



Obstetrics

Fertilization and Maternal Recognition of Pregnancy



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Some facts about semen deposition in animals

- Animals like: **Cow, sheep, rabbit, primates, dog and cat** Semen deposited in the cranial vagina
- Animals like: **Pig, mare and camels** Semen deposited in the cervix, and most of semen go to uterus.

For Conception to occur, all the pieces need to fit together perfectly....

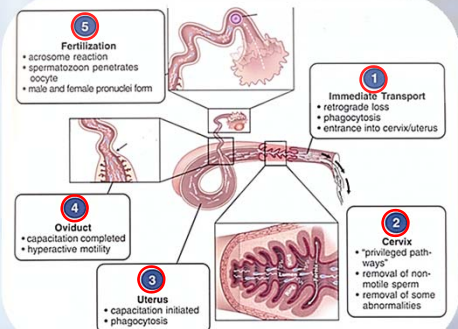




Some facts about semen deposition in horses

- Stallion ejaculates in a series of "jets" (around 8 jets) in which a sperm rich fraction is ejaculated.
- First 3-4 jets are of high pressure and responsible for conduction of 80% of the spermatozoa.
- Last 5-8 jets are of low pressure and contain few sperms.
- Seminal plasma in final jets is highly viscous to minimize retrograde sperm loss.





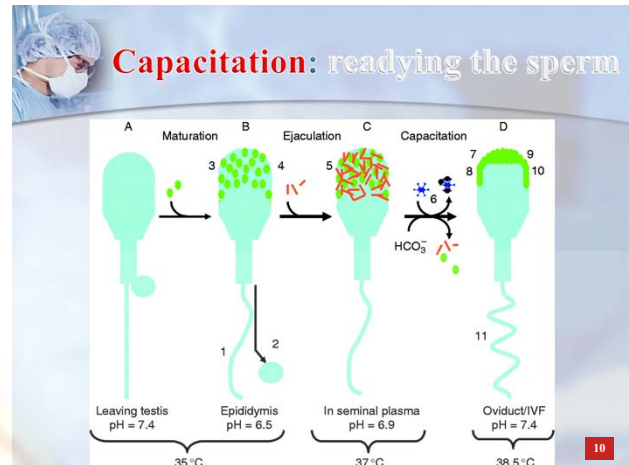
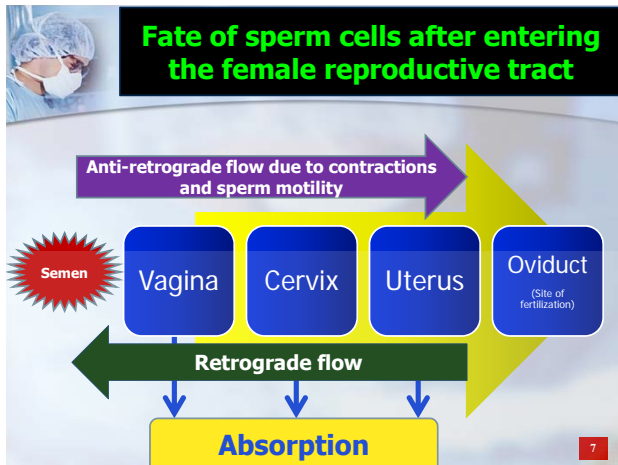

Major sequence of events following deposition of spermatozoa in the female reproductive tract

Some facts about semen deposition in animals

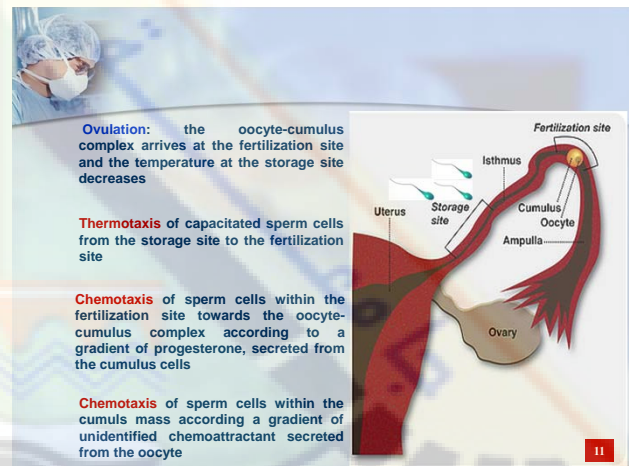
- Camel and pig seminal plasma contain protein (LH) that enhance or induce ovulation.
- In pig, ovulation occurs after 11 h of introduction of seminal plasma into uterine horn.



