Tikrit University
College of Veterinary Medicine

1-Fertilization
2-Physiology of pregnancy
3-Maternal Recognition of Pregnancy

Subject name: Obstetrics

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Lecturer name: Fertilization

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Lecturers link

Fertilization/1

Fertilization also known as conception, fecundation, syngamy and impregnation, is the fusion of gametes to initiate the development of a new individual organism.

There are many events precede the **Fertilization** which includes:

- Ovulation,
- Ovum transport to the fertilization site,
- Sperm deposition and sperm transport.
- Sperm capacitation
- Fertilization

❖ **Ovulation**:

The ovulation occurs under the influence of LH released from the pituitary gland and this ovulation occurs in different time according to species as following :

in cow ovulation occurs 12 hr after ending of estrus ,in mare before 48 hr from ending of estrus ,in ewe occurs after 24-36 hr after starting estrus and some animals the ovulation occurs after mating (induced ovulation) like rabbit ,cat and camel.

❖ **Ovum transport**:

At ovulation the ovum or egg is collected by the infundibular end of the oviduct or fallopian tube .

It is transported down the oviduct towards the uterus possibly by a combination of cilial (hair-like) action and muscular contractions.

Transport through the oviduct appears to be under the control of ovarian steroid hormones since estrogens reduce and progesterone increases the speed of passage of ova through the oviducts. Fertilization normally occurs in the ampulla section of the oviduct close to the junction with the isthmus.

In the cow, the ovum enters the uterus 4–5 days after ovulation in morula stage.

❖ **Spermatozoa transport** :

In the case of natural service, semen is deposited in the anterior vagina whereas with artificial insemination it is usual to place it just inside the uterus or in the anterior cervix.

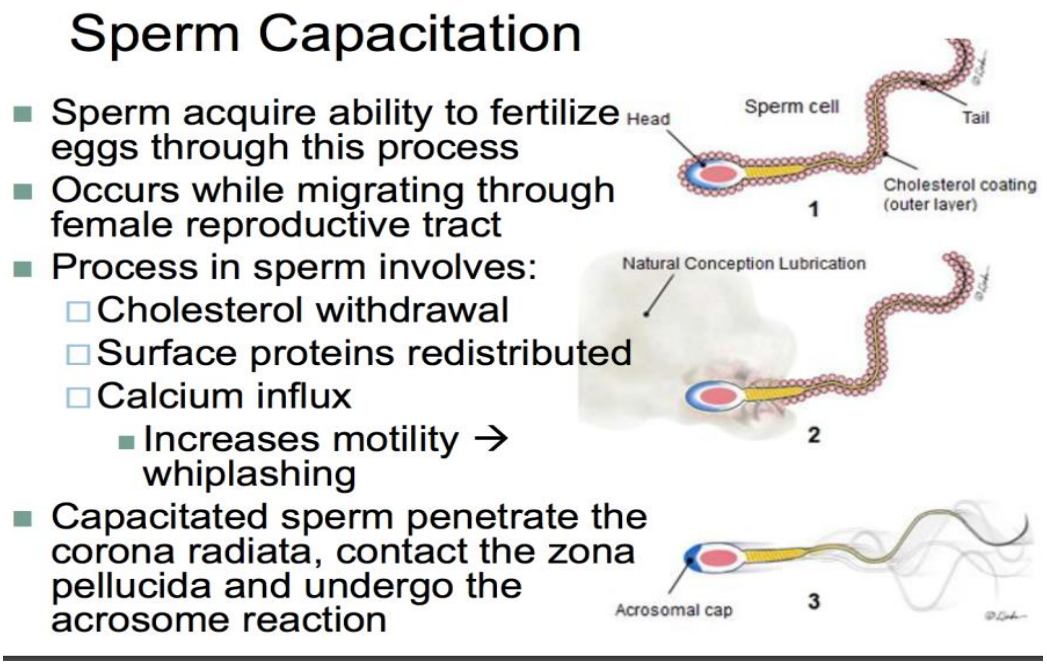
Spermatozoa ascend the female tract by both active and passive processes. Active transport involves activity of the sperm tail or flagella, but clearly its interaction with epithelial surface secretions and cilia is also important. Propulsion of spermatozoa through the uterus appears to be quite rapid and the isthmus(site fertilization) of the oviduct acts as a spermatozoa reservoir in many species.

