

# Theriogenology



**(Gynaecology, Andrology & Obstetrics)**

*Session4*

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# **Placentation, the Endocrinology of Gestation and Parturition**

*The final prepartum steps of reproduction are:*

- *formation of a placenta*
- *acquisition of endocrine function of the placenta*
- *initiation of parturition*

# Placentas are classified according to:

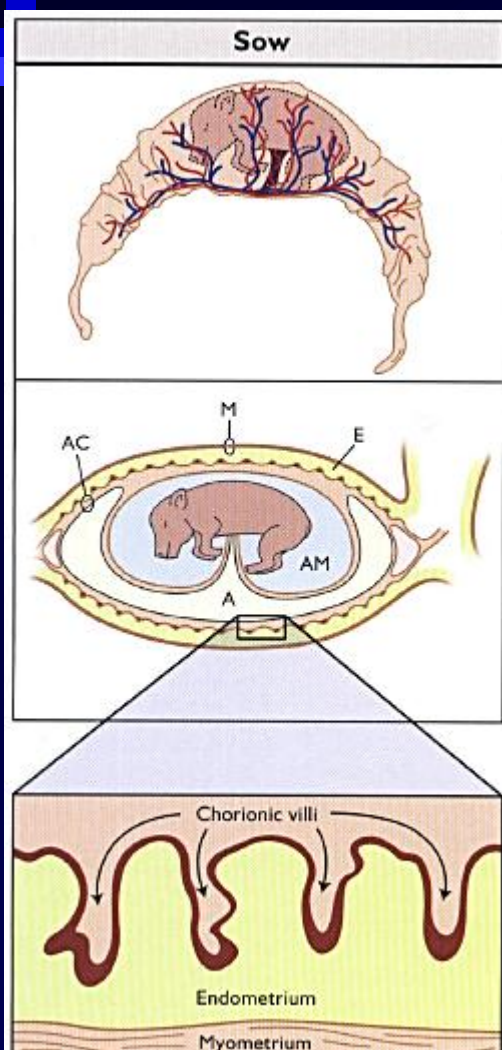
- ❑ Distribution of chorionic villi on their surfaces
- ❑ Number of tissue layers separating maternal and fetal blood



*Placentas are classified according to the distribution of chorionic villi. These classifications are:*

- *diffuse*
- *zonary*
- *discoid*
- *cotyledonary*

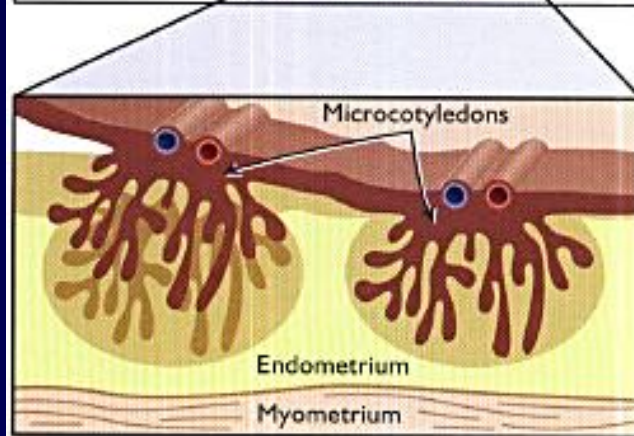
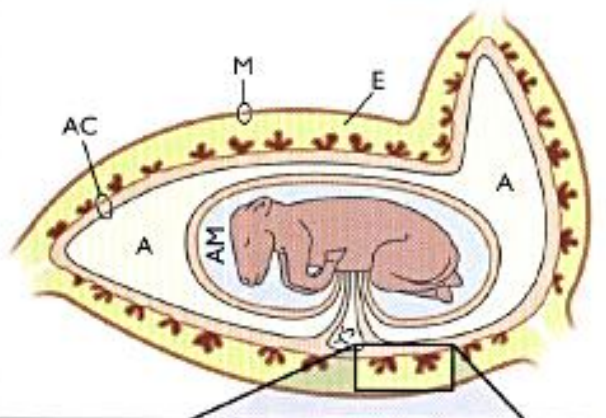
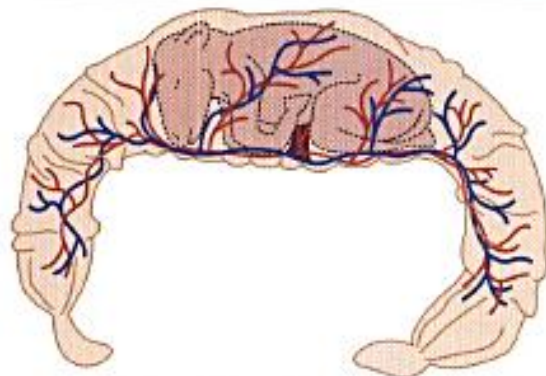




*Diffuse placentas have uniform distribution of chorionic villi that cover the surface of the chorion.*

- \* The diffuse placenta of the pig has a Velvet-like surface.
- \* Attachment occurs around day 18-20 after ovulation.

## Mare

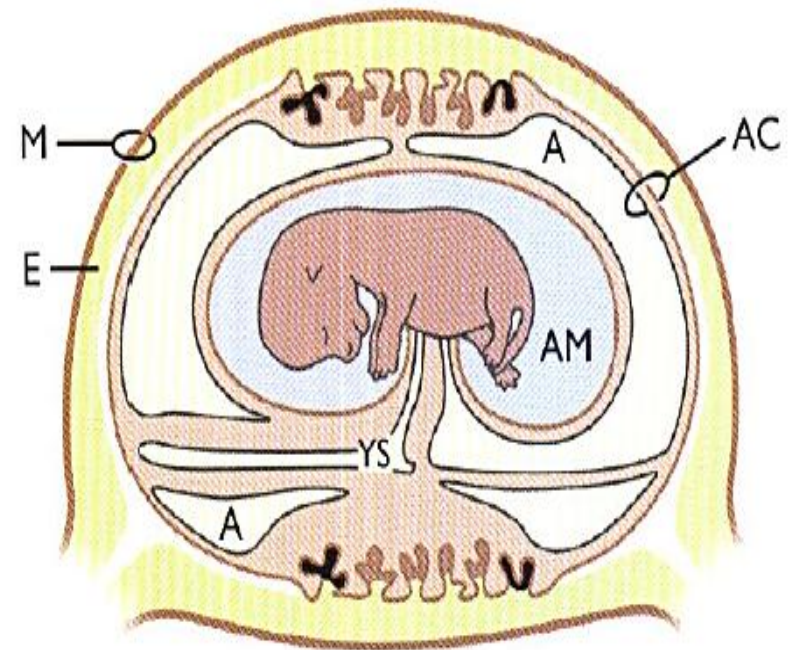
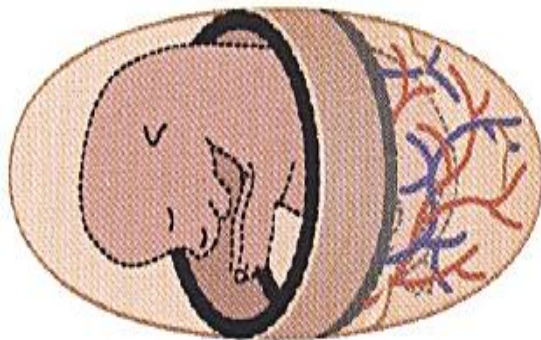


The mare placenta also contains unique transitory structures known as **endometrial cups**. These are discrete areas that range from a few millimeters to several centimeters in diameter. The endometrial cups are of both trophoblastic and endometrial origin. There are 5 to 10 endometrial cups distributed over the surface of the placenta (See Figure 14-6). Endometrial cups produce **equine chorionic gonadotropin (eCG)** and develop between days 35 and 60 of pregnancy. Following day 60, the endometrial cups are sloughed into the uterine lumen and are no longer functional. Attachment of the conceptus to the endometrium is initiated at about day 24 and becomes well established by 36 to 38 days (See Chapter 13).



