Certified Fertility Counselor Course-Session 5- Conception and Pregnancy Testing

Process of Fertilization

Once millions of sperm are deposited into the vagina, fertile cervical mucus then pick up a few thousand. In the period of a few minutes or hours in the cervical mucus, sperm move upward into the uterine cavity toward the opening of the fallopian tube. The cervical mucus works as a filter, eliminating abnormal sperm. It contains a series of channels whose width is precisely the width of a normal sperm head. Sperm whose shape and size is standard will fit in the canals comfortably, and will quickly migrate through the fertile mucus. Abnormal sperm will be left behind and won't move on to the cervix. Some of the normal sperm that move into the cervical mucus will migrate up into the uterus and into the fallopian tubes within five to ten minutes. Others will be held in the cervical mucus as a reservoir for as long as 24 hours before moving on. Usually the fast swimmers are the ones that move on first.

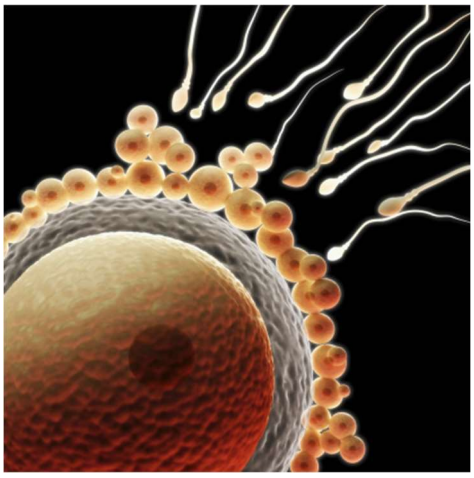
Once in the uterine cavity, sperm face a daunting task. Compared to the size of the actual sperm, the uterine cavity may seem like an exhausting journey. The sperm must make its way through the uterine cavity, and towards the openings of where the fallopian tubes are located. Because of uterine muscle contractions, and the fast propelling of the sperms tail, they can swim 25-50 microns per second. Once sperm reach the fallopian tube, they now begin the final phase of their journey.

Assuming the fallopian tubes are clear and not obstructed the fallopian tube will then allow the sperm to enter. Hundreds of them begin to race towards the egg. With the help of tubal contractions, chemicals, and hormone signals it begins to pull the egg towards the sperm. At this point the sperm will begin interacting with the egg's protective coating, called the Cumulus.

The stripping away of the Cumulus is the first phase of the fertilization process. If you remember, the Cumulus is a massive group of cells outside the actual ovum. Hundreds of sperm will have to interact with the massive group of cells before it is broken down and the protective membrane surrounding the egg is exposed. The Cumulus cells are held together by hyaluronic acid bonds. Each individual sperm that reaches the egg attacks it from all angles, as they do they release an enzyme called hyaluronidase, which breaks down these bonds. Individual Cumulus cells then fall away from their partners, until in a matter of a few hours, the egg is stripped clean. Thousands of sperm will die in the process. Their places are taken by a new group that migrate up into the fallopian tubes.

How the Sperm Fertilize the Egg

After the sperm remove all the Cumulus cells, the sperm then begin to interact with the membrane around the egg, the Zona Pellucida. Hundreds of sperm attach themselves to the protein membrane of the Zona Pellucida, until one finally penetrates and fertilizes the egg. In order for one sperm to penetrate and fertilize the egg, it must be “capacitated” or “activated”



Since the sperm consist of a head, middle, and tail, the head is basically the protein carrier for the genetic package that fuses with the genetic material of the egg when fertilization takes place. It's surrounded by a double layer protein membrane, called acrosome membrane. In order for the sperm to attach and break through the membrane of the egg, enzymes between the two protein layers must become activated. This is a process known as acrosome reaction.

In order for the sperm to penetrate the egg and fertilization to take place, a high percentage of sperm must be acrosome reacted by the time they reach the outer membrane of the egg. Some sperm become “activated” as early as first coming in contact with the cervical mucus, others as they move through the uterus and fallopian tube. Most frequently the acrosome reaction occurs when the sperm encounters the Cumulus cells that surround the egg, or when it meets the Zona Pellucida.

