenta contain approx 150 ml of blood which is replenished 3-4 times / min
- This blood moves along chorionic villi which have a surface area of 4-14 meter square



PLACENTAL MEMBRANE/ PLACENTAL BARRIER



FUNCTIONS



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CLINICAL CORRELATES

- Erythroblastosis fetalis
- Synthetic progestins masculanize female fetuses
- Diethylstilbestrol can cause CA of vagina
- Fetal immunity is provided against diphtheria, small pox and measles but not against pertussis, and varicella (chicken pox)

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Types of placenta

- One classification scheme for placentas is based on which maternal layers are retained in the placenta or which maternal tissue is in contact with chorionic epithelium of the fetus.

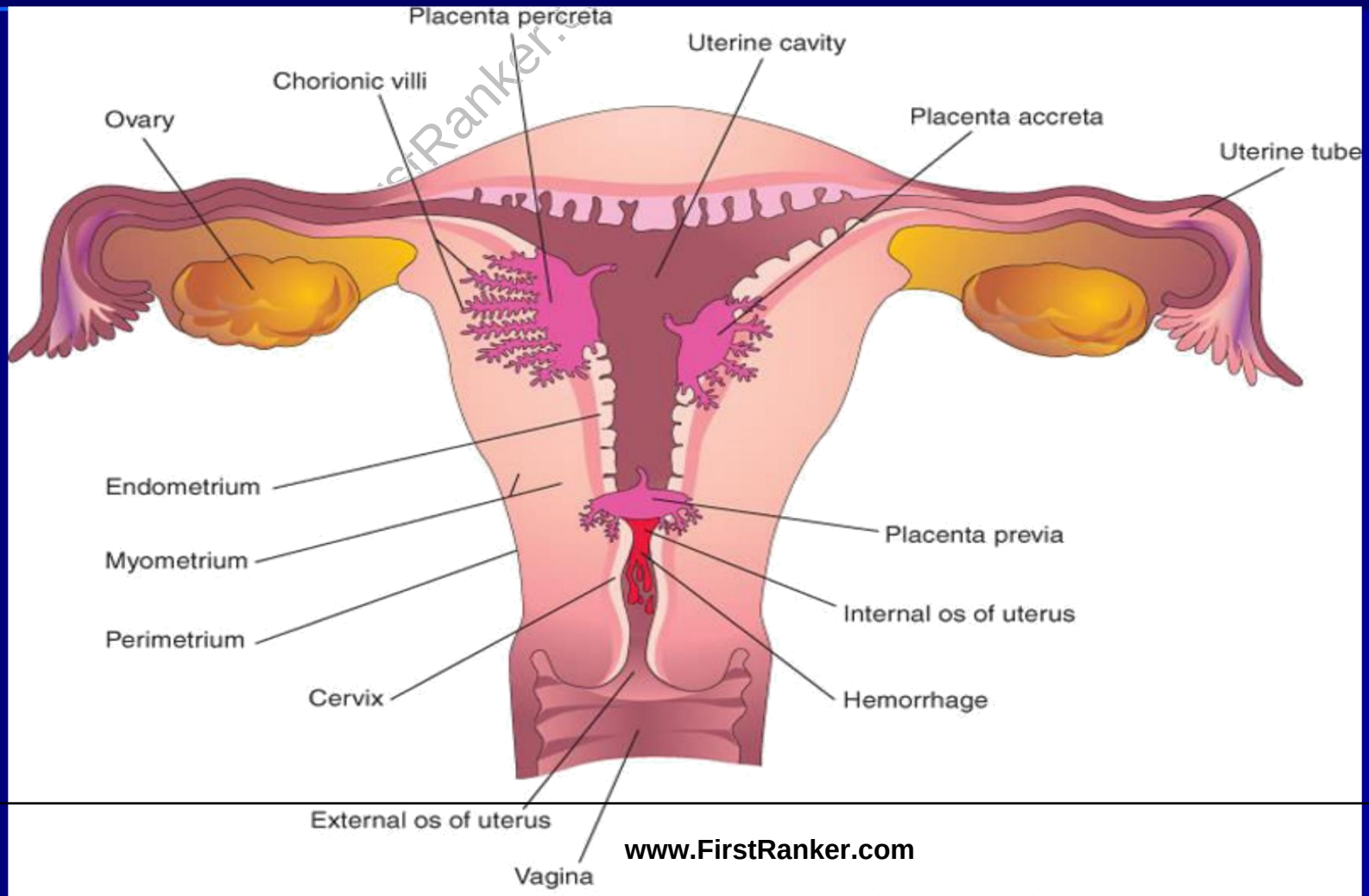
Type of Placenta

Maternal Layers Retained

Types of placenta

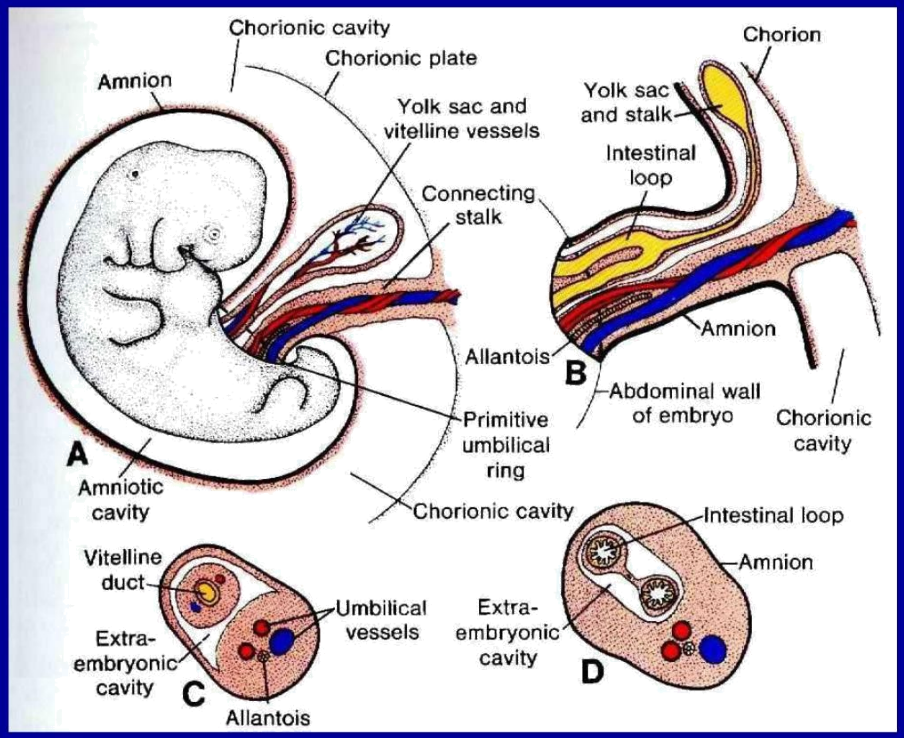