*Zonary placentas have a band-like zone of chorionic villi.*

### Bitch

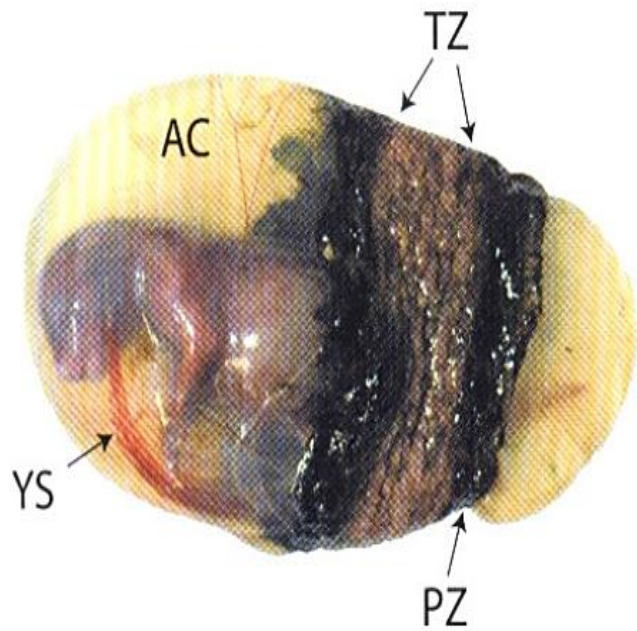




**Broad Zone: prominent region of exchange**

**1- Pigmented Zone(Paraplacenta): iron transport from the dam to the fetus.**

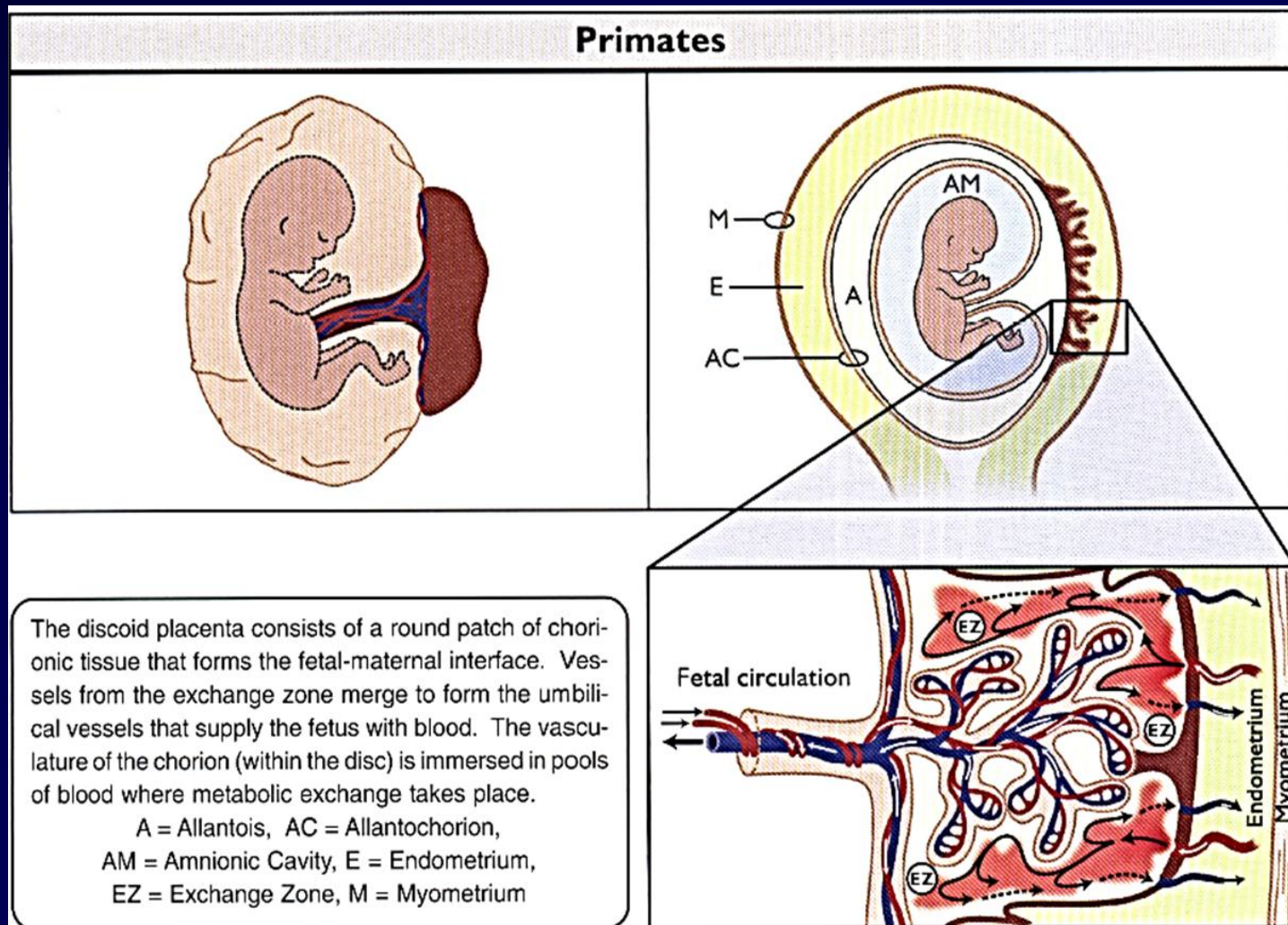
**2- Transparent Zone: absorption materials directly from the uterine lumen**



The zonary placenta consists of three distinct zones; a transfer zone (TZ), a pigmented zone (PZ) and a relatively nonvascular zone, the allantochorion (AC). In the zonary placenta, a band of tissue forms around the conceptus where nutrient transfer occurs. The pigmented zone (PZ) or paraplacenta represents local regions of maternal hemorrhage and necrosis.

A= Allantois, AC= Allantochorion, AM= Amnionic Cavity,  
E= Endometrium, M= Myometrium, YS= Yolk Sac