❖ **Capacitation**:

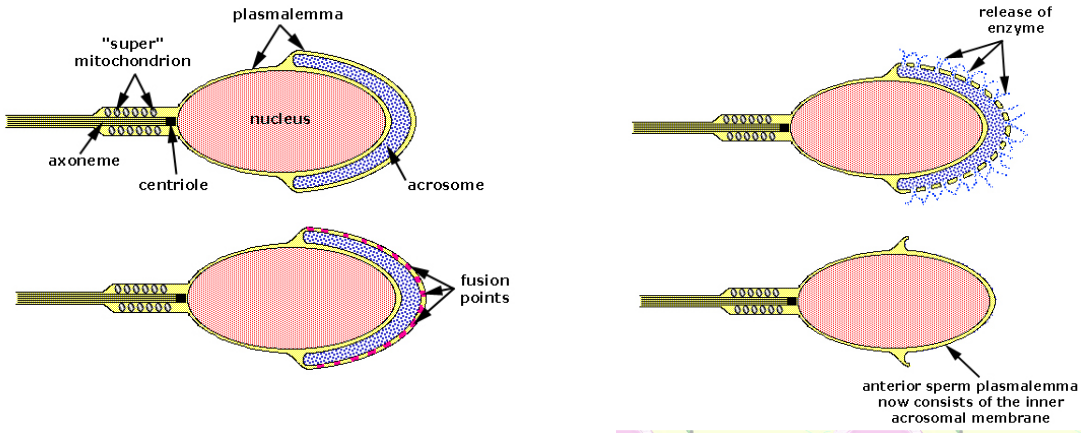
Before spermatozoa are able to fertilize the ovum, they have to undergo a further series of maturational changes in then female tract. **Capacitation:** (the process by which the glycoprotein coat and the seminal proteins are remove d from the surface of the sperm's **acrosome**by substances secreted by the uterus or fallopian tubes of the female genital tract, thereby permitting the **acrosome reaction** to occur are thought to require about six hours in the cow).

This requirement for maturational changes is the main reason why it is preferable to inseminate cows several hours before ovulation.

The process of capacitation is stimulated when sperm enter the female reproductive tract.



The acrosome reaction follows capacitation and involves the fusion of the sperm cell membrane and the acrosome and the formation of gaps through which the acrosome contents can diffuse. The acrosome reaction is necessary to allow penetration of the oocyte by the sperm.



❖ **Fertilization**:

- When the sperm reaching the ovum, the sperm penetrates any remaining cumulus oophorus by the action of the enzyme hyaluronidase from the acrosome and comes into contact with the zona-pellucida.
- Mobility of the spermatozoa is also important in the process of sperm penetration.
- The fusion of the sperm and ovum cell membranes begins at the middle of the sperm head region. The sperm head becomes engulfed by the ova with the loss of the tall.
- Fertilization is completed with the fusion of the haploid male and female pronuclei, a process known as syngamy.
    - What is meaning **(Polyspermy)**
    - Only one of sperm contributes to fertilization (**explain**)
    - **polyspermy** describes the fertilization of an egg by more than one sperm. Diploid organisms normally contain two copies of each chromosome, one from each parent.

Physiology of pregnancy/2

Pregnancy: is the condition of female in which unborn fetus are contained within the body, begins with fertilization, end with parturition and includes implantation and placentation.

