SECTION 12

Placental Function

Functions

responsible for transmission of nutrients to fetus and excretion of wastes

Also produces hormones that affect pregnancy and lactation

Structure

Fetal membranes give rise to placenta.

All farm species have Chorio-allantoic type of placenta.

Outer layer of allantois fuses with chorion.

This brings fetal blood vessels in allantois close to umbilical vessels which are in connective tissue between allantois and chorion.

Chorionic Villi

project into uterine endometrium to increase the area for nutrient and waste exchange.

present in all farm species
Villi are diffusely spread over uterus in pig and early on in mares.

Later mares develop microcotyledons.

Ruminants: cotyledons form connected to maternal caruncles.

Membranes of Placenta

First Functions

Chorion Trophoblast Encloses other membranes and associates with uterine lining.

Allantois Hindgut Blood vessels connect fetus and placenta

Amnion Inner cell Encloses fetus in mass fluid

Umbilical cord amnion Encloses allantoic wraps around blood vessels

Yolk sac endoderm Vestigial

Some nutrients

In monotocous species the horn of the uterus with the pregnancy is called the Gravid horn and the other is
the Nongravid horn.

Chorion often extends into nongravid side.

In pigs chorions often come in contact but no vascular anastomosis. True also of sheep with multiple pregnancies.

In cows vascular anastomosis does occur resulting in freemartins if opposite sexes connect.

Placental and Maternal circulations do not mix in farm species. Their placentas are classified as epitheliochorial: uterine epithelium contacts chorion.

Maternal blood flows to placenta by uterine arteries and is carried away by uterine veins.

Blood flow to uterus increases 2-3 times at maternal recognition. A further increase is seen at implantation.

About 80% of the blood goes to placenta.

Umbilical arteries carry blood from fetus to placenta and umbilical veins carry blood from placenta to fetus.

In species with cotyledons maternal capillaries surround the cotyledons which have fetal capillaries within.

Exchange of Gases

Oxygen from maternal blood passes to fetus and CO2
goes from fetus to mother

Fetal Hemoglobin has higher affinity for oxygen and a lower affinity for CO2 than does adult.

Nutrient exchange

all nutrients for fetus come from mother Some flow across due to concentration differences and others use a carrier.

Glucose, amino acids, vitamins have specific carrier systems.

Placenta converts glucose from mother to fructose.

Amino acids cross quickly but larger proteins do not cross well.

Free fatty acids cross by diffusion.

Immunoglobulins do not cross the placenta in farm species.

Fetal Growth and Development

Fetus has priority over mother for nutrients and if maternal nutrition is inadequate this leads to problems such as Pregnancy Toxemia in ewes.

Fetus can pull calcium from maternal skeleton to
supply its needs.

Fetal growth is most rapid early in terms of percent change in size. But greatest increase in weight occurs late in gestation.

Calves gain over half of weight in last 2 months.

This is time when maternal nutrition can affect fetal growth.

Twins are smaller at birth than singles in monotocous species.

Maternal parity and size can affect birth weight.

Primiparous animals usually have smaller young.

Heat stress in late pregnancy can decrease birth weight by decreasing uterine blood flow.

Hormones of Pregnancy

Progesterone is required for maintenance of gestation. The source of P4 is not always the CL in some stages of pregnancy.

In the sow, cow and doe the CL is required throughout pregnancy because it is the only source of progesterone.
In ewes the CL provides progesterone for the first half of gestation and the placenta produces P4 for the last half.

In mares the CL produces P4 for about 40 days at which time accessory CL's are formed.

The formation of accessory corpora lutea is due to secretion of PMSG also called Equine Chorionic Gonadotropin (eCG).

PMSG acts like FSH in other species but in horses acts more like LH.

It causes development and ovulation of follicles about day 35 of gestation.

PMSG is produced by Endometrial Cups.

Endometrial cups develop from trophoblast cells called chorionic girdle cells. They detach from chorion and invade endometrium.

PMSG is produced from day 40 to 130 of gestation.

Genotype of fetus can affect PMSG production. Accessory CL's regress about day 150 and placenta takes over production of progesterone.
Progesterone levels decrease when accessory CL regress but placenta produces enough to maintain pregnancy.

Estrogen increases in mares about day 90 of gestation and remains elevated through pregnancy.

Estrogen produced by Feto-Placental unit. Neither placenta or fetus has all the enzymes needed to make estrogen.

Progesterone is made by placenta. Some of it goes to fetus to be converted to androgens.

Then androgens come back to placenta to be aromatized to estrogen.

This is true for all of the farm species.

High levels of estrogen cause the increased blood flow to the uterus during late gestation.

Elevated estrogen and P4 during pregnancy stimulate mammary gland development.

Relaxin is produced by placenta in mares and in CL in sows and cows. Its function is to relax or soften connective tissue. This allows uterus to expand to accommodate growing fetus.

Relaxin also dilates cervix and relaxes pelvic
Placental Lactogen or Chorionic Somatomammotropin

Resembles Growth hormone and Prolactin structurally and functionally.

Produced only in ruminants.

Stimulates mammary gland development.

It also spares glucose from mother for fetus.

Mother can use other energy sources but fetus needs glucose.

May stimulate fetal growth.

Human placenta also makes a placental lactogen.

hCG: human chorionic gonadotropin

Produced by embryo as early as day 7 of pregnancy

Maintains CL

Often substituted for LH in research or in treating reproductive problems.

Other hormones produced by placenta.

Pregnancy Specific Protein B

cows and ewes
Found about day 25 of gestation in cows and increases throughout gestation.

Function still unknown.

Beta-endorphin,
Corticotropin releasing Hormone
GnRH.

Functions of these are not known.

Placenta protects fetus from immunological rejection by mother.

Not sure how placenta is protected from attack.

Some of these hormones are likely to have a role in regulating the immune system.