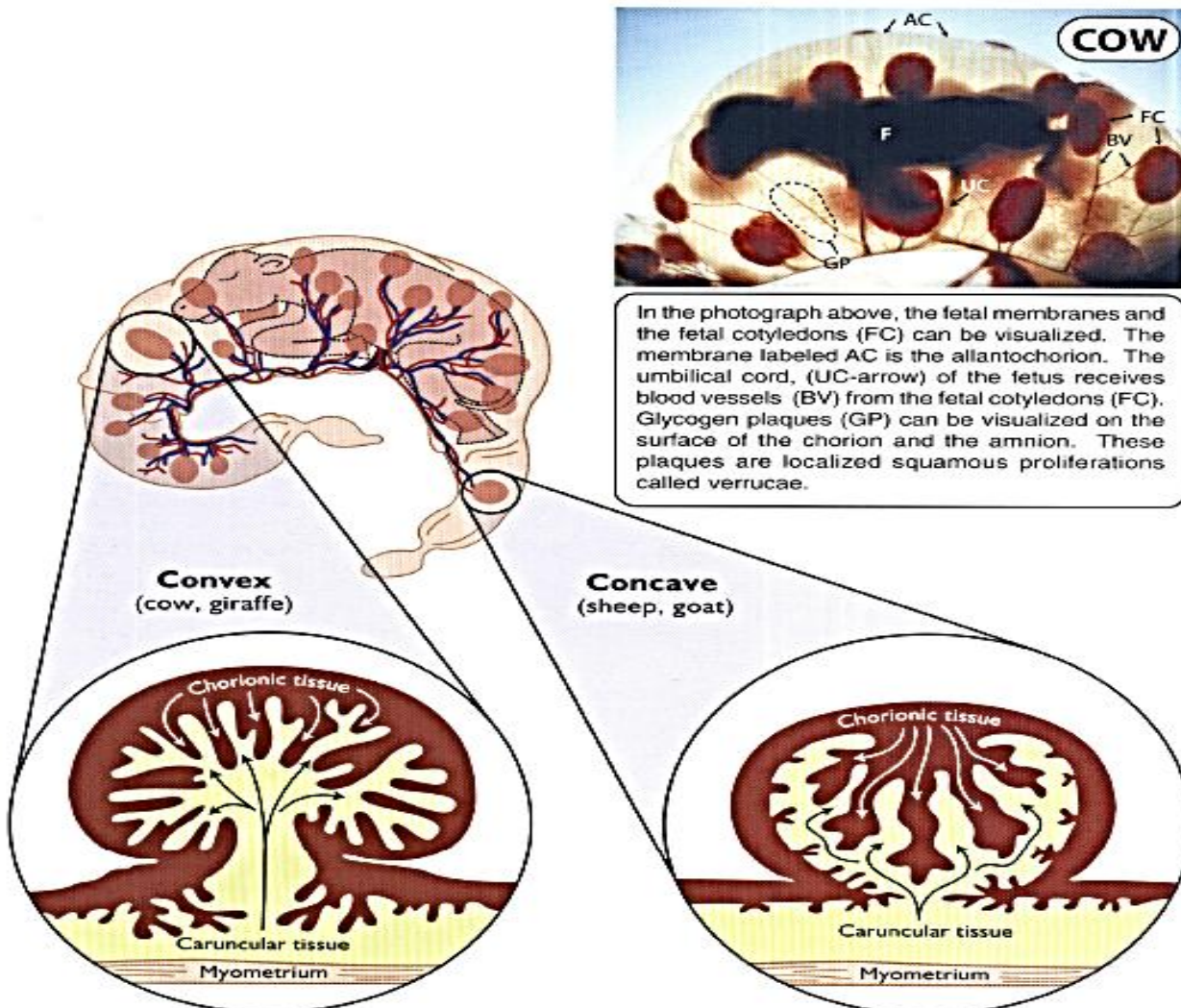
The discoid placenta is found in rodents and primates.





*Cotyledonary placentas have numerous, discrete button-like structures called cotyledons.*

**Figure 14-3. The Cotyledonary Placenta**





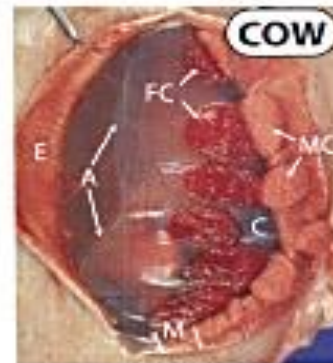


Note!

Cow: 70-120, Convex structure

Sheep: 90-100, Concave structure

**Figure 14-3. The Cotyledonary Placenta**



The diagram in the upper left illustrates the distribution of the extraembryonic membranes prior to complete attachment. The extraembryonic membranes consist of the amnion (blue sac), yolk sac (YS) and the allantois (A). Even though the fetus is located in one uterine horn, the chorion invades the contralateral uterine horn and forms placentomes.

#### **Cow**

Some fetal cotyledons (FC) have been partially separated from maternal cotyledons (MC). The chorion (C) is the outer fetal membrane. Arrows indicate the border of the amnion (A). The myometrium (M) is indicated by the arrows. Notice that the fetal cotyledon (FC) is attached to the surface of the caruncle creating a convex cotyledon. E= Endometrium

#### **Ewe-A**

The chorion can be seen entering the placental stalk (P). The chorionic stalk (CS) contains the fetal vasculature.

#### **Ewe-B**

A portion of the chorion has been incised so that the fetal vasculature can be visualized clearly. The fetal vessels (arrow) and chorionic tissue "push" into the caruncular tissue forming a concave cotyledon. A set of arteries (A) and veins (V) emerge from each cotyledon and eventually merge in the umbilical cord (UC). P= Placentome

#### **Ewe-C**

A concave placentome is clearly visible. The chorionic stalk is draped over the needle holder. Notice the vessels (arrows) within the chorionic tissue. The reddish-beige tissue is the maternal cotyledon (MC) that is covered by the allantochorion. The dark tissue in the center (arrows) is the fetal component of the placentome.

# Placental Classification by Microscopic Appearance is Based on the Number of Placental Layers that Separate the Fetal Blood from the Maternal Blood

*Prefix =maternal side    Suffix =fetal side*

*“epithelio”*

*“chorial”*

*epitheliochorial*





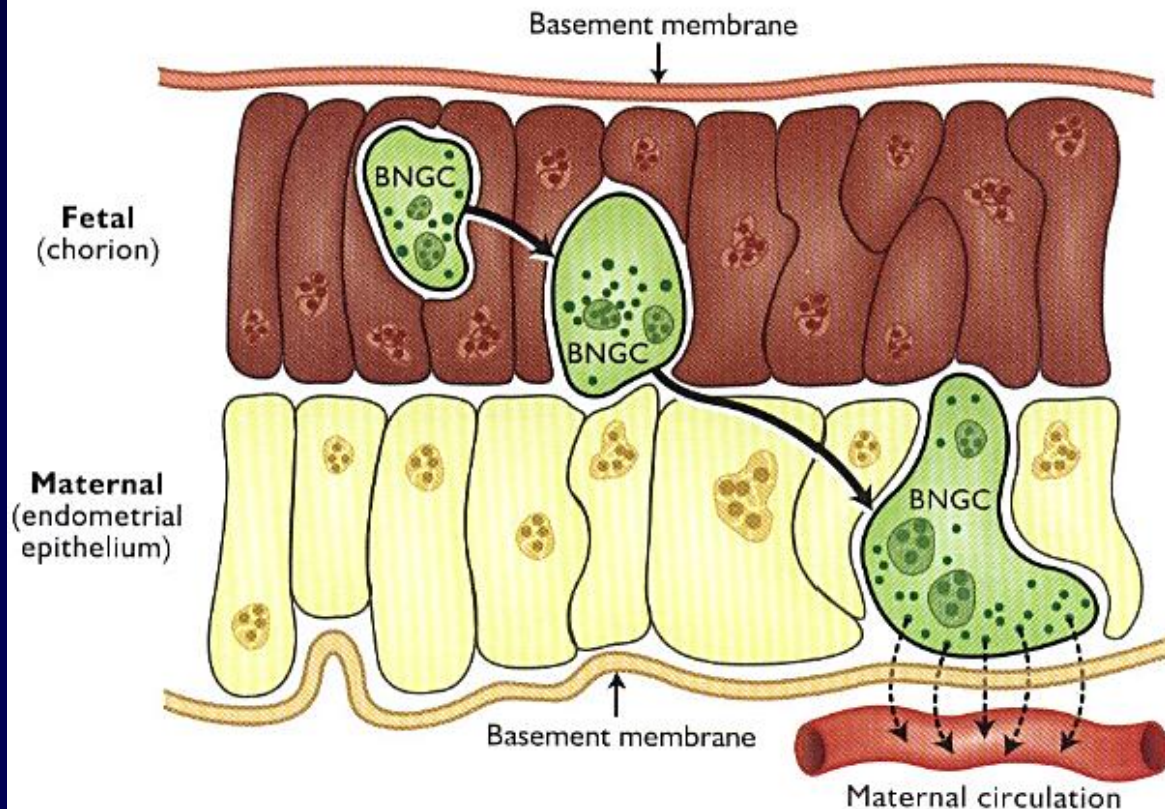
Note!