Gestation is often divided into three stages:

(1) the ovum from 0–13 days,

(2) the embryo from 14 days, when germ layers begin to form until 45 days, and

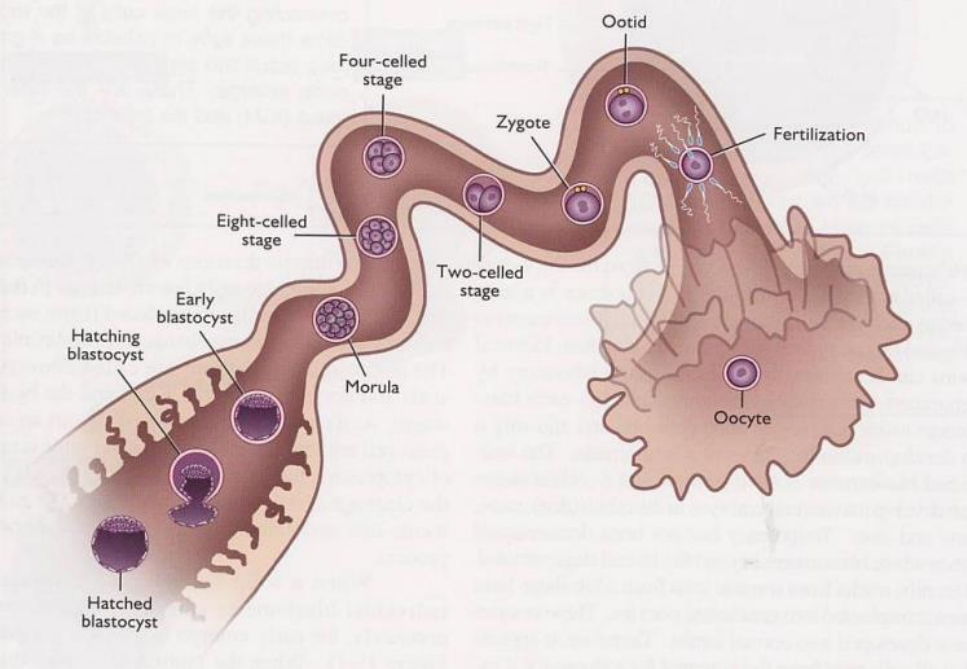
(3) the fetus from 46 days until parturition.

1- After fertilization, the zygote divides many times without significant growth (**cleavage**).The first cleavage produces a 2-cell embryo, followed by 4-cell, 8-cell, 16-cell embryos and so forth.

During the cleavage process, the embryo enters the uterus as a 16- 32cell embryo (**morulla**) in 3-4 days.

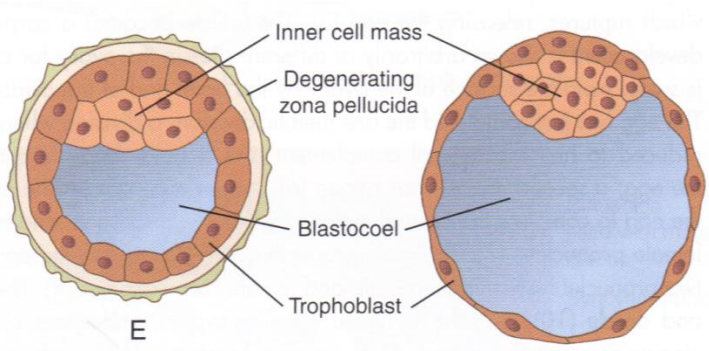
Peristaltic contractions transportx the embryo to the uterus. These contractions appear to be controlled by a balance of estrogen and progesterone.

During the next several days, fluid collects inside the embryo, forming a cavity surrounded by single spherical layer of cells, (the trophoblast) with a group of cells, (the inner cell mass) at one edge to form **blastocyst**.



A mass of cells, destined to become the fetus.

The embryo or blastocyst, as it is called at this point, begins to elongate ending the period of cleavage.



The nutritive requirement of the developing blastocyst are satisfied by diffusion from yolk in the oocyte and by secretion of the oviduct and uterus (uterine milk) until it become fixed in position in the uterus.

At about day 8 the zonapellucida begins to fragment and the blastocyst 'hatches'. This is then followed by a period of blastocyst elongation.