- **Placenta Accreta**: An invasion of the myometrium which does not penetrate the entire thickness of the muscle.
- **Placenta Increta**: Occurs when the placenta further extends into the myometrium.
- **Placenta Percreta**: The worst form of the condition is when the placenta penetrates the entire myometrium to the uterine serosa (invades through entire uterine wall). This variant can lead to the placenta attaching to other organs such as the rectum or bladder
- **Placenta previa**: Blastocyct implants close to or overlying the internal os of uterus.

TYPES OF PLACENTA



AMNION AND UMBILICAL CORD

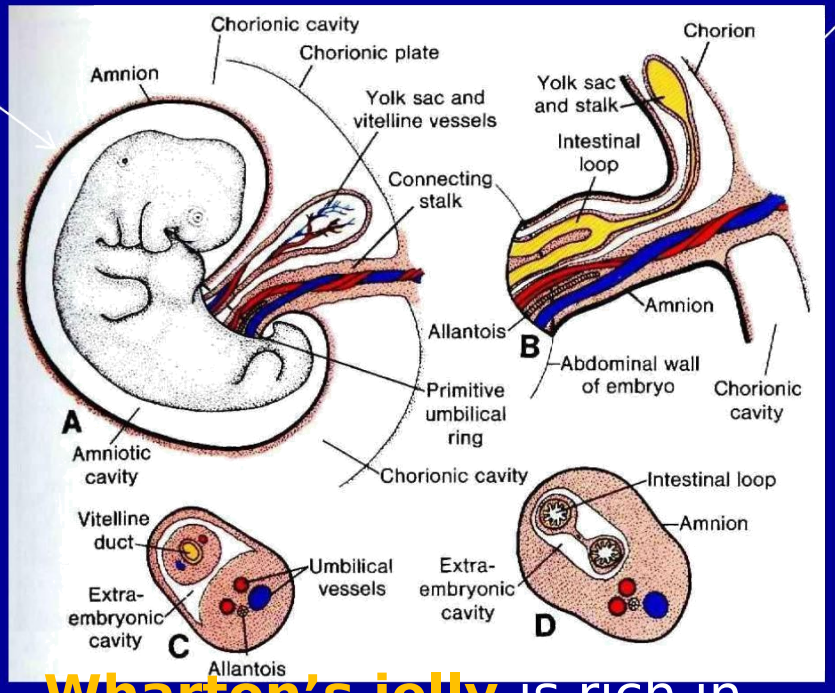
- The oval line of reflection between amnion & ectoderm is amnio-ectodermal junction (**primitive umbilical ring**).
- Following structures pass through the ring at the 5th week of development:
  - Connecting stalk, containing Allantois and the umbilical vessels
  - Yolk stalk (vitelline duct), accompanied by vitelline vessels
  - Canal connecting the intraembryonic and