Tissue layer (between maternal and fetal): 3-6

## Binucleate giant cells:

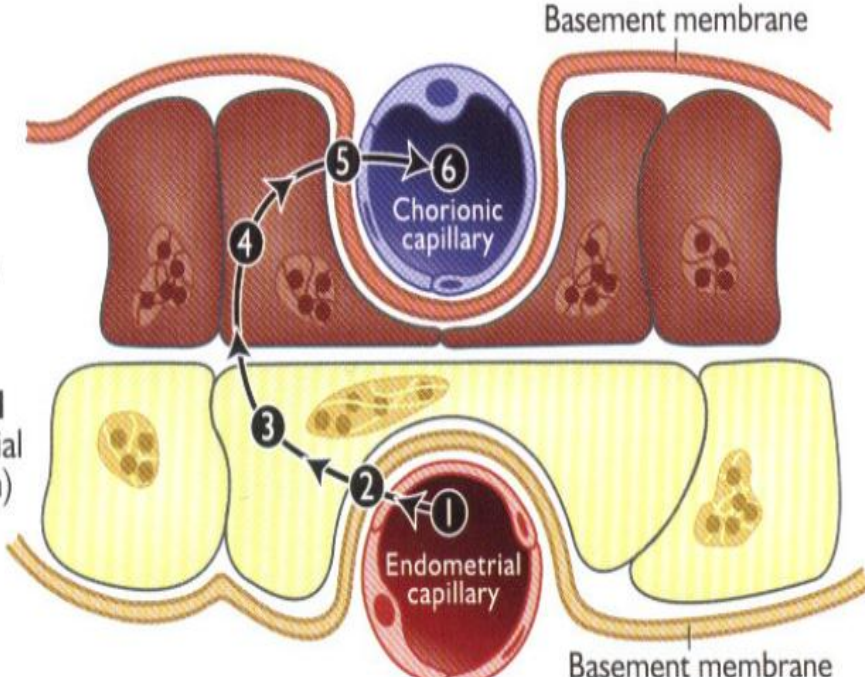
- \* appear at about day 14 in the sheep and 18-20 in the cow.
- \* Constitute around 20% of the fetal placenta.
- \* Transfer complex molecules from the fetal to the maternal placenta.
- \* Secrete PL, PSPB(PAG), estrogen and progesterone.

**Figure 14-4.** The Migration of Binucleate Giant Cells in the Ruminant Placenta



Binucleate giant cells (BNGC) migrate from the chorion to the endometrial epithelium in ruminants. These cells are thought to secrete placental lactogen and pregnancy specific protein B.

## Epitheliochorial



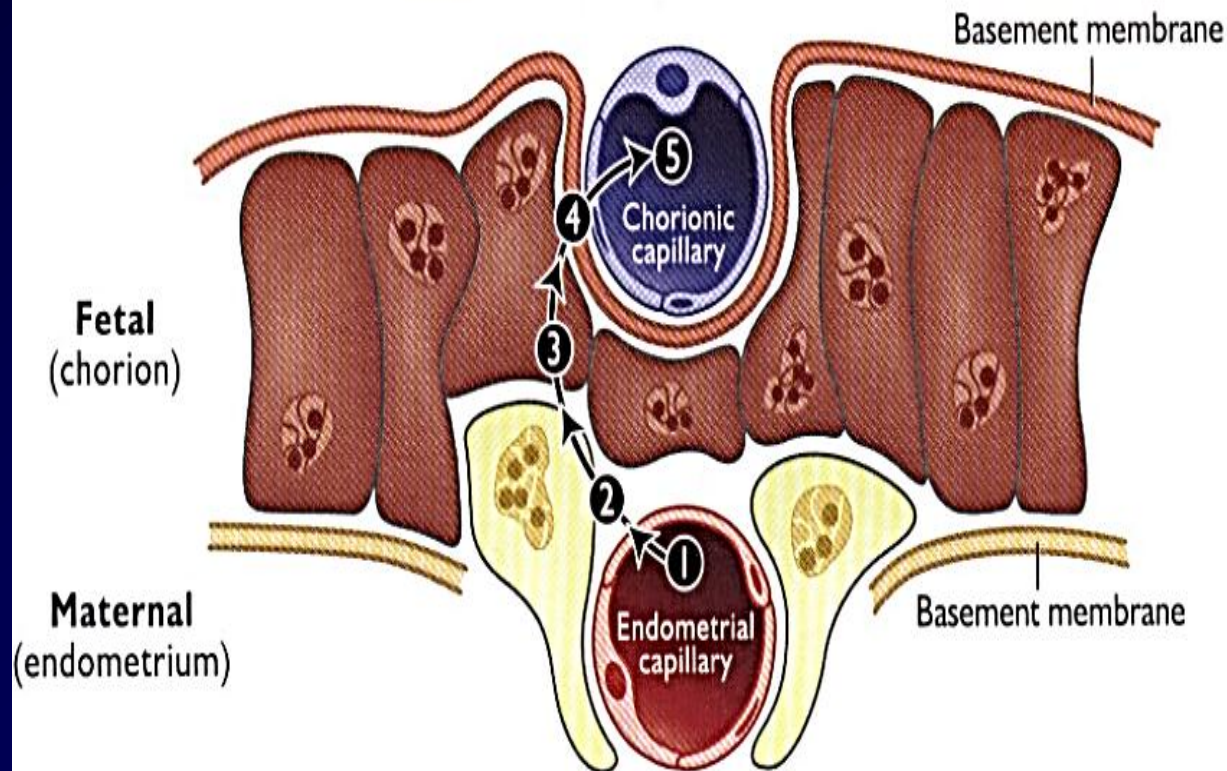
## Epitheliochorial

(pigs, horses and ruminants)

6. Chorionic capillaries
5. Chorionic interstitium
4. Chorionic epithelium
3. Endometrial epithelium
2. Endometrial interstitium
1. Endometrial capillaries