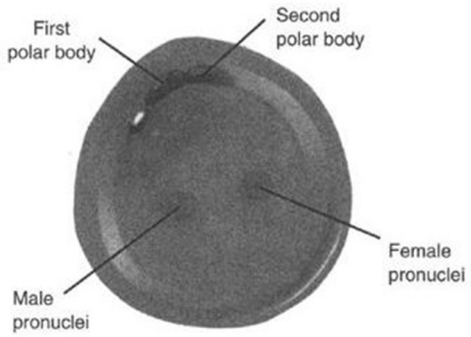
As the acrosome membrane breaks down, the enzymes that it contains will allow the sperm head first to fuse with the membrane of the egg, and ultimately break through it to get inside the Zona Pellucida. Once inside the Zona Pellucida, the sperm enters the perivitelline space.

The perivitelline space is the area between the zone membrane and the vitelline membrane, which is the final layer separating the sperm from the nucleus of the egg. Once a single sperm breaks through the Zone Pellucida, it quickly attaches to the vitelline membrane, and within a matter of just minutes fusions of the sperm's acrosome membrane, and the egg's vitelline membrane takes place. During this process the sperm’s head is actually inside the nucleus of the egg.

While the sperm is fusing with the egg (fertilization), and undergoing fusion with the outer membrane of the Zona Pellucida, the egg is undergoing a reduction of its chromosomes to become a 23 chromosome cell rather than a 46 chromosome cell. This set of 23 chromosomes is released in a small blister called the first polar body. The sperm head that enters the nucleus of the egg already contains 23 chromosomes. Therefore the fertilized egg cell will contain a total of 46 chromosomes, half from the female and half from the male. Within eight to twelve hours after the sperm has penetrated and merged with the nucleus of the egg, its head disintegrates.

Fertilization of the Egg

Over the period of about 12 to 16 hours the female and male pronuclei come together in the cytoplasm of the egg. Pronuclei are two small crater-like structures that appear on top of the egg. This confirms fertilization has taken place. This is how they usually confirm it during the in vitro fertilization process. The chromosomes now form a single packet, and the fertilized egg cells divides into a two cell embryo. Each cell of the two celled embryo contains 46 chromosomes, which are identical to the 46 that the fertilized egg contained prior to its division.



As this zygote embryo starts to develop it divides every 16 hours, from two cells to four, and then from four to eight and so on. The chromosomes will also continue to develop themselves, so that each cell always contains 46 chromosomes that are identical to the original 46.

In the early stages of development from the two to four to sixteen cell development the cell is called a zygote. During the cell division of the zygote, it is also traveling down the Fallopian tubes with the help of Cilia. Cilia are tiny like finger projections inside the fallopian tubes which start to wave in a sequence carrying the developing zygote cell down the tube, which takes about 3 to 5 days to complete. If Cilia are damaged or reduced in number, a tubal pregnancy can result. If the cells within the fallopian tube have been damaged through infection or surgery, through the use of an IUD or any other type of trauma, the developing zygote may not receive adequate nutritional support during its growth and journey through the tube, and may die before it has a chance to implant.

If all goes well during the zygote development, the zygote goes through a process called

“cleavage”. This stage is what prevents other sperm from entering the egg. The zona pellucida forms a protein altering the egg’s coat, so that sperm cannot bind to it. By the time the zygote reaches 16 cells in development it starts to form into what's called Morula. Morula is a collection of thirty cells known as blastomere. This starts to form about four to five days after the initial fertilization process.

About this time the developing zygote should have reached the end of the fallopian tube. The shape also begins to change during the morula stage. The shape is now called a compaction. Compaction is when the morula is still enclosed within the pellucid zone and it begins to join up with each other. Because of this, a cellular layer forms which is thicker on the outside, a cavity then forms in the interior of the blastocyst into which fluid flows.

The Morula cells then move on to stage two, which is the separation of the blastomeres into embryoblast and trophoblast which is accomplished in this stage. Morula cells serve as the origin for the embryo and its membranes, and also for the placenta and its associated structures.