- The embryonic cavity enlarges rapidly and the amnion envelops the connecting and yolk sac stalks crowding them and giving rise **to primitive umbilical cord.**

5th week

10th week



- Formation of physiological umbilical hernia.
- At the end of 3rd month loops with draw, chorionic cavity and yolk sac are obliterated.

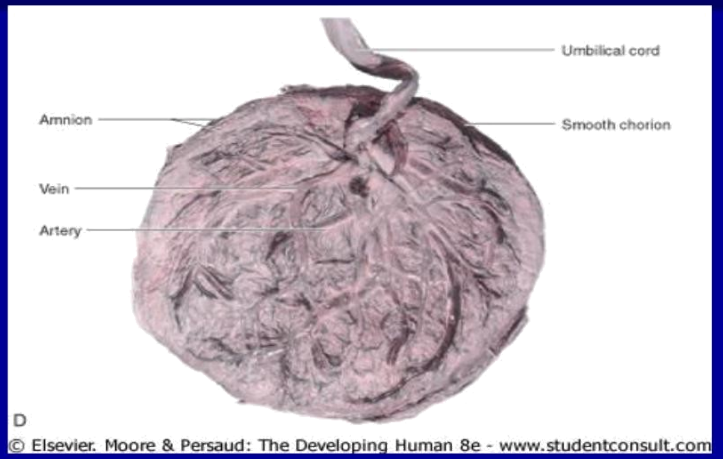
- When the canal, allantois and the vitelline duct and its vessels are also obliterated, all that remains in the cord are the **umbilical vessels** surrounded by the **jelly of Wharton.**

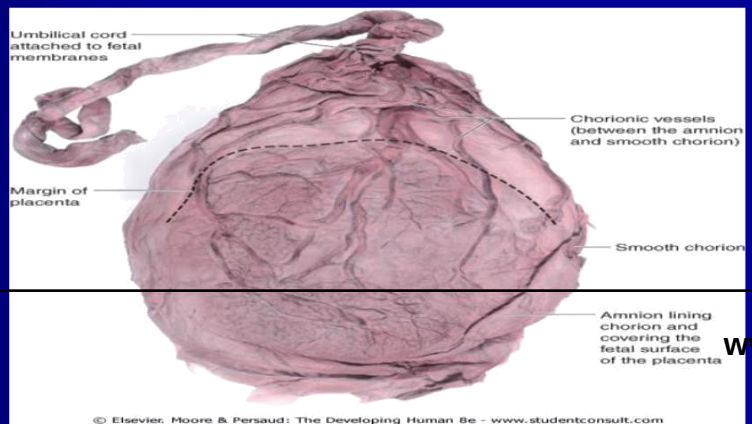
Wharton's jelly is rich in proteoglycans, functions as a protective layer for blood vessels. The walls of the vessels are muscular and elastic, once the cord is tied off, rapidly constrict.