## Endotheliochorial

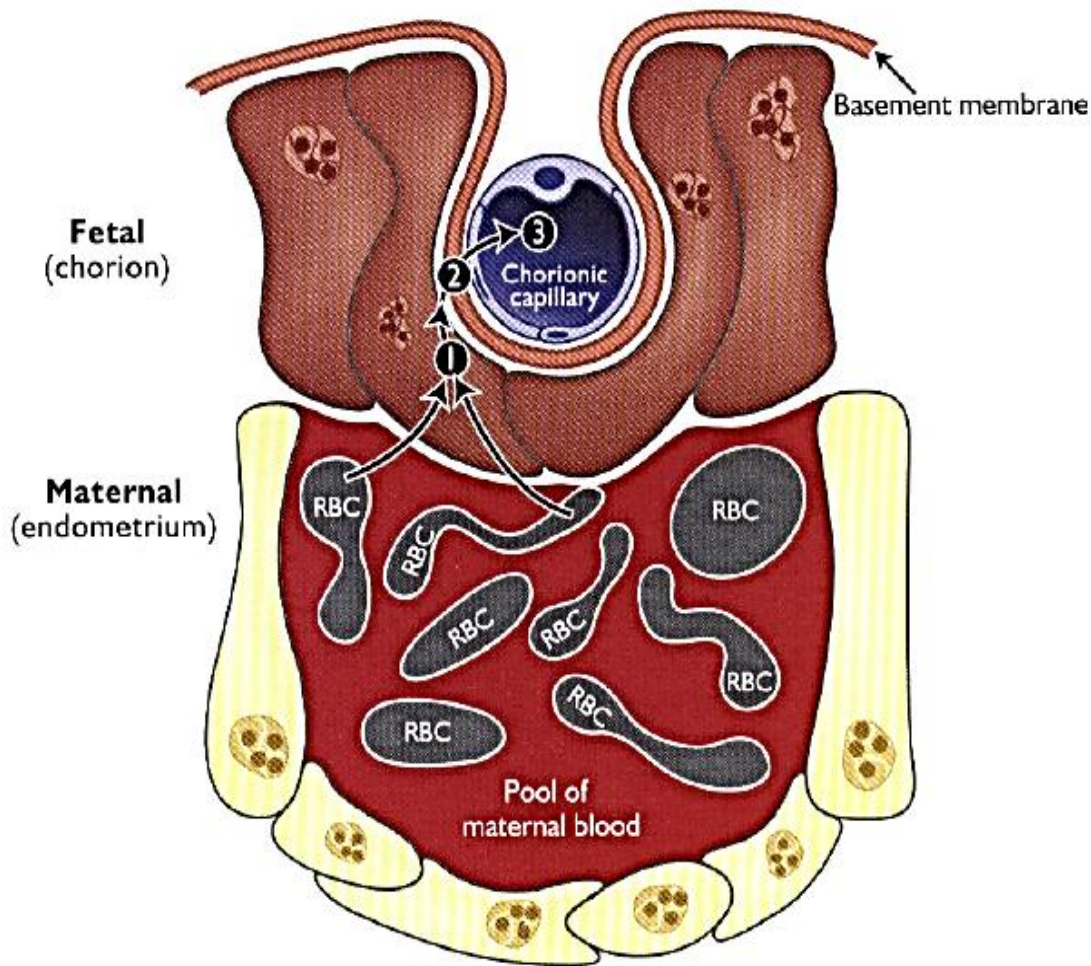


### Endotheliochorial

(dogs and cats)

- 5. Chorionic capillaries
- 4. Chorionic interstitium
- 3. Chorionic epithelium
- 2. Endometrial interstitium
- 1. Endometrial capillaries

## Hemochorial



### Hemochorial

(primates and rodents)

- 3. Chorionic capillaries
- 2. Chorionic interstitium
- 1. Chorionic epithelium

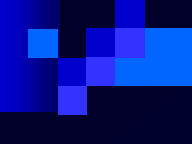
**RBC**= Red blood cell

# The Placenta Regulates the Exchange Between the Fetus and Dam

## ■ Mechanisms:

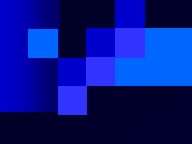
- 1- Simple diffusion (Gases & Water)
- 2- Facilitated diffusion (Glucose, Amino acids)
- 3- Active transport (Sodium, Potassium and calcium)





\* Lipids, maternal proteins, TSH, ACTH, GH, insulin and Glucagon and fat soluble vitamins don't cross the placenta barrier.

\* Many substances easily cross the placental barrier include: (Ethyl alcohol, lead, phosphorus mercury, opiate drugs, barbiturates, antibiotics, amphetamine, DESB, thalidomide, viruses, bacteria



*The placenta produces hormones that can:*

- *stimulate ovarian function*
- *maintain pregnancy*
- *influence fetal growth*
- *stimulate mammary function*
- *assist in parturition*

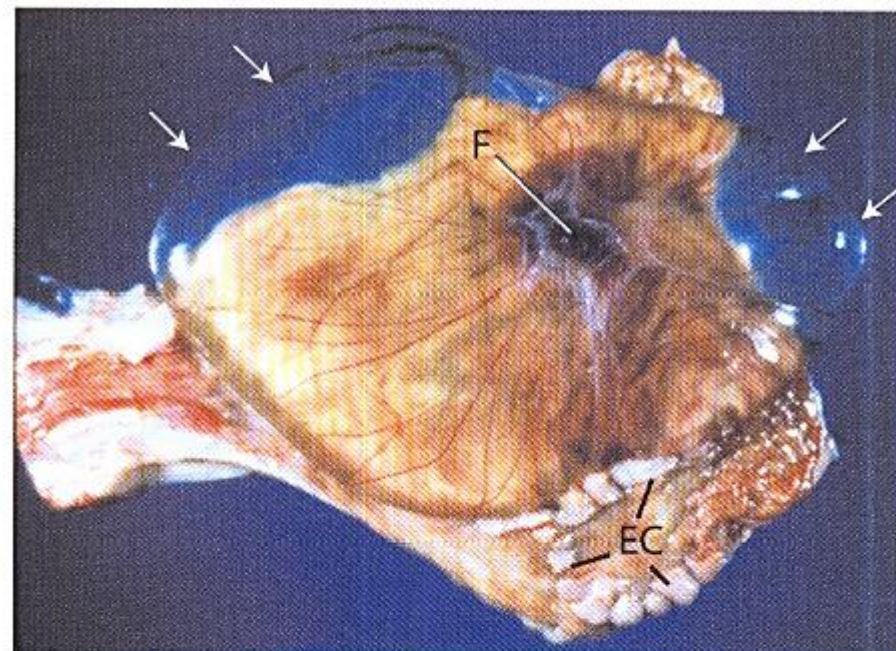
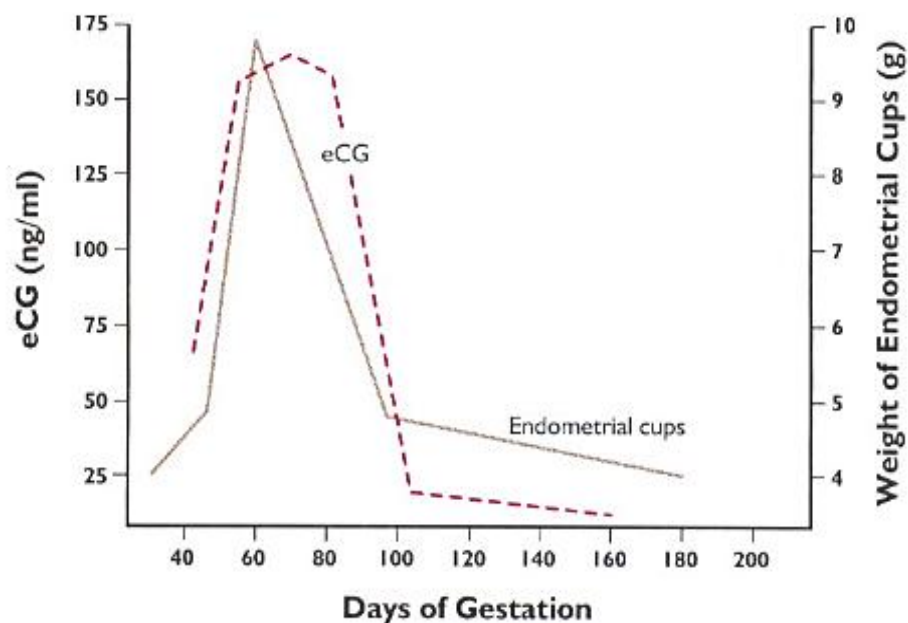
# The Placenta is a Major Endocrine Organ During Pregnancy

1. *PMSG OR eCG (Equine)*
2. *hCG (Human)*
3. *Progesterone*
4. *Estradiol*
5. *Placenta Lactogen OR Somatomammotropine*
6. *Relaxine*



**Figure 14-6.** Production of Equine Chorionic Gonadotropin (eCG) is Closely Related to the Weight of the Endometrial Cups

(Modified from Ginther, *Reproductive Biology of the Mare*)



Endometrial cups (EC) are seen here in a U-shaped configuration. The fetus (F) is surrounded by the amnion (not visible). The membrane indicated by arrows is the allantochorion. This specimen was removed from a mare at 50 days of gestation. (Photograph courtesy of Dr. O.J. Ginther from *Reproductive Biology of the Mare*, 2nd Ed.)