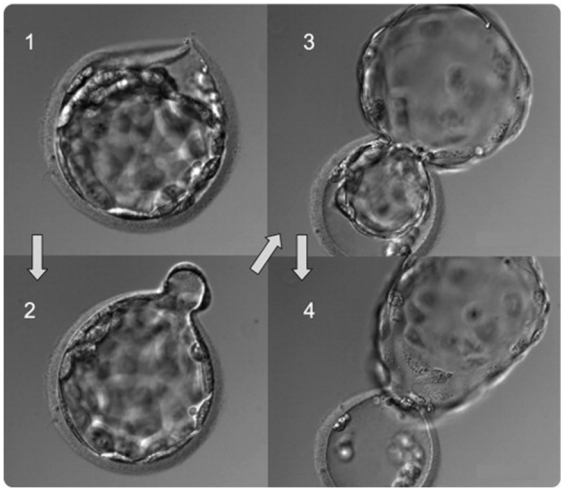
The Blastocyst Formation to Implantation

A blastocyst now has over a hundred cells that formed during the zygote stage. For a blastocyst to form, it must go through the Morula stage where it forms an outer layer known as a trophoblast. Cavitation occurs next, where the outer layer (trophoblast) secretes fluid into the Morula. Because of this, a fluid filled cavity forms (blastocoel). The zona pellucida then begins to degenerate, allowing the blastocyst to increase in volume. This usually occurs around day five or six after fertilization and continues until implantation occurs. This last process is referred to as the “preimplantation phase of development”.

The blastocyst is characterized by a group of cells called inner cell mass (embryoblast). The inner cell mass is what gives rise to the definitive structures of the fetus. The trophoblast will eventually form the placenta. The blastocyst can be thought of as a ball layer of trophoblast cells, with the inner cell mass attached to the ball’s inner wall. The embryo plus its membranes is called the conceptus.

Hatching of the Blastocyst

Before the blastocyst implants, a process known as hatching takes places. The zona pellucida develops a crack and the blastocyst escapes, the zona pellucida then completely disappears. By this stage the conceptus is taking place in the uterus. After hatching, this allows the blastocyst to implant into the endometrium.



This process takes about twenty four hours to complete.

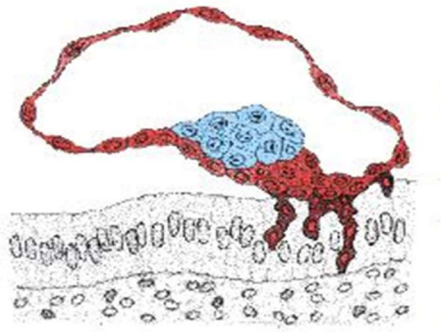
Implantation of the Blastocyst

Now that the entire process of fertilization, cell dividing, and hatching of the blastocyst has taken place, the blastocyst can implant into the endometrium. Cells called epithelial cells located on the endometrium, and the trophoblast cells of the blastocyst interact with one another. The epithelial cells pull the blastocyst to the endometrium wall.

The endometrium lining must be at a certain thickness for implantation to occur. During the four to five days after ovulation, during the development of the embryo, the endometrium continues to thicken into a spongy, receptive lining. It also grows new blood vessels. The final maturing of the uterine lining is generated by the secretion of the hormone progesterone. It is progesterone that triggers the receptivity of the uterine endometrium for implantation and attachment. Under its influence the endometrium softens and develops a web of new blood vessels to nourish the soon to be implanted embryo.

Once the blastocyst enters the uterus for implantation it floats in the fluid of the cavity until it finds a place to attach. With the help of the new epithelial cells, the blastocyst now starts attaching to the uterine lining.

The attachment begins roughly around the sixth or seventh day after fertilization. Because the trophoblast is made up of two different cell masses, the outer part being syncytiotrophoblast and the inner part being cytotrophoblast, implantation happens in stages. The syncytiotrophoblast is what facilitates implantation of the blastocyst in the maternal endometrium by the production of lytic enzymes, proteins, sugars, and lipids that have formed. Eventually the expanding syncytiotrophoblast surrounds the embryo entirely (burrowing deeper inside the endometrium lining) then secreting HCG (human chorionic gonadotropin) throughout the cellular mass. While this is going on, the cytotrophoblast (inner cells) grow rapidly. The syncytiotrophoblast and cytotrophoblast pull the embryo into the endometrium until it is fully covered by endometrial epithelial, which seals the embryo within the uterine wall.