Number of sperms per ejaculate, site of semen deposition, and number of sperms reaching the oviduct

Species	Total sperms per ejaculate ($\times 10^6$)	Site of semen deposition	No. of sperms in oviduct
Cattle	3000	Vagina	<100
Sheep	1000	Vagina	600-700
Pig	1000	Uterus	1000
Human	280	Vagina	200
Rabbit	280	Vagina	250-500
Rat	58	Uterus	500



Capacitation: readying the sperm

- Sperm cannot fertilize oocytes when they are newly ejaculated
- The process of capacitation takes 5-7 hours
- Capacitated sperms are more active
- Location: Capacitation occurs in the uterus and oviduct and is facilitated by substances of the female genital tract
- The acrosomal reaction cannot occur until capacitation has occurred

Not capacitated

Capacitated

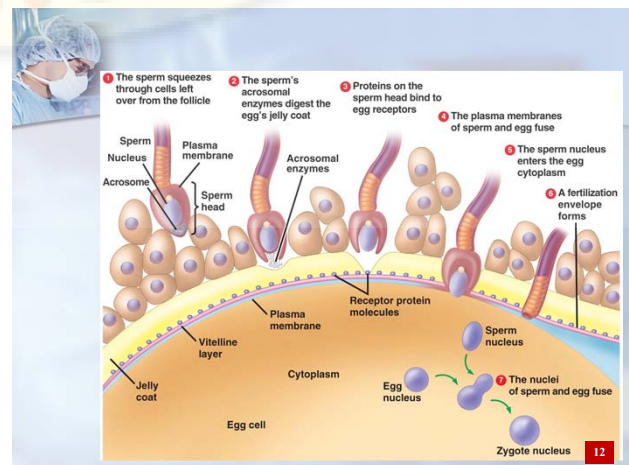
Sperm with slow rate of capacitation

Sperm with average rate of capacitation

Sperm with fast rate of capacitation

Egg

Sperm bind to oviduct wall and capacitate



Block to polyspermy

**Polyspermy is common in birds and reptiles
In mammals: The incidence of polyspermy is 1-2%
The pig is the most susceptible species**

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Immunological interference with the properties of the zona pellucida

The inhibition of fertilization by anti-zona antibodies not only inhibits sperm binding but also interrupts sperm penetration through the zona pellucida.

This effect is achieved through:

- Masking the sperm receptor sites at the zona surface.
- Stabilizing the zona structure against dissolution by acrosomal proteases.

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Embryonic Development

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Maternal Immunological Response During Pregnancy

a- Maternal recognition of pregnancy (MRP)
b- Protection of the fetus

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Immunological interference with the properties of the zona pellucida


- The treatments of zona with anti-zona antibodies block sperm attachment.
- Treatment of sperm with anti-sperm antibodies prevents their binding to the zona pellucida.

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a- Maternal Recognition of pregnancy

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What is the mechanism of the maternal recognition of pregnancy???



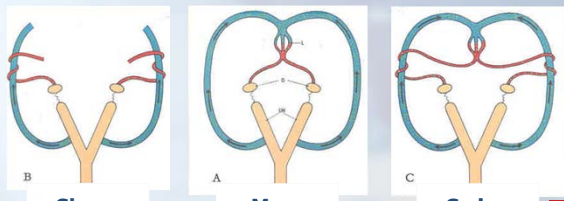
Bioactive compounds "sensed" by local maternal tissues.

- Interruption of maternal ovarian cyclicity
- Extension of corpus luteum (CL) lifespan.

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Uterine PGF_{2α} can reach the corpus luteum by three possible pathways:

1. Local utero-ovarian (ovarian artery and uterine vein).
2. Systemic utero-ovarian (passage through lungs).
3. Local uterine lymphatic vessels.