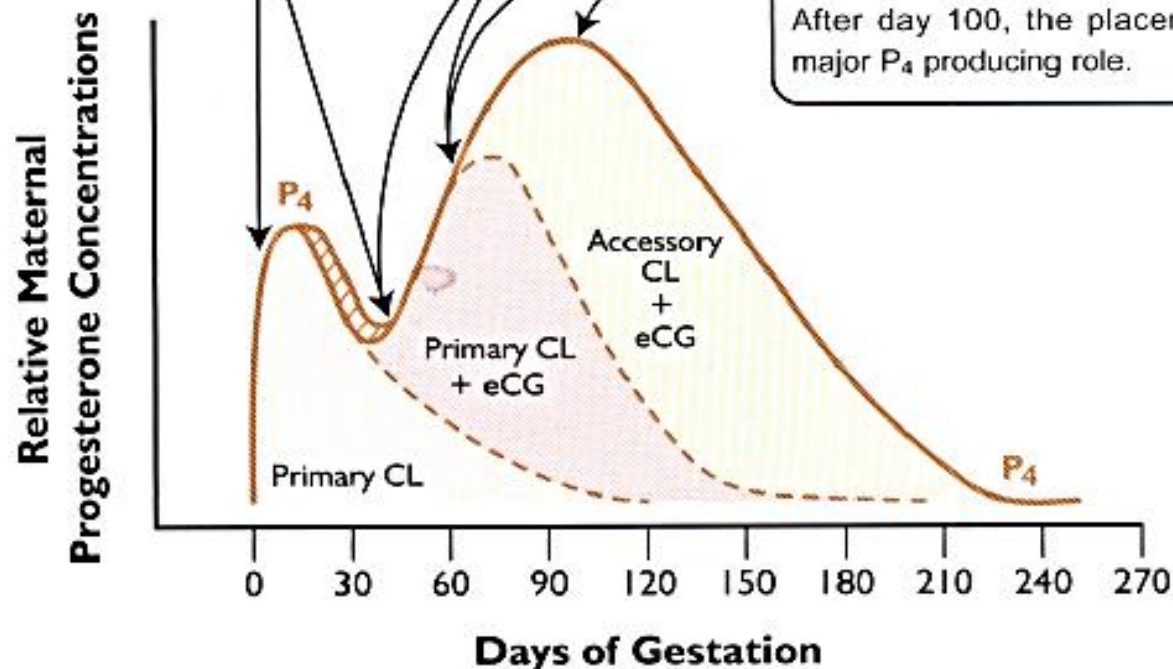
## Figure 14-7. Luteal Progesterone Output During the First Half of Gestation in the Mare

(Modified from Ginther, *Reproductive Biology of the Mare*)

Progesterone ( $P_4$ ) from the primary corpus luteum increases rapidly after ovulation and then decreases (hatched region). Without eCG,  $P_4$  would continue to decrease (dashed line) and the pregnancy would terminate.

Upon stimulation by eCG, the primary CL is stimulated and  $P_4$  in the maternal blood again increases. If eCG were not produced,  $P_4$  would continue to decrease (dashed line).

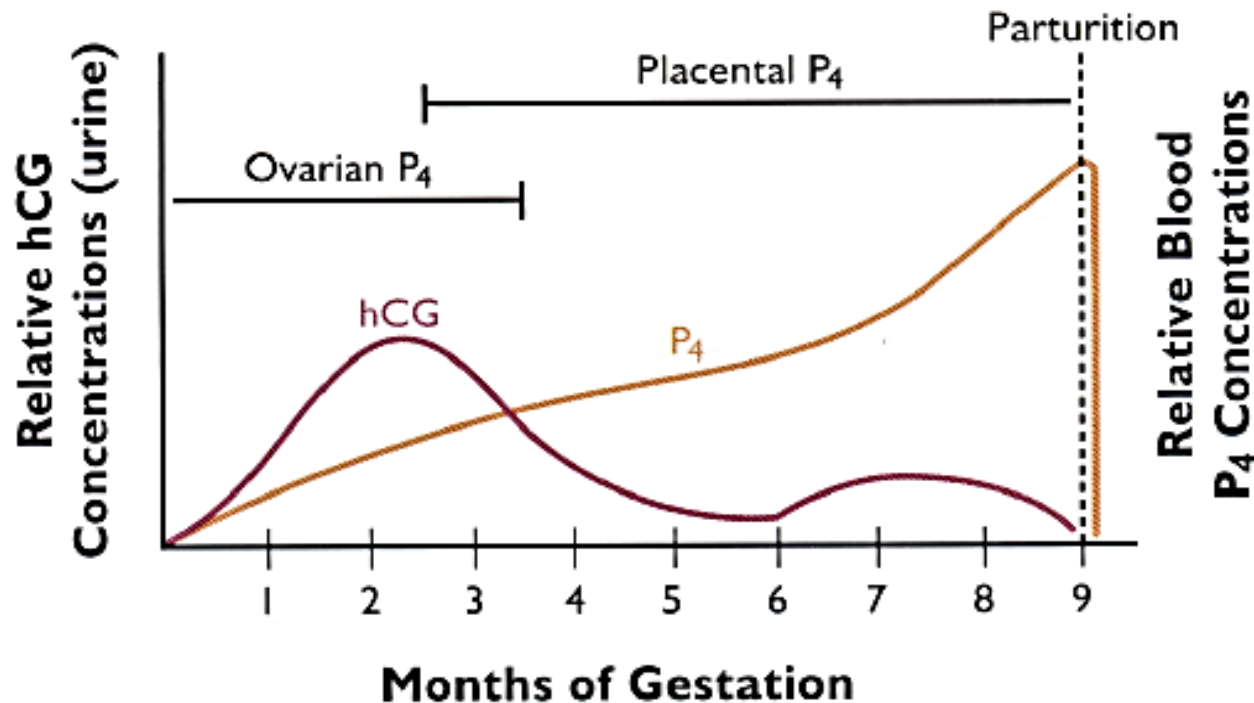
As eCG continues to increase, accessory CL develop and  $P_4$  increases until about day 100. After day 100, the placenta assumes the major  $P_4$  producing role.



**Figure 14-8.** The Production of hCG and Progesterone During Gestation in the Pregnant Woman

Human chorionic gonadotropin peaks at about 2.5 months of gestation and then declines. This period of time is critical for maintenance of pregnancy because the corpus luteum assumes primary responsibility for progesterone secretion.

At about 2.5 to 3 months of gestation the placenta begins to assume the primary responsibility for progesterone secretion and continues this role until the time of parturition. hCG increases slightly between months 6 and 9 because of the increased placental mass.







## *Placental lactogen (Somatomammotropin)*

- \* Polypeptide hormone
- \* Have been found in Rat, Mice, Sheep, Cow, Human.
- \* Stimulate grow of the fetus or mammary gland of the dam(depends on the species).