The implantation process takes about 3 to 4 days to complete. Once implantation fully completes, the fast formation of an embryo to a fetus occurs. However, there is a window of timing for implantation to occur. The initiation of the hormone progesterone that is secreted starts a “clock” and the uterine lining passes through a receptive window of time when implantation can occur. After this window, implantation cannot occur. If the embryo fails to implant within that time, the embryo will then absorb back into the body or passed out by the uterus.

Pregnancy Testing

During the entire cell development the female body does not recognize anything is happening. However the immune system has a lot to do in regards to conception actually happening. In order for a woman to conceive, her body first has to view her own embryo as foreign and try to get rid of it. If her body does not do this, the blocking antibodies that protect the embryo through the pregnancy won't be produced, and the normal process of implantation will not take place.

It is true that the trophoblast produces its own Human Chorionic Gonadotropin Hormone (HCG), however *before* implanting into the uterine wall, the HCG hormone does not secrete into the body. Once implantation takes place, HCG starts to increase the more the trophoblast rapidly grows forming the embryo. HCG enters the blood stream first, and because this is a

protein hormone, it can be detected in blood serum about 48 hours after implantation fully occurs. About three to five days after HCG has moved through the entire blood stream, it then starts moving into the urine as it is produced rapidly by the developing embryo. Since the growth of the embryo happens differently in mothers, it may vary on HCG levels in the blood and urine when testing is performed.

Over the counter pregnancy tests can detect as low as 6.3mIU of HCG in the urine shortly after implantation occurs. HCG's primary role is to keep the Corpus Luteum functioning so that the corpus luteum keeps producing estrogen and progesterone.

Twin Pregnancy

There are several factors that cause a twin pregnancy. There are two types of twin pregnancies. They are: fraternal twins and identical twins. Fraternal twins are when two eggs release and get fertilized by two different sperm. There are times a woman will release two eggs during ovulation, however within a twenty-four hour period from each other. Each egg will develop in separate sacs, and be completely separate. Identical twins are created during the early stages of a zygote stage development. When the fertilized egg starts to produce more cells it will double itself creating two embryos. Since both babies are produced by the same fertilized egg they share almost all the same chromosomes and DNA structures.

Ovulating Twice in a Cycle - The Misconceptions

Unfortunately there are many misconceptions on ovulation. While this is a very rare occurrence, a process called Superfecundation can happen. Superfecundation most commonly happens within hours or days of the first fertilization with an ovum released during the same cycle. Ovulation is usually suspended during pregnancy to prevent further eggs from becoming fertilized and to help increase the chances of a full term pregnancy. However, if an egg is released after a woman already conceived from previously ovulating, there is a chance of a second pregnancy, but at a different stage of development. This is known as superfetation. Most the time this happens a woman has Uterus Didelphys which is known as a double uterus.

Miscarriage and Abnormal Development

It's a fact that miscarriage happens to 1 in every 4 women. According to the American Pregnancy Association, a miscarriage happens before the 20th week of pregnancy. Several studies have indicated that 10-25% of recognized pregnancies will end in miscarriage.

There are several different types of miscarriage. Chemical pregnancy is much more common and which is recognized in 50-75%. A chemical pregnancy happens when the developing embryo implants but quickly releases itself from the endometrium lining. Most chemical pregnancies occur due to chromosomal abnormalities, inadequate levels of the hormone progesterone, too thin of lining, too thick of lining, or other immunity issues. In this case, if a woman is trying to conceive, she may test for pregnancy prior to a missed period, and catch a chemical pregnancy when her test turns positive. However, her test will quickly soon turn negative shortly after her missed period. A chemical pregnancy is often before the sixth week period, prior to a heartbeat being heard.