Umbilical cord

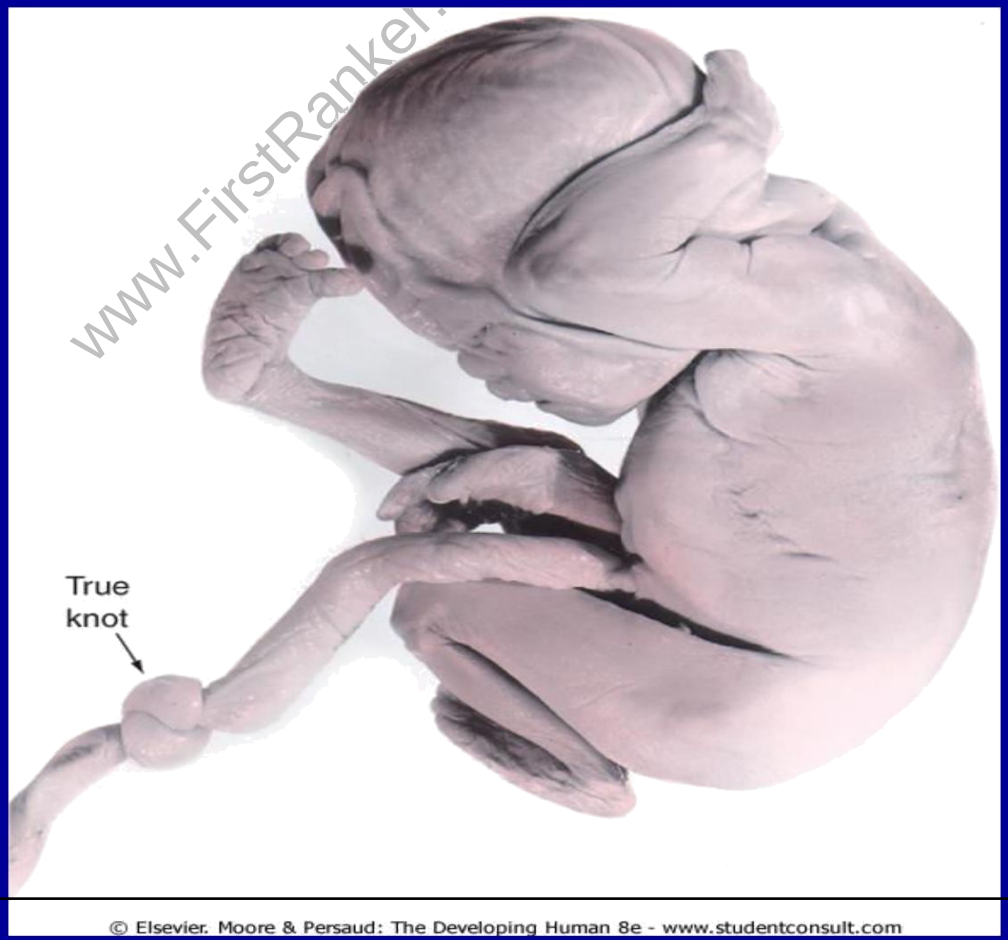
(2cm thick ; 50-60cm long)

- Battledore placenta: Marginal insertion
- Velamentous insertion of cord: attached to fetal membranes





KNOT IN UMBILICAL CORD



PLACENTAL CHANGES AT THE END OF PREGNANCY

- Increase in fibrous tissue in the villus core
- Thickening of basement membranes in fetal capillaries
- Obliterative changes in small capillaries of villi
- Fibrinoid deposition on the surface of villi (infarction of intervillous lake or of entire cotyledon giving whitish appearance)

AMNIOTIC FLUID

- Amniotic cavity is filled with clear watery fluid
- Derived from maternal blood and amniotic cells
- 800-1000ml at 37 weeks
- By fifth month fetus swallows own amniotic fluid-
  about 400ml a day
- Fetal urine is added daily in amniotic fluid in 5th month

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Functions of Amniotic Fluid

- Absorb jolts
- Prevent adherence to the amnion
- Allows free fetal movements
- Helps in dilatation of cervical canal at the time of birth

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Clinical correlates

Polyhydroamnios (more than1500-2000 ml)

- Causes: Idiopathic, maternal diabetes, congenital malformations, anencephaly, esophageal atresias.

Oligohydroamnios (less than 400 ml)

- Causes: Renal agenesis, premature rupture of membranes.