Ewe, Human: lactogenic

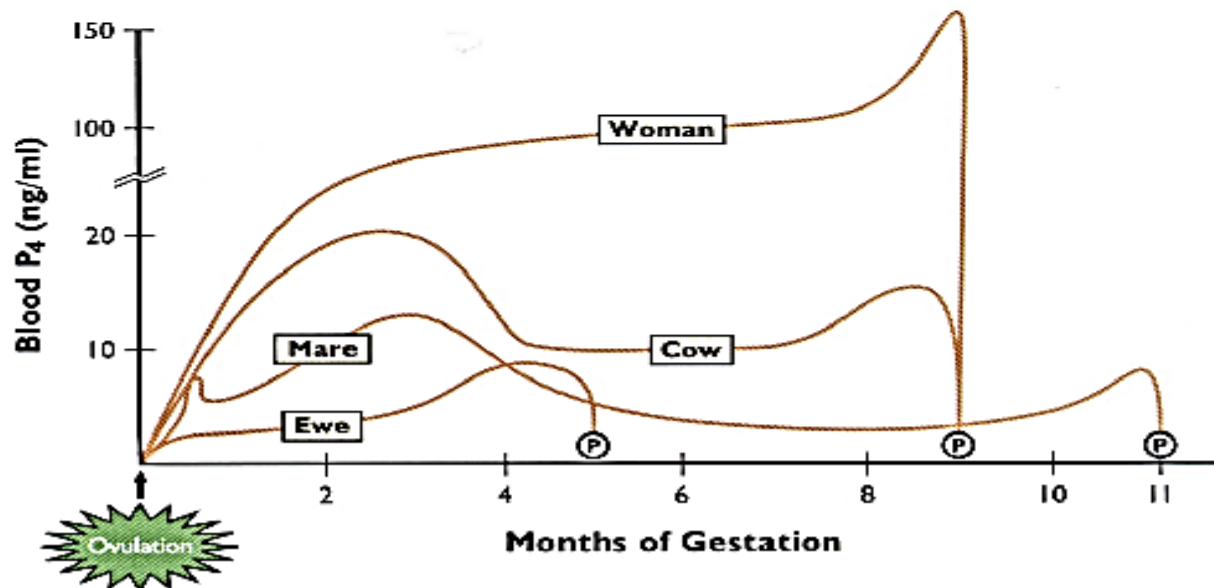
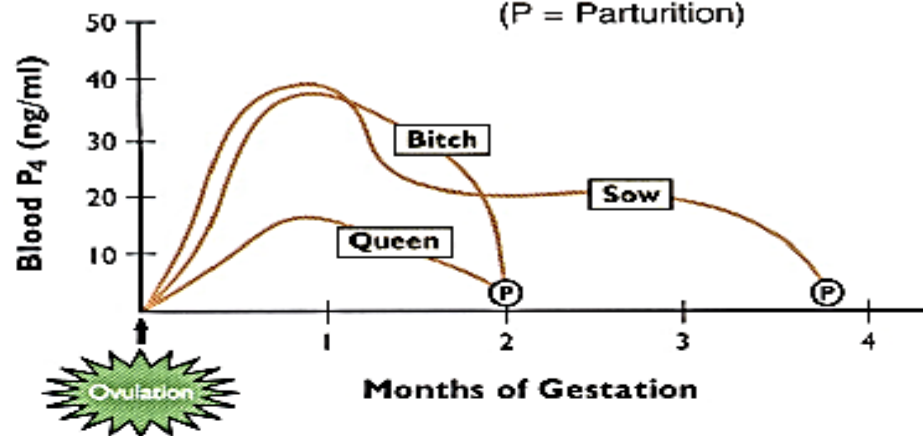
Cow: somatotropic



## *Relaxin*

- \* Produced in human, mare, cat, dog, pig, rabbit and monkey.
- \* In the rabbit may be produced entirely by the placenta.
- \* During the time of parturition originates from both the ovary and the placenta.
- \* Pregnancy detection test at about 30 days of gestation in the bitch.

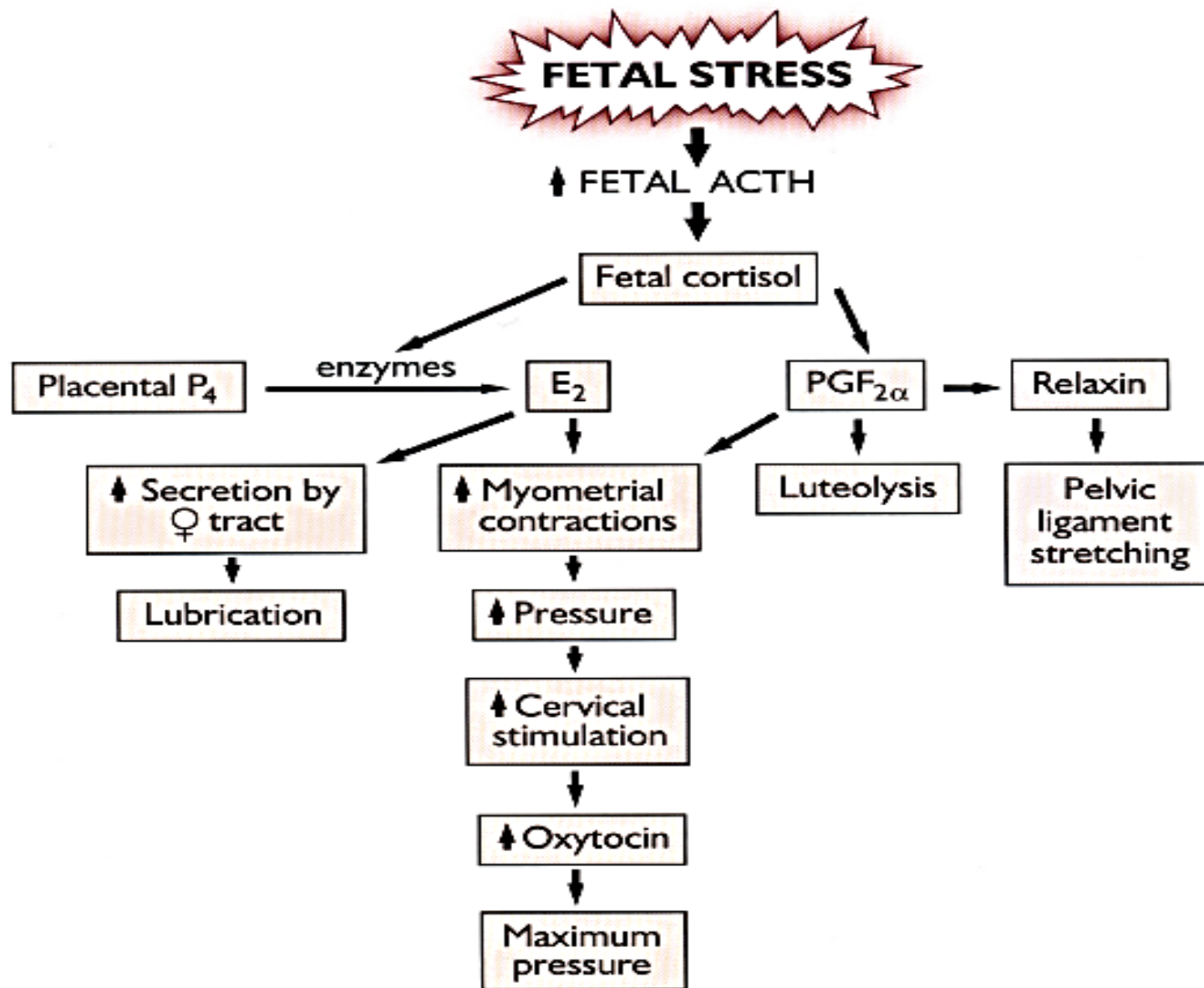
**Figure 14-9. Progesterone Profiles in Various Pregnant Females**  
(P = Parturition)