An Ectopic pregnancy happens when the developing blastocyst implants in the Fallopian tubes. As the embryo starts to attach and grow, this will obstruct the fallopian tube, and if not

caught in time, there is a possibility that the particular tube will have to be removed. Once the growth of the embryo starts to expand, this can be accompanied by extreme cramping and bleeding. Most of the time, it will seem as if the pregnancy was developing as it should. A period will be missed, and often times pregnancy symptoms will increase. However, HCG levels will be abnormally high, increase abnormally, or slowly increase yet decrease at the same time. Sometimes HCG numbers will seem normal, then start to decline, yet rise again. There are a few reasons why Ectopic pregnancies happen, Cilia in the fallopian tube could be damaged, the tube itself could be damaged, or the blastocyst reached the Morula stage too quickly and started the process of shedding the zona pellucida, causing early implantation to form in the fallopian tubes.

A molar pregnancy is the result of a genetic error during the fertilization process that leads to growth of abnormal tissue within the uterus. Molar pregnancies rarely involve a developing embryo, but entail missing a period, and having pregnancy symptoms. About 1 out of 1,500 women will have a Molar pregnancy. There are two types of Molar pregnancies. A complete molar pregnancy is when an egg with no genetic information is fertilized by a sperm. The sperm grows on its own, but it can only become a lump of tissue, and not a fetus. As the tissue grows, it looks like a cluster of grapes. This cluster of tissue can fill the uterus.
A partial molar pregnancy is when an egg is fertilized by two sperm. The placenta becomes the molar growth, and any fetal tissue that forms is likely to have severe defects.

A blighted ovum is when the fertilized egg implants into the uterine wall but fetal development never begins. Often there is a gestational sac, but no yolk sac. Generally a blighted ovum is due to problems with the chromosomes. This may be from a poor-quality sperm or egg, or it may occur due to abnormal cell division. Regardless, the body stops the pregnancy from developing because it recognizes the abnormality.

Recurrent miscarriage is defined as 3 or more consecutive first trimester miscarriages. This can affect 1% of couples trying to conceive.

Who's at Risk?

For women in their childbearing years, the chances of having a miscarriage can range from 10-25%, and in most healthy women the average is about a 15-20% chance.

- An increase in maternal age affects the chances of miscarriage
- Women under the age of 35 years old have about a 15% chance of miscarriage
- Women who are 35-45 years old have a 20-35% chance of miscarriage
- Women over the age of 45 years old can have up to a 50% chance of miscarriage
- A woman who has had a previous miscarriage has a 25% chance of having another (only a slightly elevated risk than for someone who has not had a previous miscarriage)

CERTIFIED FERTILITY COUNSELOR COURSE - SESSION 5 – QUESTION & ANSWERS

NAME: _____

ADDRESS: _____

PHONE: _____

FAX: _____

E-MAIL: _____

Please be sure to fill out the information above, complete the test and e-mail it back to us at iridology@netzero.net. We will grade your question & answer session and will let you know if we have any questions or concerns.

1. During the process of fertilization what happens to the sperm in the cervical mucus?
2. What is the Cumulus?
3. How are the Cumulus held together?
4. After the sperm attacks the Cumulus what enzyme is released?
5. What does capasitated or activated mean?
6. What is acrosome?
7. What happens after the sperm has penetrated and merged with the nucleus of the egg?
8. What is the vitelline membrane?
9. What Is the Pronuclei, and how many hours does it take to form?
10. How often does the zygote develop?
11. What are Cilia?
12. Cleavage prevents other sperm from entering the egg. T/F
13. What is Morula?
14. What is a blastocyst?
15. How is a blastocyst formed?
16. What is Hatching?
17. Once the blastocyst reaches the end of the fallopian tube, what does it do?
18. How long does implantation take to complete?
19. What is the trophoblast made of, and what are their roles?
20. Where does HCG develop first?
21. Explain the two types of twin pregnancies.
22. What is superfetation?
23. How many pregnancies will end in miscarriage?
24. What are four types of miscarriages? And how do they differ?
25. Who's at risk for a miscarriage?
26. What are recurrent miscarriages?

Watch the following videos and explain what you learned:

27. How Conception Happens
28. The Great Sperm Race