AMNIOTIC BANDS (Infections or toxic insults)

FETAL MEMBRANES IN TWINS

- Dizygotic/Fraternal twins (womb- mates)2/3rd
  - 7-11 / 1000 births
  - Simultaneous shedding of two oocytes and fertilization by different spermatozoa
  - Hereditary tendency
  - Incidence increases with maternal age
  - Sex may be same or opposite
  - Resemblance like brothers and sisters
  - Each develops its own placenta, amnion, and chorionic sac
  - Erythrocyte mosaicism

Dizygotic/Fraternal twins (womb-mates)2/3rd
- 7-11 / 1000 births
- Simultaneous shedding of two oocytes and fertilization by different spermatozoa
- Hereditary tendency
- Incidence increases with maternal age
- Sex may be same or opposite
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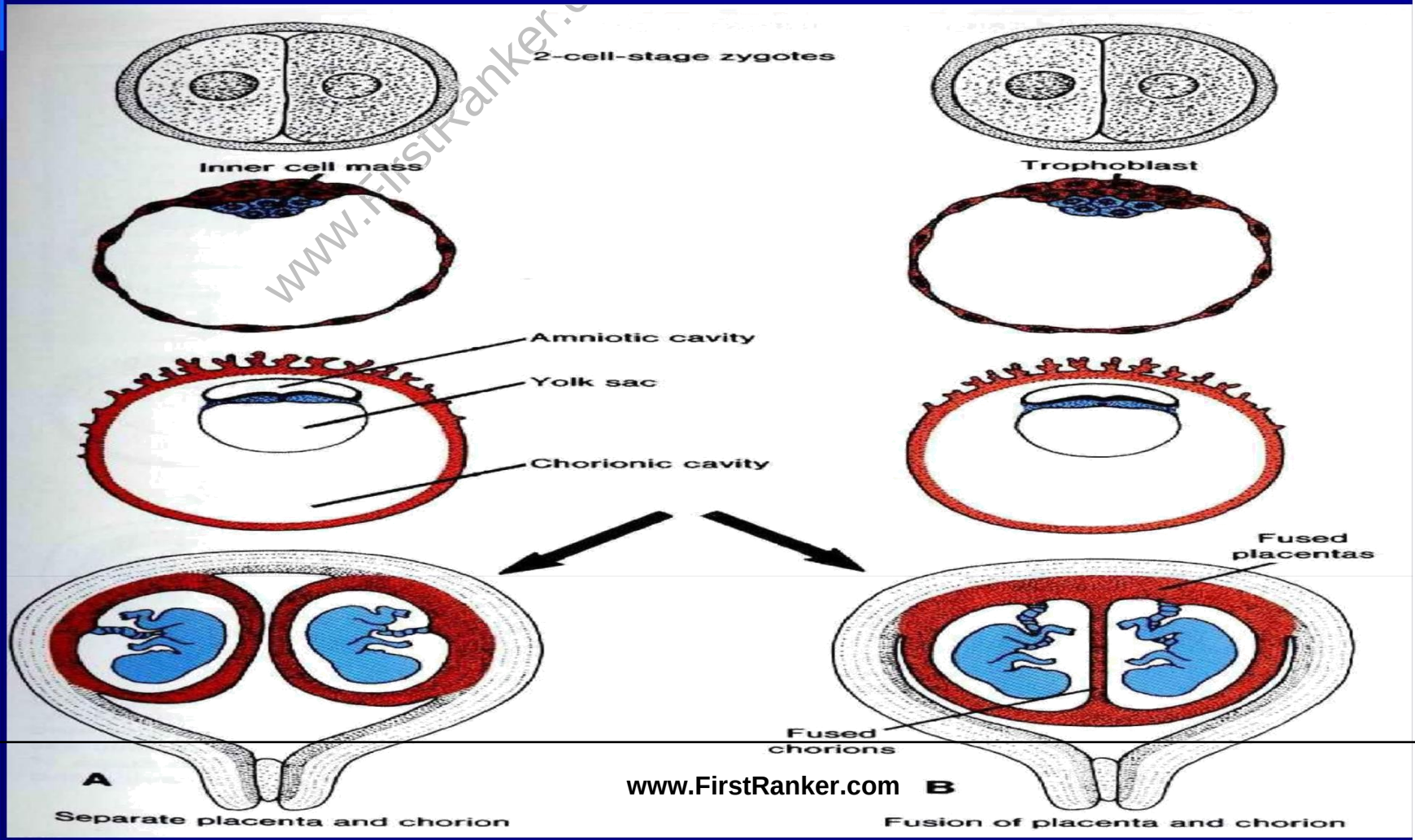
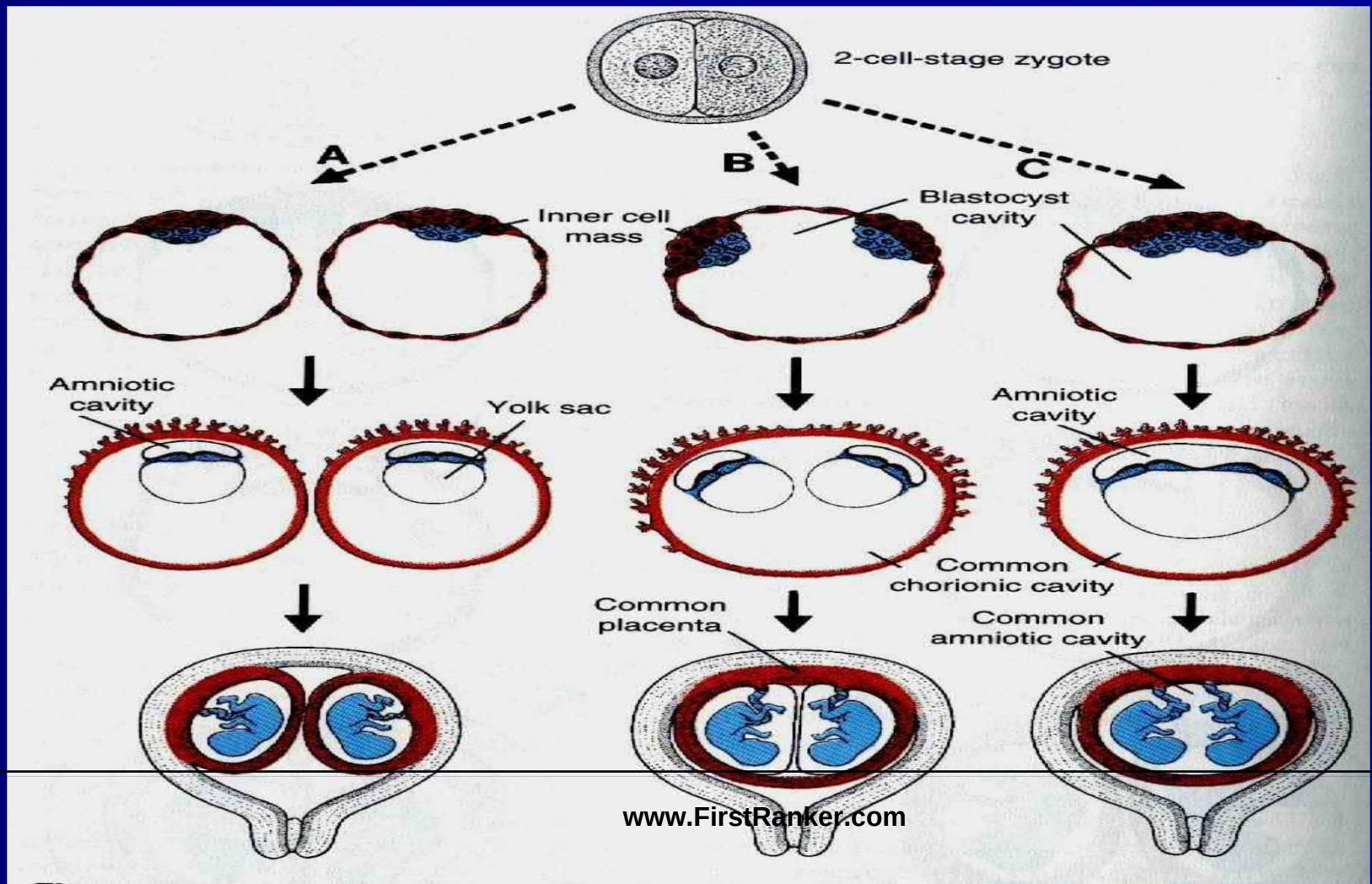
DEVELOPMENT OF DIZYGOTIC TWINS