Sheep Mare Swine

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Maintenance of pregnancy can occur in three methods (depend on the species):

The signal which originates from the pre-attached blastocyst

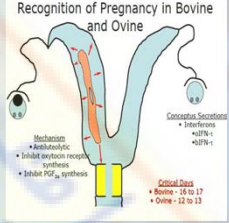
- In Pig, mare, cow and ewe acts directly at the endometrial level
- In Human and non-human primates Act indirectly at the ovarian level

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In ruminants during 12-18 days after ovulation.



Recognition of Pregnancy in Bovine and Ovine



Conceptus Secretions: Interferon-τ, αIFN-1, αIFN-2

Mechanism:

- Anti-luteolytic
- Inhibit oxytocin receptor synthesis
- Inhibit PGF_{2α} synthesis

Critical Days:

- Bovine - 16 to 17
- Ovine - 12 to 13

- Trophoblast produces trophoblast protein-1 (Interferon-τ) at 12-18 days of pregnancy.
- These anti-luteolytic proteins are primarily responsible for inhibiting uterine production of luteolytic amounts of PGF_{2α}.


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Maintenance of pregnancy can occur in three methods (depend on the species):

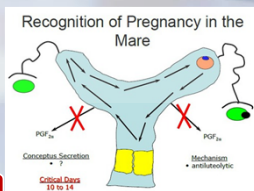
- Decreasing the synthesis and release of PGF_{2α} from the uterus.
- Altering the direction of PGF_{2α} so that it cannot reach the ovaries to cause luteal regression.
- Preventing the action of PGF_{2α} at the CL.

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In equines during 10-14 days after ovulation.



Recognition of Pregnancy in the Mare



Conceptus secretes physiologically effective quantities of PGF_{2α} and PGFE₂

Stimulate the uterine contractions

Help equine capsule to migrate throughout the uterine lumen

Distribute the anti-luteolytic signal

Inhibiting the endometrial release of PGF_{2α}

Mechanism: anti-luteolytic

Critical Days: 10 to 14

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In pigs
during 11-12 days after ovulation.

In Pigs

- the pregnancy recognition factor is **estradiol**.
- 10-12 day of pregnancy
- blastocyst produces large amounts of estradiol
- Alter the direction of PGF_{2α} secretion by uterine endometrium.
- From endocrine to exocrine fashion
- Protect luteal cells from the luteolytic action of PGF

Recognition of Pregnancy in the Porcine
Endocrine Secretions
• Estradiol
Critical Days 11 to 12
Mechanism
• Kolutolytic
• Inhibits PGF_{2α}
• Requires 2 embryos per horn

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a- Protection of the fetus

Immune response

- Humeral immune response
- Cellular immune response

The feto-placental unit can be considered as a temporary allograft.

i.e. The conceptus must be able to escape immune rejection by the mother.

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In human
during 8-12 days after ovulation.

In human and primates, the pregnancy recognition factor is chorionic gonadotropin produced from chorion (tropho-ectoderm) of the developing embryo 7 days after ovulation, reaching peak 30 days after ovulation and counteract luteolytic signals

Recognition of Pregnancy in the Human
Gonadotropin Secretions
• HCG
Mechanism
• Luteotrophic
Critical Days 8 to 12

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a- Protection of the fetus

The fetus:

- The fetus forms an immunosuppressive factor (**Alpha-fetoprotein**) .. **inhibits interleukin interaction**...suppress proliferation of T-lymphocytesindirectly inhibits proliferation of B-cells.
- Immunoglobulin from trophoblast reacts specifically with trophoblastic basement membrane, but not with basement membrane from other organs.

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Maternal Recognition of pregnancy

Ability of the embryo to sustain maternal production of P4

Protection of the fetus

Counteract mechanism that defend the maternal system invasion by foreign body

Successful pregnancy

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a- Protection of the fetus

The dam

Estrogen and progesterone are the main suppressors of cell-mediated immune system.

- Estrogen** depresses natural killer cells, T and B cells activity.
- Progesterone** blocks either the production and/or the response to chemotactic substances in the endometrium.

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