The complete process of cleavage takes about 2 weeks in the dairy cow. While the embryo undergoes cleavage, the uterus also changes in preparation for implantation.

During this period, the uterus is primarily under the control of progesterone. Progesterone decreases the muscle tone of the uterus and increases the secretory capacity of the inner lining of the uterus (endometrium). This endometrium supplies the free-floating embryo with carbohydrates and proteins for nourishment during the life of the blastocyst.

2- By day 16, the embryo enters a new stage of development known as differentiation. During this period, **formation of extra-embryonic membranes** and **formation of all major organs and systems** (circulatory system, muscular system, central nervous system, etc.) occurs.

Four extraembryonic membranes form during differentation: the amnion, the allantois, the chorion, and the yolk sac.

The yolk sac contains a source of nutrients but disappears by the end of this stage of development.

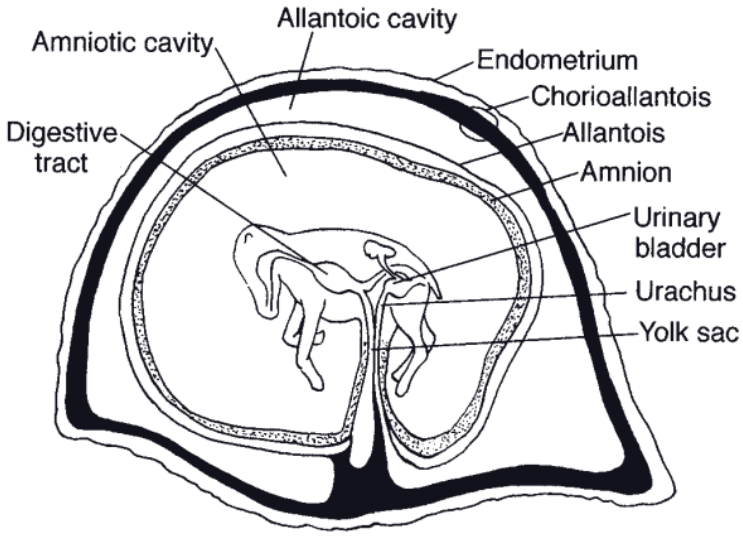
The amnion (innermost layer) folds around the embryo and contains fluids which suspend the embryo, protecting it and permitting its free growth. During the period of differentiation, the fluid in the amnion becomes turgid, and can be palpated through the rectum between days 35 and 45.

The allantois (middle layer) forms a pocket for waste products from the developing embryo.

The chorion forms the outer membrane. Gradually, during differentiation, the allantois and chorion fuse forming a single membrane (the allantochorion). This membrane is the tissue which attaches to the endometrium.

The process of differentiation occurs between days 16 and 45 of gestation. During the process of differentiation, the embryo attaches to the wall of the uterus. In the dairy cow, this process begins about day 28 of gestation.

The allantochorion adheres to the uterine wall in specific areas known as caruncles (buttons). Dairy cows have 80 to 100 of these specialized attachment organs. After the allantochorion attaches to the caruncle, a cotyledon (placentome) is formed.



The placenta is the fusion of the fetal membranes with the maternal membranes. The growing embryo derives its nourishment from the mother through the placenta via a "lifeline," the umbilical cord. Although the placenta serves as an interface for fetal and maternal blood and the exchange of nutrients, gasses and water, the blood of the fetus and mother never mix. Thus, the placenta substitutes for the fetal digestive tract, lungs, kidneys and liver, yet separates the maternal and fetal organisms to ensure separate development of the fetus. Complete attachment occurs by the 45th day of gestation.

Development of the so-called germ layers begins from about the fourteenth day and characterizes the beginning of the embryo phase.

Inner cell mass of embryo is developing to fetus, through formation of the 3 germ layers (**Ectoderm, Mesoderm and Endoderm).**

1. **Ectoderm** :In general forms The ectoderm gives rise to the external structures such as skin, hair, hooves and mammary glands and also the nervous system.