- Monozygotic twins (identical twins)
  - Develop from single fertilized ovum
  - 3-4/1000 births
  - Genetically identical
  - Result from splitting of zygote at an early stage
  - Close resemblance in blood groups, fingerprints, sex and external appearance such as eye and hair color

DEVELOPMENT OF MONOZYGOTIC TWINS



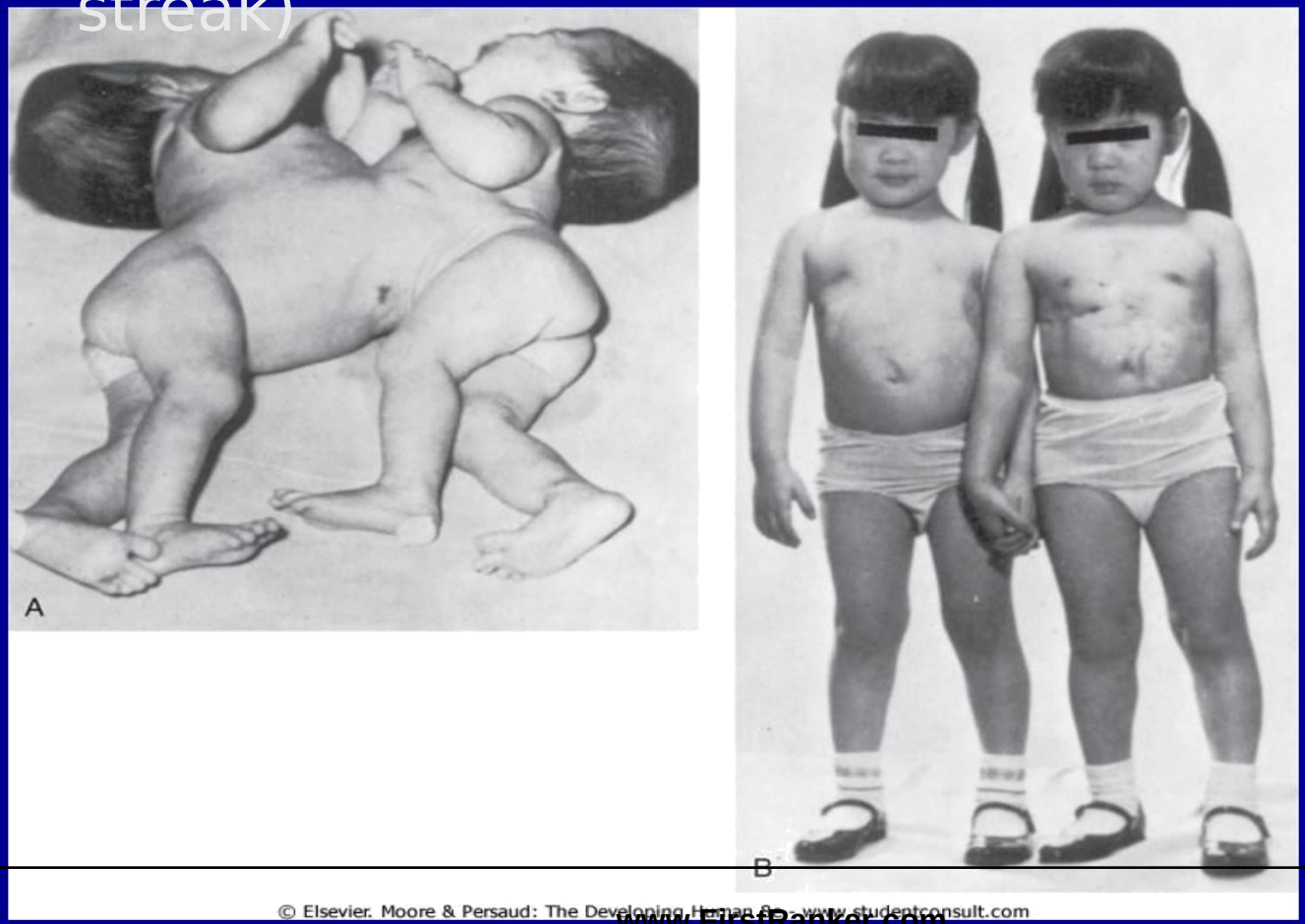
TWIN DEFECTS

- **Erythrocyte mosaicism**: Anastomosis b/w blood vessels of fused placenta of DZ; RBCs of two different types.
- **Twin transfusion syndrome**: Shunting of arterial blood from one twin through AV anastomosis into venous circulation of other twin. Donar twin is anemic while the recipient twin is polycythemic.
- Fetus papyraceous: Death and resorption of one fetus

TWIN TRANSFUSION SYNDROME

CONJOINED OR SIAMESE TWINS

(Partial splitting of primitive node & streak)



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PRETERM BIRTH
(Delivery before 34 weeks)

Causes:

- Premature rupture of membranes
- Premature onset of labor
- Pregnancy complications requiring premature delivery
- Maternal hypertension
- Maternal Diabetes
- Maternal vaginal infections

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