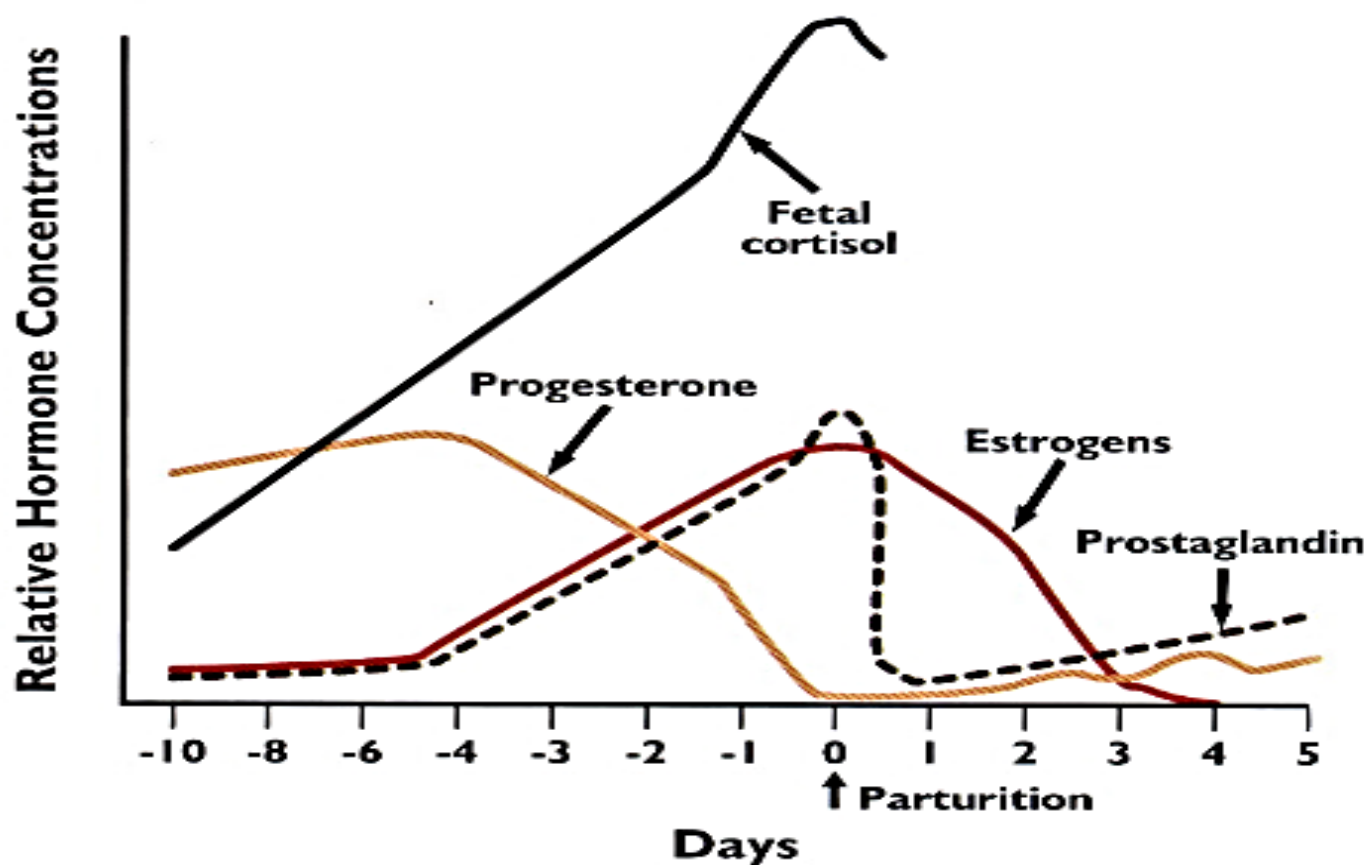


**Table 14-1.** Gestational Length and Time of Placental Takeover for Progesterone Production in Various Species

<u>SPECIES</u>	<u>GESTATION LENGTH</u>	<u>TIME OF PLACENTAL TAKEOVER</u>
Alpaca	11.4 mo	11.4 mo (none)
Bitch	2 mo (65 days)	2 mo (none)
Camel	12.3 mo	12.3 mo (none)
Cow	9 mo	6-8 mo
Ewe	5 mo	50 days
Goat	5 mo	5 mo (none)
Llama	11.3 mo	11.3 mo (none)
Mare	11 mo	70 days
Queen	2 mo (65 days)	2 mo (none)
Rabbit	1 mo	1 mo (none)
Sow	3.8 mo	3.8 mo (none)
Woman	9 mo	60-70 days



**Figure 14-13.** Relative Hormone Profiles in the Cow During the Periparturient Period



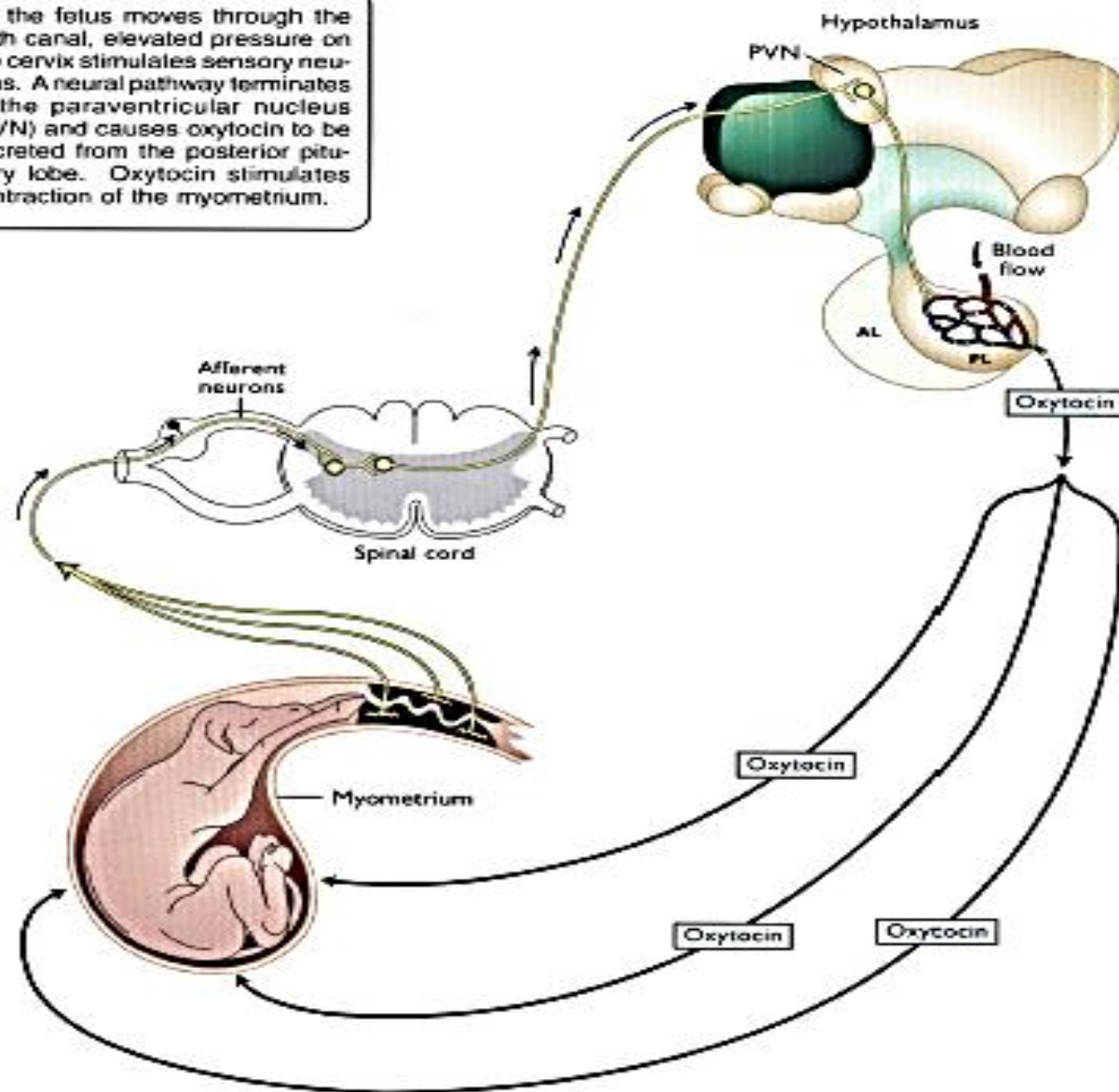


*The three stages of parturition are:*

- *stage I: initiation of myometrial contractions (removal of progesterone block)*
- *stage II: expulsion of the fetus*
- *stage III: expulsion of the fetal membranes*

**Figure 14-15.** Pressure on the Cervix Causes Oxytocin Release and Subsequent Myometrial Contractions

As the fetus moves through the birth canal, elevated pressure on the cervix stimulates sensory neurons. A neural pathway terminates in the paraventricular nucleus (PVN) and causes oxytocin to be secreted from the posterior pituitary lobe. Oxytocin stimulates contraction of the myometrium.





*Thanks for your attention*