2. **Mesoderm**: In general forms structural tissue including: Muscle, Circulatory system, and reproductive system heart, muscles and bones

3. **Endoderm**: In general forms internal organs including: Digestive system, liver, and endocrine glands

3- For the remainder of gestation, 45 to 280 days (After differentiation period), fetus has all the necessary parts & mostly have an increase in size.

The fetus grows increasingly in weight, from 1/8 ounce (smaller than a mouse) to about 100 Ibs. Several landmarks in the development of the calf occur during this period. Tooth formation begins around 110 days and extensive bone formation by 180 days. By 230 days, the body of the calf is covered entirely by hair. During the period of fetal growth, the pregnant animal gains weight due to an increase in the weight of the fetus, an increase in the weight of the placenta and nutrient retention.

Maternal Recognition of Pregnancy/3

In most domestic species, the establishment and maintenance of pregnancy require that the luteal phase of the oestrous cycle is prolonged by the persistence of a single corpus luteum (CL) or a number of corpora lutea (CLs). As a result of the persistence of the luteal tissue, progesterone concentrations remain elevated. This results in a negative feedback on the hypothalamus and anterior pituitary with a resultant inhibition of follicular development and ovulation and, in polyoestrous species, a prevention of return to oestrus.

Maternal Recognition of Pregnancy: is detection of a developing embryo, which prevents regression of the progesterone-secreting corpora lutea. Several mechanisms have been identified in different species, but in general, the mechanisms involve secretory products from the developing embryo. These products (e.g., proteins or steroids) act locally within the reproductive tract. In most cases, the embryonic secretory products inhibit the uterine secretion of prostaglandin F2α (PGF2α).

The sheep

In sheep , the conceptus produces a protein. It was named ovine trophoblast protein or oTP-1.This substance has been shown to be a type 1interferon, which together with the same substance produced by the bovine conceptus, is classified as a tau interferon (IFN-τ). It is produced by the trophectoderm from about day 10, when the blastocyst starts to elongate.

The effect of IFN-τ in the maternal recognition of pregnancy is to alter the dynamics of PGF2α secretion at this early stage of pregnancy, compared with the same stage of the oestrous cycle.

IFN-τ prevents the rise in endometrial oestrogen receptors which precedes the rise in endometrial oxytocin receptors ,which is necessary for the secretion of PGF2α.The consequence of this is that there is a reduction in the synthesis of PGF2α from arachidonic acid.

The cow

In the cow, the importance of the blastocyst in prolonging the life span of the CL,if the blastocyst was removed at day 17 or day19, the inter oestrus intervals were extended to 25and 26 days, respectively, compared with those in which the embryo was removed at day 13, or which were not mated; in the latter cases the intervals were 20–21 days.

The anti luteolytic signal produced by the bovine conceptus is called bovine trophoblast protein (bTP-1) As in sheep, it is now classified as tau interferon (bIFN-τ), with maximum secretion occurring between days 16and 19 of gestation; it is first secreted at the time of elongation of the blastocyst.

As in the ewe, It is likely that bIFN-τ exerts its anti luteolytic effect by modifying oxytocin receptors, there by inhibiting the synthesis from arachidonic acid and subsequent release of PGF2α.

The goat

In the goat, the removal of conceptuses from the uterine lumen between days 13 and 15 does not prolong the life span of the CL, but removal on day 17 increases the inter oestrus interval by 7–10days. The caprine conceptus secretes a protein, originally designated cTP-1, which as in other ruminants is cIFN-τ .

The mare

In the mare, the mechanisms responsible for the recognition of pregnancy are less well understood.

The importance of the migration of the conceptus within the uterine lumen until it becomes ‘fixed’ at 16–18days of gestation at the base of the uterine horn has been demonstrated in some elegant experiments and which have important role for the prevention luteolysis. By restricting the mobility of the conceptus using ligatures at various parts of the uterus, the maternal recognition was compromised so that the CL regressed spontaneously.